

# National Goat Handbook

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# ADJUSTMENT FACTORS FOR MILK RECORDS

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Extension Goat Handbook

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TI ADJUSTMENT FACTORS FOR MILK RECORDS

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DE Genetics and Reproduction

Text

1 Lactation records of milk and fat production provide important information for managing a dairy goat herd and for breeding better goats. Environmental factors such as length of lactation, age of doe, and season of kidding should be standardized through appropriate adjustment factors to make genetic evaluations more accurate.

2 Length of Lactation

A lactation length of 305 days has been defined as the standard for dairy cattle and also is used for goats. This standard assumes a 365-day interval between parturitions, which includes a 60-day dry period. However, many goats do not milk 305 days. A recent study shows that only one-third of all does with official records ending with a dry date milked 305 days. One reason for shorter records is that production of many does declines sharply with the onset of seasonal estrus and the does then are dried off. A standard lactation length of less than 305 days might be more useful for comparisons among does; however, the 305-day standard allows for reduced computing costs because doe and cow records can be computed the same way.

3 If a doe's lactation ends on or before 305 days because her production declined to the point at which continued milking was not worthwhile, then her record is considered complete. Such records are not projected to 305 days but are treated as complete 305-day records.

If a lactation ends before 305 days for any reason other than going dry, such as the doe's being sold or the herd's discontinuing testing, the record is considered incomplete and is adjusted. If a doe is still milking and has fewer than 305 days in milk, the record is considered incomplete, adjusted, and referred to as a record in progress. If a doe milks for more than 305 days, the production for only the first 305 days is included in the 305-day record.

4 A method to adjust incomplete records and records in progress uses the USDA projection factors in Table 1. Different categories of factors are required to adjust records because of variations in the lactation curve, particularly in the rate of decline of production after the peak and the number of days milked. To select the appropriate factor, the following information is necessary: breed, herd average production, month of kidding, days in milk, and age of doe at kidding.

5 An adjusted or projected record is the incomplete record plus an estimate of production for the rest of the lactation. That estimate is the projection factor times the last sample-day production times the number of days from the end of the incomplete record through 305 days.

6 Suppose a Nubian doe freshens in March at 25 months of age. She has an incomplete record at 130 days of 800 lb milk and 27 lb fat. Her last sampled day production is 5 lb milk with 3.4 The herd average is 1,725 lb. Then, her projected record would be  $800 + 0.69(5)(305 - 130) = 1,404$  lb milk and  $27 + 0.76(5)(0.034)(305 - 130) = 50$  lb fat.

7 Age-Season

Lactation production increases with age until maturity and then declines. Month or season of kidding also influences lactation production. For example, does kidding in the early spring produce more milk than those kidding later in the year. Lactation records can be adjusted to a common age and season of kidding to standardize the effects of age and season. The factors in Table 2 standardize production to that expected from a doe kidding from January through March at 36 months of age.

8 The adjustment factors vary by breed, age, and season of kidding. Records are adjusted for age and season by multiplying production by the appropriate factor from Table 2. To illustrate, consider the Nubian doe from the previous example:

$$\text{Adjusted milk} = 1.07(1,404) = 1,502 \text{ lb}$$

$$\text{Adjusted fat} = 1.08(50) = 54 \text{ lb}$$

9 The factors in Table 2 were computed by assuming a smooth change by age and by ignoring lactation number. Recent results, however, suggest that lactation number should be considered, particularly for does kidding about 24 months of age. Equations recently developed at the University of California in Davis provide factors that vary by parity.



# ALL ABOUT A.I.

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Text

1 Is AI For You?

If you have a few backyard does that you enjoy as a hobby, with little concern for genetic improvements of their offspring, then artificial insemination (AI) is probably not for you, assuming a suitable buck can be located for servicing the does. The expense of purchasing the necessary equipment and learning to do AI are likely not worthwhile. However, if there is an experienced inseminator in the area who is willing to work with your goats, then this may prove to be a viable alternative and certainly is much simpler than hauling your does in heat to the buck's home.

2 AI has some key advantages over natural breeding.

1) It eliminates the necessity of keeping one or several bucks on the farm (depending on herd size). Costs of feeding, housing, separate fencing and labor are eliminated. However, heat detection may be more difficult in the absence of a buck.

2) AI can increase the rate of genetic improvement in an herd, as long as superior bucks are consistently selected. In natural service,





- 1) basic knowledge of the doe's reproductive organs and their functions;
- 2) understanding of storage and handling of semen;
- 3) ability to use, in a proper and sanitary manner, the equipment required for inseminating goats;
- 4) ability to accurately detect heat at an early stage;
- 5) necessity of keeping accurate, up to date records of heat cycles, breeding, kidding, reproductive problems, treatments, and any other pertinent information that may reflect on the goat's reproductive patterns.

## 7 Reproductive Organs and Functions

The two ovaries are the sites of egg formation. They produce estrogens and progesterone, and as such are determining factors of heat cycle, ovulation and pregnancy. Basically the estrus (heat) cycle in goats operates as follows:

1) Proestrus is the time of follicle growth. As an egg (ovum) begins to mature in an ovary, it becomes surrounded by a fluid filled sac on the outside of the ovary, much like a blister forms on the skin. This growth is accompanied by increasing levels of estrogen in the blood.

2) Estrus - As estrogen levels peak, the doe will come into heat. This can be observed by changes in behavior (increased bleating and restlessness), willingness to be bred, and the swelling of the external genital area. The period of 'standing heat' (acceptance of the buck) will generally last for 24 to 36 hours.

3) Ovulation, or the release of the egg, is accomplished by the rupturing of the follicle, expelling the egg from the ovary, and receiving it into the oviduct via the fimbria funnel. This occurs very near, or soon after, the end of standing heat (6 hours before to 12 hours after). Egg life is 12 to 24 hours, while the sperm lasts 24 to 48 hours.

4) Metaestrus - in this stage, the ruptured follicle is undergoing cellular differentiation to form a functionally important tissue mass, the corpus luteum (yellow body). This structure is responsible for the secretion of progesterone, a hormone which prevents the development of another follicle and prepares the uterus to receive a fertilized egg.

5) Diestrus - is the longest period of the estrous cycle in does. During this period of corpus luteum influence, two events may happen:

- a) if fertilization of the egg occurred, the corpus luteum will persist for the entire gestation period, preventing follicular development and keeping estrogen levels low.

b) if no fertilization took place, the progesterone secretions of the corpus luteum gradually lessen, allowing a new cycle of follicular development to begin, with a corresponding increase in estrogen levels. The length of time required for one estrous cycle without fertilization, ranges from 17 to 24 days in goats, with the majority taking 21 days. Shorter cycles are not uncommon (5-10 days).

8 The egg, after being expelled from the ovary, passes into the oviduct via the infundibulum, and toward the cornua (horns) of the uterus. This movement is produced by wave-like motions of the ciliated (hair-like projections) cells of the oviduct. Sperm and eggs meet in the oviduct and fertilization occurs in the middle to upper one third of the duct.

9 The egg continues into the horn of the uterus, where, if it has been fertilized and undergone several cellular divisions, it will become attached to the uterine wall. If no fertilization has occurred, the egg will degenerate and the cycle goes on.

10 The cervix of the uterus plays a key role in artificial insemination, as it is the external entrance to the uterus which must be located and penetrated with the inseminating instrument. The cervix is normally tightly closed, except during periods of heat or kidding. Semen is deposited on the vaginal side of the cervix in natural services, but AI requires the deposition of semen in the uterine side of the cervix. This is because of the greatly reduced volume of semen that is used in AI. If the 0.5 to 1 cc of semen in AI were deposited on the vaginal side of the cervix, there is a good chance that none of the sperm would reach the egg.

11 The vagina serves as the connecting tube between the uterus and the outside opening, the vulva. It is part of the birth canal, and also contains the urethral opening, from which urine will pass during emptying of the bladder.

## 12 Purchase and Preparation of Semen

In most cases, the inseminator will acquire the semen needed by direct purchase from a commercial operation, in which case it will be shipped to the inseminator. It is of the greatest importance that the semen be transferred to permanent storage (the liquid nitrogen tank) without exposing it to anything approaching air temperature. Generally, this means transferring the container element which houses the semen directly to the liquid nitrogen tank. Here it can be safely stored for long periods of time, since biological activity practically stops at liquid nitrogen temperatures (-320F). Semen is generally to be used within 6 months, but conceptions have resulted from semen stored for several years, although sperm survival is decreased, resulting in lower conception rates.

## 13 Semen Collection

Bucks are handled basically the same way as bulls for semen

collection. Three basic methods may be employed, but all three require an artificial vagina, a double walled device with an opening at one end and collection tube at the other. The inner lining holding warm water should be coated with a light application of water soluble lubricating jelly. The three methods are:

1) A buck may be allowed to mount a doe, with the semen collector manually diverting the buck's penis into the artificial vagina (ram or dog size). Don't touch the penis directly, instead direct the penis into the artificial vagina by grasping the buck's sheath. After ejaculation (usually 0.5 to 1.0 cc) has occurred, remove the artificial vagina and tip it so that the semen will all run into the collection tube. This method may require practice and adjustment by both the buck and the collector before good samples are collected.

2) A buck is trained to mount a dummy instead of a live doe. The same procedures are followed for sample collection. Mounting may be facilitated by applying vaginal mucus scrapings of a doe that is in heat to the dummy, at least during the training process.

3) Use of electro-ejaculation. The buck is not required to mount an object, although an artificial vagina should still be used for semen collection. An electrode unit, which has a number of contact rings, is inserted into the buck's rectum. Slight electric stimulation brings on ejaculation. This technique generally results in good samples in quantity and quality. However, the sperm concentration of the sample will be lower. This method does not require extensive training, and will allow collections from bucks that may refuse or are unable to mount and serve an artificial vagina.

14 Semen, once collected, may be used in one of three different ways:

1) As liquid semen, directly or on the same day one ejaculate can serve 3 to 5 does. If kept at body temperature, the semen may be good for three hours.

2) Semen may be stored 24 to 48 hours by placing the collection tube in a container of water and putting this unit in a refrigerator. No diluter is needed, although plain egg yolk can serve as simple extender to double the number of does that can be served.

3) Semen that is to be stored for longer periods of time must be mixed with a diluter and very carefully frozen. A commercially prepared diluter extender, such as Ortho Semen Diluter is desirable, although plain milk can be used successfully also. Following are steps in semen extending:

a) with a commercial preparation, use a diluter to semen ratio of 19:1, adding the semen to the diluter, and rolling the bottle gently to achieve a thorough mixing. The semen and diluter should be at the same temperature. This mixture can be stored in the refrigerator and used for a week, or slowly cooled and stepwise frozen for storage in a

liquid nitrogen tank for later insemination.

b) for a homemade milk diluter, it is best to use fresh 3.5 pasteurized, homogenized whole milk. It must be heated and held at 210F for 10 minutes in a glass boiler, keep the lid in place so that no moisture is lost. Next, the milk is cooled in a water bath with the lid on. When the milk is in equilibrium temperature with the water bath, the water condensation on the inside of the lid is shaken back into the milk. To every 400 cc of milk, add 100,000 units of potassium G crystalline penicillin and 500 mg crystallin di-hydrostreptomycin sulfate, mixing well. Warm this diluter to about body temperature before adding the fresh semen at 19:1 ratio. Place the diluted semen in a water bath at body temperature of 101F and allow to cool slowly. Semen may be frozen, if the extender contains an antifreeze compound, slowly, stepwise for storage on dry ice or in liquid nitrogen.

15 A microscope, capable of 900x magnification is an essential tool when doing your own semen collection in order to determine semen quantity and quality. First, place a semen sample on a clean slide and cover with a coverslip or another slide. Set the magnification to 400x and observe the appearance of dark patches or spots thru the scope; four dark areas or more per microscope field represent high concentrations of sperm, a really good sample. Three dark areas is somewhat chancy for use at a diluted service, but is good enough for natural service. Two dark areas should be used only for natural services and one dark area means that the concentration of sperm is too low for even natural service.

16 Switching to 900x, the sperm cells can be individually observed for normal structures. Diluting in warm saline is helpful. Coiled tails, broken tails, absence of tails and abnormal shapes all constitute deficient sperm cells. Sixty to 70 2.256835e+199ood motility before freezin should be observed in a good sample, with a minimum of 30motility after freezing and thawing. Any insemination program, no matter how carefully carried out, will yield poor results if the concentration and quality of the collected sperm is not of high standards. Sophisticated techniques of washing the sperm free of seminal plasma before extending and freezing will improve post-thaw viability.

17 The concentration of a buck semen ejaculate can be determined accurately by using a red blood cell diluting pipette and standard hemocytometer techniques. Typical results during the breeding season are 3 to 5 billion sperm per cc. Optical density can also be used to estimate sperm concentration if the photometer has been calibrated for buck semen. A simpler technique involves the determination of a spermatocrit using microhematocrit pipettes. The aliquot of semen is centrifuged for 10 minutes; for each percentage point of packed sperm, approximately 200 million sperm cells per cc are present. Correction is made for the percent motile sperm, after which the ejaculate can be diluted appropriately to supply a minimum of 125 million motile sperm in each breeding dose. It is often difficult to introduce more than 0.2 ml of semen into the cervix, so dilution to a final concentration of

600 million to 1.2 billion live sperm per cc has been recommended. When no laboratory support is available, fresh semen for immediate use may be diluted up to 5 times in extender if it is yellowish and 10 times if the ejaculate is white. A straw holding 0.5 cc of this diluted semen will provide adequate sperm if excessive reflux does not occur.

18 Storage and Removal of Semen from the Liquid Nitrogen Tank

A liquid nitrogen tank is basically a very large thermos-bottle in which liquid nitrogen is placed to keep the inner temperature near -320F (-196C). The spacing between the inner and outer walls is insulated and under vacuum. The temperature in the tank is maintained uniformly at -320F up to the bottom of the tank neck until the liquid nitrogen level gets down to around 5''. To measure liquid nitrogen, use a piece of black metal rod that is long enough to hold and touch the bottom of the tank. Dip the rod to the tank bottom and remove after 30 seconds. By waving it in the air, a white frost line will appear on the rod. This line indicates the liquid nitrogen depth of the tank. Levels nearing 5'' require a refill. The only real differences between tanks is their storage capacity (number of ampules or straws that they will hold) and their length of holding time (liquid nitrogen evaporation rate). The neck diameter varies somewhat also, with wider openings being easier to work with, but an increased evaporation rate usually results.

19 When working with semen in the liquid nitrogen tank, it is important to keep the racks below the frost line in the neck of the tank. Removal of semen from the tank for periods as brief as 10 seconds, such as for identification, before replacing it to the tank will often result in lowered fertility levels. If the right rack can't be located in 5 seconds, lower the canister back to the bottom of the tank for at least 30 seconds before trying again. Also, when handling semen, try to stay out of any direct sunlight, as ultraviolet light has a spermicidal effect.

20 The semen comes in two basic types of packaging: ampules (1 ml) and straws (0.5 or 0.25 ml). The ampule is the most common type of packaging for buck sperm. Both ampules and straws are stored in racks (canes), which are aluminum pieces that hold a vertical row of ampules, usually six, or two g +++MISSING DATA+++

21 A few key reminders concerning semen storage:

- 1) Always keep the liquid nitrogen level above 5''.
- 2) Never lift a canister above the frost line of the tank.
- 3) When the semen is removed with a forceps from the tank it should be placed immediately in the thaw box.
- 4) Never expose semen to direct ultraviolet light.
- 5) Never refreeze semen that has been thawed as it will be

destroyed.

- 6) Check for proper identification on ampule or straw.
- 7) A defective ampule may blow up after it is removed from the tank. This is due to a small leak that allows nitrogen to enter the ampule. When removed from the tank, the gas expands too rapidly to vent back out the hole and it explodes the glass. A hissing sound is usually audible when it is removed. Keep your hand between the ampule and your face when putting it into thaw box.
- 8) Always wear gloves and goggles for your own protection when working inside a liquid nitrogen tank.

## 22 Thawing Procedures

Methods for semen thawing vary among manufacturers, and it is best to follow their recommendation. The thawing procedure for lcc ampules, the most common for goat semen, is generally the ice water bath:

- 1) Ice water (38-42F) is placed in a styrofoam box long enough before-hand to allow temperature to equilibrate.
- 2) Remove the ampule from tank and place immediately into thaw box. Ampule may be placed in a small plastic cup with holes in the bottom. This prevents ice from coming into direct contact with ampule.
- 3) Ampule should thaw in 3 to 5 minutes. Check for slushiness and allow more time if needed.
- 4) Ampule may sit in ice water for as long as 30 minutes with no damage. Once removed, the semen must be used right away.
- 5) The layer of ice on the ampule must be peeled off before opening to avoid possible contamination.

23 The ice water thaw method is especially good during winter breeding of does because of low risk of cold shock to thawed and exposed semen. Thawing of semen can be done from -320F rapidly, but any subsequent exposure to lower temperatures after thawing will kill many or all of the sperm.

24 The warm water method of thawing is more exact than the ice water method, but probably will not work in cold weather, although it may give somewhat better results the rest of the year. The procedure is basically the same as for the ice water thaw except that:

- 1) The water must be maintained at 92 to 98F. This requires a source of warm water and an accurate thermometer.
- 2) Thawing will be complete in about 1 minute with no ice layer

formation of the ampule.

- 3) Ampules thawed with the warm water method should be used within 5 minutes.

25 Straws (0.5 or 0.25 ml) can be thawed by either of the previous two methods. A given amount of semen in a straw will take about one half as long to thaw as an equal amount in an ampule. Many inseminators simply thaw straws by placing them into their shirt or pants pocket.

## 26 Inseminating Procedures

All the care in handling, storage and preparation of semen will be useless if the inseminating process is not done carefully and cleanly. Hygienic practices at this point cannot be over-emphasized. All reusable items such as inseminating guns (for straws), scissors for cutting straws, scribe for cutting ampules, etc. must be wiped clean with 70 isopropyl alcohol and allowed to dry before reuse. Disposable items should be kept in their sealed packages until they are to be used. The speculum should be sterilized after each use (this is one reason why the cattle industry discontinued the speculum method; the inseminator would have to carry a few dozen specula on his daily rounds, sterilizing them each night). This is best accomplished by boiling for 10 minutes, allowing to air dry. Then place inside a sterile container or wrapping, such as a new plastic AI glove. Disposable plastic type specula for goats can be obtained from mail order companies, eliminating the need for constant reesterilization.

## 27 Materials needed for artificial insemination:

- 1) Speculum, Pyrex 22 x 175 mm for doelings; 25 x 200 mm for adult does; or stainless steel human vaginal speculum; or plastic disposables; with a small clip-on flashlight.
- 2) Sterile lubricating jelly (K-Y)
- 3) Thaw box
- 4) a. Inseminating pipette with bulb or syringe (ampules only) or  
b. Inseminating gun (straws only)
- 5) Paper towels
- 6) Facility for securing doe (stanchion, fence, rope hoist)
- 7) Recording journal for breeding dates, buck's name, etc.

## 28 Preparing Ampules:

- 1) Partially remove an inseminating pipette from its plastic bag.
- 2) Place bulb or syringe on exposed end.



- 3) Thaw ampule according to the described methods.
- 4) Dry ampule after thawing, hold in paper towel and scribe (with proper tool) one side of ampule collar. Some ampule types do not need to be scribed, but can be snapped open.
- 5) Pull syringe back 1/2 cc on plunger or squeeze bulb closed before placing pipette into ampule.
- 6) Tip ampule to slight angle and maintain constant suction on pipette while it is slowly inserted into the ampule. Try to get all the semen into the pipette, keeping the semen column down near the end of the pipette.
- 7) When filled, the pipette should have a semen column with no air spaces, with the bottom of the column being 1 to 2'' from the pipette tip. Do not draw semen into the syringe or bulb.
- 8) Keep the ampule for information to complete breeding records.
- 9) Keep the pipette away from sunlight or cover with paper towels.
- 10) The semen is now ready to be placed into the doe in estrus.

#### 29 Preparing Straws:

- 1) An inseminating gun, designed for your type of straw is needed, obtainable thru farm supply houses or the local cattle AI technician. Have cover sheath available, sealed until needed.
- 2) Place straw in thaw box.
- 3) Remove when thawed, wipe dry. Check buck information.
- 4) Pull plunger on gun back 4 to 6'' and insert straw into gun, cotton plug end first (towards plunger).
- 5) Hold gun in upright position, allowing air bubble to rise to the sealed end.
- 6) Cut sealed end of straw with scissors. Take care to cut straw squarely for proper seating.
- 7) Install the sheath over the gun, fastening it down with the provided O-ring. Install it so that the wider side of the ring faces the straw, with the narrower side facing the syringe end.

#### 30 Insemination:

Assuming that the doe has been observed in heat, has been suitably restrained (i.e. in stanchion) and the steps for preparing the ampule or straw have been followed. The next steps are:

- 1) Position doe on milk stand. The inseminator places his left foot on the stand and drapes the hindquarters of the goat across his horizontally positioned thigh. The goat is allowed to stand as long as she does not struggle or collapse. The vulva is cleaned.
- 2) Hold pipette or inseminating gun, wrapped in a paper towel, in your mouth; or let someone else hold it if extra hands are available.
- 3) Turn head light on and insert lubricated speculum in a slow and gentle manner. Begin entrance at a somewhat upward angle for the first several inches. This is to prevent the speculum from scraping across the vaginal floor, possibly doing damage to the urethral opening.
- 4) Complete insertion of speculum and locate cervix. Center the end of the speculum over the os uteri (entrance to cervical canal).
- 5) Cervix should be of a red-purple coloration with a viscous whitish mucus present if doe is truly in heat.
- 6) Insert pipette or inseminating gun into speculum to the cervix. Gently manipulate the instrument through the cervical canal (cervix is 1 to 2'' long) to the 4th or 5th annular ring.
- 7) Deposit semen near the uterine end of the cervix or just inside the uterus. Do not enter too far into the uterus as the semen will then tend to be dumped into one horn or the other. If the semen is pushed into the wrong horn (i.e. egg produced in left ovary, semen dumped into right horn) then fertilization may not occur.
- 8) Deposit semen slowly, taking at least five seconds.
- 9) Slowly withdraw instrument without release of syringe or depressed bulb, then carefully remove the speculum.
- 10) Record all pertinent breeding information.
- 11) Carefully discard all disposable materials. Arrange to sanitize reuseable items and sterilize the speculum (if it is a non-disposable type).

31 Frequently, the pipette cannot be passed all the way through the cervix even though the doe is in heat. If it has penetrated deeply into the cervix (3 to 4 cm, as determined by laying another pipette alongside the first and observing the distance by which the outer ends are offset), cervical insemination will provide a conception rate almost equal to that of intrauterine semen deposition. The conception rate expected from intra-vaginal insemination, however, is less than 30 If semen is very valuable, it may be advisable to pass a trial pipette to determine patency of the cervix before thawing the semen unit.



# ALL ABOUT GOATS

COLLECTION: GOAT HANDBOOK

ORIGIN: United States

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Extension Goat Handbook

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TI ALL ABOUT GOATS

AU G. F. W. Haenlein; U. of Delaware, Newark

RV D. L. Ace; Pennsylvania State U., University Park.

DE The Goat Industry

Text

1 Distribution

The goat is one of the smallest domesticated ruminants which has served mankind earlier and longer than cattle and sheep. It is managed for the production of milk, meat and wool, particularly in arid, semitropical or mountainous countries. In temperate zones, goats are kept often rather as supplementary animals by small holders, while commercially cows or buffaloes are kept for milk, cheese and meat, and sheep for wool and meat production. Nonetheless, there are more than 460 million goats worldwide presently producing more than 4.5 million tons of milk and 1.2 million tons of meat besides mohair, cashmere, leather and dung; and more people consume milk and milk products from goats worldwide than from any other animal. Cheese production, e.g., from goat milk even in France, Greece, Norway and Italy is of economic importance. Goat herds, on the other hand low producing though, are an expression of capital assets and wealth in Africa and Asia where they are found in large numbers. In the United States, there are between 2 and 4 million head; with Texas leading in Angora, meat and bush goats; and California leading in dairy goats.

2 Goats can survive on bushes, trees, desert scrub and aromatic herbs when sheep and cattle would starve to death. Goat herders often have neglected a rational numerical balance between goat numbers and sparse vegetation. Over-grazing has destroyed many tree and woodland areas which was blamed then on goats rather than man, and this has caused widespread ecological and political concerns, erosion, desertification and even ban on freely grazing goats in some areas. On the other hand,

goats are valued by cattle and sheepmen in the fight against brush encroachment on millions of acres of open rangeland.

3 Swiss goat breeds are the world's leaders in milk production. Indian and Nubian derived goat breeds are dual-purpose meat and milk producers. Spanish and South African goats are best known for meat producing ability. The Turkish Angora, Asian Cashmere and the Russian Don goats are kept for mohair and cashmere wool production. In addition, there are Pygmy goats from Western Africa of increasing interest as laboratory and pet animals.

4 Goat milk casein and goat milk fat are more easily digested than from cow milk. Goat milk is valued for the elderly, sick, babies, children with cow milk allergies, patients with ulcers, and even preferred for raising orphan foals or puppies. Fat globules in goat milk are smaller than in cow milk and remain dispersed longer. Goat milk is higher in vitamin A, niacin, choline and inositol than cow milk, but it is lower in vitamin B6, B12, C and carotenoids. The shorter chain fatty acids (C6, C8, C10, C12) are characteristically higher in goat milk than in cow milk. Otherwise milk gross composition from goats or cows is similar except for differences due to breeds, climate, stage of lactation and feeds.

5 Breeds of goats vary from as little as 20 lb mature female bodyweight and 18 inches female withers for dwarf goats for meat production up to 250 lb and 42 inches withers height for Indian Jamnapari, Swiss Saanen, Alpine and AngloNubian for milk production. Some Jamnapari males may be as tall as 50 inches at withers. Angora goats weigh between 70 to 110 lb for mature females and are approximately 25 inches tall. Birthweights of female singles are between 3 and 9 lb; twins being often a pound lighter and males 1/2 lb heavier. Twinning is normal in goats with a high percentage of triplets thus giving several breeds an average annual litter size above 2 per doe and more than 200 reproduction rate. Females are called doe, young are kids, males are bucks; one speaks of buck and doe kids, and doelings, and of wethers or castrates.

## 6 Differentiation

Morphologically, goats may have horns of the scimitar or corkscrew types, but many are dehorned in early age with a heated iron, caustic or later on with a rubber band or surgical saw. Goats may also be hornless genetically. They can be short haired, long haired, have curled hair, are silky or coarse wooled. They may have wattles on the neck and beards. Some breeds, particularly the European, have straight noses, others have convex noses, e.g., the Jamnapari and Nubian breeds or slightly dished noses (Swiss). Swiss and other European breeds have erect ears, while pendulous, drooping, large ears characterize Indian and Nubian goats. The American LaMancha breed has no external ear. A 'gopher' ear rudiment in LaMancha is less than 1 inch long with little or no cartilage; an 'elf' ear is less than 2 inches long, but

bucks can be registered only with gopher ears. The responsible gene for rudimentary ears is dominant, thus sires with gopher ears will always have gopher or elf-eared offspring, no matter what the genotype of the dam is to which he was mated.

7 Goats come in almost any color, solid black, white, red, brown, spotted, two and three colored, blended shades, distinct facial stripes, black and white saddles, depending on breeds.

8 Teeth in goats are a good guide to age. Six lower incisors are found at birth and a set of 20 'milk teeth' are complete at 4 weeks of age consisting of the eight incisors in the front of the lower jaw, and 12 molars, three on each side in each jaw. Instead of incisors in the upper jaw there is a hard dental pad against which the lower incisors bite and cut. Some goats have an undesirable inherited recessive condition of 'parrot' (overshot upper jaw) or 'carp' mouth (undershot upper jaw) which does not interfere with barn feeding conditions but handicaps the goat severely in pasturing and browsing, because the lower incisor teeth cannot cut correctly against the upper dental pad. With progressing age, the permanent teeth wear down from the rectangular cross-sectional shape and cores to the round stem which is a further distinguishing mark of age. Furthermore, there are pregnancy rings marking horns and telling age.

9 The digestive tract of the goat after nursing has the typical four stomach compartments of ruminants consisting of the rumen (paunch) (4-6 gallon), the reticulum (honeycomb) (1-2 liters), the omasum (maniply) (1 liter), and the abomasum (true stomach) (3.5 liters). The intestinal canal is about 100 feet long (11 liters), or 25 times the length of a goat. The total blood volume of the goat approximates 1/12-1/13 of bodyweight; it takes about 14 seconds for goat blood to complete one circulation.

10 Among diseases, goats are not too different from cattle and sheep in the same regions. Goats tend to have more internal parasites than dairy cows, especially in confined management. They tend to have less tuberculosis, milk fever, post partum ketosis and brucellosis than dairy cows and their milk tends to be of lower bacteria counts than cow milk. They have more prepartum pregnancy toxemia than dairy cows, and are known to have laminitis, infectious arthritis, Johne's disease, listeriosis, pneumonia, coccidiosis, scours, scabies, pediculosis, liver fluke disease and mastitis.

## 11 Reproduction

The skin of the goat has sebaceous and sweat glands besides growing the hair cover, horns, hooves and the two compartmented mammary gland (udder). Before the first pregnancy, the udder is underdeveloped, but with sustained repeated gentle massaging, a small, normal milk producing gland can be stimulated in virgin does and even in goat bucks. In contrast to sheep, the teats of goat's udders are

conveniently long and large for hand milking.

- 12 Tails, scent and horns distinguish goats easily from sheep and cattle. The goat tail is short, bare underneath and usually carried upright. Major scent glands are located around the horn base. They function in stimulating estrus in male and female goats, improving conception. The goat odor is, however, a detriment to goat keeping and milk consumption if not properly controlled. Many goat breeds are seasonal breeders, being influenced by the length of daylight. Artificial insemination is commercially practiced in regions where numbers of females make it economical. Goats are in puberty at 1/2 year of age and can be bred if of sufficient size. Does come into estrus in 21 day cycles normally, lasting approximately 1 to 2 days.
- 13 In temperate zones, goats breed normally from August through February. Nearer the equator, goats come into estrus throughout the year. Thus more than one litter per year is possible, considering the length of pregnancy of 150 days. Five days after ovulation one or several corpus luteum form to protect the conceptus from abortion. The goat pregnancy is corpus luteum dependant in contrast to cattle. If no conception occurred, the corpus luteum disappears and new ovulation takes place. A buck ejaculates normally 3/4 - 1 1/2 ml of semen with 2-3 billion spermatozoa each. The life of an ovum after ovulation is about 8-10 hours. As the ovum travels down the goat's oviduct, it is fertilized by semen which traveled up through the uterus. The fertilized embryo becomes firmly attached to the uterine walls and surrounds itself with a nourishing placenta starting at 52 days after conception. Semen of goat bucks freezes as well as that of bulls and may be stored for years in 1 ml ampules or 1/2 ml straws in liquid nitrogen tanks for artificial insemination use.
- 14 Origin
- Wild goats or escaped feral goats are found in many countries and islands and can be harmful to the vegetation if numbers are left uncontrolled.
- 15 Truly wild goats are found on Creta, other Greek islands, in Turkey, Iran, Turkmenia, Pakistan; in the Alps, Siberia, Sudan, Caucasus; the Pyrenees, the Himalayan, Central Asian, Russian and Tibetan mountain ranges, and prefer rocky, precipitous mountains and cliffs. Goats can not be herded as well with dogs as sheep; instead they tend to disperse or face strangers and dogs headon. Relatives of true goats are the Rocky Mountain goat, the chamois of the Alps and Carpathian, and the muskox.
- 16 Goats belong, scientifically, to the Bovidae family within the suborder of ruminants (chevrotain, deer, elk, caribou, moose, giraffe, okapi, antelope), who besides the other suborders of camels, swine and hippopotamuses make up the order of eventoeed hoofed animals called artiodactyla. They have evolved 20 million years ago in the Miocene

Age, much later than horses, donkeys, zebras, tapirs, rhinoceroses, who make up the order of uneventoed hoofed animals; and the hyrax, elephants, manatees who make up the ancient near-hoofed animals. All these are herbivorous mammals, i.e., they live from plants and nurse their young with milk from an external gland after the young is born, having been carried in pregnancy to term relatively long in an internal uterus with a complex, nourishing placenta.

17 Goats and sheep make up a tribe within the Bovidae family called Caprini that include six goat, six sheep and five related species. Goats have a 2n chromosome set number of 60 while domestic sheep have a 2n set of 54; yet living hybrids of the two genera have been reported. The six species of goats can be distinguished by their horn shapes:

1. *Capra aegagrus*, the wild (or bezoar) goat of Near East Asia has scimitar-shaped horns with a sharp anterior keel and a few knobs interrupting it.

2. *Capra ibex*, the ibex of the Alps, Siberia and Nubia has scimitar shaped horns with a flatter front and many transverse ridges.

3. *Capra falconeri*, the markhor of Central Asia has sharpkeeled horns that are twisted into open or tight spirals.

4. *Capra pyrenaica*, the Spanish goat has outward-upward curving horns with a sharp posterior keel.

5. *Capra cylindricornis*, the Dagestan tur of the Caucasus mountains has round outward-back inward curving horns.

6. *Capra hircus*, the domestic goat evolved principally from *capra aegagrus*, except for Angora, Cashmere goats, and Damascus types who descended from *capra falconeri*.

18 Breeds

Domestic goat breeds are many. Swiss breeds are distinguished in milk producing ability and have influenced significantly milk production from goats around the world, especially in Europe, North America, Australia and New Zealand. A few breeds kept mostly for meat are the South African boer goat, the Indian beetal, black Bengal, the Latin American criollo, the US ''Spanish'' goats and most of the small or nondescript goats. Fiber producing goat breeds are the Angora in Turkey, USA, South Africa; the Cashmere in Afghanistan, Iran, Australia and China; and Don breed in Russia.

19 The major breeds of US goats are:

20 Saanen originate from Switzerland (Saanen Valley), are totally white, with or without horns. The white color is dominant over other colors. They are mostly short haired. The ''Appenzell'' is a similar breed, but partially related to the Toggenburg is from Northern Switzerland, longhaired, white and hornless. Saanen have been exported around the world as leading milk producers. An Australian Saanen doe holds the world record milk production of 7,714 lbs in 365 days. Saanen



have been bred in Switzerland for odorfree milk long ago.

- 21 Toggenburg, brown with white facial, ear and leg stripes, another straight nosed, horned or hornless, mostly shorthaired, erect eared goat, as all Swiss are, has been very popular in the USA, comes from N.E. Switzerland, but is 4 inches shorter in height and 18 lb lighter in average than the Saanen. They have been bred pure for over 300 years, longer than many of our other domestic breeds of livestock. They are reliable milk producers summer and winter, in temperate and tropical zones. Mrs. Carl Sandburg, wife of the famous US poet had several world record Toggenburg does on official USDA tests.
- 22 Alpine (including French, Rock and British), another Swiss breed (French Switzerland), horned or hornless, shorthaired, as tall and strong as the Saanen, with usually faded shades of white into black, with white facial stripes on black. They are second in milk production to Saanen and Toggenburg.
- 23 LaMancha is a new, young breed developed in California from Spanish Murciana origin and Swiss and Nubian crossings. They are known for excellent adaptability and good winter production. They are also producing fleshier kids than the Swiss, but are not milking as much. They have straight noses, short hair, hornless or horns, and no external ear due to a dominant gene. They are more the size of Toggenburg. Their milk fat content is higher than that of the Swiss breeds.
- 24 (Anglo)-Nubian is a breed developed in England from native goats and crossed with Indian and Nubian which have heavy arched ''Roman'' noses and long, drooping, pendulous ears, spiral horns and are shorthaired. They are leggy and as tall as Saanen, but produce less milk, though higher milk fat levels and are more fleshy. They are less tolerant of cold but do well in hot climates. They ''talk'' a lot, and are in numbers the most popular breed in USA and Canada. They have a tendency for triplets and quadruplets. They are horned or hornless and have many colors that may be ''Appaloosa''-like spotted.
- 25 Oberhasli, a western Swiss breed, usually solid red or black, horned or hornless, erect ears, not as tall as Saanen, very well adapted for high altitude mountain grazing and long hours of marching; popular in Switzerland, but milk production is variable. They are also called Swiss Alpine, Chamoisie or Brienz.
- 26 Angora originated in the Near East. The long upper coat (mohair) is the valuable product in the Angora in contrast to the Cashmere, where the fine underwool is the valuable product. Head has a straight or concave nose, thin, not very long; pendulous ears and twisted horns, in both sexes. It is a small breed, usually white. The haircoat is long with undulating locks and ringlets of fine, silky hair. The top quality fleece of purebreds may be 1-2 lbs, but slightly more in males and



# ANGORA GOATS

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## A SMALL-SCALE AGRICULTURE ALTERNATIVE

### Angora Goats

United States Department of Agriculture

Angora goats may be the most efficient fiber producers on Earth. These makers of mohair came from and were named after Ankara (Angora prior to 1930), the Turkish province where they have thrived for centuries. Turkey guarded these goats against exportation until 1849 when seven does and two bucks were imported into the United States. Later, more were imported from Turkey and South Africa, the two principal mohair producers in the 19th century.

But now the United States has become one of the two biggest producers (along with South Africa) of mohair - the long, lustrous, wavy hair that goes into fine garments. The other primary fiber from goats is cashmere. (See "A Small-Scale Agriculture Alternative, Cashmere Goats," December 1992). Never the twain should meet! To cross Angora with cashmere goats results in a fiber called cashgora, with very limited uses and characteristics of neither fine fiber.

The two goat types differ in temperaments, too. The Angoras are pretty laid back and docile, while cashmere and/or Spanish meat goats are often flighty and high strung. (Incidentally, Angora goats, which do produce mohair, do not produce Angora hair; only rabbis can produce that.)

Although Angora goats are somewhat delicate, they grow their fleeces year-round. This puts considerable strain on the animal and probably contributes to their lack of hardiness.

About 90 percent of the U.S. mohair clip originates in Texas, but the goats are raised over wide areas of the United States.

They adapt well to many conditions, but are particularly suited to the arid Southwestern States. Central and southwestern Texas have all the major mohair warehouses.

### Shear Twice a Year

Angora goats are sheared twice a year, before breeding and before kidding. The hair grows about 3/4 of an inch a month, and adult hair should be 4-6 inches long at shearing. Shearing most often follows the method developed by the Mexicans, with the goats lying down with legs tied. Shearing should be done on a clean-swept floor or sheet of plywood.

Care should be give to keep mohair clean and free from contaminants-weeds, grass seeds, or urine. Buyers severely discount unclean hair and hair showing second cuts. Fleeces should be bagged separately in 6-foot burlap bags. Not acceptable are polyethylene bags or poly twine.

Each bag should show the grower's name marked with a permanent-type felt-tip pen, be tagged, and contain only one fleece type clearly marked: Kid, yearling, young adult, adult, buck and stained with spring or fall clip. Special problems, such as burns or coarse, extra long, or short fleece, should also be listed on the goat. Buyers slit the bag's side when inspecting before buying; sellers must present a uniform product.

An adult goat usually will produce 8-16 pounds of mohair a year. Kid mohair should be 4 inches long, is finer, and may yield 3-5 pounds a year. Mohair fiber diameter ranges from 20 to 40 microns.

If kemp fiber (long, straight, hollow and brittle) shows up on any goats, especially along the backbone and thighs, such "kempy" animals should be culled, as suggested by the U.S. Mohair Marketing Board. Kemp fiber breaks easily and does not readily accept dye.

The U.S. Government has a direct-payment program for mohair producers help maintain a viable industry. The direct payment through the U.S. Department of Agriculture's (USDA) Agricultural Stabilization and Conservation Service (ASCS) is based on the difference between the national average market price and a support price. In one recent year, producers received an average of @2.475 for every dollar's worth of mohair marketed. Details can be found at ASCS offices in many counties.

### Selecting Bucks

Bucks should be chosen for body conformation and fine hair. Preferred are open-faced bucks not blinded by hair. Bucks should be left with does for 6 weeks. Angora goats are seasonally in estrus. The normal breeding season is from late September into December.

The gestation period for goats is usually 150 days, but it can vary several days each way. Kids are usually dropped from late February through April or early May. Twins may account for 40 percent of births, with a much lower percentage being triplets.

### Fiber Comes First

Angora goats have high nutrient requirements and give nutritional advantage to fiber growth at the expense of other demands. Meeting nutritional needs should be the producer's main concern. Range forage of browse and forbs, protein supplements, grain and crop residues, and cereal crop pastures can help supply needed nutrients for growth and reproduction.

Goats, browsing animals, can be pastured with sheep and cattle; each species prefers different plants. Goats prefer brush, tree leaves, and rough plants. They can improve pasture, clear reforestation areas, control leafy spurge and destroy multiflora roses, red cedars, sand burs, knapweed, hound's tongue, Canadian thistle, sagebrush, backbrush, giant ragweed, sunflowers, and many other weeds.

When growing plants are not available, Angora goats need supplemental hay and perhaps grain. While gaining at breeding time, young does should weigh at least 55 pounds (sheared weight) and mature does at least 75. Does need extra feed before and after breeding so fetuses can develop hair follicles.

During pregnancy and lactation, does need almost 1/2 pound of crude protein daily. Supplement feeding must start as soon as does begin to lose weight and condition. Improved nutrition brings more and better big growthy kids and heavier fleeces. Poor nutrition is the leading cause of abortion and poor mothering. Young or lighter-weight goats are most subject to abortion. Stress from disease, moving long distances, or cold wet weather also cause abortions.

Goats should be give adequate nutrition before and after shearing. Angora goats must be able to take shelter from wet and cold; great death loss can occur without shelter for 4 to 6 weeks after shearing. Goats to not carry layers of body fat, unlike sheep.

## Kidding on the Range

Due to lack of labor and facilities, large herds are usually kidded on the range, while many smaller herds use a more intensive confinement system. For open-range kidding, small pastures with shelter, centrally located watering and supplement feeding areas, and bedding spots reduce numbers of lost kids.

Angora does and kids should be undisturbed for several weeks, since does may abandon their kids. When goats are moved, pastures should be rechecked for kids.

An even more intensive kidding system uses buildings, small individual stalls, heat lamps, and feeder space. This "system kidding" can be done earlier in the year but is much more labor intensive and therefore more expensive. But a larger kid crop can be realized with good management. Before kidding, does should be outdoors except in cold or wet weather or at night; this helps keep bedding cleaned and dry and encourages needed exercise.

As does kid, they should be moved into stalls and kids' navels treated with 7 percent iodine. C and D antitoxin should be given. Cold kids will not try to suck and may need a heat lamp. When warm, they will usually suck by themselves but may need help to begin. Angora kids, very sensitive to cold, can die within a short time if too chilled. Immersion in warm water to speed restoration of body temperature and then thorough drying may save severely chilled kids.

After identification with matching paint or ear tags, well fed does and kids can be moved to group pens or holding areas. Twins and triplets should not be grouped with singles since stronger kids often rob milk from usually smaller multiple-birth kids. Groups should contain kids of similar age.

## Parasites Trouble Goats

Among goats, major health problems are internal and external parasites, coccidiosis (in kids before and after weaning), and pneumonia. A good health care program includes vaccination for most diseases and should be established between a grower and a veterinarian.

Goats' hooves may need to be trimmed, depending upon walking conditions. Rocky ground may take care of that problem.

Goats may need special 4-foot-high fencing to keep them in and

## ANGORA GOATS

predators out. Goats like to go under or through obstacles. Five wire electric fences, with three wires hot and two grounded, make a good system. Woven wire fences may be used with the addition of a 12 inch "outrigger" electric wire about 12 inches above ground. Small-mesh fencing also may be used.

Horns caught in the fence or the crotch of a tree become life-threatening, not only from predators but also from other goats. While most goats are not aggressive toward humans, they are not always kind to other goats and in seconds can do serious or lethal damage with their horns. A goat raiser may find horns useful-as handles. For safety, both for the handler and for other animals, horns' sharp points may be clipped, using a bolt cutter or similar device.

Following are additional information sources on Angora goat production:

Mohair Council of America  
P.O. Box 5337  
San Angelo, TX 76902  
Telephone: 915-655-3161

Ranch Magazine  
P.O. Box 2678  
San Angelo, TX 76902  
Telephone: 915-655-4434

E (Kika) de la Garza Institute  
for Goat Research  
Langston University  
P.O. Box 730  
Langston, OK 73050  
405-466-3836

Texas A&M University  
System  
7887 North Hwy 87  
San Angelo, TX 76901  
915-653-4576

"Angora Goats the Northern Way"  
Susan Black Drummond  
Stony Lonesome Farm  
1451 Sisson Road  
Freeport, MI 49325

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# ANGORA GOAT PRODUCTION

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TI ANGORA GOAT PRODUCTION

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DE Management and Housing

Text

- 1 Angora goats are an important enterprise for ranch operators in certain areas of Texas, mostly, but also in New Mexico and a few other Western states. Angoras produce income from the sale of mohair and meat. They also are used for biological control of brush and weeds in range improvement programs. Production costs have increased in recent years. This places a heavier burden on the ranch manager for decision making for greater efficiency in production and higher economic returns.
- 2 Goats require the same major production resources as other species of livestock. These include land, labor, capital and management.
- 3 Goats often are grazed on forage land less suited for other livestock. They prefer browse, thus are not totally competitive with cattle and sheep for limited land resources. However, goats must convert forage into salable products to justify their presence in most multi-species operations. Since land is a costly resource in ranching operations, goats should recover their share of the costs.
- 4 The total annual cost of maintaining an Angora goat varies by area and from ranch to ranch. This is influenced by the productivity of the land resource and by the level of management. Annual income per goat also varies for the same reasons.
- 5 Type of Production  
Doe and kid operation should consist of a flock of healthy animals



of productive age, three to six years of age. Raise replacements to make improvements in flock. Keep Spanish or meat-type animals separate. Sell all crossbred kids so they do not become mixed in the Angora flock. Replace wether goats for mohair production when the mohair becomes coarse and loses its character. Stock goats at a rate that will insure maximum mohair production with a minimum of supplemental feed.

## 6 Range Management

Use stocking rates consistent with the area of production. Practice mixed grazing of livestock consistent with the area of production. Practice rotation grazing for pasture improvement and internal parasite control. Follow range improvement practices recommended for the area and consistent with ranch economics. Make use of supplemental grazing when available.

## 7 Breeding Practices

Flush does by supplying 1/4 to 1/3 lb of supplemental feed daily or move to a fresh, rested pasture about two weeks before turning bucks out. Protein blocks may be used in flushing when range conditions are not too severe. When ranges are extremely dry, it may pay to give does vitamins A, D and E two weeks before breeding.

8 Follow a good selective breeding program. Mate best does to best bucks, second best does to second best bucks, etc. Save replacement does from top two groups. Adaptability to the area of production is probably the most important single point. Good bucks are essential to a good selective breeding program. Purchase bucks from one breeder whose goats possess the desired characteristics to produce a uniform flock. Select animals for quantity and quality of mohair but do not sacrifice size and vigor. Fleeces also should be uniform in quality and length over the body of the goat.

9 Use three to four bucks per 100 does, depending upon the size, brushiness and roughness of the pastures. Avoid using one buck per pasture in commercial goat production. Condition bucks by supplemental feeding about two weeks before turning them out. Breed does in September and October for February and March kids. It is not good management to run does and kids in the same pasture with wether goats. Wether goats travel too much.

## 10 Supplemental Feeding

Angora goats respond to supplemental feeding more than other livestock. They reflect this through heavier fleece weights. Feed goats during dry periods and especially during the winter months.

11 Feed 1/4 to 1/2 lb of cottonseed cake, 1/2 to 1 lb of yellow corn or 1/2 to 3/4 lb of goat cubes per head daily depending upon the condition of the pastures and the does. Pregnant does require larger amounts of feed than dry animals. Abortion often can be prevented by supplemental feeding.

- 12 Self-feeding, using salt as an inhibitor, may be used in large, rough or brushy pastures. Keep salt as low as possible and place the feeders 3/4 to 1 mile from water. Move feeders for better pasture utilization. A popular mixture is three parts of ground milo, one part cottonseed meal and one part salt. Salt-controlled feeding is not recommended unless all other methods are impractical.
- 13 Feed kids during winter months to insure good growth and development. This will improve the kid crop on two-year-old does. Cull undeveloped kids that do not learn to eat. Protein blocks may be fed during kidding season. This method of feeding prevents kids from becoming lost from their mothers.
- 14 Kidding  
Use rested pastures for kidding and do not disturb does during the kidding season. Kid in a small pasture, confine kids and let does out to graze until kids are large enough to follow mothers.
- 15 Marking  
Vaccinate kids for soremouth and earmark for identification when most of the kids are large enough to travel. Plastic ear tabs are a practical way of identification.
- 16 Castrate kids the following December or January or when the kids are about nine to ten months old. This produces a heavier horn on wether goats that buyers prefer.
- 17 Shearing  
Spring shearing time is January through March depending on the area of production. Goats may be shedded during this period.
- 18 Goats may be caped. Caping is the practice of leaving a strip of unshaired mohair about eight inches wide down the neck and back of the goat. This should be sheared after a month or six weeks. If capes are not sheared, they should be taken out and packed separately at shearing.
- 19 Goats may be sheared with special goat combs. These combs leave about 1/4 inch of stubble on the goat and give him about two weeks start over goats sheared with regular combs. Producers usually supply the special combs and pay a small premium for shearers using them.
- 20 Goats are sensitive to weather changes for a month to six weeks following shearing.
- 21 Fall shearing runs from July through September. Most producers shear with regular combs in the fall but some prefer the special combs.

22 The responsibilities of the producer are to:

- Provide a clean place to shear.
- Instruct the shearing crew so they know what is expected.
- Separate kids and third shearing goats from older goats so they can be sheared separately.
- See that goats are dry and not too full for shearing.
- Supervise the shearing pen or provide a supervisor other than himself.
- Register complaints with shearing crew captain.
- Caution shearing crew about cutting off teats of does.
- When mohair contamination ('vegetable matter') is a severe problem, a change in shearing dates may be advisable.
- Do not pack mohair in plastic bags.

23 The responsibilities of the shearer are to:

- Keep fleeces clean and remove each fleece in one piece.
- Avoid double cutting.
- Avoid injury to animals.

24 Spraying

Spray goats out of the shearing pen and again in twelve to eighteen days for best control of external parasites. Follow recommendations in B-1306, Texas Guide for Controlling External Parasites of Livestock and Poultry. Change sprays occasionally to get best control. Spray so goats will dry before dark. Use only recommended sprays or dips in strengths advocated by the Food and Drug Administration. Follow guidelines for spraying or dipping animals to go to slaughter. Do not spray under a shed or barn. Spray with the wind, not against it. Do not mix solutions with your hands. Spray or dip animals at a time of day when you will be able to bathe and change clothes. Do not mix chemicals.

25 Drenching

Watch animals closely for signs of internal parasitism and drench as necessary. Drench out of the shearing pen using one of the recognized drenches. Change drenches occasionally so that parasites do not build up resistance to any specific drench. Move animals to a fresh pasture following drenching. Phenothiazine salt is not recommended for



# ANGORA GOAT SELECTION

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TI ANGORA GOAT SELECTION

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DE Genetics and Reproduction

Text

1 The Angora goat has been selected almost exclusively for fiber (mohair) production, and as such can be considered one of the outstanding success stories in animal breeding. Many Angora goats produce up to 20-25% of their body weight annually in fiber. In terms of growth rate of mohair fiber, they produce approximately double the rate of most types of sheep. Expressed as a function of body weight or feed intake, their rate of fiber production is about four times that of most sheep. However, since a high proportion of their nutrient intake is expended for fiber production, Angora goats are relatively poor meat or milk producers. Of course, slaughter of cull breeding stock provides some meat. It may be possible to develop dual-purpose meat and fiber producers, but only under conditions of better nutrition than that where most are run at the present time. Thus, for this discussion it is assumed that Angoras are bred primarily for fiber. The possibility is recognized that Angoras are kept for their usefulness in clearing brush and weeds on the farm or ranch also and that some are simply pets.

2 In selecting for fiber, one is interested in both quantity (weight) and quality of fiber (length, fineness, style, character, absence of kemp, etc). In addition to fiber, one must be concerned with traits that contribute to the survival or viability (soundness, fertility, etc.) of the individual and flocks.

3 Selection for quantity of fiber is accomplished efficiently by using fleece weights of those Angoras (mostly young males or young females) which are being considered for use as breeding animals.

However, history indicates that most producers practice visual selection. In this case the predicting indicators of fleece weight are: size of the animal, completeness of cover, length of fiber, diameter of fiber and differences in density. The amount of grease (oil) or dirt in the fleece contributes to overall fleece weight, but not to fiber weight. It is preferable to emphasize fiber weight over total fleece weight. Environmentally (i.e. phenotypically), the two tend to be positively correlated, but genetically they are negatively related since the oil production requires a substantial amount of feed-energy. Similarly, one should not overemphasize the size of Angoras as a means of obtaining fleece weight.

4 Phenotypically, size and fleece weight are positively related but genetically they tend to be negatively correlated. For assessing efficiency of production, the genetic correlation is the more accurate term since it is not possible to produce meat and fiber from the same units of feed-energy. Fiber diameter is phenotypically and genetically positively related to fleece weight, but negatively to fleece quality since the finer fiber is more desirable. Completeness of cover includes mostly head, neck, belly and legs. They are genetically related to fiber production. Face cover, however, can interfere with vision and have serious effects on the animal's welfare. This is even more true with range goats where reduced vision can interfere with their ability to graze selectively. The amount of mohair cover on the face contributes little to total fleece weight, but is genetically linked to total cover at other points. The amounts of fiber on neck and belly make important contributions to fleece weight, but the value of fiber grown on the legs (below the knee or hock) is rather low. Therefore, selection for body cover should be limited to the neck and belly, primarily the former. Animals with extensive cover in the face should be eliminated.

5 Selection for mohair quality includes primarily fiber diameter (finer fibers preferred), length (four inches minimum), freedom from kemp (coarse, brittle, chalky white hair mixed in the fleece), and desirable lock formation. There is little technological support for selecting for a specific lock type or formation, but in the absence of detailed studies it seems undesirable to allow the fleece to become straight or without some more appealing lock character.

6 Limited research indicates that all the desirable economic traits of Angora goats are moderately to highly heritable and can thus be changed through selection. Some strong negative relationships exist. Also, problems may be encountered due to genetic, environmental interactions. For example, selection for high level of fiber production tends to make the animal poorly adaptable to the range conditions under which most are produced presently.

7 Age of selection deserves some discussion. Weaning or first shearing is a poor time to select Angora goats. The second and third



# ARTHRITIS

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TI ARTHRITIS

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DE Health and Disease Management

Text

1 The limb joints of animals are designed for mobility. In conjunction with the muscles and tendons, the joints allow for flexion and extension of the legs and permit a wide range of motion and activity. Normal joint function is essential for good health, particularly in grazing animals such as goats which may have to cover large areas over varying terrain in search of food. Normal joint function also allows flight from predators and is important for breeding success in active bucks. In addition, lameness or swellings over joints may reduce an animal's chances in the show ring.

2 Normal limb joints are comprised of several structures. First are the bone ends, covered with cartilage and shaped to interlock for increased stability. The cartilage is quite smooth, for reducing friction and wear in the joint. A space exists between the cartilage surfaces called the joint cavity. This space is filled with joint (or synovial) fluid which lubricates the joint and acts as a shock absorber to reduce the trauma associated with movement. The fluid is held in place by a fibrous joint capsule which is lined with a synovial membrane that produces the joint fluid. Outside the joint capsule are numerous ligaments, muscles and tendons which add further strength and stability to the joint. The tendons are also surrounded by sheaths containing fluid known as bursae. Inflammation of the tendon sheaths is known as bursitis. Inflammation of the joint from any cause is known as arthritis. Any or all of the structures comprising the joint may be damaged in arthritic conditions.

3 Recognizing Joint Disease



Arthritis may result from a variety of infectious and noninfectious causes. A single joint may be affected or multiple joints involved (polyarthritis). Depending on the cause, signs of arthritis may vary. For example, in bacterial or traumatic arthritis, the affected joint may be swollen and warm to the touch. In early viral or nutritional arthritis, no visible change may be detected in the joint. In these cases, the presence of arthritis is suggested by observation of signs such as reluctance or difficulty in rising, slowed return to the barn at milking time, inability of bucks to mount does at breeding time, limping or uneven gait, or complete disuse of a single limb. Even when these signs are noted, other conditions which might result in abnormal motion should be considered. These would include fractures, laminitis or founder, foot rot, and white muscle disease (vitamin E/selenium deficiency). In addition, various neurological problems may be misinterpreted as musculoskeletal disease.

4 Several diagnostic procedures may be employed to identify the cause of arthritis. Examination of the joint fluid obtained by aseptically tapping the joint may be useful. Large numbers of neutrophils in the fluid are suggestive of bacterial arthritis. Large numbers of mononuclear cells are more indicative of viral arthritis. Little change in the fluid composition may be observed in traumatic or nutritional arthritis. In the case of bacterial arthritis, joint fluid may be cultured to identify the causative organism and to select the appropriate antibiotic therapy.

5 In cases of nutritional or traumatic arthritis, radiographs may be helpful in establishing a diagnosis and prognosis for recovery. Serological testing may be required for the diagnosis of arthritis due to virus or mycoplasma. Successful treatment of individual cases of arthritis and control and prevention of additional cases depends on accurate and specific diagnosis.

#### 6 Specific Causes of Caprine Arthritis

Bacterial Arthritis -- Lacerations or puncture wounds over joints can lead to bacterial infection. Injuries such as these should be cared for immediately. The affected area should be cared for immediately. The affected area should be cleaned thoroughly with soap and water. If the joint has been opened, suturing may be indicated. Antibiotic therapy should be initiated to prevent infection.

7 In young kids, bacterial polyarthritis can occur. The organisms involved are usually *E. coli*, *Corynebacterium pyogenes*, or staphylococci. The condition is recognized by lameness and swelling in one or more joints, particularly the front knees (carpi), hocks and stifles. This condition is secondary to bacterial infection elsewhere in the body, usually the navel or digestive tract. The bacteria are carried to the joints via the bloodstream. Therapy is often ineffective and prevention is the preferred method of control. Unclean environment and improper kid care promote the incidence of polyarthritis. Improved

management practices will reduce the occurrence of this disease. Maternity pens should be used for kidding, and kept clean and dry with bedding changed between births. Navels of newborns should be dipped in iodine immediately after birth. Kids should receive adequate colostrum within six hours after kidding. They should be housed in warm, dry quarters, and not overcrowded.

8       Mycoplasma Arthritis -- Mycoplasmas are small microorganisms which differ from bacteria in that they do not have a cell wall. They are difficult to culture in the laboratory and much confusion exists with regard to the species of mycoplasma responsible for caprine arthritis in the United States. Several species of goat mycoplasmas are known in the US but *Mycoplasma mycoides* subspecies *mycoides*, large colony type, appears to be most responsible for cases of mycoplasmal arthritis. The prevalence and distribution of caprine mycoplasma arthritis is unclear, and sporadic reports from several regions of the US have appeared in the veterinary literature, most notably from California.

9       Mycoplasma infection produces a severe systematic disease in which arthritis may be the only sign or may be accompanied by high fevers, inappetence, pneumonia, diarrhea, keratoconjunctivitis (pink eye), or sudden death. All animals in a herd may be affected, but the more dramatic signs are seen in kids and younger adults. Outbreaks are often preceded by some stress such as dehorning. The infection may be carried unnoticed in a herd for extended periods.

10       Whenever several animals in a group are suddenly affected with arthritis along with signs of illness elsewhere in the body, mycoplasma should be suspected. Any dead animals should be submitted to a diagnostic laboratory for specific diagnosis. Blood samples from living animals should also be taken for evaluation of titers to mycoplasma infection. Correct diagnosis is important since few antibiotics are effective against mycoplasma. Tylosin and tetracyclines may be useful in controlling herd outbreaks although losses may be high.

11       Viral Arthritis -- (CAE) A recently discovered retrovirus has been identified as a cause of chronic arthritis in goats. It is very likely that many previously unexplained cases of caprine arthritis were the result of this slow virus infection. The caprine arthritis encephalitis virus (CAEV) was first recognized as a cause of progressive paralysis in two of four month old kids resulting from infection of the brain (encephalitis). Later it was demonstrated that the same virus also produces a progressive chronic arthritis in older goats. The presence of this virus in the US goat production is believed to be very high.

12       Nutritional Arthritis -- One specific syndrome of arthritis related to feeding deserves mention. It involves the excessive consumption of calcium in the ration by mature bucks. Lactating does and young growing animals may require supplemental calcium in the diet. However, mature bucks fed in similar ration are likely to develop arthritis due



# AVOID RESIDUES IN GOAT MEAT AND MILK

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TI AVOID RESIDUES IN GOAT MEAT AND MILK

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DE Management and Housing

Text

1 The wholesomeness of American food is a cherished goal for all involved in the production and processing of edible goods. In cooperation with producers, federal regulations ensure that food is safe and free from objectionable levels of residues. All persons involved in the daily production of meat and milk are constantly aware of the necessity to closely monitor their management practices to assure that their products, whether used on the family table or sold for processing, meet accepted standards.

2 Occasionally, animals become ill and require medication. Goats are no exception. However, the owner has little guidance in the use of medication because few drugs are labeled for goats and professional advice often is not available. As a result, treatment of an ailing animal may require a more cautious approach when deciding on the method of drug application and dosage. There is a greater chance for error and the possibility that goat meat and milk could contain unwanted chemical residues for an extended period of time.

3 A survey conducted among goat breeders in Pennsylvania as part of the USDA Residue Avoidance Program found that many goat owners subscribe to the organic method of food production. An awareness of situations that could induce residue problems in any food supply appears to be foremost in their management programs. Even so, there are numerous instances where medication of an animal for various ailments, infections, and parasite problems is a necessity. In nearly all cases, when animals were given medication there has been extreme

caution in the use of milk and meat from the treated animal. Withholding products several days beyond the recommended period is an accepted practice among goat owners. This type of concern and caution has sponsored a supply of meat, milk and milk products for use in the home or for sale, that meets federal standards. One packing house that slaughters approximately 1,000 goats each year has yet to find a carcass with a residue violation. This would support the observation that goat raisers are thoroughly conscious of potential problems and are taking steps to assure a wholesome product. The industry is to be commended.

4 There appears to be an ever increasing number of persons practicing goat husbandry. The homesteading movement with its agrarian intent, but often limited to small acreage, finds the dairy goat a perfect animal to meet home food production needs. Many newcomers to the business are not agriculturally trained. The lack of knowledge about adequate ventilation in goat housing and uncertainty about sanitation procedures could lead to a greater incidence of pneumonia, diarrhea, and parasite problems. This, coupled with a scarcity of drugs labeled for use on goats, and in some areas, no access to veterinary care, increases the risk of accidental medical application. Those raising goats for a long period of time find it difficult to make treatment decisions. It is doubly difficult for the newcomer.

5 Let's examine the route that drugs and chemicals take to get into meat and milk. Medication may be given orally, injected subcutaneously (under the skin) or into the muscle, infused into the udder or reproductive tract, or applied to the skin as a salve or a powder. Regardless of the treatment method, the medication may be absorbed into the blood stream and carried to all parts of the body. Therefore, a drug injected into the muscle to treat pneumonia symptoms or fed to the animal to control internal parasites will eventually find its way to the milk secretory cells and all body tissues. Body tissues may retain detectable levels of drug residues longer than body fluids such as milk. It is not uncommon to find labels stating a longer withholding time before it is safe to send the animal for slaughter as compared to using the milk.

6 Withholding times vary! When you treat an animal, be sure to follow directions when administering the drugs. If it calls for intramuscular injection and you inject subcutaneously, the stated withholding time on the label may be rendered inaccurate. Unusually large doses of medication will require longer withholding times, so stay with the recommended dosage if you expect the label to be an accurate guide. Mastitis medication formulated for dry treatment generally has a long meat and milk withdrawal time because the drugs are mixed in a slow release, long acting vehicle. Treatment over several days can extend the withdrawal period because of the additive effect.

7 Therefore, depending on the drug you use, the dose given, the

length of the treatment, and the drug vehicle (substance used to mix with or dissolve the drug), you may need to extend the withholding time to allow the body to eliminate the drug residue.

8 Residues may occur from sources other than medication. Forages, such as hay, weeds, and browse that may have grown on or near roadsides or right of ways that have been sprayed with herbicides or pesticides can become polluted by spray or spray drift. If eaten by the goat, they can be the cause of residues in meat and milk. The browsing nature of goats can lead them to eat both dead and living forage that another species of animal might shun. In addition, if you spray or dust your sweet corn, cabbage, turnips and other garden vegetables to control disease or insect do not permit the goats to eat any of the garden plants.

9 Be careful when purchasing a grain mix, especially one not formulated for a ruminant. Read the feed tag. If it says medicated on the tag be sure you read further to find what limitations may be recommended. Also, some milk replacers may contain a medicated ingredient that could pose a problem in the sale of a kid consuming the replacer in its daily ration.

10 If you have treated a milking doe for mastitis, milk her last and discard all the milk even though you may have treated only one side of the udder. By milking her last, you prevent possible contamination of milk from other does. As little as a teaspoon of milk left in a pail or in a milk line can contaminate the milk from the next doe.

11 Don't take chances. Mark a treated animal with a paint stick or a dye to remind you and anyone else doing the milking that the milk from that doe must be discarded.

## 12 Testing for Residues

Modern-day testing methods make it easier for officials to test for trace levels of residues. Levels that once went undetected now are found in both meat and milk. In addition, procedures have been developed to permit the tracking of a carcass in a slaughter plant back to an auction or buyer and finally to the person who sold the animal. Not only are the tests becoming more accurate and refined, it is now easier to identify the person who committed the error.

13 Several tests have been developed to assist the producer in checking for the possibility of residues present in the animal or the milk. The Live Animal Swab Test (LAST) developed by scientists in the USDA's Food Safety and Inspection Service (FSIS), is the first tool available for on-the-farm use in checking animals for antibiotic residues before they are shipped for slaughter. LAST is an adaptation of a test used since 1979 by FSIS, called STOP (Swab Test on Premises). STOP has been used in slaughter houses to check presence of antibiotics and other antimicrobial substances in the killed carcass. Now producers

and/or their veterinarians can perform the LAST on live animals at the farm simply by testing the urine of any suspect animal. Test kits are available for purchase and anyone wishing to learn more about the test and how to perform it may write to Publications Office, FSIS-ILA, Room 1163-S, USDA, Washington, DC 20250.

14 The DELVO test has been used for several years by milk plants and sanitarians and more recently by dairymen to check for levels of antibiotics in milk. More and more farmers are routinely running this test on milk from any treated, mastitic cow prior to including her milk with that of the herd. It is also used on milk in the bulk tank prior to shipping. Contact any dairy sanitarian, milk plant, veterinarian or Extension agent for information on purchasing this test kit. Or, write to G. B. Fermentation Industries, Inc., 555077 Centre Drive, Charlotte, North Carolina 28224. Other test kits are being developed for on-farm use. LAST, STOP and DELVO tests are all designed to detect the presence of antibiotics and sulfas. They will not detect other chemicals such as wormers or insecticides. Federal meat inspectors use other methods to detect these chemicals.

15 Today, there is little reason to use or sell residue-contaminated products. You can test a product to be sure it is residue free. This should be especially good news to the goat producer since most of the goat products are used by the family. Rather than to waste several days milk or hold a live animal an extra couple weeks just to be sure the medicine has been eliminated from the body, you can now test and know when the product is safe to place on the family table.

## 16 AVOID RESIDUES

- \* Provide a clean, well bedded, dry area for the does at kidding time.

- \* Be sure kids receive colostrum; 4 ounces (1/2 cup) within 2 hours following birth. Colostrum contains protective antibodies and helps keep kids from getting sick.

- \* Provide kids and adult animals with clean, dry bedding and good ventilation to reduce incidence of scours and pneumonia.

- \* Feed hay in a hayrack or keyhole feeder; protect grain boxes and watering devices from manure contamination to reduce parasite problems.

- \* Dip teats in an approved germicidal dip after each milking.

- \* Clean and sanitize all feeding equipment.

- \* Fence animals away from chemically sprayed areas and don't feed forages or garden refuse that contain chemical residues.





# BEHAVIOR

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TI BEHAVIOR

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DE Anatomy and Physiology

Text

1 The study of goat behavior, like so many aspects of the recorded knowledge of the genus *Capra*, is sketchy at best. Many inferences to the behavioral patterns of goats have been drawn from the more abundant and detailed information available on the closely related genera of sheep, deer and antelopes. While many behavioral characteristics of these genera are indeed similar, it is important to realize that several basic behavioral differences occur. It is these unique aspects of goat behavior that must be understood by the goatsman so that his management system is not at odds with the natural ways of the herd. An understanding of the caprine way is sure to present a twofold benefit to the goatsman. First, it will enable him to provide a more thorough and efficient management system, thereby deriving an economic benefit. Secondly, and perhaps more importantly, a greater knowledge of goat behavior will help cultivate an enhanced appreciation and enjoyment for the species.

2 Nine basic behavioral systems are generally recognized but the two most interesting in regards to goats are their ingestive and allelomimetic behavior. Sexual, agonistic, epimeletic (care-giving) and etepimeletic (care-seeking) behavior, while also important, are predominantly of a seasonal nature. A real significance to the specific eliminative behavior of the goat has not been described sufficiently.

3 Basic Behavior Systems: Ingestive Behavior

Grazing -- Goats are differentiated from most other domestic

ruminants by the fact they are browsers as opposed to being grazers. Under natural conditions, goats are not the great destroyers of vegetation that they are often indicated to be, as they will range over a large area, grazing and browsing selectively. Under confined conditions however, goats will become heavy browsers of trees and shrubs, and less discriminating in their grazing habits, due to the reduced supply of available herbage.

4 Goats exhibit a definite preference for a varied diet, often consuming no less than 25 different plant species. This penchant for variety serves the goat well, for many of the 'weed' species that are so eagerly consumed by goats have a higher mineral and protein content than grasses, owing to the greater root depth of the weeds. This grazing behavior can also work as a bonus for the livestock manager, as goats can graze quite productively on land that has been grazed over by cattle and other livestock, thus providing the manager with extra income from inter-species grazing of an otherwise 'depleted' field. It also may help to explain why goats are less likely to bloat than almost any other ruminant. They will not overgraze succulent legumes. They do provide roughage for normal rumen activity through browsing of pasture grasses and brushes.

5 In an unconfined grazing system, goats will almost uniformly reject any plants contaminated with the scent of their own species' urine or feces. From an evolutionary standpoint, this is significant in that it limits parasite infestation. However, in confined, highly contaminated areas goats may be forced to consume such plant material with the obvious bad consequences.

6 Grazing intake is related to the metabolic rate and body size of the goat, varying with the breed and age of the animal. The species and stage of growth of the plants being eaten also have an effect on the amount of herbage intake. Feed intake of goats fluctuates in accordance with environmental temperature, and appetite is subject to a thermoregulatory brain control. The amount of time spent eating and the rate of mastication both tend to increase as the temperature goes down. However, once the surrounding temperature drops below 10C (50F), eating activity decreases again. There is a correlation between lower temperatures and reduced water intake, and restriction in the amount of water consumed will cause reduction in dry matter consumption. The digestibility of dry matter may actually be increased especially the digestibility of the crude fiber portion of feeds.

7 Goats are known to be able to distinguish between bitter, salt, sweet and sour tastes. The fact that they have a higher tolerance for bitter tasting feeds than most other ruminants can be attributed to the browsing propensity for bark, leaves, shoots, shrubs and branches which may have a more bitter taste than grasses, forbs and general pasture. Goats also have a well developed ability to discriminate sweets. Although proper amounts of salt are very important, amounts of

more than 5 gm/100 cc are generally refused.

8 Goats tend to spend more time eating each day than other ruminants, often eating for as long as 11 hours. This may be misleading though, for they spend more time and distance moving from one plant to another than sheep or cattle.

9 The length and regularity of rumination is inversely related to the alert state of the goat, with long regular periods of rumination occurring during a semi-somnolent state. If subjected to random noises, rumination may become irregular. Fully aroused goats will generally not ruminate.

10 Water Intake -- Goats are well adapted to limited water intake and short term shortages, as their water turnover rate is only 188 cc/kg/24 hrs. This compares to a rate of 185 cc/kg/24 hrs for the camel, an animal that is known for its ability to go without water for long periods of time. Rates in comparison for sheep and cattle are 197 cc/kg/24 hrs and 347 cc/kg/24 hrs, respectively.

11 During some seasons when sweating or respiratory cooling is not necessary for the maintenance of body temperature, goats can often sustain an adequate intake of water from their grazed feeds alone, if it has a moisture content of 60% or more.

12 During environmental temperatures of about 38C (100.4 F), the panting rate (respiratory cooling) of goats is only about half that of sheep. Their sweating is limited, and the loss of water through feces and urine is much reduced. Reduced water intake over a period of several days will result in a corresponding decrease in the excretion of urine, with the concentration of urea being increased.

13 Water intake will be much greater for lactating goats, since milk is approximately 85% water. The greater the production of the goat, the more water will be required. A goat producing 8 lbs of milk per day will require more than an equal amount of water merely for milk production.

14 Suckling Kids -- Within a short time after birth, the kid will begin a tentative search of the doe's body, trying to suck at numerous locations along the doe that can be grasped in the kid's mouth. Often, nursing will be attempted between the doe's front legs. Eventually, the nipples are found and true nursing begins. After the first day or two, a normal kid will have no difficulty in promptly locating a teat when hungry. While nursing, the kid may often be observed to "'butt'" at the doe's udder, which serves to facilitate milk letdown, thus increasing the amount of milk available to the kid. The sucking reflex of the kids enables them to be easily transferred to a "'lambar'" or bottle, allowing the doe to return to the milking herd soon after the kids have received an adequate intake of colostrum.

## 15 Elimination Behavior

There appears to have been little evolutionary importance in the development of specific eliminative behavior among goats. There is no evidence, of any form of territorial marking by urination or defecation, as is common to many other animals. However, bucks can determine if a doe is in estrus by sniffing her urine. Elimination occurs at random in the field, with goats avoiding areas of defecation or urination while grazing. This avoidance behavior is depressed in confinement management and widespread contamination occurs.

16 When urinating, the doe goes into a squat position similar to the one assumed by a female dog. Even buck kids will arch their back and bend their legs while urinating. This behavior is not displayed in adult bucks. All goats wag their tails back and forth while defecating, although the significance of this act, if any, is not known.

## 17 Sexual Behavior

Sexual behavior among most goats at least those derived from the temperate zones is seasonally dependent, with the females lacking an estrus period during the late spring and summer months. The libido, or sex drive, of the buck is also at a low ebb during this time, but semen volume is lowest already in early spring and motility is poorest in the winter. The volume and motility of semen is greatest during the late summer and fall. The return to normal sexual behavior is first achieved by the buck, generally about 2 weeks before does return to estrus. It is thought that the courting of the buck may accelerate the onset of the breeding season. The length of the breeding season is influenced by such factors as day length, temperature, and geographic origin. Those breeds that originate from high, mountainous areas have an abbreviated breeding season. All goats have a peak estrus cycle in the fall of the year, thus allowing for most kids to be born during the favorable spring time.

18 The doe is usually on a 21-day cycle during the breeding seasons. This cycle is somewhat variable among individuals, as is the duration of estrus, or standing heat. This period generally lasts 18 to 24 hrs, although it may even last considerably longer. At the beginning and end of each breeding season, the doe may go through a 'silent' estrus in which ovulation is not accompanied by normal estrus behavior. In other species, this has been attributed to a lack of circulating levels of estrogens at the time of estrus.

19 The 'goat odor' of bucks is of significance in sexual behavior in that it serves as a stimulus to the doe. Through conditioning and previous sexual experience, the odor elicits a series of responses in the female that serve to facilitate the courting and breeding process. The doe will rub her neck and body against the buck, and will stand to receive his attentions.

20 Behavioral patterns of the buck are more unique and complex among the two sexes during the breeding season. He becomes aggressive as he struggles to attain and maintain the position of lead (alpha) buck. He is more active and verbal during the breeding season, constantly on the lookout for does in estrus and invading bucks. He will often be sniffing the urine of does, extend the head and neck into the air with the upper lip curled up (the 'Flehmen' posture), searching for the olfactory and gustatory stimuli that indicate to him that the doe is in estrus.

21 Upon identifying a doe in estrus, the buck will follow her, and then move up in an attempt to herd the doe away from the rest of the flock. Once separated the buck will begin to paw the ground around the doe in an apparent display of masculinity. During these and subsequent stages of precopulatory behavior, the buck emits a frequent hoarse, 'baaing' that is often termed a 'grumble'. The buck can also be observed to run his tongue in and out of his mouth during these first two stages and is generally very excited. Next he proceeds to sniff and nuzzle the genital areas of the doe, while intermittently rubbing against the side of the doe.

