PROCEEDINGS OF THE 30th ANNUAL

GOAT FIELD DAY

April 25, 2015

Agricultural Research and Extension Program
Langston University
Langston, Oklahoma 73050

WELCOME

We deeply appreciate your attendance at this 30th Annual Goat Field Day of the E (Kika) de la Garza American Institute for Goat Research of Langston University. Goat Field Day is one of the most important things we do each year. The primary purpose of Goat Field Day is for education and extension in areas of greatest interest to stakeholders of the Institute. Thus, please share your thoughts with us on today's activities and suggestions for Goat Field Day next year. In addition to extension and education, Goat Field Day provides an excellent opportunity for the staff of the Institute to meet other people who work with goats. Such interaction helps make our program the most appropriate it can be for the people it serves. The proceedings of Goat Field Day is a very useful tool for the Institute beyond impact realized from the program today. First, there are reports on Goat Field Day presentations. After this information, there are highlights of research, extension, and international activities of the Institute in the past year. This section is an aid to assess our recent progress, display current activities, and contemplate future directions to be followed. This year's general theme for Goat Field Day is "Taking Control of Marketing".

Here is the exciting program planned for today that has developed from your input.

The morning program consists of:

- **Available Marketing Options for Meat Goat Producers** — *Ms. Tess Caudill*
- **Providing Safe, High-Quality Value-Added Goat Milk Products to Consumers** — *Dr. Stephanie Clark*
- **Marketing: Ordeal Or Opportunity?** — *Ms. Yvonne Zweede-Tucker*

The afternoon workshops are:

- **Factors Affecting the Marketability of Meat Goat Kids** — *Ms. Tess Caudill*
- **What IS a Goat Worth?** — *Ms. Yvonne Zweede-Tucker*
- **The Other 8/9 of Your Business Plan** — *Ms. Yvonne Zweede-Tucker*
- **Good News! Reaching Customers – They Are Looking for You** — *Ms. Yvonne Zweede-Tucker*
- **The Art of Cheesemaking** — *Dr. Stephanie Clark*
- **Internal Parasite Control** — *Dr. Barry Whitworth*
- **Basic Herd Health** — *Dr. Lionel Dawson*
- **Basic Goat Husbandry** — *Mr. Jerry Hayes*
- **Nutrition for Health and Production** — *Dr. Steve Hart*
- **DHI Training** — *Ms. Eva Vasquez*
- **USDA Government Programs**
  - **USDA/AMS: Market Strategies** — *Mr. Cole Snider*
  - **Perkins Livestock: Livestock Auctions** — *Mr. Robb Taylor*
  - **USDA/NRCS: Conservation Programs** — *Mr. Kenneth Hitch*
  - **USDA/FSA: Farm Loans** — *Mr. Phil Estes*
  - **USDA/WS: Wildlife Programs** — *Mr. Kevin Grant*
  - **USDA/NASS: Animal Inventories** — *Mr. Wil Hundl*
- **Tanning Goat Hides** — *Dr. Roger Merkel*
- **Fitting and Showing for Youth and Adults** — *Mr. Coleman Sanders*
- **Fun Tent** — *Ms. Sheila Stevenson*

On behalf of the staff of E (Kika) de la Garza American Institute for Goat Research, we thank you for your continuing interest and support.

Tilahun Sahlu

Director, E (Kika) de la Garza American Institute for Goat Research

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Available Marketing Options for Meat Goat Producers

Ms. Tess Caudill

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Introduction

Meat goat producers have several different options for marketing their kids, from direct off the farm sales to local auction markets. Each marketing outlets has pros and cons associated with it and it is for the individual producer to decide which outlet or outlets fit his or her operation the best.

Live, direct off the farm sales are very common in the meat goat business and would include the sale of breeding and show stock as well as sales of market animals for personal slaughter. These sales can be the result of extravagant advertising means, internet marketing such as crag's list, or simply by word of mouth. In general, direct off the farm sales of live animals is a lucrative method for marketing meat goats. It often results in a cash sale, there is no commission or hauling to worry with and you essentially set the price. However, you need to be aware of current marketing trends so you are not pricing yourself way over or under the market. Direct sales also require dealing with other people and possible negotiation and some simply do not wish to be bothered in this manner. The final drawback to this type of marketing is that it is not likely you will be able to market all of your kids this way so some other marketing outlet may also be needed.

A second marketing option would be direct marketing of processed meat kids. This could be done out of your home, over the internet, at farmers' markets, to restaurants, local retail outlets/butcher shops, or even large national chains. You could be marketing whole carcasses or individual cuts. Advantages to this type of marketing are similar to selling live animals direct in that you get to set the price and you avoid paying commission, however, there are a number of other considerations. All meat sales in the US are regulated either by the USDA or an equivalent state meat inspection program. You must make sure you are abiding by all federal and state regulations before attempting direct meat marketing. In addition, the time involved in hauling animals to processors, processing fees and marketing expenses add up quickly and you must make sure you are able to price and sell your products at a level that covers all these additional expenses. Additionally, as previously mentioned, you may or may not be able to market all of your animals this way, or in the case of very successful ventures you may need to source animals from other producers in order to meet demand for year round products.

A third marketing avenue for meat kids is direct off the farm to an order buyer or processing plant. In order for this to work you would need an established relationship with the order buyer or owner/buyer at the processing facility and would most likely be marketing fairly large numbers of uniform kids as they reach the desired weight of that particular buyer. Advantages include no commission and possibly no hauling if you are able to achieve on farm pick-up in your negotiations. While the price you receive is most likely going to be the current market price for that size kids, you at least know the price ahead of time and may even be able to negotiate a small premium for quality or for being willing to deliver on a particular date or for a particular holiday. A caution for this type of marketing would include making sure the buyer you are dealing with is reputable as you have no protection from an auction barn in the event of non-payment.

The most common type of marketing for meat kids is through the stockyards or livestock auction barn. This is by far the easiest method for marketing meat kids as you simply show up with your kids on sale day and you are essentially guaranteed a check after your animals are sold. It must be noted, however, that in this system you are a price taker and are subject to the whims of the market on that particular day. You are also responsible for all hauling cost associated with getting the kids to market and commission will be taken from your check for the work performed by the auction barn. While there are definite disadvantages to this type of marketing, it is still the most efficient means of marketing large volumes of kids. The auction barn experience can be improved by bringing quality animals to the sale, by bringing the appropriate weights desired in your area, and by researching local auction barns to determine who has the best and most consistent buyers present at their sales.

A twist on traditional auction barns being seen in some areas of the country such as Kentucky is to offer graded goat sales. These are auction type sales where a state paid grader sorts the animals prior to the sale into co-mingled, uniform lots. Because buyers are typically able to purchase large groups of uniform kids at one time, it has proven to increase the competition for those groups and leads to higher prices than traditional auctions. Graded sales are particularly beneficial for the smaller producer that alone may not have enough animals in one group to command a fair market price. Offering those small groups co-mingled with other like animals protects that seller from being overlooked and thus discounted.

In conclusion, the avenues available for marketing meat kids are plentiful but as previously mention there are advantages and disadvantages to each. For successful meat goat marketing each producer should consider the methods available and evaluate the pros and cons to determine the best marketing option or options for him or her.

Providing Safe, High-Quality Value-Added Goat Milk Products to Consumers

and

The ART of CHEESEMAKING (with GOAT MILK)

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Introduction

Goats and sheep were among the first animals to be domesticated, and it is arguable which species' milk yielded the first cheese more than 5,000 years ago. In the US, The population of dairy goats has increased from approximately 325,000 head in 2008 to 365,000 by the end of 2014 (USDA National Agricultural Statistics Service, 2015). The top five states for numbers of dairy goats are Wisconsin, California, Iowa, and Texas (USDA National Agricultural Statistics Service, 2015). The increase in dairy goats is likely a direct result of the growing popularity of farmstead and artisan creameries and demand for local, artisanal goat milk products. Goat milk products often command higher prices ($8 to $12/gallon goat milk; $18 to $30/lb of goat cheese) than cow products. Although some consumers elect to drink goat milk, commonly because of dietary restrictions, most of the goat milk in the U.S. is primarily converted to cheese, and to a lesser extent, yogurt. Goat cheeses are often featured at farmers' markets, fancy restaurants and in recipe magazines.

Regardless of the species, dairy product quality will never be better than the materials used to make it. High quality dairy products can only be made from high quality milk and other ingredients (enzymes, cultures, salt, fruit, sweeteners, flavor, color, etc.). For those who are just starting to investigate the potential to make cheese with goat milk, and for those who have made cheese for some time, understanding some dairy chemistry and microbiology, along with sanitation, is a must. This paper will provide some information on the chemistry and microbiology of cheesemaking, discuss sanitation, explain the general steps in cheesemaking, then focus in on goat milk and cheesemaking with goat milk, including some make procedures.

Goat Milk Chemistry

Compared to the milk of cows, goat milk can be described as more rich in solid nutrients (Table 1). Goat and sheep milk contains a higher proportion of short and medium-chain fatty acids than cow milk (Table 2). This feature makes goat and sheep milk and cheese have characteristic flavors that are more piquant and rancid than cow milk products.

In summary, compared to cow milk, goat and sheep milk:

- Have lower water content
- Have higher, fat, protein and ash
- Have higher normal titratable acidity (TA)

- Have more overall flavor
  - Higher proportion of short chain volatile fatty acids
- Yield more cheese per pound of milk
  - Yield less whey
- Cheese is more white
  - Beta-carotene converted to Vitamin A

Chemistry and Microbiology of Cheese Milk

Regardless of the type of cheese or species from which the milk is derived to make a given cheese, without question, the production of high quality cheese requires a high quality starting material: milk.

Some of the primary considerations that go into defining high quality milk include, but are not limited to the following:

- Good health of animals from which the milk is collected
- Normal somatic cell counts (SCC)
- Low bacteria levels
- Lack of inhibitory substances (antibiotics)
- Milk cooled to less than 45°F (7°C) within two hours of collection
- Fresh milk (stored less than 48 hours)
- Pasteurized milk (required if one plans to sell fresh cheese) but not homogenized
- Use of sanitary stainless steel equipment, pipes and fittings (no copper)

Animal health, and udder health in particular, is of critical importance in the production of high quality milk and cheese. Factors such as weather, season, stage of lactation, parity, udder condition and nutrition not only affect the amount of milk an animal produces but also the quality of milk she produces. In times of highest production, cheese yield will be the lowest due to an inverse relationship between solids content (fat and protein, in particular) and milk production. While the yield of cheese per pound of milk will be higher during times of low production, overall yield (total amount of cheese) will be low.

Somatic cell counts (SCC) are an accepted parameter for the evaluation of milk quality and as a management tool in dairies worldwide (Paape et al. 2007). In the U.S., the legal SCC, established by the Food and Drug Administration for cows is 750,000 per mL and for goats and sheep is 1,000,000 per mL because somatic cells are typically associated with abnormal milk. In a recent study by Paape and colleagues (2007), the SCC of milk from over 26,000 goats, 5 million cows and 2,000 sheep were studied. For goats and cows, SCC increased with stage of lactation and parity. For sheep, SCC for the first parity were higher than for later parities. Sheep SCC were similar to those of cow milk, which were lower than those of goat milk. Increases in SCC due to stage of lactation and parity for cows and sheep are mainly the result of intramammary infections, while non-infectious factors such as estrus, season and milk yield, also affect goat milk SCC.

Although Grade 'A' milk is not required for cheese, it is good to cover some of the regulations for Grade 'A' milk production. Grade 'A' farms are not only licensed, but also permitted with a Grade 'A' permit, and must comply with the regulations set forth by the *Grade 'A' Pasteurized Milk Ordinance* (PMO) and state regulations (USDHHS 2007). The Grade 'A' requirement is only necessary if the milk is being processed into a Grade 'A' product, specifically: fluid milk, yogurt, sour cream, cream, half and half, buttermilk, and any variation of these products. The Grade 'A' quality standards for milk are:

- Milk cooled to less than 45°F (7°C) within two hours of collection
- Standard Plate Count (SPC) for total aerobic bacteria less than 100,000 per mL
- SCC less than 750,000 (1,000,000 for goats and sheep) cells per mL
- Antibiotic (beta-lactam drug residue) tests negative

There are three types of cheese-milk that may be used to make cheese: raw, heat-treated, and pasteurized. Raw milk cheeses must be aged at least 60 days at greater than 35°F. The time-temperature combination is important because the microbial metabolism must be active so that pathogens (if present) go through life cycle into death phase. Any heat treatment less than legally pasteurized is called heat-treated, but it is treated as if made from raw milk. Any microorganisms that remain in milk will influence flavor, body and texture (sometimes positively, sometimes negatively).