22 Copulation is achieved by the buck mounting and gaining intromission through repeated thrusting movements of the hind quarters. If the doe is fully receptive and experienced, she will stand completely still to receive the male. If she is not fully receptive or lacks previous sexual experience, she may move about or even begin to walk away, thus making it more difficult for the buck to gain intromission. This creates a greater expenditure of both time and energy on the buck's part, and if many does behave in this fashion, it may cause problems in getting the flock covered by the buck.

23 Epimeletic Behavior (care-giving maternal)

The doe will separate from the rest of the flock when kidding time approaches. After the kid is born, she will lick the youngster clean of any afterbirth and may even eat the afterbirth. The licking of the kid has a general stimulatory effect on it, and if necessary may be done also by the manager in the form of a brisk rubbing with a clean dry cloth or wad of straw. The doe may give a parturient call, consisting of a short, low pitched bleating either to her young or in response to the call of any kid. If a strange kid should approach her, however, she will rebuke it.

24 Constant contact between the doe and the kid, with much sniffing and licking on the doe's part, is necessary for the formation of an early close bond and imprinting. If a kid is removed at birth from its mother and returned before 2 hours have elapsed, the doe will accept the kid; later, it may be rejected; certainly after 3 hours. Acceptance of a kid can be achieved through forced exposure if the doe is restrained, tranquilized or fooled by washing the kid with the doe's scent. This procedure is difficult and time consuming, and may take as long as 10

days before acceptance is complete. In a flock situation, subordinate does may allow any kid to nurse after a brief bonding period of about 10 minutes. Bonding in goats is primarily based on olfactory cues.

25 Et-epimeletic Behavior (care-seeking)

Young kids, if captured, held, or hurt will emit a high pitched general distress call, which is capable of conveying emotional distress. Even the most novice goatsman has no trouble recognizing it as a distress call.

26 Adults will also 'baa' rather stridently when separated from the rest of the flock. This accounts for the fact that when several herds are mixed, there is usually a great deal of noise as the goats mill about, trying to locate their herd members.

27 Agonistic Behavior (antagonistic)

Bucks engage in a form of rearing and butting in order to establish dominance for the formation of a flock hierarchy. While animals such as sheep approach each other and butt head on, goats stand about 4 to 6 feet apart, then rear up so that their body is at right angles to their opponent, with their head turned and facing toward the opponent. They then pivot and lunge forward and down to the ground, coming together in a sharp crack. This difference between sheep and goat behavior enables the two to be kept together with little conflict between them.

28 The establishment of a social hierarchy among the bucks results in the selection of the dominant (alpha) buck, who is responsible for flock safety and the breeding of the does. The other bucks in the flock, because they do not breed, are peripheral males or 'social castrates'. If the buck is not fertile or of low fertility, then the flock kidding rate will be low, even though several fertile bucks may be available.

29 The dominant buck is aggressive during the breeding season, but during the rest of the year he is content even to be pushed around by the leading female (queen). This queen is the true leader of the flock, and usually achieves her rank by virtue of having the most descendants. The dominance of the mother over her young is maintained throughout life.

30 It appears that dominance may be established by such factors as relative age, play fighting and whether or not the goat is horned. A horned female may be dominant over a hornless male.

31 The development of dominance is enhanced by crowding and the use of small feeding areas, as the increased competition for the same food and space exerts an organizational pressure. Once a dominance order is established however, it may remain stable for several years even though the organization of the flock itself changes as individuals are born, die or mature. Newcomers to the herd have to find their own level and

establish themselves in the flock order, with the result of increased fighting for a short period of time. Any fighting is always on a one to one basis; there is never a gang attack on a goat, although one after another may fight against the same goat.

32 When alarmed, goats will stomp one forefoot and produce a high pitched, sneezing sound. Goat flocks exhibit a tendency to move about a short distance away, forming a thin line in front of the disturbance. If pursued further, they will tend to break up from the group. This prevents them from being herded like sheep, which tend to bunch together while being pursued. This is one reason shy dogs have never worked well in goat herding attempts.

33 Young kids, instead of following their mother while she grazes, remain in one spot, 'freezing' at the sign of any danger. By freezing, a predator (if that is the danger), may pass the kid without locating it.

34 Adult goats are also occasionally known to go into a catatonic state when scared or threatened. This response, which is similar to the opossum, was first recorded by Ivan Petrovich Pavlov, the Russian scientist who pioneered the classical conditioning experiments with dogs. He felt that goat response was related to some inhibition of the goat's normal self-protective impulse to run.

35 This unique response was studied again in 1961 at Cornell and Duke Universities, and the Institute of Muscle Research at the Marine Biology Laboratory at Woods Hole, Massachusetts. It was noticed that the catatonic sym ++++MISSING DATA++++

### 36 Shelter Seeking Behavior

Goats are generally quite hardy animals, being able to weather the heat and the cold comparatively well, so long as they are provided with a well constructed shed. If there's one thing a goat doesn't like, it's rain. Goats will run to the nearest available shelter on the approach of a storm, often arriving before the first drops of rain have fallen. They also have an intense dislike for water puddles and mud. Probably through evolution they have been more free of parasites if they have avoided wet spots. Goat management should copy this.

37 While hot weather poses no great problem to most goats, high level of humidity does cause them stress. This will lower milk production, cause loss of body weight and even may increase hostility within a flock.

38 An interesting adaptation of shelter seeking behavior occurs among goats that are living in hot, dry and treeless areas. They have been observed to congregate and huddle during the midday heat, when it seems preferable to be apart from one another. This crowding occurs when the rate of heat taken in by the goat's body is in excess of its





# CAE: CAPRINE ARTHRITIS ENCEPHALITIS

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TI CAE: CAPRINE ARTHRITIS ENCEPHALITIS

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DE Health and Disease Management

Text

1 In 1974, a scientific report described a previously unreported nervous disease of goats which was believed to be caused by a virus. This was followed by a report of an arthritic disease in goats presumably caused by the same agent. Shortly afterward the viral cause of these conditions was confirmed and the virus characterized. The development of a diagnostic serologic test was soon reported along with the observation that a high percentage of goats in the United States appeared to have experienced the virus. Investigation into the transmission of the disease suggested that virus was spread through colostrum and milk of infected dams and that virus free herds might be maintained by raising kids in isolation.

2 Nomenclature

The nervous disease first reported in 1974, was named Viral Leukoencephalomyelitis of Goats (VLG). When it became apparent that arthritis could also result from the same virus infection, the name of the disease was changed to Caprine Arthritis Encephalitis Syndrome (CAE). It is now apparent that the virus also produces changes in the lung and udder. The name CAE however still remains in place.

3 The Causative Virus

The virus which causes CAE is very closely related in structure to the virus which causes Ovine Progressive Pneumonia, a common respiratory ailment of sheep in the western US, and to the virus which causes Visna, a nervous disease of sheep first reported from Iceland. These agents, called retroviruses, are classified as slow viruses which means that they usually produce disease only after a very long

incubation period and that once an animal is infected, the infection persists throughout the animal's life. This fact is important in regard to interpretation of diagnostic tests. CAE virus has not been shown to cause any disease problems in man.

#### 4 Transmission of CAE Virus

Knowledge of how a disease is transmitted is often the key to developing a successful program for preventing the spread of infection. To date, all published reports suggest that goats become infected with CAE virus as newborn kids. Experimental evidence for this is persuasive. Kids delivered either naturally or taken by cesarean-section, but deprived of colostrum and fed cow milk remain free of the virus despite the fact that their dams are infected. If taken by cesarean-section or delivered naturally, but allowed to nurse colostrum or milk from an infected doe, kids will show evidence of virus infection. These findings indicate that kids are not infected in utero or during passage through the birth canal; but do pick up infection when nursing colostrum or milk from infected dams. This suggests that control of the spread of new infections might be achieved by separation and artificial rearing of kids at birth.

#### 5 Prevalence of CAE

One aspect of the CAE syndrome which has proven most troubling to the US goat industry was a published report that a high percentage of goats tested from all over the United States showed serological evidence of infection with CAE virus. Of 1160 goats tested from 24 states, 81 showed antibody to CAE virus using the agar gel immunodiffusion (AGID) test. It can be assumed that animals with antibody to CAE virus have been exposed to and infected by the virus. The only exception to this could be young kids with detectable antibody picked up from the dam's colostrum. Unlike most bacterial diseases, where a strong antibody response means that the animal has cleared itself of the invading organism, infections with CAE and other retroviruses are likely to persist in the animal despite a high antibody titer. Therefore, it is probably true that a large percentage of antibody positive goats carry persistent infections. However, it does not necessarily follow that the majority of these goats are likely to show clinical signs of the CAE syndrome. The factors which contribute to the onset of clinical signs in animals infected with the virus are unknown.

6 The major problem associated with this high prevalence of infected US goats is not the actual incidence of clinical disease so much as the negative perception of prospective goat buyers and regulatory officials confronted with a positive AGID test. Already some countries importing US goats, like Kenya, have refused or destroyed shipments of goats which turned out to be antibody positive. Economic restraints such as this increase pressure on the goat industry to aggressively tackle the CAE problem.

## 7 The Clinical Signs of CAE

Two separate distinct syndromes are caused by the CAE virus, a neurological disease in the spinal cord and brain of young kids and a joint infection of older goats resulting in arthritis. How individual animals infected with CAE virus escaped one or the other or both syndromes remains a mystery. The clinical signs of the two syndromes are as follows.

8 The Nervous Form of CAE -- The nervous form of CAE was the first to be described. All breeds of goats can be affected as can both sexes, and most individuals first show signs between one and four months of age. The problem is one of progressive weakness (paresis) of the hind limbs leading to eventual paralysis. The early paresis may be perceived as lameness, incoordination or weakness in one or both rear legs. Knuckling over of the feet and difficulty in rising may follow until such time that the animal is unable to rise at all. The course of the disease is from several days to several weeks. Despite the progressive paralysis, the kid will usually remain bright and alert and continue to eat and drink. Mild pneumonia may be present. If the correct diagnosis is made, the animal is often euthanized since there is no known treatment for the condition.

9 The development of these signs results from inflammation in the spinal cord induced by the virus. Nerves which control motor function of the hind limbs are progressively destroyed. In spite of the ongoing inflammation, there is little or no change observed in the cerebrospinal fluid on CSF tap nor in the complete blood count (CBC). Diagnosis is based on recognition of the clinical signs and confirmation depends on observation of the characteristic changes seen microscopically in the spinal cord at the time of postmortem examination.

10 In older goats, a clinical variation of the nervous form of CAE has been observed which is clinically indistinguishable from Listeriosis. Signs include circling, head tilt and facial nerve paralysis. On postmortem examination, the characteristic lesions of CAE virus are found in the brain stem rather than the cervical spinal cord.

11 The Arthritic Form of CAE -- The joint form of CAE most often appears clinically between one and two years of age. There can be great variability in the progression and severity of signs. Some goats can be severely crippled within a few months while others may show only intermittent lameness or stiffness for years without ever becoming completely debilitated. A 'typical' case would fall somewhere in between. The disease is usually first recognized as a gradually developing lameness accompanied or followed by swelling of the joints. Swelling is most often noted in the front knees (carpi) and can also be seen in the hock and stifle joints. As the condition progresses, joint pain and stiffness become more apparent. The animal may spend a good deal of time lying down, will begin to lose weight and develop a rough

hair coat. In severely affected joints, the range of motion may become limited and goats are forced to walk around on their carpi. No specific cure is known for CAE arthritis. The well-being of affected goats may be improved by proper foot trimming, extra bedding and administration of anti-inflammatory drugs such as aspirin.

12 As in the nervous form, the complete blood count in goats with CAE arthritis will most likely be normal. Fluid taken from affected joints, however, may show changes suggestive of CAE. These include a reddish brown discoloration, increased volume, low viscosity and an increase in mononuclear cells. All joint fluid aspirates should be cultured for bacteria, chlamydia and mycoplasma since these organisms can also cause arthritis in goats. In addition to these infectious causes, traumatic injury and poor conformation can also lead to joint problems. Keep in mind, that not all swollen joints or stiff limbs are CAE arthritis.

13 Other Clinical Syndromes of CAE -- Young kids with the nervous form of CAE may show a concurrent pneumonia. On postmortem examination, goats with either the nervous form or the arthritic form may show characteristic changes in the lungs attributable to CAE virus infection. These changes are described as interstitial infiltration of mononuclear cells. Pneumonia due to CAE virus however is rarely seen as the only clinical sign in infected goats.

14 Another interesting microscopic finding from postmortem examination is a similar mononuclear infiltration of the mammary gland of infected does. There is some speculation, but no certain confirmation, that the well known condition of hard udder seen in some does at freshening may be due to CAE virus. This mysterious condition is often misdiagnosed as udder edema or mycoplasma mastitis.

15 In arthritis of goats due to CAEV, clinical signs are limited to the joints and surrounding structures. Affected goats may initially show soft fluid swellings over the joints, especially in the bursae of the front knees. Over a period of weeks to months pronounced lameness may develop and progress to the point where animals are unable to extend the limbs and may walk on their knees. Radiographs may reveal extensive calcification of the soft tissues surrounding the joint. Joint fluid will contain excessive numbers of mononuclear cells. Postmortem examination will reveal extensive proliferation of the synovial membrane. In other animals the advance arthritic signs may not be so severe and these animals show only intermittent pain, reluctance to move and progressive weight loss.

16 A serum test can be run which demonstrates that the goat has been exposed to the virus, but the test will not absolutely confirm that arthritis is due to the virus infection. No treatment or vaccine is available for arthritis due to CAEV. A separate chapter on CAE follows because of its importance.

## 17 Prevention and Control

Suggestions for the control of CAE infection and plans for the establishment of CAE free herds have been published. These plans are based on current knowledge concerning the transmission of the virus and controversy has arisen regarding the practicability and effectiveness of these programs. Perceptions of how reasonable these suggestions are, may depend largely on the interest to establish a CAE virus free herd. A hobbyist with two grade does in the backyard for home milk consumption may not be motivated sufficiently to change the management in order to raise CAE free kids. On the other hand, an internationally reputable breeder with sales of registered stock may in fear of a positive AGID test want strongly to establish and maintain a CAE free herd. A control plan would include the following:

1. A serologic survey of all animals presently in the herd.
2. Culling of all AGID positive animals if economically feasible.
3. Repeated AGID testing at 6 month intervals to insure that all positive individuals were identified.
4. If some or all AGID positive animals are maintained for the time being, the strategy then shifts to the creation of a new CAE free herd founded with the next kid crop.
5. At the next kidding season all births are observed and the kids are removed from their does immediately. These kids are either deprived of colostrum, fed only frozen colostrum from does previously identified as AGID negative, or fed pasteurized colostrum. Only experienced herdsman with a strong background in kid rearing should attempt to raise colostrum deprived kids since these animals are susceptible to a variety of dangerous infections if not given protective immunoglobulin injections. Pasteurization of colostrum is considered a poor alternative because heating to 161F causes the liquid colostrum to congeal. Slow pasteurization at 131F for 1 hour may minimize this problem but this is time consuming. Feeding colostrum from AGID test negative does may be the best compromise although it must be pointed out that an occasional seronegative doe may actually be shedding the virus and a small number of new kids may be infected.
6. Kids should be raised in separate quarters from does and fed cow milk or milk replacer until weaning.
7. All kids should be tested at 6 months of age and periodically thereafter to insure their seronegative status. Seropositive animals should be culled immediately.
8. As the new replacement herd matures, older previously seropositive animals, still in the herd, should be systematically



# CASEOUS LYMPHADENITIS AND PINKEYE

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TI CASEOUS LYMPHADENITIS AND PINKEYE

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DE Health and Disease Management

Text

1 Goats, like all other food animals, are plagued by numerous infectious diseases which reduce their productivity and profitability. Infectious diseases are ailments produced by microscopic organisms as a result of their existence and replication in the tissues of the host. These microorganisms are really parasites but the term 'parasite' is commonly reserved for larger multicellular organisms such as lice, mites, flukes and various gastrointestinal worms. Thus, infectious diseases are commonly distinguished from parasitic diseases but also from metabolic diseases, nutritional diseases, toxic diseases, neoplastic diseases, etc. Infectious diseases are not necessarily communicable, that is, transmissible from animal to animal. Tuberculosis for example, is caused by a bacterium, *Mycobacterium tuberculosis* and is readily spread from man to man or animal to animal. Tetanus (lockjaw), on the other hand, although caused by a bacterium, *Clostridium tetani*, is not transmissible from animal to animal. It is associated with contamination of deep, penetrating wounds and is caused by a toxin elaborated by the organism.

2 Infectious diseases can be broadly subdivided as specific diseases caused by specific microorganisms (e.g. brucellosis: *Brucella melitensis*) and non-specific diseases such as mastitis, pneumonia, etc. which can be caused by a variety of different kinds of microorganisms. Mastitis for example, may be caused by staphylococci, streptococci, enteric bacilli, yeast, corynebacteria, etc.

3 Infectious diseases can also be subdivided according to the type of microorganism responsible for the infection, e.g.:

1. protozoal diseases (due to one-celled animals): coccidiosis, toxoplasmosis
2. fungal: ringworm
3. bacterial: tuberculosis, brucellosis, caseous lymphadenitis, arthritis, Johne's disease
4. mycoplasmal: pleuropneumonia, arthritis
5. rickettsial: pinkeye
6. chlamydial: abortion, arthritis
7. viral: contagious ecthyma (sore mouth), arthritis

4 Mycoplasma, chlamydiae, and rickettsia are bacteria-like organisms. Mycoplasma will grow on special artificial media. Chlamydiae and rickettsia are also bacteria-like but, like viruses, can only replicate in living hosts.

5 No matter what causes a particular infectious disease, the eventual outcome of that infection is influenced by a number of different factors. Certain parameters of the host, the environment, and of the infecting microorganism are important.

6 With regards to the host, the integrity and preparedness of the immune system are critical. Some animals are born with defects of the immune system which make them unable to combat infectious diseases. Some animals are genetically endowed with superior resistance to infection; others are not. The newborn animal which receives passive immunity via maternal colostrum (first milk) is in an enviable position since it has a temporary protection against the microorganisms in its immediate environment at a most vulnerable time. Age of exposure is an important host factor since young animals are almost always more susceptible than older ones. In addition, poor nutrition can adversely influence an animal's resistance as can the presence of a concurrent illness or parasite infestation.

7 The nature of the environment can also have a profound effect on the outcome of a disease process. Cleanliness and adequate ventilation can reduce exposure to disease-producing organisms and prevent contamination build-up. Population density is also important since overcrowding almost invariably leads to disease problems. With infectious diseases in particular, the interchange of populations of animals is apt to be troublesome. Many cases of infectious disease outbreaks can be traced to the introduction of new animals into a herd. Such animals may appear healthy but may be incubating a disease or may be carriers of microorganisms to which the main herd has not



been exposed. Of course, transfer of infection can also occur from the herd to the new animals.

8 Finally, there are factors associated with the infectious microorganisms themselves which can influence the nature of the disease produced. The virulence is genetically determined so that within a particular species of bacterium, there are a number of strains which vary in their ability to cause severe, even fatal disease. The dose of microorganisms involved is obviously important. In a contaminated environment, exposure to many microorganisms is more likely to result in a serious infection. A microorganism which can live peacefully if applied to the skin might wreak havoc if introduced to the lungs or mammary gland.

9 There are many infectious diseases of goats, even though goats as a species have not been well-studied from the infectious disease point of view. As goats are more intensively reared and investigated, new disease problems will undoubtedly be discovered. A brief discussion of some of the more important infectious disease problems of goats follows.

#### 10 Caseous Lymphadenitis

Caseous lymphadenitis, also called pseudotuberculosis or merely 'abscesses' has been referred to as the curse of the sheep and goat industry throughout the world. It is considered by some to be the major disease problem of dairy goats in the United States. The causative agent, *Corynebacterium ovis*, also called *C. pseudotuberculosis*, was first described in 1894 from the same disease in sheep. It is a small rod-shaped bacterium which is colored blue (Gram +) by the common differential stain used in bacteriology. *C. ovis* grows readily on sheep blood agar and other bacteriological media enriched with serum. The organism forms small, dry, white to yellow colonies which are initially very tiny but grow to a pin-head size in about 48 hours. If an abscess has not ruptured and is lanced in a sterile fashion, pure cultures of *C. ovis* are commonly obtained from the pus.

11 The pus is thick, often dry, and greenish-white in color. Its consistency is best likened to toothpaste or putty. The abscesses formed by *C. ovis* are usually associated with lymph glands and may be 'external' where they handily break to the outside or internal where they are not at all visible. In the goat the external abscesses of *C. ovis* are most often found around the head and neck, frequently below the ear and behind the jaw. They are initially small but invariably grow larger. Because the goat often manages to put a thick connective tissue wall around them, they do not readily rupture until they reach the size of walnuts or larger.

12 Internal lymph gland involvement often affects the mediastinal (between lungs), gastrohepatic (between stomach and liver) and

mesenteric (intestinal suspensory) areas. Interference with organ function in these vital areas produces unthrifty and weakened animals which are frequently afflicted with difficult breathing and a chronic cough.

- 13 Much of our knowledge of caseous lymphadenitis comes from the experience of Australian workers with the disease in sheep. They found that environment contamination with *C. ovis* was common in afflicted herds and that the widespread distribution of abscesses in the species could be related to contamination of shearing wounds. The distribution of most external abscesses about the neck and head suggests that goats are most commonly infected via ingestion of the organism. Frequently goats are exposed as kids but abscesses don't become evident until the animals are at least a year of age. The disease is insidious in its development.
- 14 To minimize environment contamination, encapsulated abscesses should be drained before they rupture. The hair should be clipped away around the abscess and its surface disinfected with tincture of iodine or other suitable antiseptic. The abscess should be incised vertically to promote drainage and pus should be squeezed out and collected for destruction by incineration or exposure to strong disinfectant solutions. Since *C. ovis* has been associated with infections in man, care should be taken to avoid direct exposure to the pus.
- 15 Following drainage, the affected goat should be isolated from other goats until healing is well-progressed. The wound should be irrigated initially and on a daily basis with an antiseptic solution such as chlorhexidine ('Nolvasan') diluted 1:10 in hydrogen peroxide. Intramuscular application of penicillin - streptomycin on a daily basis for at least 3 days can minimize complications and continued shedding of the organism. Because of the presence of veins, nerves, arteries, esophagus, and glands in the throat region, abscesses in this area may require professional assistance in lancing. 'Throatlatch' abscesses are especially serious and endanger the life of the affected individual.
- 16 Once established in a herd, caseous lymphadenitis is difficult to eliminate. Even goats in which abscesses are properly lanced and treated will often have recurrences, and environmental contamination leads to infection of kids. To remove caseous lymphadenitis as a herd problem, it is best to cull chronically affected goats. Kids should be separated from infected does at birth, given colostrum from clean does, and raised in a clean area on 'clean' milk or replacer. Some experienced goat people have recommended the administration of bacterins made from *C. ovis* isolates from the herd in question but this practice remains controversial since no clearly definitive scientific studies have been made. Dr. Sam Guss, the eminent goat veterinarian, recommends initial application of an autogenous bacterin at 3 weeks of age, a second dose at 5 weeks of age, and booster doses at 3 to 6 month

intervals thereafter. Lastly, the importance of cleaning and disinfecting premises before repopulation must be emphasized.

17 A bacterin is a young broth culture of C. ovis which has been inactivated with a dilute formalin solution. In this way the organism and its exotoxin are destroyed while the constituents which serve to stimulate the immune response are still active. Bacterins in theory should cause previously unexposed animals to more effectively resist natural infection or infected animals to more readily purge themselves of infection. The difficulty with C. ovis is that infected goats seem to have the ability to wall-off the organism temporarily but mobilize an immune response inadequate to effectively destroy it. Accordingly, recurrent abscessation is common.

18 Bacteria other than C. ovis may be responsible for abscessation as a result of contamination of lacerations or punctures. These are usually associated with poor sanitation. Corynebacterium pyogenes is frequently responsible for abscesses containing yellowish pus of a mayonnaise consistency. Streptococci often produce a watery discharge while staphylococci cause a creamy exudate. Although the nature of the pus can give clues to the cause of a particular abscess, only laboratory cultural methods can give definite information. Commercial bacterins against C. pyogenes and Pasteurella species are available and have been used prophylactically against pneumonia (which often accompanies the stress of shipping) and even against caseous lymphadenitis. Varying degrees of success have accompanied their use but, again, their real value is not well-established.

19 Pinkeye

Infectious keratoconjunctivitis or pinkeye is a disease which usually appears in hot dry weather and is spread by close contact and flies. The cause is not definitely established in goats but rickettsia are believed to be involved in some cases and mycoplasma in others. The eyes are afflicted with excessive tearing, reddened mucous membranes, then a white discoloration of the cornea which obscures vision. In severe cases the cornea ulcerates and loss of the eye may result. In most cases, when the goats are protected from sunlight and given good nursing care, recovery is usual. Nevertheless, all goats, even those not affected, should be treated with broad spectrum antibiotic ophthalmic powders or ointments to minimize the spread of infection. Resistant carrier animals may serve as the source of the organism when dry, dusty, sunny days predispose a herd to the disease.

%f TITLE;CASEOUS LYMPHADENITIS AND PINKEYE  
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# CASHMERE GOATS

COLLECTION: GOAT HANDBOOK

ORIGIN: UNITED STATES DEPARTMENT OF AGRICULTURE

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## A SMALL-SCALE AGRICULTURE ALTERNATIVE

### Cashmere Goats

United States Department of Agriculture

The world is beginning to give goats - nature's best herbicide - more attention. Leafy spurge - poisonous to some animals - is causing even people who laughed about goats to take a more serious look. When some Nebraska goats were taken on a demonstration tour, people could hardly believe the sight of goats walking through high brome grass to select out spurge heads!

But while most goats go for spurge, only cashmere goats also have the fiber of kings. And their owners know better than to cross them with Angora producing goats. (Angora hair is another important fiber.) Australia and New Zealand breeders experimented with a cross to try to develop heavier fleeces. It proved to be a mistake. The crossed goats produced cashgora with limited uses and characteristics of neither cashmere nor mohair.

### Demand Exceeds Supply

Demand for cashmere, the fine underdown from cashmere goats that has long been preferred by royalty, has always exceeded supply. Garments made of cashmere are prized for their unique feel. Cashmere is very soft, warm and long wearing. It feels much softer to the skin than wool, and while not as strong, cashmere outwears wool!

Cashmere goats are a type, not a breed. Most goat breeds, except Angora, can produce this down in varied quantities and may be called cashmere goats. There is no such thing as a "purebred" cashmere goat.

The fleece consists of the very fine, crimped down and the usually longer, outside, coarse, straight guard hairs. A goat that

does not display both types of fiber should be avoided.

Cashmere fibers must be separated, either by combing out the down or by using a commercial dehairer on sheared fibers. The longest, finest down is used in knitted garments and the shorter down in woven fabrics. The separated guard hairs go into rugs or hair canvas used in tailored garments.

The majority of the world supply of cashmere has come from Afghanistan, Iran, Outer Mongolia, India, and China. In recent years, when these countries' political disarray disrupted cashmere supplies, manufacturers began looking for more stable sources.

New Zealand and Australia have been producing cashmere for more than a decade. Breeding selection began even some years earlier with captured feral (wild) goats.

### Selecting Breeding Stock

Prospective herd members can be selected from either dairy goat or meat goat sources. Cashmere down growth begins on about the longest day of the year and stops about the shortest day. (Shortly after down growth stops it will be shed naturally if not combed or sheared.) Best time for goat selection is in the latter part of growth-stopping period; down quality can be easily assessed. The guard hair is parted to determine whether there is down underneath.

If the goat carries the gene for down, it can, over time, be developed into saleable amounts. The crimp is called the character or style of the fiber; a very tightly crimped down is most desirable. The diameter (measured in microns) of the fiber must be under 19 microns to be labeled cashmere. Select goats may have fiber as fine as 14 microns. The usual range is 16 to 19 microns.

A yield of at least 30 percent down is desirable, but is not the average by any means. Buyers pay on the down weight or weight of dehaired fiber, not the weight of the entire fleece. Prices vary over time.

Goats come in many colors and combinations of colors, but solid colored goats are much preferred. Cashmere down is either white, brown, or gray in solid colored goats. The less desirable down from mixed colored goats is classed either as white with color or mixed color.

Some U.S. growers have imported goats from Australia or New Zealand as a herd of as breeding stock to improve selected native

goats. This might produce greater return more quickly than would native stock alone.

### Some Natives Are Good

There are, however, many very good goats among native breeds. Their fiber's diameter is apt to be smaller, but the length and yield of fiber are much less. The aim through selective breeding is to keep the finer diameter and increase the length and yield. Dramatic results in fiber are shown in crosses of imported bucks and native does, these crosses are FI or bred-on crosses.

The Spanish meat goats from Texas and the Southwest provide cashmere breeding stock that also produces big meaty goats. Of the dairy breeds, Toggenburg, Saanen and Nubian are being used with good results. Pygmy and Fainting goats are being used by some growers.

Large goats with wide, thick, meaty bodies bring in more income when sold for meat or culled. Large bodies can also produce more hair if they also have dense hair follicles.

The gestation period for goats is usually 150 days, but it can vary several days each way. The first kids can be expected 156 days after the buck goat is turned in the does. Kids are usually "dropped", as the term goes, from late February through April or early May.

As noted above, goats are browsing animals can be pastured with sheep and cattle, since each species prefers different plants. Goats prefer brush, tree leaves and rough plants. They are used for pasture improvement and in reforestation areas. Ranchers in the high plains find them most useful in controlling leafy spurge. Goats will also destroy multiflora roses and red cedars.

### Breeding Does Need Extra Feed

When growing plants are not available, goats will need to have supplemental feedings of hay and, perhaps, grain. Does also need extra feed prior to breeding. Pregnant does need good feed in order for the fetus to develop hair follicles. To assure big growthy kids, nursing does need good feed.

In does, poor nutrition is the leading cause of abortion and poor mothering, with younger or lighter weight does most likely to abort. Stress from disease, moving long distances, or cold wet weather also can cause abortions.

Does should be in good condition and gaining weight at breeding time. Young does should weigh at least 55 pounds and mature does at least 75 pounds sheared weight at breeding.

During pregnancy and lactation, does need almost 1/2 pound of crude protein daily. Supplement feeding must be started as soon as the goats begin to show a loss of top condition and/or weight. The rewards of improved nutrition are more and better kids and heavier fleeces. However, overfeeding of protein can cause fleeces to coarsen prematurely.

Goats should be given adequate nutrition both before and after shearing. Goats have neither the layer of body fat nor lanolin-laden wool that sheep have. So, goats sometimes need shelter from cold rains and chilling winds. If shelter has not been provided, goats may even die. Depending on weather variations, goats may need shelter for 4 to 6 weeks after shearing.]

### Not Many Triplets

Twins may account for 10 percent of births, most commonly in older does, with a much lower percentage being triplets. With proper management it is possible to get three kid crops within a 2-year period.

Does may be bred to kid when they are a year old if they have sufficient growth. Since male kids usually reach sexual maturity at 4 months of age, they should be removed from the herd to prevent accidental breeding.

Kidding problems are nothing any experienced livestock person would find unusual. Unless it is a breech deliver or a tough sack that does not break and allow the kid to breathe or the doe is too small, there usually are no complications.

Due to lack of labor and facilities, large usually kidded on the range, while many small herds use a more intensive confinement system to handle the goats. For open kidding, small pastures with some sort of shelter, centrally located watering and supplement feeding area, and a bedding area are required. This arrangement reduces the number of kids that get separated from does.

On the range, does and kids should be left undisturbed for several weeks, since the does may abandon the kids. When goats are moved, pastures should be rechecked for kids that have been left behind.

A more intensive kidding system makes use of buildings, small



individual stalls, heat lamps, and feeder space. With this type of system kidding can be done earlier in the year. However, such a system is much more labor intensive and therefore more expensive. A larger kid crop can be realized if the facility is well managed. Before kidding, the does should be outdoors - except in cold or wet weather or at night; this helps keep bedding clean and dry and encourages the does to exercise.

As does kid they should be moved into stalls and the kids' navels treated with 7 percent iodine. C and D antitoxin should be given. Cold kids will not try to suck and a heat lamp may be needed; they will usually suck by themselves when they are warm. Some kids may need help to begin to suck if does' teats are not adequately open. After identification with matching paint or ear tags, does and kids can be moved into group pens or holding areas after the kids are well established. Twins and triplets should not be grouped with singles since stonger kids often rob from the usually smaller multiple-birth kids. Likewise, the groups should contain kids of similar age.

#### Maintenance Pointers

As with sheep, internal and external parasites and pneumonia are a major health problem with all kinds of goats. Lice can be controlled by spraying after shearing. Coccidiosis is a threat to kids, both before and after weaning, and any kid not growing properly is probably infected.

Their hooves may need to be trimmed, depending on the walking conditions, but wear from rocky ground sometimes helps take care of this problem.

Working with a veterinarian, a grower should establish a good health care program that includes vaccination for most diseases.

Goats need special 4-foot-high fencing both to keep them in and predators - always a threat to kids - out. Goats like to go under or through obstacles. Five wire electric fencing constructed with three hot wires and two grounded wires work well. Existing fences can be used with the addition of a 12-inch outrigger electric wire located about 12 inches above the ground.

#### Horns Handy, Sometimes!

Other types of small-mesh fencing may be used. Horns caught in the fence or the crotch of a tree become life-threatening, not only because of predators but also because of other goats. While most goats are not aggressive toward humans, they are not always

## CASHMERE GOATS

kind to other goats who cannot defend themselves. They can quickly do serious or lethal damage with their horns.

A goat raiser soon discovers that horns are useful - as handles! A goat without horns is hard to control; some shearing stands even depend on horns when securing the goat for shearing. Unlike Angora goats, cashmere animals are sheared standing.

Care should be taken not to damage a young goat's horns by rough handling. A frightened or startled goat is apt to jump or flail around and handlers should always use caution to prevent injury from the horns - especially to eyes. For safety, both for other animals and the handler, sharp points of horns may be clipped off using a bolt cutter or similar device.

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# CHEVON -- MEAT CUTS

COLLECTION: GOAT HANDBOOK

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Extension Goat Handbook

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TI CHEVON -- MEAT CUTS

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DE Management and Housing

Text

- 1 Chevon is valued highly by certain people, for example, of Mediterranean, Caribbean, Near Eastern, Indian, Far Eastern, Central American origin. Among Spanish speaking people it is called 'cabrito.'
- 2 The US National Livestock and Meat Board has issued uniform standards and identifications of retail cuts for beef, pork, veal and lamb but none for chevon; probably because this market is relatively small or not well organized.
- 3 The goat carcass is different from the lamb carcass, being much leaner and having only little subcutaneous and muscular fat. Otherwise, the bone structure and muscle position may be quite similar. Therefore, in the absence of official charts on the anatomy and retail cuts of goats - chevon - , it is suggested that the respective lamb charts, as attached may serve a useful purpose.
- 4 A goat weighing 100 lbs may have a carcass weighing approximately 50 lbs, or 50% of liveweight. Goat carcasses unlike pork or beef but like lamb are not split nor 'ribbed,' i.e. the whole carcass is handled readily, being lighter than pork or beef and are cooled as a whole. For carcass evaluation, however, the fore- and hindsaddles are separated between the 12th and 13th rib to show rib eye and loin eye areas, and subcutaneous fat thickness. The foresaddle, shoulder, rack, foreshank and breast make up approximately 51% of the carcass or 25.5% of liveweight. The hindsaddle, loin, leg and flank comprise the difference of 49% or 24.5% respectively.

## 5 Principal Cuts

Primal cuts are the leg, loin, rack and shoulder. The largest cut is the leg, about 33% of the carcass or 16.5% of the live goat. On a retail basis it would be trimmed down to 24% of carcass weight. The sirloin is normally included with the leg after separation of the loin at the seventh or last lumbar vertebra. In beef and pork the sirloin and rump are separate cuts.

6 Leg - The leg may be prepared as Frenched, American or boneless. For the Frenched leg, only the tail bones, hock bones, Achilles tendon, fat trim and prefemoral lymph node are removed and the shank bone is exposed. For the American leg, the shank bone and the shank muscle are also removed. The whole leg may also be cut into 4 to 6 sirloin chops, the rump, center roast and shank. The latter two can be sliced into steaks. The best use of the leg is as boneless cut, after removing the whole pelvic bone and femur. For roasting, the boneless leg needs to be tied together or jet-netted.

7 Loin - The loin is the most valuable and most tender cut. Only 4% of the live weight are retail loin cuts. Kidney fat is usually left on the wholesale carcass to protect the valuable tenderloin muscle underneath from discoloration and dehydration. The loin may be prepared as double loin chops, or after sawing through the lumbar vertebrae as single chops containing the characteristic T from the vertebral process as in T-bone steak of beef. The rack may be prepared likewise into rib chops, containing at least one rib, but may be cut considerably thicker than pork chops or beef steaks because of their small size.

8 Shoulder - The largest cut in the foresaddle is the shoulder, second in size only to the leg. Shoulder cuts are priced less than leg and loin because of less tenderness and palatability. However, Saratoga roll boneless shoulder blade chops composed largely of rib eye muscle make very tender and juicy chevon. The rest of the shoulder goes for stew or shish kabobs. The shoulder can also be made into a jet-netted boneless shoulder roast. Rough cuts, the flank, fore shank and breast are best ground up, but can be utilized also cubed or as spareribs.

9 Overall, 50% of live weight is wholesale carcass but only 34% is retail boneless chevon meat.

10 Adapted from Chapter 14, 'Lamb Identification and Fabrication' in 'The Meat We Eat', 11th ed., by J. R. Rowans and P.T. Ziegler (Danville, Ill.: The Interstate Printers & Publishers, Inc. 1977), 489-526.

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# CHEVRES FOR GOURMET

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TI CHEVRES FOR GOURMET

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DE Management and Housing

Text

1 Chevre, a name increasingly heard in American cheese stores, is the French word for goat - and by extension, cheese made from goat's milk. Though goat cheeses of one description or another are as old as cheese-making itself, the selection of chevres in most American cheese stores has been comparatively modest until the last few years, when importers and distributors began looking more vigorously for small, out-of-the-way rustic French cheeses formerly thought too difficult to transport. Today, the larger factory-made chevres are a staple in specialty stores and cheese departments across the country, and their farm-produced cousins are snatched up by the knowledgeable within hours of arrival.

2 As a group, French chevres hark back to the simpler era of farm cheesemaking when fresh curds were merely salted, formed into small shapes, and drained for varying amounts of time - days, weeks, or months - during which flavor and consistency gradually changed. They are rarely aged long enough to undergo the changes in curd structure that separate Emmenthaler, Gruyere, cheddar, or most other semihard cow's milk cheeses from fresh cottage or pot cheese. In France, chevres can sometimes be bought at a few days of age, and rarely are they aged more than four to five months. Their youth means that the difference among them does not fit easily into categories. There is much variation - from chevres very mild to rockhard consistency and stunning acidity. Chevres can include white cheeses as soft as butter, wrinkled tan ones with the look of half-cured leather, and objects that appear to have been picked up off the barn floor. All have the unique edge of

goat's milk, a complex and faintly biting flavor. Even the young chevres share a hint of the pungent overtones of all goat cheeses.

### 3 Progress to Maturity

It is the young, mild cheeses that are most popular with American chevre-lovers. They are moist, creamy and easily spreadable, the goat taste is an agreeable accent rather than a powerful flavor. As the cheese ages and moisture evaporates, leaving behind the salted curd, the texture becomes firmer, crumbly, compact, and finally hard and dry. With decrease in moisture content, flavors intensify. By the age of several months, most chevre are strong, salty, and pungent. These older cheeses are appreciated by connoisseurs.

4 A different development is followed by those chevres that are not left to age after being shaped but are surface-inoculated with bacteria to form a soft natural rind. Though these too will eventually dry out if left, they go through stages comparable to soft-ripened cow's milk cheeses like Chaource or Camembert. The chevre curd mellows and takes on a buttery smoothness, then will become glistening and semifluid. If left for more than a few days after reaching this stage, soft-ripened chevres usually become rank and ammoniated. It can't always be predicted whether a given cheese will get to the runny stage, but - unlike Bries and Camemberts - soft-ripened chevres are generally acceptable if they remain firm.

### 5 Appearance Influences Flavor

Chevres are made in a variety of shapes and sizes, which influence the ways in which the cheeses develop. Certain shapes are associated with particular kinds of chevre so that knowledgeable shoppers will often buy chevre by shape instead of peering at labels.

6 The importance of shapes and sizes is that they determine the ratio of surface area to internal area, so that a cheese in the shape of a large, thin, flat disc will be more exposed to the air and dry out faster than one formed into a smaller higher cylinder. The way in which flavor develops with aging will also be affected by size, small cheeses will age more uniformly than large ones. Air and dryness discourage the kinds of bacterial action that might take place in the airless, protected interior of a thicker cheese, so that the very smallest, thinner cheeses are unlikely to develop a soft, runny center. Chevre connoisseurs learn to expect certain possibilities of flavor and texture along with the various traditional shapes.

### 7 Coatings

Coatings and coverings of chevres are associated with particular varieties. Leaf coverings were at one time a practical packaging material and came to be traditional for certain chevres. Some factory-made products today bear token chestnut leaves of green paper to link them with rustic originals. If these natural coverings - chestnut leaves, grape leaves, ferns - are in good condition, not moldy

or off-smelling leave them on until serving time, since their appearance is part of the cheese's attraction. The black or gray ash coatings are also a traditional appearance of some cheeses. Ash coatings are made of burnt leaves or vine cuttings and are nearly flavorless, though they may have a slightly astringent taste. They slow but do not stop the process of drying out as the cheese ages.

8 Chevres are often rolled in dried or powdered herbs or spices: sarriette (savory), fennel, rosemary, pepper, paprika mixtures. These additions will change the balance of flavors if the cheese is used in cooking.

9 A number of chevres have no coating or are covered by a soft rind. When young, uncoa ++++MISSING DATA++++

#### 10 Chevre Families

Sorting of different chevres is confusing to novice shoppers though it shouldn't be because many developed as rustic specialties known by traditional shapes or by names of local landmarks. The different flavors and textures of most chevres reflect not so much difference among basic categories than different degrees of aging. The same cheese can be moist and delicate tasting in the spring, dry and pungent in July. There are some cheeses that are served at a particular stage of development, but uniformity is not the rule with chevres. For this reason, classifications tend to be difficult. Here is a rough grouping of some familiar types and names.

11 Among the young rindless chevres eaten at an early stage, the factory produced MONTRACHET - a snowy white log shaped cheese available with or without coating of black ash is the most widely sold in this country. Mild and creamy, with only a hint of goatiness, it is excellent for introducing friends to the realm of chevres.

12 Of those with a rind that permits them to develop some of the characteristics of a soft ripening cheese, BUCHERON (a factory cheese, produced by the large St. Saviol cooperative) and LEZAY BUCHE (made by the Lezay cooperative) are commonly available. Both of these are log-shaped cheeses (hence the names Buche - log - and Bucheron - log-cutter) that develop a more buttery quality and unctuous texture than Montrachet. DOLMEN, a large truncated cone, the square CARRE D'ALZOU, and the ring shaped CAPRICORNE are bloomy rind cheese, but because of their sizes and shapes they will often develop like Bries, becoming mellifluous and semiliquid on the inside as they age. The Savoy-made TOMME DE CHEVRE, also surface-ripened, is a low cylinder (like a cheesecake) with some of the characteristics of the soft, supple Reblochons of Savoy.

13 The large category of rindless cheeses that can be met at various stages of development includes -to name only a few - the log-shaped ST. CHRISTOPHE and STE. MAURE, the small cylindrical LE CORNILLY, various



pyramid-shaped cheeses (VALENCY, POULINGY ST. PIERRE, and a few close siblings), the ball-shaped BOULE DE SOREDA, the heart-shaped cheeses (solid plain - COEUR BLANC - or with a black ash coating - COEUR NOIR), the brick-shaped LINGOT DE POITOU (also sold with or without ash), the small tapered cylinders - all variations on a basic cheese - sold under the general name of CHABI or CHABICHOU, and the flat round SELLES SUR CHER. When very young, these can be as moist and mild-flavored as a Montrachet; but they are usually left to develop and take on character for a few weeks or months, becoming fuller and 'goatier' while shrinking to size and becoming firm textured. It is a good idea to ask for a sample taste of such cheeses whenever possible before buying, to judge whether the cheese's particular stage of development is to your liking.

14 The group of chevres generally marketed at a fairly advanced age and in a hard, sharp flavored condition is less well known in this country than the young cheeses and the variably aged ones. The most widely available here is CROTTIN DE CHAVINGNOL - though the examples brought into the United States nowadays are often on the young and mild side, enough so that it may be hard to reconcile cheese-lovers' description of the traditional evil looking blackened French crottins (the word literally means dung cakes) with these more innocuous imports.

15 Partial and Sometimes Chevres

There is also a group of cheeses that are not pure goat's milk but that for one reason or another are associated with chevre. When goat's milk was in short supply or not available at all, it has always been traditional to make some local cheeses with cow's milk or various mixtures of cow's, sheep's, or goat's milk. In addition, there are some cheeses made of goat's milk enriched with cow's cream - for example, ROYAL PROVENCE, a buttery-textured, golden half-wheel encrusted with a sprinkling of savory. BANON and ST. MARCELLIN are among the either-or cheeses, small fresh discs traditionally wrapped in chestnut leaves, they are generally made of cow's milk (less often a goat-cow mixture) when manufactured on a commercial scale, but a few farms still produce all-goat versions. Unfortunately it is not always possible to tell an all-goat from an all cow or mixed-milk cheese simply by reading a label; though the words 'pur chevre' on a label indicate 100-percent goat's milk cheese, there are many all-goat cheeses that do not carry this description, and there are mixed milk cheeses whose names or logos might lead one to suppose them pure goat's milk. Dealing with a knowledgeable cheese seller is the best guarantee of knowing what you are buying.

16 Though seasonality is no longer as decisive a factor as it once was in the making of goat cheeses, it is still an important consideration in any serious exploration of top-quality chevres. Today the larger commercial producers freeze goat's milk for consistent year-round supply. Cheeses like Montrachet, Bucheron, and Lezay Buche are available

in good condition throughout the year, to the great pleasure of cheese lovers both here and in France. However, the better cheese stores still make a point of searching out farm produced chevres made by traditional methods on individual farms (hence the name that sometimes appears on labels, fermier) rather than mass produced at factories. Farm cheeses are often made from unpasteurized milk and developed fuller, deeper flavor than most commercially produced cheeses. They are still distinctly seasonal, late February to September being the best shopping time. Chevres fermier cheeses are more individually distinctive.

#### 17 Goat Cheeses From Other Countries

France is certainly not the only country to make good goat cheeses. A few American produced chevres - for the most part young, delicate cheeses - are starting to be carried by major cheese stores in this country. Soft, young Italian goat cheeses are also increasingly available. But at present nothing matches the rich array of French chevres available in the best American cheese stores.

18 Turi is the generic word for cheese in Greek, and the two most common types - both available in American stores - are Feta and Kasseri. Feta, produced from either goat's or sheep's milk, can be superb. If one is lucky enough to have a cheese store that knows its Mediterranean gastronomy, he'll be offered mature Feta that is rich and creamy, similar to that which is turned out in small measures in the hills close to Delphi and Mount Parnassus.

19 As one of the so-called pickled cheeses, Feta is white, soft, and salty. The best Feta that comes to the United States travels in kegs of milk in which the cheeses slosh to keep them from dehydrating. The worst is dry and acrid and should be avoided, but there are also medium quality Fetas, which, though a little crumbly, have a pleasant tangy flavor. Very good variations are made in the Greek islands, including small rounds from Zante, which are matured in vats of olive oil.

20 Kasseri is the other Greek sheep's milk product of which a good imitation is made nowadays in America. It is interesting to note that some travelers in Greece have found Kasseri to be so soapy as to be almost inedible. Good Kasseri should be as white as Feta but harder, so it slices well, and its salty flavor should be as well tempered as that of fine Roquefort. Kasseri and other firm Balkan cheeses such as Halumi, Hashkaval, and Kefalotyri (the last is also made from goat's milk) are delicious when cut into cubes and grilled over charcoal or under a broiler, or fried in oil or butter, then served extre  
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21 Queso de Cabrales, a white Spanish goat cheese, becomes a dessert when its faintly salty tang is balanced by thick honey. In the mountainous province of Asturias in the north of Spain, goat's and sheep's milk are combined with cow's milk, pressed into round forms in farm kitchens, salted, and then aged in limestone caves until the

cheeses look like the mold-cured Roquefort of France, but, taste like Stilton when eaten with a draft of country cider. Queso de Cabrales is named for a village hidden away among the trout streams of the Cantabrian Mountains called Arenas de Cabrales. Most cabrales end up on local tables, but some goes to distant markets wrapped in leaves.

22 On the Iberian Peninsula, the cheeses are almost exclusively goat or sheep. Many of those from Portuguese mountain villages are generically called queijo de serra, cheese of the mountain. Most of these are made from ewe's milk, but, in areas where goats are common, their milk is also made into Serra cheese; others, which look and taste much the same, are the result of combining both kinds of milk. One of the creamiest and richest is to be found in Azeitao not far from the port of Setubal.

23 A unique goat cheese, called Gjetost is made in Norway and is now often found in US stores. It looks brown and tastes a bit like semi-sweet fudge candy, because it is caramelized. It consists of whey cheese.

24 There are many other countries with interesting goat cheeses, too many to mention, or too little known about them here.

25 Before beginning to cook with chevre, it is necessary to realize that this is not one of those neutral flavors that can be casually added to all kinds of foods. The characteristic bite of chevre magically sets off some foods and sharply contradicts others. Chevres go beautifully with Mediterranean ingredients and seasonings; for example, eggplant and tomato gratin with accents of thyme and olive oil.

26 Though they can be excellent with many other foods from fish to pasta, it is essential to use them in judicious amounts and to remember that the effect of the goat tang in combination with other strong, full flavors can be quite different.

27 Though it is possible to use stronger, older chevres in cooking (for example, grated or crumbed on green salads or composed salads), you will probably want to begin with mild young cheeses. In some cases, a Montrachet-like cheese could be substituted for a Bucheron type without ill effect. A rind-aged cheese like Bucheron has slightly better melting qualities. Montrachet is made both with and without black ash coating, the two versions are interchangeable in recipes. The ash coating will not affect flavor, though it may produce a slightly bluish tinge in some dishes.

28 If only a subtle hint of chevre is wanted, decrease the amount of chevre and substitute an equivalent amount of a milder product like cottage or pot cheese, ricotta, or even cream cheese. If you enjoy the pungency of goat cheese, you may wish to increase suggested amounts of chevre and tone down the contribution of other cheeses in recipes where



# COCCIDIOSIS

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TI COCCIDIOSIS

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DE Health and Disease Management

Text

- 1 Coccidiosis is a contagious disease of goats, especially young kids, throughout the world. The disease is caused by one or more of approximately 12 different species of protozoa, called Eimeria, which parasitize and destroy cells lining the intestinal tract of the goat. Sheep are also very susceptible to coccidiosis, but even though the sheep forms may share the same names with goat coccidia, many parasitologists believe that the disease cannot be spread from goats to sheep or from sheep to goats.
- 2 An infected goat sheds thousands of microscopic coccidial oocysts in its feces every day. When first passed, the oocysts are harmless to another goat. However, under favorable conditions of warmth and moisture, each oocyst matures (sporulates) in 1 to 3 days to form 8 infective sporozoites. If a young kid swallows the sporulated oocyst, the sporozoites are released and rapidly penetrate the intestinal cells. From here on, the life cycle gets very complicated. The coccidia pass through several periods of multiplication during which large schizonts are formed. The intestinal cell of the goat is destroyed and thousands of small forms called merozoites break out and invade other intestinal cells. Eventually sexual stages are reached and new oocysts are produced. The entire life cycle from oocyst to new oocyst takes 2-3 weeks.
- 3 If a young kid is suddenly exposed to many sporulated oocysts, it may become severely ill 1-2 weeks later. It will be off feed, listless, and weak. It may show abdominal pain by crying or getting up again as soon as it lies down. At first, the kid might have a fever, but later the body temperature is normal or even below normal. Diarrhea begins

## COCCIDIOSIS

pastey, then becomes watery. The kid may dehydrate rapidly. Contrary to various reports written by people more accustomed to calves than kids, the diarrhea is only rarely bloody. Neither is straining common. Signs often show 2-3 weeks after the kids are weaned, because the lactic acid produced by the digestion of milk helps to inhibit oocidia in the nursing kid.

4 Young kids may be killed quickly by a severe attack of coccidiosis. Others - those initially stronger or less heavily infected - will develop a chronic disease characterized by intermittent diarrhea and poor growth. Tails and hocks are dirty. The kid with chronic coccidiosis cannot digest its feed properly because the intestines have been severely damaged. As a consequence, such a kid will be a potbellied poor-doer for months afterwards. Frequently, such a stunted kid will be too small to breed it's first winter.

5 Even though coccidiosis is typically a disease of the young growing kid, most adults are mildly infected and continuously shed oocysts which serve to infect young kids. Occasionally an adult goat shows temporary diarrhea when stressed or exposed to a new species of coccidia. This is especially common after the doe has been boarded on another farm for breeding.

6 Diagnosis of coccidiosis can be based on clinical signs or microscopic fecal exams. Coccidiosis is so common that it should be suspected whenever kids older than about 2 weeks of age are scouring. Sudden dietary changes can also cause diarrhea, but these make the kid more susceptible to coccidiosis. Thus diarrhea that begins with the consumption of too much milk, grain, or lush grass may drag on for days because of coccidiosis. Older kids and adults with diarrhea may have worms rather than coccidiosis, or they may have both problems together. Oocysts can be identified if the feces are mixed with a concentrated sugar solution. The oocysts float to the top, along with larger worm eggs. They are collected and examined with a microscope. Oocysts may be shed in the feces as early as 10 days after a kid is infected, but often the first attack of diarrhea occurs before oocysts are available to be identified. In these cases, the trained technician can do a direct fecal smear to look for smaller merozoites, which do not float in the sugar solution.

7 If a kid dies of coccidiosis, post-mortem examination will quickly give the diagnosis. The small intestine will have many irregular raised white areas, often about 1/8 to 1/4 inch in diameter. A smear taken from these white spots will show many coccidial forms if examined under a microscope.

8 Whether or not a goat gets sick with coccidiosis depends on several factors. One is the number of oocysts swallowed at one time. Small exposures, frequently repeated, lead to immunity. Large exposures destroy all the intestinal cells at one time and kill the kid. The age of the goat is also important. This is partly because the older animal has usually had time to develop some immunity. Also, very young kids

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are more fragile creatures. Good nutrition (including vitamin E-selenium supplementation in selenium deficient areas) helps the goat to defend itself against coccidiosis. Immunity to coccidiosis is rarely complete. This means that the healthy adult goat continues to pass many oocysts in her fecal pellets. However, most of her intestinal cells are safe from invading coccidia. As each of the 12 or so coccidia species is completely independent from the others, with no cross immunity, a goat that is happily living with one type of coccidia may develop diarrhea when exposed to a different type.

9

Prevention of coccidiosis is very important in larger herds if young kids are to thrive. Once diarrhea has developed, most of the damage to the intestine that leads to stunting has already occurred. Sick kids are treated to save their lives and to limit contamination of the pens, but the owner has already lost control of this contagious disease. Several key facts will help to design a prevention program. The first is that the adult goats are the original source of infection for young kids, because they shed oocysts constantly. All old bedding and manure should be removed from the kidding pens before the new kids are born. Sporulated oocysts are commonly present on the skin of the udder; thus the kid may become infected at the same time as it takes its first drink of colostrum. The doe's udder should be washed and dried before the kid nurses or else the kid should be removed from its dam at once and bottle or pan fed the colostrum.

10

If only one doe and her kid are present on a farm, and the pens are dry and spacious, coccidiosis is not apt to be a problem. The kids may be safely left with the doe. In larger herds, it is best to raise kids completely separate from the adults until they are ready to breed. Even when rushed from the doe to a clean barn, kids still manage to pick up a few coccidia. As multiplication is rapid, a few can become many very quickly unless good sanitation is stressed. Fecal contamination of feed and water must be prevented. This means that feeders and waterers should be outside the pen whenever possible, and arranged so that fecal pellets can't fall in. Grain should be put in keyhole creep feeders rather than the open troughs that kids love to play and sleep in. Hay racks also must be covered to keep kids out.

11

Because oocysts have to sporulate to become infective, exposure can be reduced by cleaning the pens daily. Slotted floors are helpful. However, daily cleaning entails a vast amount of work and give disappointing results, if used alone. Ordinary disinfectants don't destroy oocysts. Even 5 2256834976225877000000000000000000000000000000 to concentrate on keeping the pens very dry, as moisture is necessary for sporulation. Leaking waterers should be fixed at once. Otherwise, the wet ground or floor around the water source is a perfect environment for oocyst sporulation. Small grassy 'exercise lots' are also very dangerous and should not be used. It is very important to avoid overcrowding; spreading the kids out decreases the number of oocysts on any given square inch of pen floor or pasture. If many kids are present on the same farm, they should be grouped by age. Putting a 2-week-old innocent kid into a pen with kids 2 months old, where

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coccidial numbers and immunity have been building up for some time, is to invite disaster for the newcomer. Oocysts are killed by very cold temperatures (far below zero) or by hot dry conditions above 104. Thus, at the end of the kidding season, pens and feeders should be moved out into the hot sunshine for natural sterilization.

- 12 A variety of drugs may be given orally to treat the kid sick with coccidiosis. These include sulfa drugs such as sulfaguanidine and sulfamethazine, tetracyclines (aureomycin or terramycin), and amprolium (Corid R). Each of these has associated dangers if overdosed. Sulfas can cause kidney damage in the kid that is dehydrated. Tetracyclines will interfere with rumen function in older kids and adults. Very high levels of amprolium may lead to a fatal nervous disease, called polioencephalomalacia, because of a thiamin deficiency. Usually treatment is continued for about 5 days. Labels and veterinary instructions should be followed. If the diagnosis is not certain, and the kid may have bacterial enteritis or pneumonia rather than coccidiosis, sulfamethazine or tetracycline is usually given instead of amprolium.
- 13 All of these drugs are coccidiostats, which means that they slow down rather than kill the coccidia. Thus, if a kid is very heavily infected when treatment is begun, medication may not help that kid much. The drugs will greatly reduce the contamination of the environment, and thereby give other kids time to develop immunity. After kids have become immune to the disease they still continue to shed oocysts. Fecal exams may reveal thousands of coccidia per gram of feces. Medicating these older kids or adults will temporarily reduce the passage of oocysts but will not improve growth rate. Within 2 or 3 weeks after medication is stopped, coccidial levels will return to pretreatment values. Thus, except for protection of younger kids, it is a waste of time and money to treat older apparently healthy animals that don't show diarrhea. It is far better to separate the young kids from these older carriers.
- 14 Medication of apparently healthy animals is necessary for kids on large farms with previous problems with coccidiosis. The aim is to prevent damage to the intestines rather than waiting for diarrhea to occur. For instance, it may help to treat the kids with anticoccidial drugs on a daily basis for a week or more before stressing them by weaning or moving onto pasture. In some herds, a drug such as amprolium may have to be given daily beginning at 2 weeks of age and continuing until the kids are several months old. Amprolium levels of 25-50 mg/kg daily should be used. This is approximately 10-20 mg per round, and is 2 1/2-5 times the treatment level recommended for calves. Amprolium is not approved for use in goats in this country. It can be given to each kid individually or it can be mixed with the food or water. As an example, if there are 50 pounds of small kids in a pen, 500 mg of amprolium is mixed with the water, milk or feed that they will consume in one day. The larger kids, by eating more, get more of the drug than do the smaller kids.





# COMMERCIAL GOAT MILK PRODUCTION

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TI COMMERCIAL GOAT MILK PRODUCTION

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DE Management and Housing

Text

1 Many dairy goat breeders reach a point in the development of their herd when they contemplate commercial marketing of their milk. They may have been utilizing most of the milk produced by their herd to raise kids for replacements and for sale as breeding stock. Some milk may have been sold to neighbors or used in raising calves or hogs. Due to expansion of the herd and a good program of breeding and selection, health, and nutrition, the herd milk yield now exceeds the demand of neighbors and the few calves previously raised.

2 The question arises as to the economics in the production of Grade A goat milk and alternative methods of marketing goat milk. A specific Grade A goat operation located in Central Arkansas will be used as an illustration. The characteristic costs of production and income from sales are unique to this operation. The objective is not to show how much a producer can expect to earn from producing goat milk but to delineate questions which need to be answered in order that a proper economic analysis can be made.

3 The Petit Jean Goat Dairy

This goat dairy is located atop Petit Jean Mountain, 20 miles southwest of Morrilton, Arkansas. The dairy was constructed as a semi-confinement system with seasonal grazing of fertilized southern grass-clover pastures supplemented by purchased alfalfa hay and commercial mixed concentrates. Pen space was allotted for 125 milking does plus bucks and replacements. Yearling does from five breeds - Alpine, LaMancha, Nubian, Saanen, and Toggenburg were purchased in 1976

from several different herds in the Southwest US. First kiddings occurred in January of 1977. The budget below is for the 1981 production year.

4 The milk price received from the Yellville, Arkansas, processor in 1981 for 3.5butterfat milk was \$14.65 per cwt (hundred pounds). An additional \$2.00/cwt winter milk bonus in December, January, and February was paid also. However, milk production in those months was only 50f the 1981 total herd output, making the 'adjusted' milk price \$14.75/cwt for 1981 in average. Transportation of milk, 150 miles from Petit Jean Mountain to Yellville, cost \$2.50/cwt by an independent bulk shipper. Collecting and shipping relatively small quantities of milk over long distances results in high costs per unit transported.

5 The principal products sold from the Petit Jean Goat Dairy in 1981 were wholesale milk, cull adult does, breeding bucks and does and cull, newborn kids, primarily bucks. No milk was sold raw, on-farm, as this is prohibited by Arkansas law. Cull adults and kids were sold through a local auction barn or on-farm.

6 The Petit Jean Goat Dairy was designed and licensed as a Grade A goat milk production facility, but in 1981 all milk was sold to an evaporating plant at Yellville, Arkansas. The Yellville market only requires a 'manufacturing grade' milk license (Grade C). However, since Grade A facilities had been constructed, little or no additional efforts were required beyond normal repair and maintenance.

#### 7 1981 Cost Factors

In Table 1 are prices paid for inputs and received for products in 1981. Several points need to be emphasized. The cost of purchased alfalfa hay in many parts of the US has risen dramatically as a result of increased fuel costs. Central Arkansas is 'alfalfa-deficient' and good quality baled alfalfa must be transported several hundred miles from Kansas, Oklahoma, or Missouri. Competition from a growing dairy cow and horse population at times makes alfalfa difficult to procure. Several alternatives to alfalfa have been tried by Central Arkansas producers, including hay made from lespedeza, sudan-sorghum hybrids and well fertilized Bermuda grass. Most have found, however, that dry matter consumption and milk yield are highest when alfalfa is fed. Dairy goats are known for wasting hay by picking leaves, rejecting stems and pulling hay from feeders. Alfalfa pellets offer an excellent low-waste alternative to baled alfalfa. The cost of pellets dry matter are high relative to hay and the cost of investment in storage facilities can reduce the advantage from feeding pellets. Drying and pelleting also can reduce the nutritional quality of pellets, especially digestible protein.

8 An analysis of the advantage of alfalfa pellets compared to alfalfa hay should include amount of hay lost due to wastage (some waste can be recovered by feeding to other livestock), increased cost of dry matter

for alfalfa pellets, annual cost of storage facilities (interest on investment and annual repairs) and differences in nutritional quality which must be compensated for by purchased concentrates.

9 Early in 1977 it was realized at the Petit Jean Goat Dairy that the labor of one 'owner-operator', even when supplemented with additional labor from the family, was not adequate to handle all the chores of a 125-doe operation. Part of the problem was in the nature of the dairy goat production cycle with peak demands for labor in the spring kidding and fall breeding season. Seasonal labor demand overlaid the constant non-seasonal requirement of labor for milking, feeding, daily cleaning and maintenance. Coupled with the need for responsible, motivated, and qualified help in such tasks as kid raising and milking, the labor requirement is an input which deserves close attention in the design and planning of a commercial Grade A dairy goat operation.

10 Table 1. Prices Paid and Received for Inputs and Products (Petit Jean Goat Dairy, Arkansas, 1981)

## Paid For:

Item	Unit	Price
Alfalfa hay	ton	\$105.00
16		
18		
Hourly labor, incl. fringe benefits	hr	5.30
Milk hauling	cwt	2.50

## Received For:

Item	Unit	Price
Milk, 3.5butterfat	cwt	14.75
Buck kids, 3 days old	head	5.00
Doe kids, 3 days old	head	15.00
Cull adult does and bucks	head	20.00
Breeding bucks, 7 months old	head	200.00
Breeding does, 7 months old	head	150.00

11 1981 Operating Budget

In Table 2 are the 1981 operating costs. 'Cash' costs are actual outflows of money paid in the course of the operation of the dairy.

'Imputed' costs, in this case interest on equity capital and owner-operator salary, are costs charged against the operation but represent no actual cash outflow. An imputed cost can be defined as 'opportunity cost'; that income which might be received if capital or labor were used in its most productive alternative enterprise. The 'owner-operator' borrowed no money to buy land, stock, and construct facilities. All \$86,000 of the capital cost of land, buildings, fences, stock, and equipment was available without bank financing. Therefore, no yearly cash outlay for interest on borrowed capital was necessary. The opportunity cost of the equity capital an owner-operator has in his facility is that interest he could earn if his assets were liquidated and invested in an alternative enterprise. In this case, there is a 10% imputed cost which is the approximate interest that could be earned in 1981 in a short-term bond or savings account.

12 An owner-operator's labor also has an opportunity cost. A plumber or electrician who operates a Grade A dairy goat farm, foregoes the salary he could earn in his trade. Along with the opportunity cost of equity capital, an owner-operator 'salary' is often over-looked in evaluating true costs of operating a dairy. 'Pride of ownership', the pleasure received from owning and milking a productive herd of dairy goats, may compensate for some of the imputed costs but the reality of income foregone cannot long be ignored.

13 Imputed, or non-cash costs, included depreciation of equipment, interest on equity capital (all \$86,000 of the capital costs of constructing and equipping the dairy is equity as no money was borrowed), an 'owner-operator' salary and the milk used to feed replacements (\$12.25/cwt).

14 Concentrate and hay costs made up 47% of the total cash costs. A mixture of alfalfa and grass hay was purchased with alfalfa used primarily for milking does and replacements. Young and early lactation does, and dry does in late gestation, received the best feeds. Bucks, unbred, and late lactation does were fed good quality grass hay, trace-mineralized salt, and a minimal supplement of low cost grain. Attention paid to the appropriate distribution of protein and energy in feeding the herd will result in an optimum return of milk per dollar of feed cost.

15 One full-time laborer was employed at the Petit Jean Goat Dairy in 1981 to supplement the labor of the 'owner-operator' who was actually a paid manager. During the peak labor seasons of kidding (late winter-early spring) and breeding (fall), more than 80 hours per week, or 2.0 man equivalents, were required. Hired labor supplied only 40 hours of any week, with the 'owner-operator' expected to provide the remainder. This is a common situation on farms where total hours above 40 per week are paid at time-and-a-half or more and where activities at kidding and breeding are critical to the economic health of the operation.

16 Five replacement bucks were purchased in 1979 at an average cost of \$350.00. An alternative would have been to purchase frozen semen from proven sires to produce replacement bucks out of the best does in the herd. The choice of whether to buy bucks or use frozen semen to upgrade the genetic potential of a herd requires careful analysis. There is a need in the US for data recording on dairy goats to identify superior sires with an adequate accuracy. Use of frozen semen from a buck with records on a few daughters in only a small number of herds is risky. However, if semen from 'proven' sires is available and replacement bucks were selected from superior does, more rapid genetic progress would be possible at a lower cost than if replacement stock were purchased. Using AI would allow fewer bucks to be maintained. In the case of the Petit Jean Goat Dairy, only one buck per breed would be needed instead of two. The success with AI in dairy goats will be important in the future development of the dairy goat industry.

#### 17 Break-even Analysis

Cash and 'imputed' costs in 1981 totaled \$68,488.31 or \$547.90 per milking doe. For the operation to be economically sound, each doe should generate at least \$547.90 in income from sale of milk supplemented by the sale of cull adults and kids. The budget in Table 2 does not include costs for raising and selling weaned kids of breeding quality. In the 'short-run', for example, a period of one or two years, if each doe had covered cash costs of \$352.01 from the sale of her milk, the operator probably would continue to produce goat milk. However, over the 'long-run', if imputed costs are not covered, the operation is not economically healthy. A producer realizes this when a new tractor must be purchased or a job is offered at a salary which the cash profits from the dairy operation cannot match.

18 The price received for milk, net of hauling in 1981, was \$12.25/cwt. The cash costs of production per milking doe of \$352.01 per year call for a breakeven level of milk production of 2,874 lb per doe. To cover cash plus imputed costs of \$547.90, the per doe level of production ought to be 4,473 lb. This level of production greatly exceeds yearly averages recorded for the top producers, Alpine or Saanen dairy goats on Dairy Herd Improvement production tests between 1968 and 1978.

19 At a given level of milk production, what milk price must be received to 'break-even' on the operation? That is, what milk price allows the producer to cover all cash costs or cash costs plus imputed costs? With 1981 cash costs of production of \$352.01 per doe, the necessary 'break-even' milk prices for production levels of 1,500, 2,000, 2,500, and 3,000 lbs per doe are \$23.47, \$17.60, \$14.08, and \$11.73 per cwt, respectively. At these prices per cwt and the respective levels of production, cash costs of \$352.01 per doe would be paid for by the sale of milk. Some distortion in this analysis might be expected with higher costs for such inputs as feed and veterinary

expenses at the higher average levels of production but the analytical procedure remains the same. Given the same annual levels of production per doe (1,500, 2,000, 2,500, and 3,000 lbs), the 'breakeven' prices per cwt milk, f.o.b. farm, necessary to cover cash plus imputed costs (\$547.90) are \$36.53, \$27.40, \$21.92, and \$18.26, respectively. Unless the price received for milk sold is adequate to cover cash plus imputed costs of production, a producer would receive a better return on his labor and equity capital in an alternative enterprise.

## 20 Breeding Stock Enterprise

The analysis above assumes that only replacement doe kids were raised in 1981 sufficient to allow removal of 30 adult does from the milking herd's culls. All buck kids and the remaining doe kids were sold at 3 days of age at \$5.00 and \$15.00 per head, respectively. As the genetic potential of a dairy goat herd increases, surplus kids sold as breeding stock become a significant source of income to supplement that received from sale of milk. As an example, 50 does and 5 bucks might be raised to seven months of age and sold as breeding stock at \$200 and \$150 per head, respectively, or a total income of \$8,500. The contribution of the breeding stock enterprise is evaluated by considering the cost of producing the seven-month old kids. In Table 3 is an analysis of cash costs for a breeding stock enterprise in 1981. Total cash costs to raise 55 kids to 7 months of age in 1981 would have been \$4,878.24. Net income on the sale of 55 kids would have been \$3,621.76. Sale of breeding stock would reduce the breakeven level of production necessary to cover cash costs from 2,874 lb per doe to 2,637 lb. To cover cash plus imputed costs, the reduction would be from 4,473 lb to 4,236 lb, assuming a milk income of \$12.25/cwt f.o.b. farm. It is important to note that all costs in Table 3 are 'cash' costs. If extra investment in land, building, and fencing is required, or additional 'owner-operator' labor is needed, imputed costs for the breeding stock enterprise would need to be evaluated.

## 21 Other Alternative Sources of Income

Marketing wholesale directly to a milk plant is not the only way to gain income from the milk produced by a dairy goat herd. Alternatives include direct marketing of milk in raw or pasteurized form as fluid or processed products, and growing calves or pigs on high milk diets. Each marketing method has its distinct advantages and disadvantages which a producer needs to accurately evaluate before a decision is made. Direct sale of milk is often an attractive alternative to wholesaling goat milk to a processing plant, especially in those states where raw milk sales are allowed. However, there is also beyond the capital investment required for processing, packaging, and delivery equipment, the labor and management required for direct marketing enterprises. Management time must be adequately compensated at its value in alternative activities or the enterprise is not producing an adequate return. Many producers who investigate direct marketing of their herd's milk find that the time necessary to process and distribute their milk would give a better return if applied to the milk





COMMERCIAL GOAT MILK PRODUCTION

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# CULTURED PRODUCTS MADE FROM GOAT MILK

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Extension Goat Handbook

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TI CULTURED PRODUCTS MADE FROM GOAT MILK

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DE Milk and Milk Handling

Text

1 General -- Nature of the Products

Cultured goat milk products are those products made from goat milk by culturing with specific microorganisms (bacteria) so as to induce specific changes in flavor, physical, and chemical qualities. The most noticeable change is the conversion of lactose to lactic acid which results in the development of a sour flavor. The increase in acid content, measured by an increase in titratable acidity and reduction in pH, causes denaturation or coagulation of the milk protein which results in the great increase in viscosity. Other less noticeable changes include the production of other flavor compounds and changes in the physical dispersion of milk fat, protein and some minerals. As a result of the synthesis of lactic acid, there is a decrease in the lactose content of the milk so that it may be more acceptable to persons who have difficulty digesting lactose. The production of uniformly high quality cultured products depends on practicing great care in preparation of the milk, providing suitable cultures of uniform activity, and careful processing of the product.

2 The sale of cultured goat milk is dependent upon the product being uniform in flavor and body characteristics from day-to-day. Uniformity from one day to the next is more difficult to obtain in cultured

products than in other items in the dairy line. This is so because conditions favorable to the growth of the cultured microorganisms also encourages the growth of organisms which produce undesirable flavors and body qualities. There is also the possibility that the desired bacterial growth will be prevented or greatly reduced by the presence of antibiotics or bactericidal chemicals in the milk. A third cause of partial or complete failure to attain in desired microbial growth is the presence of bactericidal factors known as bacteriophage. With all of these possibilities for inadequate or interrupted bacterial growth, some failures are to be expected resulting in the final products being less than desirable or outright unsaleable.

### 3 Manufacturing Procedures

Selection and Preparation of Milk or Cream -- Only Grade A quality, fresh sweet milk, free of objectionable flavors and foreign material (antibiotics, bactericides, etc.), and of low bacteria and somatic cell content should be used to make cultured products. There is an inclination to think that because cultured products have a sour flavor they are a good dumping ground for old or off-flavored milk or cream. Such is not the case -- incubation generally amplifies objectionable flavors, rarely covers them up. Thus, the previous statement takes on greater importance.

4 The milk or cream to be made into buttermilk, yogurt, or sour cream should be standardized for fat content. It also may need to have the milk solids-not-fat content adjusted if low. Standardization of the composition is essential to assure the legality of the finished product as well as its uniformity. Consumers have as much concern about uniformity in the foods they purchase as in the suits or automobiles they buy. Buttermilk is usually made from skim milk (less than 0.5 milk fat); yogurt may be made from whole milk (3.25 225683497622587700000000000000 low fat milk (0.5 to 2.5 225683497622587700000000000000000000000000000000 18 225683497622587700 body (viscosity) it may be due to low protein content, in which case the milk solids-not-fat may need to be increased. Such may prove to be impossible unless low-temperature vacuum evaporator equipment is available because Grade A nonfat dry goat milk may not be available commercially. Superior quality cultured milks can be made when the milk solids-not-fat content is adjusted to 10 to 11

5 Proper pasteurization of the milk or cream to be made into a cultured product is very important. If raw products are used, the normal microflora reproduce rapidly during incubation and undesirable flavors generally result. This is so critical that the heat treatment recommended for these products is 185F (85C) for 30 minutes. The high temperature not only deactivates the bacteria and enzymes but also denatures the protein which aids in developing the smooth thick body desired. Following pasteurization, the product should be cooled to the incubation temperature. Great care should be exercised in preventing recontamination of the pasteurized material.

6 Cultures: Purchase vs Propagation -- It is not possible to make

fine quality cultured products without having bacterial cultures of proven purity and activity. Fortunately, a number of organizations make a business of supplying such materials. Improved techniques now make it possible to supply cultures in a form ready to be added to the customers pasteurized milk or cream. Even so, many manufacturers of cultured products, including cheesemakers, prefer to maintain their own stock of 'mother cultures.' Skilled personnel, special equipment, and facilities providing a controlled atmosphere are needed for complete success in that operation. Most small operators will have fewer failures and more uniform quality through the use of 'ready to use' cultures.

7 Those who are using rather large quantities of bulk starter culture on an almost daily basis may find it economical to carry mother cultures. To do so successfully, the technician must have knowledge of microbiology and aseptic technique. An especially high quality milk must be used as a culture medium. Facilities must be provided for sterilizing the milk and all utensils used. Temperature controlled incubators must be provided, if several kinds of culture are to be used, it would be necessary to have an incubator operating at the temperature most favorable to each species of microorganism.