In the U.S., most fermented dairy products are made from pasteurized milk. Pasteurization (145°F/62.8°C for 30 min or 161°F/71.6°C for 15 sec) kills all pathogens but not all microorganisms (some thermoduric microorganisms survive). Some psychrotrophs and or their enzymes are thermoduric (bad for quality). When a high number of psychrotrophs are present before pasteurization, milk and cheese quality will suffer, which is why only fresh milk should be used for dairy products. Cheeses made from pasteurized milk can be sold fresh or aged. Excessive heating of milk (higher than the legal pasteurization temperature) should be avoided, because over-heating causes the whey protein, b-lactoglobulin, to bind to k-CN across the chymosin-sensitive bond, which results in softer curds and lower yields. Further, homogenization of milk intended for cheese is not recommended because fat is lost in the whey and cheese yield is reduced.

Although it is legal to leave milk in a bulk tank for up to 72 hours prior to processing, it is not advisable to do so. Cold-loving bacteria (called psychrophiles and psychrotrophs) continue to multiply at in the refrigerated bulk tank and produce off flavors in milk and flavor, body and texture defects in cheese. It is strongly advised to utilize only fresh milk (held for less than 48 hours) for any dairy product.

Only high quality, sanitary stainless steel equipment, pipes and fittings are recommended in a dairy plant. Any stray oxidizing metals can induce oxidation and off flavors in the milk and cheese.

Utmost care in cleaning, hygiene and sanitation must be taken in all areas of milk handling to ensure safety and quality of milk and cheese. Section IV provides some guidelines for sanitation.

Cheesemaking proceeds with high quality ingredients and supplies, including but not limited to:

- Viable and appropriate starter cultures
- Functional coagulating enzyme
- Viable and appropriate molds (microbial)
- Appropriate cheesecloth, molds or hoops (for pressing)
- Salt (non-iodized)
- Other inclusions (herbs, fruits, nuts)
- Good record-keeping

Starter cultures are lactic acid bacteria that "start" the fermentation process and contribute to the flavor, body and texture of the resulting cheese. When selecting cultures, cheesemakers may choose mesophilic and/or thermophilic cultures. Mesophilic cultures like warm temperatures (68-111°F/22-44°C) and are typically used for Cheddar, Monterey Jack, Cottage, Gouda, and Blue cheeses. Thermophilic cultures like hot temperatures (111-140°F/44-60°C) and are typically used for Italian style cheeses. Culture houses are available to help you select the appropriate combination of cultures for a given cheese. They can also assist with selecting the style of culturing you may use. For instance, for farmstead and artisan cheesemakers, direct vat set (DVS) cultures are usually recommended because the convenient freeze-dried cultures can be easily measured and added to small vats of cheese milk without the need for large reserves of media to be held on site.

Other ingredients and supplies will be discussed in more detail in the next section.

Sanitation

In addition to animal and udder care, safe, high quality cheese requires commitment to strict sanitation practices, including but not limited to:

- Properly designed and maintained licensed and inspected facility and equipment
- Clean walls and floors
- Properly trained employees
- Hair nets, beard nets, boots, clean and sanitized hands (gloves)
- Foot baths
- Vermin control
- Appropriate chemicals, instructions for usage and personal protective equipment
- Time, temperature, concentration and agitation

Strict hand-washing criteria, appropriate plant design, foot baths, personal protective equipment are a must. Appropriate dairy-approved chemicals must be acquired from approved vendors (consult with state Department of Agriculture staff). All chemicals must be diluted carefully with water of the right temperature, while wearing eye and hand/arm protection. If any undiluted chemical contacts skin or eyes, rinse for 15 minutes with cold water. If chemicals must be put into secondary containers, it is essential that every secondary container be clearly labeled, and marked with the date the chemical was removed from the primary container. Usage instructions must accompany the chemical. Inclusion of a hand sink, equipped with an eye-wash station, is recommended (though not required) for in the chemical storage area.

For cleaning and sanitizing milk and cheese equipment and utensils, the following are recommended:

1. Chlorinated alkaline cleansers are recommended for dairy plants because they are effective at protein and fat removal from equipment surfaces. The proper concentration, water temperature, and contact time protocols must be followed. Chlorinated alkaline cleansers are cleansers, not sanitizers, since chlorine is not effective as a sanitizer at alkaline conditions.
2. For sanitizing (including gloves), chlorine-based or iodine-based sanitizers are recommended. The proper concentration (100 – 200 ppm), water temperature, and contact time protocols must be followed.
3. Occasionally, acidic cleansers are recommended. Acids help minimize inorganic build-up (milk stone or hard water corrosion). An acid cleanser will not be necessary if an acid sanitizer is used. Peracetic acid is harsh and is inappropriate for hand-washing of utensils and equipment.
4. NOTE: quaternary ammonium compounds ("Quats") should only be used for floors, floor drains and foot baths. Quats leave a residual antimicrobial film that will kill starter cultures so should never be used on equipment and utensils used for cheese making.

A stainless steel triple sink with drain plugs is highly recommended for sanitation in the plant during cheesemaking. The triple sink can be stationary or on wheels. The objective is to enable entire pieces of small equipment, pipes, fittings, etc. to be rinsed, washed (hand-scrubbed), then sanitized during the cheesemaking process.

Every day, the sink should be set up this way:

1. The first basin is the "rinse" sink. It should be filled with a dilute chlorinated alkaline cleanser solution (1/2 the concentration of the "wash" sink).
2. The second chamber is the "wash" section. The sink should be filled with fresh chlorinated alkaline cleanser (diluted according to manufacturer's instructions) for scrubbing utensils and equipment.
3. The third chamber is the "sanitizer" section. The sink shall contain 100 to 200 ppm sodium hypochlorite (bleach—check concentration with chlorine test strips) for sanitizing utensils and equipment. Our objective is to sanitize all equipment surfaces and utensils with 100 to 200 parts per million (ppm)

of active sanitizer to eliminate microbial contamination. Use at the rate of about 50 mL / 10 L, or as directed by supplier. Additionally, dilution water for sodium hypochlorite (bleach) must be cool, because it evaporates upon heating. Equipment and utensils must **not** be rinsed after sanitizing, prior to use. Water may contain microorganisms that could contaminate product. The food will not smell or taste like bleach because it evaporates when it comes into contact with organic material.

Refresh each basin every 4 hours or any time the solution appears cloudy or greasy. Sanitizer is inactivated when in contact with organic materials. Thus, when a as sanitizer solution becomes cloudy or oily, it must be replaced. Hands and utensils should be dipped in the 1st, 2nd and 3rd sinks after soiled, and/or prior to touching product. Shake of excess sanitizer, but do not rinse or dry hands or utensils.

The Steps in Cheesemaking (Figures 1 – 4)

As mentioned earlier in this manuscript, all high quality cheeses share one common feature: high quality milk. From that point on, any modification in the processing can yield a different cheese. Different cheeses are made based upon source of milk, type of culture used, temperature of ripening, cooking regime, temperature of aging, size of curd cutting, use of coagulating enzyme and type, style of curd handling, style of salting, etc.

The basic nine steps in cheesemaking are listed below and are elaborated upon in subsequent pages.

1. General steps in Cheesemaking

1. Place high quality milk into recently cleaned and sanitized vat (avoid foaming)
    a. Gradually raise the temperature of the milk to target temperature for culture
2. Agitate milk and add culture (note time and pH or TA)
    a. Allow to ripen for the recommended period of time
3. Addition of coagulating enzyme (chymosin or rennet)
    a. Stop agitation (note time)
4. Check curd
    a. Look for sharp cut in curd and clear whey to fill cut
    b. Cut curd (note time)
    c. Heal (rest curd for 5 – 15 minutes, depending on cheese)
5. Begin gentle agitation of curd (note time and pH/TA)
    a. Begin heating/cooking/stirring of curd to target temperature (some types require no cooking)
    b. Increase agitation along with temperature incrementally (note time and pH/TA)
    c. Turn off heat at target temperature and agitate until target time (note time and pH/TA)
6. Drain whey
    a. This part may be incremental, and may include addition of water, depending on cheese type
7. Subsequent steps vary according to cheese type
    a. Chevre (Figure 1)
        i. Gently ladle curds into cheese cloth or perforated shaped molds
        ii. Drain for approx. 3 hr, salting and flipping cheese hourly
        iii. Unmold
        iv. Season, coat with ash, or inoculate with spores (if desired)
    b. Feta (Figure 2)
        i. Mold/hoop
        ii. Salt/Brine
    c. Cheddar and Jack types (Appendix 1)
        i.Cheddar (flip and stack loaves of curd) or stir curds

ii. Mill (if cheddared)
iii. Salt
iv. Mold/hoop
v. Press

d. Romano-style (Figure 3)
i. Curds must be very finely cut, cooked, drained
ii. Mold/hoop
iii. Press
iv. Brine

e. Blue-veined mold-ripened varieties (Figure 4)
i. Inoculate with mold spores
ii. Mold/hoop
iii. Aerate with needles

f. Soft-ripened (Camembert-style varieties; Figure 1)
i. Mold/hoop
ii. Spray surfaces with mold spores

g. Mozzarella and Provolone styles (more difficult with goat cheeses)
i. Stretch
ii. Brine

8. Package
   a. May include plastic, wax, etc.
9. Age/ripen
   a. All raw milk cheeses must be aged at least 60 days at 35°F/2°C or greater
   b. Fresh cheese (pasteurized milk) may be sold right away
   c. Mold-ripened cheeses require oxygen and high relative humidity (~90%)for formation
   d. Dry/grating cheeses need ~18 months aging

The most important milk component for cheesemaking is the protein generally referred to as casein (CN). It is generally accepted that native milk casein (pH of about 6.7) is in the form of casein micelles, which are composed of the sub-classes of caseins (as_1-, as_2- k-, and b-CN). The micelles are between 40 – 300 nm in diameter (smaller than fat). Submicelles are thought to be 10 – 20 nm in diameter. The hydrophobic caseins (as_1-, as_2- and b-CN) orient themselves to the insides of the micelles. Hydrophilic (whater-loving) caseins (k-CN or hydrophilic parts of proteins) extend beyond the micelles into the surrounding milk serum. Since k-CN is not susceptible to Ca^{++} precipitation, it stabilizes the micelle against precipitation. There is a net negative charge on the surface of the micelles at the pH of milk, so the k-CN hairs stretch out. Micelles repel each other and are very stable to dessication, heat and cold. At low pH, fewer negative charges exist, therefore the hairs curl up, and coagulation occurs.

When milk is acidified, as in the case of fermentation by mesophiliic and/or thermophilic starter cultures, lactose is converted to lactic acid. This results in several important features, including:

1. Neutralization of charges on proteins, which leads to coagulation of proteins
2. The acid protease enzyme (chymosin/rennet) becomes more active at acidic pH, which speeds coagulation
3. Some minerals go into solution (the amount of Ca^{++} in final cheese dictates texture)
4. Syneresis (water is squeezed out), the form of the product changes, and shelf life is increased

Some cheeses (cottage cheese, chevre) are made by the process of acidification, but it is a slow process. We can wait for lactic acid to form and coagulate the milk, but we can speed up the process with the enzyme chymosin (commonly called rennet). The enzyme is specifically active on the k-CN in milk. It essentially

cuts the negatively charged "hairs" off of the casein micelle, which allows the micelles to come together and coagulate. The chymosin cleaves specifically at the phenylalanine-methionine amino acids bond in k-CN. Part of the k-CN, the glycomacropeptide, remains soluble and ends up in whey, while another part of it, the para-kappa-casein, stays with the curd.

- When using chymosin, there are several important issues to keep in mind, which are listed below:
  - Dilution (1 part enzyme to 40 parts water) is necessary so localized coagulation does not occur.
- The enzyme degrades over time and in heat. Keep refrigerated until use.
  - Mix enzyme with cold water immediately before use. Don't pre-mix & let sit.
- Distribute the enzyme as evenly as possible in the vat.
- Coagulating efficiency increases approx 1.5% per ˚F between approx 68-100˚F.
- Maximum temperature for chymosin is 106˚F (in activated at high cooking temperature).
- Hard water, chlorine and heat will destroy enzyme activity.
  - If mix-water contains high chlorine levels, mix drops of pasteurized milk in to neutralize chlorine before adding the coagulant (organics inactivate chlorine).

When the caseins coagulate, most of the fat is trapped in the matrix. For most cheeses, about 90% of the casein and fat are retained in the cheese. The remaining material that is not trapped in the curd matrix is called whey. Whey is primarily composed of water, but it also contains most of the lactose, almost all of the whey proteins, as well as some fat, vitamins and minerals. Whey can be used to make ricotta cheese, but it is a good idea to supplement the whey with milk to increase the yield of ricotta.

Other considerations in cheesemaking include use of molds, calcium chloride ($CaCl_2$), salt and color. Molds include the microbiological kind and physical kind. Different molds can produce great flavors and attractive appearance to products. $CaCl_2$ promotes ionic cross-bridging of caseins, gives a stronger coagulum with the same amount of chymosin, may also give greater yield, but does not increase calcium in curd. Color is added to some cheeses to identify them, but does not provide flavor or other attributes. The most typical color, annatto (natural extract from Lipstick tree) binds to caseins. Salt is added to most cheeses. It assists in syneresis, serves as a preservative (slows microbial growth), and provides flavor.

Cheesemaking with Goat Milk

One of the most popular types of goat cheese is chevre, a fresh, soft, white piquant cheese that is commonly spread on bread, crumbled on salads, and used in a multitude of recipes at restaurants. An un-aged cheese, chevre must be made from pasteurized milk. The flavor should be clean, with a hint of sharpness or "goaty" flavor, which is a consequence of the short chain fatty acids (butyric, caproic, caprylic or capric acid) that are naturally higher in goat milk than cow milk. However, just about any cheese that can be made from cow milk can also be made from goat milk. The reader should expect that a the resulting cheese will have some different flavor characteristics than cow milk cheeses. Traditional cheeses made from goat milk include, but are not limited to:

- Banon (soft, small, round, ripened pure goat or mixture of goat, sheep and/or cow milk)
- Chevre (means goat in French; white, fresh, soft pasteurized milk cheese)
- Feta (Greece; sheep and/or goat milk; salty, crumbly)
- Gjetost (sweet, Norwegian boiled-whey cheese (at least 10% goat cheese whey); brownish in color from condensing to about ¼ its original volume)
- Halloumi (Greece; sheep and/or goat milk; not cultured, mild flavor; good for frying)
- Mizithra (Greece; sheep and/or goat milk and/or whey; mild)
- and others

General procedures for several cheeses (Figures 1 – 4), along with a make sheet for the production of stirred curd Monterey Jack cheese from goat milk (Appendix 1) are included in this Proceedings. Try following the steps as written, then modify the make sheet to meet your needs as you improve the recipe according to your starting material and taste.

Conclusion

Cheesemaking involves both science and art. Because so many things influence the product, careful procurement of and handling of milk, along with strict sanitation and record-keeping are essential if you are to prevent recurring disasters and, more importantly, reproduce fabulous cheeses.

Table 1. **Cow, Goat and Sheep Milk Production and Composition Compared.**

	Cow	**Goat**	**Sheep**	*Human*
Component (%)	Mean	Mean	Mean	*Mean*
Water	87.5	87.5	80.9	*87.7*
Protein	3.4	3.6	5.9	*1.8*
Casein	2.7	2.9	4.7	-
Whey	0.7	0.9	1.2	-
Fat	3.6	4.1	7.0	*3.6*
Lactose	4.8	4.5	5.3	*6.8*
Ash*	0.7	0.8	0.9	*0.1*
Production (kg/day/animal)	18-23	1-5	0.5-2.0	-
Cheddar cheese yield (%)	9.9	9.8	14.8	-

Table 2. **Fatty acid profiles of milk from different species** (USDA, 2009).

	Cow	**Goat**	**Sheep**	**Buffalo**	**Human**
		g/100g of milk			
Saturated total	2.08	2.67	4.60	4.60	2.01
4:0	0.11	0.13	0.20	0.28	-
6:0	0.06	0.09	0.14	0.15	-
8:0	0.04	0.10	0.14	0.07	-
10:0	0.08	0.26	0.40	0.14	0.06
12:0	0.09	0.12	0.24	0.17	0.26
14:0	0.34	0.32	0.66	0.70	0.32
16:0	0.88	0.91	1.62	2.00	0.92
18:0	0.40	0.44	0.90	0.68	0.29
Monounsaturated total	0.96	1.11	1.72	1.79	1.66
16:1	0.08	0.08	0.13	0.14	0.13
18:1	0.84	0.98	1.56	1.57	1.48
20:1	trace	-	-	-	0.04
22:1	trace	-	-	-	trace
Polyunsaturated total	0.12	0.15	0.31	0.15	0.50
18:2	0.08	0.11	0.18	0.07	0.37
18:3	0.05	0.04	0.13	0.08	0.05
18:4	trace	-	-	-	-
20:4	trace	-	-	-	0.03
20:5	trace	-	-	-	trace
22:5	trace	-	-	-	trace
22:6	trace	-	-	-	trace

Table 3. **Composition of a variety of sheep, goat and cow milk cheeses, compared** (Fox et al. 2000).

Cheese	**Fat (%)**	**Total solids (%)**	**Salt (%)**	**pH**
Camembert	23.0	47.5	2.5	6.9
Cheddar	32.0	63.0	1.5	5.5
Feta	20.3	40.3	2.2	4.2
Gouda	28.5	59.0	2.0	5.8
Manchego	25.9	62.1	1.5	5.8
Mizithra	25.0	56.3	1.6	5.0
Mozzarella	18.0	46.0	0.7	5.2
Ricotta	12.7	28.0	<0.5	5.9
Romano	24.0	77.0	5.5	5.4
Roquefort	31.0	60.0	3.5	6.4

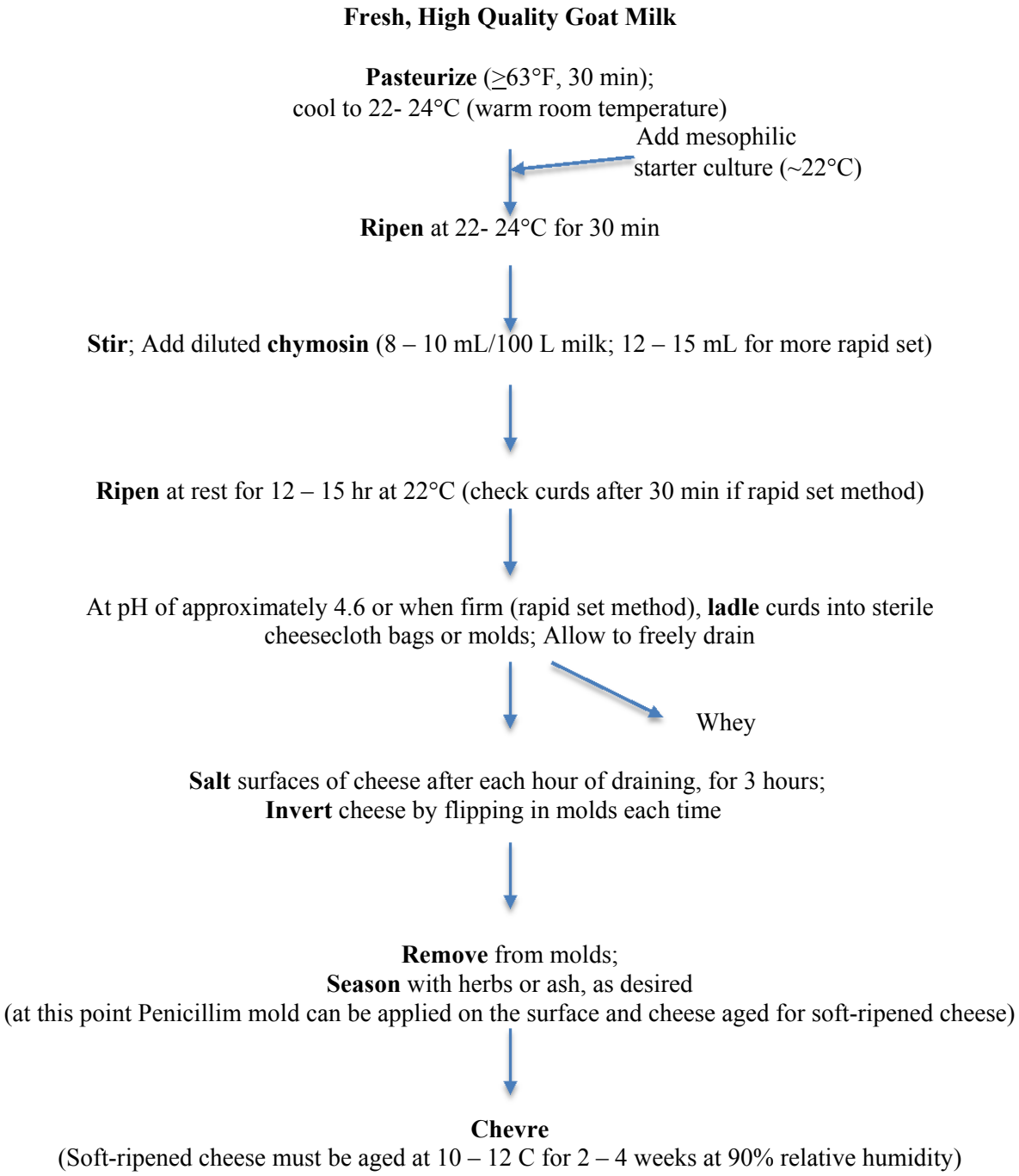

Figure 1. Manufacturing Protocol for Chevre and Soft-ripened Goat Cheese (adapted from Le Jaouen, 1987).

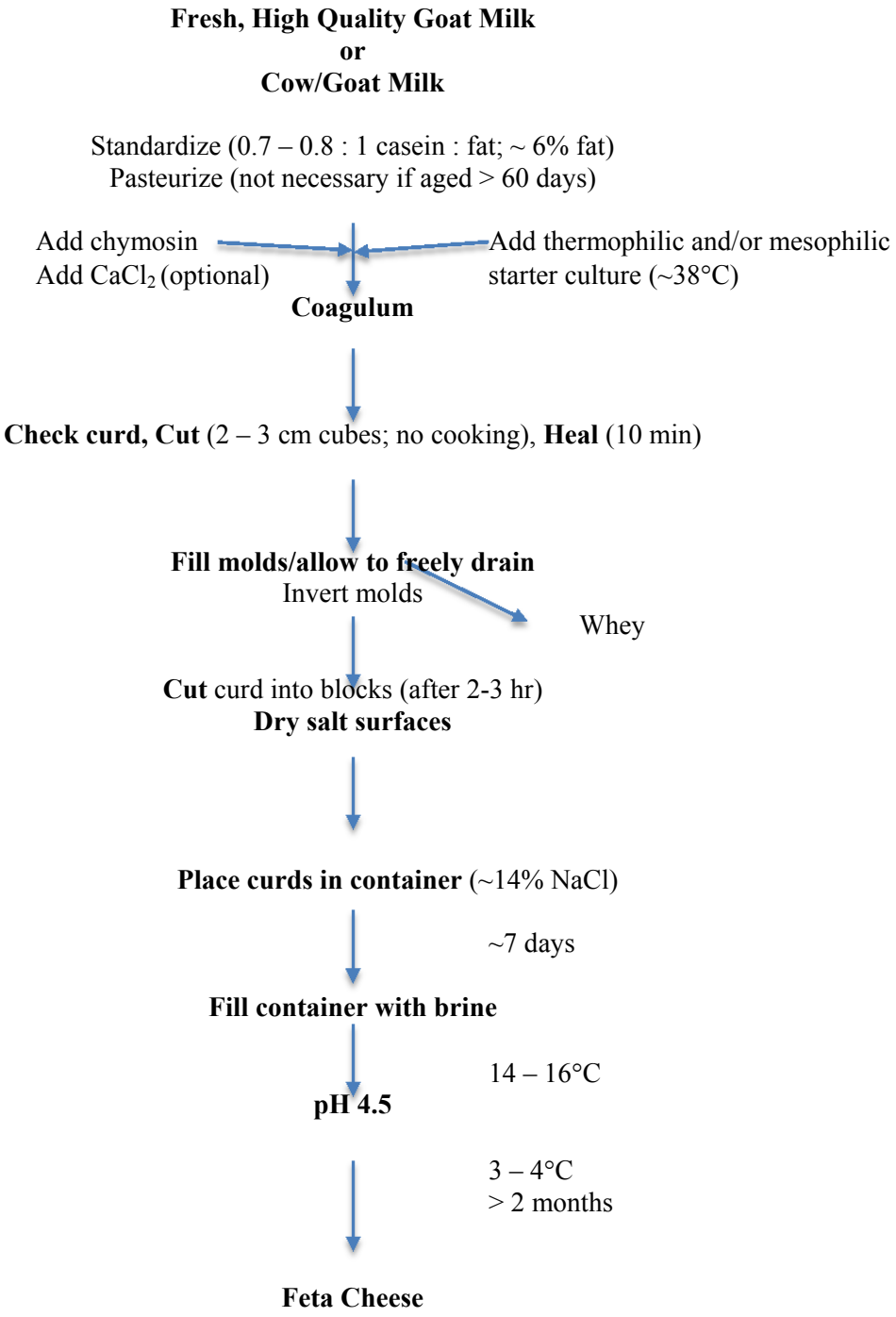

Figure 2. Manufacturing protocol for Feta cheese (adapted from Fox et al. 2000; Kosikowski & Mistry 1997; ARS:USDA 1978).