8 Setting and Incubating Cultured Products -- While each kind of cultured product requires specific procedures, all have some commonality in the treatment required. After the milk or cream has been standardized as to composition and heat treated to deactivate bacteria and enzymes normally present, it should be cooled to the setting temperature. Precisely what that temperature should be depends on the kinds of organisms introduced by the culture. A summary of the kinds of microorganisms used in making various cultured products together with suggested sources of culture, rates of inoculation and incubation conditions is shown in the accompanying table. It is possible to vary these conditions and make high quality products, but a specific set of conditions should be adhered to once the desired product has been attained. To do so the operator must have equipment and supplies which permit composition control and time and temperature regulation.

9 Buttermilk, Dip, and Sour Cream -- The details of manufacture of these products are discussed at the same time because the microorganisms used in all of them are similar. That is not to say that the cultures used should all be identical -- some variation in species and mixed species can be used to produce differences in the finished product.

10 There is a major difference in the several products as to their milk fat content. Buttermilk is usually made from skim milk because it originally was the by-product from churning butter out of sour cream so was essentially free of fat. Buttermilk can be made from milk of any fat content; it is thought of as a product for drinking. By increasing the fat content of the base, chip-dips and sour cream are produced. They usually have a consistency suitable for dipping or spreading. All of these products are frequently used as ingredients in baked or other

prepared foods.

- 11 Viscosity is very important in consumer evaluation of these products. Generally, it is not possible to get the desired viscosity without adding to the milk solids-not-fat (MSNF) of the base -- this is especially true in making buttermilk. A superior product usually requires the skim milk to contain 10 to 11 percent MSNF. If Grade A nonfat dry goat milk is available, it is no problem to add a sufficient quantity (usually 1 to 2) to increase the MSNF content to the desired level. In the absence of nonfat dry goat milk, the easiest procedure is to concentrate part of the skim milk in a vacuum evaporative condensor and add that back to the remainder of the skim for buttermilk. Sour cream and dips may require added MSNF, depending on the composition of the milk from which they were obtained and the manufacturing process used.
- 12 The procedure followed in setting these kinds of cultured products consists of adding the desired quantity of the inoculum selected to the prepared milk base in an aseptic manner and stirring the mixture till homogeneous. This batch is then allowed to remain undisturbed, with the desired temperature maintained throughout the incubation period, until the desired degree of acidity has developed. That may be estimated by tasting, but tests for titratable acidity and/or pH give more precise control. Usually a titratable acidity in the range of 0.7 to 0.8 is desired -- it will continue to increase while the product is cooling.
- 13 When incubation is completed, the product should be cooled by circulating cold water around it and agitating it mildly. Development of too much acid, or too vigorous agitation may cause the protein to separate from the whey, in which case cheese has been produced instead of buttermilk.
- 14 Special Cultured Milks: Kefir and Acidophilus -- Production of these types of cultured milk drinks should be undertaken only to meet special market requirements. The production procedures are not so much more specialized or difficult, but the finished products are somewhat unusual and so little known as to require special marketing.
- 15 True Kefir is a drink developed by utilizing both bacteria and yeast as the culture organisms. The fermentation involves the production of lactic acid, carbon dioxide, and ethyl alcohol; acid to a concentration of about 0.8, alcohol to about 1, and carbon dioxide to give slight effervescence. It is a delightful drink used extensively in some parts of the world but not made much in America. A substantial market for the product probably could be developed if one wished to make the effort.
- 16 Acidophilus buttermilk is also a specialized product for which no market has been developed. It utilizes the activity of a bacterium, *Lactobacillus acidophilus*, which is capable of converting a greater proportion of the lactose to lactic acid. The lactic acid content of the finished product approaches 2a level of sourness not generally

accepted in American markets. This organism is one of very few capable of surviving the strong acid (pH +/- 2) of the human stomach, which means that when consumed, living organisms pass into the lower digestive tract where they may live and reproduce. There is some evidence that this may aid digestion and have other healthful benefits.

17 Yogurt -- Even though yogurt has been consumed for centuries by some people, it is a relatively new item in the dairy product line in the US. The products being manufactured here are not the same as the old world products. Yogurt made from goat milk provides excellent sales potential; wherever offered, it has been well received.

18 In its simplest form, yogurt is a cultured milk product, but as it is offered to the consuming public in the US, it has become more complex as to manufacture and sale. This is because a variety of different forms are being produced. There are now two basic products -- one is a viscous liquid suitable for drinking, and the other is semi-solid and eaten with a spoon. The yogurt consumers in other countries prefer is a simple cultured milk product, but in the US the major share of the market is for products with added flavoring material. Specially prepared fruits and berries are most frequently used for flavoring yogurt. The flavored yogurts have undergone diversification - there are three different methods used for flavoring material distribution. The most widely used has the flavoring distributed throughout the body of the yogurt -this is called Swiss-style yogurt. Another fairly common yogurt is called Sundae style; in it, the flavoring material is all in the bottom of the package. This style product is supposed to be eaten by discharging the product from the carton onto a plate with the result having the flavoring material flow down the sides of the yogurt in the manner of an ice cream sundae. In practice, most of the yogurt is eaten directly from the package, so a third style has been developed with the flavoring material at the top of the container. Each form or style of yogurt does require some special procedures in manufacturing and special packaging equipment when made in large quantities.

19 Yogurt to be consumed as a drink is made in essentially the same way as buttermilk excepting a different combination of microorganisms are cultured which necessitates a higher incubation temperature. Skim milk is most frequently used, but either low fat or whole milk can be used for yogurt. It should have a consistent fat content, and may require added MSNF. After standardization and pasteurization, the milk should be cooled to 110 to 114F. It should then be inoculated with about 1.250f each of the two bacteria *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. After thorough mixing the inoculated milk should remain undisturbed until the desired acidity is attained - usually about 0.9 The coagulum should then be broken by gentle stirring and cooled by circulating chilled water around it. If the unflavored product is desired, it can be packed when cold, if flavored, the flavoring material (fruit puree is most frequently used) should be added at a rate of 12 to 20, thoroughly distributed, and then packaged. The most frequently encountered problems with this product

are separation of clear whey and settling of the flavoring material in the package. Both are associated with insufficient viscosity in the yogurt. High temperature long time heat treatment and increased MSNF content of the milk are the most effective remedies. If the fruit particles in the flavoring material are too large, they will settle out. Most fruit flavorings prepared for use in yogurt have some sweetener added, if not it may be added with the fruit if desired. Two to four percent added sweetener may make the product more acceptable.

20 The manufacture of yogurt which is intended to be spoonable and of custard-like consistency is a little more complicated. While the basic procedure is the same, some modifications must be made to provide the greatly increased viscosity. Three alternatives can be used to do so. The first, probably the most difficult for the goat dairyman, is adding MSNF to the milk. The second alternative is to prepare the milk and inoculate it in the usual way, then package it and incubate it in the package. The time and temperature of incubation would be the usual. This permits all the viscosity developed during incubation to be retained in the finished product, since it is never agitated after packaging. If alternative method number two is practiced, a level of 11 to 12MSNF may be adequate but if alternative number two is not feasible, the level of MSNF required may be 13 to 14 The third alternative and the easiest and cheapest by far is to incorporate a water-binding agent or stabilizer (usually gelatin or a special starch) to the milk prior to pasteurization. Any desired viscosity can be attained by adjusting the amount added - less than 10s usually adequate.

21 Each of the three alternatives have disadvantages which must be considered. The main problem with increasing the MSNF is that in most situations it simply cannot be done because no commercial product is available or is so large that small quantities of goat milk cannot be handled. Alternative number two may require special package filling equipment and certainly requires more space for incubating the product at controlled temperature. Also, cooling of the product when incubation is complete is slow and costly and is conducive to more variability in the finished product. The third procedure offers good quality control at low cost but necessitates showing the presence of the additive on the label. Some customers find this objectionable even though some nutritive qualities may be improved by the added material.

22 Packaging Cultured Goat Milk Products -- Most cultured products are packaged in 4 to 8 oz cups because they generally are consumed as snacks. Bulk packages, varying from quart to 10 lb size have also been used successfully. Only single serving size packages can be used for making products with the flavoring material separate from the cultured milk. Most regulatory agencies require packages to be filled mechanically. The manufacturer should check with the proper regulatory body about packaging requirements and also about proper labeling of the products. In most situations, these products must carry nutritional information on the label. If required, it must be quite definitive; and this necessitates very stringent composition and quality control in the





# DIARRHEAL DISEASES

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TI DIARRHEAL DISEASES

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DE Health and Disease Management

Text

1 Diarrheal diseases are common in newborn kids, as they are in calves, lambs and piglets. It is the authors impression that these diseases are continuously present (endemic) in fewer goat herds and the morbidity, severity and mortality are lower in goats than in newborn calves, piglets and probably lambs. The most severe diarrheal diseases are colibacillosis and salmonellosis. In calves, these two are also the most common whereas less severe, non-specific causes of diarrhea may predominate in kids. The discussion which follows will pertain mostly to colibacillosis and salmonellosis; some of what is said will be the result of extrapolation from calves and sheep and some will be from the very few reports and experience on goats.

2 Transmission

The primary source of infection is feces of infected animals and transmission is by ingestion. The propensity of young kids to nurse objects especially just after being bottle fed and their innate curiosity, often satisfied by mouth, make them easy prey for infection. All objects which can be contaminated by feces are potential transmitting agents including bedding, pails, nipples, clothing, tools, feed, water and the skin of the udder and perineum of the mother. The organisms are often ingested within minutes after birth. The more intense the management system and dense the population the more heavily contaminated the environment becomes.

3 Salmonellosis may have the additional source of infection; that is, the mother herself may be a latent (inapparent) carrier. In the latter

case shedding the organism is precipitated by the stress of kidding.

#### 4 Salmonellosis

Probably most species of the genus *Salmonella* (*S.*) are capable of producing enteric disease in farm animals. *S. typhimurium* is the most common of the genus in goats and cattle in the USA but the incidence of *S. dublin* infection has increased dramatically in cattle in the Western United States. *S. dublin* is much more likely than *S. typhimurium* to form a latent carrier state by quietly residing in the lymph nodes and tonsils of cattle, only to emerge, produce disease and transmit infection during time of stress such as calving. *S. typhimurium* is more likely to subside after initial exposure and to recur only when the source of infection reappears.

5 Reports of the disease in goats are sparse, therefore the following generalizations may not be valid. However, *S. typhimurium* seems to affect any age goat with a short, fatal course and is highly contagious. *S. dublin* may be less contagious and infected goats seem more apt to recover.

6 Clinical Signs -- The peracute case is found dead without previous signs and is most frequent in the newborn. The acute form has been reported in 2-4 week old kids with a high morbidity and mortality (32 of 35 animals dying) and in adults over 1 year old. First there is a profuse, watery, (the fecal consistency may be more like paste or putty with *S. dublin*) yellow diarrhea; this is rapidly followed by depression, rapid dehydration and weakness. Some die in 8-12 hours, most in 24-48 hours and a few live for a week. The temperature may reach 106-108 but often returns to normal or subnormal near death.

7 Tissue Changes -- Post mortem findings are often not striking. The peracute case may have excess fluid in the abdominal (peritoneal) cavity and heart sac (pericardial space); there may be tiny (petechial) hemorrhages in various parts of the body especially around the heart, the middle small intestine may fill with gas, contain some fluid and have a thin wall.

8 Acute cases will have mild to moderate inflammation (reddening) of the inner lining (mucosa), and less frequently hemorrhagic enteritis will be present. The outer surface of the intestine and linings of the body cavities (serosa) will likely have petechial hemorrhage. The mesenteric lymph nodes are usually enlarged, wet and when cut have a soft consistency. In animals that live longer, the liver will appear enlarged, have rounded edges and often the gall bladder is full. Only rarely will the intestinal mucosa show varying degrees of erosion or ulceration. Increased volume of amber joint fluid with or without white fibrinous clots or casts are not an uncommon finding in the joints of longer lasting acute cases.

9 Diagnosis -- Signs will mimic colibacillosis, coccidiosis, certain

parasite infestations and enterotoxemia; tissue changes are also nonspecific. It is important to conduct a necropsy examination on the first as well as all animals dying. It is equally important to attempt isolating the causative organism at least from the intestinal contents, the mesenteric lymph nodes and the liver. A diagnosis of Salmonellosis is important because it will indicate the need to concentrate more on prevention than on drug therapy. However most laboratories will not be able to type the species of Salmonella that was isolated. It is important that this be done, however, and for this purpose the isolate can be sent to the National Animal Disease Center in Ames, Iowa via your regional Federal Veterinarian's Office.

10 Prevention and Treatment -- The few reports of Salmonellosis in goats have been very discouraging regarding prevention and treatment. However, the strict management practices employed in well run cow dairies should always be followed and should help keep Salmonellosis at a low level.

11 Prevention and fluid therapy will be discussed as a separate section because it applies to all enteric and many other diseases. Management practices that prevent or reduce the amount of exposure to Salmonella sp. is the only real hope of control for an endemic herd. The following treatment recommendations are made with the reservation that they are often not successful.

12 Chloramphenicol is a drug that is not cleared for use in goats and should only be given under veterinary prescription. It is inactivated by a functioning rumen and should therefore not be given orally to the kid that has started to eat roughage in any significant quantity. However, it is often the only drug to which the organism is sensitive. Trimethoprim-sulfadoxine combinations and nitrofurans have been successfully used in calves and systemic Salmonellosis will sometimes respond to ampicillin.

13 Dehydration and acidosis should be combated with oral, intravenous or subcutaneous administration of fluids, electrolytes and energy as will be discussed later.

#### 14 Colibacillosis

The bacterium *Escherichia coli* (*E. coli*) has several serotypes, most of which are normal nonpathogenic inhabitants of the gastro-intestinal tract. There are pathogenic serotypes, however; some of these are capable of gaining entrance to the body (septicemic form) through the intestinal wall, others remain in the intestinal tract and liberate a toxin which is absorbed by the body and causes generalized disease and diarrhea (enterotoxogenic form). A milder enteric form, without signs of toxemia but causing diarrhea, is a third and intermediate form. Colibacillosis is a disease of very young animals usually 2-10 days old.

- 15 Clinical Signs -- The septicemic form usually occurs in the first 4 days of life and when there has been no absorption of colostral antibodies. The animal is depressed, weak, anorectic (won't eat), the temperature is elevated early but drops below normal when the animal becomes weak and goes down. Diarrhea is not common. Death usually occurs in 2 days. Animals surviving for a week may show signs of the organism localizing in the joints, brain, eyes or lungs. The septicemic form is the most common form in lambs and is usually peracute. The same may be true in kids. ++++MISSING DATA++++
- 16 The most important factor in determining an animal's ability to survive colibacillosis is the serum immunoglobulin level before the animal develops the disease. Antibiotic therapy may help animals with marginal to adequate serum antibody levels but are probably of no value in helping the agammaglobulinemic (no immunoglobulin in the serum) animal.
- 17 Prevention of Colibacillosis and Salmonellosis  
Newborn ruminants are born with antibodies against various disease producing microorganisms (germs). These antibodies are proteins called immunoglobins. A newborn kid receives all of its protection (immunoglobulins) against germs as a result of drinking the colostrum milk produced by its mother. Milk of the very first milking contains many times more antibodies than does that of the second and later milkings. Further the intestinal tracts of the newborn can absorb the antibodies at maximum rate only during the first 12 hours of life; absorption decreases rapidly from 12 to 36 hours after which time no more are taken into the blood stream. In addition to these circulating antibodies there is another type (local antibodies) that attach to the surface of the intestinal tract, are never taken into the blood stream and do a certain amount of bacterial neutralization from this position.
- 18 Thus, colostrum is the first essential nutrient of the newborn. Without it, death of the newborn can be assumed. As a rule of thumb, one ounce of first milking colostrum per pound body weight (of the kid) should be received by that kid in the first 8-12 hours of life. Ideally this would be given in small quantities frequently. Removing the kid from the mother immediately after kidding has two advantages. First the udder can be cleaned prior to milking (this should be done even if one insists on letting the kid nurse) and the kid is removed from the relatively early heavy exposure to pathogens. Second, by feeding with a bottle, one will know how much colostrum is taken by the kid and can force feed the amount not voluntarily consumed. During the kidding season, extra first milking colostrum can be frozen in ice cube trays, transferred to plastic bags for storage and dispensed, thawed and fed as needed. Measure the size of your cubes. They are probably 2/3 to 1 ounce each.
- 19 Housing is probably the next most important consideration in the

prevention of enteric diseases of the newborn. Much of what will be suggested may be impractical or at least not cost effective under ordinary circumstances when there is no problem. However, if an enteric problem becomes endemic in a herd, some or all of these measures may need to be taken regardless of inconvenience.

20 Before proceeding, however, two observations are worth stating. Many times with any adverse change in the health status of a herd or individual (not limited to enteric problems) a manager will hesitate or even refuse to make recommended changes on the grounds that the management system has not changed 'for years' so the system could not be contributory to the sudden problem now being faced. One can often and for a long time get by with slightly less than optimum down to even poor management practices. For reasons that often cannot be explained even by the veterinarian, a variety of subtle adverse factors will accumulate and finally culminate in an epizootic of worrisome to severe proportions. This will usually not be corrected by one step of managerial improvement, rather drastic measures are usually required to reestablish optimum health.

21 The second observation is especially applicable to enteric diseases but applies to all areas of health maintenance. One optimal management has achieved good health maintenance, there is a strong tendency to relax, take short cuts and save money. This will result in a recurrence to suboptimum health of the herd. One can only hope that this change is dramatic enough to be noticed and corrected. Unhappily the dramatic change is often preceded by a prolonged period of gradually diminishing growth rate of kids as well as decreased reproductive and productive capacity of the adults.

22 Kids should be removed from their mothers to a well cleaned, dry pen, free from drafts. Newborn kids should have access to the warmth of a heat lamp in cold weather (however, if the barn is closed and heated, respiratory problems will likely develop). Crowding should be avoided; ideally with no direct contact with others. The kid pens should be separate from the adult herd. Ideally different personnel would be in charge of kid care than those attending older and adult animals. An alternative would be to care for the unweaned kids, then the weaned kids, then milk and care for the adults.

23 After weaning the kids, pens should be cleaned thoroughly by scraping, then detergent and water, then disinfectant. The pens should be allowed to dry, sprinkled with lime and left idle 2-4 weeks.

24 Feeders and waterers should be constructed so as to always prevent their fecal contamination.

25 Fluid and Electrolyte Therapy -- Much of the body's fluid and electrolytes (minerals and other circulating chemicals necessary for normal body function) are lost via the feces (manure or stool) when an





# DIGESTION

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TI DIGESTION  
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DE Anatomy and Physiology

## Text

- 1 Digestion in the goat is the process by which ingested feed materials are broken down and readied for absorption through the gastrointestinal (GI) tract in order to furnish energy and building blocks needed by its metabolism. All feed sources originally are the result of plants utilizing the energy of the sun and the minerals of the soil, without which the herbivorous goats and other farm animals could not exist.
- 2 In the food chain, the primary consumers are the herbivorous animals. They have specially developed fore-stomachs and GI tracts that enable them to utilize cellulose and other forms of plant polysaccharides. They are also maintaining large symbiotic populations of bacteria and protozoa in these fore-stomachs, which can break up the complex structures of plant celluloses into digestible sugars and a variety of useful organic acids. Some energy from this breakdown is used by the bacteria to synthesize their own body mass, proteins and vitamins, which are then later utilized by the herbivore when the bacteria pass on down the GI tract and are themselves digested by their host, e.g. the goat.
- 3 Herbivores are classified into: pre-gastric fermentors, ruminants or pseudo-ruminants; and post-gastric fermentors, whose cecum has evolved to function similarly to a degree as the forestomach of ruminants. Cows, sheep, goats and deer are ruminants, horses and rabbits are members of the second group.



4 Pre-gastric fermentation enables the most efficient utilization of roughages, which are fermented and chemically degraded before passing into the small intestine, where most nutrient absorption takes place. In post-gastric fermentation, the bacterial break-down occurs in the cecum, after roughages have passed through the small intestine. Such animals derive benefit from cecal fermentation by resorting to the practice of coprophagy (feces eating).

5 Feedstuffs basically consist of six kinds of nutritive materials: carbohydrates, fats, proteins, vitamins, minerals and water. Through digestion, they become available to the goat by way of absorption in simple chemical forms such as sugars, fatty acids, glycerol, amino acids and salts.

## 6 Mouth

The initial step in digestion is prehension, the conveyance of food into the mouth. In the goat, the lips, teeth and tongue are the primary prehensile organs. The lips of goats and sheep are most important in seizing feed, while the cow makes more use of the tongue for grasping and tearing of grasses and forbs. Thus, the goat is capable of greater selectivity in its grazing. Goats, like other ruminants, lack an upper set of incisor teeth. Instead they possess a hardened dental pad, against which they bite.

7 Mastication, or chewing, is necessary for the reduction of feed to smaller particle sizes. Goats, exhibit an accentuated lateral movement of the jaws while chewing, which greatly increases the grinding action of the teeth. These lateral movements result in the molars developing a sharp, pointed surface on the inner edge of the lower teeth and on the outer edge of the upper teeth. Due to the fact that the upper jaw is wider than the lower jaw, only one side of the mouth can be used at a time to grind the feed.

8 While grazing or browsing, the feed is only chewed enough to be mixed with saliva to form a bolus of suitable size to swallow. Saliva, which is a mixture of serous and mucous fluids, is released by the stimulation of chewing from five pairs of glands. The parotids, which are located behind the angle of the jaw; the submaxillaries, on the inner sides of the parotids; the sublinguals, on each side of the tongue base; and the inferior molar and buccal glands in the cheeks. Saliva functions primarily as an aid in mastication and swallowing, along with providing some enzymatic (amylase) breakdown of starches. Saliva contributes very importantly to the buffering of rumen fermentation, provides nutrients to rumen microorganisms and certain anti-frothing properties.

## 9 Pharynx and Esophagus

When the bolus has been formed, it is passed through the pharynx into the esophagus, which is a musculo-membranous passageway connecting the pharynx to the rumen. The bolus is projected forcefully through the

esophagus and into the rumen. The rapid movement is made possible by the presence of striated muscles in the esophagus of ruminants, not found in most other animals.

## 10 Compound Stomach

Upon entering the rumen, the bolus is subject to microbial fermentation. In young ruminants, liquid feed will by-pass the rumen, entering into the omasum instead. This is accomplished by means of the esophageal groove, a fold of mucous membranes that can be formed in response to the mechanics of sucking or pursing. The rumen (paunch) is the largest compartment of the compound stomach in the adult ruminant consisting of four compartments (the rumen, reticulum, omasum and abomasum) or three fore-stomachs and the true stomach. The rumen has a capacity of 4-5 gallons in the adult goat. The pH in the rumen is kept within a range of 5-7 normally. The rumen serves as fermentation vat, organ of maceration and grinding, bacterial digester, and organ of absorption. The bacterial populations may count 10 billion cells per gram. Ciliated protozoa usually are also present in the rumen, besides a number of flagellated microorganisms. Rumen muscular contractions churn the boluses with the other contents of the rumen. The rumen microbes break down plant fibers into sugars and organic acids. Soluble compounds are absorbed through the rumen walls which are covered with many papillae, while the larger food particles may require to be remasticated before they can pass out of the rumen. This involves also the reticulum, the second of the four stomach compartments.

11 The act of rumination is accomplished by a combination of factors. There is an increase in fluid pressure of the reticulorumen compartments accomplished by extra-reticular contraction; there is also, a contraction of the diaphragm, creating negative pressures in the trachea; and the sudden contraction of the diaphragm tightens the esophagus which is normally in a collapsed, flacid state. This, results in the passage of reticulorumen material into the esophagus. Anti-peristaltic movements of the esophagus transfer the bolus to the mouth, where 'cud-chewing' occurs. The bolus is rechewed at the goat's leisure, re-insalivated and swallowed again. The feed materials, because of smaller particle size, have a comparatively higher specific gravity and will eventually pass through the reticulum into the omasum. The total residence time of feed spent in the rumen is usually about 8 hours.

12 The predominant end products of fermentation in the rumen are the volatile fatty acids (VFA), which consists of 60-70% acetic acid, 15-20% propionic acid, 10-15% butyric acid and smaller amounts of longer chain VFA's. Some alcohol is also formed in small amounts. These fermentation products from the rumen are absorbed through the wall and pass into the bloodstream. About 90% of the energy required by the ruminant is provided by these short chain fatty acids.

13 Rumen fermentation results in large quantities of gas, principally

methane and carbon dioxide. Amount and rate of gas evolution is directly related to type of feed. For this reason, ruminants are prominent belchers, and if the belching process is inhibited, e.g. by foaming, the animal will bloat. The mechanics of eructation (belching) are complex, and are associated with secondary rumen and specific reticulum contractions. Rumen gas is forced out by contraction of the dorsal blind sac of the rumen. It is allowed to enter the esophagus by the relaxation of its lower sphincter diaphragm. The esophagus fills with gas, the lower sphincter closes, and the upper pharyngo-esophageal sphincter relaxes. The gas is released into the nasopharynx, while the nasopharyngeal sphincter is closed. The glottis remains open while the lips are closed, so that much of the gas enters into the lungs and respiratory system.

14 There is a free flow of material between the rumen and reticulum and vice versa. The reticulum is the second and smallest of the four compartments of the goat compound stomach, making up only about 50% total volume. It is lined with a mucous membrane that is folded into hexagon like patterns (honeycomb). The reticulum receives the heavier substances from the rumen and serves as a muscular transit reservoir. Contraction of the reticulum aids in the rumination process, but is not vital. Rumination will occur even if the reticulum is removed.

15 Feed passes then into the 3rd compartment, the omasum, which consists of many folds (maniply) and comprises about 70% of the total volume of the compound stomach of goats. Here, excess moisture is removed from the ingested feed, and finer grinding occurs here also, even after rumen-recticular fermentation. The omasum is not involved in the rumination process.

16 Feed then passes into the abomasum, or true stomach. Glandular secretions of gastric enzymes and hydrochloric acid are produced, and its functions are similar to the stomach of monogastric species. It makes up about 80% of the total volume of the compound stomach and is essential to life. The abomasum consists of 3 parts, the fundic, body and pyloric regions. The pyloric region joins the small intestine, separated by the pyloric sphincter muscle. Glands of the fundic area, near the omasoabomasal orifice, secrete a mucus which protects the walls of the abomasum from protein-degrading enzymes and hydrochloric acid, secreted by the fundic and pyloric glands. The fundic glands are the most important for digestion. A specialized secretion from the fundus combines with vitamin B12 to stimulate the production of red blood cells.

17 Gastric juice, consists of water, inorganic salts, organic substances and hydrochloric acid, and between four to six liters per 24 hrs are secreted in goats. The enzymes rennin, pepsin and gastric lipase are part of the organic constituents of gastric juice. Rennin is the enzyme for milk coagulation, acting on milk casein by producing a gel-like mass, in preparation for the protein digestion by pepsin.

18 Pepsin, from its precursor pepsinogen, converts proteins into peptides, intermediary products of digestion. Further breakdown of proteins does not occur in the abomasum. Gastric lipase degrades fats eventually to fatty acids and glycerol, operating in conjunction with bile (an emulsifying agent) after the chyme (the liquid feed) leaves the stomach and reaches the small intestine. Feed chyme is moved through the compound stomach and abomasum in peristaltic waves of contraction. Some movement is also attributed to reticular actions that lift the body of the abomasum by virtue of its thin muscular attachment. The acidity of the abomasal contents usually remains close to pH of 3.

### 19 Small Intestine

Feed passes from the abomasum into the duodenum, the first segment of the small intestine, in a series of spurts of 30-40 ml each, as the pyloric sphincter opens. Such spurts may last for 10-15 minutes, after which little feed passes. Some feed may be returned to the abomasum from the duodenum by antiperistaltic contractions; in goats, about 40 of the chyme reaching the duodenum, may be returned to the abomasum for a short time. The rate and volume of discharge from the abomasum is dependent upon the amount of feed that is present in the duodenum.

20 While digestion in the abomasum occurs in an acid environment, duodenal digestion depends on an alkaline medium. By the time the feed chyme has reached the lower end of the duodenum, the pH must have risen from 3 to about 8 normally. Pancreas, liver and glands of the duodenum contribute secretions that make the medium alkaline.

21 The pancreas is a diffuse dual-purpose gland located along the duodenum and secretes enzymes for starch, fat and protein digestion via the pancreatic juice into the intestinal tract, when stimulated by the hormones pancreaticozym and secretin which are produced in the small intestine. The pancreas also produces the hormones insulin and glucagon.

22 Another glandular secretion, the bile, is produced by the liver and stored in its gall bladder (horses and rats have no gall bladder, but goats do). Cholecystokinin, a hormone that comes from the small intestine, controls release of bile from the gall bladder. The purpose of bile is to emulsify fats in the chyme, thus enabling lipase enzymes to work effectively. Bile also aids in alkalization of the chyme in the duodenal tract.

23 There are four general types of glands located in the small intestine. Brunner's glands are situated in the submucosa of the duodenum, producing an amylase enzyme which is needed for the reduction of sugars. The crypts of Lieberkuhn are deep folds in the intestinal membranes, and although they are not true glands, they contain enzyme producing cells. Peyer's patches are congregations of lymphoid tissue

in the walls of the small intestine. They control populations of local bacteria, function in antibody production and aid in fluid filtration. Specialized secreting cells of Paneth, the crypts of Lieberkuhn, and goblet cells of the intestinal tract secrete an intestinal mucus.

24 Movements of the intestines churn the contents, and mix in the digestive secretions. Intestinal motility also brings the chyme into contact with intestinal membranes for enhanced absorption of nutrients. Peristaltic contractions propel the chyme through the intestine, and assist the flow of blood and lymph in the walls of the intestine.

25 There are three main aspects of intestinal movement. One is of a propulsive nature, including peristaltic and antiperistaltic motions. Pendular movements and rhythmic actions are related to intestinal absorption. Third, there are control movements which initiate or stop peristalsis by the creation of waves.

26 After the duodenum, feed chyme passes through the section of the small intestine, called ileum and jejunum to the large intestine.

## 27 Large Intestine

The large intestine mainly functions to remove water from the intestinal contents, and to concentrate the feed residues for excretion. In order to maximize water removal efficiency, the large intestine causes delay in the rate of passage of intestinal contents. While feed may transverse through the small intestine in about 3 hours, it takes approximately 18 hours to move through the large intestines. This is especially impressive considering that the large intestine of goats is only about 6 1/2 feet long, while the small intestine is almost 36 feet long. The extent of water resorption from the large intestines in goats is relatively high, as evidenced by their dry faces, and is an important water conservation mechanism in goats.

28 Material passes from the cecum, a blind pouch located at the juncture of the small and large intestine, to the first part of the large intestine by peristaltic movements, which undergo periods of high activity and almost inactivity. During high activity, pressure waves of 6-36 seconds can occur, with a movement occurring about once each minute. The extent of digestion and absorption of nutrients in the large intestine has not been studied closely.

29 The last foot of the large intestine, the rectum, is a modified storage organ for the fecal material. Upon accumulation of sufficient amounts, nervous stimulation triggers defecation. The anus is located at the termination of the digestive tract. It is made up of two sphincter and a retractor muscle, all of which are normally closed, except during defecation.

30 Studies of goats have indicated that it takes about 11-15 hours for



# DISEASES AND THE SHOWRING

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TI DISEASES AND THE SHOWRING

AU C. S. F. Williams; Michigan State U., East Lansing

RV S. B. Guss; Pennsylvania State U., University Park

DE Health and Disease Management

Text

1 Taking goats to a show is like taking children to nursery school; they are at risk to every disease available. As long as this is understood, the positive aspects of showing can be balanced against the negative aspects and a decision can be made to show goats or choose some other method of promotion.

2 Predisposing Causes of Disease (Stressors)

Protect animals during hauling from exposure to wind, rain, dust, excessive heat and cold. When traveling only a short distance to reach a show location, place compatible animals of a similar size together and allow enough space so they can help support each other while the vehicle is in motion. For long hauls, there should be lots of bedding and enough room to permit the goats to lie down. Open pick-up trucks, slatted horse trailers and campers with little ventilation offer differing but equal opportunities for stress on show animals.

3 To find out how stressful the ride is, try riding with the goats. If you are barely able to crawl out of the truck or trailer afterwards, do not be surprised if the goats don't show well or 'break' with some infection following the show.

4 Reducing Stress at Shows

Several factors may make showing less stressful:

1. Arrive at the show well ahead of time.

2. Be sure that a veterinarian has examined all animals entered and found them healthy.
3. Place animals in a clean, safe pen.
4. Provide plenty of familiar hay.
5. Make sure that animals have plenty of rest and quiet before they are brought into the show ring.
6. Do not overbag your doe so that her legs have to swing around her udder. At showtime, an udder should be filled to about the size and texture it reaches at peak lactation on twice daily milking.
7. Provide drinkable water - many goats refuse to drink chlorinated or other ''strange'' water at shows. Many who show goats bring from home a 10 gallon milkcan full of water to be sure their animals will drink enough. Sometimes, strange water can be made acceptable by adding a quarter cupfull of molasses or a tablespoonful of baking soda per three gallon bucket.

## 5 Individual Goat Stress

Goats vary in their ability to withstand the stress of being on the show circuit. Some goats appear to thrive on it and eat well, maintain production and manage to look good most of the time. These animals are very likely to be some of the most reliable producers at home as well. The goat that is easily upset on the show circuit, and needs a lot of individual attention, will probably not show well, neither will she produce to her potential in a large herd.

6 In many ways, showing results in the survival of the fittest. An aged doe, with good conformation and the constitution, both mental and physical, to survive the stresses of production and showing is a truly admirable animal.

## 7 Diseases

These can be divided into two groups. Firstly, there are those that occur during or immediately after a show, so there is little or no doubt as to where the disease came from. Secondly, there are the diseases which take a long time to develop and there is no reliable way of telling where they came from. You only know that goats have been in contact with goats from other herds and more disease problems are now present than you think are justified.

## 8 Acute Diseases

The most obvious epidemic disease in this category is soremouth, a virus disease capable of infecting humans. Sores and scabs appear on the gums, lips and nose, and occasionally around the teats, tail, eyelids and feet. Sheep also suffer from this disease, and since many



goats are housed in the sheep pens at fairs, it is possible for goats to acquire the disease by contact with scabs and virus on the pen walls. Handling of goats by judges and visitors will also spread the disease. Thorough examination of goats as they arrive at the show will not eliminate risk of this disease. A goat may have no lesions at all, when she arrives, but may be incubating the disease, and then the sores and scabs will appear on the lips a few days later. During this time, she has spread the virus to many other goats.

9 Pink-eye, or conjunctivitis, may be due to an injury if it only affects one eye of one goat. If it spreads from goat to goat, then it is an infectious conjunctivitis. Any pink-eye case will be aggravated by dust, flies and bright sunlight, and affected animals should be kept out of the sun and the wind with easy access to food and water.

10 Respiratory infections are very common after susceptible animals have been to a show, and the infection often spreads through the rest of the animals that did not go to the show, especially if there was no isolation of the returning goats. Goats will cough and have a nasal discharge. They may run a fever, be off-feed, and stand around, in a depressed state with drooping ears. There is no one specific infectious organism that causes this. Very likely there are several agents involved, similar to the shipping fever situation in cattle. After several shows and bouts of respiratory infection, most goats develop some resistance. After that, it is usually only the newcomers that will be affected. However, some animals may remain as chronic coughers, and these often relapse into pneumonia following stresses such as a sudden change in the weather.

11 If pseudorabies exists in the local hogs, then goats should not be housed near hogs, or transported in hog trucks to the fair.

12 Rotavirus infection has been reported to cause acute short-term diarrhea in show goats, but the prevalence of this virus in US goats is not known. Digestive upsets may occur at the fair, but this is usually due to erratic feeding schedules and strange food and water rather than any infectious disease. Mastitis may occur as a result of injury to the udder during transport or the stress of overbagging.

### 13 Long Term Diseases

It is highly unlikely that showing goats will expose them to any parasites that they did not have already. It is also highly unlikely that goats will contract tuberculosis or brucellosis because these diseases are extremely rare and subject to regulatory action.

14 The issue of abscesses and transmission via shows is controversial. The disease, caseous lymphadenitis, is caused by *Corynebacterium ovis* (pseudotuberculosis). These bacteria have been shown to be capable of causing an abscess in a goat, after being placed on the skin. Therefore, it is prudent to avoid contact with abscessed goats and



# DISEASE MANAGEMENT

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TI DISEASE MANAGEMENT

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DE Health and Disease Management

Text

1 It is important to recognize that the principles and problems associated with raising goat kids are no different from those of raising other farm animals. The beginner who is raising only a few animals in a place where kids have never been housed will experience fewer and simpler problems than the person who has been raising large numbers of kids in the same building for many years. It follows, that the system of management used in the early years of raising goats may not give the same results three or four years later, when the kid numbers have increased, and the pens have been in constant use. Pens should be cleaned, sanitized and left vacant for as long as possible between each batch of newborn kids. Raising kids outside in small portable pens or hutches has been useful in preventing kid losses due to diarrhea, pneumonia and some other diseases that have become a problem in long established goat herds.

2 Preparations Prior to Breeding

(1) Cull the problem goats before breeding. Does with chronic pneumonia and mastitis, disabling arthritis and poor body condition will not have kids with the best chance of living. These does will serve as a focus of infection for the rest of the herd and the next generation. Cull does who have a history of producing kids with problems. Cull poor producers and those with personality traits that make them a nuisance in the herd. Devote more time to your higher quality and best producing goats. The return on investment of time and money will be greater and efforts more satisfying than being burdened with work on a large number of lesser quality goats.

(2) Keep only as many does as can be fed and cared for properly. Undernourished goats in late pregnancy are likely to develop pregnancy toxemia, and may deliver kids with poor livability. Overnourished goats have a tendency to do the same thing. Pay attention to the condition of individual does.

(3) Check with a veterinarian regarding the iodine and selenium status of soils in the area. Goats in iodine deficient areas should have access to loose iodized salt at all times. If not, the kids will be born with goiters, may be born dead or die shortly after birth. In selenium deficient areas, it may be advisable to supplement the goats with selenium, in one or more of the following ways:

- a) use a trace mineral salt or a mineral mix fortified with selenium;
- b) inject the pregnant does with vitamin E plus selenium preparations;
- c) selenium can be incorporated into grain mixes such as calf starter and dairy concentrate;
- d) inject the young kids with vitamin E plus selenium preparations.

If the necessary supplements are not provided, the kids may die of acute muscle damage in the heart, or suffer from muscular weakness, may be especially susceptible to pneumonia or have difficulty sucking and may inhale milk. Selenium-vitamin E supplementation may prevent losses from various forms of white muscle disease in selenium deficient areas of the US. Selenium poisoning may occur in areas of the country where soil selenium levels are high, so it is important that you discuss with your veterinarian the need for selenium supplementation. Extra selenium may be vital, a waste of money, or toxic, depending on the area of the country.

### 3 Preparations Prior to Kidding

(1) Plan ahead and buy supplies like vaccine, nipples ++++MISSING DATA++++

(6) Kid pens should have three solid sides with the fourth side gated and open to the floor. This provides adequate air movement and yet prevents drafts. A design similar to a calf hutch, with an outside pen, is appropriate. Avoid wood preservatives and all lead-based painted surfaces because these may be toxic or irritating. Slotted floors with spaces not exceeding 3/8 inch wide may be used for hot weather pens for kids. Avoid construction methods that permit heads or legs to be caught in openings, thus causing broken legs or strangulation.

(7) Decide with the help of a veterinarian what the health program will be for the kids. Devise a record keeping system to make sure the program and plan is followed, which kids received which treatment and what needs to be done.

(8) There are various infectious goat diseases which may be controlled or reduced by removing baby kids from their dams at birth and raising them in facilities, separate from mature animals in the herd.

#### 4 Kid Care at Parturition

(1) The kid born during a normal parturition seldom needs human help to survive.

(2) Kids born during dystocias or difficult birth may need help. The most important thing is to clear the mucus out of the mouth and start the kid breathing. Poke a straw up the nose to provoke sneezing. Pinch hard on the skin between the toes or on the ears or the tail. This will usually make a kid scream and in order to scream, it must breathe first. A kid which is not breathing well, will not inflate its lungs properly and will be a candidate for pneumonia.

(3) The umbilical cord may be trimmed to about one inch long and then dipped in tincture of iodine. This will control infections such as bacterial arthritis (joint-ill) and septicemia, caused by bacteria entering via the cord.

(4) Be sure the kid gets colostrum early. Hand milking the doe and bottle feeding the kid is the most certain method of insuring a known intake. Colostrum contains antibodies which gives the kid temporary protection against diseases to which the doe was subjected. Feed colostrum as quickly as the kid will nurse to gain the greatest benefit from antibodies. Save extra colostrum for later feeding. Freeze several ice cube trays of colostrum and store the cubes in a plastic bag in the freezer. If a fresh doe is ill with mastitis or has no milk, it's easy to thaw several cubes and warm them to body temperature in order to give the newborn kid its first feeding of colostrum. If there is no goat colostrum available, use day-one cow colostrum, pay extra attention to sanitation, and raise the kid away from other goats, until it is several weeks old and is better able to resist infection.

#### 5 Kid Care Till Weaning

(1) Dirty milk bottles, dirty nipples and erratic feeding schedules will cause digestive scours. Baby kids may be successfully fed with a pan and it's easier to clean them than a bottle. A lamb bar may be a labor saver and use of cold milk in the lamb bar can prevent kids from drinking too much milk at one time. Nursing the mother is a time honored method and often used, especially after the first couple of

hand feedings with colostrum. The choice of rearing method depends on the owner's preference.

(2) To control pneumonia, ventilate the barn so that there is never any smell of ammonia and that means down at floor level where the kid has to breathe, not 5 feet up in the air where you breathe. If moisture condenses on the ceiling in winter, insulate the ceiling and ventilate more. Young kids are much healthier in a cold, dry environment than they are in a warm, damp, smelly one. It makes no sense to let kids out in the fresh air in the daytime and then lock them in a smelly barn overnight.

(3) Restrict contact of kids with adult goats, other goat raisers, and especially newly purchased kids. New arrivals and any goats that have left your premises and are returning, should go into quarantine for at least two weeks.

## 6 Some Disease and Parasite Problems and Control Procedures

Tetanus -- This occurs infrequently but is very distressing to both the owner and the goat. Occasionally, it follows disbudding and is more likely to occur with rubber band castration, than any other method. If the risk is considered to be high, then kids should receive 150 units of tetanus antitoxin at the time of disbudding and castration. This will give temporary protection. For complete protection, vaccinate the kids with 2 doses of tetanus toxoid starting three weeks after the initial dose of the tetanus antitoxin.

7 Ear Mites -- Ear mites are quite common in kids if the adults are infected. When they scratch their ears and shake their heads at an early age, they should be examined and treated with a miticide. The infected ears often show a scaly, grayish material in the ear canal. The mites can be seen easily when the material is examined with a magnifying glass on a piece of black cloth.

8 Lice -- When kids scratch and rub themselves, they should be examined carefully for lice. All goats should be checked periodically, especially in late winter. Blood sucking lice are large and easy to see because they don't travel much. Biting lice are tiny and straw colored; they may cause intense itching. When it is necessary to treat any animal in the herd for lice, all animals including baby kids and the bucks should be included.

9 Worms -- Bottle or pan fed kids raised in isolation rarely become infected with worms prior to weaning. However, kids allowed to run with their dams may become infected. Clinical signs include: weakness, unthriftiness, anemia (gums and membranes under eyelids are pale), chronic constipation or diarrhea by the time they are two to three months old.

10 Coccidia are single-celled parasites that live and multiply in the



# ECONOMICS OF DAIRY GOATS

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TI ECONOMICS OF DAIRY GOATS

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DE The Goat Industry

Text

1 There are few goat dairies in the United States that are operated as a commercial enterprise capable of generating enough income to be self-sustaining. Most often the goat enterprise is considered a supplemental source of both income and food. Information compiled by USDA on goats enrolled in official production testing programs (DHIA) (DHIR) indicates that in 1980, 670 of the herds had less than 10 milking does, 23 had between 10 and 20 milking does and herds numbering more than 50 milking does were but 20 of the total.

2 Market

Most of the milk produced is consumed at home. Some dairies close to housing developments have been successful in building a juggling business while a smaller number have ventured into pasteurizing, processing and packaging fluid milk, cheese, yogurt and ice cream for distribution to retail sales outlets including health food stores. The number of commercial processors available to which raw milk may be shipped is indeed small. Building or finding a market for goat milk is truly one of the major economic factors to consider if herd size and production is designed to exceed home use needs.

3 State Requirements

In order to produce milk and sell it legally to a wholesaler, most states require dairy goat milk producers to meet the same requirements demanded of dairy cow milk producers. This includes housing for the



animals which would be acceptable from the standpoint of drainage, cleanability, light and ventilation. Milking parlor areas must be constructed so that all floors, stalls, walls, ceilings and feeding facilities are cleanable daily with water under adequate pressure. This mandates that all surfaces in the milking parlor, including the milking equipment, must be made of stainless steel, glass, plastic or washable painted surface which is classified 'acceptable' under FDA-state approved standards.

4 Most milk regulatory agencies require that milk be held in cans or stainless steel bulk tanks at a temperature under 40 F. They also require regular inspection by an approved dairy sanitarian at specified intervals.

5 A discussion of economics of goat keeping may not be a practical consideration for those owners who produce milk for home use and who make up a majority of the dairy goat industry. If it is viewed as an exercise to produce food for the table, a husbandry-hobby pastime; a desire and/or need for goat milk in place of cow milk, then economics may be of secondary or little importance.

#### 6 Milk Producing Potential

The average production of does on DHIA test in the United States is nearly 1650 lbs of milk per year. That's about 4.5 pounds of milk for each day in the year or just a taste more than two quarts per doe per day. Nature says that fresh does give the greatest amount of milk so production may range from a high of 12 or 14 pounds per day down to zero at the time the doe dries off. Some does may produce between 3000 and 4000 pounds per year while others may produce closer to 500 pounds. Therefore the economics of a goat herd depends on the milk producing potential of the animals. If milk can be sold for 85 cents per quart via a jug sales outlet at the farm or home and 45 cents per quart to a commercial milk processor one can easily calculate the gross income from milk by multiplying quarts sold times price received per quart.

#### 7 Sale of Stock

A second source of income may be realized from sale of kids not needed for herd replacement purposes. Most breeders believe that registered animals and milk production records are an essential part of a successful animal merchandising program. Sell a kid at three days of age for \$30; a cull doe for \$50; a grade milking doe for dairy purposes at \$150 and a registered doe for \$250 or more; a grade kid at 3 months of age for \$65 or if registered for \$100 and one can add gross income from all sources contributing to the positive side of the enterprise ledger.

#### 8 The Home Dairy

Costs are much more complicated to calculate. How fancy do you plan to make the goat dairy? A couple milking does and their offspring can be housed in a small shed that may be of no value except to house the

animals. As long as it is clean and dry with plenty of light and fresh air the housing is solved. Does can be milked on a milking stand in one corner and no one is concerned. A milk bucket, milk strainer, some feeding and watering utensils, a means to cool the milk (an ice water bath works great, followed by the household refrigerator for storing milk), then add a fork, shovel, and broom and you're in business.

#### 9 The Commercial Dairy

However, if plans are to go public with milk sales or sell to a commercial processor and build the herd to 50 or 100 or more milking does then the subject of cost economics changes greatly. Now the thoughts turn to major construction of barns to reduce labor needed to feed the animals and clean out the manure and refuse. Hay and straw storage buildings are needed and if the forages are produced on the farm either purchase and upkeep costs of tillage and crop harvesting equipment or lease of same is necessary. Let's add a milking barn or parlor, a milkhouse, bulk tank, washing equipment, perhaps a milking machine or pipeline milker, electricity, water, detergents and many other items too numerous to mention.

10 If the decision is to go big and invest in buildings and machinery and truly be a commercial goat dairy, the production level in the milking herd and gross income becomes terribly important. Now, there is interest to pay, mortgage principal to pay, equipment repair costs, veterinary care and the many cost features not of real concern to the owner of one to ten milking does. There is no relevancy to a discussion of economics when considering these two extremes. The best advice on economics is to enter your appropriate level of goat husbandry with open eyes.

11 At any size of herd there are a number of management practices that will affect greatly the economic outlook of profit perhaps more so than the building and equipment.

#### 12 Breed Early

Growing young stock to enable breeding at 7 months of age reduces the number of nonproducing animals in the herd at any one time and increases total lifetime milk produced. Animals that are big enough to freshen at 12 months of age but stand around another six to ten months in a non-milking state because the owner doesn't believe in early breeding are costly, nonproduction units in a herd.

#### 13 Single Breed

Keep one breed of goats. This decision greatly increases genetic improvement potential, especially in a small herd of 20 or fewer does, and reduces the needs for keeping one or two bucks for each breed selected.

#### 14 Cull Does

Keep only the number of milking does needed for milk demands. To

permit the milking herd to multiply because you have become attached to certain animals and cannot bear to sell or cull is often a costly practice. Low producers who fail to put milk on the table or extra does who produce more milk than is needed for the table or for sale should be moved out of the herd.

#### 15 Sell Kids

Sell kids not needed for herd replacements or for sale as breeding stock. If this decision can be made at 1 to 3 days following birth, the extra colostrum can be fed to kids being raised, you have more herd milk for the table or for sale plus fewer growing costs, vet bills and less labor. A day old kid may sell for \$30 at the local market. You may feed it milk, grain and hay until 90 days old and sell it at that same market for \$60. Costs far exceed the extra sale income.

#### 16 Low Mortality

Keep kid mortality low. A good sanitation program, feeding regime and clean, dry housing is usually all that is required. High mortality reduces animals available for sale and often necessitates the purchase of mature animals to keep milking herd numbers at a desired level.

#### 17 Use Extra Milk

Try selling extra goat milk during flush production periods rather than feeding it to a pig or veal calf. An option is to learn to make cheese that can be stored and aged to provide food during those 'dry' months. Try freezing some of the extra milk. Wasting precious milk is a fairly common practice.

#### 18 Correct Feeding

Avoid overfeeding and underfeeding of grain. Underfeeding especially during periods of high production, greatly reduces milk production potential for the lactation. Overfeeding can cause excess fat to be laid down in the udder and reproductive tract thus reducing breeding performance and milk production potential. Both extremes are obviously costly practices. Buy a grain mix formulated for a ruminant.

#### 19 Prevent Feed Waste

Build hay mangers that prevent wasting of hay, especially the precious leaves from clovers and alfalfa. Goats are notorious forage wasters.

#### 20 Year-round Milk

A milk market is better served if breeding practices in the herd encourage freshening the does over as wide a time span as possible. This is especially valuable during base building periods and as an aid to providing the customer with a year-round source of milk.

#### 21 Keep Records

The selling price of does and their offspring is enhanced if those animals are registered and parentage is documented, and if high milk

records are documented through a DHIA testing program.

## 22 Use a Processor

If a commercial processor is available it is usually more economical to sell the milk to the plant or to employ that service to process and package under your label. Quality control in milk and milk products for the novice is a difficult art and science to master and cost of processing equipment is beyond imagination.

## 23

Those points are not listed in priority order; neither are they the sole factors to consider. However, if the goat enthusiast is to have a chance at a profitable economical enterprise, his or her management abilities must be positively accounted for in addition to the cost of brick, mortar, concrete and stainless steel, feed and animals.

## 24 Budget

In the foreseeable future a small herd of 5 to 10 high-producing registered does will produce an adequate quantity of nutritious milk to supply several neighborhood families. The income from sale of milk will pay for the out-of-pocket costs to feed and care for the animals and extra income can be realized from sale of breeding stock to other dairy goat enthusiasts.

## 25

Those who plan to produce goat milk for sale off the farmstead should make as accurate a budget of cost and income as is possible. Overestimate the costs and underestimate income on your first attempt and refine it later. Have a realistic plan at the time you approach the lending agency. At the same time be working with the milk regulatory agency and, if applicable, the milk plant where the milk will be received. It's better to answer their questions before any concrete is poured or nail driven. If marketing is to be done by the ownerproducer, be sure you have more than a verbal contract with the prospective buyer (hospital, health food store, etc.) and knowledge of the specific quantity they will purchase. If stock must be purchased make every effort to assure that it is disease-free. Work with the Cooperative Extension Service in your county to set up an adequate record keeping system both for milk and cash flow and discuss production and management details. If it's a farm you are purchasing, check soil maps, drainage and crop production potential. Finally, be a lover of animals with an appreciation for working 365 days a year. Goats are lovable, affectionate creatures, easily handled and intelligent but they depend on the owner-caretaker for constant and complete care every day in the year.

## 26

An understanding of the economics of goat dairying demands a mixture of personal goals, philosophical outlook, cash income and expense, a labor of love, a willingness to learn and change, enthusiasm and decision making abilities. To consider goat dairying from purely an economical viewpoint is to miss the essence of life. To embark on the project with no consideration of cash flow will lead eventually to



# ENTEROTOXEMIA

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TI ENTEROTOXEMIA

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DE Health and Disease Management

Text

- 1 Enterotoxemia is one of the very important diseases and in some areas it is the most prevalent disease of goats. Despite the fact that it is also called "Overeating Disease" it is not caused by overeating. Actually, the cause (etiology) of the disease is the toxin (poison) produced by the bacterium *Clostridium perfringens* type C or type D.
- 2 The bacteria are normally present in the soil and the intestinal tract in relatively small numbers. Under certain conditions the organisms proliferate (reproduce billions of their own kind) in the intestine and produce toxin in lethal quantities. These conditions are those which (1) provide an ideal environment and food for bacterial proliferation and (2) slow down the normal movement of material through the intestinal tract; they are often satisfied by ingesting large amounts of starch when the intestinal tract is not accustomed to it. The disease is often associated with lush fast growing pasture or cereal crops, heavy grain feeding or access to a lot of milk. Illnesses which slow down the intestinal tract, may predispose to the accumulation of dangerous quantities of the toxin.
- 3 Most of our knowledge about the disease comes from sheep. There are some important differences in purpose and manner of raising (management systems) that exist between sheep and goats that should be kept in mind when one reads and applies sheep information on goats. First, the disease usually occurs in single (rarely in twins) lambs of a high milk producing ewe; all the milk is consumed by that lamb. In contrast,

most goat births are twins, triplets or quadruplets and in the best caprine management systems, the kids are removed from their mother soon after birth. Thus, the type of birth is no factor in goats. Second, dairy kids are seldom fed large amounts of high energy diets for meat production and therefore do not have the same opportunity (unless accidentally or by mismanagement) of exposure to grain. Finally, goats are natural browsers (eat from bushes and trees with their head reaching out or up); they do graze but do not consume as much lush feed (usually in a pasture) as rapidly as sheep. Summarizing, the well understood predisposing factors in the sheep disease are not strictly applicable to goats.

4 The predominant predisposing factors in goats have to do with sudden exposure to grain or large increases in quantity of milk consumed without gradually increasing the amount over several days. This leads to indigestion with slowing of the intestinal tract. This probably plays a large role in the disease in goats by allowing more time for toxin to accumulate within the intestinal tract.

5 The Type D infection is probably far more common than Type C. The latter type produces a toxin called 'Beta Toxin' which causes intestinal necrosis and severe intestinal hemorrhage. It occurs in adult goats.

6 Epsilon toxin is produced by the Type D bacteria. It produces vascular damage and increases the permeability (openness) facilitating its own absorption. In the animals that die with neither signs nor tissue changes, an extremely large amount of toxin was absorbed very rapidly. When less toxin is produced, the animal lives longer and there is more time for clinical signs and pathological changes to develop.

## 7 Signs

In the Peracute disease course, a baby kid may be found dead with no signs or lesions. It may occur after consuming excess feed or after sudden access to highly palatable feed or after prolonged hunger and a normal quantity of feed.

8 The Acute course of disease lasts 4-26 hours and usually ends in death. Initially the temperature may go to 105F with severe abdominal pain (the kid cries so loudly it is best described as screaming). Profuse slimy or water diarrhea will occur. Depression, wobbly gait, recumbancy (lying down on side often with head down) occur early. Convulsions often occur intermittently and may be accompanied by continuous or intermittent opisthotonos (head thrown straight over back). The animal may slip into a coma before death or die groaning or even crying. These signs occur in kids but can occur in adult milking goats from either Type C or D bacteria.

9 The Subacute disease is more apt to occur in older kids and adults.

They may be ill for several days or weeks and show anorexia (refusal to eat) and intermittent severe diarrhea occasionally with epithelial shreds in the feces. They will occasionally eat and with time and appropriate treatment, they will usually recover.

10 The Chronic form is characterized by intermittent illness lasting several weeks. The goat (usually an adult) will have a dull, stary look, loose feces, an irregular appetite and, if a milker, drop in production.

#### 11 Tissue Changes

Type C is associated with acute hemorrhagic inflammation and necrosis of the mucosa of the omasum and small intestine.

12 Type D causes mild to moderate (occasionally severe) inflammation and even hemorrhage of the small intestinal mucosa. Petechial hemorrhages may be present anywhere in the body but especially on the epicardium and endocardium. The pericardial sac may contain slight excess of yellow fluid. Microscopic examination of the brain may reveal degeneration of the vascular endothelium with perivascular and intercellular edema with foci of necrosis in several subcortical areas.

#### 13 Diagnosis

The diagnosis of 'enterotoxemia' in goats is probably overdone and is sometimes used to lump any sudden death or acute intestinal disease. The peracute and acute signs are helpful but can also occur with acute salmonellosis or intestinal torsion. Individual or first cases of salmonellosis would probably be diagnosed by post mortem bacteriological examination but if a herd problem exists the history, signs and lesions would justify a presumptive diagnosis. Intestinal torsion is an individual and uncommon event and would rarely be diagnosed ante mortem.

14 Subacute or chronic cases could resemble coccidiosis, salmonellosis, rumen impaction. Fecal examination, culture and smears would aid in diagnosis of the first two and abdominal palpation, the latter.

15 The petechial hemorrhages, especially on the epicardium should make one think of enterotoxemia. However, one should look for at least two other signs which together give good presumptive evidence of enterotoxemia; these are, glucosuria and the presence of many short, plump gram positive rods on an intestinal smear.

16 Ante mortem diagnosis is made early if one can demonstrate a distinct, though transient, improvement of signs after the intravenous injection of 40-100 ml of Type C and D Cl. perfringens antitoxin.

17 Definitive diagnosis, however, can only be made in the laboratory. Intestinal contents should be preserved by adding 1 ml of chloroform to 10 ml of contents which have been collected in glass within 12 hours





# ESTRUS SYNCHRONIZATION AND EMBRYO TRANSFER

COLLECTION: GOAT HANDBOOK

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Extension Goat Handbook

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TI ESTRUS SYNCHRONIZATION AND EMBRYO TRANSFER

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DE Genetics and Reproduction

Text

1 In temperate climates, most goats are seasonally polyestrous. They exhibit cyclic heats during the fall months, under the influence of decreasing day length. Sometime between January and March, as days lengthen, the typical goat enters into a period of anestrus. The physiological differences between the breeding and the anestrus seasons necessitate the use of different techniques for the control of estrus during each time period.

2 Reasons for Synchronizing Estrus

During the breeding season, estrus synchronization permits the efficient use of artificial insemination and of a trained technician. Owners with full time jobs can schedule breedings, artificial or natural, for weekends or vacation periods. In herds or animals where heat detection is difficult, goats may be successfully bred even though they cannot be found in heat. Does may be bred to kid at a certain time, for instance to take advantage of the Easter market for sale of buck kids. Five months after synchronized breeding, parturitions will be closely grouped or can be further synchronized by the use of hormone injections. Additional advantages are the simplification of kid rearing and the control of diseases such as bacterial scours and coccidiosis afforded by an all in, all out, kid raising program. Finally, estrus synchronization is an important tool for embryo transfer procedures.

3 Outside the normal breeding season, synchronization has additional advantages. It permits the breeding of does to freshen in the fall, thereby assuring a supply of milk when most of the herd is dry. In areas with a demand for goat milk, there may be an economic incentive in the form of higher prices paid for winter milk.

4 An alternative to synchronization that permits breeding during the spring months is the use of lights. If goats are kept under long days (16-20 hours) for several months (for instance, January and February) and then returned to ambient day length, many will exhibit fertile cycles during the next few months. If natural breeding is to be used, it is imperative that the buck also be subjected to the controlled lighting. This is not a synchronization technique, as the induced estrus periods will be somewhat randomly spaced.

#### 5 Methods of Synchronization

Does to be synchronized should be placed on a high energy diet 2 to 4 weeks before breeding is desired. Anthelmintics, if needed, also should be administered in advance. In general, best results will be obtained with normally fertile does for which the most recent parturition was without complications. Polled animals with both parents polled should be examined first before commencing with synchronization to eliminate intersexes and sterile animals. Polled animals with masculinized anatomy, masculine behavior, or a total absence of estrus periods prior to synchronization are poor candidates for synchronization and the probability of successful breeding is greatly reduced.

#### 6 The Buck

One of the simplest means of synchronization is the sudden introduction of a buck or his odor early in the fall. It has been shown that many does will come into estrus approximately 8 to 10 days later. If a teaser buck is first introduced and then replaced after 3 weeks by a fertile male, reasonably good synchronization and an increased ovulation rate will be achieved on the second cycle. If does are already cycling, the synchronization effect will be largely lost.

#### 7 Vaginal Sponges

In France, synchronization of goats is commonly obtained by the use of intravaginal sponges. They are available commercially abroad and are impregnated with 45 mg of fluorogestone acetate. Sponges with less hormone (marketed for sheep) give lower conception rates. The sponge is coated with an antibiotic powder or ointment and is placed deep in the vagina for 17 to 21 days. The string designed for removal of the sponge should be cut short unless each goat is housed separately. When the sponge is removed, it will be covered with a purulent exudate, but this exudate does not interfere with conception and no further treatment is necessary.

8 Hormone injections are used to stimulate follicular development when the sponge is removed. Pregnant mare serum gonadotrophin (PMSG) is preferred but is often hard to obtain in the United States. It is

available from Francea (as are the sponges), but a permit from the USDAb is required for importation of the hormone and may be impossible to obtain. The dose of PMSG used depends on the age of the goat, the current milk production, and the season of the year. In dairy breeds, fertility is poor during the first 4 months after parturition. Adults for AI giving more than 8 pounds of milk a day receive 700 IU of PMSG during the period from March 15 to June 14, 600 IU from June 15 to September 14, and 500 IU during the fall breeding season. Does milking less heavily receive 100 IU less during each time period, as do adults that are to be serviced naturally. Overdosing results in superovulation and potential abortion due to uterine crowding. Doelings receive 400 IU of PMSG during all seasons, but it is important that these animals weigh at least 77 lbs (European breeds) before hormonal treatment is attempted.

9 During the anestrous season, the PMSG is administered 48 hours before sponge removal. During the breeding season, this treatment is given simultaneously with sponge removal. The goats are generally in heat 12 to 36 hours after sponge removal, and are bred within 48 hours. If fixed time insemination is to be used, 2 breedings at 31 and 55 hours or 36 and 60 hours have been recommended.

10 Limited trials have been performed substituting follicle stimulating hormone (FSH) for the PMSG, using 2 doses of 2 mg each at 12 hour intervals. The FSH appears to be less effective than PMSG.

#### 11 Progesterone Treatments

A removable subcutaneous implant containing progesterone or other progestogen in silastic tubing can be substituted for the vaginal sponge. This technique avoids vaginal infections as well as the rare occurrence of adhesions preventing sponge removal, particularly in doelings. Another technique involves the subcutaneous or intramuscular administration of progesterone in oil, 20 mg every other day for 18 days. Where it is available, the oral use of 6-methyl-17-acetoxy-progesterone (MAP) at 50 mg/day for 15 to 20 days is yet another option. With all these products, PMSG will improve fertility.

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12 ++++MISSING DATA++++

13 The donor doe is anesthetized 3 to 5 days after mating, using halothane or barbiturates. A midventral or flank laparotomy incision permits flushing of the oviducts and uterine horns for the recovery of fertilized eggs. Approximately 10 ml of tissue culture medium 199 with



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TI FEEDING

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DE Nutrition

Text

- 1 Goats are good browsers and can selectively utilize a wide variety of shrubs, woody plants, weeds, and briars. If you allow the goats to roam the woods, be sure that there is no wild cherry, hemlock, azaleas, or species of laurel family nearby because these plants are poisonous. While such grazing simplifies management, it can result in bad eating habits.
- 2 Does enjoy browsing, but they cannot produce much milk without hay or pasture plus grain. Yearlings, dry does, and even low producers, however, may get enough nutrients from browsing to satisfy their minimal needs.
- 3 Feed Choices  
Pasture -- Often the lowest cost feed available is pasture. It does not have to be harvested, stored, and fed out if grazing is permitted. You can economize by relying heavily on pasture during the summer months. The best pasture for goats consists of alfalfa-bromegrass or a mixture of clover and timothy. Pastures will yield their most when they are limed, fertilized and clipped on a routine basis. Small herd owners very likely will not have the equipment to develop good pastures. When limited pastures are available, they are often overstocked and overgrazed, which kill off the pasture and encourage

the growth of weeds. When circumstances do not permit extensive pasture management, an effort should be made to rotate animals to other pasture lots if they are available. If not, pasture feeding should be appropriately supplemented with other feeds such as greenchop, root crops, or wet brewery grains.

4 Pasture has some limitations. Bloat is a constant concern with pastures heavy in alfalfa, particularly in early spring and fall. The quality of pasture changes with each passing day. The energy level drops between 0.5 and 0.75 megacalories per hundred pounds of dry matter per day. The water content of lush pasture is so high that it cannot support high levels of milk production.

5 Because of these fluctuations in nutrient content, it is always good management to provide grazing goats free access to hay while they are on pasture. It will offer some protection against bloat and provide a source of feed to compensate for the decline of nutrients in the pasture.

6 Management tips for goats on pastures:

1. Provide easy access to shade and water.
2. Have available salt and a mineral mix or offer a mix of equal parts trace mineral salt and dicalcium phosphate.
3. Rotate animals among pastures where possible. This permits pastures to rejuvenate and also tends to break the cycle of internal parasites.
4. Provide ready access to hay.
5. During early spring pastures, be alert to possible cases of bloat and grass tetany.

7 Dry Forages -- Aside from brush lands and pasture, another low-cost feed for goats is good quality legume hay, such as alfalfa or clover, even when heavily mixed with bromegrass, orchard grass, or timothy. Legumes are favored over grasses because they are much higher in protein and in a variety of minerals.

8 The nutrient composition of forages can be determined by analysis in a forage-testing laboratory. Your county agricultural agent can help you select a laboratory. A visual examination can yield considerable information about hay quality such as:

1. Earlier cutting date indicates more digestible nutrients.
2. More leaves provide more protein and minerals.

3. Lack of seed heads indicates early cutting.
4. Coarse stems suggest late cutting while crushed stems indicate early removal from the field, and thus less damage.
5. Foreign material (weeds or tree leaves) mean reduced feed value.
6. Green color indicates presence of vitamin A.

9 The date of harvest is the most important single factor affecting feed consumption and quality. As the stage of maturity changes, there is a marked effect on the protein content.

10 As the protein content decreases over this period, the fiber content increases from about 27 percent to approximately 38 percent. When this occurs, the digestible energy values not only decline but the crop is less palatable so that animals consume less.

11 Silages, Haylages, and Root Crops -- Silages and haylages have never been used extensively as feeds for goats. This is due more to management problems than to any limitations in the nutritional or feeding value of the crops. A small herd of goats would have to be associated with a cattle operation to have enough volume to justify using silages and haylages as a practical feed.

12 Because silage contains only about 30 to 35 percent dry matter, 2-1/2 to 3 pounds are needed to replace one pound of hay. Only about 2 pounds of haylage are needed to replace one pound of hay. Normally, silage should be limited to the replacement of only 1/3 of the hay - about 1-1/2 to 2 pounds of silage daily for a mature goat. Young goats should not be fed silage until their rumen is functional (6-8 weeks after birth); otherwise digestive disturbances and scouring may result.

13 Even mature goats should be allowed a period of adjustment when silage is incorporated into the ration. Gradual increases in the amount of silage will prevent any digestive disturbances.

14 Goats are quite fond of root crops and garden products. These types of feeds can be effectively incorporated in the ration for a change of routine. Carrots, beets, turnips, and cabbage are especially relished by goats. These types of feeds are high in moisture and should be fed in the same manner as silage. Several of these feeds, such as turnips, can create off-flavors in milk, if fed too closely to milking time. A general rule of thumb is to avoid offering feeds which impart flavors to milk within 3 hours of milking time. It is better to offer these feeds after milking.

15 Feeding Additives -- There is some evidence that antibiotics and other drugs can increase growth rate and feed efficiency when added to the rations of diseased animals. However, improved performance has not



been demonstrated in disease-free animals. Dairy goat owners would do well to use only feed additives commonly available for dairy cows and to avoid those for which extravagant claims are made.

16 There is no research to show that dairy goats require any vitamins, minerals, 'organic' health food additives, or medications that are not required for milking dairy cows. Indiscriminate use of such highly touted materials can be expensive and can do more harm than good.

17 Concentrates -- The cereal grains are excellent sources of energy. Corn, oats, barley, and wheat frequently form the foundation of concentrate mixes for goats. Beet or citrus pulp is especially valuable in the ration when the hay is poor and fibrous.

18 Grains should not be fed whole or most of them will go straight through the animal. They should be rolled, crimped, cracked, or flaked. This will improve digestibility and taste. They should be free of mold and have very few fine particles.

19 Concentrate mixtures for goats should include pellets containing linseed meal, soybean meal, or dried brewers grains. No supplemental calcium is needed for alfalfa-fed herds, but add 1.0 percent trace mineralized salt and 0.75 percent monosodium or monoammonium phosphate. If grass hay is being fed, then the mineral supplement could be one percent dicalcium phosphate in place of the monosodium phosphate.

20 When a protein supplement is needed, a commercial supplement containing other nutrients in addition to protein may be preferable to one of the meals. This could either be fed separately or mixed with grains available on the farm. Be sure it does not contain urea to avoid problems with palatability. These commercial supplements also contain minerals, so additional minerals may not be needed.

21 Molasses, an excellent energy source, is commonly used to reduce the dustiness of feed and to increase palatability. If too much molasses is included in the ration, the feed becomes sticky and the digestibility of other ingredients is reduced. For these reasons, molasses is usually limited to 5 to 10 percent of the concentrate mixture.

22 Premium-quality dairy cow feeds can usually be fed to dairy goats satisfactorily. Occasionally commercial cow feeds contain by-product ingredients that are not palatable to goats, but this is rarely a problem.

23 Horse feeds should be avoided. Most have too much molasses, excessive amounts of fiber, excessive calcium for alfalfa-fed goats, and few have enough protein for milking does.

24 Kids

While there are several ways of raising kids, one of the most

popular is to take the kids away from the does immediately, before they begin to suckle. Then put the colostrum milk in a bottle with a nipple and encourage the kids to drink from this.

- 25 Colostrum -- Colostrum is the first milk produced. It contains higher levels of total protein, milk solids, globulins, fat, and vitamin A than normal milk. It is also laxative. Most important, colostrum contains antibodies against diseases to which the doe has immunity. Young kids are able to absorb this antibody protection effectively at birth, but by the time they are three days old, this ability will almost disappear. The newborn kid should receive fresh warm colostrum before it is 15 minutes old, if possible, to give maximum protection. During the first two days of life, kids should receive at least three colostrum feedings per day. A kid will consume about 1-1/2 to 2 pints daily.
- 26 As soon as the kids are strong and can drink milk easily, they can be fed from a pan or pail. Cow's milk may be substituted for goat's milk after the kid is a few days old. This sometimes reduces the cost. Make the change gradually over a period of several days. Excellent growth and health can be achieved by feeding kids one of the high-quality milk replacers currently available. Because of varying formulations, care should be taken to follow the manufacturer's directions. The milk or milk replacers should be heated to about 100F. Twice-a-day feeding of milk is adequate and no more than 3 pounds should be fed.
- 27 Weaning -- As young kids approach weaning age - three to four months gradually add warm water to their milk diet. This will provide them with the necessary fluids for rumen development and ease the stress of weaning them. After the kids are weaned from the milk, feed them all the bright green forage they will eat, plus 3/4 to 1 pound of any good dairy calf-starter ration.
- 28 Feeding grain and forage -- Young kids will not consume much solid food at first, but small amounts of a starter feed can be placed in front of them during the first week. A mixture of equal parts of cracked corn, crushed oats, wheat bran, and about 10 percent soybean meal can be used. Early consumption can be encouraged by putting some of the grain in the milk. Hay can also be offered at this time, but it should be the finest hay available. Early forage consumption will lead to early rumen development and will thus permit early weaning.
- 29 To develop prime herd replacements with a chance for good milk production, good eating habits must be established. Browse feeding is not necessary. Such feed is often very fibrous, woody, and low in energy. Train a goat to eat a ''domesticated'' ration of hay, pasture, and grain from the early days of life. If treated to woods and weeds from birth, kids will not break such habits easily.

## 30 Yearlings

In feeding young animals, the object is to provide enough nourishment for body maintenance and growth. Too much feed causes animals to fatten which could lead to difficulties in breeding. After 4 to 6 months of age animals should have good pasture - if available, high-quality hay and a place to exercise. A 1/2 pound of grain per day should lead to ample growth. If the forage is poor, animals may require 1 to 1-1/2 pounds of grain daily. Yearlings can be fed the same grain mix that is fed to the milking herd. Low-quality forages should be supplemented with a 12 to 14 percent protein grain mixture. Free access to water, if located away from the manager, will encourage exercise. A mixture of equal parts of trace mineralized salt and dicalcium phosphate is suitable for free-choice feeding.

## 31 Dry Does

Dairy goats should be given a 4-to 6 week dry period prior to kidding. The unborn kid develops 70 percent of its weight during these last 6 weeks of pregnancy. It is important that a balanced diet be fed. Unborn kids grow rapidly and need protein, calcium, and phosphorus for muscle and bone development. A steady diet of scant pasture and poor hay could produce weak or dead kids, or ones that die shortly after birth.

## 32 The dry period is a good time to rejuvenate the ruminant system.

Good pasture will maintain a doe at this time, with only mineral supplementation needed (salt and dicalcium phosphate should be available). In the absence of pasture, a mixture of good alfalfa and grass hay can be used. Alfalfa contains too much calcium in relation to phosphorus to be used as the sole forage for pregnant does. If the doe is under weight, 1/2 to 1-1/2 pounds of grain might be fed daily. The grain should contain 12 percent protein if alfalfa hay is fed or 16 percent protein if grass is the major forage. Does should be kept in good flesh but not fat.

## 33 A few days before freshening, cut the grain feeding in half and replace it with wheat bran. This is a good source of protein and phosphorus. The laxative effect of the bran will help clean out the digestive tract.

## 34 Milking Does

The nutritional demands upon the lactating does are tremendous. It is essentially impossible for the doe to consume enough to meet the demands for body maintenance and milk production during the first few months of lactation. She must draw upon her body reserves to balance the nutrients consumed.

## 35 To meet the needs of the lactating doe as closely as possible, it is necessary to feed the best quality legume hay or green forage available. The quantity of hay may have to be limited to 3 pounds to encourage the consumption of a maximum amount of grain. The grain



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# FEET AND LEGS

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TI FEET AND LEGS

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DE Anatomy and Physiology

@TX

Structure

Feet of goats are pair-hoofed (ungulates) as in other members of the zoological order of artiodactyla. The fore-knee of goats is called the carpus joint, resembling the wrist of people. Below it follows the cannon or metacarpus bone (people's hand bones) while above are, in vertical alignment, the radius and ulna bones (lower arm), almost totally fused into one. This is the extent of the visible part of the foreleg of goats while the part resembling the upper arm of people above the elbow, the humerus bone, is not a free appendage in goats, similar to sheep, cattle or horses, for example. Yet, the humerus must be tightly attached to the ribcage so to provide the goat with maximum support. A loose attachment gives the appearance of 'wing shoulders', i.e. a visible distance between elbow and body proper, resulting in weakness and fatigue on standing and thus shortened feed intake and reduced milk production.

Text

1 The bones of the goat's hindleg (pelvic limb) are similar to those of the foreleg (thoracic limb) in a number of details. The invisible upper hindleg bone is called femur ending in the knee joint called 'stifle' which is also not free from the body proper. Then follow the fused tibia and fibula bones into the hock joint or tarsus. Below it is the cannon or metatarsus bone. As in the case of the foreleg, it is very important for productive goats to have the hindlegs in overall perpendicularly vertical alignment with the legs parallel flat to the body and strongly attached. Evidence to this desirable condition is that the legs are not 'sickle hocked', not walking 'under the belly', the forelegs are not 'buckled' in the knees, and the feet

are not toeing in or out.

2 The feet of goats, as in sheep and cattle resemble fingers and toes of people. The third and fourth fingers or toes, called digits of goats, are fully developed, while the second and fifth are vestigial. The digits consists of three phalanx bones, in line each, starting from the cannon bones, metacarpus or metatarsus, respectively, and are externally marked by the fetlocks or dewclaws. The phalanges are placed ideally at a 45 angle to the cannon bones, for optimum support of the goat. This is known as 'correct pasterns'. They should not be 'post-legged' which is too straight, nor 'bear-pawed' which is a weak pastern.

3 The hoofs of goats are derived from the skin, along with hair, horns and claws. The horny material that covers the end of each digit is also referred to as the claw of goats as on other artiodactyls such as deer, sheep and cows. The claw is composed of three basic segments: wall, sole and periople.

4 The wall of the claw is the part that is visible when the foot stands flat on the ground. The inner area of the wall, the sole, is made up of closely spaced plates of horn (lamellae). The horny lamellae fit into the sensitive lamellae that are produced by the connective tissue (corium). Both the sensitive and the horny lamellae have secondary fibers (laminae) on their surfaces which interlock among themselves. It is in this area that the nutrition of the wall of the hoof take place.

5 The actual growth of the claw begins at the coronet border region, the uppermost area of the external foot, just at the hairline of the leg. The outer part of the coronet is covered by a brown layer of horn, the periople. The horn grows out from the coronet. The wall of the foot joins the sole by a type of horn that is both lighter and softer textured than the rest of the horn. This white line is known as the zona lamellata. The periople is fairly extensive in goats, covering not only around the top of the claw, but also the entire surface of the heel, blending in with the sole. There is no clearly visible breaking point between the periople and the sole of the foot.

## 6 Foot Care

Foot care in goats is a fairly simple matter that one can readily learn, although a conscientious effort must be made in order to insure that the required work is done on a regular and consistent basis. Many foot and leg problems that goats develop are either directly or indirectly caused by a lack of or improper trimming techniques.

7 The amount of time between trimmings depends on several factors, such as the type of ground on which the goats walk, their age and level of activity. Generally, foot trimming should be done at least every three months, although once every 6 weeks may be considered ideal and should be the goal of the goat herd owner. All goats in the herd, including kids that are over two months of age should be trimmed

regularly. To allow more than 3 months between trimmings is an invitation for the development of chronic leg problems, especially in the pastern area, because the toes are getting too long and the vertical alignment of the legs and the proper angularity of the feet are changed.

8 It is always easier to trim feet after the goats have been outside in the wet grass of a dew laden or rain soaked pasture, as the moisture is taken in by the hoof walls, making them softer and easier to trim. There are also commercial preparations that may be used to harden or soften the hoof if one feels that this is necessary.

9 The essential tools for the trimming job are relatively few, with the best items a set of hoof shears and hoof knives, both with a sharp edge; a rasp, some iodine, turpentine, copper sulfate, formalin and gloves.

10 There are several ways of holding or restraining a goat in order to care for her feet, the best method being whichever works well in a particular situation. One method is to place the goat on a milking stand, perhaps offering a little grain or hay for a cooperative attitude. One may best work from the side of the goat on which she used to be milked. Doing first the front, then the back feet reduces the goat's fright and resistance. The front feet can be done by drawing the leg straight out in front of the goat or by bending it at the knee so that the foot is brought back under the goat. The hind feet may also be extended straight back, away from the goat or picked up and lifted under the belly for trimming. One advantage of working off of a milkstand is that the trimmer does not have to bend over in order to get the job done. He may even sit down. In this way, the milkstand can be a real back saver, which indirectly helps the regularity of the hoof care and the health of the goats.

11 Another method is to merely tie or have someone hold the goat while the feet are being done from the ground, in the same fashion as a farrier works on a horse.

12 Another method involves placing the goat between one's legs in the same position used for shearing sheep; that is, the animal is in an upright sitting position. This method has the advantage that if the trimmer must work alone without the aid of a milkstand, he still can restrain goats better than when they are tied somewhere but do not like to stand still.

13 The first step in trimming is to clean off the foot, so that it will be free of dirt, stones, rot and manure. Besides being easier to see and more pleasant to handle, a clean foot will not dull a knife's edge as fast as a dirty foot. The next step is to remove any rim or excess growth from the walls of the foot. The wall may have grown and folded back under the foot, in which case first some of the toe will have to be cut back so that the rim of the wall can be removed properly. The trimming of the wall and toe should be done with the







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TI FENCING

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DE Management and Housing

Text

1 There are many different types of fencing at a great variance in initial cost. The selection of a specific type for a certain size or sex of dairy goat, can be very important.

2 For large pasture areas in which the mature milking herd resides, the less expensive 48" high sheep and cattle fencing ++++MISSING DATA++++

3 Stock Panels

Another very durable fence in areas of high stress or to confine strong bucks is the stock (or hog) panels. They come in 52 inch heights, 16 feet long, with the horizontal stay rods 3 inches apart at the top. The vertical rods are 6 inches apart. These panels are more costly but they will outlast all fencing.

4 Picket Fence

There are other types of fencing on the market. The following, may be less suitable: The single or double picket lawn fence is a heavy-duty fence that withstands weather (rusting out, etc.) for a greater number of years than the sheep and cattle fence; but the staywires on it are not as tight and goats soon learn that they can play with the fence and get it to slip, eventually making holes in it that they can simply walk through.

5 Snow Fence

The wooden picket (snow) fence, although probably the cheapest in

cost, should not be used unless for a temporary situation. Dairy goats eat right through it in a matter of a few months.

#### 6 Welded Fence

The one-inch by two-inch spot-welded fence has a tendency to loosen at the spot welds quite fast and therefore is not recommended.

#### 7 Electric Fence

The electric fence with the use of one or more strands of electrified wire has been used successfully by some dairy goat breeders, but each animal must be introduced to the shock.

8 Although this fencing may work to confine the introduced dairy goats, protection against stray predators and dogs may be minimal. Fencing serves two purposes, first, to keep dairy goats where you want them and, second, to protect them from predators.

9 Four strands of electric fence, the second from the bottom preferable being a barbed wire, seems most effective. The bottom wire should be about six inches off the ground, just high enough to clear the power lawn mower under the fence. Tall grasses must be cut to prevent shortening-out of the electric fence. An average charge unit is usually best, but it must be well grounded in moist ground six to eight feet deep. Barbed wire can be used as goat fence if many strands not too far apart (6-10 inches) are used, very tightly strung on 6 feet high posts. However, if there is attractive pasture on the other side of the fence and the goats especially kids are hungry, then they will squeeze through, especially under the bottom wire.

#### 10 Turkey Wire

Just plain turkey wire makes good fence but again it must be tight and the posts no more than 10 feet apart.

11 The best fence from an animal behavior standpoint can be found e.g. at Laurelwood Acres in California. It consists of vertical pipes with horizontal and bottom pipes, posts and bottom edge in concrete. Certainly not cheap but very effective for dry-lot operations, long lasting, easy to maintain, and easy to run the herd back and forth to the milking parlor. In the absence of horizontal strands, goats have nothing to climb on.

12 When installing fencing, it is necessary to brace the corner posts either by wires to stays on the outside or by posts placed diagonally on the inside, or embedding the corner post in enough concrete to keep it from moving as the result of the tension of the wire.

#### 13 Gates

Gates can be varied in size. Large aluminum or steel gates are good to use in areas where a vehicle such as a truck or tractor needs to pass through. Smaller gates can be chainlink or woven wire. In areas



# FIRST AID KIT

COLLECTION: GOAT HANDBOOK

ORIGIN: United States

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Extension Goat Handbook

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NO G-2

TI FIRST AID KIT

AU S. B. Guss; Pennsylvania State U. University Park

RV D. L. Ace; Pennsylvania State U., University Park

DE Health and Disease Management

Text

- 1 A small tight cupboard hung on an inside wall of the goat barn makes an ideal location for storage of a few instruments, emergency medication, routine medication and first aid supplies. The cupboard should be placed high enough to be beyond the reach of small children and it should have good latches to keep it securely closed.
- 2 The purpose of a medicine cupboard or cabinet should not be for "do it yourself" veterinary medicine. Rather, it should be used with your veterinarian's approval and counsel to do routine things and emergency things in his absence.
- 3 Talk over the following list of requirements with your veterinarian and resolve to keep your herd in top health condition. Experience with the medical problems peculiar to your herd will help both of you to be better prepared to do the best possible job of disease prevention and emergency medical care.
- 4 Necessary supplies stored in your cabinet should include:

## 5 INSTRUMENTS

A fifteen inch piece of 3/4 inch diameter pipe which can be used as a speculum for giving medication by mouth.

A four foot long section of 1/2 inch rubber or plastic tubing for use as a stomach tube. This can be passed through the 3/4 inch pipe

which is held in the mouth as far back as the rear molars. The stomach tube can be gently passed beyond it as the animal swallows. The speculum is a good means of holding the head steadily in a natural position.

A small funnel can be used for pouring the medication into the tube.

A good hoof shear for trimming feet (a Burdizzo hoof shear) should be hung on the wall or inside the cabinet door.

A ''caulking gun'' dose syringe for dosing goats with Thibendazole or other wormer paste should also be placed in that location.

A curved serrated scissors for use in removing extra teats should also be hung nearby.

An electric clipper, such as that commonly used for grooming dogs, plus at least one extra blade should be kept in its box on a shelf in the cupboard.

An open hoof groover at least 3/8 inch wide should be placed with the clippers, speculum, tube and hoof shears. It will be useful for cutting out excessive growth from foot soles and for removing foreign bodies from soles of the feet.

The tattooing equipment and necessary numerals and ink for using it should be placed on this shelf.

## 6 MEDICAL SUPPLIES

A half pound roll of absorbent cotton, several rolls of 1 inch adhesive tape and a dozen 4 x 4 inch sterile gauze pads should be kept together in a small carton on a shelf in the cupboard.

Several 10 ml glass hypodermic syringes should be sterilized by boiling ten minutes and stored in a sterilized dry fruit jar on a shelf.

At least a half dozen 18 gauge 1 inch sterile hypodermic needles should be kept in the fruit jar covered by their protective plastic tips. These, of course, are used for various subcutaneous or intramuscular hypodermic injections.

## 7 MEDICATIONS

Liquid medicines necessary should be put together in one location:

An eight ounce bottle of 2Tincture of Iodine and a small baby food jar with a cover should be placed together for use in disinfecting navels of newborn kids.







# FITTING AND SHOWING

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NO B-9

TI FITTING AND SHOWING

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DE Management and Housing

Text

1 Why Show?

Dairy goat shows can be interesting and educational, and goat owners enjoy the opportunity to compete with their animals. Although showing involves a great deal of time, energy, and extra stress on the animals, there are many positive aspects to attending shows as an exhibitor or a spectator.

2 Dairy goat shows can be a good learning experience. Many people show to get an opinion of their animals from a judge who is objective and experienced in appraising conformation. Listening to the judges' reasons for making placings helps in learning about your animals. Acting as a ringside 'judge' and comparing your placings and reasons with those of the show judge helps develop your eye for desirable type.

3 People enjoy being competitive with their animals. Competition against other breeders helps you learn how to select animals and present them at their best. If the animals do well at the show, owners gain confidence in their animal husbandry skills and an increased awareness of the relative worth of their animals.

4 Showing is a favorite activity of 4-H members with dairy goat projects because it is a good way to determine progress they are making as animal breeders. Showing also helps develop sportsmanship, management skills, the ability to display an animal to its best advantage, and an appreciation of good livestock.

5 Goat shows are fun socially and provide a good opportunity to meet other breeders and visit with friends. Exhibiting your goats at shows is good advertisement for your herd and can lead directly to sales, either at the show or in the future.

6 Dairy goat shows are also an effective way to promote dairy goats and the use of goat products because the show animals are groomed and look their best, and breeders are available to answer questions for show visitors with a developing interest in goats.

### 7 Getting Ready

There are many things that need to be done once you decide to enter a goat show. The better prepared that you are, the more you will enjoy the show.

8 The first thing is to decide which of your animals to show. Be selective about the animals. Look for animals in your herd that are correct in conformation and in good condition, neither too fat nor too thin. Strong, healthy animals will be more competitive, better able to withstand the stress of travel and the show, and not be a source of health problems for other goats attending the show.

9 Read the show rules, fill out the entry form completely, and send it to the specified person on time. If you have questions about the show, contact the show secretary. It is a good idea to keep a copy of your show entry so that you have a record of the animals entered and their classes. Check the health rules for the show and work with your veterinarian to make sure that you meet the rules.

10 Take some time before to review the parts of the goat and become familiar with the dairy goat scorecard. The judge's placings and reasons at the show will be more meaningful if you are aware of the point differences defined by the scorecard.

### 11 Fitting

Goat shows are far more relaxed if your animals are groomed and ready to go when you get to the show. Otherwise, you may end up rushing at the show stables trying to get your animals clipped and their feet trimmed with probably hasty results. There is always some last minute bathing and grooming but it helps if the time-consuming portions of the job had been done at home.

12 Hooves should be trimmed a few days before the show. Goats can be clipped from a few days up to 2 to 3 weeks before a show. A number 10 blade is commonly used for clipping the body, while a shorter blade (number 20 or even number 40) can be used on the udder. The entire body can be clipped, with the clippers running against the hair, including whiskers, beard, and hair inside the ears and around the tops of the hooves. The hair on the tail is squared off below the last bone in the tail, leaving a triangular tuft of hair at the end of the tail. It is

easier, and usually safer, to clip the udder when it is full of milk.

- 13 Bathing goats with a mild shampoo before clipping them helps keep clipper blades sharp. Goats should be rebathed and rinsed well after clipping to remove loose hair and dandruff. Newly clipped goats, especially those with light skin, are apt to sunburn and should be provided with shade or a lightweight coat until the hair grows out a little and the skin becomes less sensitive. Newly clipped goats are also sensitive to draft and chills and need to be covered while not in the show ring.
- 14 Practicing with your goats at home can result in better behaving animals in the ring and increased confidence on your part. Animals should be accustomed to being handled by strangers, especially having someone else's hand move over their neck, withers, back and sides, and udder so that they will stand still when being examined by the judge.
- 15 Chain collars are usually preferred for showing, although narrow leather collars are also used. Collars should fit correctly, so that you can control your animal's movements in the ring. It is ideal to work with your animals ahead of time until they lead readily and respond quickly to signals. They should move forward with a slight pull on the collar and stop when you pull slightly up and back. Getting your animals used to wearing a collar and teaching them to lead and be tolerant of strangers is important with young stock, because they can often be stubborn about learning show manners.
- 16 Horned goats cannot be shown, and goats with large ++++MISSING DATA++++
- 17 Feed and Bedding
- Some shows will have a supply of hay and straw for sale. Check ahead of time to see whether such will be available before you decide to bring your own. Some exhibitors prefer their own hay, so their animals will not have a change in diet. You need:
- hay
  - straw
  - grain
  - hay feeders
  - grain feeders
  - water buckets
  - bottles and nipples (if you are taking kids)
  - salt or trace minerals
- 18 Equipment -- After you have attended a few shows, you will know what equipment is useful, including:
- clippers (for last touchups)
  - hoof trimmers

- extra collars
- tie ropes
- livestock shampoo
- short hose (for bathing)
- wash bucket
- towels (to dry animals)
- clean cloths (for last cleanups)
- brushes
- portable milking stand
- paper towels
- udder wash
- teat dip
- milk pail
- goat coats (for the young, and chilly times)
- first aid items, antibiotics,
- disinfectants, bandages, flyspray)
- herd signs (above your pens)
- pitchfork
- rake
- broom
- pliers
- hammer and nails
- scissors
- staple gun
- extension cord

19 Personal items -- Many exhibitors prefer to spend the night in the barn with their animals. Personal items that may be needed include:

- cot
- sleeping bag
- pillow
- folding chair
- clean clothes
- show whites
- toilet articles
- flashlight
- snacks and food
- equipment for cooking

20 What to do at the Show

Goats should be unloaded and settled into pens with bedding, feed, and water as soon as they arrive at the show, especially if they have been travelling very far or the weather is unpleasant. Once your animals are bedded down, you can take your registration and health papers and check in with the show secretary; unless the show rules require health checks before unloading. There are usually copies of the show program available that contain the schedule of classes and special instructions. Your goats have to be checked prior to the start of the show by the show veterinarian. He has the authority of dismissing

animals from the show if they are sick or appear to be potential health problems for other exhibitor's animals.

- 21 Extra space should be available adjacent to your animals for your equipment and feed. Exhibitors are responsible for care of their animals throughout the show, including clean bedding, feed, and fresh water, as needed. It usually takes goats a while to settle down into the show routine, especially if they have not been shown before. Walking your goats around the ring before the show starts helps them feel more relaxed when it is time for their class.
- 22 Your goats may need to be bathed at the show prior to their classes, even if they were bathed earlier at home. Bathing should be done during the warm part of the day, followed by a thorough drying, to prevent added stress from chilling. If the weather is cold or unpleasant, goats can be brushed and spot cleaned with a damp rag, instead of bathing. Most goats will benefit from a final touchup cleaning with a damp cloth just prior to being shown. This is a good time to double check areas that are hard to keep clean, such as hooves, inside the ears, around the eyes and nose, and under the tail.
- 23 Showing  
In some shows there is a preset milk-out time, usually 12 hours before the show starts, so that all does are shown at the same length of time after milking. If not, show your animals with the amount of milk in the udder that looks the best. Letting the udder overfill can weaken udder attachments, stress milk-producing tissue, make it difficult for the judge to determine udder texture, and usually lowers your show placing.
- 24 Exhibitors should wear appropriate white clothes to show their animals, such as clean jeans or slacks and a white shirt or blouse. Goats should be brought to the ringside a few minutes before start of their class, so that you are ready to enter the ring as soon as the class is called. You will need to know the birth date of each of your animals in the ring, the freshening date and number of lactations for milkers.
- 25 Watching the class ahead of yours will give you an idea of the judge's procedure and preferred method of lining up animals. When it is your turn to enter the ring, lead slowly and gracefully in a clockwise direction. Leave about 3 feet between your goat and that of other exhibitors when walking around the ring; and about 2 feet between animals when lined up head to tail or side by side. Stay attentive to the judge but, at the same time, be aware of your goat and what she is doing.
- 26 Keep your goat between you and the judge at all times. If you need to change sides, move around the goat's head and change hands on the collar. Keep the collar high on the goat's neck, holding it in your

hand at the top of the neck, just behind the ears. This gives you better control over the animal's movements and keeps her head up high enough so that she has an attractive carriage.

- 27 After the goats have walked around the ring a few times, the judge will ask the exhibitors to form a line with their animals, usually side by side. When you set your goat up in line, pose her with her feet squarely under her body and her hind feet slightly spread. It is usually easiest to set up the hind feet first. You can move the back feet where you want them by pressing back on the opposite shoulder or by picking up the leg between the hock and pastern and setting it down in the desired position.
- 28 Once you have your goat well placed, let her be. Keep your hands off your animal as much as possible when she is set up, so that you will not draw the judge's attention away from your animal to you. Talking quietly to your goat or lightly rubbing her belly or side nearest you keeps her alert and contented. Some exhibitors prefer to squat beside their goat while they are waiting in line. However, do not kneel with your knees on the ground, and be sure to stand up when the judge approaches your animal.
- 29 Be ready to restrain your goat if necessary while the judge examines her. This can be done in two ways: (1) put your knee in front of her shoulder so she can't move forward; and (2) grasp a front leg between the knee and the pastern and flex the leg back against the chest.
- 30 If the judge asks you to change places in the ring, lead your goat forward out of the line, up or down the line to the place indicated, and back through the line, making a U-turn to get back into position. Do not back your goat into a different position unless the distance is short.
- 31 Watch the judge closely, and respond quickly when the judge indicates the placings in the final line up. Be aware of show procedures; first and second place winners in each class are usually expected to remain at ringside to compete for champion. In ADGA-sanctioned shows, the judge will check tattoos and the show secretary will check registration papers for all breed champions before they leave the ring.
- 32 Conformation of the animal is not considered in showmanship classes; only how well the animal is prepared and shown. The secret of good showmanship is to control your animal in such a manner that the judge sees her at her best but never notices you. Showmanship classes help teach poise, courtesy, and the ability to stay calm, even under pressure. They give exhibitors an opportunity to show how well they can prepare and exhibit goats. They also encourage good husbandry; animals that can be successfully groomed to look as good as possible for

a show are those that are well fed and cared for, in good health, and generally of good type.

33 In showmanship classes, the judge looks for exhibitors that recognize the conformation weaknesses of their animals and show them effectively to overcome those weaknesses. Exhibitors are usually asked by the judge to trade animals so that the judge can see how well they handle strange animals.

#### 34 Guidelines

Although every show is different, the following will make shows more enjoyable and worthwhile:

- Cooperate with the show officials to the best of your ability.
- Learn the rules of the show and follow them.
- Keep your pens and animals neat and clean at all times.
- Be prepared and willing to answer questions from show visitors about your goats and goats in general.
- Handle your goats with dignity, pride, and gentleness, both inside and outside of the show ring.
- Stay calm with troublesome animals; abusiveness is uncalled for.
- Be courteous to the other exhibitors and the judge.
- Restrict conversation in the ring except to respond to the judge or show officials.
- Respond quickly to requests from the judge, ring steward, and other show officials.
- Be gracious about accepting the judge's opinion.
- Show your animals the whole time you are in the ring, until the judge has given his reasons and the class has been dismissed.
- If you have questions about the judging, wait until after the show is over to talk to the judge.
- Smile and enjoy yourself -- it's part of showmanship.
- Remember that placings at a show are one judge's opinion of how a certain group of animals compare with each other on a certain day. Placings of the same animals can be quite different under a different judge or at a different time, especially with nonmilking stock.



## 35 TABLE 1. ADGA Dairy Goat Showmanship Score Card

Based on Usual Order of Consideration

## 1. APPEARANCE OF ANIMAL 40

Condition and Thriftiness - showing normal growth - neither too fat nor too thin. 10

Hair clean and properly groomed. Hoofs trimmed and shaped to enable animal to walk and stand naturally. 10

Neatly disbudded if the animal is not naturally hornless. Clipping - entire body if weather has permitted, showing allowance to get a neat coat of hair by show time; neatly trimmed tail and ears. 10

Cleanliness - as shown by a clean body as free from stains as possible, with special attention to legs, feet, tail area, nose, and ears. 10

## 2. APPEARANCE OF EXHIBITOR

Clothes and person neat and clean - white costume preferred. 10

## 3. SHOWING ANIMAL IN THE RING

Leading - enter, leading the animal at a normal walk around the ring in a clockwise direction, walking on the left side, holding the collar with the right hand. Exhibitor should walk as normally and inconspicuously as possible. Goat should lead readily and respond quickly. Lead equipment should consist of a collar or small link chain, properly fitted. As the judge studies the animal, the preferred method of leading is to walk alongside on the side away from the judge. Lead slowly with animal's head held high enough for impressive style, attractive carriage, and graceful walk. 10

Pose and show an animal so it is between the exhibitor and the judge as much as possible. Avoid exaggerated positions, such as crossing behind the goat. Stand or kneel where both judge and animal may be observed. Pose animal with front feet squarely beneath and hind feet slightly spread. Where possible, face animal upgrade with her front feet on a slight incline. Neither crowd other exhibitors nor leave too much space when leading into a side-by-side position. When judge changes placing, lead animal forward out of line, down or up to the place directed then back through the line, finally making a U-turn to get into position. To step animal ahead - use slight pull on collar. If the animal steps badly out of place, return her to position by leading her forward and making a circle back thru your position in the line. When judge is observing the animal, if she moves out of position, replace her as quickly and inconspicuously as possible. Be

natural. Overshowing, undue fussing, and maneuvering are objectionable.  
15

Show animal to best advantage, recognizing the conformation faults of the animal you are leading and striving to help overcome them. 15

Poise, alertness, and courteous attitude are all desired in the show ring. Showmen should keep an eye on their animals and be aware of the position of the judge at all times - but should not stare at the judge. Persons or things outside the ring should not distract the attention of the showmen. Respond rapidly to requests from judges or officials, and be courteous and sportsman like at all times, respecting the rights of other exhibitors. The best showmen will show the animals at all times - not themselves - and will continue exhibiting well until the entire class has been placed, the judge has given his reasons, and he has dismissed the class. 15

TOTAL 100

Suggested Uniform: Long-sleeved white shirt, regulation white pants, 4-H or FFA necktie, 4-H or FFA cap (if applicable), with matching shoes and belt in either black, white, or brown.

### 36 TABLE 2. ADGA Dairy Goat Score Card for DOES

(Ideals of type and breed characteristics must be considered in using this card.)

Based on Order of Observation

#### 1. GENERAL APPEARANCE 30

Attractive individuality revealing vigor; femininity with a harmonious blending and correlation of parts; impressive style and attractive carriage; graceful walk.

#### \*Breed Characteristics 5

Color, size, nose structure and ears appropriate for breed.

#### \*Head 5

Medium in length, clean-cut; broad muzzle with large, open nostrils; lean, strong jaw; full, bright eyes; forehead broad between the eyes

#### \*Shoulder Blades and Topline 8

Shoulder blades - set smoothly against the chest wall and withers, forming neat junction with the body.

Back - strong and appearing straight with vertebrae well defined.

Loin - broad, strong, and nearly level.

Rump - long, wide and nearly level.

Hips - wide, level with back.

Thurls - wide apart.

Pin bones - wide apart, lower than hips, well defined.

Tail head - slightly above and neatly set between pin bones.

\*Legs and Feet 12

Legs - wide apart, squarely set, clean-cut and strong with forelegs straight.

Hind legs - nearly perpendicular from hock to pastern. When viewed from behind, legs wide apart and nearly straight. Bone flat and flinty; tendons well defined. Pasterns of medium length, strong and springy. Hocks are cleanly moulded.

Feet - short and straight, with deep heel and level sole.

2. DAIRY CHARACTER 20

Animation, angularity, general openness, and freedom from excess tissue, giving due regard to period of lactation.

Neck - long and lean, blending smoothly into shoulders and brisket, clean-cut throat.

Withers - well defined and wedge-shaped with the dorsal process of the vertebrae rising slightly above the shoulder blades.

Ribs - wide apart; rib bone wide, flat, and long.

Flank - deep, arched, and refined.

Thighs - incurving to flat from the side; apart when viewed from the rear, providing sufficient room for the udder and its attachments.

Skin - fine textured, loose, and pliable. Hair fine.

3. BODY CAPACITY 20

Relatively large in proportion to size of the animal, providing ample digestive capacity, strength, and vigor.

Barrel - deep, strongly supported; ribs wide apart and well sprung; depth and width tending to increase toward rear of barrel. 12

Heart girth - large, resulting from long, well-sprung foreribs; wide chest floor between the front legs, and fullness at the point of elbow. 8

4. MAMMARY SYSTEM 30

A capacious, strongly attached, well-carried udder of good quality, indicating heavy production and a long period of usefulness.

Udder; Capacity and Shape - long, wide, and capacious; extended well forward; strongly attached. 10

Rear attachment - high and wide. Halves evenly balanced and symmetrical. 5

Fore attachment - carried well forward, tightly attached without pocket, blending smoothly into body. 6

Texture - soft, pliable, and elastic; free of scar tissue; well collapsed after milking. 5

Teats - uniform, of convenient length and size, cylindrical in shape, free from obstructions, well apart, squarely and properly placed, easy to milk. 4

TOTAL 100

\*Note: 5 points for Breed Characteristics and Head as taught at Training Conference.

37 TABLE 3. ADGA Dairy Goat Score Card for BUCKS

1. GENERAL APPEARANCE 45

Attractive individuality revealing vigor, masculinity with a harmonious blending and correlation of parts; impressive style and majestic carriage; graceful and powerful walk.

Breed Characteristics 10

Color, size, nose structure and ears appropriate for breed.

Head 5

Medium in length, clean-cut; broad muzzle with large, open nostrils; lean, strong jaw; full, bright eyes; forehead broad between the eyes.

Shoulder Blades and Topline 12

Shoulder blades - set smoothly against the chest wall and withers, forming neat junction with the body.

Back - strong and appearing straight with vertebrae well defined.

Loin - broad, strong and nearly level.

Rump - long, wide nearly level.

Hips - Wide, level with back.

Thurls - wide apart.

Pin bones - wide apart, lower than hips, well defined.

Tail head - slightly above and neatly set between pin bones.

Tail - symmetrical with body.

Legs 18

Wide apart, squarely set, clean-cut and strong with forelegs straight.

Hind legs - nearly perpendicular from hock to pastern. When viewed from behind legs wide apart and nearly straight. Bone strong, flat and flinty; tendons well defined. Pasterns of medium length, strong and springy. Hocks cleanly moulded.

Feet - short and straight, with deep heel and level sole.

## 2. DAIRY CHARACTER 30

Animation, angularity, general openness, and freedom from excess tissue.

Neck - medium length, strong and blending smoothly into shoulders and brisket.

Withers - well defined and wedge shaped with the dorsal process of the vertebrae rising slightly above the shoulder blades.

Ribs - wide apart, rib bone wide, flat and long.

Flank - deep, arched and refined.

Thighs - incurving to flat from the side; apart when viewed from rear.

Skin - fine textured, loose and pliable. Hair fine.

## 3. BODY CAPACITY 25

Relatively large in proportion to size of the animal, providing ample digestive capacity, strength and vigor.

Barrel 10

Deep, strongly supported; ribs wide apart and well sprung; depth and width tending to increase toward rear of barrel.

Heart girth 12

Large, resulting from long, well-sprung foreribs; wide chest floor between the front legs, and fullness at the point of elbow.

TOTAL 100

## 38 TABLE 4. Evaluation of Defects

	GENERAL	BREED SPECIFICS
Slight	1. Broken or wry tail	
Slight to serious depending on degree	1. Undershot or overshot jaw 2. Close in the hocks 3. Front, rear or side udder attachment lacking 4. Separation between halves of udder 5. Presence of scar tissue 6. Udder of beefy texture 7. Udder with pocket	
Moderate	1. Large scurs or stubs 2. Enlarged knees; non-disabling lameness 3. Swollen hocks 4. Turned-out or crooked	NUBIAN Mature does less than - Min. height (30 in) Min. weight (135 lbs) Straight face

feet	
5. Teats that are:	SAANEN
a. Set close together	Mature does less than -
b. Bulbous	Min. height (30 in)
c. Extremely large or small	Min. weight (135 lbs)
d. Pointed sideways	TOGGENBURG
e. Uneven in size	Mature does less than -
f. Having small streams or otherwise hard to milk	Min. height (26 in)
	Min. weight (120 lbs)
g. Not clearly separated from the udder	Few small white spots in hair of does
	AMERICAN LAMANCHA
	Mature does less than -
	Min. height (28 in)
	Min. weight (130 lbs)
	FRENCH ALPINE
	Mature does less than -
	Min. height (30 in)
	Min. weight (135 lbs)
	Does with Toggenburg color and marking
	Does - all white color

39 Table 4. Evaluation of Defects (contd.)

	GENERAL	BREED SPECIFICS
Moderate to serious Depending on degree	1. Loose, winged or heavy shoulders	AMERICAN LAMANCHA Roman nose
	2. Narrow chest or pinched heart girth	FRENCH ALPINE
	3. Short, shallow or narrow body	Roman nose
	4. Low-backed or steep-rumped	SAANEN Roman nose
	5. Small-boned for body size	
	6. Bowed-over front knees or, buck-knees	TOGGENBURG Roman nose
	7. Hind legs close together	
	8. Sprung pasterns	
	9. Postiness	
	10. Swollen stifle joints (All of these more serious in bucks)	
Serious	1. Natural horns (neatly disbudded or dehorned -	FRENCH ALPINE Bucks with Toggenburg

no discrimination)	color and markings
2. Udder	Bucks - all white color
a. Pendulous	
b. Too distended to determine texture	SAANEN
c. Hard or swollen (except in does just fresh)	1. Dark cream color
d. So uneven that one half is less than half the size of the other	2. Several small dark spots in hair
3. Leaking orifice	TOGGENBURG
4. Misplaced orifice	1. Black color in does
	2. White stomach (except British Toggenburgs) on does
	3. Large white spot (1-1/2" or more in any direction) on does
	4. Few small white spots in hair of bucks

40 Table 4. Evaluation of Defects (contd.)

	GENERAL	BREED SPECIFICS
Very serious	1. Udder lacking in size and capacity in relation to size of doe	NUBIAN
	2. Double orifice in teat of doe	1. Dished face
	3. Extra teat or teat(s) that have been cut off on does	2. Barely drooping ears
	4. Crooked face on does	
	5. Very crooked or malformed feet	
Disqualifications	1. Total blindness	AMERICAN LAMANCHA
	2. Serious emaciation	1. Anything other than gopher ears on bucks
	3. Permanent lameness or difficulty in walking	2. Ears other than true LaMancha type on does
	4. Blind or nonfunctioning half or udder	
	5. Blind teat	FRENCH ALPINE
	6. Double teat(s)	1. Pendulous ears
	7. Extra teat(s) that interfere with milking	NUBIAN
	8. Active mastitis or any other cause of abnormal milk	1. Upright ears
	9. Evidence of hermaphrod-	SAANEN
		1. Large (1 1/2"





# GENETICS OF MILK AND TYPE

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NO D-1

TI GENETICS OF MILK AND TYPE

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RV D. Van Vleck; Cornell U., Ithaca, NY.

DE Genetics and Reproduction

Text

1 There have been few genetic studies on dairy goats. The principles of their genetic improvement should differ little, however, from other farm animals. Most of the genetic data available on economic traits pertain to milk and fat yields and fat percentage. They indicate differences between animals within and between breeds that can be utilized for breed improvement.

2 Breed Comparisons

The six recognized breeds of dairy goats in the United States are the Alpine, LaMancha, Nubian, Oberhasli, Saanen, and Toggenburg. According to the records of the national Dairy Herd Improvement program (DHI), production averages during 1968 to 1978 were similar for Saanen, Alpine, and Toggenburg 305-day lactations, but LaMancha and Nubian had lower milk yields in that order. Average fat percentages in Alpine, Saanen, and Toggenburg milk were also similar. The Nubian had the highest fat percentage in milk. The higher yielding breeds had lower fat contents in their milk and vice-versa. Thus, the breeds did not differ greatly in total yield of fat, but Nubian, despite their low milk yield, had the highest yield of milk fat. Oberhasli are a more recently recognized breed in the United States and insufficient records exist for breed comparison. They are expected to resemble the other Swiss breeds in milk and fat production. The average production figures in Table 1 cover a 10-year period, and little change in milk or fat production in any of the breeds seems to have occurred during that period.

3 The breed comparisons are national averages, but regional differences exist. For example, Toggenburg in the North Central and Northeast regions have higher milk and fat yields than Alpine and Saanen, but in the West, Toggenburg have lower fat yields than other breeds. The possible reasons in climate or management are not certain.

4 There is little published information on breed comparisons for body type traits. Alpine, Nubian and Saanen have similar minimum height and weight standards; LaMancha are less and Toggenburg are smallest. Considering that the average milk yield of Toggenburg does is similar to the other breeds, it is likely that Toggenburg have a high dairy merit efficiency in terms of milk yield per unit of body weight or per unit of metabolic weight ( $W^{0.75}$ ).

5 The six breeds differ in physical characteristics, particularly with respect to ear shape and face profile. Alpine, Oberhasli, and Toggenburg are of Swiss origin and have ears of medium length that are held in an upright position. LaMancha ears are externally almost absent with a 'gopher' rudiment considered ideal. Nubian are of Asian-African origin and have long, pendulous ears. They also are characterized by a less lean body condition and a distinctly convex face profile or 'Roman' nose. The Swiss breeds have either flat or dish-shaped face profiles.

#### 6 Inheritance of Production and Type Traits

The inheritance of milk production and most body type traits is complex. Unlike some physical traits that are simply inherited (qualitative traits) and are controlled by a few genes (for example, coat color and the presence of horns), milk production and body type traits are under the control of many genes (quantitative traits), perhaps a thousand or more. Although the individual influence of each of these genes may be small, their collective influence can be great.

7 Production and type traits also are affected by environmental factors such as feeding, management, and disease and in most cases their influence is greater than inheritance. However, this does not mean that genetic selection is not effective for improving many of these traits. Environmental influences, however, can mask genetic differences when selecting between animals, and the genetic constitution of an animal cannot be determined with certainty by physical observations or by test matings as is the case with some simply inherited qualitative traits. One cannot be sure if above or below average performance of an individual goat is due to genotype or environment. Accordingly, parents may not 'breed true' for production and type traits, and more likely will have wide variations in their offspring. Each kid receives only a sample half of each parent's genes, which by chance can be above or below average. Furthermore, each kid can be subjected to different environmental conditions.

#### 8 Environment Corrections

Environmental influences can be controlled and corrected to permit more accurate identification of genetic differences between individual goats. Major environmental factors include level of herd management, year, age, season, parity of kidding, length of lactation, dry period and previous lactation.

9 Milk production records are expressed as deviations from the herd average (including herd level adjustments) to remove the influence of herd management and to facilitate comparisons between does from different herds. Most differences between herds for average milk production are due to feeding, housing, diseases, etc. Probably 10 to 20% of the differences in production between herds are due to genetics. The remainder is due to environment.

10 One difficulty with deviations from herdmate averages arises from the small herds in which goats usually are kept. A herdmate average based on few records is less reliable than one from large numbers of herdmates. Production records vary from herd to herd, and from year to year. Therefore, they are expressed as deviations from average production of contemporaries in the same herd and year. Such herd-year deviated records facilitate genetic comparisons between animals.

11 Season of kidding has a marked influence on milk production. Does kidding between December and March have, on the average, higher milk and fat yields than does kidding later in the year. The influence of season of kidding on percentage of fat is considerably less than on yields of fat and milk, but does kidding in April to July have slightly higher fat tests than does kidding earlier. If comparisons are made between does with records initiated during different seasons, they should be adjusted for season of kidding. Season adjustment factors in conjunction with correction for age of kidding have been published for each breed.

12 Age of kidding affects milk production strongly. Age and season of kidding jointly account for 30 to 40% of the total variation within a goat herd for milk and fat yields, which increase up to 5 years of age and then decline with advancing age. Effects of age on fat percentage are less pronounced.

13 Parity or lactation number, in addition to the effect of age, has a large influence on milk and fat yield in the dairy goat, which makes the dairy goat different from the dairy cow. The average difference in 305-day milk yields between first and second goat lactations is approximately 300 lb. The magnitude of this difference varies with season and region, being greatest in herds in the Western states during December to March. Factors that account for the variation of parity include the effects of previous lactation, and seasonal breeding.

14 Length of lactation also needs to be standardized when comparing dairy goat records in order not to give unfair advantage to does with

abnormally long lactations. Credit for milk production is given normally up to the 305th day of lactation. This has been the traditional method for standardizing milk production records in the dairy cow, but unlike her, the goat is a seasonal breeder and the methods of standardizing need further studies. Seasonal breeding can influence the length of lactation, and this affects yields of lactations usually on the latter part of lactation. Frequency of milking influences lactation yields also and records are corrected to a two-times a day milking standard.

15 The following example illustrates how adjustments for known environmental factors can be made to enable comparisons between goats on the basis of their milk production records. Consider two Alpine does with 305-day milk yield records: Daisy with 2000 lb and Buttercup with 1400 lb (Table 2). At a first glance, one might think that Daisy is the better doe. However, she initiated her lactation in January at 24 months of age while Buttercup began in April at 12 months of age. Buttercup kidded at a younger age and less favorable season. The age-season adjustments correct for this handicap. Her records then are calculated as deviations from the average milk yield of other Alpine does with their records adjusted for age, season of kidding, and same herd and year as Daisy and Buttercup. As a result Buttercup's production is 258 lb above herd-year-season average and Daisy's is 70 lb below. Given no other information and assuming that the herdmates of each doe were genetically similar, one should select Buttercup over Daisy as the better doe for milk yield.

16 As far as body type traits of dairy goats are concerned, there is little published information on the effects of environment, although its factors certainly have an influence; for example, stage of lactation causes some conformational changes, particularly udder characteristics. Research is needed to improve the ability to select goats for these traits. Type classification programs initiated in recent years for goats may provide important data soon.

### 17 Heritability

Heritability indicates the relative importance of heredity in the expression of a trait and measures the average percentage of variation between individuals that is due to heredity. For example; 300f differences between individuals for a particular trait are attributable to genetics but the remaining 70are due to environmental influences if that trait had a heritability of 30

18 Heritability also gives an indication of the potential for phenotypic selection to improve a trait genetically. A high heritability suggests that individual selection will produce rapid genetic improvement, but a low heritability value indicates that progress from such selection will be slow and other means should be adopted to improve the trait.

19 The heritability of milk yield of goats is moderate and about 30 Fat yield has a similar heritability. Heritability of fat percentage is higher about 50, and although few data exists, heritabilities of other milk constituents such as protein and solids-not-fat are similar to that of fat percentage.

20 Applying the concept of heritability to the genetic evaluation of goats (Table 2), one expects Buttercup to be 77 lb above average (30 of +258) and Daisy to be 21 lb below average (300f -70) in genetic merit for milk yield. The remaining 700f the deviation from herdmates (Table 2) would be due to unexplained environmental influences.

21 Data on heritability of body traits of dairy goats are scarce. There have been numerous studies on heritability of type of dairy cattle, and they indicate that most conformation traits have moderate to low heritabilities. It is likely that this applies also to dairy goats.

## 22 Repeatability

Performance of goats either good or poor, tends to be repeated although not perfectly. Repeatability represents the average correlation among records of the same animal and measures the tendency to be similar on successive records by the same animal. The repeatability of successive milk and fat yield records of the same doe is about 50 Repeatability of fat percentage, and probably the other major milk constituents, is approximately 60 Few repeatability estimates of the type traits are available.

23 Repeatability can be used to estimate future production of a doe on the basis of her past performance using the formula for the Probable Producing Ability (PPA):

$$\frac{nr}{1 + (n-1) r} \quad \text{(Average adjusted deviation from herdmates)}$$

where n is the number of records, and r is repeatability of the trait. For example, the estimated future probable producing ability for milk yield of a doe with 3 lactation records averaging 200 lb above herdmates is +150 lb (assuming r = 0.50; 0.75 x 200 = 150). Not all does will produce as expected, but the fewest errors in estimation will be made when this method is used.

24 Repeatability (r) and heritability (hh) in a formula for the Estimated Breeding Value (EBV) can be used to estimate the genetic value of a doe on her past performance:

$$\frac{nhh}{1 + (n-1) r} \quad \text{(Average adjusted deviation from herdmates)}$$



# GENETIC EVALUATIONS

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Extension Goat Handbook

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TI GENETIC EVALUATIONS

AU G. R. Wiggans; ARS-USDA Beltsville, MD  
M. Grossman; U. of Illinois Urbana  
M. R. Dentine; North Carolina State U., Raleigh

RV G. F. W. Haenlein; U. of Delaware, Newark.

DE Genetics and Reproduction

Text

1 The genetic potential of dairy goats to produce milk and fat can be improved each generation if does and bucks with the best genotypes in the current generation are selected as parents for the next generation. The practical difficulty in mating 'the best to the best' is to evaluate which does and bucks are 'the best'.

2 Does

A doe's production is the result of both genetic and environmental factors. Methods have been developed to adjust for some of the environmental effects on production. Adjustment is necessary to measure a doe's genetic ability accurately. Records are adjusted to remove bias due to the effects of age and season at kidding and to project incomplete records to a standard 305-day basis.

3 Many environmental factors are common to does kidding in the same herd and year (herd-year). Comparisons among does freshening in the same herd-year are not affected by such factors. However, comparisons among does in different herd-years should be based on differences between does' individual production and production of other does in the same herd-year; i.e., herdmate deviations. Genetic differences among herds could be corrected by considering the genetic values of herdmate sires. This correction becomes more effective as the accuracy of the evaluations of herdmate sires increases.

## 4 Bucks

Evaluation of bucks for milk traits is more complicated than evaluation for growth, meat, and fiber traits or evaluation of does because bucks do not produce milk. Information on milk traits for a buck comes from observations on female relatives, particularly daughters. One buck's genetic ability to sire superior daughters can be compared with another buck's ability if both have daughters kidding in the same herd-year. Indirect comparisons also are possible. For example, if two bucks have daughters in different herd-years but in common with daughters of a third buck, the two bucks in question can be compared through the third buck. Thus, daughters of bucks used in more than one herd-year serve to tie evaluations together. A buck cannot be evaluated properly if he does not have daughters in a common environment with daughters of another buck; i.e., if he is the only buck with daughters in a herd-year and has daughters only in that herd-year. Artificial insemination (AI) can increase the number of bucks in different herd-years and thereby increase the accuracy of buck evaluations. Furthermore, AI may be the most practical way to use several bucks in a herd each year and for many bucks to have daughters in more than one herd.

5 Generally, a genetic evaluation of a buck is an estimate of the amount by which a buck's daughter production differs from production of daughters of bucks chosen as the base group. More daughters records provide more information; however, the distribution of daughter records among herd-years and the number of comparisons with daughters of other bucks determine the amount of information each record provides. The prediction of performance of future daughters varies with the amount of information available as well as with the level of current daughter performance.

6 Research to evaluate dairy goat bucks is progressing. Recent data show that the number of lactation records received for genetic evaluations increased from 2,858 in 1974 to 7,516 in 1977 and that the number of herds increased from 389 to 1,171. The number of lactations per herd-year, however, decreased from 7.3 to 6.4. This drop was probably a result of an increase in the number of smaller herds on test in recent years. Of the 4,853 herd-years in the data, 942 (19.4) had only 1 buck represented per herd-year. About 530 of the herd-years had fewer than four bucks represented. Of the 10,102 bucks, 5,608 (55.5) had only 1 daughter record. About 87 had fewer than four daughters records. A total of 9,812 bucks had daughters in herd-years with daughters of other bucks and thus had information suitable for daughter comparisons. Among these tied bucks, 5,068 (51.7) had daughters in only 1 herd-year. The number of dairy goats enrolled in testing plans has increased to 14,449 does and 1,616 herds as of January 1, 1982.

7 A dairy buck summary with evaluations for 143 Alpine, 205 Nubian, 72 Saanen, and 82 Toggenburg bucks was published by the University of



California at Davis in the fall of 1980; lists of elite bucks and does also were published. Data for the summary came from official Dairy Herd Improvement records from California for 1970 to 1978 on file at USDA. Records of bucks with fewer than four daughters could not be used because of the limited reliability of the evaluations. Predicted differences for milk yield, fat yield, and fat percentage were given, along with their standard errors. The base was established so that an average buck's evaluation was zero. Bucks and does with evaluations at least one standard error above averages for milk or fat were designated as elite.

8 Genetic evaluation is an evolving process. Preliminary identification of some superior bucks should encourage their widespread use. As a consequence of this, bucks could be evaluated more accurately, which would promote genetic progress.

#### 9 Young Buck Proving Scheme

The possibility of a national program for buck evaluation is becoming more likely, but poor distribution of daughters across herds or years impedes progress. Breeders interested in having their bucks included in a future summary can take several approaches to insure that their bucks have the information needed:

(1) Breed a buck to does in several herds. Trade breedings with other buck owners so that each buck will have daughters in several herds. Some herd owners offer incentives, such as lowered stud fees, to other herds on official test and classification.

(2) After daughters of a buck are born, distribute them to different herds. A buck-proving cooperative made up of several herds might test daughters of four or five young bucks by trading daughters until several from each sire are in each herd. This system might be preferable to trading breeding services if herds are long distances apart.

(3) Raise daughters until fall, breed them to a young buck other than their sire, and then trade or sell them to other herds on test. In this way, daughters freshen in other herds and are compared with daughters of other bucks.

10 In establishing and following any young buck proving scheme, several points must be kept in mind:

(1) Five daughters each in five herds is considered a minimum goal for a buck to be evaluated.

(2) Daughters must be in tested herds with daughters of other bucks.

(3) Bucks should be bred to several does so that the choice of



# GOATS

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## A SMALL SCALE AGRICULTURE ALTERNATIVE

### Goats

United States Department of Agriculture

Since before Biblical times, goats may have been the most useful of domesticated animals, producing milk (for drinking or for cheese), gourmet meat (cabrito), leather and fiber for clothing (cashmere or Angora), not to be confused with Angora (rabbit) wool. Relatively clean, they make fine pets and show animals and number as many as 460 million in the world. They, of course, need care to keep dogs away and skillful management to prevent diseases and internal as well as external parasites such as lice, mites, and fleas.

USDA's Agricultural Research Service (ARS) says goats worldwide produce as much as 4.5 million tons of milk a year. Goat milk is so respected that there have been people who began raising dairy goats before learning whether they could sell the milk or knew how to make cheese. Yet, most major U.S. cities do not have fluid goat milk available in local retail outlets, according to research by Judy Kapture for the American Dairy Goat Association, P.O. Box 865, Spindale, NC 28160.

The problem is that in at least 21 States, goat milk when retailed must be pasteurized. Pasteurization requires a big investment in equipment. Where milk can be sold raw, licensing is required and the nannies (the common name for milk goats) must be carefully tested and kept free of brucellosis and tuberculosis, which are contagious to humans. Selling goat milk in this country requires much marketing time.

Dairy goat owners might well follow the lead of feeder-calf producer Lillian Buckley of Laura, Illinois. Originally, she milked the goats, bottled the milk, and then let newborn calves

nurse from bottles their first 10 to 12 weeks. The shortcut, including nanny training, lets calves do the milking direct.

She and husband Mike and family raise up to 35 Holstein-Semental or Holstein-Angus crossbred feeder calves, using 25 goats. They raise their own goats and sell baby males as pets, The family also feeds about 40 to 50 hogs and handles 50 acres of vegetables, emphasizing sweet corn.

### Major Goat Dairy

Goat dairyman Rube Salada of P.O. Box 476, Melrose, FL 32666, said anyone who can come up with half a million dollars is welcome to take over his 200-goat dairy, lock, stock and trucks a tractor, a house, well, fences, 38 acres of land he and his wife, Virginia, "carved out of the jungle, pasteurization and bottling equipment, and a growing market.

He said the job keeps his son, Bill, Bill's wife Nancy, and their four children, him and Virginia, and a hired man working too many hours per week, including trips every Monday night of about 300 miles to Miami to deliver to milk outlets. So far, there's only one other qualified dairy in Florida.

Almost every week Salada gets calls from goat herders who want to sell him milk, although getting milk is the least of his worries. Much time goes into consistent marketing and distribution, he emphasizes. He says people wanting to enter the goat milk business should form a cooperative sales operation.

Dairy goat information sources are plentiful, including Dr. Thian Teh at the International Dairy Goat Research Center at Prairie View College, a branch of Texas A&M University, Prairie View, TX 77556; Barney Harris or Ernest Bliss at the University of Florida's Institute of Food and Agricultural Sciences, Gainesville, FL 32611; Dr. Christopher Lu, Agricultural Institute for Goat Research, Langston University, P.O. Box 730, Langston, OK 73050; Frank Murrill, Animal Science Department, University of California, Davis, CA 95616, and Judy Kapture, Dairy Goat Information Services, P.O. Box 298, Portage, WI 53901.

For those wanting to make goat cheese, and information sources is the American Cheese Society, a nonprofit organization cooperating with enterprisers Robert and Ricki Carroll (P.O. Box 85, Ashfield, MA 01330). Annual dues are \$25.

The society publishes "A Guide to American Specialty and Farmstead Cheeses," by Barbara Lang. It lists cow and goat cheese producers.

Not all the producers make all the goat cheeses, which include blue caerphilly, camembert, cheddar, chevre, feta, semi-aged, soft ripened, and shepherd's tomme, and capriano - the last three being hard aged cheeses.

The Carrolls also market equipment and publish the "Cheesemakers' Journal" about six issued per year (at \$12 per six in the United States or \$20 overseas). It gives tips on manufacturing and marketing cheeses.

The Carrolls also published a 206-page book, "The Making of Farmstead Goat Cheese," by Jean-Claude Le Jaouen, head of the Goat Research Section, Technical Institute of Sheep and Goat Research, Paris, France (\$24.45 postpaid). And their beginner's text is "Cheesemaking Made Easy - 60 Delicious Varieties" (\$8.45 postpaid). Also available on mold-ripened cheeses is "Goat Cheese: Small-Scale Production" (\$9.45 postpaid).

For those who don't want to get as far as cheese production, there is fresh goat's milk curd, used in sauces and from which cheese can be made. Coach Farms, the 200-goat ranch at Pine plains in the Hudson River Valley of New York, delivers curd to New York City stores, which sell it at \$6.98 a pound. Goat curd has a special attribute for cooks, not breaking down or separating like yogurt our sour cream do when heated. It enriches or thickens cooked sauces. Its fat content is 18 percent, about half that of cream. It keeps in the refrigerator 3 weeks. Coach Farms also produces a goat yogurt that retails at a price much higher than yogurt from cow's milk.

Some people sell young goats for meat as well as doing dairying. One example is Hazel McTeer, who is not only president of the Missouri Goat Breeders Association but also president of the Central States Dairy Goat Marketing Cooperative.

She operates the Fancy "M" Dairy Goat Ranch (Route 1, box 545, Springfield, MO 65803). She says dairy goat people in her area sell about 1,500 head of kids ranging in weight from 17 to 38 pounds in March. The price in 1988 is 85 cents a pound live weight. The goats go by truck to New York City at Easter time.

Nondairy Goats

Some successful entrepreneurs stay away from dairy goats, concentrating on goats for met and leather or fine hair. Those with the greatest chance for success may already pasturing sheep and/or cattle and can add some meat and/or angora goats without damaging their pasture improvement programs. Goats eat some plants that sheep and cattle don't seek, so they are not mutually exclusive. They pasture well together.

Dr. Booker T. Whatley, Alabama agriculturist and author of "How to Make \$100,000 from a 254-Acre Farm" (postpaid at \$17.95 from the Rodale Institute, 222 Main Street, Emmaus, PA 18049), has a suggestion for marketing feeder lambs that might also apply to goats. He proposes that an entrepreneur set up a Clientele Membership Club, seeking one member for each goat that can be raised. At \$30 to \$50 apiece, that could bring a fair supplemental income. If members wanted their animals butchered, that would cost extra. For humane reasons, member should not become well acquainted with their goats, which easily become pets. (Whatley's book also describes profitable goat dairy operations.)

Among those selling goats for meat are Bob Buckholz (Route 1B, Box 101, Dripping Springs, TX 78620), Tom and Helen Hill of northern Florida, Bronwyn Schuetze and Jill Darrah of Longmont, Colorado, Hazel L. McTeer of Missouri and many others who say the tender meat of young goats - cabritos in Spanish - is beginning to get recognition by gourmet restaurants.

Some say "cabrito" meat, sometimes also called chevon, has little fat and tastes better than venison. Goats of all sizes worldwide produce more meat - 1.2 million tons a year - than do cattle or hogs, according to ARS. With a flock of 350 to 400 Spanish does, Buckholz annual sells their offspring for meat at eight months of age for \$30 a head.

Since the stock is tough, thrifty, and hardy, and he has lots of pasture and some Pyrenees dogs to keep predators such as coyotes and wild dogs at bay, Buckholz's expenses are relatively small.

The Hills (Route 3, Box 1560 Lake Butler, FL 32054) sometimes feed kid goats only about 2 months, until reaching 35 to 40 pounds. They then sell them at nearly \$1 a pound, mainly in the Miami area. They say there is often a shortage of goats in November and December.

Some of the kids they produce from their own 50 nannies. They also buy day-old billies at \$5 apiece from the Salada dairy, which does not wish to bother feeding them. The Hills say they invest only about \$5 worth of grain in each. If they were fed until they were eight months old, they would bring as much as \$100, considerably more than Buckholz's goats.

### Mohair Makes Bucks

Buckholz also manages about 1,800 Angora goats, which in recent years have been making him and other Texans some profits. Mohair prices range from \$1.75 to \$7.25 a pound, depending upon quality. The raw adult mohair price has ranged from 25 cents a pound in the 1970's to \$2.06 in mid-1987. Kid hair ranges up to \$7.25 a pound. USDA's Agricultural Stabilization and Conservation Service (ASCS) also helps keep growers in business by matching the price with a substantial subsidy under the Wool Act.

An adult doe produces anywhere from 8 to 16 pounds of mohair during two shearings a year. Buckholz has been selectively upgrading the quality of his flock. He finds a registered Angora sells at \$300 to \$500 in Texas, with a quality nonregistered female bringing \$85 to \$100. Bucks are usually higher priced, at \$250 to \$5,000, depending on quality and registered bloodlines indicating quality and production totals. He's also looking for cashmere lines, with enthusiastic backing from Teh at Prairie View. The Texas Town of Junction, incidentally, is the biggest goat market in the country, having handled as many as 23,000 of all types in one week.

The mohair business needs to be approached on the basis of long-term investment, since lean years can be mixed with good ones, according to Dr. R.M. Jordan, Professor in the Department of Animal Science, University of Minnesota (St. Paul, MN 55108), and information source on mohair.

### A New Industry?

Bronwyn and Schuetze and Jill Darrah have been gathering Spanish and feral (wild) "junk" doe goats that they are crossbreeding with a cashmere buck from Australia worth about \$10,000. They hope some of the mixed offspring will produce cashmere "down" that could bring as much as \$50 a pound. If they are successful, they can claim credit as pioneers in launching a new U.S. Farm industry. They will be competing not only with the Chinese, but also the Turks, Iranians, Iraqis, New Zealanders, and

Australians.

Schuetze and Darrah have about 100 head of females and have launched the American Cashmere Growers Association, P.O. Box 443, Longmont, CO 80501.

If they and Buckholz were able to get clean cashmere from their goats, they could get from \$39.98 to \$77.93 per kilogram (1 kg. = 2.2046 pounds), notes Hugh Hopkins, transplanted Australian employed at Forte Cashmere Company (148 Halet Avenue, P.O. Box 869, Woonsocket, RI 02895), one of three cashmere processing plants in this country. (There are only eight in the world, Teh reports).

Forte pays its highest prices for first quality Chinese fiber that is clean and white. The longer and finer the fiber, the higher the price.

Teh and Hopkins agree that the United States as the goat population to produce cashmere in about 10 years. That might require imports of semen, embryos, or male goats from Australia or elsewhere. Teh says cashmere could get started in 2 or 4 years if some stock from China or elsewhere were imported. A few people are exploring the idea.

Dr. J.M. Shelton, professor of sheep and goat genetics and physiology at the San Angelo Research Center at Texas A&M University (7887 N. Highway 87, San Angelo, TX 76901), says it appears the cashmere idea is "a long shot but has potential." The cashmere goat can provide double as a meat goat. Teh at Prairie View is also exploring the idea of crossing cashmere with dairy goats.

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# GOAT 4-H PROJECTS

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TI GOAT 4-H PROJECTS

AU C. Short; Fort Collins, CO

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DE The Goat Industry

Text

## 1 4-H Projects

Dairy goats have become an increasingly important part of the 4-H program in many states. One of the most impressive qualities of the dairy goat is that a goat can be handled with equal ease by the youngest 4-H member to the oldest. This is an advantage over large livestock species, such as beef and dairy cattle, where adult help in handling the animal may be needed. Most states require that the 4-H members provide most of their animal's care in a livestock project, often as high as 80%. Dairy goats are ideal for such a livestock project, because even young children can handle the care of their animals.

2 Dairy goats require little space in comparison to horses and cows. Because of this, children with limited space can still participate in a 4-H livestock project by choosing dairy goats. Dairy goat projects may also be an ideal opportunity for city or suburban children to participate in a 4-H livestock project, because goats are often tolerated in neighborhoods where other small livestock, such as pigs and sheep, are excluded.

3 Goats have the type of personality that make them ideal candidates for 4-H projects. They are unique among livestock because of their tendency to become companion animals, as well as livestock in the more traditional sense of the word. A bond is quickly formed between a child and a goat, especially when starting with a young animal. Chores are

often more willingly done due to this sense of companionship.

4 The initial investment to start a 4-H dairy goat project does not need to be large. Kids, even purebreds, are usually within the reach of even modest budgets. Dairy goats do fine with only a simple shed, provided they are free from drafts and protected from rain and snow. Fencing for goats, however, is a special concern. Although fancy fences are not necessary, fences do need to be tight and high enough that the goats can not jump out or sneak through between strands especially on the bottom.

5 Dairy goats can be transported easily in any type of vehicle. Horse or stock trailers are handy, but goats can be satisfactorily moved in pickup trucks, station wagons, or even economy cars. Extensive training and equipment are not needed in order to show goats at 4-H fairs. A collar is required for the goat; the exhibitor ought to wear clean, white clothes.

6 A 4-H dairy goat project has a special advantage for younger and more sensitive children, because it is a breeding project rather than a market project. Breeding projects usually mature over a period of years, with the activities of one year blending into the next and long term goals more important than short term goals. Breeding projects are more enjoyable for many 4-H members than market projects where the end goal of the year's effort is to sell an animal for meat, no matter how strong an attachment for the animal was formed.

7 One goal of 4-H livestock projects is to show a profit at the end of the project year. Projects involving the dairy goat, with its efficient conversion of feed to milk, 10-month lactation, and multiple births, can realistically be expected to show a profit. The milk can be a welcome supplement to the household food budget and extra milk can be used to feed calves, pigs, and lambs as a source of income or meat.

8 There are many reasons why dairy goats and 4-H are such a positive combination. For example, children learn that animals need care every day and cannot be neglected. Being responsible for the care of goats, even when the weather is unpleasant or other activities look more interesting, is a big step toward growing up.

9 4-H dairy goat projects can help children learn how to select animals. Judging activities, including giving reasons for how animals were placed, develop the ability to recognize desirable type in dairy goats and to weigh strong and weak points within an animal and between animals.

10 A 4-H dairy goat project is often the start of the life-long interest. Participating in the project develops the skills and discipline necessary to be successful at livestock breeding and management. Rigorous record keeping is usually required in 4-H dairy



# GOAT CHEESE

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Extension Goat Handbook

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TI GOAT CHEESE

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DE Milk and Milk Handling

Text

1 Cheese is perhaps the first food to be manufactured that is currently consumed by man. The oldest written records have references to cheese as a food. Today, cheese is available in an almost innumerable variety of kinds, flavors and consistencies. Agriculture Handbook No. 54, Cheese Varieties and Descriptions, published by USDA describes over 400 varieties and indexes over 800 names. Why? The answer is that it is made by many different races of people under widely varying conditions all over the face of the earth. And the people who eat it like the various flavors and consistencies produced.

2 For a better understanding of the art and sciences of cheese-making one needs to know what kind of product it is and how the manufacturing procedures developed over the years. Even though the varieties differ quite widely in composition, cheese can be characterized as a product made from milk in which the protein is coagulated and concentrated. The collection of protein is accompanied by recovery of most of the fat in the milk by its entrapment in the curd. Other constituents in milk remain in the curd or are removed with the whey depending on their solubility (fat soluble vitamins and minerals associated with protein are retained in the curd; water soluble vitamins and minerals are passed off in the whey).

3 For centuries, cheesemaking has been a farm or home industry with the individual producer using surplus milk to make small batches of cheese. Goat cheesemaking in the US still follows this general practice. It was, and still is to a considerable degree, an art; since the middle of the 19th century however, more and more cheese has been

made in specially equipped factories with greater application of science in the manufacturing procedure. Milk from all species has been used for cheesemaking. Because more attention has been given to increasing the productivity of the bovine species, a large proportion of commercial cheese is now made from cow milk; the milk from the buffalo, zebu, sheep and goat is also used extensively.

4 There are rather significant differences in the proportions of major components (fat, protein, lactose and ash) in the milk from these various species and there are also important differences in the chemical nature of each of these components. Thus, it is to be expected that a given manufacturing procedure will produce cheese differing in flavor and consistency when made from the milk of different species. The milk may even respond to the manufacturing procedure in a different way. Much of this difference can be minimized or eliminated by adjusting or standardizing the composition of the milk from the various species to a common level before using it in cheesemaking. More about that later.

5 Just as the nature of the milk from which it is made causes variations in the characteristics of the cheese, so can modifications of the manufacturing procedure. In spite of the development of the cheesemaking art over centuries by many individual practitioners, certain basic processes are common to all. Even though many modifications of each may be utilized, the four basic steps in cheesemaking are:

1. Preparation of the cheese milk
2. Coagulation of the protein
3. Freeing coagulated protein (curd) from whey and collecting it into a defined mass.
4. Aging under controlled conditions to produce desired flavor and consistency.

6 In this discussion of goat cheesemaking, each step will be treated in some detail. In most of the material, there will be no special methodology required for making cheese from goat milk, when compared with the use of milk from other species; when special techniques are required, they will be discussed at length. For more detailed information on cheesemaking procedures than can be given here, refer to the book ''Cheese and Fermented Milk Foods'' by Frank V. Kosikowski, Edwards Brothers, Inc., Ann Arbor, Michigan distributor.

#### 7 Preparation of Cheese Milk

The cheesemaker must have high quality milk to make high quality cheese. The production of high quality milk has been discussed before. In summary, milk selected for cheesemaking must be free of objectionable flavor, free of all foreign materials, including antibiotics, free of pathogenic organisms and contain relatively few

nonpathogenic bacteria and somatic cells.

## 8 Standardization

Probably the most important aspect of preparing milk for cheesemaking is the standardization for composition, that is, adjusting the fat and protein content to the desired proportion. This is of extreme importance for two major reasons: it is necessary in order to produce cheese which is legal in composition and to provide uniformity in the cheese made. Agriculture Handbook No. 51, 'Federal and State Standards for the Composition of Milk Products,' is the most comprehensive source of information on this subject. Those making cheese in the home for personal consumption obviously do not need to be greatly concerned about composition, but if cheese is to be sold in the market, it will have to meet some standard.

9 Making saleable cheese from goat milk will pose a problem in respect to composition. The problem arises from the fact that goat milk, collected from only a few does, is more variable in fat and protein content than is cow milk. Wide variation in those components results from having most of the milk producing animals at the same stage of lactation at any given time and also because mid-lactation, when fat and protein are expected to be low, usually comes in mid-summer when climatic conditions favor production of low fat, low solids milk. Experience has shown that milk may vary from 2 to 5% fat and 22.5 to 25.8% solids-not-fat mid-summer and late fall; milk solids-not-fat may vary from 7 to 9% or more during the same time span. Cheese made from milk differing so widely in composition will vary in a similar manner. Also, the cheesemaker may experience difficulty making cheese with the low fat, low solids milk.

10 How can the goat cheesemaker solve this problem? While any one making cheese for only personal consumption can just ignore the situation and follow personal desire, those making cheese for sale cannot. To make cheese which is uniform in composition, which is legal, to be offered for sale, two conditions must be met. Provisions must be made to test the milk (and the cheese if possible) for its fat and total solids content, and a source of concentrated goat cream and goat milk solids-not-fat must be available. The Babcock Test is the analytical tool most widely used to determine fat content of milk and cheese.

11 Although the test is quite simple and can be performed wherever cheese is made, it does require special equipment and supplies which are somewhat expensive. Total solids content is determined by drying a weighed sample to constant weight in an oven at 212°F (100°C) and calculating the percent of sample found in the moisture free residue. A very accurate scale must be used to weigh the residue. Sweet cream, if needed for standardization of cheese milk, can be obtained from the fluid milk. It probably will be necessary to have a centrifugal separator to produce the needed cream since gravity separation of cream in goat milk is slow and incomplete. Since cheese is usually made from ungraded milk (or surplus Grade A milk) it is usually possible to add

nonfat dry milk (the only known source of nonfat dry goat milk is Ozark Milk Products, Yellville, Arkansas - it is not Grade A quality) to cheese milk to standardize the milk solids-not-fat content. Such standardization may be necessary to maintain the quality of cheese when the milk solids-not-fat content of the milk decreases to less than 8. In the manufacture of any specific variety of cheese, it is important to determine the ratio of fat to protein (or milk solids-not-fat) needed to meet legal standards for that cheese, then standardize the cheese milk to that ratio.

## 12 Bacterial Quality

Most cheese making procedures involve controlled growth/activity of bacteria and/or enzymes in either the coagulation stage, the aging stage, or both. The necessary control may not be possible unless the cheese milk is unusually low in bacteria count or is pasteurized. Since it is possible that the milk may contain pathogenic microorganisms, it is very desirable (legally required in most states if the cheese is to be sold) that all cheese consumed when fresh be made from pasteurized milk. Some very competent cheesemakers who can be highly selective in the milk used for cheese, use unpasteurized milk for making those varieties of cheese which must undergo prolonged aging -pathogenic organisms are supposedly destroyed in the aging process. Because heating milk causes some physical changes in its fat and protein components, pasteurization usually involves the least heat treatment permitted. In the cheese factory equipped with a continuous HTST pasteurizer, treatment at 161F (71.6C) for 15 seconds is usual; in the home or small factory, pasteurization is best accomplished with a treatment of 145F (62.7C) for 30 minutes. If volume justifies the cost, this may be done in a pasteurizer vat, but can be accomplished easily by placing the milk containing vessel (preferably a stainless steel, flat bottomed, rectangularly shaped container not exceeding 12 inches in height) in a shallow pan containing 1-2 inches of water over the heating unit. An accurate thermometer should be used. Heating and holding should be followed immediately by cooling the cheese milk to the setting temperature (the best temperature for obtaining coagulation). For most cheese varieties, utilizing the production of lactic acid by rapidly multiplying bacteria to cause or aid in protein coagulation, the setting temperature should be in the range of 72-90F (22-32C).

## 13 Setting the Cheese

This term is associated with practice and procedures followed in coagulating the milk protein. The three processes most often involved are: (1) culturing the cheese milk with substantial numbers of desirable bacteria (predominantly lactic acid forming) and controlling incubation conditions, the milk protein is coagulated when sufficient lactic acid is produced - giving a titratable acidity (TA) of 0.50 - 0.55, pH of 4.6 - 4.9; (2) culturing the cheese milk with protease enzyme (rennet), incubating at favorable temperature until protein is coagulated - with very little change in TA or pH; the third procedure is a combination of one and two. In a modification of the first procedure, no bacterial culture is used; instead of producing protein





hole left when the thermometer is removed should fill with clear whey in a short time. It will break cleanly in a fairly straight line when the proper firmness has developed - experience is needed to determine the proper 'curd break' for each cheese variety.

17 When the coagulum has attained the proper characteristics it is ready to be cut. This may be done at home with a long thin spatula or knife; commercial cheesemakers will use metal frames, sized and shaped to fit their cheese vat, having parallel fine wires spaced at regular intervals. Pairs of frames are generally used with one having the wires attached in a vertical pattern and the other in a horizontal pattern. By passing the frame with the vertical wires through the curd in the container first lengthwise then crosswise, and following that with the frame having the horizontal wires, the curd is cut into uniformly sized cubes. The size of the cubes is determined by the spacing of the wires. Uniformity in particle size is conducive to regular expulsion of whey and uniformity of cheese. Large curd particles tend to retain more moisture (whey) than small particles. The cut curd is allowed to remain undisturbed for a short time to undergo some firming due to whey expulsion.

18 Up to this stage, the manufacture of all cheese has been quite similar but from this point on the process is different and specific for each variety. Space does not permit a detailed description of each; a number of books, bulletins and other publications are available describing specific manufacturing procedures in detail. Those who wish to enter into the business of making and selling cheese should refer to such publications as well as confer with the proper regulatory officials. Others who desire to make cheese for personal consumption may wish to recover the coagulated protein by any simple method. Most such methods involve the application of mild heat (cooking) to help firm the curd particles and expedite whey expulsion. Heating may vary from only a few degrees above setting temperature to as high as 130F with times varying from a few minutes to one hour or longer. Heating should be accompanied with mild stirring - sufficient to prevent the curd particles from remaining on the bottom or fusing together.

19 When the curd particles have reached the desired firmness and whey retention, the excess whey should be removed and the curd drained. The simplest way to accomplish this is to dip, siphon or drain off (through a valve in the cheese making vessel) the free whey using some form of strainer to retain the curd particles as the liquid whey flows. In some cheesemaking procedures, when cooking is minimal, very little free whey can be removed, so that most of the coagulum is transferred to the curd collecting device. In all cheesemaking processes, final expulsion of whey and curd collection is accomplished by some special technique. These may vary from a cloth filter bag into which the high moisture curd may be ladled, to lined molds of many sizes and shapes, to allowing the curd particles to settle to the bottom of the cheesemaking vessel where further drainage and matting together occurs. In this process, weight or pressure may be applied to fuse the curds into a solid mass and to further reduce the moisture retained in the curd.

- 20 Variations from simple cooking, draining, and curd collecting can be used in this stage of cheese manufacture. Salt is frequently added to the curd during the final stages of draining, or the newly formed cheese block is floated in a salt brine. The addition of salt improves the flavor, texture, and keeping quality of the cheese. Cheese frequently contains one or more percent salt.
- 21 In several procedures, after the free whey is removed, the curd is held at incubation temperature for 1/2 to 1-1/2 hours with frequent stirring, or compact in masses matted together, in order to promote bacterial and enzyme activity and speed up the aging process. In some instances, bacterial or enzyme concentrates may be added during this stage so as to produce more rapid and more controlled flavor and texture development during aging. At the completion of this stage of processing, the whey-free curd is either ready for consumption, or has been formed into regularly shaped masses suitable for storing and aging.
- 22 While each of the foregoing processes makes some contribution to the particular flavor, body and texture qualities of each variety of cheese, the manner and time of aging probably influences those qualities more than all other phases of manufacture. Those cheeses eaten while fresh obviously owe their flavor, body and texture qualities to the manner in which manufactured -including the incorporation of flavor inducing ingredients. Cottage cheese may be consumed as just the curd, but usually is found to be more palatable if a milk or cream dressing is added. Many variations of cottage cheese can be derived by the addition of fruit, vegetables, nuts and other condiments. Baker's or pot cheese is similar to cottage but is usually softer and of higher moisture content and is generally used without any added flavoring material as an ingredient in other foods such as cheesecake. Neufchatel and cream cheese, being higher in fat content, are richer tasting than cottage or Baker's, but can be flavored in the same way and are practically interchangeable as to usage.
- 23 Those varieties of cheese which are consumed after 60 or more days of aging present special problems. The purpose of aging is to develop specific flavor, body and texture qualities; these result from the growth and activity of microorganisms and enzymes. For such development to take place, the cheese must be maintained under conditions favorable to the growth and activity desired. These same aging conditions can also result in objectionable changes if the original milk was contaminated with undesirable microorganisms, or if improper manufacturing procedures were used. Aging large quantities of cheese requires special physical facilities. Sufficient space must be provided to contain more than the amount of cheese produced in a time span equal to the expected age of the cheese when ready to consume. Such space must be under strict control as to temperature and humidity. If the cheese is to be sold when 90 days old, sufficient cubic footage of space, climate controlled with shelving, for storage of the amount of cheese which is to be manufactured in 90 days must be provided.

Obviously, the space will have to be reused several times annually if cheese production is continuous.

24 There are numerous variations in the way in which the compressed masses of cheese curd may be treated in preparation for aging. In aging cheese, those microorganisms and enzymes which were active in coagulating the protein are retained in the cheese and contribute to physical and chemical changes throughout the aging. Whether or not they predominate depends on what other ripening agents (bacteria, yeast, molds and/or enzymes) are added during curd collection and pressing or in the early stages of aging. Most cheese contains added salt; it may be incorporated in any phase of manufacture (several varieties of cheese are made from milk containing high levels of added salt) by adding to the curd during pressing, by soaking the formed masses of curd in brine, or by surface application of dry salt. Numerous varieties of cheese owe their characteristic flavor, body and texture qualities to the predominating activity of a single kind of agent throughout the aging period (several examples are Blue cheese inoculated early in the aging process with *Penicillium roqueforti* and Brick or Limburger from the bacteria *Brevibacterium linens*).

25 Directions for Making Goat Cheese in the Home

Up to this point this discussion has dealt with cheesemaking procedures in general and their application to goat cheese. It warrants reiteration that most varieties of cheese can be made from goat milk - some adjustment of milk composition might be necessary, and aged cheeses made from goat milk would not be identical to those made from cow milk in terms of flavor, body and texture. It is the purpose of this final section to give specific directions for making several varieties of cheese from goat milk only for home consumption with equipment and supplies usually found in the home. It is hardly worth the time to make cheese unless at least one gallon of milk is available.

26 Cottage or Baker's Cheese -- Collect surplus milk, selecting that which is free of objectionable odors; cool to and hold at 40F until used. Skim off cream; use the skim or low fat milk for cheese and the cream as cheese dressing. Better quality cheese can be made from pasteurized milk; collect all the milk to be processed in a flat bottomed straight sided vessel (rectangular shape is best) and heat to just 145F using low heat or by placing vessel in a slightly larger one containing water. Try not to exceed 145F; hold at that temperature 30 minutes, then cool at 72-80F by circulating cold water around milk containing vessel. Use a dairy thermometer.