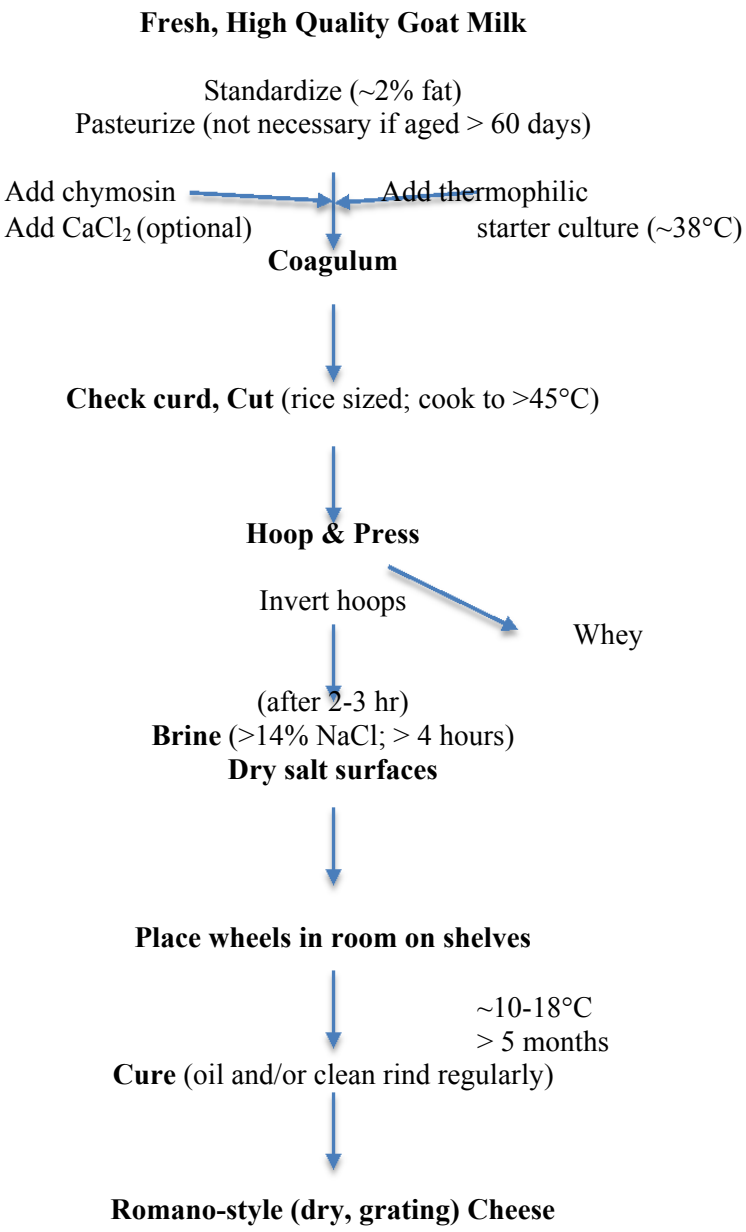

Figure 3. Manufacturing protocol for Romano cheese (adapted from Fox et al. 2000; Kosikowski & Mistry 1997; ARS:USDA 1978).

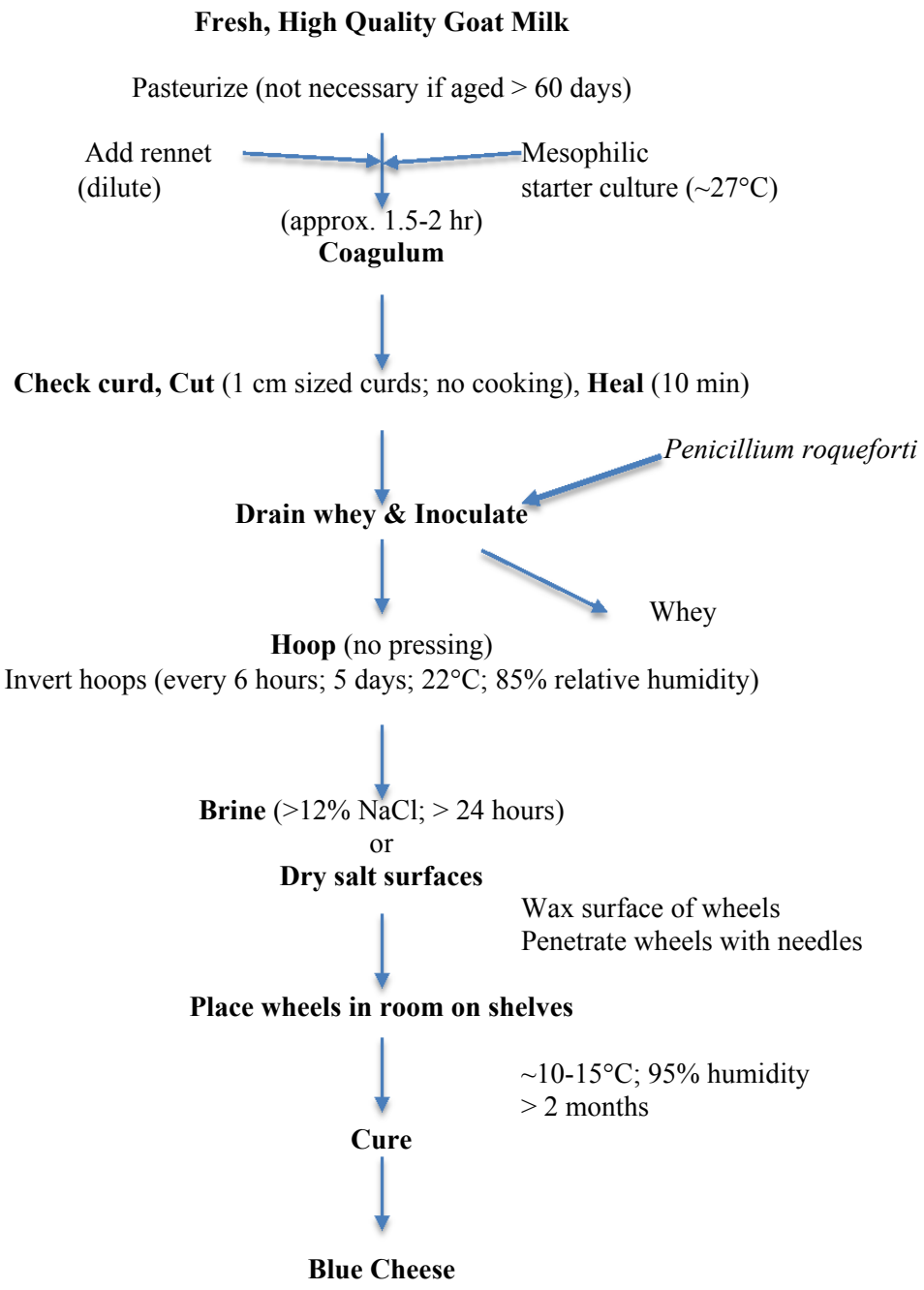

Figure 4. Manufacturing protocol for Roquefort-style blue cheese (adapted from Fox et al. 2000; Kosikowski & Mistry 1997; ARS:USDA 1978).

Appendix 1. Make Sheet for the Production of Stirred Curd Monterey Jack Cheese from Goat Milk

Date: _____ Amount of milk (10 gallons): _____
Culture (lot #): _____ Amount (1/2 pint): _____
Coagulant (lot #): _____ *A*mount (3 tsp ss): *(dilute, 5 oz water):* _____
Salt (lot #): _____ *A*mount (~1/3 lb): _____

Operation	Target time/temp	Target pH/TA	Actual time/temp	Actual pH/TA
Add past. milk	Warm gradually	6.7/0.20		
Add culture	0:00/90˚F	6.7/0.20		
Add chymosin, stir, then stop agitation	0:45/90˚F	6.6/0.25		
Cut curd	1:15/88˚F	6.5/0.18		
Heat on (slow rise)	1:30/88˚F	6.5/0.19		
Heat (increase agitation)	1:45/94˚F	6.3/0.20		
Heat off	2:00/100˚F	6.3/0.22		
Continue stirring (once every 5 min)	2:15/100˚F	6.1/0.24		
Do not go above 100˚F (can add cold water)	2:30/100˚F	5.9/0.26		
Drain whey (allow curds to settle)	2:40/	-		
Stir curds (every 5 min)	2:45/	5.8/0.28		
Measure/record pH/TA (every 15 min)	3:45/	5.3/0.32		
Salt (1/3)	4:00/	-		
Salt (1/3)	4:05/	-		
Salt (1/3)	4:10/	-		
Fill hoops, molds or cheesecloth	4:15/	-		
Press or hang	4:30/70˚F			
Remove from hoop or cloth, wax or wrap	12:30/40˚F	-		
Ripen	60 d – 6 mo			

Weight of cheese after pressed: _____ *yield:* _____

Form updated: 02/26/15

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Voutsinas, L. P., M. C. Katsiari, C. P. Pappas and H. Mallatou. 1995b. Production of brined soft cheese from frozen ultrafiltered sheep's milk. Part 2. Compositional, physicochemical, microbiological and organolpetic properties of cheese. Food Chemsitry. 52: 235-247.3.

Marketing: Ordeal or Opportunity?

Ms. Yvonne Zweede-Tucker
Smokeridge
Choteau, MT

1) Show of hands, please: ordeal or opportunity?

2) Show of hands, please: what business are we in?

- goats for consumption (eating)
  - what is their short-term (< 1 yr.) purpose?
- goats for production (breeding)
  - what is their long-term (> 1 yr.) purpose?

Marketing is seen as one leg of the three-legged stool supporting business:

- *marketing*
- *management*
- *money*

Please come to breakout session #2 this afternoon to learn more!

Marketing: What, Why, When, Where, How, Who?

What *is marketing?*

"**Communicating the value of a product** or service to customers, **for** the purpose of **selling that product** or service."

Needs and wants of customers are primary 'Market research'
Do customers like the product? Make changes if necessary
Sell improved product, Assess progress

Why *should you "market" or "do marketing?"*

So that customers can find you and will want to buy your product.

When *should you "market?"*

"Constantly." Ongoing. Pay attention. "Two ears and one mouth."

Where *should you "market?"*

Cost-effective media; print, radio, television, on-line "desktop advertising," socialHYPERLINK "http://en.wikipedia.org/wiki/Social_marketing" marketing focuses on benefits to society.

How *should you "market?"* "Clearly."

- 4 Ps
    - **P**roduct Meat Goat(s)
    - **P**romotion/**P**ositioning - Why our solution is better Delicious, Healthy
    - **P**rice *How much; w*hy the product is worth it
    - **P**lace (Distribution: Delivery? Auctions?)
- SIVA
    - **S**olution to a problem Hunger (humans), Weeds

- **I**nformation How do I solve the problem?
- **V**alue Why they are worth it
- **A**ccess (Distribution: Delivery? Auctions?)

Who *should "market?"*

All of those involved in meat goats/goat meat. *All of us.*

Marketing: What IS a Goat Worth?