27 Inoculate cheese milk with desirable lactic acid fermenting bacterial culture. Initial source may be purchased commercial buttermilk, sour whey saved from previous cheesemaking (if not more than 4 days old and held at 40F) may be used if it has clean acid taste and no gas formation has occurred. Add about 5 Onnoculum (6-1/2 to 7 oz to 1 gallon or 8 oz to 10 lb of milk), stir well, and set undisturbed where temperature will remain at 72-80F until firm curd is formed in

10-16 hours.

- 28 If raw milk is used for making cheese it must be of the best possible quality and as fresh as possible. Follow the procedure outlined previously; it will be best to purchase a fresh source of innoculum for each batch of cheese.
- 29 When the curd has attained the proper degree of firmness, as determined by the way it breaks when the thermometer is lifted through it, do the best possible to cut curd into uniform cubes not more than 1/2 inch in size, using a knife, spatula, or wire cutter.
- 30 Allow the curd to remain undisturbed for a few minutes, then begin to warm it very slowly, with frequent but delicate stirring. Cooking temperature should not exceed 135F and should continue till curd has desired firmness and freedom from whey.
- 31 When the curd has the desired firmness, discontinue heating and stirring. Dip, siphon, or decant the excess whey from the top of the cheese making vessel. The curd should settle to the bottom of the container; if it floats, gas producing bacteria have been active and a new source of culture must be used for subsequent batch.
- 32 When excess whey has been removed, replace it with cold water, wash curd, and remove wash water. Wash a second time with ice water to chill curd so it will keep its fresh flavor longer.
- 33 Final drainage of the curd, using draining board or a cloth lined form with perforated sides and bottom, completes the manufacturing procedure.
- 34 In making Baker's cheese, the procedure is like the cottage cheese process excepting that rennet is added to hasten coagulation (see discussion of Domiati cheesemaking for sources and usage of rennet in cheese setting). The cooking process will be greatly shortened, and the whey separation is accomplished by transferring the curd, together with the minimum whey necessary, to a coarse mesh bag. From 4 to 16 hours may be needed to completely drain excess whey; this should be done at refrigeration temperature if possible.
- 35 Neufchatel and cream cheese are both made by the procedure described for cottage cheese, excepting that richer milk or cream is used as the starting material, and whey drainage must be done in a cloth bag as little free whey is separated.
- 36 Cottage cheese, when consumed, should have the curd as separate and distinct particles and is usually dressed with a milk or cream mixture containing salt and/or other condiments.
- 37 All of these fresh cheeses may be served in a large variety of forms through the incorporation of chopped fruits, vegetables, nuts, olives, etc. Condiments should be added to give the desired flavor.

- 38 All equipment used in making cheese should be washed especially carefully to remove all milk residues; all items should be sterilized by heat or chemical (chlorine such as bleach) application before using.
- 39 Domiati Cheese -- This is a variety of cheese made extensively in the area around the Mediterranean Sea. It can be eaten fresh or aged for 60-90 days before consumption. Goat milk is well suited for making this variety of cheese.
- 40 Domiati cheese can be made from milk varying from 2 to 7 2256834976225 quality milk, free of objectionable flavor, should be collected as previously described. Cool the milk to 105F and to each gallon of milk add 8 ounces of salt. This must be stirred till completely dissolved. This cheese can be made from raw milk, but pasteurization by the method previously described is recommended.
- 41 Coagulation of this cheese milk is accomplished by the addition of a protease enzyme (rennet). The enzyme may be purchased in liquid or tablet form from supply houses advertising in goat magazines, or locally from some drug stores, health food stores, or a cheesemaker if available in area. If purchased in the original container, directions should be given for usage. Dilute and dissolve concentrate in water, add to cheese milk and stir for several minutes. Liquid rennet preparations are usually standardized to 1:10,000, that is 1 part rennet coagulates 10,000 parts of milk. If no directions are available, use 1 milliliter (ml) of rennet liquid diluted with 40 ml water, to each 20 lbs or 2-1/2 gallons of cheese milk. Rate of usage should be adjusted on subsequent batches to smallest amount needed to produce coagulation in no more than 30 minutes. Setting should be at 102-105F. When enzyme is completely dispersed, allow cheese milk to remain undisturbed till firm curd is formed. Curd firmness should be measured by lifting thermometer upward through curd mass. When desired curd firmness is attained, cut the curd into as uniformly small cubes as possible. Allow a few minutes for whey separation--this may be enhanced by very slow heating and very gentle stirring.
- 42 Within 10 to 20 minutes the clear, free whey should be separated; allow the curd to settle and remove and retain about 1/3 the volume of cheese milk set as clear salted whey. Additional free whey which can be removed can be discarded.
- 43 Transfer curd and retained whey to previously prepared cloth lined molds. These may be columnar or rectangular in shape, made of stainless steel (or wood) having perforated sides and bottom; a cover which fits inside the mold body should be used. Molds should be 7 to 10 inches in height so that a drained, compacted curd block, 3-4 inches thick, is formed when draining and pressing is completed. Fill molds with fresh curd, fold cloth liner over the top, and allow whey drainage to continue. After curd is firm enough to permit it, weight or pressure should be applied to tops of molds. Pressing and drainage should

continue for 10 to 18 hours until desired moisture content of cheese is attained. It probably will be necessary to release the pressure and rearrange cloth around cheese during the operation.

44 When pressing is completed and cheese is formed into a compact block of desired moisture content, remove from molds, and if necessary cut into blocks 2 to 4 inches thick. Place these blocks in plastic containers for which tight fitting lids are available. Fill the cheese container with the salted whey retained from earlier separation. The cheese should be covered with an inch of whey, and the container should be so filled that when the lid is firmly attached, almost complete exclusion of air is accomplished.

45 The cheese filled containers should be placed where a relatively constant temperature can be attained. The best curing temperature is 60 to 65F; a desirable flavor, body and texture should develop in about 60 days at that temperature. Aging at higher or lower temperatures should shorten or lengthen aging times, and may encourage the development of undesirable flavors.

46 Feta cheese is another variety made from goat milk - it is made in a manner very similar to Domiati excepting that no salt is added to the milk prior to coagulation and aging is accomplished in 14% brine after the cheese cubes have been salted by holding in 23% brine for 24 hours.

47 Variations in flavor, body and texture qualities of goat cheese can be produced by following the setting and curd gathering procedures described, but modifying the aging process. Modifications might include adding enzymes or flavorings to the curd or applying enzyme, bacteria or mold cultures to the cheese surface as aging starts.

48 Sources of Supplies for Cheesemaking

New England Cheesemaking Supply Co.  
P.O. Box 85, Ashfield, MA 01330

American Supply House  
Box 1114, Columbia, MO 65201

Dairyland Food Laboratories, Inc.  
620 Progress Ave., Waukesha, WI 53186

Marschall Dairy Ingredients Division  
32 S. Proudfit St., Madison, WI 53701

Chr. Hansens Lab., Inc.  
9015 W. Maple St., Milwaukee, WI 53214

Microlife Technics  
P.O. Box 3917, Sarasota, FL 33578



# GOAT MANURE

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TI GOAT MANURE

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DE Management and Housing

Text

1 For gardening, goat manure can be a real asset. In their naturally dry, pelleted state, goat feces are easily handled, stored or directly applied on vegetables, trees, and flower gardens, as mulch, organic matter, fertilizer, or just to increase the water holding capacity of the soil; and goat feces do not normally attract flies or breed maggots. A daily raking or sweeping of the goat yard keeps the goats clean and free from parasites; and the garden will soon show its appreciation.

2 Few research data are available on the value of goat feces or manure. Of course, it depends on the level of feeding. Thus, high producing, well fed dairy goats should produce more and better feces than other goats. In general, 2.0 to 6.00f live weight of goat in fresh feces weight can be expected. Depending on feed and water intake, the fresh feces voided per day might weigh between 30, and as much as 1000f the daily dry matter consumed. Dry matter content of goat feces is between 50 and 60ormally; the color depends on the type of feed. Hard feed kernels, like barley and corn may appear in goat feces, especially at high levels of feeding, but generally they are masticated and ruminated much finer and more completely than by calves or cows.

3 Goat feces contain not only feed residues but endogenous substances from the goat's intestinal tract too. Swedish research established that goats excrete daily, regardless of feed type, a minimum of 34g protein, 8g fat and 13g carbohydrates for each kg (2.2 lb) feed dry matter eaten. This would mean that a 150 lb goat milking a gallon of milk a day, and been given 7 lbs of feed dry matter daily; this goat would lose  $7/2.2 \times 34 = 108\text{g}$  protein daily in her feces, not even accounting



for her milk production and her own maintenance needs. This 108g endogenous protein loss also translates into a 3.4 minimum protein content in the 7 lb daily feed dry matter to avoid a negative protein balance for this goat. In comparison, a daily goat ration with a 14 protein content supplies just 445g protein, of which a certain percentage is always undigestible and a loss to the goat too. This percentage increases when the crude fiber content of the feed increases.

4 Goat manure i.e. feces plus bedding and wasted feed, fresh or usually composted in pens or outside piles can average 10 lb per day for the above example goat or more, depending on bedding amount, urine drainage or fermentation losses. This can amount to around 1-1/2 ton of manure per goat per year or more with a possible composition of 31 dry matter; 1.3 nitrogen, 1.50001:0000 phosphorus (P205), 0.46952:DE9E potassium and 2.4 fertilizer asset per goat of at least 1/2 ton dry matter with 15 lb nitrogen, 17 lb phosphorus, 5 lb potassium and 27 lb lime.

5 For large herds or flocks, disposal of goat manure could have problems, but in some parts of the world animal wastes serve numerous useful purposes. In fact, animals are frequently kept beyond their period of usefulness for the production of milk or work so that they can provide dung. Approximately 40 percent of the farmers of the world depend wholly or in part on animal wastes to enhance soil fertility. Generally, manures do not increase short-term crop yields to the extent of equivalent amounts of nutrients supplied in refined chemical form. The differences in yields are, however, with long-term usage. Small farmers who till land by hand or with chisel type plows prefer manures over chemical fertilizer because manure enhances the aggregate crumb structure and soil permeability which aids in cultivation. Marginal micronutrient deficiencies, which may occur after repeated cropping with chemical fertilizers, can be prevented with supplementary applications of manure.

6 The value of manures for soil fertility can be markedly influenced by handling procedures. At least 50 percent of the nitrogen and 60 to 70 percent of the potassium are found in the urine. Frequently, manure has a low fertility value due to failure to incorporate the urine, or the nitrogen is lost through leaching. Eighteen to 20 Mcal of energy inputs are required to produce one kg of nitrogen fertilizer. Fuel costs to produce nitrogen have already aroused new interest in research on storage and handling of manures. Predictions for the future are that animal wastes will again be viewed more favorably as a useful resource. Predictions for the future are that animal wastes will again be viewed more favorably as a useful resource.

7 Fuel

The energy in ruminant manures is rather high (dry cow dung 4.58 to 4.72 kcal per gram) and can be used as efficiently as energy from coal or oil if appropriate equipment is used. In some cases, dry dung cakes are preferred over plant residues because of uniformity of heat. India

annually uses 60 to 80 million tons of dry buffalo, cattle, sheep and goat dung for fuel. In the central plains area where there is no firewood, per-capita use is as much as one ton per year. In two instances, the sale of dung cakes to urban centers provided up to 60 percent of the total cash income per rural family. The expected return per animal per day from the sale of dung cakes is 1.03 rupees or \$0.12. India would need to expend over US \$3 billion per year, exclusive of distribution costs, for coal and oil to replace dung.

8 Pastoral herders, especially nomads, largely depend on cattle, sheep, or goat manure as fuel for cooking, heating and light. Estimates are that over 200 million tons of manure are used per year as fuel in developing countries. Supplies of firewood or charcoal - traditionally the chief sources of fuel in central Africa fringing the Sahara, the Andes region of Latin America, the highlands of Central America and the Caribbean islands - have become scarce or non-existent. In many areas nearly 20 percent of the total family labor is expended to gather wood or crop residues for fuel, and the time spent is increasing. Expenditures by salaried workers for firewood or crop residues have risen from 15 to 25 percent of income. In Africa and the Americas, animal manures have not been used extensively as fuel, but usage will probably increase rapidly in the near future. Over the long run, methane gas from animal wastes will likely make the greatest contribution.

#### 9 Methane Gas

During the 1930's and 40's, digesters were used rather extensively in central and northern Europe for producing methane gas, but production declined to nearly zero when oil became cheap during the 1950's. Currently there is vast interest in digesters to meet fuel needs. In 1975, South Korea had 29,000 bio-gas plants and planned to build another 50,000. India has about 20,000 plants, two-thirds of which were built since the energy crisis, and plans to build 100,000 more within the next 5 years. Taiwan has a large number of plants and there are some in Bangladesh and Nepal.

10 The US could obtain nearly 1.0 percent of its energy by 1985 from renewable resources, and this could increase to 25 percent by 2020 AD. Of this, methane production is capable of producing about 5 percent by 1985 and 25 percent in 2020. Canada has a similar capability.

11 Fecal material produced by ruminants, particularly buffalo, cattle, sheep and goats, is an ideal substrate for anaerobic fermentation because it is already buffered and contains large populations of methanogenic bacteria. Methane from manure has a value of 5 kcal per cubic meter which is 71 percent of the energy value of natural gas. It works well for household use but is difficult to handle in mobile power. Processing manure through bio-gas plants has the added advantages of better preservation of fertilizer in some areas where dung is burned.

12 A major handicap for methane production is capital cost for small



# GOAT MILK VERSUS COW MILK

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DE Milk and Milk Handling

Text

1 To most people today, especially in the more developed countries, the term milk is synonymous with cow milk, as if cows alone possess a singular ability to produce mammary secretions. Perhaps nowhere has the feeling been more prevalent than in the US, where over 10 million cows are maintained to provide an abundant, clean source of nourishment and refreshment to our country, producing more than 125 billion pounds of milk annually. Yet on a world wide basis, there are more people who drink the milk of goats than from any other single animal. Over 440 million goats (world wide) produce an estimated 4.8 million tons of milk that is predominantly consumed locally, or processed into various types of cheeses.

2 Here in the US, which historically has been one of the staunchest denigrators of the 'stinking' goat, there are approximately a million dairy goats actively producing milk. Most of the upsurge in goat popularity has been the result of a growing trend towards attaining some measure of selfsufficiency on the part of many people, for both economic and aesthetic purposes. A goat will eat little, occupy a small area and produce enough milk for the average family (a good milker will produce about a gallon a day); whereas the prospect of maintaining a cow in a suburban backyard is usually more than the homeowner is willing or able to cope with. Hence the growing popularity of the 'poor man's cow'.

3 As the interest in dairy goats and their products continues to rise, it is apparent that many misconceptions, discrepancies and exaggerated claims are being perpetuated. A comparison of cow and goat milk seems to be in order, so that some prejudices against goat milk may be erased. Also, while goat milk is somewhat unique, it is certainly not a magical elixir.

4 One of the primary misconceptions concerning goat milk is that it has a peculiar 'goaty' odor or taste to it. This effect is produced by the presence of the buck, whose scent glands are rather odoriferous and may indeed cause the 'goaty' type of milk people object to if he

is present among the herd, especially at milking time. Does, however, do not have the powerful odor of the buck and milk produced in the absence of a buck should bear no objectionable odor.

5 Diet also plays a large role in the palatability of goat milk, as well as cow milk. While cows are usually rather closely regulated as to what they may eat and when, goats are often allowed to consume a great variety of materials at any time, including browsing. This kind of feeding may allow a certain 'off' taste or smell to be transferred to the milk, just as cows may produce a 'garlicky' milk from some spring pastures. What holds true for the cow also holds for the goat; i.e. what comes out is based on what goes in! If goats and cows are similarly managed, the smell and taste of both milks are quite comparable.

6 Goat milk is similar to cow milk, in its basic composition. In average, cow milk contains about 12.2 Dry matter (3.2 protein, 3.6 fat, 4.7 lactose and 0.7 mineral matter). Goat milk contains about 12.1 dry matter (3.4 protein, 3.8 fat, 4.7 lactose and 0.7 mineral matter). These figures are only averages of course, as there are considerable differences between breeds, and among individuals of a breed. There are 6 breeds of dairy cows in the US, and 6 breeds of dairy goats producing milk.

7 The Saanen is best known as the Holstein of the goat world, producing a high quantity of milk with somewhat low fat levels. At the other extreme is the Jersey of the goat world, the Nubian. This breed produces a lesser amount of milk with a high fat content. The Toggenburg, LaMancha, Oberhasli and Alpine fall somewhere in between.

8 However, there are also differences that give goat's milk a place for special purposes. In summary:

++++MISSING DATA++++

9 Allergies appear to be more common than formerly thought, especially in very young children. In an allergic type reaction, the symptoms are produced by histamines, which are stored in body cells. Histamines are released when triggered by a local stimulus. Antibody-antigen type reactions that manage to find an anchorage on cell walls trigger a release of histamine and produce the allergic symptoms. Such a release brings on a congestion of the capillaries and a flooding of the intracellular spaces by the lymphatic glands. The stimulation of local nerve endings also occurs. People who display an allergic reaction are usually more sensitive to the release of a given amount of histamine and also tend to produce greater numbers of antibodies to certain proteins.

10 Some of the so called 'sudden deaths' of infants seem to be related to allergic type responses, resulting in anaphylactic shock. About 60 of the infants in the US suffer allergic responses to cow's milk. Of this number, however about only 14 (of the 6) react to

bovine serum present in cow milk. Most infants are allergic to various constituents of cow milk which may also be present in goat milk. Individuals who are allergic to bovine serum in cow milk will undergo also an allergic reaction to a variety of dairy products that are made with cow milk.

11 Other types of digestive upsets can result from milk due to a lack of the lactosedigesting enzyme. While the presence of lactase is universal in infants (up to 3 years), the presence of this enzyme in adults is somewhat irregular and genetically determined.

12 Fat

One of the more significant differences from cow milk is found in the composition and structure of fat in goat milk. The average size of goat milk fat globules is about 2 micrometers, as compared to 21/2 - 31/2 micrometers for cow milk fat. These smaller sized fat globules provide a better dispersion, and a more homogeneous mixture of fat in the milk. Research indicates that there is more involved to the creaming ability of milk than merely physical size of the fat globules. It appears that their clustering is favored by the presence of an agglutinin in milk which is lacking in goat milk, therefore creating a poor creaming ability, especially at lower temperatures.

13 The natural homogenization of goat milk is, from a human health standpoint, much better than the mechanically homogenized cow milk product. It appears that when fat globules are forcibly broken up by mechanical means, it allows an enzyme associated with milk fat, known as xanthine oxidase to become free and penetrate the intestinal wall. Once xanthine oxidase gets through the intestinal wall and into the bloodstream, it is capable of creating scar damage to the heart and arteries, which in turn may stimulate the body to release cholesterol into the blood in an attempt to lay a protective fatty material on the scarred areas. This can lead to arteriosclerosis. It should be noted that this effect is not a problem with natural (unhomogenized) cow milk. In unhomogenized milk this enzyme is normally excreted from the body without much absorption.

14 Another significant difference from cow milk is the higher amount of shorter-chain fatty acids in the milk fat of goats.

15 Furthermore, glycerol ethers are much higher in goat than in cow milk which appears to be important for the nutrition of the nursing newborn. Goat milk also has lower contents of orotic acid which can be significant in the prevention of fatty liver syndrome. However, the membranes around fat globules in goat milk are more fragile which may be related to their greater susceptibility to develop off-flavors than cow milk.

16 Protein

The protein composition of cow and goat milk is fairly similar, although the typical major alpha-s-1- casein in cow milk is absent in goat milk and the formation of casein curd under rennin action is

different. The quality of curd is judged on two criteria:

1. Curd tension - a measure of the hardness or softness of the curd. The softer the material, the more easily digestible it is. This tension is largely a breed characteristic. Holsteins generally have the softest curd in the bovine family. Cow range = 15-200 g, avg = 70 g. Goats range = 10-70 g, avg = 36 g.

2. Relative size of flakes - formed by the addition of strong acid to milk, causing curd flakes to precipitate. It can be seen that goat milk forms finer flakes more rapidly than cow milk, which tends to form large lumps and more slowly. This test tends to duplicate reactions that occurs in the stomach, and demonstrates why goat milk is more easily and rapidly digested.

#### 17 Vitamins

Goat milk has greater amounts of vitamin A than cow milk. Also, goats convert all carotenes into vitamin A, creating a white type of milk.

18 Vitamin B levels are a result of rumen synthesis in goats and cows, and are somewhat independent of diet. Goat milk is higher in B levels especially riboflavin, but vitamin B6 and B12 are higher in cow milk. Niacin levels are also higher in goat milk.

19 The milk levels of vitamin C and D are low and roughly the same for cows and goats.

#### 20 Lactose

Cow milk is higher in lactose levels, although the difference is minor.

#### 21 Ash (Minerals) and Buffering

Goat milk is higher in minerals, calcium, potassium, magnesium, phosphorus, chlorine and manganese; but it is lower in sodium, iron, sulphur, zinc and molybdenum.

22 Cow and goat milk is slightly on the acid side, with a pH range of 6.4-6.7. The principal buffering components of milk are proteins and phosphates. The good buffering capability of goat milk appears to make it ideal for treatment of gastric ulcers.

23 Goat milk has also less of certain enzymes, ribonuclease, alkaline phosphatase, lipase and xanthine oxidase. Thus, some differences exist but their nutritional significances in human nutrition have yet to be researched and documented. The goat probably will never replace the cow for commercial production of milk, but there seems to be a great potential for diligent efforts in practice and research to improve production and marketing of goat milk and its products. The value of goat milk as an alternative food for children and sick people, because it is easier digested, extends also to feeding animals, young dogs, foals, even calves. Experience in the field indicates that calves can





# GRAIN OVERLOAD

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TI GRAIN OVERLOAD  
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DE Health and Disease Management

## Text

1 This condition which is also called 'acute carbohydrate engorgement' or 'lactic acidosis', is life threatening and must be handled as an emergency. Treatment must begin as soon as it is realized that the goat has eaten a more than normal amount (as little as half again as much) of grain or other sources of readily fermentable starch. The longer treatment is delayed, the more difficult it is to reverse the progressive chain of events that will end in death in 2 to 4 days. The underlying problem is the rapid fermentation of starch in the rumen with the resultant production of lactic acid. This acid is picked up by the blood stream in dangerously high amounts that disrupt the normal body chemistry.

## 2 Clinical Signs

The severity of the signs depends largely upon the amount eaten. In the first few hours, a full rumen, restlessness and crying in pain may be all that is seen. There are mild forms which do not progress beyond simple indigestion. However, in severe forms there may be evidence of extreme pain (crying and getting up and down) which will become intermittent and then be predominated by depression. They will often stagger and even appear blind. The appetite will disappear during the first day as will rumen contractions. The fecus may become soft.

3 The temperature will become sub-normal unless the animal is exposed to hot sun. As the acidosis (lactic acid level in the blood and body fluids) increases, circulatory collapse (shock) will begin; this will increase the heart rate. In cattle, animals with a heart rate of less

than 100 will much more likely respond to treatment than one with a heart rate of 120-140. It seems likely that a similar prognostic aid would be valid in goats. Respiratory rate becomes fast and breathing is shallow. Diarrhea usually develops and is profuse.

4 The excess lactic acid in the rumen causes a large amount of body fluid to be transported into the rumen. This is a dehydration process which is detectable by an increase in the hematocrit (the percentage of red blood cells in whole blood). This decrease in the amount of fluid in the blood and the acidosis cause circulatory collapse. The shock is best detected clinically by a paling of the mucous membranes, a fast heart but barely perceptible pulse. As long as the hematocrit stays normal (30-40) the prognosis (outlook) is favorable. A hematocrit above 45 aids in the diagnosis of grain overload and indicates a less favorable prognosis.

5 The rumen may feel full and doughy; if less grain was consumed, it may feel resilient because of increased fluid and gas. The rumen will have no contractions but one may hear a lot of gas rising through fluid.

6 Usually after two days the animal will lie down and not voluntarily get up. They will be extremely depressed.

#### 7 Tissue Changes

In animals dying within two days; the cornified rumenal epithelium is soft and easily removed; there is hemorrhage of the underlying surface. There may be abomasitis and enteritis. There is an odor suggestive of fermentation and, if the necropsy is conducted within an hour of death, the pH of rumen contents will be 4 to 5.

8 In cases lasting 2-3 days, the rumen and reticulum walls may be greatly edematous and hemorrhagic resulting in marked thickening.

#### 9 Diagnosis

When there is a known exposure to grain, the signs may be easy to interpret. When grain is offered to a group of animals, especially for the first time, a predominant fast-eating bully animal may be able to overfeed on the grain meant for the other animals. However, if one does not expect or can't find evidence of overload, the symptoms are quite similar to any other acute septicemic disease such as peracute mastitis or metritis or diffuse peritonitis. Careful clinical examination by the veterinarian will be very useful and the most revealing tool will be the collection and finding of rumen fluid with a pH of 4 to 4.8 and no protozoal activity.

#### 10 Prevention

Under most management systems, grain overload in goats results from escape of animals from their pens and finding an open or otherwise unsecured source of grain. The first step of prevention is having good

pens. Even then escape occasionally occurs; therefore the most important step is to store grain inside a room or shed that is absolutely goat-proof. To avoid human error, the door should be self-closing and self-latching.

## 11 Treatment

Because grain overload is life threatening, your veterinarian should be consulted immediately. Two different clinical possibilities exist which require different courses of action. In the first the animals are 'caught in the act' or you find them out of their pens with evidence that they have eaten grain. They are not yet ill. The second situation should be less common if the goats and facilities are observed frequently. Here engorgement took place 12-48 hours previously and they now show signs of lactic acidosis.

12 When the animals are found eating illicit grain, call your veterinarian. In the event a veterinarian is not immediately available the following course of action is recommended.

13 First, remove all sources of feed and water for 12-24 hours except good quality hay equal to a one-half days ration per animal. Exercise them 5-10 minutes every hour. The author prefers to give 1 tablespoon (15cc) of Milk of Magnesia orally followed by 1 ounce (30cc) of water (no more than 2 ounces) to an adult goat. This should be repeated later if the animal starts to show signs of restlessness or discomfort.

14 The second situation involves animals that have engorged themselves 12-48 hours previously and have progressively worsened. They may be discovered this way or are worsening despite early treatment. These goats should be isolated and observed closely.

15 The color of the mucous membrane of the eyes (or vulva or sheath of the penis) should be observed early and regularly for evidence that the healthy pink is changing to pale pink to white. The heart rate can be counted by pulling a front leg forward and placing ones ear over the chest where the goat's elbow was. If the heart rate of the resting, unexcited goat is as high as 90-100 beats per minute range, they must be watched closely.

16 If the mucous membranes are becoming pale and the heart rate is above 100-110, if the animal is becoming depressed or if it staggers slightly or is showing evidence of pain, the veterinarian should personally evaluate and treat the animals.

17 In moderate cases drenching or dosing 50 grams of magnesium hydroxide or magnesium oxide in a liter of warm water to a 70 kg (155 pound) goat, followed by kneading the rumen to obtain mixing may be sufficient treatment. In more severe cases that are still standing and the rumen pH is 5 to 6, a large stomach tube may be passed and the rumen washed with 10-15 irrigations. Tepid water is pumped in until



# GRASSES, FORBS AND BROWSE

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TI GRASSES, FORBS AND BROWSE

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DE Nutrition

Text

1 While much of the scientific agricultural community attempts to provide more and better forages for specific animal use, goats do well on what they have, provided they are given the chance to choose. Although their nutrient requirements exceed those of most other livestock species, goats succeed while others fail. The reason for this success is that goats are particular. They consume the best parts only.

2 Vegetation

Vegetation is often divided into three groups: grasses, forbs, and browse plants. Grasses are monocotyledons and belong to the family, Gramineae. Leaves of these herbaceous plants appear as blades, with parallel veins. Forbs, often called weeds, are dicotyledons and include individual plants from many families. Veins in the leaves are not parallel but are netted or branched. The general term, forb, refers to any herbaceous, broadleaf plant without regard to family classification. Browse plants include plants other than grasses and forbs but are usually taller plants, such as trees, shrubs, and vines having woody stems.

3 Nutritional Values of Grasses, Forbs, and Browse Plants

Even though grasses are usually considered the most desirable type vegetation for livestock production, forbs and browse plants often contain higher levels of nutrients. Leguminous forbs and browse, for example, commonly contain more than 25 percent crude protein, whereas

perennial grasses seldom exceed 15 percent in crude protein content. The energy contents of flowers, fruits, seeds and nuts of forbs and browse can exceed 1.6 megacalories digestible energy per pound of dry matter. In grass foliage, 1.2 megacalories per pound of dry matter is considered high quality.

4 Each plant, whether a grass, forb, or browse plant, is composed of many plant parts that differ from one another in nutritional value. Generally, leaves are more nutritious than stems and new leaves more valuable than old leaves. There are some exceptions to this generalization, especially when certain plant chemicals, such as tannins prevent proper digestion of the plant tissue. The total effect of these binding chemicals on the nutritional values of plants are not fully determined, especially in many of the browse plants.

#### 5 The Goat and Diet Selection

Goats are agile and have exaggerated control of their mouth parts, allowing them to be very selective for diet. They are able to stand on their hind legs and climb rock cliffs and low growing trees to gain access to relished plants and plant parts that are unavailable to other livestock species. Goats have a mobile upper lip, effective in nipping off plant parts very selectively. As a result, the goat's diet is very diversified, consisting of small components of a large number of plant species. Very simplified vegetation, an all-grass meadow, for example, does not provide good nutrition for goats over a long period of time. Goats need access to a wide variety of plants in order to exercise diet selection, as different plants increase and decrease in nutritional value with seasonal changes.

#### 6 The Goat as a Brush Control Tool

Many of the browse species have invaded or become overabundant in old, abandoned fields or on range and pasturelands following prolonged grazing by other livestock species. These invading species, collectively called 'brush', often can be suppressed or eradicated using goats. Goats are effective as brush control tools, when the following requirements are met:

1. The brush is either low-growing or is reduced to low growth by mechanical means,
2. The brush species is preferred by goats,
3. Goats can be concentrated in large numbers for a relatively short period, then removed for an extended period.

7 Each time the goats are concentrated, they consume the leaves and twigs of the brush species, as well as a substantial portion of the grasses. When the goats are removed, the grasses recover more quickly than the brush. After several sequential grazing and rest periods, the brush is reduced to a density easily controllable, with a few goats



# HEAT STRESS

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TI HEAT STRESS

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DE Anatomy and Physiology

Text

1 Nearly every life form is affected in some way by high temperatures, and goats are no exception. It is not heat alone that causes stress to the goat; but it is the combination of temperature and humidity when some crucial limit has been reached, which shuts down all bodily functions other than those critical for survival.

2 Water and Feed Intake

The most immediate impact of heat stress can be seen in changes of water and feed consumption. As the temperature rises, so does the animal's need for water. Plenty of water should be provided, free-choice, at all times. However, if water becomes scarce, goats hold an advantage over other domestic non-desert species in that they are better adapted to utilize the water content of feeds. However, rising temperatures also tend to reduce voluntary feed intake. This is the result of an attempt by the animal to reduce the production of body heat especially from fibrous feeds, lower physical activity, seek shade and change grazing to night hours.

3 Nutrition and Reproduction

A long range result of diminished nutrition due to heat stress is a reduced kid crop. If the doe is pregnant, especially near the end of gestation, this heat induced lack of proper nutrition may result in literal starvation of the fetus. On the other hand, if the doe is not pregnant, an insufficient supply of energy due to heat stress will



cause absence of follicular development. The same is true for the buck in terms of sperm production. Extremes in heat can affect reproduction directly as well, through 1) sperm and ova degeneration within the reproductive tract, 2) creation of hormone imbalances via action of the hypothalamus, and 3) suppression of libido and the physical act of mating.

### 4 Removal of Body Heat

In order to keep such drastic events from occurring, three major physical processes exist by which heat can be dissipated. They are:

- 1) convection
- 2) conduction, and
- 3) radiation cooling.

Convection cooling occurs when an air stream passes over the body either by wind or b ++++MISSING DATA++++

### 5 Hair Coat

Fortunately, the goat has it's own line of defense when environmental temperatures exceed body temperature. The first means of protection is provided by the coat, both from it's color and physical characteristics. The principle behind coat color involves the reflection of sun rays. It has been documented that white coats provide maximum protection against radiant heat and black coats give minimum protection, with variations falling in between. Reflective protection can be provided through physical characteristics of the coat as well. Contrary to popular opinion, long hair which lies close to the body is desirable. In this way, the coat acts as a mat to physically prevent the sun rays from reaching the animal's body. In addition, long hair serves as an insulator from the heat, providing an air buffer zone between the outer environment and the animal's body.

### 6 Skin Color

The next line of protection is the skin. Color of the skin is important, except this time darker colors are preferred. The function of the darker skin is to absorb any ultraviolet light which may have penetrated the coat, thereby preventing damage to tissue proteins. Having an excess of skin has also been implicated as providing heat relief. It is believed that this excess skin serves to increase the surface area in relation to body size in order to enhance evaporation. This has been the explanation used in order to account for the large, floppy ears found on goats and other tropical animals. Horns have also been suggested as providing benefit by providing an area where blood can be cooled before reaching the brain. Certainly, the little understood rete of goats is in this connection a unique anatomical structure designed to keep the brain of goats cooler than the rest of the body.

## 7 Sweating and Respiration

The greatest form of relief for the animal comes as the result of two seemingly contrasting forces: 1) water evaporation, and 2) water conservation. Water evaporation provides a direct form of relief as the result of two principle forces: 1) sweating, and 2) respiration. Sweating serves to cool the surface, but though it does provide some relief, respiration has been found to have eight times more evaporative capacity, thereby rendering it the chief form of relief from hot temperatures.

8 Water conservation on the other hand, plays a more indirect, but equally important role in the ability to tolerate heat. This function becomes extremely important if evaporative cooling is to occur when water supplies are scarce or nonexistent, otherwise dehydration will occur. Water conservation occurs chiefly through reduced renal and fecal excretion, and is facilitated by low potassium, high sodium excretion.

## 9 Methods of Heat Relief

If the goat continues to suffer from heat, even with all of these forms of protection, then it becomes the producer's responsibility

++++MISSING DATA++++

- 1) non-metallic reflecting
- 2) non-metallic non-reflecting
- 3) metallic reflecting, and
- 4) metallic non-reflecting.

10 When keeping animals in confinement, costs are expected to be higher. The most expensive yet most beneficial method of relief is provided by airconditioning. Of course, this investment is usually economically questionable. In order to reduce such costs, experiments have tried to determine if air-conditioning of just the head might provide relief. However, cooling the head or sprinkling with water provided little benefit. Instead, it was best to ensure a roof for protection from the sun, that air be allowed to circulate under the roof and that the roof was sun reflecting or cooled with a water sprinkler.

11 A long range means of increasing heat tolerance can be accomplished through genetic selection. It is important not to select for individual characteristics, i.e. ear length, but rather for a general over-all tolerance coupled with the capacity to produce milk. Once those individuals have been selected, additional benefits can be gained by cross-breeding to take advantage of hybrid vigor. Studies are needed to



# HERD HEALTH PROGRAM

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TI HERD HEALTH PROGRAM

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DE Health and Disease Management

Text

- 1 Herd health programs attempt to organize all the information applicable to goat herd health, into a concise, simple to remember and usable form. The goal of a herd health program is to improve the herds' productivity. This goal is achieved through nutrition management, disease control, reproductive management, parasite control and environmental management. Careful records must be kept in order to know where the program has been, how it is progressing and what to do in the future to make it better.
- 2 Each herd is unique and requires that its program be tailored to fit the needs and goals of that herd. The following discussion attempts to provide idealized guidelines that can be used to develop a program that fits the goals and aspirations for that herd.
- 3 Late Pregnancy and the Dry Doe  
Since this period of time is so important to the future of the herd, and offers many opportunities to institute many aspects of a herd health program, the discussion will begin during the dry period.
- 4 The pregnant doe should have a 40-60 day dry period, in order to regain condition lost during lactation, allow the mammary gland to rest and for the doe to get ready for kidding and the next lactation. At drying off, treat all udders with dry cow mastitis antibiotics. This is important, even though the udder has been healthy throughout the last

lactation. Many new udder infections begin during the first several weeks of the dry period. Dip teats daily with an approved teat dip until the udder begins involution.

- 5 The dry period is an ideal time to deworm. Internal parasites experience increased activity during late pregnancy and this is called the pre-parturient rise. More parasites can then be eliminated if the doe is dewormed at this time. Don't forget to check for external parasites and treat if any are found.
- 6 Parasite control at this time helps prevent excessive levels of parasite exposure to the newborn, as well as helping the doe.
- 7 Late pregnancy is also an ideal time to give the yearly booster doses of the vaccines that are utilized in that herd. The vaccines will give protection to the doe as well as ensure high levels of antibodies in the doe's colostrum for the newborn kid's protection. The vaccines used depend upon the problems and needs within each individual herd, but should include enterotoxemia, and tetanus.
- 8 Nutritionally, the dry period is a critical time. The metabolic and physiological needs are demanding. This is a rebuilding time for the doe, getting her ready for the demands of her next lactation. The developing fetus(es) grow rapidly during the last several weeks of gestation, thus greatly increasing the metabolic demands on the doe.
- 9 The most common problem seen during this dry period is allowing the doe to become over-conditioned. Over-conditioning puts excessive stress on the heavily pregnant doe and predisposes her to serious metabolic problems, one of which is ketosis. The excessive abdominal fat and pregnant uterus reduce the holding capacity of the doe's rumen, preventing her from being able to consume enough feed to meet her metabolic needs as well as the needs of the rapidly developing fetuses. Subsequently, to meet her metabolic need she begins to metabolize her fat reserves and potentially may develop ketosis. It is important during the early dry period to provide good quality roughage to ensure active, normal rumen function. During this brief period the doe's metabolic needs are minimal and the hay will be adequate to meet her energy needs; but 2-3 weeks before freshening, her metabolic needs begin to increase and she will require more concentrated forms of energy (grain). During this dry period, the doe should slowly gain in condition and weight. The eyes and hands of the owner can best determine the doe's condition. The quality and quantity of feed during the dry period will affect the doe and the kids throughout, at least, the next year. Not enough emphasis can be given to the tremendous importance of nutrition in any animal production unit.
- 10 Each dairy goat herdsman should have an annual calendar listing approximate times and ages when certain activities should be performed to maximize profits per productive unit. This annual calendar should



# HORMONES

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TI HORMONES

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DE Anatomy and Physiology

Text

- 1 Hormones are endocrine gland secretions that are transported by the vascular system to aid in the integration of body processes by their stimulatory or inhibitory effects on target organs. The time lapse between release and effect is longer than for the other major response system of the body, the nervous system. The complementary function of the two systems provides for full coordination of body responses of goats. The ultimate purpose of hormones is to provide a means of adaptation between the body and its external or internal environment.
- 2 Hormones may be classified into two categories by their chemical composition. Steroid hormones are secreted by the adrenal cortex and the gonads. Protein or protein-like hormones are secreted from the pituitary gland, thyroid, pancreas and adrenal medulla.
- 3 Hormones regulate bodily reactions through their effects on target organs, but they merely modify the rate at which target organs perform functions. They do not cause a reaction or event to occur per se that could not otherwise occur. Hormones also function at extremely small levels in the body, with the rate of secretion varying according to the level of stimulation.
- 4 Hormonal output is often controlled through a feedback system from the target organ. This is most evident through the interaction of the anterior pituitary gland, whose hormonal release controls the level of

activity of several other endocrine glands (adrenal cortex, thyroid, gonads). The increased secretory products of these glands serve as a negative feedback on the pituitary, causing a reduced rate of secretion of the stimulatory hormone.

5 The pituitary and the hypothalamus work together as a functional unit to coordinate the endocrine and nervous systems in their actions, with the hypothalamus being the ''center'' of the autonomic nervous system and master of the pituitary.

#### 6 Posterior Pituitary

The hormones of the posterior pituitary (neurohypophysis) differ from the other pituitary hormones in that they do not originate from the pituitary, but are only stored there until needed. The two hormones, oxytocin (milk let-down hormone) and vasopressin (antidiuretic hormone or ADH) are actually produced in the hypothalamus. Their method of transfer from the hypothalamus to the pituitary is unique because it is not through the vascular system, but along the axons of the nervous system.

7 Vasopressin, is a small polypeptide. Its amino acid structure varies slightly. In the goat, arginine is the main base. ADH does not always function under every day events; but hemorrhaging, trauma, pain, anxiety and some drugs will trigger its release and low environmental temperatures will inhibit it. ADH exerts its effects upon the distal tubules and collecting ducts of the loops of Henle of the kidney, resulting in increased water absorption.

8 Oxytocin, the other hormone of the posterior pituitary, is one of the important and ''practical'' hormones from a dairy goat owner's point of view, as oxytocin controls lactation and reproductive phases of the goat. A neural stimulus, such as suckling or washing of the udder causes the hypothalamus to stimulate the posterior pituitary into releasing oxytocin, which is circulated through the blood until it comes into contact with the myoepithelial cells surrounding the alveoli of the mammary gland. The oxytocin causes the myoepithelial cells to contract, effectively squeezing the milk out of the secreting alveoli and releasing it into the milk ducts, cystem and teats of the mammary gland. The release of oxytocin can also occur through a conditioned reflex response, such as the banging of milk buckets, or even just putting the goat on the milk stand. Anything that the goat learns to associate with being milked may serve as a stimulus of oxytocin milk let-down through the process of conditioning.

9 Oxytocin also plays a role in reproductive processes. During the follicular phase of the ovarian cycle and during the late stages of gestation, oxytocin stimulates uterine contractions, which facilitate the transport of sperm to the oviduct at estrus and which aid parturition. It has been demonstrated that stretching of the cervix stimulates the release of oxytocin.



## 10 Anterior Pituitary

The hormones of the anterior pituitary (adenohypophysis) are produced within the pituitary itself. They consist of the follicle stimulating hormone (FSH), luteinizing hormone (LH), prolactin, adrenocorticotrophic hormone (ACTH), thyroid-stimulating hormone (TSH), growth hormone, and intermedin from the pars intermedia, the segment between the anterior and posterior pituitary.

11 The two pituitary gonadotropins, FSH and LH, are necessary for the maintenance of gonadal functioning. FSH, while not actually initiating the formation of a follicle in the female goat does stimulate overall follicular growth after several layers of cells have already enveloped an oocyte. Follicle maturation is achieved through the combined actions of FSH, LH and the female sex hormones.

12 The action of LH on a follicle, that has been subjected to FSH, is to increase the growth rate and stimulate the secretion of estrogen from thecal cells. Ovulation is triggered by this process. The conversion of the follicle to a corpus luteum is the result of LH activity; and the continued secretion of progesterone from the corpus luteum is also believed to be controlled by LH.

13 Prolactin, the lactogenic or luteotropic hormone (LTH), is vital for the proper development of lactation in goats, although it cannot initiate the secretory process, and requires estrogen and progesterone to 'prime' the mammary system. Prolactin does not seem to be as necessary for the continuation of lactation as it is for its initial development, and for stimulating the corpus luteum.

14 The action of these hormones in bucks are analogous to those in female goats. FSH in the male stimulates spermatogenesis by exerting its effect on the seminiferous tubules. Full spermatogenesis cannot be accomplished without the conjunctive effort of LH, known as interstitial cell stimulating hormone (ICSH) in the male, and certain levels of testosterone. ICSH facilitates the production of testosterone from the interstitial cells of the testes. Prolactin has not been demonstrated to have specific effects in male reproduction so far, but in general is known to lower blood pressure.

15 Adrenocorticotrophic hormone (ACTH) secreted from the anterior pituitary causes several events to occur, but of primary importance is the release of adrenocorticoid steroids from the adrenal cortex into the bloodstream. Other effects include a reduction of lipid levels from the adrenocortical cells, a lowered concentration of adrenal cholesterol and ascorbic acid, a general increase in adrenal cell size and number, along with an increase in adrenal blood flow. ACTH promotes the secretion of aldosterone, especially following body stress, such as loss of blood. ACTH also influences processes not related to adrenal function, including movement of fatty acids and neutral fats from fat

## HORMONES

depots, ketogenesis, muscle glycogen levels, hypoglycemia, and amino acid levels of the blood.

- 16 The thyroid stimulating hormone (TSH) promotes the release of thyroxin from the thyroid gland. It also increases the rate of binding of iodine within the thyroid. The release of thyroxin serves as a general metabolic control, with higher levels of thyroxin producing an increased metabolic rate.
- 17 The basic function of the growth or somatotropic hormone (STH) is to stimulate an increase in body size. Growth hormone, along with other pituitary hormones, is important in protein synthesis providing high intracellular concentrations of amino acids. It exerts its effects on bone, muscle, kidney, liver and adipose tissues in bones in particular, the epiphyseal plates are sensitive to it. Growth hormone causes hypertrophy of the kidney after one was removed. Growth hormones regulates along with the thyroid hormone, the glomerular filtration rate and renal blood flow through the kidney; and growth hormone is synergistic to ACTH and antagonistic to insulin.
- 18 Growth hormone mobilizes fat from adipose tissue, resulting in increased blood levels of ketone bodies, together with stimulation of the alpha cells of the pancreatic islets, causing glucagon secretion. Growth hormone also exerts a stimulating influence on milk production in lactating goats, either partly or entirely due to an increased amount of mammary gland tissue.
- 19 It has been suggested that intermedin, the melanophore stimulating hormone (MSH), regulates excitatory states of the central nervous system. MSH is involved in pigmentation patterns in mammals, although not to the same extent as known in reptiles, amphibians and fish where large variations in color due to changes in temperatures, humidity and illumination can be produced. All secretions of the anterior pituitary require a releasing factor from the hypothalamus, referred to as MRF, TRF, SRF, LRF, FRF, CRF and PIF, depending on whether the MSH, TSH, STH, LH, FSH, ACTH or LTH are involved.
- 20 Pineal
- The pineal gland or epiphysis in goats and most other mammals is responsible for melatonin synthesis. It functions on a photo-receptive basis, causing different levels of melatonin production depending on light intensity. The pineal also affects the development and function of the gonads.
- 21 Thyroid
- The thyroid gland is filled in its spherical follicles with a colloid consisting of thyroxin bound to a protein which is essential to life. Thyroxin is secreted into the blood and lymph system to control the rate of oxidative metabolism. Another hormone, calcitonin, is also produced by the thyroid tissue, aids in the metabolism of calcium, and

is essential for general bone development.

22 The thyroid is interrelated to other endocrine glands, the adrenals and the gonads through the pituitary; but there is little interrelationship between the thyroid and the parathyroid. The structure of the thyroid hormone, thyroxin, is unique because the element iodine is essential for biological activity and release from the gland itself. Thyroxin is necessary for the maturing of animals. While growth hormone is responsible for physical growth, thyroxin is necessary for the proper differentiation of body structures. Growth and eruption of the teeth of goats is under thyroid control, as well as the growth of horns. Even the skin and hair are affected by thyroid changes. A lack of thyroxin will cause a thinner coat of hair, with individual hairs being more coarse and brittle.

23 Reproductive failures and deficiencies in both sexes may be at least partly attributed to a lack of thyroxin, causing a variety of problems from abortions and stillbirths in does to impaired spermatogenesis and lowered libido in bucks. Perhaps the most sensitive reproductive gland of all is the mammary gland. Thyroxin has been shown to be a powerful galactopoietic agent, increasing milk production 10 to 30 when feeding iodinated casein. The feeding of thropoteins, however, has the disadvantage of increasing the susceptibility of the goats to heat stress during periods of high temperatures.

24 The thyroid hormone has an impact on thermoregulatory processes. By increasing the general rate of oxygen consumption at the cellular level, heat production is increased. Thyroxin stimulates general nervous functions at all levels, decreases the threshold of sensitivity to many stimuli, shortens reflex time and increases neuromuscular irritability. There is also an interrelationship between thyroxin, epinephrine and norepinephrine, the hormones of the adrenal medulla. Thyroxin inhibits the breakdown of epinephrine and norepinephrine.

25 Low levels of thyroxin during developmental stages have detrimental effects on the nervous system, the cerebral cortex, and general myelin development.

26 Goiter, the enlargement of the thyroid area, can be brought about by either hyper or hypothyroid conditions. The most common cause in animals is a deficiency of iodine making the animal hypothyroid. Many feedstuffs have goitrogenic effects, and inhibit the activity of the thyroid. Vegetables such as cabbage, soybeans, lentils, linseed, peas, peanuts and all of the cruciferous (mustard-like) plants possess goitrogens such as thiocyanate and goitrin which is especially prevalent in the Brassica family. They interfere with the process of trapping iodine by the thyroid, and their effects can be counteracted by feeding increased levels of iodine in the ration.

27 Parathyroid

This gland, located dorsal to the thyroid in goats, is responsible for the maintenance of proper calcium levels in the blood and extracellular fluids. Parathormone, the secretion of the parathyroid increases calcium levels in the blood and affects calcium and phosphate levels of the bones and kidneys. Thyrocalcitonin from the thyroid has the opposite function to parathormone, causing a decrease in blood serum levels of calcium during events of hypercalcemia. Parathormone effects bones directly by mobilizing calcium from the bones into the bloodstream. Parathormone also lowers the ability of the kidney to excrete calcium, thereby increasing calcium retention. Parathormone and vitamin D work together on calcium release from bone and in increased absorption of calcium from the intestine.

## 28 Pancreas

The pancreas is primarily an organ of digestive secretions, although there are functionally different groups of cells mixed throughout the pancreas, known as the Isles of Langerhans. They have rich blood supplies and consist of so-called alpha and beta cells. The alpha cells are responsible for the production of glucagon. Low b  
++++MISSING DATA++++

29 Other sources of steroid hormones besides the adrenal cortex are the ovaries, testicles and placenta. Steroids are inactivated by their target organs and in the liver and kidney. These inactivated hormonal substances are water soluble and are readily eliminated through the urine.

30 Deficiencies in glucocorticoid levels have detrimental effects on the general body metabolism. A primary function of the glucocorticoids is as a catalyst in the gluconeogenic process, i.e. formation of glucose from proteins and fats. They also help regulate water metabolism together with the mineral corticoids and aldosterone.

31 The secretion of the glucocorticoids from the adrenal cortex is stimulated by ACTH. Due to the negative feedback system involved between glucocorticoid levels and ACTH secretion from the anterior pituitary, a condition of adrenal atrophy will develop if glucocorticoid injections are administered for any length of time.

32 Structural changes, in the form of size increases of the adrenals can be observed in animals that are involved in stress situations. The stress of crowding is a major factor in adrenal enlargement, and adrenal weights of wild animals are used as a measure of population density. Over-activity of the adrenals produces androgens that inhibit the production of gonadotropins, which lower the reproductive performance of the population.

## 33 Gonads

Sex hormones are primarily secreted by the ovaries and testes, also by non-gonadal organs such as the adrenals and the placenta, to some

extent. They are of four types: androgens, estrogens, progestins and relaxin. The first three types are steroids while the fourth is a protein.

34 The strongest and most predominant of the androgens is testosterone, which is produced by the interstitial or Leydig cells of the testicles. Testosterone and its by-products androsterone and dehydroandrosterone, circulate throughout the bloodstream, and are bound to plasma proteins. They are rapidly used by target organs or degraded by the liver and kidneys. Testosterone and related hormones are responsible for male secondary sex characteristics of bucks, body conformation, muscular development and libido. They are also responsible for the growth and development of secondary sex glands of the males, as well as maintaining the viability of the spermatozoa and stimulating penile growth.

35 The ovaries produce two steroid hormones, estradiol and progesterone; plus another protein hormone, relaxin. Estradiol, a specific estrogen, comes from the Graffian follicles; progesterone from the corpus luteum. A ruptured follicle (corpus luteum), develops into a second endocrine structure, and its primary production shifts from estrogen to progesterone. The function of progesterone is in the areas of preparation of the uterus for implantation and maintenance of pregnancy. Also involved is the suppression of formation of new follicles, new estrus and preparation of the female goat for lactation through increased mammary development.

36 Relaxin is a hormone related specifically to the birth process, and does not appear until late in pregnancy, just before parturition. It acts upon the ligaments and musculature of the pelvis, cervix and vagina. The precise site of formation of this hormone is not known, yet it is speculated that production may occur in the cells that are located in the boundary region of the cortex and medulla of the ovaries.

37 During pregnancy, the uterus itself takes on hormonal functions through the production of placental hormones: chorionic gonadotropin, estrogens and progesterone. These hormones serve to maintain the uterus in a way that is favorable for the continued growth and development of the mammary gland.

### 38 Gastrointestinal Tract

All hormones secreted by the gastrointestinal mucosa and small intestine are related to the digestive process. Five of these have been chemically identified, with the possibility of more existing, making the small intestine a major site of hormonal production, second only to the pituitary.

39 One hormone, secretin is responsible for stimulating pancreatic, bile and duodenal secretions. While causing an increase in fluid levels



# HOUSING

COLLECTION: GOAT HANDBOOK

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Extension Goat Handbook

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TI HOUSING

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DE Management and Housing

Text

1 Dairy goats do not need fancy housing. Many older buildings can be adapted to cut costs. Those intending to remodel a building for housing goats or build a new one should first visit several goat dairies, inquire about the strengths and weaknesses of their housing systems, then contact the local county agent regarding insulation and ventilation needs.

2 There are two main methods of housing dairy goats: (1) shed type or loose housing, and (2) tie stalls or individual confinement. Some use a combination system, stalls for milking does and loose housing for the yearlings and kids.

3 Loose Housing

This has many advantages and some disadvantages. These may be summarized as follows:

Advantages:

1. Exercise resulting from the freedom is desirable.
2. Daily handling of manure is minimal or possibly eliminated.
3. Manure pack, when kept dry, provides heat and comfort.
4. Building construction and maintenance costs are minimized.

Disadvantages:

1. Boss goats, especially when horned, may cause injury.
2. There will be much riding when a doe is in heat.
3. More bedding is required.
4. A separate milking parlor is an absolute requirement.

4        Dirt pen floors are preferred over cement. At least 15 sq ft of bedded area should be provided for each goat. The floor should be bedded regularly with dry straw, wood shavings or ground corn cobs to absorb moisture. Some dairymen construct feeding stanchions at the feed bunk. Stanchions permit one to control intake of feed grains. At least 10 ft of vertical space from floor to ceiling rafters is desirable to facilitate cleaning with a tractor and front-end loader.

5        Goats prefer to be outside some on nice days, even when it is cold. The outside exercise lot should provide a minimum of 25 sq ft of space per animal, be well-drained and properly fenced. Goats like to lean on the fence to greet visitors. A 6-inch woven wire fence (4 to 5 ft high) is adequate. Some goats will get out of nearly any fence. In this case, place an overhanging wire from 10 to 12 inches from the inside and top of the fence, supported by offset pieces nailed to the posts. This wire may be electric, although barbed wire is usually adequate. Put snap hooks on all gates. Goats are able to unlatch other types of hardware.

#### 6        Confinement Housing

      This also has several advantages and disadvantages, namely:

##### Advantages:

1. Less bedding is used.
2. Individual pens permit more attention to the needs of each animal.
3. It is easier to show animals to prospective buyers.
4. An outside exercise lot is not an absolute requirement.

##### Disadvantages:

1. Building costs are increased because of concrete floors, and individual pens.
2. Individual pens are more labor intensive.
3. Poorly ventilated housing is conducive to more health problems.



7 Individual pens should be about 6 ft square, and equipped with a hay feeder, grain box and water pail, all attached to the pen wall. The pen floor may be constructed to slope 3 to 4 inches toward a gutter cleaner.

## 8 Ventilation and Insulation

Ventilation is a continuous process to remove moisture and other contaminants given off from the breath of animals from inside the building, provide fresh air for the animals, remove odors and gases from animals waste, provide a satisfactory minimal temperature in winter, and maintain a summer temperature inside the barn that is approximately the same as outside.

9 A system is required to bring fresh air into the building, distribute it evenly, and remove it. This system is completely different for the 2 types of housing environments, 'cold' and 'warm.'

10 In 'cold' housing, natural convection forces move the air, and properly located adjustable inlets provide distribution and volume control. In 'warm' housing, a mechanical ventilation system, either exhaust or pressure, is used. Exhaust systems are the more popular. Air distribution is provided by properly located inlets and exhausted via 2 or more mechanical fans, at least 1 running continuously.

11 Cold Housing - This is becoming more popular because of increasing energy costs and simplicity in providing a healthy environment. The cold unit is mainly a 'shell' to keep rain and snow off the animals and to protect them from wind.

12 Sufficient air movement must be provided to prevent fogging and excessive condensation beneath the roof. Satisfactory ventilation can be provided through a continuous open ridge (minimum 4-inch width with no screen over the opening) together with suitable wall openings. A 1-inch thickness of rigid insulation is recommended under the roof to reduce condensation in winter and heat gain in summer.

13 Inlets in the wall of the building need to be at least 2 sizes, large openings for summer and much smaller ones to provide air movement in winter. Summer air inlets are often 3 x 6 ft or 4 x 8 ft doors, which may be adjusted during changing weather. Winter air inlets are commonly under overhangs and may be equipped with hinged doors that can be closed during snowstorms.

14 Since 'cold' barns may get below 32F in winter, depending on the number of animals housed, it is recommended their use be limited to loose housing systems whereby heated, insulated waterers may be provided for each group of goats.

15 Warm Housing - This involves a mechanical ventilation system in which winter temperatures are maintained at 40F or above. To control temperature and moisture, the following items must be provided:

1. Insulation in the walls and ceiling (insulation R values in the walls of at least 14, ceilings should have an R value of 23 or more).
2. At least 2 exhaust fans (1 running continuously and 1 thermostatically controlled).
3. Adjustable air inlets.
4. Limited door and window openings, and,
5. Supplemental heat if needed.

16 Adequate insulation usually can be obtained by placing 3-1/2 inches of blanket insulation in the walls and 8 inches of fill insulation in the ceiling. All insulation must be protected with a tight vapor barrier installed on the warm side. The thermal resistance (R values) of the more common insulation materials available are shown in Table 1. These may help you select the insulation that best meets your needs.

17 The ventilation system consists of: (1) a fresh air inlet system, and (2) the exhaust system. Each is equally important. A fundamental requirement of any successful ventilation system is that at least 1 exhaust fan run continuously. A minimum of 4 air exchanges per hour is recommended.

18 Total winter ventilation capacity, including the thermostatically controlled exhaust fans, should approach 15 air exchanges per hour. A practical summer ventilation rate is one air exchange every 2 minutes, or 30 air exchanges per hour.

19 An Example - Consider a barn 20 ft wide, 28 ft long, with an 8 ft ceiling.

1. Total cu ft capacity

$$\begin{aligned}
 &= \text{length} \times \text{width} \times \text{height} \\
 &= 38' \times 20' \times 8' \\
 &= 6080 \text{ cu ft}
 \end{aligned}$$

2. To obtain 4 air exchanges per hour, divide total cu ft capacity by 15 minutes, e.g.:

$$6080/15 = 405.3 \text{ cfm (cu ft per min)}$$

Thus, a 400 cfm fan running continuously would be appropriate.

3. To obtain 30 air exchanges per hour, divide total cu ft capacity by 2 minutes, then subtract 400 cfm (supplied by the continuous fan), e.g.:

$$6080/2 = 3040 - 400 = 2640 \text{ cfm}$$

Thus, two 1300 cfm fans, thermostatically controlled, would be appropriate. These could be set in different settings, so only one would operate intermittently in winter.

## 20 Fresh Air

An inlet system must be provided for satisfactory ventilation. This is frequently overlooked or ignored, especially when attempting to use older buildings, and is the most common cause of unsatisfactory ventilation performance.

21 A slot inlet system permits adequate distribution of small amounts of air in many places. It can easily be built into the barn during construction by making an adjustable slot at the junction of the walls and ceiling, except for a distance of 4 ft on either side of each exhaust fan. Air is drawn into the barn through these inlets by the exhaust fans.

22 This slot should be 1 inch wide for winter use. Note: if all fans are placed along one side of our 36 ft long 'example' barn, then a 1-inch slot along the other side will provide 3 sq ft of air inlet. Air velocity entering the building will be 133 ft per minute (400 cfm / 3 sq ft) or 1.5 miles per hour, enough to prevent a back draft (excess of 100 ft per minute is recommended), but not enough to be considered an excessive draft.

23 During the fall and spring months, when one of the thermostatically controlled fans will be operating much of the time, the slot inlets should be opened to a width of 1-1/2 inch to 2 inches to allow more air to enter. This will prevent a vacuum from forming within the building, thus limiting exhaust fan performance.

24 In older, existing buildings, it often is more practical to construct ceiling intakes rather than remodeling to make a slot. In our example where 3 sq ft of slot intake was recommended, one could locate 6 ceiling intakes (each 0.5 sq ft capacity) to draw air from the attic or hay loft. These should be equally spaced (about 5 ft apart) along the ceiling and about 5 ft from the wall opposite the exhaust fans. Additional ceiling intakes for summer use may be placed in the ceiling closer to the exhaust fans, but remember to close these during the winter months.

25 Remember that satisfactory ventilation in poorly insulated older buildings of wood construction or those having stone or concrete block walls, single windows, and loose fitting doors is often an impossible

task. Often one or more fans are installed in an attempt to improve conditions with mediocre results. As a consequence, air enters through available openings around loose fitting doors and windows, hay chutes, cracks, etc. The results often times are excessive drafts and/or decreased fan performance. In either event, the result is one of damp and wet facilities, diseased animals and dissatisfaction.

## 26 Rules for Locating Exhaust Fans

1. In barns where animals are maintained all year on a manure pack, space the fans uniformly in the south or west wall to provide for best air flow across the barn in summer.

2. Locate all fans at least 10 ft away from doors or other openings.

3. Locate the thermostats controlling the high capacity fans near the center of the building and at a height of 5 to 6 ft. Do not place the thermostats on an outside wall.

4. In winter, attempt to maintain the temperature at 40 to 45F. Remember, the higher the inside temperature, the more difficult it is to control moisture during cold weather.

5. Do not locate fans near pens of kids or yearlings in an attempt to draw heat to this area from areas where older animals are kept. Aerosol contaminants from the older animals may cause younger ones to have more disease problems.

6. Wet corners often can be dried up by admitting fresh air. In parts of the stable where fewer or smaller animals are housed, added insulation and possibly heat, may be required.

7. Install all fans near the ceiling. In barns with limited insulation, build a duct 12 inches deep and as wide as the fan frame around the continuously running fan to draw cooler air from near the floor in winter. Locate a door in the duct directly in front of the fan. Keep the door closed in winter, open in summer.

8. If the continuous fan has too much capacity and creates too much air flow, place a damper near the bottom of the duct to reduce air movement in extremely cold weather.

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HOUSING

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# JOHNE'S DISEASE

COLLECTION: GOAT HANDBOOK

ORIGIN: United States

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Extension Goat Handbook

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TI JOHNE'S DISEASE

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DE Health and Disease Management

Text

1           Johne's disease, also known as paratuberculosis, is an infectious contagious disease of ruminant animals affecting primarily the digestive tract. The causative bacterium, *Mycobacterium paratuberculosis* localizes in the wall of the intestines, producing an inflammatory response which disrupts normal digestion and absorption of nutrients. This leads to chronic progressive weight loss with eventual debilitation and death. This disease was first recognized in cattle in 1895, and in goats in 1916. Since the disease has been studied more intensively in cattle, many aspects of the bovine disease have been assumed to hold true for goats. Following are the differences and similarities between goats and cattle discussed in terms of transmission, clinical signs, postmortem lesions, laboratory diagnosis and control.

2           Transmission

The organism causing Johne's disease is passed in the manure of infected animals and contaminates the environment. Ingestion of contaminated feed and bedding is the most common mode of transmission. It has been shown that cattle are most susceptible to infection as very young calves and individual animals become more resistant to infection as they grow older. This is confusing from the standpoint that cattle do not show signs of the disease until they are at least two years of age. Apparently, they carry the infection in a dormant state until some stress, such as calving, triggers the onset of clinical signs. This same mode of transmission appears to hold true also for goats.

3           However, it has been suggested but not proven, that individual

goats may be susceptible to new infections throughout life, if the level of environmental contamination is sufficiently high. At least in cattle, there is evidence that occasionally, infected dams may transmit the disease to offspring in utero, with the result that newborns are already infected.

#### 4 Clinical Signs

Johne's disease in cattle is characterized by the appearance of a chronic, profuse, watery diarrhea. A typical Johne's cow is three to five years of age. Often, the onset of diarrhea follows some stress such as calving, transport or concurrent disease. The diarrhea which occurs may continue intermittently or constantly for several weeks to months. During this period the cow maintains a good appetite. Despite her willingness to eat, however, the animal progressively loses weight and may appear as a walking skeleton as death approaches.

5 In goats, diarrhea is rarely a prominent sign. If it occurs at all, it is usually in the terminal stages after a prolonged period of weight loss, lack of appetite and depression. This absence of diarrhea makes the diagnosis of caprine Johne's disease difficult. Animals showing progressive weight loss should be suspected of having Johne's disease. However, heavy parasitism, chronic viral arthritis, internal abscesses, chronic pneumonia, and an inadequate ration should also be considered in the differential diagnosis. Herd outbreaks of diarrhea are not likely to be Johne's disease. Salmonellosis, Coccidiosis, Exterotoxemia and grain overload are more likely causes of diarrhea in goats. Whereas the typical Johne's goat is also an adult animal, terminal cases have been seen in goats as young as fourteen months of age.

#### 6 Postmortem Examination

Any animal dying after a period of weight loss should be subjected to a thorough postmortem examination by e.g., the state diagnostic laboratory. This helps establish the existence of Johne's disease in a herd.

7 It should be remembered that the extent of grossly visible lesions is variable in animals infected with Johne's disease. It is essential that microscopic examination of selected tissues be performed using special acid-fast stains to reveal the presence of the Johne's organism. If tissues are to be submitted by the local veterinarian to a pathology laboratory, these should include sections of ileum, cecum, ileocecal valve, ileocecal lymph node and enlarged mesenteric lymph nodes, if present.

8 There is sometimes a thickening and roughening of the wall of the small intestinal tract (especially the posterior portion), the colon and cecum. A more consistent finding is an enlargement of the iliocecal-colic lymph node as well as the other mesenteric lymph nodes. When the latter are cut, they appear necrotic (consistency of cooked oatmeal), edematous (wet and swollen) and sometimes irregularly

reddened. Microscopic examination of the intestinal wall and lymph nodes reveal the proliferation of epithelioid cells and the presence of macrophages. This is called a granulomatous inflammatory reaction. When the sections are stained by an 'acid-fast' method, the small organisms are stained red and can be seen within the epithelioid cells and macrophages. There are sometimes secondary lesions of amyloid and fibrinoid degeneration in the kidney, adrenal glands and mammary glands.

9 As far as gross lesions are concerned, there are differences between the cow and the goat. Cows may show a dramatic thickening of the intestinal wall causing the lining of the intestine to be thrown up into accordion-like folds. Goats almost never exhibit this lesion, and at best, may show only some lymph node enlargement. Appropriate tissues should always be submitted for histopathological examination if the history suggests Johne's disease, since the presence of gross lesions is unreliable in the goat.

## 10 Diagnosis

There are two major problems associated with the successful control of Johne's disease. First, it is peculiar to this disease that for every clinically affected animal in a herd, there are probably several animals which are infected but not showing clinical signs. These are termed subclinical carriers, and they are the major source of ongoing environmental contamination and transmission. The second problem is that there is no rapid, reliable, inexpensive test for identifying these subclinical carrier animals.

11 The current diagnostic method of choice is the bacterial culture of feces on specialized media. Unfortunately, the causative agent, *Mycobacterium paratuberculosis* is a finicky organism, is hard to grow on artificial media, culturing takes about 14 weeks but can take as long as twenty weeks for colonies to appear. This makes the process of identifying and removing infected animals from the herd a painfully slow task. In addition, the number of organisms shed in the feces of infected animals may vary with time, meaning that several attempts at fecal culture may be necessary before an infected individual is finally identified as a shedder. The results of intradermal injection of Johnin are inconsistent; however I.V. injection of infected animals will often give a body temperature elevation of 1.5 to 3F (but stay below 103.1F) and it will double the blood neutrophil to lymphocyte ratio.

12 Many other diagnostic tests have been tried in both cattle and goats with little success. These include skin testing, the complement fixation test and the hemagglutination test. All suffer to a greater or lesser extent from the same problem. Many infected animals are missed and many noninfected animals are falsely identified as infected.

13 There may be some good news for the goat industry in the diagnostic application of the agar gel immuno-diffusion test (AGID). This test



involves the formation of a precipitation line in semi-solid media (agar) between wells containing an extract of the causative organism and antibodies against the organism present in the serum of infected goats. Surprisingly, the test has been of little value when applied to the diagnosis of Johne's disease in cattle but appears to be quite accurate when applied to goats and sheep. Both clinical and subclinical goat cases can be identified with an accuracy equal to the fecal culture test. The test is inexpensive, requires a small serum sample from each animal and can yield results in only 24 hours. Though currently not an accepted diagnostic test, AGID has potential for future widespread application in the diagnosis of caprine and ovine Johne's disease.

#### 14 Treatment and Control

Unfortunately there is no satisfactory treatment available against Johne's disease. Because the causative agent is in the same bacterial genus as the organism causing tuberculosis, various antitubercular drugs have been employed, but with little or no success.

15 Vaccination holds some promise for control, but several pitfalls have obstructed progress in this area. Large draining nodules may form at the vaccination site. These are especially objectionable to owners of show animals. In addition, vaccination may cause false positive reactions to the tuberculosis skin test, thus interfering with tuberculosis regulatory programs. At present, state controlled cattle vaccination programs are underway in several states but vaccination has not been approved for use in goats.

16 Regulatory attitudes vary from state to state concerning the identification and control of Johne's disease. Some states have a voluntary control program whereas others may have mandatory controls. Regulations concerning Johne's disease in goats may be less clearly defined than those concerning cattle. It is best to check with the livestock regulatory agency in your state to acquire accurate information concerning the status of this disease.

17 Control programs may be aimed at identification of infected individuals coupled with rigid culling of animals identified as positive. At present, identification is achieved by fecal culture. Improved diagnostic techniques such as AGID can accelerate the identification process. Along with identification and culling, improved management and sanitation will help reduce the incidence of new infections. Kids should be taken immediately from does and raised in separate quarters. Before removing, kids should receive colostrum by bottle or by nursing a thoroughly washed udder to limit oral contamination. Because of the likelihood that adult goats may infect each other, animals should not be overcrowded, manure should not be allowed to build up and feed and water should be provided in such a way that fecal contamination is kept to a minimum. When possible, herd additions should be purchased from known, Johne's free herds. If the



# MACHINE MILKING SYSTEMS

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NO E-2

TI MACHINE MILKING SYSTEMS

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DE Milk and Milk Handling

Text

1 The production of high quality milk depends upon clean, healthy goats, properly fed and cared for, and milked in a clean efficient manner.

2 Dairy goats may be milked equally well by hand or by machine. In either case, care must be taken to produce a clean, wholesome product and to prevent injury and/or infection of the udder.

3 Vacuum

The milking unit removes milk from the teat of the animal by the application of a partial vacuum. Vacuum is measured in inches of mercury. The recommended range of vacuum level on the milking system is between 10.0 and 14.0 inches of mercury. The primary effect of the different vacuum levels is milking rate. As vacuum level increases, milking rate increases. Within these vacuum level ranges, no difference in udder infection rates will be noted.

4 The Milking Unit

The operation of the milking unit is shown in Figure 1. The pulsator causes the machine to switch from the milking phase to the rest phase. As the pulsator operates, it causes the chamber between the shell and the inflation to alternate regularly from vacuum to air source.

5 During the milking phase, the space between the inflation and shell becomes a vacuum. Equal pressure inside and outside of the inflation causes it to open and the milk to flow.

6 During the rest phase, air at normal pressure enters between the shell and inflation. Due to the vacuum in the stem the inflation collapses around the teat. The pressure of the collapsed inflation on the teat prevents congestion of blood and body fluids in the teat skin and tissues.

7 The rate at which the inflation is closed and opened, called the pulsation rate, varies from 40 to 80 pulsations per minute depending upon the manufacturer. The optimum pulsation rate is yet to be determined. The manufacturer's recommendations for a particular pulsator should be followed.

#### 8 Pulsator Ratio

The pulsator ratio is the length of time the pulsator is in milking position compared to the time it is in rest position. It is expressed as a simple ratio or as percentage of time open to time closed. The ratio should range between 50:50 and 60:40 milk to rest ratio.

#### 9 Inflations or Teat-cup Liners

Many types of teat-cup shell and inflation combinations are available. Teat size governs the choice of inflation size. In general, large teated animals can utilize larger inflations without discomfort, while the smaller teats are best milked with smaller inflations.

10 Claw units should be equipped to admit a small amount of air in order to prevent milk from building up in the claw and creating 'milk block'. An air bleed is necessary on most types of pipeline units.

#### 11 The Vacuum Pump

The most important consideration with regard to the vacuum pump is that it possess ADEQUATE CFM CAPACITY AT THE OPERATIONAL VACUUM LEVEL. Manufacturers can provide CFM ratings for various vacuum pumps or the CFM delivery can be determined by the use of a flow rate meter.

12 The size of pump needed for milking machine operation depends upon a number of factors. Among these are:

1. Number of units
2. Size and length of pulsating lines
3. Type of pulsator
4. Type of system (bucket or pipeline)
5. Requirements of other vacuum-operated equipment

13 The recommended capacity of the vacuum pump(s) used in bucket milking systems is shown in Table 1. Table 2 indicates suggested capacities for

pipeline systems.

14 ++++MISSING DATA++++

15 Make sure that your system has adequate CFM capacity. Check with your manufacturer for the vacuum pump ratings.

16 The vacuum pump and the power unit should be installed as close as possible and practical to the center of the milking area. Such locations as a feed room or near a haymow chute should be avoided. The exhaust from the pump should be piped to the outside of the building through a pipe whose diameter is at least as great as that of the pump's discharge port.

17 Since oil is present in most exhausts, the exhaust should be directed downward and away from the side of the building, which prevents rain water from entering the pump, and also prevents accumulation of oil and dirt on the side of the building.

18 Servicing the pump should be performed as directed in the service manual. Maintaining the oil level in the sump or supply cup and checking the belt for proper alignment and tension are the two most important maintenance procedures, and should be done every two weeks. Recommended annual or semi-annual service checks will vary with the pump and the manufacturer's specifications.

19 Vacuum Regulators

Vacuum regulators admit air into the milking system to prevent the vacuum level from going too ++++MISSING DATA++++

20 Regulator performance is affected by basic design. Servodiaphragm regulators are the most effective, while weighted level types are the least desirable.

21 Pipe Sizes

The milking units are operated by a piping system(s) which must be large enough to permit the units to function properly. Restricted vacuum and milk line sizes may result in ma ++++MISSING DATA++++

22 Install low lines where possible. The hoses to the milking units should not exceed six (6) feet in length. Adequate pipeline slope and size are essential to prevent flooding of the system. Flooding causes erratic vacuum changes in the system, which may result in increased udder irritation and a possible increase in the incidence of new infections.

23 The size of sanitary milk pipe is shown in Table 3.

Table 3. Sanitary Milk Pipe Size (inches)

---

Pipe Size

Maximum Number of  
Units per Slope

---

1 1/2	4
2	8

---

These sizes apply to conditions where the animal is milked directly into the milk pipeline. Pipes for weigh jar systems operated primarily as milk transfer and wash lines must be of adequate size for washing.

## 24 Number of Units

The number of units you should have varies widely, depending upon the type of system, the nature of the goats (fast or slow milking), and the operator. The following table may serve as a guide for the number of units to use.

Table 4. Maximum Number of Milking Units per Operator

---

Type of System	Maximum Number of Units
Milking area only	2
Elevated single stall	2
Elevated platform	3
Herringbone parlor	6

(units both sides of parlor)

---

## 25 Milking Practices

Good milking practices are essential to keep goats healthy and to achieve good labor efficiency.

26 During milking, there are two critical periods when udder damage is most likely to occur: at the beginning and the end.

27 Make sure the animal is properly stimulated for 'let-down' prior to attaching the machine. The stimulation should be accomplished in the same manner at each milking. The interval between stimulation and machine application should be short and constant. Ideally, the stimulation to machine-on time should be about one minute. The 'let-down' hormone effect lasts about 7 minutes. It is important that the goat be milked out rapidly and the machine removed as soon as the goat is milked out.

## 28 Preparation

Washing the udder to remove dirt and at the same time stimulate the goat for 'let-down' is u ++++MISSING DATA++++

## 29 Checks and Maintenance

A regular thorough checking and maintenance schedule is essential to keep equipment in top working condition. The manufacturer of your equipment has specified many items. Follow those instructions carefully.

30 Several items apply to all systems. The most important are as follows:

DAILY:

1. Check vaccuum level.
2. Make sure pulsators are operating properly.
3. Check rubber parts for breaks, tears, and cleanliness.
4. Check vacuum pump oil supply and belt tension.
5. Install clean filters.
6. Make sure air inlets to claw assemblies are open.

WEEKLY:

1. Check and clean vacuum regulator.
2. Inspect and rotate inflations.
3. Check couplings and stall cocks for leaks and electrical connections.

MONTHLY:

1. Disassemble pulsator and check for wear. Clean all air passages and screens.
2. Check condition of vacuum pump oil.
3. Check CIP (clean-in-place) system for proper cycling and water temperature.
4. Check pulsator performance with portable test gauge.

ANNUALLY:

1. Check operation of the vacuum pump. Use a flow rate meter to determine if it is pumping at its rated capacity.
2. Connect the system and obtain an air flow reading with the system in operation. A loss of more than 10 percent of the vacuum pump capacity indicates excessive leaks in the system.
3. Check all pipeline gaskets for leaks and condition. Replace as needed.





# MANAGEMENT -- BIRTH TO BREEDING

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TI MANAGEMENT -- BIRTH TO BREEDING

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DE Management and Housing

Text

1 Kid management from birth to breeding is an essential component of the dairy goat enterprise. With the possible exception of the nutritional management of the doe herd, the kid management program has the greatest effect on the long-term productivity of the dairy goat herd. The dairy goat kid at birth represents a genetic resource necessary to replenish the herd gene pool which has a changing composition due to death, culling and sales for breeding stock. While the genetic character of the kid is determined at the time of conception, survival to lactation and an adequate body size are necessary to realize inherent genetic potential for lactation. One of the advantages of the dairy goat is the opportunity for rapid genetic progress due to early sexual maturity (breeding is possible at 7 months or less), short gestation interval (150 days) and multiple offspring per parturition (2.0 or more for mature does). Kid mortality has a direct effect on genetic progress by its effect on selection pressure, that is, the percentage of the kids which must be retained as replacements. Maintaining low mortality from birth to weaning while producing a 100 lb doe at kidding should be the primary objective of the kid management program.

2 As practiced on most dairy goat farms, the kid raising enterprise is highly labor-intensive. Because in the absence of control programs involving lighting and/or hormonal treatments, dairy goats have a highly seasonal reproductive cycle, a labor-year profile for kid raising would show a peak demand in January through May, with low demand in July through November. In order to reduce the characteristic high labor input per unit of milk produced on dairy goat farms, attention should be given to systems of kid management which reduce

labor while keeping mortality low.

### 3 Pre-Parturition

The kid management program should actually begin prior to parturition with attention to the nutritional needs of the gestating doe in late lactation and during the dry period. With a gestation period of 150 days, most of the development of the dairy goat fetus occurs when the nutritional demands on the doe are at their lowest; late lactation and during the dry period. The tendency is to regard the late-lactation and dry doe as a nonproductive part of the milk-producing system. On the contrary, however, an adequate diet for the dry doe is essential to producing a healthy litter of kids. Depending upon the forage source and size of the doe during the dry period from one to two lb of a 10 to 16 percent concentrate ration should be fed daily. Pregnant does should receive plenty of exercise. An overly fat doe should be avoided but the high producing doe needs to recover body weight lost during the previous lactation. Clean, cool water and free choice trace-mineralized salt should be available. A supplement of bone meal will aid in fetal development but care should be taken to not overfeed calcium.

4 Vaccination boosters for *Clostridium perfringens* C and D and tetanus toxoid should be given not less than 3 weeks prior to kidding. Vitamin E/selenium injections are given during the dry period to prevent white muscle disease in the kids, especially in areas where soils are selenium deficient. Does should be wormed at drying off.

5 The goal for average kid weight at birth should be 8 to 11 lb. Underweight, weak kids do not do well and require extra care and labor. Kid mortality in the first 10 days is highest among kids born underweight either due to a premature parturition or poor doe nutrition.

### 6 Parturition

The doe should kid in a clean environment, either a well-rotated pasture or stall bedded with straw or other absorbent material. The kid prior to birth has been existing in a germ-free environment and parturition represents exposure to common disease organisms to which the mature animal has developed resistance. The location of the kidding stall or pasture should be near a well-travelled area in order that the doe will be frequently observed for kidding difficulties. Few adult does require assistance at the time of kidding though problems are always a possibility. First-freshening does should be closely watched, especially if bred to bucks known to sire large kids.

7 At birth two management practices are critical to the future health and survival of the newborn kid. The navel cord should be dipped in a solution of tincture of iodine to prevent entry of disease-causing organisms through the navel cord and directly into the body of the kid. If necessary, a long navel cord can be cut to 3 or 4 inches in length. A bleeding cord should be tied with surgical suture material. Dipping of the cord in iodine not only prevents entry of organisms but

promotes rapid drying and the eventual breaking away of the cord from the navel.

8 The second critical practice is the feeding of colostrum milk as soon after birth as possible. The colostrum, or first milk, contains antibodies which the doe did not pass to the fetal kid in utero. Consumption of colostrum must occur as early as possible and prior to 18 hours after birth as there is a rapid reduction in the permeability of the intestinal wall of the newborn to the antibodies. The colostrum milk should be bottle-fed to the newborn to insure adequate consumption. Excess colostrum can be frozen for use in orphan or bonus kids. Recent research indicates that disease organisms, especially caprine arthritis encephalitis (CAE), may pass from doe to kid through the milk and transmission might be avoided through the use of extra colostrum frozen from does tested and shown to be CAE-free or pasteurized colostrum. An additional practice at birth which enhances the health of the newborn kid is to give injections of iron dextran and vitamins A and D after birth. A vitamin E/selenium injection may be beneficial in areas of selenium-deficient soils.

9 Kids should be checked carefully at birth for any deformities or abnormalities.

10 Pneumonia is a major killer of young kids. A dry, draftfree environment is an excellent preventative measure.

#### 11 Birth to Weaning

Milk is the principal component of the diet of the preweaning kid. There are numerous ways to feed milk including the use of bottles or pails, suckling the dam or nurse does, and self-feeder units. The method chosen will depend upon such factors as the size of the herd and available labor, as well as personnel preference. With any system, the health of the kid, sanitation and available labor are the major factors to consider. Under natural suckling, kids consume small amounts of milk at very frequent intervals. Ideally, artificial rearing should mimic natural suckling but the constraint of available labor precludes frequent feeding. Nevertheless, kids should be fed 2 to 4 times daily for the first week or two and twice daily thereafter. Bottle feeding is more labor intensive but kids receive more individual attention and are easier to handle post-weaning than kids that are allowed to suckle does. Pail or pan feeding may reduce labor somewhat but bodyweight loss and need for extra ''training sessions'' at the beginning must be expected.

12 For larger herds, self-feeder units such as a ''lamb bar'' may successfully reduce labor. The key to use of the system is the maintenance of a low temperature of the milk (40F) which will limit intake by the kid at any one time. Small, frequent feedings increase digestibility and decrease digestive disturbances. Consumption of large quantities of milk may lead to bloat due to entry of milk into the reticulo-rumen or rapid passage of milk through the abomasum and small intestines resulting in diarrhea or nutritional scours.

- 13 Where a strong market for goat milk exists, milk replacer is an important option available for raising kids. Lamb milk replacer containing 240001:0000rotein and 30 358904871194044100000000.000000at has b milk/self-feeder systems for raising lambs. A limitation to the use of milk replacer is the tendency by manufacturers to substitute whey for skim milk as a protein source. Whey is high in lactose which causes bloat and scours in young kids. Research conducted on raising kids on lamb milk replacer fed cold and free-choice from 4 days of age to weaning at 6 weeks indicates that growth performance is lower and the incidence of digestive disturbances such as scours and bloat are increased compared to goat's milk under the same system. If milk replacer is to be used it is recommended that it be given to animals older than 2 weeks of age, or combined with goat's milk on an equal weight basis. It is best to make a gradual change to milk replacer over a few days.
- 14 In raising dairy goat kids, increase in size and weight are not the only measurements of success. A well formed skeleton and proper development of internal organs are often neglected when the emphasis is on rapid gains. An average daily gain of 250 gm during the first weeks of life should be the goal. By limiting daily milk consumption to about 2 quarts, daily consumption of dry feed will be encouraged. Dry feed consumption is important in developing body capacity. By increasing body capacity, feed intake and digestion increase. Research has shown that at two months of age a weaned kid has a reticulo-ruminal capacity 5 times as large as suckling kids of the same age.
- 15 Kids should be consuming forages such as pasture grass or hay by two weeks of age and grain within four. Careful attention need be given to formulation of a concentrate supplement for the pre-weaning kid. Palatability is of primary concern. Molasses at the rate of 100f the total dry matter, corn (preferably chopped or rolled) and whole or rolled oats make up the energy 'core' of a good preweaning diet. Balance the crude protein needs by adding cottonseed or soybean meal or another high protein source. Though few studies with kids have been done, crude protein contents of the pre-weaning ration should be within the range of 14-18 Ground alfalfa may be added at 50r less to provide additional stimulation for reticuloruminal development.
- 16 Several factors need to be considered when making the decision as to when to wean dairy goat kids. The most important consideration is whether or not the average daily consumption of concentrate and forage is adequate for growth and development to continue in the absence of milk. Fixed weaning ages are less desirable than weight goals such as 2.0 to 2.5 times birth weight. Many producers who have an erratic or marginal market for their milk delay weaning for longer periods than necessary. While milk feeding may promote more rapid growth than a concentrate-forage diet, maintaining kids on milk may delay the attainment of the dry feed intake level necessary to weaning and also leaves the kid disposed to diarrhea.

- 17 Kids should be dehorned between 3 and 14 days of age, while the horn bud is visible. The hair should be clipped and a hot electric disbudder held over the area for 15 to 20 seconds with firm even pressure. The center of the ring formed by the iron should also be burned and the cap remaining pried off. A topical spray should be applied to avoid problems with flies on the resulting wound. A local anesthesia such as lidocaine may be used to decrease pain and permit easier handling of the kid. Restraint devices are available to purchase or may be homemade.
- 18 At about 3 to 4 weeks of age kids should receive a vaccination for *C. perfringens* CD and also tetanus or any bacterin for which there is a problem in the herd. A booster should be given in two weeks.
- 19 Buck kids to be slaughtered under 2 months of age need not be castrated. If meat goats are to be kept until an older age, castrating can be done at 2 to 4 weeks. The lower part of the scrotal sac is cut with a knife and the testicles squeezed through the openings. The cords are then cut by scraping with a sterilized knife or scapel. Iodine or topical spray is applied. The 'bloodless' method of castration using a Burdizzo clamp can be equally effective if care is taken to crush both cords. Use of elastic bands is not to be recommended due to potential development of gangrene.
- 20 Weaning to Breeding
- The objective of raising the dairy goat kid should be to produce a lactating animal with an adequate body size as inexpensively as possible and in the shortest possible time. For the heavier breeds (Saanens, Alpines, Nubians), the goal should be a 110 lb doe freshening at 12 months of age and 90 lb for the lighter breeds (LaMancha, Toggenburg). If a doe is weaned at 8 weeks, weighing 20 lbs and is to kid at 12 months, at 110 lbs, then she must gain 90 lbs in 10 months, or approximately 1/3 lb daily. Therefore, the nutritional program must aim for a growth rate of approximately 150 gm daily with consideration for both the nutritional requirements of the growing doe and the growing fetus over the 5-month gestation period.
- 21 Forage must constitute the core of an economical diet for growing dairy goat kids with mixed concentrates or simple grains fed to provide the nutrients that are not provided by the forage consumed. Forage quality is therefore very important but because the dairy goat is a browsing animal, it is quite poorly estimated. Leaves and young stems chosen by browsing animals have crude protein and digestible energy values higher than the average for the whole plant. The kid grazing on improved pasture, browsing in woodlots or consuming alfalfa hay is able to select plant parts which have a higher nutritional value than laboratory analyses of the forage samples might show. Given the ability of the dairy goat to selectively browse, in order to formulate a program of supplementation on a forage-based diet, one must estimate what the kid is actually consuming rather than what is available. If good quality, leafy alfalfa hay is fed in quantities which allow for selection, a simple supplement of 2 lb of corn or oats per head, daily



# MANAGEMENT OF BRUSH GOATS

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TI MANAGEMENT OF BRUSH GOATS

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DE Management and Housing

Text

- 1 Many brush goats may be feral goats which were originally domestic goats that escaped or were released by early settlers. Their number is unknown, but they may represent a natural resource in some areas and play a role in today's agriculture, when managed effectively.
- 2 Current interest in brush or bush goats is centered on their browsing behavior and dietary preferences in scrub and weed control. However, this diet alone does not produce sufficient monetary gains from goats; their by-products of meat, skin and fiber are of special economic interest.
- 3 Breeding  
The ''type'' of goat upon which to base this kind of ''wild'' breeding program is not yet understood. Obviously the selection of a specific ''type'' will be affected by the by-products envisaged and the role of the goat itself.
- 4 Feral goat flocks that have evolved over years consist of long and short-haired goats, a mixture of colors and a variety of conformation. Short-haired goats are thought to be better but research suggests that long-haired goats lose less weight under nutritional stress. However, goat deaths in winter indicate that long-haired goats with little down are cold sensitive and less viable. For meat production it is easy to suggest the selection for twin progeny with high yearling weights, regardless of lengths of hair and color.

5 The improved Boer goat of South Africa is valued in various parts of the world for good meat characteristics and its skin. Boer goat breeders select a white, short-haired animal but evidence is lacking on aspects of skin quality. The following breeds of goats are recognized as having good quality skins: Maradi, small East African Goat, Boer goat, Somali, Black Bengal, Moxoto, Marota, and Sahil. Fiber color appears to be unimportant but the above breeds are short, fine haired goats. An example is the Sahil of Africa which has long-haired and short-haired types. Only the short-haired goats have acceptable skins with no information on the diameter of fiber.

6 For cashmere (down) goats exist selection criteria. A difficulty is to determine whether the associated coarse fiber should be long or short. This may be dependent on the method of harvesting. Fortunately, it appears that selection for cashmere does not conflict with selection for growth rate.

## 7 Products

The products of brush goats are skin, meat and fiber. Skins may be from kids up to six weeks or from older goats. Goat skins are a valuable product in some countries. Processors identify the following problems:

Coarse grain -- notably from males with ridge-back hair lines but also in the majority of brush goats and probably associated with broad diameter fibers of low density.

Scars -- presumably from fighting, scrub, fences

Excessive odor -- from aged males

Excessive fat -- corium connective tissue 'left-over' layers

Meat -- may be kid meat, yearling meat or from older cull goats. Goat meat is valued throughout the world. Australia exports live goats to the middle East and Singapore; bone-in and boned carcasses to the Pacific Islands, West Indies, Great Britain, Americas, Japan. The latter two markets are essentially as manufacturing meat, e.g. for pet food. A small quantity of carcasses are exported dehaired with skin on primarily to Hong Kong. Consumption of goat meat is restricted because of marketing problems and the need for all meat to be slaughtered i  
 ++++MISSING DATA++++

8 Cashmere can be white, brown, grey or black in color with a price differential in favor of white fiber. Commercial processes are available to separate small amounts of coarse hair from a predominantly cashmere mixture. Combing produces a relatively pure sample but obviously shearing includes coarse hair. There is now an



economical, commercial procedure available for separation of mixtures that include much coarse hair.

9 Shedding of cashmere occurs annually in spring. Combing after shedding has begun, is successful but any delay leads to loss of much of the cashmere. The operation of combing is physically demanding and tedious and its economic utilization will probably depend on mechanization. Traditionally, hand combers have preferred a long guard hair to minimize tangling of the cashmere and to modify its rate of loss.

#### 10 Nutrition

All grazing animals have preferences for some forages and dislikes for others. This determines the order in which forage plants are eaten and influences management decisions. Growth and survival of some plants - those that are readily eaten and those that are never eaten - may be altered over periods of time. This order of preference identifies goats as browsing animals. Preference is always in relation to what kind of plants are available, how much is available, the relative succulence of different kinds and the individual habit of eating. Rarely is the diet made up of one plant species. In weed and scrub control it must be expected that there is a maintenance cost in terms of desirable plants eaten by goats.

11 Brush goats in a weed or scrub control program should not be expected to receive supplementary feeding. Normal stocking rate management should be such, that the goats enter the winter in good condition. There are two possible exceptions. In a difficult, cold winter it may be necessary to feed hay to ensure survival of the goats. In all areas, there may be periods where phosphorus may have to be provided as a supplement. There have been instances of a form of rickets and slow growth rates under rangeland and browse conditions probably due to an imbalanced P:Ca ratio.

12 Following is a list of plants and scrubs observed to be eaten by goats. It is not complete and tends to identify problem species. Stage of maturity of plants and scrub influence selection by goats and produce a marked seasonal variation in the composition of their diet. Management has to recognize these factors.

13 Highly preferred plants and scrubs: Orange bush (*Capparis mitchellii*), supplejack (*Ventilago viminalis*), Kurrajong (*Brachychiton populneum*), gruie colane (*Owenia acidula*), emu bush (*Eremophila longifolia*), mature mulga (*Acacia aneura*), rosewood (*Heterodendrum oleifolium*), belah (*Casuarina cristata*), current bush warrior (*Apophyllum anomalum*), white wood (*Atalaya hemiglauca*), lignum (*Muehlenbeckia cunninghamii*), sucker leaves of boxes, gums and mallees, blackberry (*Rubus* spp.), sweet briar (*Rosa rubiginosa*), lucerne tree (*Chamaecytisus proliferus*), flower lucerne - alfalfa (*Medicago falcata*), turnip weed (*Brassica tournefortii*), rye grass (*Lolium* spp.), pine

(*Pinus*, *Picea*, *Abies* spp.), maple (*Acer* spp.), grape (*Vitis* spp.), oak (*Quercus* spp.).

- 14 Moderately preferred: Punty bush (*Cassia eremophila*), hop bush (*Dodonaea viscosa attenuata*), young pine (*Callitris* spp.), young mulga (*Acacia aneura*), ironwood (*Acacia excelsa*) and other acacias, yarran (*Acacia homalphylla*), canegrass (*Eragrostis australasica*), some box and gum trees, hawthorn (*Crataegus* spp.), poa tussock (*Poa labillardieri*), serrated tussock (*Nassella trichotoma*).
- 15 Eaten occasionally: Budda (*Eremophila mitchellii*), wilga (*Geijera parviflora*), mature poplar box bumble (*E. populnea*), horse nettle (*Solanum carolinense*), common nettle tall (*Urtica dioica*), kangaroo thorn (*Acacia armata*), galvanized burr (*Bassia birchii*).
- 16 Readily eaten but dependent on stage of growth-(frequently associated with the flowering stage): Scotch thistle (*Onopordum acanthium*), variegated thistle (*Silybum marianum*), inkweed (*Phytolacca octandra*), nodding thistle (*Carduus nutans*), black thistle (*Cirsium vulgare*), rushes (*Juncus* spp.), sucker regrowth of yellow box (*E. melliodora*), white box (*E. albens*), and red box (*E. polyanthemos*), black wattle (*Acacia mearnii*), horehound (*Marrubium vulgare*), St. John's Wort (*Hypericum perforatum*), curled dock (*Rumex crispus*), purple top (*Verbena bonariensis*), skelton weed (*Chondrilla juncea*), mustard weed (*Sisymbrium* spp.), patterson's curse (*Echium plantagineum*), barley grass (*Hordeum leporinum*), spear grass (*Stipa* spp.), lucerne - alfalfa (*Medicago sativa*).
- 17 Mechanical damage only: Bracken fern (*Pteridium esculentum*).
- 18 Isolated plants eaten - (yet to be tested adequately): Sifton bush bidy (*Cassinia arcuata*), mature cotton bush (*Asclepias fruticosa*).
- 19 Not eaten or harmful: Slender thistle (*Carduus pycnocephalus*), peppermint (*Mentha* spp.), yew (*Taxus* spp.), rhododendron, solanaceae.
- 20 **Reproduction**  
The seasonal breeding activity of brush goat is not unlike Merino sheep with fall being the most favorable period for breeding. Under feral conditions, breeding activity is affected greatly by nutrition and in good seasons it is possible to have two kid crops in one year. The length of estrus cycle averages between 19 and 20 days. The presence of bucks acts as an exteroceptive factor in stimulating the onset of estrus at the beginning of the breeding season.
- 21 Estrus could be successfully synchronized during the regular breeding season by the use of intravaginal progestagen pessaries, subcutaneous progestagen implants or with prostaglandin. Sexual maturity is closely related to growth rate with well grown bucks reaching puberty at 6-9 months (4 months even in some cases) and does

at 7-8 months (even 5 months). Gestation length is approximately 147 days. Parturition is usually uneventful with dystocia a rare problem.

- 22 Slaughter and experimental data indicate that kidding percent in brush goats is usually 150-180. Twins are common but surprisingly, there are few triplets. For the first 3-4 days the kids rarely move from the kidding site but thereafter will rejoin the mob with their dam. Birthweight of kids is approximately 6.5 lbs. Kid losses result from stillbirth, predation and starvation. Starvation is usually the result of faulty udders. Abortion does not appear to be a real problem in brush goats except as a result of severe stress. In that event, aborted kids are usually in the third trimester. Abortion can be readily induced artificially using synthetic prostaglandin.
- 23 At kidding and for the next four days, the does often 'plant' their kids. This appears to be largely dependent on the availability of feed. With ample feed available, the doe remains near her kids - when feed is limited she tends to plant the kids and forages at a distance.
- 24 Management
- Goats are alert and observant and are easily moved in yards and through gateways. However, they may balk and do not flow as evenly as sheep do when being counted through a gateway. Goats tend to rush more or not go at all.
- 25 When being forced in confined areas, such as the approach to a drafting race or drenching in the working race, goats will go down very readily. Although surprisingly little damage results from this packing down, it is best kept to a minimum. Dogs are rarely necessary once goats have been yarded and movement in larger yards with big mobs is best done as quietly as possible. When working in forcing areas or races, trampling can be minimized by having only 12 or 15 animals at a time in the area.
- 26 Brush goats are susceptible to the same diseases and parasites that commonly affect sheep (e.g. footrot) with the notable exception of fly strike. Medication is essentially the same with due cognizance of liveweight. Samples of feral goats have been studied for Brucellosis (melitensis, abortus and ovis) but were found to be free of that disease.
- 27 Most harvested feral goats are lice infested and the particular lice involved are *Damalinia caprae* and *Linognathus stenopsis*. The most common sheep louse is *Damalinia ovis*. Experiments have been conducted to investigate louse transfer between sheep and goats. Though some transfer did take place under pen conditions, the transferred lice did not survive longer than 12 days and there was no hatching of eggs that may have been laid.
- 28 All feral goats should be assumed to be lice infested and dipped



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# MANAGEMENT TECHNIQUES

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Extension Goat Handbook

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TI MANAGEMENT TECHNIQUES

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DE Management and Housing

Text

1 Dehorning (disbudding)

For humane reasons, goats to be dehorned should be anesthetized, although some people use dehorning restraint boxes for kids. A local block is sufficient, or general anesthesia such as xylazine is suitable. If local anesthesia is used, the infratrochlear nerve (at the dorsal medial margin of the bony orbit) needs to be blocked as well as the cornual nerve (at the caudal ridge of the root of the zygomatic process). Only about 1/2-1 cc of local anesthetic is injected at each of these sites. The anesthetic (lidocaine) should be diluted to 0.5% to avoid toxicity.

2 Xylazine at a dose of 0.1-0.2 mg/kg bodyweight given intramuscularly or intravenously is sufficient to cause short term (15-30 minutes) general anesthesia. This has proven to be very satisfactory for short surgical procedures, such as dehorning, but weights of goats must be determined accurately and overdosing avoided.

3 Ideally, goats should be dehorned when they are very young. It is advisable to wait until they are 1-2 weeks of age and in good flesh to be sure they are healthy and not coming down with neonatal diarrhea. If discolored skin is fixed to the skull in 2 rosettes, horn buds are present. Moveable skin indicates a naturally hornless condition. At this young age, the goat can be surgically or electrically disbudded. In

either case, about 1 cm of tissue should be removed around the horn to prevent regrowth and horn scurs. If an electric dehorner is the choice, it should be used very hot (to the point of being red hot) and then be applied to each horn bud for only about 10 seconds. Long term application may lead to thermal meningitis. Whether using surgical removal or this thermal cautery, the horn bud should be removed completely.

4 In older goats the surgery is much more extensive and requires opening the frontal sinus. It is a slow healing process and should not be done during fly season unless absolutely necessary. In older animals, general anesthetics ++++MISSING DATA++++

5 In preparation for surgery, it is good to fast the goat for 24 hours before surgery to decrease the chance of bloat. The ventral laryngeal area is then clipped and prepped. Xylazine (0.1-0.2 mg/kg bodyweight) and a local line block serve as sufficient anesthesia, although general anesthesia can be recommended. The goat is placed in dorsal recumbency. A ventral midline incision, about 4 cm in length, is made through the skin over the larynx. Using a pair of heavy scissors, the ventral surface of the cricoid and most of the thyroid cartilage are split. The anterior limit of the thyroid cartilage is left intact. The larynx is spread by an assistant or with a small retractor. Excess spreading will tighten the vocal folds so much they become indistinct. The edge of the vocal fold is grasped with a hemostat, and the fold is completely removed with a pair of scissors. The process is repeated on the other side. Hemorrhage is no problem with removal of the folds. Complete removal of both folds is essential to stop any annoying bleating, but even then most goats can vocalize, they just can't bleat.

6 The larynx is left to granulate, but several interrupted sutures are placed in the skin. The goat should be observed for 24-48 hours for any laryngeal edema but post-operative treatment is usually not necessary. Note, this is not a technique for laymen. The operated goat should be held off feed for 24 hours, off water for 6 hours and the head should be low to prevent inhalation.

7 Wattles and Extra Teats

Wattles may be cut off at the base with blunt scissors. They may not usually be a problem, except when preparing and clipping for shows. They are inherited by a dominant gene and are found more often in more prolific goats.

8 Extra (supernumerary) teats may be cut off young kids without anesthesia. However, a record should be kept on this in the herd book, since this is an inherited trait which should be avoided if at all possible. On older goats with larger teats, crushing at the base with a Burdizzo helps. If a duct is visible, it should be cauterized with silver nitrate. If two teats are fused, no attempt should be made to

remove one. It is considered unethical to remove a teat that would have interfered with milking from an animal for sale, show or breeding.

## 9 Castration

The best time for castration is about at 2 weeks of age, when the kid is in good flesh and healthy. Tetanus prophylaxis is advised. The open technique is best, even for older animals. The scrotum is sanitized and its bottom opened, or better yet the bottom quarter is cut off with blunt, sterilized scissors. This provides for best post-operative drainage. Local anesthesia may be used for older animals; but in young kids it is a procedure with only little, brief pain and nearly bloodless. However, good restraint is important. Kids are normally placed on a table or held in a sitting position in the lap of an assistant.

10 After the scrotum has been opened, the two testes become visible. In young animals, they can be pulled out or scraped until the cords break. In older kids, an emasculator needs to be used to avoid excessive bleeding. The crushing jaws are placed toward the kid's body and the cutting edge away from it. A knife should never be used since it causes too much bleeding. Cords should be cut short enough so they don't protrude and become infected. The cutting site needs a post-operative antiseptic application and is left open. Castrated kids should be kept quiet in a clean pen for a few days and flies should be under control. Normally, there are no complications.

11 Another technique is the bloodless use of the Burdizzo emasculatome (pinzer). Each cord ought to be crushed twice by holding the instrument in the closed position for about 15 seconds. Disinfection is only needed when the skin of the scrotum is broken. Swelling can be expected for a few days. The scrotum will remain for the animal's lifetime but the testes should degenerate.

12 A third technique involves heavy elastrator rubber bands. They are placed with an appropriate applicator above the scrotum and will cut off blood supply to the testes and scrotum. After about 2 weeks, the scrotum with the testes will drop off. The animal feels prolonged pain for a least the first day and may be off feed several days. Tetanus prophylaxis is advised, although this procedure is bloodless. Some disinfection and fly control during the 1st week is also advised.

## 13 Cesarean Section

Most caprine dystocias can be corrected manually since difficult kiddings are often caused by abnormal position of presentation. The maternal pelvis in goats is usually large enough to permit manipulation of the fetus and correction of the problem. A cesarean section may be indicated, however, and several approaches can be used at the discretion of the operator. However, performance of this and other surgical procedures should be attempted only by licensed veterinarians.



- 14 The right flank offers little or no advantage over the left flank. The left flank approach is advantageous, since it is easier for a single surgeon to hold the rumen in, than to keep the intestines in place. Consequently, the left flank is probably preferable over the right. Flank incisions for cesarean sections offer the advantage of requiring little or no tranquilizer or general anesthesia (both of which will depress the fetus). If the surgeon feels tranquilization is necessary, 1-2 mg of xylazine (total dose) should be sufficient. This often permits restraint of the animal in lateral recumbency. Flank incisions also avoid the abdominal veins associated with the udder and greatly diminish the likelihood of an evisceration or post-surgical hernia.
- 15 The ventral incision (midline or paramedian) is probably preferred with:
1. fractious animals who may not stand for the entire surgery,
  2. toxic animals who are too weak to stand,
  3. dead mascerating fetus.
- 16 Toxic animals may be tied and restrained in dorsal recumbency. However, fractious animals will require either a general anesthetic or a large dose of tranquilizer such as xylazine (0.1 mg/kg bodyweight). In either case, a large area should be clipped and surgically prepped. In standing surgery, the goat oftens moves around and drapes tend to be more of a detriment than an asset. Doing surgery without drapes requires a large, surgically clean area. If the animal is restrained in lateral or dorsal recumbency, the ani ++++MISSING DATA++++
- 17 After routine entry into the abdomen, one should locate the ovarian end of a pregnant uterine horn and gently bring it to, and if possible, through the incision. In doing this, it is often helpful to grasp a limb through the uterine wall and use this as a handle to help elevate the uterus. In case of a live, uncontaminated fetus, the uterus can be opened within the abdomen if necessary. However, if the fluids are contaminated, the portion of the uterus to be opened must be exteriorized. An incision parallel to the long axis of the uterus and along the greater curvature (3-5 inches long) will avoid most of the uterine blood supply. Grasping the feet, or the head and feet, the kid is delivered through the incision. Passing the hand back into the uterine incision, the uterus is checked for more kids. If present, they are delivered in a similar manner. Rarely is more than one incision into the uterus needed.
- 18 After the last kid is delivered, the uterine wall should be closed with an inverting suture (Cushing, Lembert or Guard's Rumen Stitch) using a #1 chromic gut. In the case of contaminated uterine contents, a second inverting suture should be used to oversew the first suture

line. Either as the uterus is being closed or after surgery, through the vagina, some type of uterine medication needs to be used. Any type of antibacterial preparation is probably acceptable for this, although 1 ounce of soluble tetracycline powder seems to work best; it medicates the uterus, is absorbed, and will provide a good systemic blood level.

19 Body closure can be accomplished in 2 or 3 layers depending on whether one p ++++MISSING DATA++++

20 Near parturition, the ligaments left and right of the tailhead on the sacrum are very much relaxed and sunken-in. The udder is full, tight, and milk is present. Some udders do not fill until after kidding.

21 Quiet does, pregnant 70 to 100 days, can be palpated rectally with a plastic rod about 50 cm (20 in) long and 1.5 cm (0.6 in) in diameter. The doe is placed on her back and the well-lubricated rod inserted about 35 cm (14 in) (inclusion of a soapy enema helps). The anterior end of the rod is moved toward the abdominal wall cranial to the pubic bone. The pregnant uterus can be felt through the abdominal wall as the rod forces it upward. The end of the rod is felt instead in the nonpregnant doe. Holding the doe off feed over night helps by reducing rumen fill. Injuries may occur if the doe struggles.

22 Ultrasound instruments in common use with swine or sheep breeders can also be used successfully in goats.

23 Normal Values

To check the health of goats and determine suspected illness, it is useful to know their normal physiological values. Pulse is about 83 +/- 6 per minute but the range may be from 50 to 115. Respiration is around 29 +/- 5 per minute with a range from 15 to 50. Panting under heat stress can increase this greatly. Body temperature is about 39.8 +/- 0.5 C (103.6 +/- 0.9F) with a normal range of 39.0 to 40.0 C (102.2 to 104.0F). Desert goats may range wider, especially on the lower end in partial adaptation to take advantage of night time cooling. It is useful to determine the body temperature of healthy goats in the herd for comparison.

24 Clipping

Various approaches and needs for clipping exist. For general management, the milking and the buck clip suffice.

25 The milking clip means that the hair is clipped around the udder, flank, thigh and hind legs up over the tail head to increase sanitary conditions during milking. During cold winter and in loose housing, such clipping may not be advisable.

26 The buck clip aids in reducing buck odor which stems from the normal urinating behavior of bucks, that often includes sprinkling of

their forelegs, brisket and beard. Clipping includes the whole belly area, brisket, neck and beard, which have no special value to bucks except in cold winter and in open loose housing.

- 27 Show clipping may include the entire animal, or just the tail, legs, udder and head, depending on preference. The purpose is to accentuate dairyness and 'clean-cut' bone, and to reduce the impression of coarseness. Total clipping during cold, wet, snowy winters, or during the summer when many insects especially sheep flies bother the goats, is not advised unless these factors are controlled. Total clipping aids in the treatment of lice.
- 28 **Tattooing**  
Permanent identification is most reliably done by tattoos in the two ears, or into the tailwebs in the earless LaMancha. Colored ears are tattooed with ink of contrasting color, e.g. green, black or white; white ears are best or most lastingly done with greek ink.
- 29 The ears are wiped clean of earwax and disinfected. When kids are 3 to 6 months old, the ears have good size for tattooing and for best permanently readable identification. Restraint of the goat is needed. Tattoo pliers and numbers should be tried on a piece of paper before use, to check the correct number sequence and letters; preferably, directly into the herdbook unto the dam's page of the kid to be tattooed. The tattoo plier should be placed midway and between the cartilage ribs of the ears, so that the numbers are readable when one is facing the goat. After quick, firm and steady impression of the tattoo needles, ink is rubbed into the puncture holes by hand. If some holes were bleeding, the ink may not take; therefore repeat inking may be advisable, especially if a few holes need to be repunctured again with a hypodermic needle.
- 30 The right procedure for tattooing is to place the herd identification into the right ear, or right tailweb in LaManchas; and to place the animal number into the left ear or left tailweb. Usually a letter is used for the year of birth; starting with 'A' in 1968 (no 'G', 'I', 'O', or 'Q'), and 'S' stands for 1982. Following the year letter comes the birthing number for that kid in that year.
- 31 Other means of identification include neck chains, leg bands and ear tags, none of which are reliably permanent. However, ear notching is practiced in some goats, especially Angoras. It has the advantage of visible identification from a distance without catching the animal. The number and equipment system used in swine works well with goats too and can identify up to the number 9999. It is not suitable for show animals, but economical. The animal is restrained and bleeding after use of the 'V' shaped ear notches and hole punch is treated with iodine. Notches on the left ear mean: 1 (top), 10 (bottom), 100 (end), 1,000 (center); on the right ear they mean. 3 (top), 30 (bottom), 300 (end), 3,000 (center). Thus, a goat with the number 135 would look as

follows:

- 1 notch on end of left ear;
- 2 notches on top of left ear;
- 1 notch on top of right ear;
- 1 notch on bottom of right ear.

32 Freeze, fire, caustic or laser branding may also be used as in cattle and horses. Freeze branding requires usually liquid nitrogen (-320F), number irons, safety gloves and a styrofoam cooler box. Freeze branding will destroy the melanocytes (color producing cells) and the hair grows out white. On white animals, deliberate overbranding kills the hair follicles. Five quarts of liquid nitrogen will be needed for 20 head to be branded. The irons are held against the clipped and alcohol soaked skin between 30 to 60 seconds on colored skin and 2-1/2 minutes on white animals.

### 33 Weighing

Keeping good weight records is important for proper feeding and medication, besides good management. Tapes can be used for estimation of weight by measuring the heart girth behind the forelegs:

34	Body Weight Lb	Heart Girth Inches	Body Weight Lb	Heart Girth Inches
	20	17-1/2	80	29
	30	20	90	30-3/4
	40	22-1/2	100	32-1/4
	50	24	125	34-3/4
	60	25-1/4	150	37-1/4
	70	27-1/2	175	39-3/4
	200	42-1/4		

35 There also exists normal growth curve to age-weight relationships. For large breed male goats, they are in average as follows:

1 month	-	25 lb
2 months	-	40 lb
3 months	-	55 lb
4 months	-	65 lb
5 months	-	75 lb
6 months	-	85 lb
8 months	-	100 lb
9 months	-	110 lb
10 months	-	115 lb
11 months	-	120 lb



# MASTITIS

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DE Health and Disease Management

Text

## 1 Aspects of Dairy Goat Mastitis

Mastitis may be defined as inflammation of the mammary gland caused by specific disease producing microorganisms. Mastitis in dairy goats, like mastitis in dairy cows, is a disease of considerable economic importance. As in dairy cows, infection is usually spread from infected to non-infected susceptible animals during the milking process.

2 Some aspects of dairy goat mastitis closely resemble mastitis in dairy cows; others resemble the disease in sheep. Subclinical mastitis may be defined as mammary gland infection as revealed by laboratory examination of milk samples. Clinical mastitis is characterized by signs of inflammation: swelling, pain, fever temperature and abnormal milk secretion. Clinical cases may be acute, where animals clearly show all the characteristic signs of inflammation and chronic, where the infection remains in a more or less quiescent state with recurrent mild to severe attacks.

3 The most common organism involved in dairy goat mammary disease is *Staphylococcus epidermitis* which is commonly found on the skin of human hands and the udder skin of goats. This organism produces progressive chronic mastitis very similar to *Streptococcus agalactiae* infection in dairy cows. Recurrent attacks where the udder is feverish and painful; the quantity of milk secreted is curtailed and the somatic cell count is greatly elevated (see Diagnosis) depending upon the frequency and severity of attacks.

4 Staphylococcus aureus is also an important organism involved in dairy goat mastitis. It is found in both non-clinical and acute mastitis cases. Acute or peracute attacks are quite similar to blue bag, the common form recognized in sheep.

5 Clinical acute cases result when infected udders are injured and they are characterized by severe inflammation which may rapidly become gangrenous, with fever, intoxication and gross changes in milk secretion. The milk secretion of a clinical mastitis flare-up in a gland or the whole udder may become yellow, thick and greatly reduced in quantity.

6 In peracute cases, gangrene quickly develops, often within a few hours and the affected animal may die unless the entire gangrenous gland is surgically removed.

7 Streptococcus agalactiae infection is often reported as a cause of dairy goat mastitis. It and other streptococci are not nearly as prevalent or economically important as they are in dairy cows.

8 Corynebacterium pyogenes mastitis in dairy goats is characterized by the presence of firm round abscesses in the milk producing tissue. The disease is usually progressive; advanced cases of the disease reveal multiple abscess formation with nearly complete destruction of milk secreting tissue.

9 Mycoplasma mastitis is rare in dairy goats. It may be found in animals suffering from systemic mycoplasma infection. This form of mastitis is not rare in countries where contagious caprine pleuropneumonia occurs in goats, but other mycoplasma infections have been suspect in severe cases of arthritis and pleuropneumonia in the United States.

## 10 Diagnosis

Subclinical mastitis in goats may be identified as it is in dairy cattle; by laboratory culture and examination of carefully collected milk samples. However, the common pathogen in goats is usually not considered pathogenic in cows. Laboratories which commonly culture cow milk for mastitis may report goat milk samples infected with Staphylococcus epidermitis as negative. That organism is not coagulase positive or hemolytic on blood agar plate culture.

11 Staphylococcus aureus is readily identified by laboratory culture of milk samples. Corynebacterium pyogenes may not be detected by laboratory examination if udder lesions are few and well isolated by abscess formation.

12 The California Mastitis Test (CMT) and Somatic Cell Counts (SCC) of milk are useful monitoring tools to detect the presence of mastitis in the mammary glands of dairy goats.

- 13 The California Mastitis Test is a simple rapid means for detecting mammary gland infection and irritation. It has had wide acceptance and use by veterinarians and dairymen in routine mastitis prevention and control programs. There is widespread belief that a higher CMT is normal for goats than for cows. Until that argument is definitely settled, a CMT of 1 or higher should be cause for concern in goats.
- 14 Somatic Cell Counts are a more accurate measure of udder health. Healthy dairy goat herds can be expected to produce milk with a somatic cell count under 500,000. The presence of mastitis infection in dairy goat herds is reflected in bulk tank milk samples with a CMT of 1 or higher and a somatic cell count exceeding 1,000,000 cells per milliliter.
- 15 Regular use of the CMT or SCC can give both the owner and the milk consumer confidence that the milk is produced by healthy animals.
- 16 Prevention and Treatment
- Tender loving care may be the most important basic requirement for mastitis prevention and treatment. Dairy goats are very sensitive, intelligent animals. When the person milking the goat likes the animals and handles them gently, quietly and patiently, goats willingly and eagerly participate in the milking procedure. With ideal milking management, goats show abundant evidence of affection for the person doing the milking job, letting their milk down for maximum ease and speed of milking.
- 17 Modern milking machine equipment, if properly cleaned and used, will milk goats rapidly without injury when used by trained operators who like the animals.
- 18 Rough hand milking which pulls on the teats and excessively strips after milk-out can be stressful and injurious as bad machine milking. Good hand milking requires full hand milking and no tug and pull on the teats.
- 19 Both hand and machine milking require good milking preparation - clean dry teats and clean dry hands and/or teat cup inflations. Rough handling, irregular milking times, overmilking or inadequate preparation for milking all take their toll in providing stress and injury. These directly affect mastitis resistance and susceptibility.
- 20 Mastitis in dairy goats, like mastitis in dairy cows, is rarely an important disease in herds where animals are thoroughly prepared for milking by massaging and washing udders. The use of a bactericidal solution to cleanse the udder and teats also stimulates good milk let-down. Dry the udder and teats with an individual paper towel before milking begins. With hand milking, it is very important that milkers' hands be thoroughly washed and dried before milking.



- 21 Milking machine teat cups should not be attached to the goat until udder and teats are thoroughly washed and massaged, cleaned and dried. Hand or machine milking which is hurtful or excessive beyond normal let-down contributes to teat end injury and the spread of mastitis from goat to goat in the milking procedure.
- 22 Teat Dipping  
This procedure has been found useful for preventing spread of mastitis from infected to susceptible glands in dairy cow herds. It is equally effective and useful in dairy goats. However, some teat dipping solutions tolerated by dairy cow teats may be too irritant for dairy goats. Teat dipping solutions should not be used for dairy goats if they produce drying or irritation of the skin of the teats.
- 23 Dry Treatment  
Dry cow mastitis treatment udder infusion formulations are recommended for goats which have had evidence of mastitis infection before drying off and they may be at least as effective in preventing mastitis attack during the dry period. A single dry cow quarter udder infusion dose is recommended for each udder half in the goat.
- 24 Systemic Treatment  
In severe acute attacks of mastitis, systemic administration of antibiotics by intravenous or other parenteral means is indicated. Frequent udder massage with gentle hand milking may be helpful to relieve pressure in the affected gland to aid recovery. Strict attention should be paid to milk withholding instructions on the label of the product used. When mastitis cases are treated by a veterinarian, be sure that you follow milk withholding instructions given.
- 25 Summary  
Mastitis in dairy goats is usually the result of defective milking management which gives the organisms responsible the opportunity to spread and produce disease.
- 26 Adequate sanitary preparation for milking which results in clean dry udders, clean dry milkers' hands or milking equipment are fundamental requirements for mastitis prevention.
- 27 Regular use of the California Mastitis Test and/or Somatic Cell Counts can successfully monitor the progress of mastitis control and the health status of udders in the herd.
- 28 Antibiotic udder treatments available are excellent for treatment of infected mammary glands, but success with their use is determined by the level of milking management and sanitation used in milking the herd. Of course, milk from treated does must be withheld from human consumption according to label instructions; nor can meat of treated



# MEAT GOAT PRODUCTION

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TI MEAT GOAT PRODUCTION

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DE Management and Housing

Text

1 Generally, three types of goats are found in the US. These are Angoras (approximately two million head), dairy (approximately one million head), and meat goats (one half million approximately). In the Southwest, the latter are widely referred to as Spanish goats, but this is a term of convenience to distinguish them from the other types. They are not necessarily of Mexican or Spanish origin. Many meat goats have been in this country since early times. Meat may be produced from all three types, but only the latter is kept exclusively for this purpose. In many small flocks of dairy goats, the does may not all be milked, and thus the main product from these flocks is meat. The sale of breeding stock from small flocks of dairy goats may represent important sources of income, but at some point, meat or milk is needed as a contribution to mankind.

2 Not all meat goats are Spanish range goats. Goat meat is relished and highly priced in many parts of the world, as cabrito by Spanish, chevon by French people, and also favored by US ethnic groups, e.g. Greek, Moslem, Jews, Arabs, Mexican, Puerto Ricans. Easter goat kids are in particular demand but require early spring or late winter kidding. Goats producing half a gallon of milk per day can raise two kids without supplemental feeding. Easter kids should weigh about 25 to 30 lbs and depending on the price per lb on the hoof can return a profit. Buck kids will grow faster and can be sold ahead of doe kids. Some people raise yearling wethers, letting them nurse as long as a half year and then letting them graze. They may custom butcher for a fee and charge retail prices for the carcass. The cost of hay, feeds and grazing must be recovered from the meat sales besides a reasonable

profit.

3 Income from meat goat or goat meat production may not compare favorably with other methods of range management except under situations where open range, idle land, bush or browse are not readily utilized by other grazing livestock, or where small land areas will not support beef or dairy cattle production. Although, in some instances the owner may have a preference for goats or wish to exploit special market situations.

4 Goats tend to be better adapted or are more prevalent in the warmer climates. There are a number of factors contributing to this, including some goats suffering in cold climates due to small body size, lack of extensive coat cover and lack of owner's income to build winter confinement and feeding facilities.

5 Problems: Markets

There is no established national or regional marketing or distribution system for goat meat with the result that market development is often a case of individual entrepreneurship. As a result prices may vary widely. Likewise, quality grades or standards are not in effect, and at the present stage seem unnecessary until regional or national distribution systems develop. Meat quality is not a serious problem for those slaughtered as kids or yearlings. Some references to lack of tenderness appear to be explained by cold shortening or quick chilling due to small carcass weights. Satisfactory market outlets for age or cull breeding stock may present problems for some producers, since such would largely go for the boning trade and the small volume would prevent effective exploitation.

6 Problems: Predators

Almost any place where goats are located in this country, predators (dogs, coyotes, etc.) are a big problem. Many approaches including approved poisons, and traps and guarding animals are available, but none are totally satisfactory. Thus, the producer needs a plan for dealing with this problem. Good net fences, at least 4.5 feet in height, or well maintained electric fences are almost a requirement. Goats are not necessarily more difficult to fence than other species, except that barb wire fences which may often be used for cattle are unsuitable because of the usual spacing between strands through which goats will be able to pass.

7 Reproduction

Most meat goat producers follow a practice of running males with the females on a more or less continuous basis. This is the simplest practice and may well contribute to maximum production. Most meat goats found in this country are seasonally polyestrous with recurring estrual periods from approximately August through February. Some matings outside these dates may occur. A more controlled breeding program may be indicated in order to (a) exploit special market situations, (b) avoid mid-winter kidding which may often be the norm

under random matings, or (c) fit seasonal feed supplies.

8 Even with the continuous presence of males, kiddings tend to be grouped. The explanation is not always obvious. The presence of the male and his rutting activity has a strong influence in terminating lactational and seasonal anestrus of does. It is possible to have some degree of control over kidding dates and the periodic removal and readdition of rutting males (i.e. one month in and one month out) can have a stimulating effect on total kid production. Due to the relatively long breeding season, twice per year kiddings do occur with individual does, especially those which lose kids, but it is by no means the norm on a flock basis. The anticipated norm for kid production should be on the order of 1.25 to 1.5 kids raised per doe per year, but may well deviate from this by a large amount due to inherent potential or production conditions.

## 9 Genetics

Excluding the dairy breeds, which are also relatively good meat producers, well established breed types do not exist in the USA for meat production alone. The Swiss dairy breeds are not very popular for meat production under range conditions. Udder problems and leggy conformation are the primary reasons. The absence of well defined US meat breed types tends to prevent organized crossbreeding programs. Some selective breeding efforts have been carried out in Texas, but as of yet breed types or names (aside from 'Spanish' goats) have not been established. There is need for improvement in growth rate, carcass yield and meat to bone ratio. An optimally high kidding rate (preferably not above two kids per parturition) should also be maintained. Selection pressures should be exerted in these directions. Limited research indicates that it should be possible to change these traits through selection.

## 10 Nutrition

Intensive feeding of meat goats is not the norm and likely may not be an economical goal. Meat goats are infrequently fattened on harvested feeds for slaughter, and heavy supplemental feeding is not normally practiced. There are times when it may be desirable to feed meat type goats. It is necessary to remember that they are small ruminants, but they do not possess the magic to digest poor quality or trash type feeds as some people think. They appear to require some more quality in their rations than larger ruminants. Their ability to survive under adverse conditions stems from their being more selective in feeding and able to conserve critical nutrients (minerals, protein, water, etc.). For a high level of production of growing kids they respond to good quality diets with 12-180001:0000rotein contents. They do utilize poor quality roughages such as stovers, straw, etc. very well. In commercial practice, supplemental feeding of goats will be restricted to winter or drought periods, and then almost any available feedstuffs will be used. Younger goats will require a better quality ration than mature animals to provide nutrients for growth and development.



# METABOLIC AND NUTRITIONAL DISEASES

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TI METABOLIC AND NUTRITIONAL DISEASES

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DE Nutrition

Text

## 1 Pregnancy Toxemia

Also known as pregnancy disease, ketosis or twin lamb disease. Pregnancy toxemia is a metabolic disease of goats and sheep in late pregnancy. Factors important in the development of the disease are: (1) Presence of two or more fetuses; (2) Undernourishment during late pregnancy when the fetuses have the most rapid growth; (3) Addition of stress such as severe weather, sudden changes in feed, other disease or transportation upon the previous factors. The disease usually appears in the last 30 days of pregnancy and is more common after the first pregnancy. The doe shows signs of ketonemia, ketonuria, acidosis and central nervous system involvement. The mortality rate is high in affected animals. Most information available is the result of studies in sheep.

2 Cause -- As pregnancy progresses, an increasing demand is on the available blood glucose supply of the doe or ewe because of fetal development. The principal source of energy to the fetus is glucose and utilization by the fetus occurs at the detriment of the mother. Glucose requirements during late pregnancy are increased 70-80% over the nonpregnant state since 80% of fetal growth occurs during the last 40 days of pregnancy. Blood sugar levels decrease as pregnancy progresses (hypoglycemia) from a normal 35-45 mg per 100 ml blood to 20-25 mg per 100 ml blood in late pregnancy. Pregnancy toxemia may develop when levels decrease to about 18 mg per 100 ml blood. The severity of hypoglycemia will be directly affected by undernourishment of the mother or by increased requirements of the fetus(es).

- 3 As the glucose supply diminishes from increasing fetal demands and decreased glucose production due to undernourishment, energy requirements are furnished by other metabolic pathways, i.e. from free fatty acids and amino acids. Breakdown of the free fatty acids results in increased production of ketones, acetoacetate and B-hydroxybutyrate. As hypoglycemia becomes more severe, the ketone level in the blood increases (ketonemia) and ketosis occurs.
- 4 As ketosis increases, the bicarbonate level in the blood decreases and acidosis may result. When the bicarbonate level declines sufficiently, the animal will become comatose. During the later stages of pregnancy toxemia, water consumption decreases, urine output is decreased and kidney function is impaired. The blood sugar level may increase severely (hyperglycemia) during the late stages of the disease as a result of the response of the adrenal glands to stress.
- 5 Circumstances which cause severe hypoglycemia will usually result in pregnancy toxemia. Under-nourishment of the doe may not meet the demands for glucose production. The level of nutrition should be increasing as pregnancy progresses so that the doe will be able to provide fetal requirements. The doe should be gaining weight during pregnancy. As previously mentioned, multiple fetuses greatly increase the glucose requirements. A gradual onset of undernourishment, as would be seen if the feed intake was not increased during pregnancy, may be tolerated by the doe and toxemia may not develop. However, if the animal is starved for several days, pregnancy toxemia may develop readily. Sudden changes in weather, infections or transport may result in periods of inappetence and may trigger pregnancy toxemia. Excessively fat animals may develop periods of poor appetite under stressful situations.
- 6 Clinical Signs -- Clinical signs are those observed with involvement of the central nervous system. Initially, the animal tends to separate from others. There is mild depression. Evidence of blindness develops, the animal runs into objects, shows little or no reaction when approached, and wanders aimlessly. Dullness and depression become progressively severe. There is reluctance to move. Eventually they go down in sternal or lateral recumbency and show little or no response to their environment. The does become comatose and eventually die.
- 7 Occasionally, animals may show a short period or intermittent periods of hypersensitivity. There may be quivering, twitching of the ears, muzzle or eyelids or spasms of certain muscles. Incoordination may be evident. Recumbent animals may have convulsive paddling movements.
- 8 Chewing, teeth grinding or vigorous licking movements may be seen. Mild scouring may be present. A snuffling respiration due to excessive nasal secretion may be common. Drooling of saliva is also seen.



9 Temperature and pulse are within normal limits. Respiration is usually normal until the later stages when it may become labored. The appetite is poor or absent. Ketones may be detected in the urine.

10 In some herds, 200 or more may be affected. Mortality may reach 80. Some may recover spontaneously following parturition or abortion.

11 Post Mortem Findings -- The liver is enlarged and has a pale yellow to orange coloration. The adrenal glands may be enlarged. The uterus contains two or more fetuses.

12 Treatment -- Oral administration of glycerol or propylene glycol or intravenous administration of glucose may be effective in the early stages of the disease. Insulin may be used with these treatments for better utilization of glucose. During the late stages of the disease, glucose administration may be ineffective or detrimental because the blood glucose levels may be very high.

13 During the later stages of the disease, acidosis and dehydration may be important factors. Intravenous administration of large volumes of electrolyte solutions with sodium bicarbonate may be important. Corticosteroids may not be effective in the later stages unless given at dosages utilized to combat endotoxic shock.

14 Cesarean section or other methods of terminating pregnancy may be effective in some cases.

15 Prevention -- An adequate nutritional level throughout the pregnancy will prevent pregnancy toxemia. Protein and energy levels during the last 30-40 days of pregnancy should meet the doe's maintenance requirements as well as the growth requirements of the fetuses. Allowing the animal to become excessively fat should be avoided.

16 Management during late pregnancy should be directed at avoiding appetite problems in the animals. Avoid sudden feed changes, diminish stresses of severe weather, delay or avoid transportation and prevent concurrent disease problems.

#### 17 Parturient Hypocalcemia

Also known as milk fever. Parturient hypocalcemia is a metabolic disease in does following kidding characterized by poor milk production, poor appetite, lethargy and low blood calcium levels. A hyperirritability characterized by tetany may occasionally occur.

18 Cause -- Much research has been done on hypocalcemia in dairy cows but knowledge is still incomplete.

19 Following kidding, most does may have a lowered calcium level in the blood (hypocalcemia). This is partially due to the drain on

available calcium by the production of colostrum. (Colostrum contains twice as much calcium as milk). Calcium is supplied from two sources: 1) dietary; 2) mobilization of calcium from the bone. Normally, calcium requirements following kidding are provided primarily from the diet since mobilization of calcium from the bone does not provide significant amounts until about 10 days after parturition. A loss of gastrointestinal function for any reason, before or at parturition, may cause a severe drop in the blood calcium level. Signs of hypocalcemia may develop. Since older animals have more digestive upsets at parturition, they have more problems with hypocalcemia.

20 A high level of calcium in the ration during gestation places almost complete reliance on the dietary source of calcium. If the prepartum diet is low in calcium, calcium mobilization from the bone is instituted to meet the calcium needs. If a gastrointestinal dysfunction occurs at parturition, the effects are not severe since part of the calcium requirements is supplied by mobilization from the bone.

21 Clinical Signs -- Usually high producing older does are affected shortly after kidding. The does show lethargy, poor appetite and poor milk production. Occasionally, hypocalcemia tetany may be observed. The doe is hyperirritable and may show muscle twitching of the lips, eyelids and ears. Trembling or twitching of other muscles of the body may also occur. Convulsions may develop.

22 Blood calcium levels may be 5-7 mg per 100 ml blood. The response to calcium therapy may be diagnostic.

23 Treatment -- Administration of calcium preparations, intravenously or subcutaneously, will provide dramatic relief of clinical signs. Lethargic does may begin eating and become more active and alert within 12 hours. Tetany usually subsides in 30-60 minutes after treatment.

24 Prevention -- The problem often involves many does in the milking herd. Usually, there is excessive calcium in the gestation diet from a mineral source and/or high quality legume hay. Correction of the calcium imbalance is necessary. A low calcium level during late pregnancy will help to control the problem.

## 25 Polioencephalomalacia

Also known as cerebrocortical necrosis. Polioencephalomalacia (PEM) is a disease of ruminant animals characterized by derangement of the central nervous system due to necrosis of the cerebral cortex of the brain.

26 Cause -- The cause and development of the disease have not been entirely elucidated. Thiamine is produced in the rumen. In PEM, thiaminase, an enzyme that destroys thiamine, is thought to be produced by certain bacteria within the rumen and thiamine deficiency develops.

A thiamine - analogue is also produced within the rumen which may replace thiamine in important metabolic reactions in the brain. Necrosis of the brain occurs.

27 Clinical Signs -- Young animals on high grain diets are affected more often. Older animals and pastured animals may be occasionally involved.

28 The onset is often sudden with blindness and disorientation. The head may be elevated. Excitement may be seen but is usually replaced with dullness. The animal may go down on its side with its head thrown back. The legs may be rigidly extended. Convulsions may occur. If untreated, death usually occurs within a few days.

29 The appetite is lost and the animal does not drink. Temperature and respiratory rate are usually normal but the heart rate may be depressed.

30 Treatment -- Administration of large doses of thiamine intravenously and/or intramuscularly early in the disease will usually produce a dramatic improvement within a few hours. In the later stages of the disease, the brain necrosis may be too severe for the animal to recover.

31 Prevention -- Until further elucidation of the cause and development of the disease, little can be done to economically prevent the disease. If a case of PEM is diagnosed in a group of animals, it is advisable to inject the remaining animals with thiamine to prevent further cases.

## 32 Calculosis

Also known as urinary calculi, urolithiasis, kidney/bladder stones or waterbelly. Calculosis is a metabolic disease of male ruminants characterized by formation of concretions within the urinary tract with obstruction to the outflow of urine. This often results in rupture of the bladder or the urethra.

33 Cause -- The disease occurs in animals on a high concentrate diet with a mineral imbalance resulting in excessive phosphorus intake. A high phosphorus level develops in the blood and in the urine. Magnesium and ammonium phosphate precipitate to form a concretion or calculus. The size may vary from sand-like particles to as much as 5-10 mm.

34 In the female ruminants, the calculi are passed easily through the short expandable urethra. In the male ruminant, the urethra is long and does not expand easily. The calculus must pass around three curves in the urethra. In sheep and goats, the urethral process is a short (2-3 cm) extension of the urethra beyond the tip of the penis. The diameter of the urethral process is slightly smaller than the remaining urethra.



# MILK HOUSE CONSTRUCTION, EQUIPMENT AND SANITATION

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TI MILK HOUSE CONSTRUCTION, EQUIPMENT AND SANITATION

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DE Milk and Milk Handling

Text

1 The milk house is the final on-farm site of quality control in the milk production process. One could consider the kitchen as a milk house for the very small herd owner since this is where milking equipment is washed and stored and where milk is cooled and stored until used. Regulations governing such a milk and equipment handling area are determined solely by the herd and home owner. However, the person producing milk for sale to the public requires more space and equipment than can be available in a kitchen. Further, milk houses, cooling systems and cleaning and sanitizing of milk handling equipment comes under the watchful eye of the dairy sanitarian and specific features must meet rigid inspection standards in order to legally sell milk publicly.

2 The United States Department of Health, Education, and Welfare publishes a handbook titled. 'Grade A Pasteurized Milk Ordinance' which covers all aspects of milk production. The same rules apply to milk production from both dairy goats and dairy cows. Consultation with a dairy sanitarian will identify those essential building, milk handling and equipment handling needs that must be part of a milk production program. If desirable, a copy of the Milk Ordinance may be obtained by writing to Superintendent of Documents, Washington, DC 20402. There is a charge for the publication.

3 Milk House Construction and Facilities

The milk house should be used for no other purpose than milk house

operations and should have no direct opening into any barn, stable, or room used to house animals. The exception is that some states may permit a direct opening so long as a tight fitting, self closing, solid door is provided.

4 The size of the milk house is dependent on size of operation and amount of equipment. Installed equipment should be readily accessible to the operator. A sanitarian can guide the herd owner to appropriate measurements. Generally, isles should be at least 30 inches wide with extra work area, if necessary, to permit disassembly, inspection and servicing of equipment. The floor must be smooth and made of impervious material, usually concrete, and graded to drain sites. Drains should not be located under bulk tanks or under the outlet of a bulk tank. Walls and ceilings must be constructed of smooth material, well painted, maintained and in good repair. This suggests that with water in constant use, a good epoxy painted concrete block wall or glazed tile wall surface plus some of the plastic coated ceiling materials are good surfaces to resist water penetration and to clean easily.

5 Window space equal to 4 square feet per 60 square feet of floor space must be provided or electric lights sufficient to offer a minimum of 20 foot candles of illumination. A combination of light source is most desirable to provide for night lighting. Windows also offer a source of ventilation. If possible, locate the windows so as to provide cross ventilation. Screens on windows and doors are essential to protect against flies and other insects.

6 Ventilation by mechanical means is desirable and sometimes necessary. Constantly wet conditions may sponsor mold and algae growth on floors and walls and encourage bacterial odors to develop. Ventilation assists in drying the surfaces plus moving fresh air through a milk house to keep musty or foul air to a minimum. Milk houses may have permanently closed windows, such as glass block and mechanical ventilation in such instances becomes critical. Fan size capable of moving 15 to 20 cubic feet of air per minute may be adequate.

7 Masonry construction offers little protection from cold and will benefit from insulation, especially in prolonged cold spells to prevent freezing of water on floors and walls. With the vast amount of water needed and with pipes, sinks, drains to protect from freezing it becomes economical to consider insulating the ceiling, walls and floor.

## 8 Equipment

Milk should be handled only in materials that are non-toxic and readily cleanable. These materials are glass, stainless steel, certain approved plastics and rubber or rubber-like materials designed for milk handling. Do not use materials such as aluminum or copper bearing metals for handling milk. Containers having tinned surfaces must be free of dents, pits, open seams and any evidence of rust spots. Such

areas harbor bacteria and may lead to such defects as oxidized flavors.

9 The wash and rinse sink should have two compartments with each compartment big enough to hold the largest piece of equipment to be washed. Sanitizing can be done in the sink just prior to milking.

10 Storage racks or tables for utensils and cans must be available and permit air movement and rapid, thorough drying of all equipment following washing and rinsing. Bacteria growth on surfaces is reduced greatly if the surface is dry.

11 A separate sink should be available for washing hands of the milkers.

#### 12 Cool Milk Quickly

Milk should be cooled quickly and held to under 40F. The most satisfactory equipment for cooling is the stainless steel farm bulk tank. The tank should be sized to hold 5 milkings. Milk should be stored for not longer than 48 hours. The 5th milking capacity is suggested in case of emergency.

13 The size of the refrigeration unit should be based upon the rate at which milk enters the tank. The BTU (British Thermal Unit) removal rate should be 90 to 100BTU loading rate. There are 50 BTU's per pound of milk to be removed, Thus, if 300 pounds of milk are put into the tank in one hour, a refrigeration unit rated between 13,500 and 15,000 BTU per hour should be utilized.

14 Cooling milk from small herds can present problems. Simply placing milk in a container into a refrigerator is not satisfactory. The milk will not cool rapidly enough by this air cooling method. Containers may be placed in circulating ice water to obtain satisfactory cooling results.

#### 15 Containers

Milk should be placed in clean sanitized containers specifically designed for milk. Store in a refrigerated space under 40F and keep out of the light. Milk is a perishable food. Keep it clean, cold and covered.

#### 16 Water Source

This must be from a supply properly located and protected and be of adequate quantity and of a safe and sanitary quality. The water supply is periodically tested to make sure it remains uncontaminated.

17 It becomes obvious that a water supply adequate for a small, hand milking operation may fall far short of needs when milking machines or pipeline milkers and cleaned-in-place systems are installed. The dairy sanitarian can be of help in evaluating total needs.

## 18 Sanitation

Good brushes, proper water temperature and the right cleaning materials reduce the effort and increase effectiveness in cleaning and sanitizing milk equipment. On many farms, regardless of size of herd, milking machines, pails and strainers are washed by hand.

19 Bacteria need three conditions for support of growth -- soil (food), moisture and proper temperature. Proper cleaning and sanitizing followed by rapid drying removes these conditions and helps keep bacteria counts low.

20 Adequate supplies of hot and cold water are essential. If the water is soft it makes the cleaning job easy. Most water supplies are hard, necessitating installation of a water softener or the use of cleaners manufactured especially for use in hard water.

21 Many cleaners are made for use in soft water and when used in hard water produce whitish residues when the equipment dries. This is called waterstone and milk solids cling to it making cleaning progressively more difficult. Equipment that is difficult to clean frequently is poorly cleaned and high bacteria counts usually result.

22 A protein film may appear if the cleaning solution is too weak or the wash temperature too low. It first appears as a bluish discoloration on equipment surfaces.

23 In manual cleaning, a sanitizer as well as a cleaner is needed. Some cleaners, such as quarternary detergent sanitizers and iodine detergent sanitizers, have a sanitizer built in. This does not mean that the final cleaning step of sanitizing before use of equipment can be omitted.

24 There are two types of cleaners. Alkaline cleaners are preferred because of their ability to remove milk-protein soil and butterfat particles from the equipment. Acid cleaners function by softening water and usually include wetting agents which emulsify and remove fatty deposits if the water temperature is correct.

25 In any case, follow instructions printed on containers of cleaners and sanitizers. The following general procedure may be used with many cleaners:

1. Rinse equipment thoroughly with water 100F to 120F immediately following milking. Water too hot sets the milk film; water too cool does not remove the fat.
2. Prepare a wash solution with water at 120F to 130F. Use a cleaner compatible with the water supply. Use a thermometer and be sure water temperature doesn't drop below 100F.





# MILK SECRETION

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TI MILK SECRETION

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DE Anatomy and Physiology

Text

1 Growth and Development

The mammary glands of goats are specialized cutaneous glands, related to the sebaceous (oil producing glands of skin and hair) and sweat glands. From a physiological viewpoint, they might be classified as accessory reproductive organs, as they are intrinsic to the reproductive function. Mammary glands are present in both sexes. Functional activity in the male is rare, although milk secreting glands have been developed in both virgin does and bucks by repeated gentle massage of the mammary area. Differentiation in growth of mammary glands between the sexes is usually not obvious until puberty. At that time, glandular enlargement occurs in the female. Most of it is in increased amount of connective tissue and fat deposition, but not increased formation of secretory tissue. Estrus periods bring on increases in the development of the secretory and duct tissues, with a recession during the anestrus period. The process of enlargement is minimal however, and the glands will not approach a functional state until the animal becomes pregnant.

2 Growth of lactating tissue is dependent mainly upon two hormones, estrogen from the developing follicles and progesterone from the corpus luteum. The corpus luteum is the naturally regressed stage of the follicle after it has ovulated, releasing ova into the oviduct. Estrogen, which is cyclic, stimulates the duct development of the mammary gland. Progesterone is almost continuously secreted during pregnancy, causing secretory tissue development. As the gestation period nears its end, the mammary glands become capable of producing

milk. After parturition, the rate of milk secretion increases for some time, reaches a peak, and then gradually declines. A loss of secretory epithelial cells occurs during involution, although some new cells are being formed. The general activity level of the individual cells declines also. At the cessation of milk production, secretory epithelial cells will totally disappear, leaving only myoepithelial cells. The frequent release of oxytocin may slow down the rate of the involution process and some goats may secrete milk for years continuously.

3 Milk secretion during lactation tends to inhibit the normal cycling of the estrus periods, with some temporary suppression of ovulation. With time, there will be a return to normal estrus cycles. Milk production will decline, and the glands will go into involution; although not complete, since the glands increase in size with successive pregnancies.

4 Hormones other than estrogen and progesterone that influence development of mammary glands or lactation originate from the hypothalamus and pituitary glands of the brain.

5 The anterior pituitary produces in response to stimulation of the hypothalamus six hormones, which exert either a direct or indirect influence on milk secretion. Somatotrophic or growth hormone (STH); follicle stimulating hormone (FSH); luteinizing hormone (LH); prolactin (most intimately associated with initiating and maintaining lactation); thyrotrophic hormone (TTH); and adrenocorticotrophic hormone (ACTH).

6 The posterior pituitary stores two hormones from the hypothalamus both related to lactation. Vasopressin or antidiuretic hormone (ADH), decreases the amount of water lost in the urine, retaining it instead for use. Oxytocin is best known for its ability to cause milk 'let down' in mammals, although it is also capable of stimulating contractions in other smooth muscles such as the uterus during estrus and parturition, as well as in the urinary bladder and intestine.

7 The pars intermedia of the pituitary secretes the hormone intermedin, which has some effect on water metabolism.

8 In mature goats secretions of FSH stimulate follicular development, which then becomes a source of estrogen. LH, working in the presence of FSH, produces ovulation; and from the corpus luteum progesterone is released.

9 Estrogen by itself generally stimulates duct development of the mammary glands, while estrogen and progesterone together cause lobulo-alveolar growth. In the goat, however, estrogen alone will initiate abnormal development of the mammary, producing dilated alveoli and even milk production in some cases. High levels of estrogen in circulation have a negative effect on feed consumption and milk

production in goats. Estrogen and progesterone are required both for the complete development of the mammary system, along with the other pituitary hormones. Large amounts of prolactin are to be used just prior to parturition in response to the higher levels of estrogen and progesterone at this time. Prolactin matures the alveolar cells to a functional condition. STH and thyroxine, also exert an influence on the amount of milk produced. Small injections of estradioltestosterone produce a colostrum-like milk in goats, while large doses produce a watery, clotted milk secretion.

10 The hormone of most interest is oxytocin. It is responsible for milk let-down, causing the myoepithelial cells that surround the alveoli to contract, forcing the milk out into the ducts of the udder. Oxytocin release is initiated in several ways, the most natural being nursing. It will directly stimulate the afferent nerve fibers of the teat, causing the release of the hormone and transportation via the bloodstream to the mammary glands, with subsequent contraction of the myoepithelial cells. This milk let-down reflex can also be initiated by other repetitive occurrences, such as washing the udder, approaching the milking area, the sounds of the milking machine or milk buckets, or even the sight of the milker.

11 The process of milk let-down is subject to interference if the goat should become excited through some disturbance. A release of epinephrine (adrenalin) follows such excitation. Epinephrine causes constriction of the small arteries and capillaries of the udder and may prevent the myoepithelial cells from contracting. Therefore, anything that may cause a disturbance or alarm near milking time should be avoided.

12 After the initial stimulus for let-down, it takes a period of about 20-60 seconds for the response of oxytocin, which influence will last about 5-6 minutes. It is important to milk goats soon after their let-down and not a stimulate more does than can be milked immediately. Due to an inability to completely close off milk ducts, goats in contrast to cows cannot hold back milk flow entirely.

13 Artificial induction of lactation has been accomplished in goats with good results by injections of hexestrol at a daily rate of 0.25 mg. Pellet implantations of estrogen and progesterone have also successfully created udder growth, with final treatment of estrogens to initiate lactation. Artificial induction of lactation has experimental value, but is not practical for several reasons. Injections must be given over a period of time on a daily basis, or tablet implants must be inserted. The methods are costly, labor intensive, give a low yield of milk, and do not produce income from the sale of the kids. There may also be questions of safety of the milk after using these injections.

#### 14 Milk Composition

Milk differs in structure and composition from the blood from which

it originates. Milk is composed of protein, fats, sugar and mineral salts. The osmotic pressure of milk is essentially equal to that of blood. The pH at 6.5 is slightly acidic. Milk contains higher levels of sugar, lipids, calcium, phosphorus and potassium than blood, but lower amounts of protein, sodium and chlorine. Proteins also differ, since milk protein is composed primarily of casein, with smaller amounts of albumin, globulins and others. Blood protein, is primarily composed of albumin and globulins. Fat composition differs, as milk lipids are predominantly triglycerides and blood lipids consist of phospholipids and cholesterol. Non-protein nitrogen compounds are also found in milk, such as urea, uric acid, creatine, creatinine and ammonia. Some of these are from the blood system, while others are waste products of the mammary gland.

- 15 Lactose, the milk sugar, is a disaccharide carbohydrate that is unique to the mammary gland. Blood glucose is the primary precursor of lactose, besides propionic acid, while acetate (another VFA) is predominantly used in milk fat synthesis. Butyrate is generally distributed fairly evenly between lactose, casein and fat constituents of the mammary secretion.
- 16 Milk lipids (fat) consist primarily of triglycerides, although there are small amounts of phospholipids, cholesterol, fat-soluble vitamins, free fatty acids, and monoglycerides. Fat exists in small globules in the freshly secreted milk, averaging under 4 microns in diameter in goats and being smaller than for cow milk. The outer layer of the globule contains phospholipids, cholesterol, protein, and vitamin A and stems from the alveolus. Acetate is the major precursor of milk fat in goats. Goat milk fat does not rise or 'cream-line' as easily as cow milk fat since it lacks the coalescing factor besides being of smaller average globule size. Rupturing the milk fat globule membrane can add to off-flavor problems of goat milk. Since milk fat synthesis depends on the supply of acetate from the rumen, any feeding regime, such as high grain feeding which lowers the production of rumen acetate, will also lower the fat content of goat milk. Supplementing the feed ration with more crude fiber sources, such as hay, sunflower seeds, peanuts in their shells, etc. will restore milk fat levels to normal.
- 17 Most major vitamins are found in goat milk, some in abundance. B-complex vitamins are manufactured by the rumen flora. Vitamin K is synthesized in the rumen and the intestine. Vitamins A, D and C tend to be diet related; especially vitamin A and the precursor carotenoids. Milk levels of vitamin D are usually increased during commercial milk processing. Vitamin A in goat milk is related to blood levels; and no carotenoids are found in goat milk.
- 18 Minerals in goat milk consist mostly of calcium, phosphorous, sodium, potassium, chlorine, magnesium and sulfur. Trace amounts of aluminum, boron, bromine, cobalt, copper, fluorine, iodine, iron,

manganese, molybdenum, silicon, silver, strontium and zinc are found in milk in less than 1 part per million.

#### 19 Colostrum

The first milk after a doe kids is of great significance to the young. This colostrum has a high nutritional value and contains antibodies essential for the survival of the newborn. Goats like other ruminants have a 5-layer placenta through which no antibodies can be transmitted from the dam to the kid in utero. Thus the kids depend on the colostrum as their source of antibodies, providing passive immunity until they are developing their own active immune system. The period in which the immunoglobulins can be absorbed through the kid's GI tract lasts 3 to 4 days in goats. Beyond this time, the digestive enzymes in the gastrointestinal tract of the kid will break down the protein structures of the antibodies, rendering them ineffective. The high percentage of these immunoglobulins in colostrum, along with albumin, gives it its thick, sticky consistency.

20 Globulin, having a high proline content, is also important for the formation of hemoglobin in the young kid. Normal milk is much lower in globulin levels, having instead a higher level of casein. The functional importance of casein is that it is the only milk protein forming a curd upon coagulation in the abomasum thereby creating a slower moving food reserve for the young kid.

21 The dry matter content of colostrum is much higher than in normal milk, primarily due to the large amount of proteins, especially albumin and globulins. The vitamin content of colostrum is also higher than normal; the lactose content is low. The colostral content of iron is generally about 15 times greater than in normal milk, while vitamin A and vitamin D levels are about 10 and 3 times those of normal milk.

22 Colostrum or milk bypasses the reticulorumen area because of the formation of the esophageal groove, thus preventing the milk from laying in the rumen and turning rancid, which would then develop scours. The formation of this groove is in response to the sucking reflex of the young kid. Actual suckling need not occur however, as a kid can drink from a bucket and still bypass the rumen.

#### 23 Milk Production

Milk production consists of secretion and excretion. Secretion is the formation of milk from its blood precursors within the alveoli. Excretion is the discharge into the lumen, ducts, cistern, teat and final harvest by the milking person. As the collecting ducts begin to fill with the accumulated excretion of the alveolar cells, they experience difficulty in ridding themselves of milk. When the pressure in the udder rises, the cells and lumina of the alveoli become distended, compressing the small collecting ducts. This prevents a pressure overload on the teat sphincter and any leaking of milk.