Ms. Yvonne Zweede-Tucker
Smokeridge
Choteau, MT

For eating? Prices "High in the winter, low in the summer"

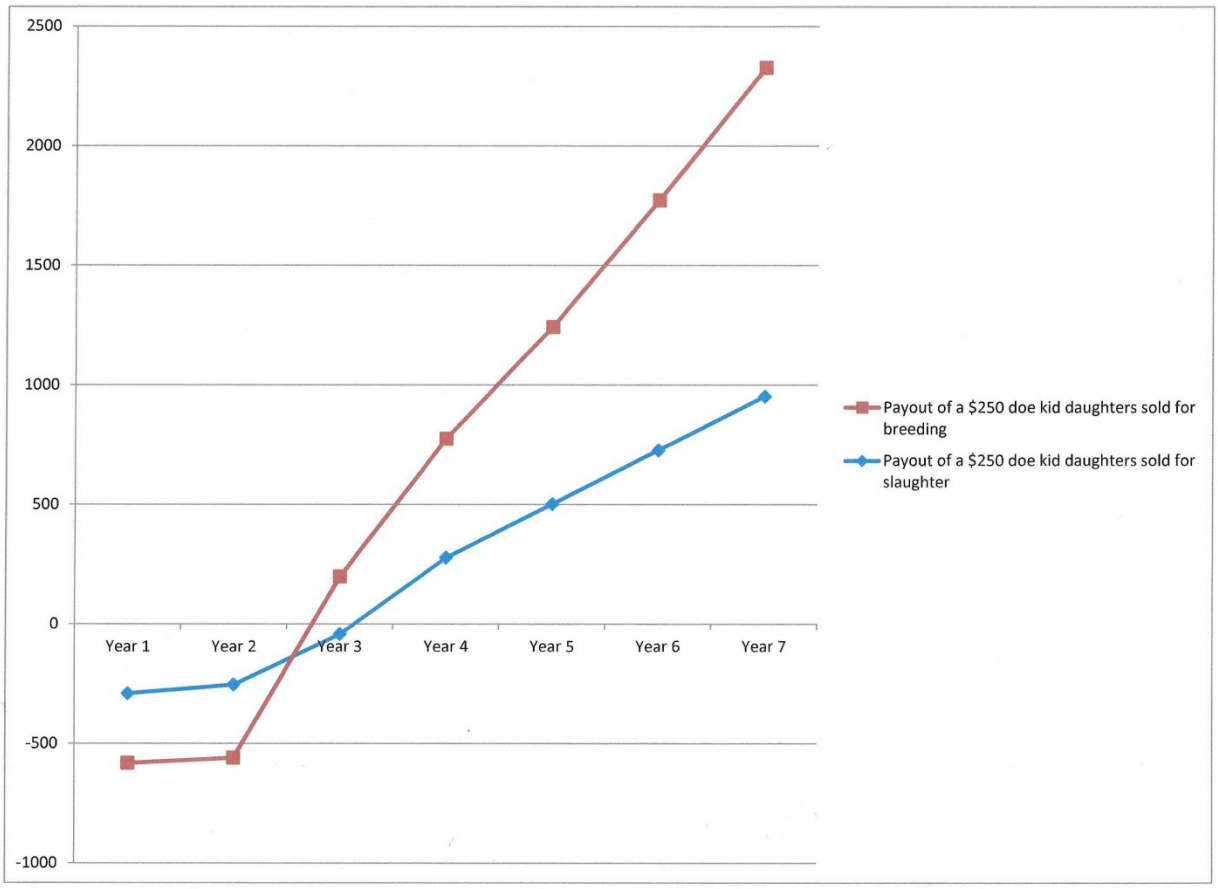
Average sale price, 60 pound selection 1 kid, San Angelo

For breeding? So what IS a doe kid worth?

Payout of a $250 doe kid, daughters sold for breeding or slaughter

Assumptions:

- Female goat at least 50% Spanish
- Healthy, born of a productive mother
- Fed hay 6 months per winter, as in Montana
    - Hay 14% protein: grass-alfalfa mix
- Pastured remaining 6 months per year
- No grain fed
- Fresh water available at least daily
- Chelated loose mineral available daily
- Livestock guardian dog for protection from predators
- De-wormed twice annually
- One buck used per 50 females
- Buck 5 year life expectancy
- Kidding estimates:
    - 0.75 having one kid at 12 months of age
    - 1.5 kids born per doe at 24 months
    - 1.75 kids born annually thereafter



Payout:

Daughters for slaughter? Sons to slaughter.

$ -43 end of year 3
$ 952 end of year 7

Daughters for breeding? Sons to slaughter.

$ 241 end of year 3
$1,375 end of year 7

The other 8/9 of Your Business Plan

Ms. Yvonne Zweede-Tucker
Smokeridge
Choteau, MT

In love and business,
trust is the beginning, middle and end of the story.

How does one earn trust?

Do what you say you are going to do.

Thank you, Entrepreneur magazine

Marketing is seen as one leg of the three-legged stool supporting business:

- marketing
- management
- money

Per a guru, most entrepreneurs are poor(er) at one of those three tasks. IF we will admit to such a weakness, how do we have a successful business/ happy home life anyway?

- Learn it
- Hire it
- Partner with or marry it

Support # **One: Marketing**

- **P**roduct Meat Goat(s)
- **P**romotion/**P**ositioning - Why our solution is better
- **P**rice
- **P**lace (distribution)

Support # **Two: Management**

Remember the introduction of Selection 1-2-3 ? That was in 2008, ***only 7 years ago***…***Selection 3 is not even reported anymore*** *at San Angelo auction (largest in the US)*

Input - Forces put into your herd
Money
Energy (human, solar)
Time

Output - Benefits harvested from your herd
Food (goat is the most widely eaten red meat worldwide)
Profit (financial, ecological)
Fun (lifestyle can equal physical benefit)

Support # Three: Money

Very easy to put money in

Very difficult to get money out

Financial health is literally the lifeblood of an enterprise

"Just say no" is not only applicable to taking drugs
Clear goals will allow you to evaluate a new (*put word here*)
Beware of competition to spend…
Competition to save is not (yet) fashionable in the U.S.

If you need to/want to
acquire financing or give your endeavor a check-up
you will need/want to have a Business Plan <=**Whole enterprise involved.**

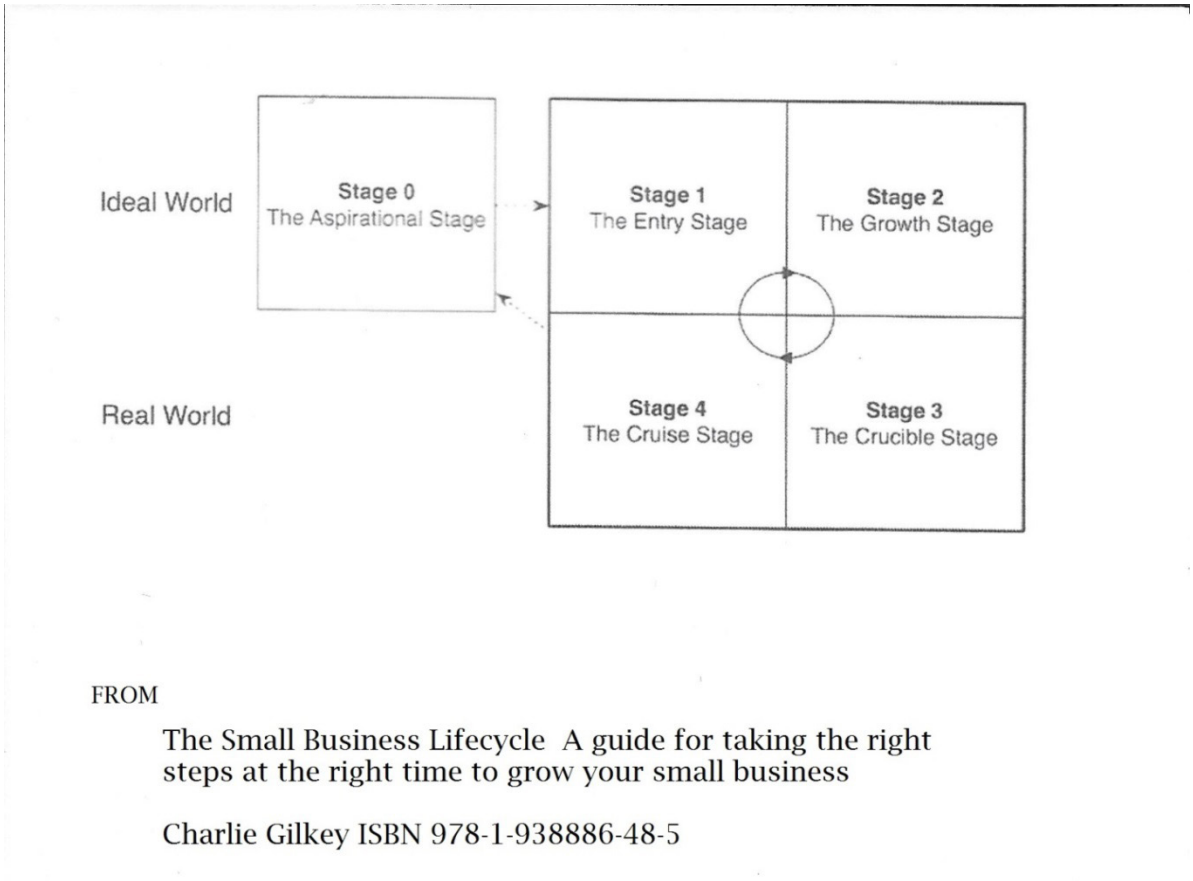
Make it, **use** it, update it; **don't** let it get permanently "shelved"

I. Executive Summary *why you are uniquely qualified to succeed*
II. Company Overview *past accomplishments, key milestones*
III. Industry Analysis
Market Overview
Relevant Market Size
IV. Customer Analysis
Target Customers
Customer Needs *why you are uniquely qualified to succeed*
V. Competitive Analysis
Direct Competitors *their strengths and weaknesses vs. you*
Indirect Competitors *their products' strengths and weaknesses vs. yours*
Competitive Advantages *your strengths and weaknesses*
VI. Marketing Plan *process through which you will satisfy customer needs*
Products, Services & Pricing "*develop a demand and satisfy it" demand there!*
Promotions Plan *sale = one-time transaction, marketing => long-term*
Distribution Plan
VII. Operations Plan
Key Operational Processes
Milestones
VIII. Management Team
Management Team Members
Management Team Gaps
Board Members
IX. Financial Plan
Revenue Model
Financial Highlights
Funding Requirements/Use of Funds
Exit Strategy

X. Appendix

GOALS = LONG-TERM
STRATEGIES = ANNUAL

Dreaming is not Doing:



FROM

The Small Business Lifecycle A guide for taking the right steps at the right time to grow your small business

Charlie Gilkey ISBN 978-1-938886-48-5

Use your business plan as a "cheat sheet," to have all top pertinent numbers/plans at your fingertips. Keep a red pen close by, make notes when new information comes to light and use those notes for making quarterly/ annual updates…

Your business plan is first and foremost a marketing document!

If you banker really gets tough, you'll get to do a balance sheet and calculate your debt to asset ratio… actually pretty cool if you can see the ratio get better (more assets to debt)

Good News! Reaching Customers – They Are Looking for You

Ms. Yvonne Zweede-Tucker
Smokeridge
Choteau, MT

- On paper

  Advertising, press releases, news stories

  What Lisa's journalism professor told her and she told me

  "Why Should They Care?"

  What the editor of our local newspaper told me:

  What – why – when – where – how - who

- On-line

  Websites

  "social marketing" *develop activities aimed at changing or maintaining people's behavior for the benefit of individuals and society as a whole.*

- On a trailer, **after** the sale

  Making it easy for your customers

Things to think about, on the three-legged stool!

Twenty-five top traits of a successful entrepreneur:

1. Do what you enjoy
2. Take what you do seriously
3. Plan everything
4. Manage money wisely
5. Ask for the sale
6. Remember it's all about the customer.
7. Become a shameless self-promoter (but don't be obnoxious).
8. Project a positive business image
9. Get to know your customers
10. Level the playing field with technology
11. Build a top-notch business team
12. Become known as an expert
13. Create a competitive advantage
14. Invest in yourself
15. Be accessible
16. Build a rock-solid reputation
17. Sell benefits
18. Get involved
19. Grab attention
20. Master the art of negotiations
21. Design Your workspace for success
22. Get and stay organized
23. Take time off
24. Limit the number of hats you wear
25. Follow-up constantly

Advertising cost-benefit calculations (which are difficult at best!)

On-line *potential* customers are doing the work of looking for you…
You "just" need to make it simple for them to

- Find you
- Understand what you are offering
- Feel positive toward you
- Purchase from you
- ***Smoke Ridge is NOT doing this perfectly!***

We are in a growth-possible industry…
Cattle/pork/sheep will wax and wane on a much bigger base

Since we can make chevon here, how does that help?

- Speed of production and shipping
- Quality control
- Less inventory, less risk
- Safety and the environment

Your "brand"

- What is your brand's **absolute loyalty?**
- What would be missing if your company went extinct?
- What is your customer's experience? (afterglow)
- Are you brave?
- What's your exit plan?

Useful to know (per Yvonne):

Multitasking is an energy drain.

Personal productivity is the single most important factor to success.

The Procter & Gamble One-Page Memo

- The Idea: What you are proposing, typically one sentence.
- Background: Non-debatable statement
- How it Works: The key details
  - How
  - What
  - Who
  - When
  - Where
- Key Benefits
  - WHY the idea is needed
  - It is on strategy
  - It is already proven (in a test)
  - It is effective (works) and efficient (profitable)
- Next steps
  - Who has to do what, by when

Parasite Management in Small Ruminants

Dr. Barry Whitworth
Area Food/Animal Quality and Health Specialist for Eastern Oklahoma
Oklahoma State University

Introduction

Gastrointestinal parasites are the most common cause of disease in small ruminants. With resistance to chemical dewormers so prevalent, controlling internal parasites is very difficult. Deworming in a sustainable way is even more of a challenge. Producers must use management and not rely solely on dewormers to stay on top of this problem.

The major nematodes (roundworms) encountered with small ruminants are:

Haemonchus contortus (Barber Pole worm) Abomasum
Teladorsagia (Ostertagia) circumcincta (Brown Stomach worm) Abomasum
Trichostrongylus columbriformis (Bankrupt Worm) Small Intestine

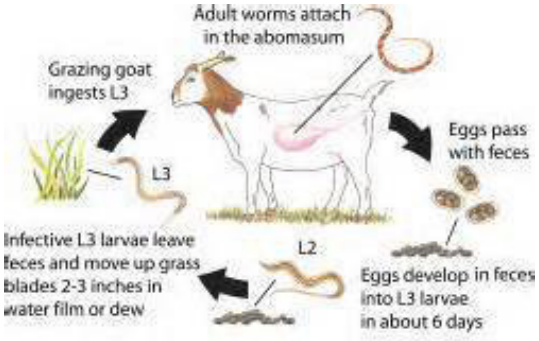
The acronym "HOT" representing *Haemonchus, Teladorsagia (Ostertagia*), and *Trichostrongylus* are the most prevalent with *Haemonchus* being the most devastating.

The following list is of nematodes that on occasion cause problems in small ruminants:

Trichostrongylus axei
Cooperia
Nematodirus
Oesphogostomum
Bunostomum
Trichuris ovis
Strongyloides papilosus

Parasite Live Cycle

Understanding the parasite life cycle will help producers better control them.



Life Cycle of Haemonchus contortus, the barber pole worm

Courtesy of www.acsrpc

The life cycle of the roundworms has three stages which are the development stage, prepatent or pre-adult stage, and the patent or adult stage. Development stage requires heat and humidity. Ideal temperature ranges from 70 to 80 degrees Fahrenheit (F), but any temperature above 45 degrees F will allow for development. Temperatures above 85 degrees F or below 45 degrees F will begin to hamper development. Humidity needs to be 80% or higher. The eggs are excreted in the fecal pellets. The egg hatches into the first stage larvae (L1). L1 molts (sheds cuticle or skin) to L2. L1 and L2 survive by eating bacteria in the feces and soil. L1 and L2 are susceptible to dying in cold, hot, and dry conditions. L2 molts to L3 which has a protective sheath and is less susceptible to the elements. L3 is the infective form of the parasite. L3 must have moisture to free itself from the fecal pellet. Once free, it rides a wave of water on to a blade of grass up to a height of 2 to 3 inches. Once ingested, this begins the prepatent or pre-adult stage. Two molts take place during this stage (L3 to L4 and L4 to L5). If conditions are not favorable for survivability of offspring, L4 will go into an arrested development stage (hypobiosis) for a period of time. The patent or adult stage is the mature breeding adult. By understanding the parasite life cycle, a producer is aware of the environmental conditions that favor the production of parasites. The producer now can make management decisions to try to combat the parasites.

Disease

The roundworms attach and live in certain locations in the digestive tract. *Haemonchus* and *Teladorsagia* live in the abomasum. *Trichostrongylus* survive in the proximal part of the small intestine. Clinical signs of disease are associate with damage done at the site in the digestive tract. The damage done to the intestinal tract results in an inability to break down nutrients and failure to absorb nutrients. This results in diarrhea and poor performance. *Haemonchus* is a blood sucker which causes in anemia. Anemia will manifest as weakness and poor performance and death if severe enough.

Dewormers

Producers have two approved chemical dewormers to use in goats. Fenbendazole (Safeguard, Panacur) and Morantel (Rumantel, Positive Pellet). Other chemical dewormers may be used in an extra label manner with a prescription from a veterinarian. A prescription may only be issued with a proper veterinary-client-patient-relationship (VCPR).

Resistance

Unfortunately, the misuse of chemical dewormers has led to parasite resistance in most goat flocks. This is a worldwide problem and is the biggest threat to the goat industry.

Monitoring

Producers need to have some way of monitoring the parasite burdens in their flocks. A fecal egg count (FEC) is a good way of accessing parasite burdens. Another monitoring device is checking eye scores (FAMACHA). FAMACHA checks for anemia by observing the eye for paleness. The producer has to remember that it only checks for *Haemonchus* and no other roundworms. The five-point-check uses FAMACHA and 4 other observations to access parasite burdens. The four other observations are body condition score (BCS), dag score (fecal soiling of tail), hair coat (appearance), and jaw (bottle jaw). By adding the other four observation to the FAMACHA score, the producer has a better chance of not missing other roundworms that cause problems in goats.

Alternative to Chemical Dewormers

Much research has been performed on other forms of dewormers. Tannin-rich forage have been used to control *Haemonchus*. Nematode trapping fungus has been used in Europe but a good delivery system has not been established. Copper oxide wire particles (COWP) are being used and do good job on *Haemonchus*.

Vaccinations against roundworms is being researched in Australia. All of these alternatives are available or may be in the future.

Management

In the future, parasite control will need to rely more on management and the careful use of chemical dewormers. Some of the following management strategies will aid in the control of parasites:

- Keep good records to find those problem goats
- Stocking rates of 2 head per acre
- Good nutrition strengthens the immune system
- Monitor worm burdens (FEC, FAMACHA, Five-point-check)
- Rotational grazing provide 6 weeks rest between grazing
- Proper use of chemical dewormers
- Provide browse
- Haymaking and tillage
- Tannin-rich forage
- Graze with cattle or horses
- Do not graze to close to the grown

Conclusion

Gastrointestinal parasites will continue to be a major problem for goat producers in the future. Producers will need to rely more on management and less on chemical dewormers to control parasites in the future.

Meat Goat Herd Health Procedures and Prevention

Dr. Lionel Dawson
Oklahoma State University

Introduction

The goal of a herd health program is to improve the goat herd's productivity through general husbandry, nutrition, parasite control, vaccination, and environmental management. An understanding of various management practices and common diseases on the farm is necessary to accomplish this goal. An effective herd health program is an essential part of a successful goat management program. Good feeding and breeding will not result in maximum production if goats are not kept in good health. Conversely, good nutrition and herd management will greatly reduce the complexity and cost of the herd health program.

Herd health programs are always described in very general terms and then modified to fit individual herds. The exact makeup of any program depends on the herd size, purpose of having the herd, and the production goals of the owner. For the most part, goats are managed as small groups of five to a hundred animals per herd. There are relatively very few large commercial goat herds with numbers above 500 head in the United States. Large herds may have problems associated with high density of animals and continuous turn over. Small herds tend to have higher nonproductive/productive ratios than do larger herds. This is because small herd owners often keep animals that would normally be culled in large commercial herds. Often, the net result is the maintenance of animals with chronic illnesses that may serve as reservoirs of disease.

Since each herd is different, each owner should work with his/her veterinarian to create an individual herd health plan. Keep good records for each animal regarding medications, vaccinations, dewormers, diseases, breeding, culling etc., and use this information to plan your herd health program. Preventive medicine is usually less expensive than treating the disease as the highest economic returns are realized when disease problems are at a minimum. Many diseases have similar symptoms and a producer should work with a veterinarian familiar with common goat diseases. A veterinarian familiar with goats has the training and experience needed to provide diagnosis and recommend animal health products used in goats to treat these conditions.

Common Herd Health Procedures

In the normal course of herd health management it will be necessary to perform different herd health procedures. Some of these procedures are performed to collect information on an animal's condition that can be relayed to a veterinarian. Others are needed in the course of disease prevention or treatment. A producer should only attempt those procedures in which they feel comfortable and sufficiently proficient so that no harm can come to the animal. If there is any doubt, consult a veterinarian. The most common procedures done by producers are listed below with a brief explanation of correct methods.

Taking temperature – rectally

The first procedure usually performed on an animal suspected to be ill is to take its temperature. In goats, this is performed rectally. Either a digital or mercury thermometer can be used. Plastic digital thermometers do not break and may be considered as safer to use than a mercury thermometer. A small amount of lubricant may be put on the thermometer and it should be inserted with a twisting motion. A normal goat's temperature should be 103 - 104ºF (39 - 40ºC).

Pulse or heart rate

There are several places on the goat where the pulse or heartbeat can be felt and measured. Heartbeat can be felt by placing one's fingertips between the ribs behind the elbow. Pulse can be measured using the femoral artery on the inside of the rear leg roughly ⅓ of the way down. Pulse may also be detected by placing the index and middle fingers on the artery located below and slightly inside of the jaw roughly two-thirds to the rear of the muzzle. A normal range is 70 to 90 beats per minute.

Respiration

Respiration is detected by watching movement of the flank or chest. A normal range is 12 to 20 per minute.

Rumen movements

Adequate rumen function is essential for a goat's health. One sign of adequate function is regular ruminal movement. This can be detected by placing the hand on the left flank of the animal. If the rumen feels soft and water-filled this should be noted and reported to your veterinarian. Rumen contractions should be easily felt and should occur 1-2 times per minute.

Checking mucous membranes

Paleness of the mucous membranes in the mouth (gums), vagina and prepuce can be an indicator that the animal is in hypovolemic shock, meaning that there is a decrease in the blood volume circulating in the animal. The color of the conjunctiva around the eyes can be an indicator of anemia that could be caused by a heavy internal parasite burden. Roll down the lower eyelid to look at the color. A pale, whitish color indicates anemia. This color can be scored using the FAMACHA system which is described in the section on Parasites of Goats. Remember that irritation of any type causes membranes to turn red. This means that an anemic goat with pinkeye may still have red membranes.

Drenching and dosing

Drenching or dosing an animal entails the oral administration of a liquid. The obvious goal of this procedure is to ensure that the animal swallows the full amount given. Grasp the animal under the jaw to raise its head. Raising the head of the animal will assist in ensuring the liquid is swallowed. A finger or thumb can be put into the mouth where there are no teeth (goats lack canine teeth as do all ruminants) to assist in opening the mouth for the drenching equipment. Generally a bottle with a tube over the end or a drenching gun is used. Liquids should be given slowly to allow time for the animal to swallow. Dewormers must be given using appropriate drenching equipment ensuring that they are given over the back of the tongue and swallowed.

Tubing an animal

In some cases it may be necessary to pass a tube down the mouth directly into the stomach in order to administer a large volume of a liquid. This could also be used to feed a young animal incapable of nursing or to either sample rumen contents or insert rumen contents into an animal having severe digestive problems. The size of the tube passed should be appropriate for the animal's size. Generally, a ½ to ¾ inch (1 to 2 cm) diameter tube should be used for adult goats. A short metal or PVC pipe (speculum) larger in diameter than the tube to be inserted is placed in the mouth to prevent the goat from biting or chewing the plastic tube. Some people prefer to use a "Harp" speculum instead. The hard-sided tube or speculum is inserted into the mouth of the goat and holds their mouth open while you pass the tube. The plastic tube is then passed down the throat and into the stomach. Administer liquids slowly. Have a veterinarian or person trained in this technique instruct you before attempting it the first time.