- 24 There is little milk production going on while milking is being done. Udders can extend themselves greatly to hold high volumes of milk. During the first hour after milking, there is no discernible mammary pressure; but a steady, gradual increase in pressure occurs until the time of the next milking. Milk let-down results in a dramatic increase in mammary pressure which will gradually subside, even if no milk is removed.
- 25 While much has been said about the virtues of milking at equal intervals (2 x 12 hrs or 3 x 8 hrs) in order to keep up good production levels, studies have shown that the drop in goat milk production may be quite small. However, stress and mastitis incidence can be reduced significantly by equal milking intervals or by 3-times milking for very high milkers.
- 26 Rapid removal of milk after stimulation of letdown is essential for complete milking. There is always some residual milk left in the udder after milking, but it is normally less in goats than in cows. Regular and complete milking is one of the requirements for continuance of lactation. The stimulus of nursing prevents mammary gland regression. The response is due to release of prolactin from the anterior pituitary. Lack of this hormone hastens mammary involution and drying off of the doe.
- 27 Stage of Lactation Effects  
There is a great difference in the composition of milk during the various stages of lactation among does. Management practices such as the length of the dry period, feeding program and general health practices play a significant role in the quality and quantity of milk that is produced during lactation.
- 28 Colostrum appears to be a waste product from the new development of secretory tissues; and while essential to the kid, is not used for human consumption normally. In some does, during the first few weeks for milk production, there can be evidence of some blood in the milk. This is more common in the heavy producing, first-time freshner and likely the result of rupturing some tiny blood vessels in the udder. Milking the doe 3 or even 4 times a day may alleviate the problem. A lack of calcium may also be involved, and should be supplemented in the diet. Forceful milking is another possibility.
- 29 The production level of goat milk increases for about 20-30 days after kidding. During this period of lactation, there is an inverse relationship between levels of milk and fat content. The percentage of total fat as well as the composition of milk fat varies. Towards the end of lactation, fat and protein contents rise while milk yields decrease.
- 30 Calcium and phosphorous levels in milk are high in colostrum, then decrease constantly until near the end, when they rise again. During

this period, the overall salt content of milk tends to increase, affecting the taste of milk. Somatic cell numbers are also very high normally in late lactation as well as in colostrum.

- 31 Persistency of milk secretion throughout lactation can be mathematically expressed by determining the average percentage of decrease in milk for each month, compared to the previous month. Goats, given proper feed and not being rebred, will continue to give milk with a high degree of persistency for a long time. High production on a yearly basis must combine high initial production and good persistency, which is a heritable characteristic.
- 32 **Age Effects**  
Milk volume increases with age up to the fourth or fifth year. After that, the volume decreases with advancing age. The rate at which production decreases is slower than the rate at which it increased to maximum yield. The average milking life of a doe maybe about 12 years.
- 33 **Body Size**  
The relationship of size to milk production provides a misleading picture. Large does are not necessarily more efficient producers. Based on gross energetic efficiency, there is little difference in milk production due to species. Although a goat produces more milk per unit of bodyweight than a cow, the actual net energy efficiency is close. Goats have, however, a relatively high basal metabolic rate and therefore tend to have among the single-purpose dairy breeds a relatively high dairy merit and net efficiency.
- 34 **Estrus**  
It appears that upon coming into estrus, the doe goes through a decrease in milk production. This is only temporary, and is usually compensated for by a brief period of higher than normal production after the estrus cycle. There may also be an increase in the level of fat produced during the estrus period, as is often the case when milk production is lowered.
- 35 **Disease Effects**  
Most diseases, including mastitis reduce milk yields. Fat content will rise due to lower milk production. The solids (and minerals), albumin, globulin and non-protein nitrogen levels will increase, while casein and lactose contents decrease.
- 36 **Dry Period**  
A dry period for the doe is necessary to rebuild her body reserves, especially minerals and to prepare for the period of heavy production in the next lactation. Fattening during the dry period can lead to ketosis or pregnancy toxemia problems. A 60-day dry period is considered normal. Goats without a dry period tend to produce less in the next lactation.





# NUTRIENT REQUIREMENTS AND FEED VALUES

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TI NUTRIENT REQUIREMENTS AND FEED VALUES

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Text

1 The Ruminant Stomach

The dairy goat belongs to the cud-chewing or ruminant group of animals. This group, which includes cows, sheep, and deer, has the unique ability of being able to digest roughages which contain relatively large amounts of cellulose. Cellulose is a part of plants and thus one of the largest potential sources of energy for animals. The digestive system of ruminants can also manufacture many essential nutrients. Drawings of the four compartmentalized stomachs of the ruminant are shown in Figure 1, indicating the changes from youth to maturity.

2 Rumen -- This is the largest of the four compartments representing about 80 percent of the total stomach area. The rumen is often called a fermentation vat because it contains a large number of microorganisms bacteria and protozoa, which supply enzymes that break down fiber and other parts of the feed. The cellulose is converted to volatile fatty acids that are absorbed through the rumen wall and provide up to 75 percent of the total energy needs of the animal. Protein is produced by the microorganisms from the nitrogen in the feed. The microorganisms also manufacture all the B vitamins along with Vitamin K.

3 A unique feature of the rumen is that it is located in the beginning of the digestive system. This position makes it possible for the host animal to take advantage of all the nutrients produced by the microorganisms as well as the organisms themselves further on down in the digestive tract.

4 Reticulum -- This is the second stomach, sometimes called the 'honeycomb' due to the structure of its wall and is located just below the entrance of the esophagus into the stomach. Actually the reticulum is a part of the rumen, separated only by a partial wall.

5 Omasum -- This portion of the stomach is shaped like a small cabbage. It consists of hanging layers of tissue similar to the curtains on a stage. The relatively large surface area of these folds permits absorption of moisture from the feed as it passes through to the fourth compartment.

6 Abomasum -- This part is more often considered the true stomach. It functions just like that of the simple-stomached animals. It contains hydrochloric acid and enzymes that break down feed materials into simple compounds that can be absorbed by the stomach wall and the intestines.

7 Food from the mouth passes through the esophagus and enters the rumen, where it is mixed with ruminal contents and fermented and degraded by ruminal microorganisms. Some of the feed is regurgitated for more mastication (chewing the cud) and then returned to the rumen for additional fermentation. Fatty acids resulting from fermentation of the feed are absorbed into the blood stream from the rumen and reticulum. The remainder of the feed passes through the omasum and abomasum where further digestive action takes place. As feed ingesta enter the small intestine, enzymes further break it down and the released nutrients are absorbed into the blood stream for use by the goat. The ruminant animal is unique in that fibrous feeds can be utilized with the help of ruminal microorganisms. Also, all amino acids can be synthesized by the microorganisms from plant proteins as well as all the required B-vitamins and vitamin K.

## 8 Primary Feed Nutrients

Generally, feed nutrients are divided into six groups. Following is a brief discussion of these nutrients:

9 Protein -- Protein is the only nutrient that contains nitrogen. Protein quality - a term referring to the amino acid content - has no significance in ruminant nutrition, except at exceptionally high levels of milk production. Rumen microorganisms manufacture their own body protein, consisting of all the necessary amino acids, which are later digested by the host animal.

- 10 Protein makes up the basic animal tissue of the body and is vital for growth, milk production, disease resistance, reproduction, and general maintenance. The body has very little if any excess protein. Mostly, the nitrogen is eliminated by the kidneys and the rest is burned as energy. Since protein is generally the most expensive part of the ration, it is costly to feed more than what is needed. Protein requirements vary between 12 and 16 percent of the ration dry matter with the latter needed for high milk production.
- 11 Urea and other nonprotein nitrogen products can be utilized by the microorganisms of the rumen for the production of protein. They are not generally recommended for goats because they are very selective in their diets.
- 12 Energy -- One of the first limiting factors of milk production is a shortage of energy. This short age is most likely to occur at the very early stages of lactation. Most of the goat's energy comes from the breakdown of the fiber of forages, while the remainder comes from the burning up of concentrate starches and fats.
- 13 Energy is measured in two different ways by the feed industry. The first and more established method is by Total Digestible Nutrients (TDN). As the name suggests, the TDN consists of the sum of the digestible carbohydrates, digestible protein, and digestible fats (multiplied by 2.25 since fats contain that much more energy than protein or carbohydrates). The TDN system takes into consideration only one nutrient loss - feces. For this reason, the net energy system is gaining in popularity. This system considers energy that is lost in the feces, urine, gases, and the work of digestion. In recent years this system has been even more refined to account for varying energy utilization needs for body maintenance, weight gain, or milk production.
- 14 Minerals -- Many minerals are required by the goat. Most can be obtained from good forage and a regular concentrate mixture. The major minerals of concern are calcium, phosphorus, and salt, which are usually added to the ration either in the grain mix or by free-choice feeding. Goats do not consume minerals free choice according to their needs. It is, therefore, recommended that minerals be force-fed through the grain mixture or mixed with a succulent feed like silage or greenchop, if possible. The ratio of calcium to phosphorus is important and should be kept around 2:1. If these minerals must be fed free-choice, such as to dry goats and yearlings, a good mixture is one containing equal parts of salt and dicalcium phosphate, or a similar commercial mix.
- 15 Vitamins -- Vitamins are needed by the body in small amounts. Since all the B vitamins and vitamin K are produced in the rumen and vitamin C is manufactured in the body tissues, the only vitamins of concern in ruminant nutrition are vitamins A, D, and E. During the late spring,



# NUTRITIONAL CAUSES OF REPRODUCTIVE LOSSES

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TI NUTRITIONAL CAUSES OF REPRODUCTIVE LOSSES

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DE Genetics and Reproduction

Text

1 It is important to realize from the beginning that there are no nutrients specifically required for reproduction which would not be needed for other physiological functions. Reproduction requires most of the same nutrients that are essential for maintenance, growth and milk secretion. Nutritional factors that cause reproductive failures or reduced efficiency will also have detrimental effects on other physiological functions, especially when deficiencies become more pronounced. There are few specific nutrients that will in themselves correct reproductive problems if goat rations are balanced to meet general nutritive needs as far as is known today.

2 The most important nutritional factors influencing reproduction are:

- Energy
- Protein
- Phosphorus and vitamin D
- Vitamin A
- Selenium and vitamin E
- Salt and trace elements

3 Energy

Many reports indicate that fertility is impaired in drought seasons, by poor pastures, change to lower quality feedstuffs, conditions which produce lower feed intake, high production (triplets,



phosphorus supplementation for high producing dairy goats is more critical. A level of 0.4P in the total ration is recommended. The ratio of calcium-to-phosphorus should not be much different from 1.2 : 1.0. Excess of phosphorus has been associated with the occurrence of urinary calculi, particularly in confined bucks; in which case a Ca:P ratio of 1.5 : 1.0 or greater is recommended.

8 Poor reproduction performance has been related to wide Ca:P ratios and to phosphorus deficiencies; such as low first service conception rates and silent heats. Vitamin D has also been implicated through its effect on phosphorus utilization. Vitamin D supplementation is advised for young, poorly growing kids and goats in confinement and exposed to little sunlight.

9 Vitamin A

Deficiencies of vitamin A, its carotene precursors or interference in their conversion all are implicated in reproductive problems in goats, although more studies exist on cattle and sheep, and species differences have been noted. Vitamin A is essential for normal spermatogenesis in quantity and quality. It is also essential in combatting various respiratory and gastro-intestinal diseases, and parasitism, and is needed for normal visual functions and healthy skin and mucal membranes. Protein deficiency in the feed ration, high energy rations, heat stress, phosphorus deficiency and presence of nitrates or nitrites in feed interfere with proper vitamin A levels or inhibit conversion of carotenes to vitamin A in goats. As a result, dead or weak kids may be born; even abortions or retained placenta may occur. Newborn kids may have low vitamin A liver reserves and suffer high mortality. Eye abnormalities are signs of more serious vitamin A deficiencies. This can occur more during or after a dry summer, while green forages have abundant carotene supplies. Commercial supplementation of vitamin A is relatively inexpensive, as is that of vitamin D or E, which all three are usually provided in commercial feeds in proper ratios, e.g. 5:1 : 0.01.

10 Selenium and Vitamin E

Retained placenta can be a selenium and vitamin E responsive disease when not caused by mechanical or pathogenic factors. That incidence can be markedly reduced with selenium - vitamin E treatment or supplementation, especially in those areas of the US where the soils are selenium deficient such as the East Coast, the Great Lakes region, New England, Florida, and the Northwest region. Selenium can be supplemented by feeding or injections. Deficiencies in growing kids and lambs can lead to white muscle disease. Vitamin E levels in goat milk are important as an antioxidant to extend shelf life and milk qualities in storage. Specific vitamin E roles in improving goat reproductive efficiency have been alleged for some time but reliable evidence is difficult to obtain.

11 Salt and Trace Elements

Lack of salt will reduce voluntary feed intake and develop various deficiency symptoms besides emaciation, urge to lick and chew dirt,





# POISONOUS PLANTS

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TI POISONOUS PLANTS

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DE Nutrition

Text

- 1 Factors contributing to plant poisoning are starvation, accidental eating and browsing habits of animals. Starvation is the most common reason. Most woodland or swampy-ground pastures contain many species of poisonous plants. These are usually eaten only when animals have nothing else to eat.
- 2 Certain plants are accidentally eaten by animals as they graze. A notable example of this is water hemlock. This plant emerges in wet areas which are the first to become green in early spring. Animals eager to eat the fresh young grass may accidentally bite off the crown of this plant with fatal results. Another type of accidental poisoning occurs when large amounts of cockle are present in wheat which is fed as grain.
- 3 Some animals on good feed in a dry lot or excellent pasture become bored with the same regular diet. They may eat unpalatable weeds or ornamental plants growing along fences. Goats and cattle like to vary the best kind of diet with a little ''browse''. Many ornamental or wild shrubs may be consumed, not because they are palatable but because the animal craves variation in its diet.
- 4 The severity of poisoning is related to the quantity of material eaten, the specie of animal eating the plant, portion of the plant and condition of the plant eaten, level of ground moisture, general health of the animal prior to ingesting the substance and the age and size of the animal. Therefore some livestock can eat some of the bad plants

and under several of the mentioned conditions, fail to show symptoms of injury or poisoning. At other times death may occur.

5 Scores of plants contain material toxic to animals if eaten in sufficient quantity. Some of the plants are well known, some quite rare, some are useful, others are valued ornamentals. They may be grouped by the type of poison contained, the effect of their toxins or the part of the plant containing the poison. Some plants may contain several poisonous principals.

## 6 Cyanogenetic Plants

These contain under certain conditions, prussic acid (hydrocyanic acid), a deadly poison which interferes with the oxygen-carrying ability of the blood. Death in these cases is usually rapid and with little outward symptoms. Members of the prunus family of plants, especially wild cherries, are dangerous. Peaches, plums and other stone fruits belong to this group of plants. Wilting of the green leaves caused by frost, storm damage, or by cutting, changes a glucoside found in the leaves to hydrocyanic acid (HCN) and sugar. The sweet, wilted leaves are thus more attractive to animals than normal foliage. HCN content varies widely; but under some conditions a few handfuls of leaves may be enough to kill a horse or cow. This type of poisoning should be suspected when sudden death of animals follows windstorms or early sharp frosts. These leaves apparently lose their poison after they have become dry; the limp, green or partially yellowed leaves are the most dangerous. Sudan grass and sorghums are also cyanogenetic plants. These plants are usually deadly when damaged or frozen. Aftermath sprouts following an early frost are particularly dangerous. Very little sudan grass poisoning occurs from animals trampling down plants and later eating them although this is often listed as dangerous. In dry weather, sudan grass is often pastured to the ground without ill effects. After sudan grass has been repeatedly frozen and the plants are completely dead, it is safe but not very valuable for pasture.

7 Once frozen, sorghum, sorghum sudan hybrids, or their aftermath should never be pastured. As long as the plants show any green color they may be very poisonous. Both frosted sorghum and sudan grass can be best and most safely utilized by ensiling them for at least two weeks before feeding. Normal ensilage fermentation safely eliminates the poisonous principle.

8 Common milkweed, a perennial that grows three or four feet high, has a heavy stem and leaves and is frequently found in pastures. The milky white sap is sticky and has a bitter taste but livestock eat the topmost, tender leaves if good forage isn't abundant. Remove plants by spading, pulling, cutting or plowing extensive areas and planting to cultivated crops for a year or two.

9 Horse nettle is a perennial plant, two-feet-high, with spiny stems and leaves, and smooth, orange-yellow berries. Fruits are more toxic

than the foliage. It's a common plant in grasslands and fields and is a member of the nightshade family.

- 10 Black nightshade is an annual plant, two-feet high, with many branches. Leaves are variably smooth or hairy. The stems angled in cross-section and sometimes spiny. Clusters of white flowers, one-fourth inch across, bloom in midsummer and are followed by small, black fruits. Both the foliage and green berries are toxic. The ripe berries are not poisonous. Black nightshade is widely distributed.
- 11 Mountain laurel is an evergreen shrub of the Appalachian Mountain region. Plants grow five-feet tall and have glossy green leaves. Flowers appear in clusters at the ends of branches. Livestock eat the leaves in early spring when little other foliage is available. Weakness, nausea, salivation and vomiting are symptoms of poisoning. The preventative is to keep livestock out of areas where mountain laurel is abundant.
- 12 **Plants Containing Deadly Alkaloids**  
Fortunately these plants are unpalatable for most wild and domestic animals. Water hemlock and poison hemlock are deadly. Poisoning rarely occurs except in early spring when young plants are accidentally eaten, but the roots, stems, leaves and flowers are always poisonous. Look for and learn to identify these plants in the summer when they are large and showy. The hemlocks are members of the carrot family and have showy, white, umbrella-like flower heads. Poison hemlock needs dry land to grow and is often found in gardens as an ornamental plant. Flowers are often incorporated into large mixed flower sprays in rural churches and at social events.
- 13 Water hemlock - a perennial frequently found in wet, fertile soil - is a five-foot-tall plant with thick rootstocks, doubly compound leaves (fernlike) and small white flowers in umbrella-like clusters.
- 14 The roots are the most poisonous parts of the plants. Cut the thick rootstocks lengthwise and you'll find air cavities separated by plate-like partitions of solid tissue. Drops of yellowish, aromatic, resin-like exudate containing the poisonous alkaloid appear at the cuts. Leaves and seeds contain little of the toxic substance and eaten in small quantities, either green or in hay, do little harm.
- 15 Water hemlock starts growth in early spring. Its green foliage may show up before most other plants leaf out. Livestock tug at the tender leaves and pull roots from the soil which are still soft from late winter rains. The combinations of foliage and roots in considerable quantity can be fatal.
- 16 As a preventative, pull water hemlock plants from the soil during the summer when they can readily be found and destroy them. Plants usually are not numerous in an area.

- 17 Poison hemlock is a hollow-stemmed biennial, four-feet high, with double compound leaves resembling parsley and a large, white taproot like parsnip. Flowers are showy, umbrella-like clusters and appear in late summer. The poison is a volatile alkaloid, coniine, found in the foliage all season and in the seeds in late summer. Most livestock poisoning comes in the spring from eating fresh foliage.
- 18 Mayapple, bloodroot, pokeweed, nightshade and hellebore are other alkaloidal plants. They are rarely eaten except when animals are starving for better feed. Deaths from alkaloidal plants usually result from severe digestive disturbances, pain and nervous symptoms. Animals usually die in convulsions.
- 19 **Plants That Are Photodynamic**  
This means photo-sensitive animals get a reaction. Conditions necessary for a reaction to occur are: 1) the animals must have white areas of skin (unpigmented); 2) the animals must eat a sufficient quantity of the plants; and 3) the animals must be exposed to bright sun. In typical cases, an animal suddenly becomes sore on the white areas of their bodies. Whole areas of white skin may raise up and slough off. White goats may become severely affected and die from this condition.
- 20 Some common plants which cause photosensitization are rape, alsike clover, buckwheat, lantana, St. John's wort, and ornamental hypericums. Both St. John's wort and ornamental hypericums have showy, golden-yellow flowers. They are not readily eaten by animals. White goats frequently become badly 'sunburned' when they are on rape pasture in bright, sunny weather with little or no shade. Alsike clover or other legumes may produce these symptoms in dairy goats under the above conditions.
- 21 **Plants That Produce Mechanical Injury**  
A number of plants may have a spiny covering, long beards, fine hairs and when eaten may cause mechanical injuries or form hair balls in the stomach and intestines. Sand bur, downy brome grass, squirrel-tail grass, poverty grass, mesquite, cocklebur and clover are some of the offending plants.
- 22 **Some Other Poisonous Plants**  
Comparatively few plants containing poisons grow in areas usually used as pastures.
- 23 Bracken fern is very common in wooded areas and unimproved pastures. Most animals will not eat bracken fern if there is adequate pasture or other feed. In ruminants, such as goats, bracken fern must be consumed over a period of several weeks before toxicity signs develop. Affected animals are listless, show weight loss and may exhibit small hemorrhages on the mucous membranes. They may die from

internal hemorrhages.

- 24 Buttercups contain an acrid, volatile alkaloid-amenenol, strong enough to blister the skin and cause inflammation of the intestinal tract. Cattle and goats poisoned by buttercups produce bitter milk and a reddish color. The toxic material volatilizes and is lost when buttercups are dried as in hay.
- 25 A heavy growth of buttercup is an indication of low soil fertility. Have the soil analyzed and apply ground lime and fertilizers as their need is shown. The increased grass growth soon crowds out buttercups.
- 26 Poison ivy is widespread over most of the United States. It's a shrub or vine with woody stems that climb by attaching aerial rootlets to fences, walls, trees, etc. Leaves have three leaflets, glossy green and smooth at the edges. Inflammation of the skin from contact with the plants is an affliction of goat-keepers more frequently than of goats. The infection can become serious and may need medical attention. Kill poison ivy with a herbicide.
- 27 Several ornamental plants that are green outdoors or indoors are highly toxic. Goats should not be fed clippings from ornamental plants. Common poisonous ornamentals are yew, delphinium, oleander, larkspur and lily-of-the-valley. Goats should not be allowed access to these plants.
- 28 NOTE: USDA and the State Department of Agriculture in each state can offer help in providing reference material on poisonous plants.
- 29 A Listing of Some Plants Known to Cause Problems When Eaten by Livestock (Source: Stock Poisoning Plants of North Carolina, Bulletin No. 144, by James Hardin; Plants Poisonous to Livestock in the Western States, USDA Information Bulletin No. 415; Poisonous Plants of Pennsylvania, Bulletin No. 531, PA Department of Agriculture)
- 30 Cyanogenetic Plants (Glucosides - Glycosides)  
 Arrow grass Black Locust Blue Cohosh Broomcarn Buckeye (Horse chestnut) Cherry Choke Cherry Corn Cockle Dogbane Elderberry Hemp Horse Nettle Indian Hemp Ivy Johnson grass Kafir Laurel Leucothoe Lily of the Valley Maleberry Marijuana Milkweeds Milo Nightshade Oleander Rhododendron Sevenbark Silver Sneezewood Sorghum Stagger brush Sudan grass Velvet grass White snakeroot Wild Black Cherry Wild Hydrangea
- 31 Alkaloid Containing Plants  
 Aconite Allspice Black Snake Root Bloodroot Blue Cohosh Boxwood Celandine Common Poppy Crotalaria Crow Poison Death Camas Dicentra False Hellebore False Jessamine Fume wort Hellebore Hemp Horse Nettle Indian Hemp Indian poke Jimson weed Larkspur Lobelia Lupines Marijuana Monkshood Moonseed Night shade Pink Death Camas



# PRODUCING QUALITY GOAT MILK

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TI PRODUCING QUALITY GOAT MILK

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DE Milk and Milk Handling

Text

1 What is Quality Milk

Every merchant offering a product to a consumer will use the term 'quality' in discussing the merits of his product. All too frequently use of the term will not be qualified - the consumer is never informed as to what 'quality' means. Is the product quality good, poor or indifferent? Thus, it must be made clear that the only 'quality' acceptable in goat milk is the best possible, that is Grade A. The following are the important characteristics which apply to 'Grade A' quality goat milk.

2 The most important requirement to be met is that the product must be safe to drink - it must be free of pathogenic bacteria, as well as all forms of antibiotic, insecticide and/or herbicide compounds. Second in importance is good flavor which may realistically be characterized as the absence of any objectionable flavor. Third in importance is relative freedom from spoilage bacteria and somatic or body cells. Complete absence of such is usually not possible, but all cities and/or states do have laws which limit the maximum numbers permitted. The last major factor related to quality is composition - the amount of fat and other solids contained. There are legal restrictions pertaining to milk components which must be adhered to. While other factors enter into the quality of fluid milk, the four listed are of greatest importance.

3 Legal Aspects

Each producer must be acquainted with the requirements of the governmental agency under whose authority he or she operates. Regulatory agencies generally operate on the basis that milk is milk,



whether obtained from a cow or a goat. Thus, the goat milk producers are expected to meet the same requirements as the cow dairy.

#### 4 Safe Milk

What must a goat keeper do to be certain the milk produced is safe for consumption -- that is free of disease producing bacteria as well as chemicals that might produce human illness? There is no such thing as absolute safety in milk, but experience has shown that adoption of certain practices has produced a satisfactory level of safety. Without a doubt, pasteurization is the most important practice followed as a means of assuring the safety of milk. When properly done, and if accompanied by the use of sterile containers and effective protection from recontamination, pasteurization does result in milk free of pathogenic organism. Pasteurization does not decrease the risk from contaminants such as anti biotics or other undesirable chemicals. Those materials must be kept out of milk; proper management practices must be followed to prevent such contamination.

5 Effective herd management has many aspects but the production of milk free of any contaminating bacteria is of major importance. Undesirable organisms may get into milk either through the body of the animal or from some external source after the milk has been drawn. Animals which are ill with or carriers of infectious diseases may transmit those pathogenic bacteria in their milk; most states require the producers to show that milk producing animals are free of TB and Brucellosis. Several organisms causing mastitis also are pathogenic to man. Regular tests and frequent inspections of milking animals coordinated with a definite plan for withholding the milk from suspect animals until confirmation tests can be completed are a must.

6 The most frequent source of antibiotics in milk is from improper use of such agents in treating animals. Less frequently milk may be contaminated by the animals consuming feeds carrying some form of herbicide or insecticide, or by improper usage of such materials around the premises. Extreme caution must be practiced in the use of such materials -- follow directions for use very carefully. Detection of these contaminants in milk probably will require testing by a branch of the Health or Agriculture departments of the state.

7 Environmental contamination of milk as it is drawn or subsequent to milking is quite common; its prevention or minimization requires strictest attention to cleanliness and sanitation in all phases of the process. Several common sources of contaminants are:

1. Animals teats, udder, flank, etc.
2. Air carrying bacteria and/or particles of dust, feed, manure, etc.
3. Insects
4. Improperly cleansed and sterilized utensils

5. People -- especially those handling the milk.

8

Contamination from these sources usually is in the form of hair, insect parts, particles of dust, feed, or manure or bacteria associated with these contaminants plus those contributed by unclean utensils. Practices required to minimize such contamination include:

1. Milking animals in a specially provided, clean, well ventilated area separated from housing and/or feeding areas and from the milk handling and storage area.
2. Milking animals only after they have been properly prepared.
  - a. Clip long hair from udder and flanks.
  - b. Wash udder to remove foreign material.
  - c. Wipe udder and teats with paper towel and a mild bactericidal solution to help prevent mastitis and stimulate milk let-down. Thoroughly dry the udder. Dip teats following milking in an approved teat dip solution.
3. Use properly designed and effectively cleansed and sterilized milk handling equipment, including reusable containers.
4. Handle milk in milk handling and storage room only.
5. Cool milk to 40F or less within 2 hours of milking.
6. No person ill with a communicable disease, or a carrier of such, shall work in any capacity associated with the production, handling, storage, or transportation of milk.

9

#### Milk Flavor

The ideal flavor of milk is slightly sweet and/or very slightly salty with complete absence of strong characterizing odors or flavors. Milk produced by a clean, healthy, properly managed goat herd usually will be as described. But off flavors may develop in milk from several sources. Probably the most troublesome flavor found occasionally in goat milk is rancid or 'goaty.' This is a strong, musky flavor having the same characteristics as the odor given off by the buck during mating season. While this flavor is sought in milk used for making certain varieties of cheese in several countries, it has no place in the American fluid milk market. If the rancid goat flavor is present in milk at the time of milking it will be necessary to closely check each individual doe in the herd to identify those responsible. They should be removed from the milking herd and disposed of since evidence indicates that this is an inherited trait and probably will be passed on to progeny.

10

Another common off-flavor which may be found in milk as it is drawn is oxidized. Both forms of rancidity, oxidized and goaty, may develop

in milk after it is drawn. These may be less common in goat's milk than in cows, but may be found, especially as the doe nears the end of her lactation. Oxidized is a cardboard-like flavor caused by nutritional imbalances or by exposure to light sources; rancid 'goaty' flavor develops when the fat is partially disintegrated by enzyme action -- both are best controlled by immediately heating the milk to pasteurization temperature and protecting the milk from sunlight and ultra-violet light. When the milking animals consume certain strong-flavored plants, such as wild onion or garlic, ragweed, etc., their milk may have objectional flavor. If these cannot be eliminated from the feed, the flavor defect can be minimized by withholding such feed from the animals 3 to 4 hours prior to milking.

11 Great care should be taken to prevent milk from absorbing off-flavors and odors from the atmosphere -- exposure to strong food, medicine, or chemical materials can quickly impart those flavors to milk. Atmospheric exposure should also be prevented insofar as possible to limit bacterial contamination. Handling milk with utensils which have not been properly cleaned and sterilized will also cause bacterial contamination which is most undesirable. Flavors such as high acid, yeasty, malty, or fermented/fruity can result from growth of contaminating microorganisms.

12 The growth of microorganisms in milk causes disintegration of fat, protein, and/or lactose and will soon make the product unsuitable for drinking. (There is an exception to this: the production of cultured dairy foods in which specific kinds of microorganisms are added and grown under closely controlled conditions). While elimination of bacterial contamination is an important factor in the production of good flavored, high quality milk, two other procedures can be used to protect and maintain good flavor and quality. The first of these is prompt cooling to near or below 40F with maintenance of that low temperature for the usable life of the milk (unless heat processing is involved in the manufacture of a product from the milk). The second is pasteurization to inactivate microorganisms and enzymes, followed by cooling and holding at low temperature. Such heat treatments may vary from basic pasteurization to ultra high temperature processing with temperatures of 145F to 191F. Examples of various heat treatments which legally constitute proper pasteurization are: 145F (63C) for 30 min, 161F (72C) for 15 sec, 191F (89C) for 1 sec. Processing at 280 to 300F (138-149C) for very short times, when accompanied by proper protective packaging, can result in a product with greatly extended shelf life even without refrigeration. Most states require that all milk offered for sale must have been pasteurized and packaged in approved containers. A few states permit the sale of raw milk under restricted conditions. In all cases, the milk must meet specified bacterial limitations.

13 Somatic Cell Content

Somatic cells in milk are an indicator of the state of health of the udder and affect the quality of milk produced. The term refers to all forms of body cells of tissue or blood origin which are passed into

milk through the mammary system. The cell count of goat milk is believed to be generally higher than that of cow milk; the milk from animals which have or have had mastitis usually has substantially higher cell content than that from completely healthy udders. Some stressors on the animal may cause elevated cell counts in milk. Many states have a legal limit ranging from 1 to 1.5 million cells per ml in milk. Beyond that level the milk is termed abnormal. Cell count determinations can be made by a number of simple tests such as the Wisconsin Mastitis Test and California Mastitis Test, both of which can be conducted in the home. A direct microscopic count may be made in a laboratory. Some states offer a somatic cell count via the DHIA testing program.

#### 14 Milk Composition

A discussion of the requirements for high quality milk must consider the composition of the product. Composition refers to the milk's content of major nutrients -- fat, protein, lactose, and minerals. Official assays for these chemical components must be made by accredited laboratories. Probably more controversy arises over the matter of composition of milk than any subject covered here. When offered for sale, to be legal, all milk must meet specific requirements as to composition. Those legal limitations may vary slightly from state to state, but most are based on the 1978 version of the 'Grade A Pasteurized Milk Ordinance' published by Public Health Service, Food and Drug Administration which the regulatory agency has adopted. Milk is defined therein as containing a minimum of 3.25milk fat and 8.25 milk solids-not-fat (MSNF) which is the sum of the protein, lactose, and minerals. Lowfat milk may contain 1/2, 1, 1-1/2, or 2 percent milk fat, and skim milk is that which contains less than 1/2 percent milk fat; all must contain a minimum of 8.25MSNF. Additional MSNF may be incorporated into the product during processing. Any milk product which differs from the 3.25milk fat, 8.25MSNF (either less fat or more MSNF) must show its proper name and the amount of fat, protein, and sugar (lactose), plus several other nutrients, in a normal serving (8 fl oz) on the label of the package.

15 These legal limitations pose some problems to the goat milk producer and/or processor. Because most of the animals still follow natural breeding habits, at any given time, most of the milking does are in approximately the same stage of lactation. This, plus the fact that the season of the year influences milk composition, results in fairly large shifts in fat and MSNF content of the goat milk available throughout the year. Experience has shown that the milk from a single doe or a very small flock of goats may vary from a low of 2 22568349762258 MSNF during mid-summer when temperatures are high and when the does are in mid-lactation to a high of 5 225683497622587700000000000000000000000000000000 animals are completing their lactation. Consumers do not care to purchase a product exhibiting such variance in composition; and a considerable amount of milk produced during mid-lactation in summer months does not meet legal standards. The cow dairy industry has the same problem; but of lesser magnitude because, at any given time, the animals in a normal herd are in all stages of lactation. They also have



# PRODUCTION TESTING

COLLECTION: GOAT HANDBOOK

ORIGIN: United States

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Extension Goat Handbook

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NO B-8

TI PRODUCTION TESTING

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DE Management and Housing

Text

1 The number of dairy goat herds has greatly increased in the United States in past years. This has brought increased needs for accurate production and management information.

2 The National Cooperative Dairy Herd Improvement Program (NCDHIP) is a production-testing and information-gathering system that provides important information for management, breed and pedigree work, genetic evaluations, education and research. The program was developed primarily for dairy cattle, but dairy goat owners also are using the program. However, the number of dairy goats participating in the Dairy Herd Improvement Program is still limited. Participation is sometimes difficult because:

\* Goat herds tend to have few animals; therefore, the cost of testing goats may be high when compared with their earning capability.

\* Participating goat owners are asked to abide by official Dairy Herd Improvement (DHI) and Dairy Herd Improvement Registry (DHIR) rules, and their breed registry organization's rules; for example, the American Dairy Goat Association (ADGA) and the American Goat Society (AGS).

\* Goat owners may be located in areas not readily served by a Dairy Herd Improvement Association (DHIA), or the DHIA may have bylaw restrictions on dairy goats.

\* Goats are seasonal breeders, so there may be a period during the year when all does in the herd are dry at the same time; although the herd is to be on test the year around, whether does are milking or are dry.

3 There are several ways to obtain official production-testing information that is acceptable to the breed registry organizations, breed registry programs, and DHI programs. There are also other production-testing programs for obtaining unofficial production data for herd management. Such records are not acceptable to the dairy goat breed registry organizations because of their unofficial status.

4 Official Production-Testing Programs

The One-Day Test is a dairy goat breed registry program and has its own rules and procedures. These tests, usually held during local fairs or special goat shows, provide opportunity for does to earn ''star'' recognition. Arrangements must be made, in advance, with the dairy goat breed registry organizations and the local DHIA. The One-Day Test is conducted by a local DHIA supervisor, and there is a special charge. For information and rules concerning the One-Day Test, contact your dairy goat breed registry organization. This test is not part of the DHI program.

5 The DHI program is a cooperative education and research project between a state's land grant university and the dairy industry. Dairymen through local, state, and national DHIA's carry out the business, operation, and service responsibilities of the testing program. To be eligible to participate in the official testing programs of NCDHIP, one must be a member of a local or state DHIA. Official records are those that are verifiable as having been made in accordance with the National Official DHI Rules, the combined rules for DHIR, and policies approved by the Policy Board for NCDHIP. In some instances, a local DHIA may not be able to accept dairy goat owners as members in a cow-testing organization because of limitations in their bylaws. Some may agree, on the other hand, to provide this official testing service on a contract basis to nonmember dairy goat owners.

6 Dairy goat owners may apply for membership in a local or county DHIA. When membership is approved, the local DHIA will send a supervisor once a month to weigh, sample, and test each doe's milk for yield and butterfat. The supervisor also gathers the necessary management information from the herd owner, then fills out and mails the completed sheets to a dairy record processing computer center.

7 The DHIA member may choose between several official and unofficial testing programs, but will be required to pay local, state, and national DHIA and breed organization fees, as appropriate, in addition to service fees for electronic data processing.

- 8 A permit to test DHIR must be obtained from the breed registry organization. All official records must comply with national official DHI and DHIR rules, dairy goat breed registry organization rules, and rules established by local, state, and national DHIA's.
- 9 Should one be in an area without the services of a local DHIA, or if the local DHIA is unable to provide testing services to dairy goat owners, it is possible to form a dairy goat DHIA separate from the local cow DHIA. ++++MISSING DATA++++
- 10 The Group Test (GT) program has been approved for official types of testing programs by the National Policy Board for NCDHIP and the National Sub-Group for Dairy Goats and is now operational in some state and local DHIA's.
- 11 The GT is not a ''type'' of testing program, but a procedure for conducting official types of testing programs. The GT enables DHIA-member dairy goat owners to participate in the official DHI and DHIR programs by allowing each group member to perform supervisor (test) responsibilities by testing herds of other group members. Group testing results in lower costs for production testing. In addition to fulfilling the requirements for official DHI and DHIR tests, GT members must also abide by special GT rules approved by the National Policy Board for NCDHIP. Each member of the test group is trained to perform supervisor responsibilities when weighing and sampling milk in the herds of other GT members. The milk sample is taken to the official DHIA supervisor or lab, the fat test is performed and the test sheets are forwarded to the dairy record processing computer center. To participate in the DHIR GT program, one must obtain a ''permit to test DHIR'' from the breed registry organization and be enrolled in the official program with the local or state DHIA. All official group testing is conducted under the jurisdiction and supervision of a local DHIA and the state extension dairyman.
- 12 Unofficial Production-Testing Programs  
Several other production-testing programs may be provided by the local DHIA to meet individual needs for management. These do not have stringent rules. It should be recognized that un official production-testing programs provide valuable data for use in herd management, but because the conditions under which the records are made cannot be verified, they are not accepted by the industry or the breed registry organization officially.
- 13 The Commercial Test is performed by the DHIA supervisor, but compliance with official rules is not required. It is basically the same type of service that is provided in the official DHI testing program. There is usually no savings in cost for the commercial test compared with an official DHI test.
- 14 The Owner-Sampler Test has responsibilities shared by the owner and



the DHIA supervisor. The owner weighs the milk, takes the sample, and records the data. The fat test is performed by the DHIA supervisor or lab. The cost of this test is usually less than other testing programs, because the owners do most of the work themselves.

15 The DHIA may take other types of tests available to dairy goat owners to meet their specific needs. These programs are also unofficial and not acceptable to the industry or the breed registry organization, however, provide valuable information for herd management.

16 Starting a Group Test Program

Timing is important in planning. If dairy goats begin freshening after the first of January, it is recommended that program planning and training take place in October, November, and December. This allows time to form the GT unit and to begin operation as soon as the goats start freshening.

17 The local DHIA board of directors must approve the local GT program. The local farm advisor or extension agent should explain the basic concepts to the test group. The DHIA board should  
 ++++MISSING DATA++++

18 There must be a group leader in charge. The group leader must attend the DHI supervisor training sessions and help train group members in testing and getting samples to the central laboratory for component testing. Where required, group leaders are trained as DHI supervisors and are licensed. They may conduct tests on member herds outside the group when hired to do so by the DHIA.

19 Duties of the group leader usually are not burdensome; however, to see that the testing program is conducted as planned and complies with all rules and policies, the leader must work closely with the DHIA supervisor and dairy farm advisor or extension agent.

20 Problems within the group should first go to the leader for solution. If the leader cannot resolve the problems, the leader should then take them to any or all of the following people in this order: DHIA supervisor, DHIA board of directors, dairy farm advisor, extension agent and/or state extension dairyman. The leader acts as liaison among these groups.

21 A special training program for all members of the test group must be held before herd testing begins. Training should be conducted by any or all of the following people: DHIA supervisor, dairy farm advisor, extension agent and/or state extension dairyman.

22 Items to consider in planning:

--procedures for weighing and sampling milk

## PRODUCTION TESTING

- animal identification
- recording management information
- handling samples
- supervisors' responsibilities
- herd owners' responsibilities
- delivering samples for butterfat, protein, and
- somatic cell testing
- herd information required
- services available for goat herds
- computer programs
- what to do when all animals are dry
- official rules and policies
- using production-testing information
- equipment maintenance
- cost assessment of testing and bill collection
- roles, responsibilities, and relationships of group members
- testing schedules
- ethics

23 The group may want to impose additional rules or guidelines for its members. The adoption of such rules should be by a majority vote of the GT members. These rules must not conflict with official rules of DHIA.

24 The group members should fully understand that the success of the program is up to each individual member. There can be no shortcuts in the operation of the program. Records must be kept in good order so that any question can be verified. Failure to abide by the rules will jeopardize the GT program and its production records.

25 National DHI Rules for Group Test

All GT herds must follow the national DHI and DHIR rules for official test. These rules are available from the local DHIA, dairy farm advisor or extension agent. The following additional rules for GT

are required.

1. A minimum of four herds in any single test group (under some exceptional circumstances, states may approve groups with three members).

2. Only those dairy goat owners attending a special training program supervised by the state extension dairyman are permitted to participate in ++++MISSING DATA++++

26 Surprise Testing Requirements for DHIR

All official DHI and DHIR herds are subject to surprise tests (check tests). A surprise test is designed to verify the authenticity of production, identification, and other details. The surprise test is unannounced and includes a preliminary milking preceding the 24-hour milking period being verified. A surprise test is conducted by a DHIA supervisor or by a qualified group leader for herds participating in the GT program.

27 The state extension dairyman for NCDHIP shall arrange for surprise tests when:

1. Data and information available indicate rules may have been violated to the extent that regular supervision would not give a true test of the herd or any individuals in the herd.

2. Requested to do so by the Superintendent of Official Testing, the American Dairy Goat Association or the American Goat Society.

3. The following requirements are met:

-if an individual doe record, after 90 days, is projected on an actual basis to be at least 3000 pounds milk and/or 105 pounds butterfat

-on a Mature Equivalent (ME) basis, after 90 days, the projected record is 3500 pounds milk and/or 125 pounds buttermilk

-on a ME basis, after 180 days, the projection is 4000 pounds milk and/or 140 pounds butterfat

28 Value of Production Testing

Information from GT, DHI, DHIR or other similar programs has important direct benefits for herd management and long range genetic progeny testing benefits for buck and elite doe selection, contracts, sales and breed improvements. Participating goat owners receive monthly computer printed reports for:

-each milking doe

-total herd



# REPRODUCTIVE MANAGEMENT

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TI REPRODUCTIVE MANAGEMENT

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DE Genetics and Reproduction

Text

- 1 The reproductive performance of goats can be exceptionally high. Conception rates of 980ver 2 estrous cycles with an average of 1.5 kids have been reported. Such fertility is probably due to maximizing proper management. Reproductive management of dairy goats involves three periods: the breeding season, the pregnant and dry period; and kidding time.
- 2 The Breeding Season  
Yearling kids may be bred in the first year at 7-10 months of age, depending on breed, if they have grown well to about 80 lb and are of good size and condition. Body weight relative to breed is more important than age and can influence lifetime performance. The doe kid may be able to reproduce at three months of age but should not be allowed to do so, as her growth may be permanently stunted. To prevent this, buck kids should be separated from doe kids at an early age. If breeding doe kids is postponed much beyond 10 months of age, they will be less productive. Older kids are not as easily settled at first breeding and may have lower lifetime productivity.
- 3 Breeding does, as the season approaches should be 'flushed', i.e. prepared by having them gain weight at least 2-3 weeks before breeding. This increases the number of ovulations. Records should be kept carefully on all heats, lengths of heat, intervals between heats and all breeding dates. Most goats are seasonal breeders, and their season is

initiated by decreasing daylight. Thus, their season is from late August through January usually, but tropical breeds of goats may cycle year around.

4 Seasonal breeding results in seasonal peaks and valleys of milk production which makes it difficult to maintain a level fluid milk market. However, goats can be milked longer than the standard 305-day lactation by delaying breeding to a later heat. Goats can also be 'fooled' into thinking that the short-day season has arrived by manipulating artificial light-hours per day and thereby initiating estrous cycles out-of-season. However, this requires an investment in housing which is suitable for light control.

5 Hormonal reproductive problems are not common in goats. Cystic ovaries may occur, usually late in the breeding season. These are a hereditary problem and show up in young animals. The signs of cystic ovaries are constant heat, male-like behavior, or frequent short cycles. Treatment may consist of giving hormones: luteinizing hormone containing compounds (3,000 IU/im) or progesterone in oil (100mg/d for 12 days). Young does with cystic ovaries probably should not be bred and be culled, to prevent the continuation of this condition.

6 Anestrus (no heats) can be a problem. This may be due to: a pregnancy from an unobserved service, if a buck is present; intersexed goats which are not discovered until examined to determine why they are not cycling; the inability to observe does in heat; or simply not cycling. Close observation and understanding the signs of estrus is the best way to determine when the doe is in heat. Signs of heat (estrus) are: swelling and redness of the vulva: mucus discharge (may become white toward the end of estrus); tail twitching; increased bleating (vocalization); decrease in milk production; increased restlessness; and frequent urination. Standing or riding are not seen as heat signs in goats as often as in cows. Observation around feeding and milking times is undesirable, because the does have their mind not concentrated on est  
++++MISSING DATA++++

7 Estrus (heat) lasts from 12 to 48 hours, averaging 36 hours and ovulations occur 24 to 36 hours after onset of heat. Goats should be bred naturally once 24 hours after onset of heat or if conservation of the buck is not a consideration, every 12 hours until the receptive period is over. In artificial insemination, it is recommended to breed every 12 hours, 2 to 3 times. Does generally have heat cycles of 21 day length, similar to cows. However, considerable variation between individual does exists without any abnormality reason. The recurrence of estrus cycles should be fairly consistent in an individual animal. A doe with an unusual cycle length of 35 to 40 days should be suspected of embryo loss and should be placed under careful observation.

8 A buck must be prepared for the breeding season with good nutrition, parasite control, foot trimming, etc. A prebreeding genital

exam should be carried out with examination of the testicles for any abnormalities. The testicle should be plump, firm and symmetrical. If any abnormalities or problems are suspected, a semen evaluation should be carried out. Many systemic debilitating diseases, arthritis, foot rot, and scrotal infections can affect fertility of bucks.

#### 9 The Pregnant Doe

Pregnancy diagnosis should be done to ensure pregnancy has occurred and if not, the situation corrected before the end of the season. Gestation in goats is 150 days. Pregnancy diagnosis continues to be a problem in small ruminants. Nonreturn to estrus is the most commonly used sign of pregnancy. This requires close observations and can be adequate. If a buck is present, return to estrus determination is simple.

10 Recto-abdominal palpation with the aid of a rectal probe can be done with great caution and experience from 70 to 110 days but many veterinarians find it too dangerous to recommend. After 110 days the fetuses can be palpated through the abdominal wall. Ultra sound and radiography prognosticators are available but the initial expense is a limiting factor.

11 Milk tests, e.g. available from DHIA labs, can be used at 21 to 23 days post-breeding to detect levels of the pregnancy hormone, progesterone. Low levels indicate a non-pregnant status. However, goat owners should keep in mind that an animal detected as pregnant may later lose the fetus, because goats may be more susceptible to abortion than cows, particularly during the periods of poor nutrition.

12 Contagious reproductive diseases are not a common problem in goats. Brucellosis caused by *B. melitensis* is not found in the United States although it is a problem in other parts of the world. Goats are resistant to *Brucella abortus*, the brucellosis of cows and it is not a problem. Enzootic abortion, a chlamydial infection, occurs in California and causes abortions. Characteristically 80 percent of abortions occur in first and second fresheners and 3 to 4 weeks before normal kidding. Natural immunity develops and vaccination programs are effective in problem areas. Whenever an abortion occurs, careful examination of the aborted fetus(es) and placenta is essential by submitting to a diagnostic pathology laboratory.

#### 13 The Dry Doe

The pregnant doe should have a 60 day dry period prior to kidding and should be gaining in condition for the last month before kidding without fattening. Nutrition must be carefully managed to provide the necessary nutrients balanced so that no metabolic disorders such as ketosis and milk fever may occur. About four and two weeks prior to kidding an intramuscular administration of a selenium treatment (Bo-Se) at the rate of 1 ml per 40 lb of bodyweight is advisable in selenium deficient areas such as the Northeast, Mid-Atlantic, Great Lakes, East

Coast, Florida, and Northwest areas in the US.

14 The Kidding Doe (Parturition)

Attendance at kidding is life saving and cleanliness is very important. The fetus acquires the capacity for extrauterine life only shortly before term, and may die in utero if parturition is unduly delayed. As kidding time approaches, the udder rapidly enlarges, the pelvic ligaments relax around the tail head, and the vulva becomes greatly enlarged. Eight to 12 hours before birth, the cervix begins to dilate and the cervical mucus plug will be in evidence, as a tan, sticky substance smeared about the hind parts of the doe. This first stage of kidding lasts 1 to 6 hours. If progress stops, a vaginal exam with clean, well lubricated hands is in order.

15 Normally the fetus enters the birth canal and the doe starts an abdominal press. The chorioallantoic sac is ruptured and the unbroken amniotic sac (water bag) is then forced through the vulva. Delivery of the kids usually occurs in a short time once the water bag can be viewed. Kids may be presented either with their front feet forward or in posterior presentation where their rear feet are presented first. The doe may rest between each kid for a short period of time. Most does are best left alone during parturition. Interference with parturition of does kidding for the first time may result in the doe rejecting the kids. It is important that does lick the kids as soon as possible after they are born as this indicates her acceptance of them. Dystocias (difficult births) are rarely encountered.

16 If labor is prolonged for more than one hour with no progress, a vaginal exam is again indicated. With multiple births, more than one fetus may be lodged in the pelvis. Careful sorting is necessary before delivery is possible. The goat's uterus is very fragile and prolonged manipulation may result in uterine rupture. 'Ring womb' occurs, when, with prolonged labor, the cervix begins to contract, making delivery impossible. Caesarean sections are done with overlarge fetuses, monsters, 'Ring womb' and other dystocia that might threaten the doe's life.

17 After parturition, the doe should begin to lick the kids, and she may eat part of the fetal membranes. There is no evidence for benefit or harm from ingestion of the fetal membranes. Normal kids will start trying to stand up immediately and should be on their feet and nursing within a short period of time. It is important that kids nurse the doe as soon as possible after birth in order to get the first milk or colostrum. It may be necessary occasionally to help slow or weak kids to nurse. Kids navels should be dipped in iodine solution. Retention of the fetal membranes, a condition not uncommon in cows, seldom occurs in goats. A retained placenta should be treated conservatively with the exposed portions clipped off. The placenta is discharged naturally 3-5 days if not normally expelled within 6 hours after kidding. Systemic antibiotics are indicated only if the doe shows signs of illness.





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# RESPIRATORY TRACT DISEASES

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TI RESPIRATORY TRACT DISEASES

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DE Health and Disease Management

Text

1 Clinical pneumonia in goats is almost invariably preceded by some event or set of circumstances commonly referred to as stress. This very broad term, stress includes such factors as weaning, long distance hauling, weather factors including sudden temperature changes or low nighttime with high daytime temperatures, poorly ventilated barns especially those heated in extremely cold weather, overcrowding, malnutrition, feed changes, parasitism and worming. The microorganisms (germs) which produce the actual disease process are often normal inhabitants of the respiratory tract. These microorganisms are prevented from causing disease by the normal animal's body defense mechanisms. The relationship between the body and the microorganism is sometimes a very delicate balance especially in the very young animal. Stressing factors can tip the balance in favor of the microorganism and against the young animal.

2 Barn ventilation in extremely cold weather deserves special comment because it is often overlooked. Warming a barn increases the relative humidity, thus producing a stressful situation. Moisture should never be allowed to accumulate on the walls, ceilings and floors. The rule to follow, especially in barns where the bedding is allowed to accumulate and help maintain the warmth, is if the inside temperature is 5F above the outside temperature, an exhaust fan of adequate capacity to prevent moisture condensation must be used. Goats kept in well ventilated barns, which protect them from drafts and becoming wet, can readily tolerate temperatures below -25F.

3 Acute Pasteurella Pneumonia

In the United States of America the most common cause of pneumonia in goats is *Pasteurella multocida* and *P. hemolytica*. It is an acute disease causing extreme debilitation and often death. It occasionally has a systemic form in which the gastro-intestinal tract is the other primarily involved system.

4 In sheep and presumably in goats, up to 400f normal animals contain one of the above species of bacteria in their nasal passages.

5 Clinical Signs -- While herd outbreaks do occur, individual cases also occur in goats. Morbidity and mortality figures are not available for goats. Depression, lack of appetite, mucopurulent (''pusy'') discharge from the nose and occasionally the eyes, occasional coughing (but not as consistent as in cattle and sheep), fever (104 to 107F) are usually present. Difficult or increased breathing is often not noticed unless the animal is forced to exercise; in this case, panting and coughing occurs.

6 Tissue Changes -- Small (petechial) hemorrhages may be present on the lining of the body cavities especially of the heart. The bronchiole lymph nodes are usually swollen and hemorrhagic.

7 The most consistent and striking change is seen immediately upon opening the chest and completely reflecting the ribs, especially of the right side. First there are marked adhesions of the visceral and parietal pleura (chest cavity lining) and pericardium. The heart and lung may be covered with yellow-gray gelatinous or clotted fluid, fibrin and fibrous connective tissue. This may completely or partially hide the underlying apical and cardiac lung lobe exposure of which reveals a very angry red or purple appearance. The lobes are necrotic, friable and often contain purulent exudate or even abscesses. The fluid may be dirty-yellow and have a fetid odor. When cut, the lungs may have a sharp line of demarcation between the less angry looking (merely consolidated or nearly normal) lung and the necrotic portion. A dark hemorrhagic band of 2 to 3 millimeters may separate the two zones. There are often necrotic cavitations containing purulent exudate or necrotic debris.

8 Diagnosis -- Diagnosis is based upon the history, signs and necropsy lesions and is confirmed by isolation and identification of *P. multocida* or *P. hemolytica*. Because of the presence of the organism in normal animals, diagnosis cannot be made by culturing the organism without the signs and lesions. Differentiation from mycoplasma pneumonia (*Mycoplasma mycoides* subspecies *mycoides*) can be tentatively assumed at necropsy by the severe, angry appearance with marked necrosis which is characteristic of caprine pasteurellosis. Differentiation is important because treatment of pasteurellosis and mycoplasmosis is different.

9 Prevention and Treatment -- Reducing stressful circumstances or

giving antibiotics preventively when stress cannot be avoided, will help reduce the severity and the incidence of the disease.

10 Penicillin and sulfamethazine are approved for treatment by injection and sulfamethazine is approved for oral administration.

11 However, oxytetracycline and the long acting sulfonamide, sulfadimethoxine are also effective against the organism. The major limitation in using these antimicrobial drugs comes from the very short but severe course of the disease. It is difficult to detect, diagnose and treat before the severe necrotizing tissue changes occur. However, in an outbreak, an alert herdsman can detect additional new cases early.

12 Acute Mycoplasmal Pneumonia

The mycoplasmal diseases of goats have taken some time for scientists to sort, classify and understand. The explanation is far beyond the scope of this article, but suffice to say, in the US there is a rather common disease characterized by acute pneumonia and arthritis. This disease is caused by *Mycoplasma mycoides* ss *mycoides* and is the most common cause of pneumonia in Arizona goats. The organism with the same name, but with very slight differences in growth characteristics (colony size), is the one which causes the dreaded Contagious Bovine Pleuropneumonia, eradicated from US cattle in the 19th century.

13 The disease occurs primarily in 2 to 10 week old kids. Two Arizona outbreaks were associated with the spring weather change of warm days but continued cool (30 to 40F) nights. The acute stage of severe disease and death loss lasted about one week. Sick animals which survived were ill about 3 weeks. The morbidity (percentage of the herd affected) was 70 and the mortality was 36

14 Clinical Signs -- The most prominent signs were swollen joints, especially the carpi and stifles (front and rear knees) with or without lameness, fever (106 to 108F) and dyspnea. Coughing is not consistent unless elicited by forced exercise or laryngeal pressure. Swelling of the face or head is infrequently seen and results from mandibular or atlanto-occipital joint involvement.

15 Tissue Changes -- The lung changes always occur on the right side and usually on the left. They consist of red-purple consolidation of the dependent or entire portions of the apical and cardiac and occasionally the diaphragmatic lobes. These portions are friable and moderate amounts of mucopurulent exudate can often be squeezed from them. Depending on the stage of the disease process, cut sections of affected lung vary from dark reddish-purple homogeneous tissue to a variegated color pattern of hepatized to necrotic lobules separated by interlobular edema or fibrosis. Occasionally thin walled abscesses are present from which the organism can be isolated in pure culture.

- 16 The copious yellow pleural exudate often contain large quantities of soft fibrin lightly adhering to the surfaces. Bronchial and mediastinal lymph nodes are generally enlarged and on cut section, very moist.
- 17 The major diarthrodial joints are most often affected. The inflammatory reaction varies from increased cloudy joint fluid with fibrin clots to marked erosions of articular cartilage with fibrosis of the joint capsule. Periarticular tissues in acute cases were often edematous and congested, with extensive fibrosis occurring in chronic cases.
- 18 Diagnosis -- As with acute pasteurellosis, diagnosis is based on history, signs, necropsy lesions and isolation of the causative organism. However, the knowledge of which disease usually occurs in a particular area is of practical importance while awaiting laboratory confirmation. As previously stated, pasteurellosis usually produces a much more severe or angry appearance than mycoplasmosis; this is a subjective determination and subject to error.
- 19 The organism will grow on ordinary blood agar but many inexperienced technicians may not keep the plate long enough to notice the tiny areas of hemolysis in which a colony can only be seen under magnification. Ideally a special mycoplasma medium should be used, and if typical colonies are found, sent by the diagnostic laboratory to one of the few mycoplasma reference laboratories.
- 20 Prevention and Treatment -- Tylosin is the drug of choice for mycoplasmosis. Prevention is as difficult as preventing the change in the weather. If outbreaks recur, the use of tylosin before an outbreak occurs may possibly prevent it. In the face of severe outbreaks, massive doses of tylosin seem to be necessary to appreciably affect the disease process. Two grams of injectable tylosin given intravenously (slowly) followed by 1 gram given subcutaneously twice daily for 14 days appear to reduce the severity of an outbreak. It must be stated that tylosin in any dose is not approved for use in goats and inclusion in this section cannot be construed as a recommendation of its use. Indeed, at these high doses, there may be a risk of killing the animal. This must be weighed against the possibility of losing the animal without this treatment and needs to be discussed by the owner and the veterinarian. The author gratefully acknowledges Dr. Dale Brooks of the University of California at Davis as the initiator of the massive dose system. The above dosage schedule may not be the same as currently recommended by Dr. Brooks.
- 21 Mycoplasmal Pneumonia of Spanish and Angora Goats  
A pneumonia disease of Spanish and Angora goats caused by *Mycoplasma ovipneumoniae* has been reported from Texas. The time changes are apparently quite similar to those produced by *M. mycoides* ss

mycoides.

- 22 Further, the affected animals were subjected to extreme stress of inadequate handling, inclement weather and disease. In two of the four cases, only *M. ovipneumoniae* was isolated. The occurrence of the disease is associated with pasturing cows, sheep and goats together; transmission may take place from sheep to goats.
- 23 **Chronic Progressive Pneumonia**  
This poorly documented pulmonary disease of goats has many of the characteristics of Progressive Pneumonia of sheep. It may be caused by a virus but it is complicated by the common pneumonia producing bacteria. It is found in breeding goats and invariably associated with the stress of bad ventilation or close confinement in dirty pens, especially kidding pens. Presumably the kids acquire the etiologic agent early, perhaps at birth from an infected mother. Each time the animal is stressed, another episode of acute pneumonia and more and more debilitation occurs; finally an acute episode causes death, often not until 6 or 7 years of age.
- 24 **Clinical Signs** -- During each acute episode the animal is anorexic (won't eat), stands by itself with its ears down, acts completely lifeless. Auscultation of the lungs reveals some rales; however, in the advanced case, so little air moves through the lungs that the lung sounds are muffled. Difficult breathing (dyspnea) is present and worsens with repeated episodes. Hypoxia with blue tinting of the mucous membranes of the mouth, vulva or sheath continually worsen.
- 25 **Tissue Changes** -- If an animal dies at a young age, lesions similar to but milder than acute *pasteurella* pneumonia may be seen. As the disease progresses, very small (miliary) foci containing mucous or mucopurulent exudate occupy more and more of the lung. Eventually the lung becomes essentially filled by these foci and by old fibrous connective tissue (scars) and abscesses. The lungs and bronchiolar and mediastinal lymph nodes become 3 to 5 times as heavy as normal. The animal has become extremely debilitated and has very little body fat.
- 26 **Diagnosis** -- The history of chronic, recurring pulmonary illness and necropsy findings of chronic lung changes facilitate a diagnosis. Because the disease in goats is not well documented, and the real etiologic agent has not been identified, definitive diagnosis is not yet possible.
- 27 **Prevention and Treatment** -- Treatment has been unsuccessful. This fact gives evidence for a viral etiology. Preventive measures should give good results. All does with a chronic cough and having acute pulmonary episodes should be culled from the herd. Kidding barns and all other types of winter housing should be kept clean and well ventilated.





# SELECTION AND BREEDING SYSTEMS

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NO D-2

TI SELECTION AND BREEDING SYSTEMS

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DE Genetics and Reproduction

Text

1 The goal of a livestock system including goats is to produce a quantity of quality products with maximum efficiency. A component in achieving this goal is the genetic improvement of goats in the areas of quantity, quality, and efficiency. Genetic improvement is achieved by selection. The rate of improvement is directly related to the accuracy with which the goats are ranked, the intensity with which they are selected, the amount of genetic variation available in the trait(s), and the generation interval. Once goats have been selected to become parents of the next generation, one must consider alternative mating plans. Various mating strategies differ in their goals, and the consequences of each should be understood when considering programs for genetic improvement.

2 Traits of goats can be considered either to be qualitative (simply inherited) or quantitative. Most economically important traits are quantitative.

3 Genetic Parameters

Quantitative traits of goats are those which are influenced by genes at many different loci (gene sites on a chromosome), each contributing a relatively small amount to the total expression of the trait. A second characteristic of quantitative traits is that their expression is influenced to some degree by the environment in which the goat performs.

4 The phenotype of a goat is the observable expression of some trait, e.g., pounds of milk produced in a lactation. The phenotype (P) for a trait can be defined as the sum of the goat's genetic merit for that

trait (G), the influence of the environment (E) on the record, and the population mean for the trait (M). If one looks at phenotype of several goats for a given trait, one can also determine their average performance and a certain variation from animal to animal called variance. The sum of the variances due to genetic and environmental influences makes up the total phenotypic variance, from which the standard deviation can be extracted; i.e., the standard deviation is the square root of the variance.

5 Average performance and standard deviation describe a trait in a given population. If a trait is normally distributed along a bell-curve, then 50% of the trait's records will lie between  $-0.67$  and  $+0.67$  standard deviations and 95% of the records between  $-1.96$  and  $+1.96$  standard deviations in a particular population (Figure 1). The ratio of the additive genetic variance over the phenotypic variance is the important parameter called heritability ( $h^2$ ), which can take on values from 0 to 1. A value of 0 means more of the variation in the trait is genetic, and a value of 1 means all the observed variation is genetic. Few economically important traits in goats have values exceeding 0.5. General characterizations for selecting traits are:

low heritability	less than 0.15
moderate heritability	0.15 to 0.30
high heritability	more than 0.30

6 Reproductive traits have low heritabilities. Milk and fat yields are examples of traits with moderate heritability. Milk composition and most growth-related traits have high heritabilities.

7 Heritability has many uses in goat genetics. For example, heritability can be used to estimate the breeding value (genetic merit) (BV) of a goat. Assume the average production of a certain breed of goats is 1000 lb (P) after adjusting the records for influences of age of doe, season of kidding, etc. A certain doe in that breed produced 1100 lb milk (P). Hence, her breed superiority ( $P - \bar{P}$ ) is 100 lb. The portion of this phenotypic superiority due to her genetic merit is  $100 \times 0.25$ , if the heritability for milk production in dairy goats is 0.25. Thus, her Estimated Breeding Value (EBV) is 25 lb.

8 The true breeding value (BV) of goats is never known and they are compared on estimates of BV, which are subject to the variance or error in estimation. Accuracy denotes how well the BV of a goat has been estimated. The more information available on an individual, either in terms of repeated records or information on relatives, the more accurate the estimated BV's (EBV), and the less likely the comparison of individuals is in error.

9 The EBV's can be used to rank goats comparatively for selection. In the example, the goat (A) producing 1100 lb of milk was 25 lb genetically superior to the breed average doe. Another doe (B) producing 900 lb milk is 25 lb inferior to the breed average ( $-100 \times 0.25$ ). Thus, goat A is 50 lb milk genetically superior to goat B.

10 The EBV of an individual represents its own genetic merit but greater interest lies in the merit of that individual's progeny. 'How much of an individual's breeding value or superiority will be transmitted to its progeny?' is the question. The concept of Estimated Transmitting Ability (ETA) equals one half the EBV of an individual goat, since one half of her genes are represented in her progeny; the other half being supplied by the other parent. Genes obtained by one particular progeny from its parent are a random sample. A progeny may receive in the extreme a sample of the parent's best or its worst genes only. This explains why poor progeny sometimes may result from good parents and good ones from poor parents.

11 The genetic parameter closely related to heritability is repeatability (r). It is also a ratio of variances, namely the variance for permanent environmental influence (e.g. injury) plus the total genetic variance, not just the additive, over the phenotypic variance. Repeatability is equal to or greater than heritability by definition. Repeatability can be used to predict the future performance of a goat based on her past performance.

12 This Most Probable Producing Ability (MPPA) can be calculated as:  $P' + r(P - P')$  when the goat has one record. The doe (A) producing 1100 lb (P) in the population averaging 1000 lbs (P') has an MPPA of 1050, if  $r = 0.50$ . When the goat had n records the calculation for MPPA is:

$$P' + \frac{nr}{1+(n-1)r}(P-P').$$

13 All domestic livestock have several traits of economic importance, and their relationships to each other are critical for selection programs. A correlation describes the relationship between two traits. There are phenotypic, genetic, and environmental correlations. A correlation can have values between -1.0 and +1.0, with zero meaning no relationship. The nearer the correlation is to +1.0 or -1.0, the closer the relationship is between the two traits. A positive correlation (+) indicates high measures of one trait tend to occur with high values of the second and low values for the first with low values for the second. A negative correlation (-) indicates a tendency for high values of one trait to occur with low values of the second. For example, milk and fat yields of goats are positively correlated. As pounds of milk per lactation increase so do the pounds of fat produced. However, milk yield and milk fat percentage are negatively correlated. As pounds of milk increase, the percentage of fat in the milk of goats tends to decrease.

14 Genetic correlations are important in selection and have two biological causes: pleiotropy and linkage. Pleiotropy is the result of one gene contributing to the phenotype of more than one trait. Linkage means a gene (or set of genes) is in close proximity on a chromosome to a gene for a second trait. Being close together on the same chromosome,

they are passed on to the progeny together and cause the genetic correlation. Thus selection for one trait will alter also the performance of the population for all other traits which are genetically correlated to the trait under direct selection. That change in a correlated trait is called a correlated response. Some correlated responses can be beneficial in terms of improving the total productivity of goats; however, others may be detrimental. Genetic correlations as well as phenotypic correlations may be used in indexing animals for simultaneous selection of more than one trait.

#### 15 Selection Response

The first step in the selection process is to define the goals of the program, e.g., which trait or traits are desired in selection. The appropriate records need to be collected on the selection candidates and their relatives. From these records, the BV's of the individuals are estimated and the goats ranked from best to worst. The breeder must now decide how many goats are needed for both sexes, and selection is then simply keeping the top ranked animals. Fewer bucks are required to maintain the population than females, therefore the intensity of selection for males can be much greater. This points out that more progress can be made by concentrating efforts on buck selection.

16 A selection differential is the phenotypic average difference of the selected parent animals ( $P_s$ ) from the population average ( $P'$ ). Selection intensity ( $i$ ) is the selection differential expressed in terms of phenotypic standard deviations ( $s$ ); i.e. the ratio of  $(P_s - P')$  over  $s$ . Selection is used in predicting genetic response due to selection because it can be related to that percent of the population saved as parents (see Table 1). If the top 100f goats available are used for selection, their mean phenotypic superiority due to selection intensity is 1.75 standard deviations above the population mean. If the top 70are selected then the selection intensity will be only 0.5 standard deviations above average.

17 Table 1. Selection intensities ( $i$ ) for different percentages of individuals selected to be parents from a large population.

Percent Saved	$i$
1	2.67
5	2.06
10	1.75
30	1.16
50	0.80
70	0.50
90	0.19
100	0

18 The parameter of heritability is used to calculate selection response. The square root of heritability is called accuracy ( $h$ ). The formula for selection response after using a certain superior male in a goat herd is

one-half of the product of accuracy, times selection intensity, times the additive genetic variance for the trait. The reason for 'one-half' is, of course, that only half of the sire's genetic superiority is passed on to his progeny. Selection response is the genetic change due to selection in one generation. Many times, interest lies in the genetic change per year. To obtain this estimate, one must divide by the generation interval ( $t$ ), which is the average age of the parents when their progeny are born. For example, if the heritability of yearling weight is 0.49, then the accuracy is the square root or 0.7. The generation interval of goats is two years. According to the above formula, the answer in the case of 10 selection intensity (equal to 1.75 standard deviations) would be  $1/2(0.7)(1.75)/2=0.31$  standard deviations selection response per year for strictly male selection only. If however, 70% of all females selected is the selection intensity program, then the selection progress becomes, according to the same formula,  $1/2(0.7)(0.5)/2=0.09$  standard deviations selection response per year above herd average. If both programs are combined, the answers are combined and the selection response for yearling weight becomes 0.4 standard deviations progress per year in average.

19 Selection for more than one trait based on independent culling levels is accomplished by ranking candidates for both traits and requiring the selected animals to meet a minimum standard in both traits. This process is repeated each year with only minimum standards adjusted for progress made by selection.

20 Figure 2 shows independent culling plotted for a large number of animals for two traits. Goats in the upper righthand quadrant meet the standards for both traits and are chosen to become parents of the next generation. Two points in Figure 2 are goats A and B for the two traits. Goat A is superior to the population for trait 1 but falls just below the culling minimum level for trait 2; so this animal would be culled. Goat B has a performance level just above the standards for both traits and is kept as a parent. It can be seen that Goat A could probably be a more appropriate parent than B. Their difference in performance for trait 2 is minimal while goat A is far superior to B for trait 1.

21 Compromises have to be made for goats which are superior for the one trait but just below borderline for the other trait. This has led to the procedure of Selection Index which allows ranking animals simultaneously for two or more traits in one single index.

22 A selection index is calculated from the sum of trait means each multiplied by appropriate factors which weigh their relative importance genetically and economically. An index provides the opportunity for multiple trait selection. For example, a goat breeder considers trait 1 two times as important as trait 2. Hence, trait 1 would have a weighting factor double that of trait 2. In figure 2, goat A would now be selected rather than goat B because of the index method. Selection index, under certain assumptions, can maximize selection response for both traits.

23 Breeding Systems

Random mating is a system where an individual goat has an equal opportunity to be mated with any other individual of the opposite sex. The mating of two particular goats occurs essentially by chance in that no breeder decision was made to join them as mates.

24 Assortative mating is based on phenotypic performance or characteristics. Mating individuals of like performance is positive assortative mating, e.g., large goats to large mates and small to small. Mating individuals of unlike performance is negative assortative mating, e.g., large goats to small mates. Positive assortative mating tends to cause more variation in the total population of progeny than would occur from random mating, and negative assortative mating tends to reduce the variation. Assortative mating is practiced for type (conformation) traits. For example, 'corrective' mating for progeny of a doe with certain physical weaknesses to a buck with strengths in those attributes would be negative assortative mating. Perpetuating strengths of a given line by selecting a buck also strong in those characteristics would be positive assortative mating. Assortative mating deviates from random mating in that decisions by the breeder based on phenotypes exclude or reduce the possibility of some matings.