The procedure for tubing a neonatal kid is similar to that for adult animals with a few distinctions. For kids, one does not need to use a PVC tube or speculum. The size tube used is smaller for baby goats (12 to 14 French or roughly ¼ inch inner diameter). The tube should be flexible without any hard edges to harm the kid's mouth or throat. Hold the kid's mouth open and pass the tube gently over the hump or base of the tongue at the back of the mouth and into the stomach.

There are some precautions to take in tubing an animal to ensure that liquids are not inadvertently administered into the lung. The first precaution is to always hold the goat's head in its normal flexed position. If you extend the head and throat, your tube has a straight shot down the trachea. When doing this, preferably have the goat standing. As the tube is inserted, watch and feel the throat area. The tube needs to enter the esophagus and not the trachea or windpipe. The esophagus is a smooth, flexible tube leading to the stomach and one can feel or see the stomach tube sliding downwards. The trachea is a rigid tube and the stomach tube can neither be seen nor felt from outside the animal. When the tube is in the esophagus, feel the bottom of the neck. You should feel "two tubes." One will be the trachea and the other will be the rigid tube inside the esophagus.

Another check can be done while midway down the trachea/esophagus is to suck on the end of the tube. If you are in the esophagus, it will collapse on the tube and you will create a vacuum. Alternatively, blow in the tube and you will see a bolus of air go down the esophagus. If using a stethoscope applied to the goat's rumen on the left side of the body, you will hear air bubbling. Sucking on the tube while it is in the rigid walled trachea will not create a vacuum. One can also check for the smell of rumen fluid to ensure correct placement. To ensure proper depth of penetration, place the tube along the outside of the animal stretching from the mouth to the last rib, a point that would be inside the stomach, and put a mark on the tube. Use this as a guide when inserting the tube. Never rely on the goat coughing as a guide to proper tube placement. It is not a reliable test.

Bolus administration - "Balling"

A "balling gun" is used to administration tablets or boluses to an animal. A balling gun has a holder for the tablet in the end and a plunger to expel the tablet into the throat. Large boluses should be lubricated with vegetable or mineral oil for easier swallowing. Pass the balling gun over the hump of the tongue and press the plunger while holding and tilting the goat's head upwards. Ensure the tablet is swallowed by holding the mouth shut. Stroking the throat can also elicit a swallowing reflex.

Be very gentle in placing the balling gun into the mouth and expelling the pill. The tissues of the throat are very delicate and pills and guns have sharp edges. This can result in serious damage to your goat or minimally a goat with a very sore throat that will not eat. Newer model balling guns have soft plastic heads that reduce the potential for injury.

Paste administration

Dewormers, rumen pastes, and the like may come in a tube and are given through the use of an instrument resembling a caulking gun. Hold the animal as described for "balling," insert the end of the tube into the mouth and squeeze the handle the correct number of "clicks" to deliver an appropriate dose. Again, holding the goat's mouth shut will assist in swallowing.

Giving injections

Administering drugs via injection is a common herd health procedure routinely practiced by almost all producers. Following proper guidelines for each type of injection and using proper equipment will ensure that injections are done correctly and inflict minimum stress on an animal. Proper sanitation will ensure that you don't inject bacteria into your goat and cause an infection. Dirty needles and syringes should never be

used. Using needles and syringes on multiple animals can transmit disease. After making six to ten injections with a needle it will be dull and should be changed and disposed of properly.

Needle selection

Proper injection technique includes selection of an appropriate size syringe and needle. Syringes should have volume markers that would ensure administration of the correct amount of drug. Needle gauge should be considered as it relates to injection type and thickness or viscosity of drug. In general, 18 to 20 gauge needles (as gauge number increases, needle diameter decreases) are sufficient.

Proper injection sites

Live animals are considered unprocessed food, especially if those goats are intended for slaughter and later used in the food chain. Injection site lesions should be a major product quality concern for goat producers raising goats for meat. Injection-site defects are lesions or scars found in cuts of meat that result from tissue irritation caused by the administration of intramuscular or sometimes subcutaneous injections. In addition to the scarred tissue, tenderness of the meat is also significantly reduced in the affected area surrounding the site. Proper injection sites are described for each type of injection described.

Common injection methods

The three most common injection methods are subcutaneous (SQ, under the skin), intramuscular (IM, in the muscle), and intravenous (IV, into a blood vessel, usually the jugular vein). Subcutaneous injections are the easiest to give and intravenous the most difficult. Whenever a drug or vaccine lists SQ as an option for injection use the SQ route. Only experienced personnel should attempt to give an intravenous injection and professional assistance should be used in most instances. Intravenous injections provide the fastest absorption of a drug by the animal while subcutaneous the slowest.

Subcutaneous injections

To inject subcutaneously, pull up a pinch of skin making a tent. Insert the needle into the tent taking care not to pierce through the other side. Depress the plunger slowly. Injecting with the needle pointing towards the ground will lessen the likelihood of the material leaking out of the hole left by the needle. Massage the injected area. If administering large amounts of a drug, over 3 milliliters (ml or cc), it is best to divide the dose among two or more sites not giving more than 2 or 3 cc per site. The preferred site for SQ injections is the skin just behind the elbow, although they can also be given in the triangular area in front of the shoulders between the top and bottom of the shoulder blade and corner of the jaw. Vaccines often cause swellings or "knots" and a knot behind the elbow indicates an injection site whereas a knot in the neck in front of the shoulder could possibly be confused with a caseous lymphadenitis abscess.

Intramuscular

An intramuscular injection calls for the needle to be inserted into a muscle. Intramuscular injections are commonly given in the triangular area of the neck, in front of the shoulder. Do not give intramuscular injections in the loin or hind leg of goats that are used for meat purposes to prevent injection site blemishes from occurring that lowers the value of the meat. Volume given in the muscle should not be more than 3 ml per site.

After inserting the needle, pull back on the plunger slightly to make sure a blood vessel has not been penetrated. Administer the drug slowly. If a blood vessel has been pierced, the needle can be withdrawn slightly, repositioned, and checked again. Never give an injection near the spine to prevent accidentally causing nerve damage.

Intravenous

An intravenous injection requires skill to locate a vein, usually the jugular vein in the neck, insert the needle, and ensure that the needle remains in the vessel while the drug is given. Prior to attempting this, it is best to receive training from a veterinarian. Animals may react quickly to drugs given in this fashion due to rapid absorption. Very few drugs need to be given intravenously; however, blood samples often need to be collected and the technique is the same. The easiest approach is to have someone straddle the goat to hold it securely. The holder will elevate the goat's head up and to the side. If you have clippers, clip all of the hair off the bottom third of the neck. Feel for the trachea on the neck and move towards the top of the neck. The area between the trachea and the muscles of the neck is the "jugular groove" and is where the jugular vein lies. Put pressure at the bottom of the groove and you will see the groove swell from your finger up to the jaw of the goat. The vein is now filled with blood. Using an 18 to 20 gauge needle, direct it at an angle of 45 degrees then stab through the skin. Pull back on your syringe and see if there is blood present. If not, adjust the depth (deeper or more shallow) or move up or down the side of the groove until blood is obtained.

When you are injecting drugs IV, it is important to ensure that all of the drug enters the vein. Give the drug slowly. The jugular vein will take the administered drug straight to the heart and at high concentrations many drugs can cause problems with the heart. IV drugs given around the vein instead of in the vein can cause an irritation or inflammation of the vein.

Minor Surgical Procedures

Castration

Males not wanted as replacement bucks should be castrated. Castration can be done by various mean as early as between 2 to 4 weeks of age. There are several methods of castration and the method selected will depend upon the age of the animal. The most common methods are elastrator band, Burdizzo® or other clamp, or surgical methods. General sanitation and vaccination precautions should be followed. Additional information on castration procedures can be found in the Meat Goat Management section.

Some producers may delay castration until bucks are 2 to 3 months of age. This may lessen the incidence of urinary calculi or bladder stones (see the Goat Diseases section) in animals on a high grain or concentrate diet. Also, remember that intact bucks have high levels of testosterone which acts as a growth promotant and stimulates the production of lean muscle mass. Many goat meat consumers that eat young goats do not care if the meat comes from intact or castrated males. There are some ethnic markets that actually prefer meat from mature bucks. Know the market in your area. The point being that if it is not necessary to castrate goats for marketing purposes, then don't. However for breeding purposes realize that some bucks are fertile and ready to breed by 3 months of age and unwanted males should be castrated or separated from fertile females. In most climates photoperiod effects keep this from being a practical problem until kids are 9 to 12 months of age. In general, castration at an early age is the normal practice to reduce shock to the animal. Older animals should receive some type of anesthesia prior to castration and a veterinarian consulted.

Dehorning

Most meat goat producers will elect not to dehorn their goats. If the decision is made to raise goats without horns then kids should be disbudded in the first two weeks of life. Buck kid horns grow faster than doe horns. Some large single buck kids should be disbudded within the first week after birth. Disbudding a buck kid is the true test of proficiency of the person doing the dehorning and many fail, judging by the number of scurs seen on adult bucks. If you try to disbud a buck kid whose horn base is wider than a regular disbudding iron, you will get regrowth of the horn in a crown outside the burned area. If you try to disbud a small kid with a wide calf dehorner, you may get regrowth of the horn from the center of the ring. If one person is

doing the job, a disbudding box offers the best and safest restraining device. Approximate dimensions are given the accompanying illustration.

The use of a local anesthetic is commonly advocated; however, the actual technique is not easy and the baby goat will scream while being held in preparation for a ring block or a cornual nerve block. One week old kids are small animals and cannot be given large doses of lidocaine or toxicity will result. A one week old kid should get no more then 1 cc total of lidocaine. One technique used is to dilute the lidocaine with distilled water allowing a larger volume to be injected into the locations shown below. Have a veterinarian administer the anesthetic or train you in the procedure.

Veterinarians typically use systemic anesthetics to anesthetize the goat for dehorning. The commonly used drugs are xylazine (Rompun) and ketamine (Vetalar). These can only be administered by a veterinarian.

The disbudding equipment most commonly used is an electric-heated metal rod with a hollowed-out end. Newer cordless, butane gas powered dehorners are available. Some disbudding irons have problems in maintaining a constant temperature, and it is extremely important to match temperature and time. Under-burning of the horn bud will result in scurs while over-burning will lead to brain damage or death. The horn buds can generally be felt in young kids to ensure proper location to burn. After the disbudding iron is hot, apply it firmly over the horn area and rock it around slowly for 3.5 to 4 seconds. Remove the iron and repeat if necessary and do the other side. Evaluate the success of the procedure by its appearance. The goal is to have the area look like "chrome tanned leather." Black color represents burned hair and is indicative of inadequate burning. Clipping the site prior to burning will eliminate the problem of burned hair. Scent glands are located near the base of the horn and descenting could be done at the same time if desired. Inject the kids with 150 IU tetanus antitoxin. Although the risk of tetanus after disbudding is not great, it is a good practice to administer tetanus antitoxin.

An alternate disbudding method is the use of a caustic paste. The hair around the horn bud should be clipped and the paste applied. A ring of petroleum jelly around the horn bud may help prevent the paste from burning other skin tissue. Caustic paste sounds more benign than burning horn tissue; however, the paste has a bad habit of causing chemical burns on other parts of the goat or on his/her pen mates. To use caustic paste, make sure the kid is kept by itself so that it doesn't rub the chemical on the udder of its mother or the faces of its friends (not practical with most meat goat kids) and that it is kept out of the rain so that rain water doesn't wash the chemical into the goat's eyes.

Lancing abscesses

Goats get a variety of swellings or "knots" at various locations on their bodies. Some of these are cysts (fluid filled structures) and some of these are abscesses (puss filled structures). There is a disease of goats called caseous lymphadenitis (CL) that causes abscesses in the lymph nodes of goats. See the section on Meat Goat Herd Health - Common Diseases for more details.