25 The concept of relationship is important in deciding on certain breeding systems. The basic principle involved in determining relationship is that a parent passes one half of its gene complement to its progeny. Hence, in a noninbred population, a parent is related to its progeny by 0.5, meaning 50% of their genes are in common or they have a relationship of 1/2. Other types of relationships in noninbred populations are calculated as products of this 0.5 or (1/2). For example, the relationship between paternal half-sibs (progeny of the same sire mated to different dams) is 1/4 as can be seen in the following diagram:

dam 1 > progeny 1 < sire > progeny 2 < dam 2

Each progeny receives a sample half of the sire's genes. The portion of genes that progeny 1 received from its sire, which are replicates of the same genes received by progeny 2, is (1/2) times (1/2) or 0.25

26 The relationship of a goat (C) to its grandparent (A) is also 1/4 because:

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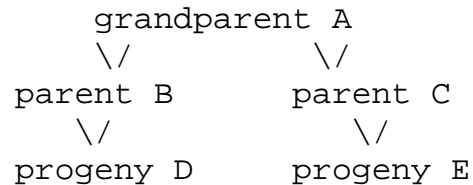
great-grandparent (E)
  \
  grandparent (A)
   \
   parent (B)
    \
    progeny (C)

```

Parent goat B received one half of its genes from grandparent A and in turn passes one half of its genes to progeny C. The relationship is (1/2) times (1/2) or 0.25

27 The relationship between C and its great-grandparents (E) would be one half of 0.25 or 12.5

28 A quick method of calculating relationships between two individuals in a noninbred population is to set each 'arrow' between related individuals equal to  $(1/2)$  and multiply. This is equivalent to raising  $(1/2)$  to the nth power,  $(1/2)^n$ , where n represents the number of arrows or generation steps. The relationship of goat D to goat E having a common grandparent (A) would be:



$(1/2)^4$ th or  $1/16$  or 6.25 since there are 4 arrows or generation steps connecting D with E.

29 The degree of inbreeding of a particular individual equals one half the relationship of its parents. This value is called the inbreeding coefficient (F). The progeny resulting from mating a sire to his daughters has an F of 0.25, while mating two paternal half-sibs results in a progeny inbred 12.5

30 The consequence of inbreeding is increased homozygosity or likeness of genes. If an individual goat has two unlike genes at a particular trait locus it is called heterozygous. However, an inbred animal has more loci in homozygous states than the average noninbred animal. For a particular trait, there is a higher number of homozygous individuals in an inbred population than in a non-inbred one. Over time with inbreeding, certain genes which were present in the initial population may get lost in subsequent generations. Within an inbred line, the tendency towards fixation of few genes reduces the amount of genetic variation. In the absence of selection, genes are lost or fixed at random. The variation between inbred lines increases, however. Inbreeding can be used to create diverse lines.

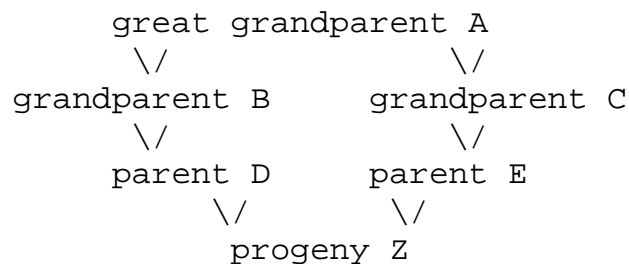
31 An advantage of an inbred goat as parent is the increased uniformity in its progeny. Uniformity does not imply superiority, which is a function of genetic merit. An inbred animal may or may not be superior. Since inbreeding increases homozygosity in a population, it follows that this includes undesirable recessive genes. Hence, with inbreeding, the risk exists that one would generate a higher incidence of homozygotes for lethal, sublethal, and undesirable genotypes than occurs in random mating populations.

32 A second negative aspect of inbreeding is inbreeding depression, which is reduced performance related to increased homozygosity. The traits most influenced by inbreeding depression are in general those which have low heritabilities. Unfortunately, this includes such traits as viability and

reproductive performance. A realistic threat associated with intensive inbreeding is producing a population of goats unable to survive or reproduce well enough to maintain the population.

- 33 Inbreeding occurs from breeding programs designed to mate relatives and in small herds where introduction of outside breeding stock is rare. The rate of change per generation in the average level of inbreeding is not large enough in most herds to be of concern. For example, if one uses 5 bucks selected from within a herd of 50 does, the level of inbreeding increases by 0.0275 per generation. However, in small herds where, for example, two bucks may be used on 20 does, the increase is 0.069 per generation. A progeny from two unrelated, inbred parents has an inbreeding coefficient  $F$  of zero. If a breeder feels his herd is getting too inbred, he can relieve the problem in the subsequent generation by using unrelated breeding stock. A breeder can also bring an unrelated, even though highly inbred sire into his herd without suffering the consequences of inbreeding depression in the progeny of that buck, because the progeny of two unrelated, although inbred, parents has an inbreeding coefficient of zero.

- 34 Line breeding maintains a high degree of relationship of individuals to a superior ancestor but has less severe consequences than inbreeding.



Assume goat A was a buck used on several does in a herd generating daughters B and C. These daughters are mated to unrelated bucks and produce a son D and daughter E. The goats D and E are related to A by 25, but to each other by 6.25

- 35 Assuming it was recognized that A was a truly superior buck. If his descendents were mated each generation to unrelated animals, the relationship of A to that progeny would continue to decrease by one half each generation. Progeny Z is related to great grandparent A not by 12.5 but by 25, because there are both parents D and E related to Z. Since D and E are related by 6.25, progeny Z has an inbreeding coefficient of 3.15. The recapture of some of A's gene combinations is not certain but possible. The probability can be increased through line breeding or increased inbreeding with its other consequences.

- 36 The opposite mating system is designed to increase heterozygosity. Crossing of lines within a breed or the crossing of breeds are examples of such strategies. The fundamental assumption is that the genes at the various loci differ in the two parent lines or breeds. For many traits, the crossing of lines or crossbreeding results in progeny whose



performance exceeds that which was expected from their parents' performance. This deviation is called heterosis or hybrid vigor and can be calculated as the difference from the expected.

37 For example, assume we cross two goat breeds, one averaging 800 lb of milk per lactation and the other 1000 lb. The expected progeny performance would be 900 lb milk while the actual performance of the crossbred progeny was 950 lb, indicating 5.6% heterosis ((950-900)/900). Progeny exceeding their expected performance for a trait are not necessarily superior to both of the parental lines for that trait. Furthermore, crossbreeding influences all traits so that if complementary breeds are used, the total merit of the crossbreds may exceed each parental breed.

38 Heterosis is associated with dominant gene action. Assume that trait (A) has three possible genotypes with the following relative phenotypic values.

genotype:	AA	Aa	aa
value:	100	100	0

Gene (A) is dominant to its recessive allele (a) and the genotypes (AA) and (Aa) have the same phenotypic values. At a second trait locus (B) assume the values for the three genotypes are:

genotype:	BB	Bb	bb
value:	100	50	0

There is no dominance at this locus since (Bb) is the average of the values of the two homozygous states. At a third trait locus (C) it is assumed that the following values exist:

genotype:	CC	Cc	cc
value:	100	60	0

There is incomplete dominance since Cc has a value exceeding 50 but less than 100.

39 Given these three loci and their relative values, one can now demonstrate heterosis from crossing two breeds of goats that have the following of the above genotypes:

-----		-----	
Breed 1		Breed 2	
AA		aa	
bb		BB	
cc		CC	
-----		-----	

The relative phenotypic value of each breed is the sum of the values of their genotypes at each of the loci. Breed 1 would have a value of 100 and breed 2 a value of 200; with an average for both parents of 150. Any



# SIMPLE INDIGESTION

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NO G-11

TI SIMPLE INDIGESTION

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DE Health and Disease Management

## Text

1 Simple indigestion is a frequent problem in goats. It is usually brought about by a change of feed or overfeeding or any factor that brings about a minor change of environment of the rumen. Common causes are: kids getting out of their pens or pasture and finding access to new highly palatable feed, sudden access to a lot of palatable feed after prolonged hunger, eating spoiled or frozen feed, sudden introduction of feed containing large amounts of urea, or placenta eating.

## 2 Clinical Signs

Discomfort manifested by restlessness or quietly lying down, pathetic, weak crying and moderate depression are usual signs. The temperatures and hematocrit are normal and the mucous membranes are pink. In those conditions associated with overeating, the rumen is full, firm and doughy and has no significant contractions. The feces are usually of normal consistency but decreased volume. Recovery occurs in 24-48 hours.

## 3 Diagnosis

Diagnosis is suggested by a history of a change in the nature or amount of diet, the elimination of other more severe possibilities, and the signs. The most important aspect of the diagnosis is to accurately determine that something worse, especially grain overload, has not occurred. As long as the color of the mucous membranes remains a healthy pink and the hematocrit has not increased above 45, the continued diagnosis of simple indigestion is justified.



# STOMACH WORMS

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NO G-5

TI STOMACH WORMS

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DE Health and Disease Management

Text

1 Some of the most important internal parasites of goats are 'stomach' worms. Because of husbandry practices, diagnosis and treatment-control of these parasites should be approached on the basis of the entire herd, not as individual animals alone.

2 In a goat herd, young animals under 6 months of age are by far the most susceptible to parasitic infection. This group of kids is highly susceptible since they have had very little exposure to parasites and thereby have very little resistance or immunity.

3 The second most susceptible animals in the goat herd are the yearlings and 2-year olds. The growing animals, with their rapidly expanding blood volumes are susceptible to blood loss due to the actions of certain species of the stomach worms. This age group also is the most likely to suffer malnutrition which will make them more susceptible to parasitic disease. It is a proven fact that animals receiving an adequate, balanced ration are less susceptible to parasite infection.

4 The older members of a herd will generally be resistant to parasitism due to prior exposure to the various parasites. However, they will harbor subclinical numbers of the common parasites and thereby serve as reservoirs of infection for the younger, susceptible members of the herd.

5 All of the parasitic organisms that are capable of producing disease in goats follow a definite life cycle pattern. In general, the



# SYMBOLS IN DAIRY GOAT BREEDING

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NO D-10

TI SYMBOLS IN DAIRY GOAT BREEDING

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DE Genetics and Reproduction

Text

1 AR -- Advanced Registry

AR is an abbreviation for Advanced Registry. The Advanced Registry is a special section of records kept for those does who have met minimum requirements for production of milk and/or butterfat for their age while on test under official supervision, and bucks who have sired daughters meeting such minimum requirements. These requirements are based on lactations of 305 days or less and begin with a base of 1500 lbs of milk and/or 52.5 lbs of butterfat for does freshening at age 2 years or less. For every day the doe exceeds 2 years of age at the time of kidding, up to the time she becomes 5 years of age, the requirement is increased by 0.2 lb of milk and 0.007 lb of butterfat. At the age of 5 years or more, a doe must produce 1719 lbs of milk and/or 60 lbs of butterfat in the 305 days or less.

2 For bucks the special AR record section is reserved for those who have sired at least three daughters by three different dams who have met their Advanced Registry requirements as listed above. They are known as Advanced Registry herdsires. There is also a unique provision whereby a buck may become an Advanced Registry herdsire if two of his sons have qualified to be Advanced Registry herdsires or if he has sired one son and two daughters who are Advanced Registry.

3 Usually the symbol AR has something following. It may be a number such as AR17 which when found with a doe's name would indicate that, at the time this registry certificate or pedigree was made out, her last record would be found in Volume 17 of the ADGA Yearbook. When found with a buck's name it would indicate that, at the time the registry certificate or pedigree was made out, the record for the last daughter

or son to make Advanced Registry would be found in Volume 17 of the ADGA Yearbook. (The ADGA Yearbook is the annually published volume of production records and show awards for a given year.) Looking in the Yearbook will show the actual age at freshening, number of days milked, pounds of milk produced and pounds of butterfat actually produced. This record may have listed a former Yearbook number, say AR16, where a previous record was published. This keying to previous Yearbooks will continue back to the first official record made by the doe or, in the case of a buck, the first volume published after at least three of his daughters or two of his sons or a combination of daughters and sons made AR.

4 On some pedigrees the abbreviation AR may be followed with the actual record, so the information is available at a glance. It might look like this:

AR14270:6-2 282-2600-96 (3.7)

-- AR14270 is the Advanced Registry record number. Each qualifying record will have a new number.

-- 6-2 means the doe was 6 years and 2 months old at the start of this particular lactation record.

-- 282 indicates the total number of days milked in the lactation. (Note that in this case less than the usual 305 days.) Years ago records of 365 days or even longer were assigned their own record number providing a qualifying 305 day record had been made in the first 305 days.

-- 2600 is the actual pounds of milk produced in this 282-day lactation.

-- 96 is the actual pounds of butterfat produced in this 282-day lactation.

-- 3.7 0s the average percentage of butterfat in the milk during the lactation.

5 \* -- Stars

The star designation (\*) briefly means there are official records that can be looked up either on the animal itself or its immediate ancestors. A buck obtains one star by virtue of having:

1) a dam who has at least one official production test record that meets minimum production requirements for both milk and butterfat for her age when tested or is a star milker, and

2) has a sire who is an Advanced Registry herdsire, a star buck, a + buck, or has a dam who has met minimum requirements for milk and butterfat in at least one lactation. Stars in themselves are never a



sufficient indicator of an animal's worth but are extremely useful as a quick guide to those animals with production records on themselves or their ancestry that can be looked up.

6 There are several ways in which a doe is entitled to have a star (\*) suffix following her name. The most common one is to be an Advanced Registry doe as outlined earlier. The second most common way is to qualify as a star milker at a recognized official milking competition.

7 An Advanced Registry test requires a once-a-month visit year-round by an official tester to weigh and sample the milk.

8 A milking competition utilizes a single day's production to estimate an animal's producing ability.

9 Naturally, the Advanced Registry lactation record is one of more value, but because the production requirements for a one-day star milker test are so high, usually only quite deserving does can secure a star in this way. The testing supervisor will check at one milking to be sure the does are milked out dry and will then weigh and sample the milk at  
++++MISSING DATA++++

10 +Plus Bucks

While a buck can get a star on the basis of his parentage, the plus (+) prefix before his name is always earned by siring worthy offspring. The usual way is to have sired at least three daughters by three different dams who have qualified as Advanced Registry or Star Milkers. He may also earn the +B prefix by having two sons who are Advanced Registry Herdsires. A +B buck is always an Advanced Registry Herdsire. If he qualifies by having both three qualifying daughters and two qualifying sons he is entitled to the + +B prefix. A buck may have a total of only one star (\*) and two pluses (++) before his name which looks like this: ++\*B. There is no such thing as a 5-star buck!

11 If a buck has a prefix of ++\*B it means he has at least three daughters (from different dams) who are AR or Star Milkers, two sons who are AR Herdsires, and parentage with qualifying production records. Since both ancestry and progeny have been proven desirable for production, such a buck can be considered a valuable asset in a breeding program.

12 Lifetime Production Records

As official production testing has become more widespread and the dairy goat industry grows up, the emphasis on lifetime production becomes ever more important. Even as it is recognized that a complete lactation record is of more importance than a single day test, it is recognized that a summary of all lactation records in the life of a doe is the most important. In making such a summary the actual production records of every lactation in the life of the doe are added together regardless of length and regardless of whether AR requirements are met in every lactation. The result is summarized by stating the actual number of days milked, the total pounds of milk and total pounds of

butterfat produced. Often the average percent of butterfat is stated since the importance of having an adequate butterfat test is very important. Here is an actual lifetime production of a real doe to give an idea of what should be included: 3,480 days 18,006 lb milk - 664 lb fat (3.7).

### 13 CH Permanent Champions

While classification scores are now of much more value than show wins in determining outstanding type, in earlier days the use of show wins was the best indication of demonstrated good type. A system was devised whereby an animal winning Grand Champion at three or more different shows with at least 10 animals of its breed shown by at least two exhibitors could win with designation of permanent Champion (CH).

### 14

While there were and are many other rules involved such as having at least two judges, two wins with at least eight milkers, allowance for Reserve Grand Championship wins, and the like, the three wins are basic necessities. Of course, at large shows with perhaps 100 head of the breed in competition, the championship is usually worth more than at a small show of 10 or 12 head. However, no satisfactory method of show size recognition has been approved. At any rate, the three wins make an animal a permanent champion and the prefix CH is placed before its name. If a doe holds an Advanced Registry or Star designation her prefix shall be GCH. If a buck is an Advanced Registry Herdsire his prefix shall also be GCH.

### 15 Classification Symbols

Official classification scores are now appearing on registry certificates, and, since all classified herds are allowed and encouraged to use their scores on pedigrees and in advertising, it seems worthwhile to present a brief summary of the most important designations.

### 16

In classification each animal is compared with the ideal of that breed, sex, and age and are given numerical scores in General Appearance, Dairy Character, Body Capacity, and, in does, Mammary System. The scores indicate the percentage of ideal the animal is. Along with this, an overall score is given. This overall score is computed on the basis of allowing 30 Dairy Character, 20 bucks 45 Dairy Character, 20 General Appearance, 30 Dairy Character, and 25 Body Capacity).

### 17

The following table shows the numerical score and abbreviations used in each breakdown:

(E) Excellent	90 or more
(V) Very Good	80 to 89
(+) Good Plus	70 to 79
(G) Good	60 to 69
(F) Fair	50 to 59

- 18 Also used is a series of numbers showing the relative excellence or deficiencies in specific areas. The wise breeder will have available an official code number chart for use in conjunction with official classification codes to determine if the animal in question is indeed useful in a type-improvement program. Of particular value in selecting breeding stock is the Whole Herd Classification Score. This is an average of the overall scores of every milking doe of a breed in a herd.
- 19 All the symbols are guides to help to look for better production and type conformation.
- 20 Purebred-American-Experimental-Grade  
The term purebred as defined by the American Dairy Goat Association (ADGA) means that the sire and dam of all animals to be registered must be purebred of the same breed, except for LaMancha. All LaMancha dairy goats with at least 3 generations of American LaMancha ancestry born after January 1, 1980 will be entered into an open purebred LaMancha herd book. Alpines, Oberhasli, Saanen and Toggenburg must also have erect ears besides the proper color markings. LaMancha can only have rudimentary ears: 'elf' (short) or 'gopher' (very short). LaMancha bucks must have gopher ears. Nubians must have pendulous ears. Saanen must be of white color or cream. Oberhasli must be of 'Chamoise' color. Black Oberhasli does are registered with a 'b' suffix to their registration number. Toggenburg must have a shade of fawn or brown with white facial stripes, outline of ears, white below knees and hocks, and a triangle on each side of the tail base in the pinbone area. Black Toggenburg does with above markings are registered with a 'b' suffix.
- 21 Dairy goats registered with the American Goat Society (AGS) may be reregist ++++MISSING DATA++++
- 22 A doe of unknown pedigree may be recorded as 'Grade' with the ADGA as a 'native on performance' or 'native on appearance,' depending upon certification by official DHIA or a nonrelated ADGA member as to conforming with one of the six specific breed types or the Experimental Registry. Recordation of grades is in 1/2, 3/4, and 7/8 levels as for American Registry.
- 23 Kids resulting from artificial insemination need an insemination certificate to accompany application for registration or recordation. At the time of service, the doe must have been positively identified by tattoo and registration papers. Semen containers (ampule or straw) must also carry complete sire identification. Color codes for dairy goats semen are as follows:

Alpine	-purple
LaMancha	-yellow
Nubian	-red
Oberhasli	-orange



# TEETH

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TI TEETH

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DE Anatomy and Physiology

## Text

- 1 Goats, being herbivores, obtain the greatest portion of their sustenance from plant materials which are of low or no nutritional value to man. Through mastication, regurgitation and rumination of these materials by their teeth, especially the molars, the plant materials are reduced to small particle sizes, thus increasing their relative surface areas and making them easier to be digested. Much of the grinding action of the teeth is the direct result of their surface angles and rotary-like movements of the lower jaw. The combination of lateral and vertical movements is due to the fact that upper and lower jaws are not perfectly matched, but the lower jaw is somewhat smaller than the upper. Food material can therefore be chewed only from one side of the mouth at a time through a lateral grinding action. Such will result in a pattern of wear that causes the teeth to develop points on the outer edges of the upper molars and the inner edges of the lower molars. Only after action of the teeth has reduced plant materials to a finely ground pulp, can effective digestion begin.
- 2 With goats as with other ruminants, complete chewing is not done at the actual time of grazing. Later, at the animal's leisure, the materials are ruminated and rechewed until the feed particles are small enough to be passed on in the digestive tract.
- 3 Throughout the process of mastication the tongue and cheeks are constantly in motion, keeping the feed material moving between the teeth until it has been ground well enough to be formed into a bolus, which

then can be moved back in the mouth and swallowed.

4 Mastication is basically a voluntary act under the control of brain centers, although in practice it appears more like an autonomic process. Mastication is dependent on sensory stimulation, with the 5th cranial nerve (trigeminal) being mainly responsible. Effector impulses travel the route of this nerve to the elevators of the jaws and along the 7th cranial nerve (facial) to the digastric muscle, and the lip and cheek muscles. Impulses may also travel the 12th cranial nerve (hypoglosseal) to the muscles of the tongue.

5 Teeth are generally classified as being of two types according to their permanence: the temporary milk teeth and the permanent adult teeth.

#### 6 Milk Teeth

Milk teeth are present either at birth or shortly afterwards and will remain for about a year before replacement with permanent teeth begins. Milk teeth are not as hard nor as numerous as adult teeth, since the adult teeth are expected to remain and function throughout the life of the animal.

7 The continual growth of the tooth root, along with other factors, serves to push the crown of the milk teeth up and out of their sockets, through the overlaying segments of the dental sac and gum. The actual time period for the eruption or 'cutting' of the teeth, while providing a general indicator of age in the goat, is not the same for all goats. Variances according to breed, climate and nutritional conditions will cause differences in the actual time of teeth eruption among individual goats.

#### 8 Adult Teeth

Permanent teeth undergo more progressive development. They press against the tissues of the milk teeth and cause the roots of the milk teeth to break down. This in turn releases the dental pulp from its anchorage in the gum. With tissues loosening and exerted pressure from the rising permanent teeth, the milk teeth are shed from the jaw.

9 Tissues surrounding the developing teeth undergo a developmental process that differentiate the mesenchymal tissue from the connective tissue which make up the dental sac. The dental sac, where the teeth roots will be, takes on three important functions. The inner cells differentiate into a layer of cementoblasts at the time of eruption. As the epithelial sheath breaks down and disintegrates in a downward direction, the cementoblast cells deposit cement upon the dentine of the teeth. This deposition occurs from the neck region downward. The surface of the dental sac becomes active in bone production as the calcification process of the jawbone progresses. The tooth becomes surrounded by spongy bone, occupying its own socket. The fibrous sac itself forms a thin membrane which serves to hold the tooth in place

## TEETH

by embedding some fibers in the cement and others in the bony wall of the socket.

- 10 Teeth can be further classified into three groups according to the way in which they grow: true teeth, constantly growing teeth, and constantly erupting teeth. Of the three, goats have two: true teeth and constantly erupting teeth.
- 11 True Teeth  
The incisors of the goat are considered to be true teeth in that they possess a crown, a root and neck, growing to adult size before they begin to gradually wear away.
- 12 Erupting Teeth  
Constantly erupting teeth are found in the goat in their molars. This type of tooth is made up of layered masses, possessing very long roots and no real neck. As the goat ages, these teeth are gradually forced upward, to account for wear, by the desposition of bone into the jaw below them. In the case of very old animals, such teeth may actually be forced out by this rising action.
- 13 Tooth Composition  
True teeth are composed of five parts and four tissues. Constantly erupting teeth have but four parts, as they have no neck. The crown of the tooth is the part which appears above the gum line, while the neck is located at the gum line. It appears as a narrowing that separates the crown from the root. Implanted into the tooth socket of the jaw is the root, which may be either singular, paired, or multiple, depending on what type of tooth it is. The central cavity of the tooth that runs from the base of the root up into the crown is known as the pulp cavity, containing the dental pulp, vessels and nerves. This cavity is large in young animals, but over time it becomes infiltrated with dentine and may be completely filled in old goats. The table surface is that part of the tooth that is actually used for grinding or tearing of the food.
- 14 Cement is the second hardest tissue, and is found as the outermost layer covering the tooth. In true teeth, this yellow to black substance covers the roots only. Enamel, the hardest tissue of the body, is the next layer, covering the dentine of the tooth. Its coloration is about that of ivory. Under the enamel lies the tissue that forms the bulk of most teeth, dentine. This substance, which is hard and yellowish, covers the pulp of the tooth, supporting numerous blood vessels and nerves.
- 15 Dental Development  
All ruminants, including goats, lack upper incisors. Instead there is a hard dental pad on the frontal part of the upper jaw which serves in place of teeth. The dental formula for goats is  $0033/4033$ . The formula is derived from the number of teeth the animal has in one half





# THE 4-H PROJECT BOOK

COLLECTION: GOAT HANDBOOK

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Extension Goat Handbook

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NO A-6

TI THE 4-H PROJECT BOOK

AU B. Ells; New Mexico State U., Las Cruces

DE The Goat Industry

Text

1 The purpose of a 4-H goat project is to help youngsters learn about goats -- their feeding, care, management, and how to select them. They will also have the opportunity to show others how to develop a kid into a good goat, specifically a dairy goat. This project is suitable for rural and urban youngsters alike.

2 Objectives

The objectives are:

- \* To gain knowledge and skills in managing and caring for dairy goats.
- \* To learn to select quality goats and how to feed them balanced rations.
- \* To maintain management records to base decisions regarding feed, production, breeding and profit.
- \* To participate in group activities within the club and to assume responsibility in the club goat program.
- \* To gain satisfaction from completing a project to the best of the ability of the youngster.
- \* Learn responsibility by regularly caring for an animal.
- \* Appreciate the role of goats in human nutrition.
- \* Develop a business ability.

++++MISSING DATA++++

3 Housing

Equipment

Breeds of dairy goats

Feeding  
 Tattooing  
 Diseases and ailments  
 Determining age  
 Grooming  
 Showing  
 Tanning a goat skin  
 Disbudding  
 Trimming the feet  
 Using goat meat  
 Products from goat milk  
 (cheese, yogurt, butter, ice cream)  
 Diseases affecting man through milk  
 The mammary system and how it works  
 Digestive system

4 Project Book

State and county 4-H leaders in Cooperative Extension offices have project record books for use by the 4-H members. Many of these books contain the basic management information on how the youngster can get started with goats. Breeds, feeds, health, fitting and showing, milking, housing, etc., are outlined usually in an introductory way. Score cards for the goat and for fitting and showmanship are included.

5 Following are record book forms which have proven useful:

HOW MUCH DO YOU KNOW ABOUT YOUR 4-H CLUB DAIRY GOAT?

Name  
 Registry No.  
 Date of Birth  
 Date Secured  
 Name of Sire  
 Registry No.  
 Number of Tested Daughters  
 Avg. Production Milk  
 Name of Dam  
 Registry No.

6 Give her milk and butterfat records:

Age	Days	Milk	Butterfat
		lbs	lbs
_____	_____	_____	_____

7 From whom did you purchase your kid?

Give Name  
 Address

8 If your kid is a purebred, it should be registered and transferred immediately. The transfer should be made out in your name. This should be done before July 1.

9 The seller of a purebred animal should arrange for the registration and transfer of an animal which he sells. It is customary for the seller to assume the expense of registration and transfer. The papers should be delivered to the buyer within a few weeks from the time of purchase.

#### 10 The Growth Record

Measure the heart girth and height at withers of your goat and record it in your book every month. Make these measurements near the day in the month that your goat was born. The chest measurement is made with a tape measure around the barrel just behind the fore legs. The withers measurement is made by standing the goat on a level floor, placing a long stick upright beside the fore legs, and a short stick level over the withers and to the upright stick. The height of withers will then be the distance from where the sticks cross to the floor.

11 If you plot the growth on the growth charts, you can see more easily how your goat is growing.

#### 12 Keeping the Feed Record

This is a very important part of your dairy club work and should be filled in every month. The grain rations used and prices are recorded in the space provided at the top of the feed record page. The different grain mixtures fed are numbered so that the number representing the grain mixture fed that month can be placed in the column marked No. when filling out the feed record. The cost per 100 pounds should be calculated from the farm price of home-grown grains and the purchase price of feeds that are bought. The problem is worked in this manner:

100 lbs cracked corn or milo	at \$2.50 per cwt = \$2.50
100 lbs rolled or crushed oats	at 4.70 per cwt = 4.70
50 lbs wheat bran	at 4.50 per cwt = 2.25
<hr/>	<hr/>
250	\$9.45

Cost per cwt =  $9.45 / 250 = .38$  cents per lb or \$3.80 per cwt

13 If you buy ready-mixed feed, report it in this way in the space provided at the top of the feed record page.

Jones & Smith dairy ration \$4.82 = .048 cents per lb.  
or  
Brown & Lee Goat Pellets \$6.20 = .062 cents per lb.

14 On the Monthly Feed Record, on the lower half of the page, record the month, the number of the grain mix used that month, the pounds of grain mix feed during the month, and the value of the grain mix used. In the columns for roughage, record the kind of hay used, the pounds fed that month, and the value of the hay fed. The same method is used

in recording any feed fed.

15 Grain should be weighed or measured at each feeding. For example, if you are feeding one pound of grain twice a day in a 30 day month, you would feed 60 pounds of grain. The hay and silage fed the goat should be weighed near the middle of the month. This weight multiplied by the days in the month would tell you the amount of hay and silage consumed by the goat. Roughages should be charged at the farm prices. This also should be recorded every month.

16 QUESTIONS TO BE ANSWERED THE FIRST YEAR

1. What is a purebred goat?
2. What is the first step in becoming a good judge of dairy goats?
3. When may milk feeding the kid be discontinued?
4. How can you tell whether your kid should be dehorned or not?
5. Name two breeds of goats not including the breed you have.
6. What are the three distinguishing features of a good dairy goat when at a peak of production?
7. How many days should newborn kids be left with their mother?
8. At what age should kids be put on pasture?
9. How often should the grain be weighed or measured?
10. What tools would you need to trim the feet?

17 QUESTIONS TO BE ANSWERED THE SECOND YEAR

1. During the winter what feed should young does receive?
2. With good pasture and browse what grain should they receive during the summer months?
3. List three essentials of a good shelter.
4. What are the two most common health risks with goats?
5. At what age should well-grown young does be bred?
6. Where should your goat be at kidding time?
7. What part of your goat should be clipped before kidding?
8. How long a gestation period do goats have?



# THE BRAIN

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TI THE BRAIN

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DE Anatomy and Physiology

Text

1 The brain is composed almost entirely of nervous tissues and is the most highly specialized organ in the body of goats. It is partially a hollow structure consisting of a central system of ducts and cavities, surrounded by myelinated nerve fibers (white matter). It is enclosed by a three-layered mass of fibrous tissues known as the meninges or membranes, that provide protection to the brain. The outer layer, or dura mater, consists of a tough resilient material that adheres to the inner cranial walls. The middle layer covers the sulci and fissures of the brain, is very delicate and transparent and is called the arachnoidea. The inner layer or pia mater, is a vascular membrane processed tightly into the substance of the brain and spinal cord.

2 Hindbrain

The rhombencephalon (hindbrain) consists of the medulla oblongata (the upper end of the spinal cord), the pons, cerebellum and the fourth ventricle. In this hindbrain are the glossopharyngeal, vagus, spinal accessory and hypoglossal nerves located; besides the respiratory and cardiac control centers, and areas that are essential for balance and sensations of touch.

3 More anterior originate the trochlear, trigeminal, abducens and facial nerves. It is also the area of entrance of the acoustic nerve and the nucleus for the pneumotaxic center.

4 The cerebellum is located at the posterior end of the cranium,

anterior to the medulla oblongata and dorsal to the pons. In cross section, the cerebellum has a tree-like appearance. It serves to maintain tonus, posture and equilibrium reflexes.

5 Midbrain

To the mesencephalon (midbrain) belong the tectum, colliculi and the pineal (epiphysis), which is an endocrine gland, and has important regulatory functions in reproduction, behavior and circadian rhythms of goats; i.e. the biorhythms related to day and night light changes. Also found in the midbrain is the RAS or reticular activating system, anterior to the medulla oblongata, which is the sleep and waking center among other functions.

6 The corpora quadrigemina are four grayish hemispherical bodies that lie under the posterior part of the cerebral hemisphere. They consist of two pairs that are separated by a groove. In this region are situated the trochlear and oculomotor nerves and the neural paths connected with ocular reflexes.

7 Forebrain

There are two main parts to the forebrain, the telencephalon and the diencephalon.

8 The inner-brain region (diencephalon) comprises the thalamus, hypothalamus, pituitary, mammillary bodies, optic tract and other structures grouped around the third ventricle, making up the central cavity of this division of the brain.

9 The thalamus is the largest structure of the diencephalon and is composed of two masses that are fused at right angles to one another. The thalamus contains the major link for the acoustic nerves and is part of the behavior control system.

10 The hypothalamus is ventral to the thalamus and just above the pituitary gland. The division between the two structures is more of a physiological nature; the hypothalamus secreting hormones and many control substances, which the thalamus is not.

11 The hypothalamus only recently has been recognized as the master 'switchboard' of body functions since sophisticated microtechniques became available for its research. To illustrate the problems involved, the isolation of 0.4 mg of the thyrotropic hormone-releasing factor from 120 lb of hypothalamuses represents the chemical extraction of 80,000 sheep brains. The hypothalamus is the main integrator of most autonomous activities of the goat, constituting the link between the two major control systems, the nervous and the endocrine systems. Neural fibers are received from the cerebral cortex and the hindbrain; efferent fibers go to the neurohypophysis, the thalamus, the vagus, parasympathetic and sympathetic centers; two hormones, oxytocin and vasopressin are secreted in the anterior parts of the hypothalamus;





# THE GOAT SKELETON

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TI THE GOAT SKELETON

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DE Anatomy and Physiology

Text

1 About one third of the weight of bone consists of an organic framework of fibrous tissues and cells. This organic matter gives resilience and toughness to bones. The remaining two-thirds of the weight of bone consists of organic salts (largely calcium and phosphorus) deposited within the organic framework. These salts give hardness and rigidity to bones.

2 Classification of Bones

Long bones are greater in one dimension than the other. Long bones function chiefly as levers and aid in support, locomotion and prehension. The best examples of long bones are found in the limbs.

3 Short bones are somewhat cuboidal, or approximately equal in all dimensions. Short bones function in absorbing concussion, and are found in complex joints such as the knee or hock where a variety of movements, as well as absorption of shock are required.

4 Flat bones are relatively thin, and expanded in two dimensions. They function chiefly for protection of vital organs (e.g. brain, heart, lungs, pelvic viscera), but also provide large surface area for muscle attachment.

5 Sesamoid bones resemble a sesame seed and are developed along the course of tendons to reduce friction or change the course of tendons. The patella (knee-cap) is the largest sesamoid bone in the body.

6 Pneumatic bones contains air spaces that communicate with the

exterior. Found in the skull.

7 Irregular bones are unpaired bones located in the median plane, e.g. vertebrae and sternebrae, etc. Irregular bones are important for protection, support and muscle attachment.

#### 8 Function of Bones

Some common functions are:

- Give rigidity and form to the body.
- Provide protection.
- Act as levers.
- Store minerals, especially calcium and phosphorous.
- Provide a site for blood formation.

#### 9 The Skeleton

Consists of two parts:

Axial skeleton, including

- skull
- vertebral column
- sternum
- ribs

Appendicular skeleton, including

- fore-limbs
- hind-limbs

#### 10 The Axial Skeleton

This includes almost all bones, except those of the limbs. It consists of four parts:

Skull -- is that part of the skeleton which forms the basis of the head. It functions in protection of the brain, supports many of the sense organs and forms passages for the beginning of the digestive and respiratory system. The skull is composed of a large number of bones which are joined together by joints called sutures. The large number of bones, and their slightly differing shapes and sizes in various animals accounts for the difference in the shape of heads of individual animals.

Vertebral Column -- is composed of irregular bones called vertebrae. There are five different regions of the vertebral column:

- Cervical - neck region
- Thoracic - chest region
- Lumbar - loin region
- Sacral - pelvic region
- Coccygeal - tail region

All vertebrae consists of various parts including:

- Body
- Vertebral arch
- Vertebral foramen
- Spinous process
- Transverse process
- Articular process

11 The vertebrae in the various regions differ in the degree of development of the various parts.

12 Cervical vertebrae generally have well-developed articular processes to facilitate the large amount of movement normally found in the neck region. Other processes are not as well-developed as in other regions of the vertebral column.

13 All domestic mammals have 7 cervical vertebrae. The first (atlas), and second (axis) cervical vertebrae differ in structure from the other 5 cervical vertebrae, and these cervical vertebrae differ from those in other regions as shown in the diagrams.

Thoracic Vertebrae (chest region):

- Large spinous process (chest region)
- Small transverse processes
- Tiny articular processes (very little movement in the chest region)
- Facets for articulation with ribs
- Small bodies

Lumbar Vertebrae (loin region):

- Large articular process
- Small spinous process
- Medium articular processes
- Medium length of body

Sacral Vertebrae (Sacrum) (pelvic region):

- Individual vertebrae fused to form one bone
- Transverse processes well developed at the front end
- Spinous process small

14 Coccygeal Vertebrae (tail region): The vertebrae of the tail change shape. The further along the tail, the less distinct do the various processes become. The last few coccygeal vertebrae do not have a spinal process, and the vertebral arch is not closed.

15 Sternum -- forms the base of the chest cavity (thorax). The sternum consists of small bone segments, called sternebrae, which tend to fuse

together as age advances. The goat has 7 sternebrae.

- 16 Ribs -- form the lateral walls of the chest cavity (thorax). Usually the number of pairs of ribs equals the number of thoracic vertebrae, e.g. goat has 13 thoracic vertebrae and 26 ribs usually.

Each rib consists of several parts:

- Head
- Tubercle
- Body
- Costo-chondral junction
- Costal cartilage

- 17 The costo-chondral junction and costal cartilage may not be present in floating ribs.

- 18 The shape of the individual ribs changes from the front of the rib-cage to the back. The first pair of ribs are short, straight and thick. As we move along the rib-cage, the ribs initially lengthen and become more curved. As we move further along, the ribs become shorter, but the curvature continues to increase.

- 19 Sternal ribs -- the number of pairs of sternal ribs equals the number of vertebrae. Sternal ribs extend from their respective thoracic vertebrae to the sternum, where they are connected directly by costal cartilages.

- 20 Asternal ribs -- do not connect directly with the sternum. The costal cartilage of asternal ribs joins to form the costal arch, then attaches the ribs indirectly to the sternum.

- 21 Floating ribs -- sometimes the last one or two ribs have no connection with other ribs via the costal arch. These are floating ribs. Not usually present in goats.

## 22 The Appendicular Skeleton

The appendicular skeleton is made up of the bones of the limbs.

- 23 The bones of the front limb are compared to those of the hind limb:

Front Limb	Scapula	Humerus	Radius
Ulna	Carpus (knee)	Metacarpus (cannon)	

Phalanges (digits)

### Hind Limb

Pelvis (ilium, ischium, pubis)

Femur

Tibia

Fibula

Tarsus (stock) (hock)



# THE PYGMY

COLLECTION: GOAT HANDBOOK

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Extension Goat Handbook

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NO B-7

TI THE PYGMY

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DE Management and Housing

Text

1 The Pygmy goat is now established in the United States, and is becoming popular. Recognizing their inherent values, breeders, primarily on the west coast of the United States, formed the National Pygmy Goat Association (NPGA) in 1975, developed a breed standard, and established national registries for the preservation of pedigrees. Today, there are the ARF (Animal Research Foundation in Quinlan, Texas) and the IDGA (International Dairy Goat Registry) with open herd books; and the AGS (American Goat Society) and NPGA with closed herd books for official registration. Nearly three thousand Pygmies have been registered so far as purebreds with NPGA or AGS.

2 A large share of the credit for this growth and development of Pygmies is due to Eva Rappaport, Monmouth, Oregon, who with energy and wisdom directed the development of the breed standard and as secretary, the success of NPGA.

3 The Pygmy goat is an unusual domestic animal. It is very hardy, alert and animated, good-natured, gregarious, and responsive. It is smaller than other recognized breeds of goats in the United States. On the average a full grown male (buck) stands at about 50 cm (20 inches), while the full grown female (doe) is somewhat less. Their size makes them delightful animals for children to handle. As smaller animals, they require less in the way of space and feed than the other large goats in this country. They make excellent animals for petting zoos catering to children.

4 The domestic use of Pygmies is not limited to children's zoos, or 4-H and FFA projects, for they are good family milkers. A doe in milk may be expected to give 500 ml (about 1 pint) of milk at both morning and evening milkings. Because of its high butterfat content (4 to 10; about 6.5 average) the milk of Pygmy goats is exceptionally delicious and tasty. In this respect it is similar to the milk of the Nubian goat. For a small family of two, one or 2 milking Pygmies would provide sufficient milk for the table including drinking, cream, topping for cereals and cooking.

5 Their well-muscled carcass provides excellent meat for the freezer. Since each carcass is small, similar to that of a spring lamb, it serves well for the family which does not require large units of protein stored in the freezer.

6 The Pygmy is an excellent brush and weed forager, converting these efficiently into useful products for human consumption. As human populations on earth expand, and the pasture space to maintain cattle and the fields for producing grain to feed cattle diminish, the domestic goat will resume a primordial position it had as man's probably first domestic animal.

7 Pygmies are readily and almost always psychologically imprinted with man, even though they may be raised on their dams. Most are friendly and inquisitive animals who are in a human lap if that lap pauses and rests for any length of time. They are usually the first to greet upon entering their paddock or pen.

8 Since they are small and easily handled, Pygmy goats make excellent animals for medical, psychological, chemotherapeutic and physiological scientific research. In immunologic research, they are excellent antibody makers.

9 In addition to all the above attributes, Pygmy goats are resourceful creatures able to fend for themselves. A pregnant doe caught out in a sudden heavy rain storm far from the barn, gave birth to three tiny babies each weighing less than 900 grams (32 ounces). She was busy covering the babies with leaves left over from the fall. Truly remarkable, thanks to a resourceful mother who shielded her brood from the downpour rain with materials at hand.

10 The American Pygmies are derived mostly from West African dwarf goats found in Nigeria, Ghana and the Cameroons, although similar ones are found in many other countries including Sudan, East Africa, Central Africa, India, Nepal, Arabia, China, Malaysia and the West Indies. The first Pygmies in the U.S.A. may have arrived with the slaves, but well publicized importations were not made until the 1950's.

11 Although friendly and gregarious, Pygmies are best not corralled

with other goats or sheep, especially because they are often not dehorned. Does may have two litters per year, thus also have short lactations. They may breed all year round. Fencing for Pygmies may have to be higher and stronger because of their agility, climbing ability ('African tree goat') and small size.

12 One reason, the Pygmy is prominent in Africa is its resistance to the tse tse fly which can destroy other breeds of goats.

13 The Pygmy is an achondroplastic dwarf. Its size is controlled by three pairs of genes that may be affected by some modifying genes. Pygmies are homozygous for small height which is recessive (ss); and they are homozygous for meatiness which is dominant (MM). In comparison, a Swiss dairy goat is homozygous for tall height which is dominant (SS) and homozygous for lack of meatiness which is recessive (mm). The third pair of genes lacks dominance. In crossing Pygmies with Swiss goats, ssMM x SSmm, the offspring, SsMm, are intermediate in size. However, mating SsMm goats produces segregation of types at the 9:3:3:1 ratio.

14 The inheritance of color in Pygmies and other goats does not exactly follow the patterns of other animals. White is dominant over all other colors (WW or Ww). A cream or brownish white is heterozygous (Ww). Red is dominant over black (just the opposite in cattle). Agouti can be inherited separately and may contain expressions of red, tan and black. Two black p ++++MISSING DATA++++

#### 15 Breed Characteristics

Coat -- the full coat of straight, medium long hair varies in density with seasons and climates. On females, beards may be non-existent or sparse, or trimmed; on adult males, abundant hair growth is desirable: the beard to be full, long and flowing, the copious mane draping, cape-like, across the shoulders.

Color -- all body colors are acceptable. The predominant coloration is a grizzled, agouti pattern produced by the intermingling of light and dark hairs, or any color.

Markings -- a. Breed specific markings are required by NPGA (but not by AGS): muzzle, forehead, eyes and ears are accented in tones lighter than the dark portion of the body in goats of all colors, except in goats that are solid black.

Front and rear hoofs and cannons (socks) are dark, as are crown, dorsal stripe, and martingale. On caramel and on white agouti goats, light vertical stripes on dark socks are acceptable.

b. Optional markings: light areas (on darker backgrounds) that appear as complete or partial girth belts are acceptable. All other patches are seriously faulted by NPGA but not by AGS. Generalized mottling is not permitted and is disqualifying.

Head -- short or medium long; pro ++++MISSING DATA++++



Hind legs -- when viewed from the rear; straight, widely set to accommodate large barrel; femur and tibia proportionately longer than in other breeds and angulated toward a more pronounced stifle joint, thus compensating for the short hock (rear cannon). Bone flat and flinty.

Hocks -- cleanly molded, sharply angled; metatarsus short.

Pastern -- short, strong and resilient.

Feet -- well-shaped, proportioned to size of animal; deep heel and level sole; hoofs symmetrical.

#### 16 Dairy Character

Animated, agile, generally open.

Withers -- nearly level with spine.

Ribs -- wide apart, well sprung; rib bone, long, wide, flat.

Flank -- deep, set low on barrel, well defined.

Thighs -- long and wide, well-muscled; incurving towards udder.

Skin -- clean and resilient.

#### 17 Body Capacity

Large in proportion to size of animal, providing ample digestive and reproductive capacity as well as strength, vigor, and stamina.

Barrel -- broad, deep, increasing in width toward flank, thus giving an impression of perpetual pregnancy; symmetrical, well supported by firm abdominal wall and well-sprung ribs. The disproportionately large circumference of the paunch is greater in females than in males.

Heart girth -- large, resulting from long, well-sprung fore-ribs; wide chest floor, full at the point of elbow.

#### 18 Mammary System

Udder -- firm, rounded, small to medium sized.

Rear attachment -- high halves evenly balanced, symmetrical.

Front attachment -- well forward, tightly attached, without pocket, blending smoothly into body.

Texture -- silky smooth, elastic, pliable but firm; free of lumps or scar tissue.

Teats -- cylindrical, of uniform length and size -sufficient for



# THE UDDER

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NO F-6

TI THE UDDER

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DE Anatomy and Physiology

Text

- 1 The udder of goats consists of two separate halves with a single gland in each half. The udder is a gland derived from the skin, and has no direct connection with the abdominal cavity except through the inguinal canal, through which strands of blood vessels, lymph and nerves enter and leave the udder.
- 2 The size of the udder depends on age and stage of lactation of the animal but should be well developed. Viewed from behind, the udder should appear deep and broad with high and wide attachments. Ideally, the two halves will be symmetrical, with a slight cleft between them.
- 3 Viewed from the side, the back end of the udder should be well contoured, rounded, deep, with smooth, strong rear attachments. The fore udder should extend forward from the teats, merging gradually into the abdomen on a forward reaching angle. The lack of good fore udder attachment often leads to a pendulous looking udder, especially during the heavy periods of lactation.
- 4 The udder quality should be free of lumps and fibrous or 'meaty' conditions. Each udder half should have only one teat, although supernumerary (extra) teats are not uncommon, being located mostly posterior to the true teat. The size of the teats varies greatly among goats; some are quite small and short, making it difficult to milk them; others are very large, plump, and funnel shaped and even

sometimes with seemingly no apparent point of connection to the udder.

## 5 Supporting Structure

The separation of the goat udder into halves and their support is achieved by the medial suspensory ligament, which is comprised of two strong sheets of elastic tissue which attach to the pelvic arch. Strong support from this ligament is required during the periods of heavy lactation in order to prevent the formation of a pendulous type udder. A flat floor to the udder is an indication that the ligament is in fact weak. A good udder support should have a slight crease or inverted 'V' shape between the teats.

6 The lateral suspensory ligaments form a fibrous layer on the outer surface of the glands, joining the medial ligaments on the bottom side of the udder. Fibrous connective tissue will also penetrate the glands, joining with the interglandular supporting tissue, thus lending support to the entire udder.

7 When the udder fills, it stretches the median suspensories, causing the teats to protrude outward and downward. This allows for the greatest expansion of the udder with a minimal amount of dropping of the udder. Around 40% of the milk, that is produced by the mammary gland, is held in the natural storage spaces of the udder. The other 60% must be accommodated by stretching of the udder. When and if these ligaments weaken, the udder will begin to break away from the abdominal wall.

## 8 Inner Structure

The basic units of the mammary system are the secretory cells known as alveoli, or acini. These production sites are extremely small, having a distended diameter of about 0.01 to 0.03 mm. In a single cubic centimeter of mammary tissue, over one thousand alveoli could be present.

9 Groups of alveoli are bound together by a wall of connective tissue that isolates the enclosed groups into functional units known as lobule. These lobules are in turn connected together like grapes by more extensive connective tissue into groups called lobes.

10 The alveoli are surrounded by myoepithelial (muscular) cells, which are responsible for the milk 'let down' that occurs through the release of the hormone oxytocin. These cells are also found throughout the various ducts of the mammary system. Milk production within the alveoli is inversely related to the pressure exerted on the alveoli from the buildup of milk.

11 A series of ductules and ducts, or milk canals, lead from the lobules and lobes to the storage area located at the distal part of the udder, just above the teat, called udder cistern or gland cistern. It is capable of storing about a pound of milk, but the majority of milk is retained within the alveoli, lobules, and ductules.

- 12 From the udder cistern, milk passes into the teat cistern, which terminates into the streak canal, the final passageway. The distal end of the streak canal is kept closed by a dense, elastic tissue consisting of circular smooth muscle fibers popularly called sphincter but being not a true sphincter by definition. Because of the lack of a true sphincter muscle, it is possible, although difficult to remove milk from a goat udder that has not undergone the let-down reflex.
- 13 Spreading from the streak canal up and into the teat cistern is a structure consisting of several folds of mucous membranes, each having several secondary folds. This structure, known as Fuerstenberg's rosette, aids in the retention of milk within the teat. It also prevents bacterial entrance into the gland. It functions as a plug and seal, so that as pressure builds within the udder this rosette closes off the teat cistern and milk leaking is prevented.
- 14 **Blood Supply**  
The main blood supplies to the udder are the posterior aorta, the right and left common iliac arteries, the external iliac arteries and the external pudic arteries. From the external pudics, the mammary arteries arise at the base of the udder. As the arteries pass upward and forward through the udder, numerous lateral and cranial branches arise. They break off into finer arteries to supply the lobules and alveoli.
- 15 It appears that the size of the external pudic artery has some determination on the development and size of the udder. If the external pudic is severed experimentally, the small arteries of the udder increase in size. Milk production will drop off to almost nothing for the first few days, then gradually return to normal. The return increase parallels the increase in size of the subcutaneous abdominal arteries to the anterior portion of the udder.
- 16 The volume of blood flow through the udder in a lactating goat has been estimated to be 280f the minute-volume of the heart, or 1,200 liters of blood per day. On the other hand, arterio-venous difference measurements have established a relationship of 400 volumes blood for each 1 volume milk, i.e. for a gallon milking goat it would mean 400 gal blood flow per day.
- 17 The venous system is more pronounced and evident than the arterial system, and blood vessels that can be seen on the udder or abdomen are veins, not arteries. The external pudic vein is the principal component of the venous system, passing back out of the udder close to the caudal border and into the abdominal cavity through the inguinal ring, finally returning to the heart via the posterior vena cava.
- 18 A second return system is via the subcutaneous abdominal veins (milk veins) that run along the abdomen until they pass through the milk



THE UDDER

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# THE US DAIRY GOAT INDUSTRY

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TI THE US DAIRY GOAT INDUSTRY

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DE The Goat Industry

Text

1 Dairy goats in the United States number between 2 and 4 million depending on source of reference. No reliable or comprehensive annual statistics of goat numbers or their production in the United States exists. Probably three-quarters of all are Angora; between 0.7 and 1 million head are dairy goats; and around a half million are 'bush', Spanish or meat goats, which also keep rangeland open for sheep and cattle from brush encroachment, forest fire breaks for safety and ski slopes grazed for tourists. A certain yet unknown percentage of goats is kept by leaders of the dairy goat industry on official production record programs. Their numbers form the best statistics available. California by far has the greatest percentage of all official goat lactation records (35), followed by Oregon, Wisconsin, Washington, Arizona, New York and Pennsylvania; these states comprising approximately three-quarters of all official records. Nubian are almost one-third of all official US dairy goat records, followed by Alpine with 25, Toggenburg 15, Saanen 11, LaMancha 6 and other 16

2 There have been more than 200,000 official lactation records processed since 1968 under the National Dairy Herd Improvement program (DHI). Almost two-thirds of all records were from first or second lactations and over 5 were from does 6 years or older. A distinct seasonality for the beginning of lactations distinguishes goats from cows. February through May accounted for 80% of all official lactations with a peak of 27% on March. Among the 6 different dairy goat breeds in the United States, 85% of the Alpine began their lactations from February to May but only 74% of the Nubians. For the 12 months in the calendar year, the percentage distribution of lactations starting with January, was 7, 20, 27, 21, 12.5, 6, 2, 0.6, 1, 2, respectively.



## 3 Age distribution of lactations

Of all the normal, official lactations, 35 were at least 305 days in length, averaging 1,978 lb milk and 73 lb fat with a 3.7 average. The last overall US average for all official lactations (1980-81) including those less than 305 days long, was 1,643 lb milk and 62 lb fat (3.8). This compares with a world leading goat milk record in Australia of 7,714 lb milk in 365 days and the US leader with 5,738 lb milk and 202 fat in 305 days. It also compares with less than 450 lb milk yields and less than 200 days of lactation length for most goats in underdeveloped countries, i.e., actually for the majority of all goats in the world, including so-called dairy goats.

4 Among the six US goat breeds, recent lactation averages differ little. Saanen lead with 2,116 lb milk, 75 lb fat, followed by Alpine 2,094-73, Toggenburg 2,026-66, LaMancha 1,797-68, Nubian 1,773-81 and others 1,916-70 lb, respectively. Yields of US lactations of more than 275 days in length increased by age of doe from 1,654 lb to 2,022, 2,132, 2,156, 2,083, 1,980 lb for 1st to 6th lactations. During the recent five years, no change in average US goat milk production has occurred which may be due in part to a decrease in the average number of lactations per herd (presently 11.3). This also means a considerable increase in the number of small US goat herds, besides a difficult condition for buck sire proofing. However, a comprehensive, national effort of sire proving is essential for evaluation of genetic transmitting ability, for the needed progress of US goat milk production and for the potential influence in developing countries. It has been shown that native goat breeds in developing countries will improve their milk production by an average of 70% on the first generation cross with US or European breeds.

5 The predominance of small herds for US dairy goats and intensive feeding management on limited acreage contrasts with the management of most US Angora and Spanish goats on the wide open rangeland. Commercial US goat milk production is limited, however, to no more than 50 herddairies for the distribution of bottled milk and other goat milk products and goat cheese. Less than 10 goat dairies derive their total income from the sale of goat milk and its products. In average, they milk approximately 40 does, retailing and wholesaling between 400 to 1,600 lb goat milk per week. Raw milk permits are available in 14 states, (Arkansas, California, Connecticut, Maine, Montana, New Hampshire, Nevada, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Utah, Washington). Among the 50 states, half do not have a single licensed goat dairy and an estimated 70% of the urban markets in the United States are not supplied with fresh goat milk. In 1978, approximately 12 million lb goat milk in the United States was processed, half into evaporated or powdered milk in California and Arkansas, the other half into goat cheeses in Wisconsin, Iowa, Arkansas, Washington, California and Colorado.

6 The economics of goat milk production under US conditions show considerably higher costs than cow milk production under similar conditions. Break-even prices to cover cash costs in 1978 for a

125-doe Grade-A goat dairy farm were calculated to be \$11.65 per 100 lb milk when the annual herd milk average would be 3,000 lb but \$23.31 per 100 lb milk when the average was more realistically 1,500 lb. Among the goat herds in the NE-USA in 1979, the top 250 of all herds on official test averaged 2,231 lb milk, 77 lb fat, 3.6 protein.

7 Participation of US dairy goat breeders in breed association programs has increased greatly in the recent 20 years. Official goat shows and animal registrations increased ten times; official production testing more than 50 times; annual association memberships more than 20 times; and 4-H projects likewise. (Table 1).

8 Future trends in the US dairy goat industry are expected to be around 10% increase. Breed improvement due to artificial insemination with reliably proven superior sires has yet to become possible for more than a few. Goat milk marketing development and promotion has yet to occur beyond a few single efforts on a continuing basis, with reliable quality control of products and processing. Research on factors imparting peculiar goat milk flavor is urgently needed. Studies on factors involved in the destabilization of goat milk during frozen storage and on proper processing methods in general are very much missing. The complex question of somatic cells and leucocytes in goat milk and the occurrence of mastitis needs studies. State sanitarians in most US states do not concern themselves seriously with goat milk producers nor do state milk codes of most US states include goat milk or permits for the production of raw milk when bacterial limits, tuberculosis and brucellosis free conditions are met. Dairy equipment dealers, manufacturers, feed dealers and veterinarians in many states and countries do not offer supplies, equipment, machinery and services suitable or available to goat breeders. Dairy Council and other milk promotion agencies in the United States do not usually include goat milk and goat milk products. Educational agencies, vocational schools, FFA judging contests do not generally include goats and goat milk as an acceptable and valuable addition to cow milk and cows. No silos for economical feeding of roughages are available for small or medium size goat farms. Not much research exists to overcome the seasonal ups and downs of goat milk supplies in contrast to fluid-milk demands.

9 Many testimonies exist from people who suffered under cow milk allergies, stomach ulcers; their children had "wasting" disease and insomnia, but they were cured by drinking goat milk; and few medical studies have been undertaken in this area. Predators, stray dogs, coyotes are a big problem with goats on pastures and especially with range goats, but few effective and acceptable controls exist when considering the high investment cost of electric fences over miles of rangeland. The biological control with imprinted guarding animals, e.g. male burros deserves research attention.

10 The mohair industry in the USA is more profitable and their marketing better organized than the goat milk industry, yet the US production of Angoras decreased steadily in the last 15 years from 15



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TI TYPE EVALUATION

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DE Anatomy and Physiology

Text

1 The identification of a correct physical trait, or its lack, is known as type-trait evaluation or more commonly 'classification'. It is the comparison of an individual animal and its parts with the ideal for that breed, sex and age. Recognizing that physical appearance of an animal has a relationship to its usefulness and concerning ourselves with those traits that help an animal function more successfully, is the basis of classifications.

2 Type evaluation is nothing new, for all livestock breeds and species have been developed through the centuries by breeders selecting their stock by looking at them. Fundamentally, type evaluation, is the art of trained people, examining animals by eye to determine physical strengths and weaknesses.

3 The idea of description type identification and its aid in developing superior dairy cattle was developed by Dr. George Trimmer of Cornell University. Holstein cattle breeders adopted the system followed by other cattle breeds, and the American Dairy Goat Association. The dairy goat industry is now collecting into its computer data banks, information on sires that can be of great importance to world goatkeeping. Bucks will be located who not only have the ability to sire high producing daughters, but also who have physical characteristics that make them valuable overall.

4 Breeders are recognizing that the true worth of a good dairy goat is not only based on milk production in a particular lactation, but on lifetime production, at a relatively low feed cost, with few health

problems, and while also producing a large number of good offspring. These characteristics can be determined. Does have yielded 20,000 to 30,000 lbs of milk while living fourteen years and delivering thirty offspring. Invariably, such animals have physical properties that a trained classifier will observe and point out in a program designed to develop durable, useful, long-lived goats.

5 It is recognized that the ideal program for dairy goat improvement employs production testing and type evaluation. A random sampling of 10,000 scores of dairy goats of the five major breeds in the United States indicate a positive correlation between front end scores (width of chest and smooth shoulders) and length of life. Of the animals five years old or more, 86 had front end scores of 1 (Excellent) and the rest was 2 (Acceptable). Those aged one through four years, had 59 with scores of 1 (Excellent) in front end. This would indicate that the higher front end scores are associated with longer life.

6 It is essential that a classifier is well-trained so that accurate coding and scoring is done. As a milking doe is brought to the classifier, his trained eye will note length of bone, overall width, strength and power as well as the correlation of parts, e.g. how well the animal 'fits together'. The ease of motion and leg action will be observed from front, side and rear. Udder and teat sizes, shape and placement will be considered. While individual techniques vary as to the order of examination, the usual method is to handle the udder and make a final appraisal of the tightness and area of attachments, ease of milking and softness of udder tissue. Usually a squirt of milk is drawn from each teat. Then a code number is assigned in each of five areas. These descriptive codes range from one to five and each has a specific meaning. 'ONE' is the excellent code and means 900r more perfection. 'TWO' is the acceptable code and covers the range from 70 to 890f perfection and includes those who are nearly undesirable to those nearly excellent. Numbers THREE, FOUR and FIVE are used to describe different characteristics that are undesirable and will probably affect the usefulness of an animal. Each number is used for a different fault in a specific area.

#### 7 Fore Udder

The Fore Udder is scored as follows:

(1) Means a strong, wide, tightly attached fore udder, extending well forward and blending smoothly into the abdomen.

(2) A moderately firm attachment of fore udder but with a noticeable degree of either looseness, bulginess, pocketing, or failure to be far enough forward.

(3) Short; a term used to indicate a fore udder that inhibits usefulness by failing to provide capacity in a safe place, that is, close to the body. It does not extend well forward and often does not extend ahead of the stifle joint.

(4) Loose, pocketed or bulgy fore attachment. A loose attachment would allow the udder to swing from side to side as well as possibly being carried too low so the chance of injury, especially while the doe is running would be greatly increased. A pocketed fore udder means that there is an open space of considerable size in between the side attachments at the front of the udder. Such a characteristic forces a doe to have more of her milk secreting tissue, the delicate alveoli, carried at a low level, down between the hocks perhaps, where the chance of injury is greater. A bulgy fore udder consists of nonmilk secreting tissue, often fat or connective tissue, extending forward and usurping the place of milk-secreting tissue.

(5) A broken attachment, a fore udder held only by a couple of folds of skin and so disastrously low that udder injury is imminent with its consequent likelihood of disease.

## 8 Rear Udder

After ascertaining which of the above codes applies to the fore udder attachment, that number is recorded and the Rear Udder attachment is likewise evaluated:

(1) Great width, tightness and height, often just an inch or so below the vulva and blending smoothly into the escutcheon. The higher the attachment, the safer the udder from scratches or injury.

(2) Adequacy, but some degree of lowness, narrowness or looseness has been observed.

(3) An udder attached very low between the hind legs.

(4) The rear udder is narrow and pinched. This is frequently found in udders with unsatisfactory production.

(5) The attachments are broken, the udder is pendulous and the doe frequently has great difficulty walking with the rear legs because the udder swings with each step.

## 9 Udder Support and Floor

This area is closely allied with the structure and strength of the medial suspensory ligament.

(1) Applies to the area where the medial suspensory ligament neatly divides the udder halves with a small inverted 'V' and proceeds horizontally right and left towards the teats for a distance of 2 to 3 inches. Normally a Code 1 in this area is used only if the codes on fore udder and rear udder are both '1' or '1' and a '2'. The length must be strong enough to keep the teats in proper placement and the udder tight against the body. The contribution of the udder support and floor to overall mammary excellence cannot be overemphasized.

(2) Some degree of:  
a. shortness

- b. over-length
- c. failure to carry well forward on the doe
- d. failure to carry high enough into the escutcheon
- e. too much cleavage
- f. not quite enough cleavage

(3) A lack of defined halving - the udder floor flat or even curving downward. Often teats point outward because of this trait.

(4) An udder floor that is too low making the udder subject to injury with each step the animal takes.

(5) A broken suspensory ligament and/or weak floor. In either case the udder hangs so low as to be a burden to the goat and is subject to injury and sanitation problems.

## 10 Udder Quality

(1) Reserved for those few does (currently about 1 in 20) who have extremely soft tissue in the udder. The udder usually requires observation both while extended with milk and then immediately after milking out before a Code 1 is given. Very little connective tissue can be palpated and the skin is soft and smooth.

(2) Most animals have a Code 2, acceptable, but not outstanding, with a bit more connective tissue in proportion to the extremely soft alveoli - the milk secreting cells.

(3) If, for various reasons, such as closeness to parturition, the udder texture can not be determined a Code 3 is applied.

(4) In those extreme cases when an udder has so much connective tissue usurping the place of milk secreting tissue that it is limiting production.

## 11 Teat Size and Placement

(1) Teats that are about 2 1/2 to 3 inches long, 3/4'' to 1'' in diameter, placed evenly and squarely on the udder, nearly plumb but pointing slightly forward. (This latter reason because all dairy goat milking in the United States is done from the side of the doe and teats pointing slightly forward are easier to grasp and milk.)

(2) Some deviation from ideal in length, shape or placement but still functionally useful.

(3) A size or shape that is either hard to milk or subject to injury. An overly large teat is both difficult to grasp by hand or milk with a machine, and it also has the disadvantage of being more easily stepped on or torn by sharp objects the doe is climbing over. On the other hand, teats that are too small may make hand milking so difficult and time consuming as to render the doe almost useless.

(4) Teats that point outward to such a degree that both hand and

machine milking are made difficult.

(5) Occasionally, does are found with abnormal teat structure, such as a double orifice (two openings for the milk to emerge in the same teat) or extra teats, some of which may actually give milk resulting in an extra chore at milking time. When abnormalities are discovered a Code 5 is used.

## 12 Mammary System

Five areas of the mammary system are now coded and along with a general observation of the shape and capacity of the udder, a final score is given. Three general guides are:

If all 5 areas are coded '1', the score must be above 90.

If all 5 areas are coded '2', the score must be between 70 and 89.

If all 5 areas are coded in combinations of '3', '4', or '5', the score must be 69 or lower.

Most udder codes are combinations of acceptable '2' with an occasional excellent '1' and some unacceptable '3', '4', or '5'. The classifier must use his skill and expertise to arrive at the over-all score.

## 13 Body Capacity

The classifier will observe the comparative length, width and depth of the animal, noting especially the length, depth, and spring of rib and width of chest floor. A comparison will be made mentally between the animal being classified and the ideal of that breed, sex and age. As the animal approaches the ideal, the score may go into the high 90's, or may be as low as 50 for an extremely small, frail animal. Younger animals, yearlings, 2 year-olds and 3 year-olds, are not expected to be as large as a mature 4 year-old; nor are does as large as bucks. Toggenburgs are not required to be as large as the other breeds. A guide of acceptable breed standards in minimum weight for mature does is:

Toggenburgs	120 lbs
LaManchas	130 lbs
Nubians	135 lbs
Saanens	135 lbs
Alpines	135 lbs

## 14 Dairy Character

In arriving at this score, careful observation is made since this is to indicate the animal's 'will to milk and the strength to sustain it'. Many factors are considered in arriving at the final score. These include:

A long, lean neck.



Proper degree in fleshing throughout.

Smooth shoulders.

Sharp withers.

Prominent vertebrae.

Incurving thigh.

A chiseled head.

Cleanly molded hocks.

Tortuous mammary veins as related to age and stage of lactation.

Production evident in the udder as related to age and stage of lactation. This score should be closely related to an animal's ability to produce milk, but is also influenced by the soundness of the udder. In general, a dairy character score is lowered by 10 points if the score previously given to the mammary system is below 70.

#### 15 General Appearance

To aid breeders in their program, this area is descriptively coded in 8 subareas much as the mammary system.

#### 16 Stature -- This term loosely defines overall size and length of bone.

(1) This animal should be tall at the withers, at least 2 inches over breed minimums which are:

26 inches for Toggenburgs

28 inches for LaManchas

30 inches for Alpines, Saanens, Nubians

These standards are for mature does, but the Code '1' doe must also have a correct length of cannon bone (from knee to pastern) and be above average in overall length of body and general size. Height at withers must be slightly more than at hips, and bone must be of good size. These characteristics make an animal 'upstanding'.

(2) Animals meeting breed minimum standards but not up to Code '1' level are coded '2' - 'intermediate'.

(3) These animals are too short and small for breed and age or have extremely short legs. Code '3' describes low set - short legs.

#### 17 Head -- It should be noted that on the head there may be observations that can be termed aesthetic besides being functional. Conformity to breed ideals in structure of nose, shape and size of ears are considered. This is balanced by the practical considerations of

length, width, strength, set of jaw and overall symmetry.

(1) This head is beautiful when judged by a breed fancier or the practical eye of the commercial dairyman. With beauty of eye, nose, ear, and overall form it must also be a combination of strength and refinement. It should have a balance of length, width and substance that insures an ability to consume large amounts of forage with ease.

(2) Acceptable, lacking some in either strength or breed character.

(3) Sometimes the head is coded '3' because it is too short - a trait often associated with lack of will to eat plenty of feed.

(4) Frequently, crossbred animals are such a hodge-podge of breed characteristics as to be unflattering plain - just not pretty - and they are coded '4'. A head is also coded '4' in the case of a large coarse animal with little indication of refinement. Often associated with poor productivity, the '4' in this case means coarse.

(5) This last code, applicable to some heads, is for those whose strength is lacking everywhere and is shown in the head by frailty with a narrow muzzle, weak jaw, pinched nostril, narrow forehead and sunken eye. It says simply 'weak'.

18 Front End - This is a combination of chest and shoulder features.

(1) A wide chest floor and prominent brisket with smooth blending of shoulder blades and sharp withers. Such a front end ensures plenty of room for the heart and lungs to do their life-giving work with ease and also is evidence of proper muscle and ligament strength in tight shoulders. As pointed out earlier, preliminary research indicates a strongly positive correlation of high front end scores with longevity.

(2) Code '2' is frequently used where there is some degree of deficiency in:

Width of chest floor;

Tightness of shoulder blades;

Proper fleshing of shoulders (the animal is a little over-fleshed).

Code '2' may mean just acceptable in all three sub-areas.

(3) If the animal is much too overfleshed or the point of shoulder is obnoxiously prominent a code '3' is given - coarse shoulder and neck.

(4) A narrow, weak condition - with almost no chest floor or brisket; the heart and lungs are extremely crowded; body capacity is adversely affected and longevity greatly reduced.

(5) An open shoulder, a condition resulting from loose ligaments holding the shoulder blade to the chest wall and often making it difficult and painful for the animal to move.

## 19 Front Legs

(1) Those legs which are straight, perpendicular to the ground, sound in the knees, full at point of elbow and move with the front feet pointing correctly straight ahead.

(2) Sound legs but not quite straight or moving quite correctly.

(3) The front legs bow forward at the knees when viewed from the side. For a stimulation of the undue strain put on muscles and tendons when this occurs, one is advised to try standing upright for some minutes with the knees curved forward. It is no wonder, the animal quits feeding before it should, and lies down; consequently producing less when this condition is present.

(4) Swollen knee joints - normally this is associated with an arthritic condition and interferes with mobility. It is frequently associated with a short cannon bone in the forelegs.

(5) Front legs which point outward as the animal walks; a peculiar 'paddling' action is observed and the points of elbow continually dig in to the sides of the chest wall.

## 20 Back

(1) A straight, strong, wide, long, level back; denotes strong physiology, indicative of strength to carry copious quantities of feed, milk and offspring for many gestations and lactations.

(2) Means acceptable and is numerically from 70 to 89 on the ideal score card.

(3) A severe dip in either the chine and/or loin.

(4) An animal is lower at the withers than at the hips and is appropriately called 'low in front'. This condition can be a serious detriment to the health and well-being of an otherwise sound animal, for as parturition approaches, the digestive and reproductive organs tend to follow the pull of gravity and fall forward onto the diaphragm. This compresses heart and lungs, making it hard for the animal to breathe and have proper circulation. A survey of classification scores shows it is rare for an animal with this trait to survive past 5 years of age.

(5) A severely roached back - very arched and high through the

loin. While not especially dangerous in itself, it is frequently associated with a weak chine, steep rump and makes the topline indicative of lack of overall strength and symmetry.

21 Rump -- Affects leg set, kidding ease, and potential udder attachment, this area is of great importance.

(1) Long, wide, level from thurl to thurl, cleanly fleshed, and having a correct slope from hips to pins.

(2) Some degree of impropriety in the above descriptions.

(3) A narrow rump - this condition often leads to a rise in the vertebral processes making the rump resemble a gable roof. Naturally, kidding ease is lessened by the narrow rump and pelvis.

(4) A very steep slope from hips to pins. Actually this condition, when combined with great width, frequently makes for easy kidding. But since it also lessens the area for a large attachment and makes for an awkward rear leg set, it must be tempered toward what is termed the 'proper slope'. A perfectly level rump is not desired either.

(5) This last deficient condition is short. It is not often found.

22 Hind Legs

(1) Rear legs that are very wide apart and straight when viewed from the rear, with clean hocks and just the right combination of bone refinement and strength. Observed from the side, a plumb line originating at the pin bone would fall parallel to the leg bone from hock to pastern and touch the ground at the heel of the foot. The resulting angles produced at the hock and stifle joint will be the most ideal for an easy walk and a minimum of joint problems. These angles are seldom, if ever, found in a leg beneath a code '4' rump (severely sloping).

(2) Acceptable rear legs will have a noticeable deviation in angle, straightness or strength, but are not yet affecting the animal's walking ability.

(3) The rear legs turn inward when observed from the rear. In such a condition, a couple of things happen. First, the udder, if of any size, is battered first one way, then the other by the doe as she walks; Secondly, the animal usually has a tendency to point the feet outward and 'paddle' as he/she walks. It is not comfortable for the goat and results in less movement for feeding and especially when heavy with kid.

(4) This animal has hind legs that are too close together. When associated with a larger udder, the mammary system is frequently twisted by lack of space and is hard to milk.

(5) A leg that is too straight or posty. Most noticeable is the

lack of angle at hock and stifle joint, and it seems to get worse with age. Probably causing more trouble than any other single leg ailment, it is of particular concern when the animal walks without flexing the hock joint.

## 23 Feet

(1) A strong, well-formed foot with tight toes, deep heel and level sole. Such a foot is highly resistant to injury or infection and is easy to keep trimmed.

(2) Slight deviations are acceptable. It might be noted here for some familiar with cattle that the dairy goat is much smaller and is not affected as much by less than ideal feet than the vastly heavier cow. Also, the horny outside of the hoof grows quite rapidly under ordinary commercial dairy conditions and is more frequently trimmed and shaped by the herdsman. Therefore, a degree of imperfection that would cause serious problems in a cow is less likely to occur in a dairy goat.

(3) This is a common undesirable affliction - a spreading toe. Often this is a result of weak ligaments in the pastern area. It produces illshaped toes that are hard to trim and also provide a place for manure and debris to build up and cause infection.

(4) This code refers to a defective condition known as 'shallow heel'. In a normal foot, the hoof hairline should be parallel with the sole of the foot. In the shallow heel there is less depth at the rear of the toe than the forward part, and the animal is forced into rocking back on the pasterns putting undue strain on them.

(5) Feet turning over. A turned-over foot is miserable to trim, hard to walk on and puts an unusual strain on the pasterns.

## 24 Miscellaneous Conditions

Occasionally some conditions are found that need to be noted to properly describe an animal.

(1) Overshot jaw - when the lower jaw is shorter than the upper jaw also known as parrotmouth - it often affects feeding ability.

(2) Undershot jaw - the lower jaw is longer than the upper jaw and can also affect feeding ability.

(3) Winged shoulder - a condition manifest in looseness of the attachment of the shoulder blades to the chest wall and especially at the point of elbow. A winged shoulder makes movement more difficult.

(4) Small for age.

(5) Weak chine - it is used in conjunction with a code '3' in the Back to point out that the chine is weak but not the loin.





# USDA-DHIA BUCK EVALUATIONS FOR MILK AND FAT

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TI USDA-DHIA BUCK EVALUATIONS FOR MILK AND FAT

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DE Genetics and Reproduction

Text

1 The USDA-DHIA Buck Evaluations are national genetic evaluations for dairy bucks. These evaluations rank bucks in order of genetic merit for milk yield for each breed. This information is of great importance to breeders because one of the most important factors affecting genetic progress is the genetic superiority of animals selected to be parents. To select genetically superior animals as parents, a breeder must have accurate information on the genetic merit of bucks and does. This information should help breeders make informed decisions about their breeding programs, resulting in significant genetic improvement for yield in their herds.

2 The USDA-DHIA Buck Evaluations represent an important first step toward eventually providing dairy goat breeders with a comprehensive array of genetic information. They are the result of several years of research at the Animal Improvement Programs Laboratory, USDA, in Beltsville, Maryland, with cooperation from researchers at the University of California at Davis, the University of Illinois at Urbana, and the University of Maryland at College Park. Information, advice, and support from the American Dairy Goat Association (ADGA) has been invaluable. However, these evaluations are not the final answer, by any means. Research will continue to improve the scope, usefulness, and accuracy of genetic evaluations for dairy goats.

3 Buck evaluations are computed so that they are best linear unbiased



predictions of genetic value. Procedures that result in evaluations with these statistical properties are used widely for dairy cattle. For dairy goats, all lactation records for each doe are used and relationships among bucks are incorporated. Lactation data are received from all dairy record processing centers in the National Cooperative Dairy Herd Improvement Program (NCDHIP), and pedigree data are received from ADGA.

4 Procedures to edit incoming lactation records include checks on yield and kidding information. Yield for only the first 305 days of lactation is considered. Records with more than 305 days in milk are excluded because a standard lactation length of 305 days is imposed. (Records with more than 305 days in milk usually have a corresponding 305-day record reported.) Terminated records have to have at least 15 days in milk and records in progress at least 80 days in milk. Actual milk yield per day has to be at least 2 lb but no more than 30 lb at the beginning of the lactation, with the upper limit declining to 20 lb as number of days in milk increases. Fat percentage has to be at least 2.0 but no more than 7.5. These restrictions were established to remove unusual or highly variable records. Records from does with a kidding date before 1976 or a birth date before 1973 are excluded because of lack of data and less reliable identification information in earlier years.

5 Lactation records also are excluded if they have the following identification conditions: (1) sire not registered, (2) sire identification missing, and (3) breed other than Alpine, LaMancha, Nubian, Saanen, and Toggenburg. These records are excluded because little interest has been shown in evaluating bucks that are not registered or that do not belong to a major dairy goat breed. Does do not have to be registered for their records to be used in computing genetic evaluations.

6 For January 1983 evaluations, 58,562 records representing 43,913 does sired by 11,670 bucks in five breeds were available for computations after editing. Distribution of records, does, and bucks by breed are in Table 1. The does were located in 3,781 herds, but numbers of herds by breed is not reported because of the large number of multibreed herds.

7 Average yields for milk and fat as of January 1, 1983, are in Table 2 by breed. Actual yields are based on lactations with 275 to 305 days in milk. This reflects the actual yield of a doe successfully completing the major portion of a 305-day lactation. Standardized yields are estimates of what a doe would produce if she had been 36 months old at kidding, had kidded in late winter, and had 305 days in milk or a completed record of less than 305 days. They are based on the entire data set used for buck evaluations and are calculated by averaging the averages for each doe's records rather than by averaging all records. Standardized yields are slightly higher than actual yields for all

breeds but Nubian. The value for Nubians may be lower because their shorter average lactation length is considered when standardizing yield. Therefore, Nubian records included when determining actual yield were more selected than for other breeds.

8 All lactation records with fewer than 305 days in milk that are used in computing genetic evaluations are projected to 305 days, not just lactation records coded incomplete. This procedure was used for the first time in computing the USDA-DHIA January 1983 Sire Summaries and Cow Indexes for dairy bulls and cows. Research with cow lactation records showed that this procedure should increase accuracy of genetic evaluations by removing environmental variation caused by different lactation lengths. Thus, dairy goat breeders were able to benefit from the most recent research findings on genetic evaluation of another species.

9 Predicted Difference (PD) is the measure usually used in the United States to express genetic transmitting ability (one-half breeding value) for a trait of male dairy animals. Each animal has a separate transmitting ability for each trait. For example, a buck can have an especially high PD for milk yield and only a medium or even a low PD for fat yield.

10 All PD's relate to a genetic base for each trait and are a way to rank bucks. A genetic base can be established in many different ways, and the way in which it is established affects the magnitude of genetic evaluations. For each dairy goat breed, genetic bases for milk and fat evaluations were obtained by setting to zero the average PD of sires of all does with lactation records used in the January 1983 evaluations. Each individual PD was weighted by the number of daughters for that buck. Future evaluations will be comparable with the January 1983 evaluations because the genetic base will be the same.

11 Goat breeders should not expect PD's to estimate the exact amount of improvement or decline for a trait that will result from using a particular buck in their herds. This amount is dependent primarily on the genetic merit of bucks that were used previously. The PD should be thought of as the amount by which the buck's average offspring would be superior or inferior to offspring of a buck with PD = 0. Individual offspring may be better or worse than expected. However, on the average, the higher a buck's PD or percentile ranking, the better his offspring.

12 An example of the first USDA-DHIA Buck Evaluations and a detailed explanation of the information in them follow.

Registration number: Buck's registration number in the ADGA or American Goat Society herdbook. The registration number is preceded by two digits required for data processing in NCDHIP.



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