One way of speeding the healing of an abscessed goat and of containing all of the infectious material from the abscesses is to lance it. This is usually a very simple and safe procedure. The first thing to do is be patient. Wait until the abscess comes to a "head." This is when the abscess is attached to the skin and the hair has begun to come off at the top of the abscess. The center of the abscess will soften. At this point, there are no vital blood vessels or other structures between the puss in the abscess and the outside of the goat.

Since pus is infectious to other animals and humans, wear gloves when performing this procedure. Remove any remaining hair from the region. Scrub the area with disinfectant soap (Betadine Scrub®) and restrain the goat. If this is done correctly it is not a painful procedure for the goat. Take a pinch of skin in the center of the abscess with your gloved hand or a surgical tool (such as a towel clamp) and stab a scalpel or sharp, sterilized knife blade deeply into the abscess and cut out a circle of skin. Just slashing the abscess

Recommended needle sizes and lengths used in goats			
Age	Gauge	Needle length	
		Intramuscular injection	Subcutaneous injection
< 4 weeks old	20	½ inch	½ inch
4 to 16 weeks	20	⅝ to ¾ inch	½ inch
4 to 6 months	20	1 inch	½ inch
> 6 months	18 to 20	1 inch	½ inch

may allow the cut to seal over before the abscess has healed from the inside out. There will be some white, or greenish white, odorless puss come out of hole created in the abscess. Catch it in a disposable bag and dispose of it where other goats can't get into it. Caseous lymphadenitis is a contagious disease. It is also a zoonotic disease, meaning it can be transmitted to humans, so wear gloves and sanitize your hands and equipment used after this procedure.

After lancing the abscess flush the area with diluted Betadine Solution® (10:1, 10 parts water to 1 part solution) to flush out any residual puss or bacteria. Make sure you keep the goat away from other goats until the lesion has completely healed.

Normal Range for Goat Physiological Parameters

Temperature, rectal	103–104° F (39–40° C)
Heart rate	70–90 beats per minute
Respiration	12–20 per minute
Rumen movements	1–2 per minute
Puberty	4–10 months
Estrous cycle	21 days
Estrus (standing heat)	12–48 hours
Gestation	150 days

Extra-Label Drug Use

There are few drugs for use in goats that have Food and Drug Administration (FDA) approval. Administering any drug not specifically labeled for use in goats or any product, either prescription or over the counter, that is not used as directed on the label is considered "Extra-label" or "off-label" drug use. Only veterinarians may prescribe or use products "off-label" or "Extra-label" provided they have a valid veterinarian - client - patient relationship (VCPR) with the producer.

The issue of "extra label" use also applies to feed medications not approved for use in goats. While extra-label use of medications in or on animal feed is prohibited, in 2001 the FDA provided guidance on extra-label use of medicated feeds in minor species such as goats. In brief, extra-label use of medicated feed in minor species is limited to treatment of animals whose health is suffering or is threatened or whose death may result from failure to treat. If medicated feed is to be used in a food producing minor species, the product used must be approved for use in a food producing major species. The FDA discourages use of medicated feed in an extra-label manner for improving rates of weight gain, feed efficiency, or other production purposes.

Most goat producers are unaware that they do NOT have "extra-label" drug use privileges. Only veterinarians who have established a VCPR with a particular client may prescribe or use drugs in an extra-label

manner on that client's animals if the animal health is threatened and suffering or death may result from failure to treat. To establish a VCPR, the veterinarian should have visited the farm, and have a thorough knowledge of the management of these animals, or has recently seen the animal to be treated. Once a VCPR has been established, the veterinarian may use drugs in an extra-label manner provided that the client has agreed to follow his or her recommendations.

Three conditions of extra-label drug use:

1. The veterinarian has examined the animal(s) in question recently and has made a diagnosis and a determination that products with proper labeling will not work in this instance.
2. The client has been instructed by the veterinarian in the proper use and administration of the product, a withdrawal period has been determined, and the client is willing to follow the instructions given by the veterinarian.
3. The veterinarian is available to respond to any adverse reaction or follow up examination and treatment that may occur to the animal due to the administration of the drug or failure of the drug to work.

FDA criteria for Using Pharmaceuticals Extra-Label

The FDA has also established five criteria that must be met before any drug may be used in a food-producing animal in a manner different from that product's label.

1. The veterinarian must first examine the animal and assumes responsibility for making clinical decisions regarding the health and treatment of the animal within the guidelines of a VCPR. Often a goat owner will not have the animal examined by a veterinarian, but will telephone a veterinarian, who may never have visited the farm, with a list of symptoms and ask for a recommended treatment. This does not qualify as VCPR!
2. The second criterion requires that the veterinarian determine there is no marketed drug specifically labeled to treat the diagnosed condition, or that the recommended dosage on the label for that product is clinically ineffective. Since there are few drugs labeled for use in goats, it is not difficult to determine whether or not there is a legally licensed product available.
3. The third criterion requires that the individual animals to be treated are clearly identified, and that accurate records be maintained regarding the treatment of those specific individuals. If there is no permanent identification such as an ear tag, notch, or tattoo, the owner must make some effort to identify the treated animals with a visible temporary mark by using temporary tags or paint. If possible, these animals should be isolated. Records on animals and treatment must be kept for future reference to avoid any drug residues in the meat or milk.
4. The fourth criterion requires that a significantly extended time period be assigned for drug withdrawal prior to marketing meat or milk from treated animals. The owner must keep accurate records of the treatment, namely the person treating this animal, date, route of administration, product used and a proper withdrawal period. Proper withdrawal period can be obtained from your veterinarian. Veterinarians can access drug information at the Food Animal Residue Avoidance Databank, http://www.farad/org.
5. Many goat owners casually treat their animals and do not keep proper records of animals treated, drugs used, or proper withdrawal period for that product. If no information is available to establish a withdrawal time, then the treated animal or animal products such as milk and meat are permanently barred from the human food chain. This is to prevent illegal drug residues in products for human consumption. Although there are no drug residue test kits marketed specifically for goat meat, owners should be aware that drug residue testing is conducted on milk and meat produced for human consumption.

6. The last criterion details the information that must be listed on the drug dispensed for extra-label use. The label should include the name and address of the veterinarian, the established name of the drug(s), and the specific directions for use including: dosage, routes of administration, frequency of treatment, duration of therapy, cautionary statements, and the withdrawal time for any food that might be derived from the treated animal.

Ten Drug Use Tips

The following drug use tips can help ensure the proper administration of drugs and adherence to proper withdrawal times. All producers should restrict access to drugs to prevent indiscriminate or improper use. Remember that animal health products can be human health hazards.

1. Read the label carefully – labeling directions change frequently.
2. Use drugs only in animal species listed on the label or follow the "extra label" directions of a veterinarian.
3. Use the proper dose for the size of animal to be treated – overdosing can cause illegal residues.
4. Calculate pre-slaughter drug withdrawal times accurately – determine pre-slaughter withdrawal and milk discard times from the latest drug administration.
5. Use the correct route of administration – giving drugs incorrectly can lead to drug ineffectiveness, adverse reactions, illegal residues, and possible animal deaths.
6. Do not "double dose" – use of the same drug in the feed and by injection can cause illegal residues.
7. Select needle size and injection sites carefully, if injections are necessary – misuse can lead to tissue damage, reduced effectiveness, and/or illegal residues.
8. Allow proper withdrawal times for feed containing drugs – during the withdrawal time ensure that storage bins and feed are completely free of medicated feed and feed only drug-free feed or illegal residues may result.
9. Keep accurate records of drugs used and animals dosed – poor records can be costly if drug residue violations occur.
10. Seek the advice of your veterinarian – your records will allow him/her to provide safer and more effective treatment and save you money by preventing illegal residues.

For a complete explanation of all the precautions you need to take in using any particular drug or feed medication, first consult the drug label or feed tag. If you have any questions about the proper use of any drugs, see your veterinarian.

Medications Commonly Used in Goats and Approximate Withdrawal Times

The following tables list medications commonly used in goats with their dosages and estimated withdrawal times (WDT). These tables are adapted with permission from the author Dr. Seyedmehdi Mobini of Fort Valley State University, Fort Valley, GA, from a paper that appeared in the proceedings of the Georgia Veterinary Medical Association Food Animal Conference in 2003. These recommendations were formulated by Dr. Mobini through a review of the literature in the United States and foreign countries, recommendations of the Food Animal Residue Avoidance Databank (FARAD), and personal experience. For many of the drugs mentioned, FARAD has calculated a Withdrawal Interval (WDI) to distinguish from the regulatory and approved WDT. The WDI is based on foreign drug approvals or extrapolations based on available tissue residue and/or related pharmacokinetic data on these drugs. In some cases, there is insufficient or no pharmacokinetic data from which FARAD can derive a WDI for goats. In those instances, FARAD has relied on sheep or cattle data and then added a scientifically-based time period to extend beyond the approved WDT to ensure safety as well as compliance with the Animal Medicinal Drug Use and Clarification Act of 1994 (AMDUCA).

Finally, the reader should be aware that there are several drugs which may be approved for specific species at a specific dose and route of administration, but are PROHIBITED FROM EXTRA-LABEL USE in any major or minor food animal species. These include Fluoroquinolones/Enrofloxacin (Baytril) and Phenylbutazone (Dairy). Other drugs are PROHIBITED FOR USE UNDER ANY CONDITION IN ANY ANIMAL THAT WILL BE USED FOR HUMAN FOOD. These drugs are: Dipyrone, Clenbuterol, Nitrofurazones, Nitrofurans (Furacin), Nitroimidazole (Metronidazole, Dimetridazole, Ipronidazole), Diethylstilbesterol, Glycopeptides (Vancomycin) and Chloramphenicol.

Herd Health at Different Production Stages

Goats have different health needs according to their stage of production. Providing for these health needs will increase your chances of having a healthy, productive herd.

Pre-breeding

Breeding does

Thirty to sixty days before the breeding season does should be examined for their udder and teat conformation, dentition (teeth), musculo-skeletal problems, and feet and body condition. Culling decisions should be made. Some common conditions seen in does include lameness, chronic mastitis, bad teats, and poor body condition due to a chronic disease, parasitism, old age, or other cause. Doelings should be at least 65 to 70% of their mature weight before their first breeding.

Prebreeding vaccination for *Chlamydia* should always be given. *Leptospirosis* and *Campylobacter* are less common causes of reproductive failure and abortion and vaccinations may be done, if the disease is present. Monitor fecal egg counts and deworm if needed. Does can be supplemented (flushed) with grain 2 to 4 weeks before breeding this will improve their fecundity (number of kids born per doe). Abrupt fence line exposure to bucks in the late transition period in the fall when does can begin to come into heat can help bring about cycling.

Breeding bucks

Bucks are too often neglected and omitted from herd health management practices. Some of the common conditions seen in bucks are urinary calculi (stones), lameness, urine scalding around the prepuce, and front leg injury due to a dominant buck in the pen. In the case of urinary scald, wash the affected area. Application of petroleum jelly can help protect the affected areas. Maintain a 2:1 ratio of dietary calcium to phosphorous and provide a high level of salt (up to 4%) and 1 to 2% ammonium chloride in the diet to prevent urinary calculi. Bucks should be vaccinated at the same time as the does and for the same diseases. Body condition and breeding soundness should be evaluated at least 4 weeks before the breeding season and adjustments made to prevent bucks from becoming overly thin or obese. As breeding season approaches, extremely aggressive and dominant bucks may need to be penned separated to prevent injury. Monitor fecal egg counts in bucks or FAMACHA score and deworm as needed.

Breeding Season

Watch does and bucks carefully during the breeding season. This is a particularly strenuous time for bucks. Lame or sick bucks will not be able to breed adequate numbers of does. Fertility is drastically decreased by hot weather. Do everything you can to cool the buck off. This may include shade and fans during the day in very hot climates.

Gestation

Pre-parturition

A kid health and 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. An adequate diet for dry does is essential to produce healthy kids. Pregnant does should be fed to have a good body condition (score of 3.0 to 3.5 just prior to kidding). Does should be scored in early pregnancy and again six weeks prior to kidding. Remember that most fetal growth occurs in the last one-third of gestation and feed quantity and quality may need to be increased during this time. Clean, cool water and free choice trace-mineralized salt should be available.

Booster vaccinations for Clostridium perfringens C and D and tetanus toxoid should be given not less than 3 weeks prior to kidding. Vitamin E/selenium injections may be given during the dry period to prevent white muscle disease in kids, especially in areas where soils are selenium deficient and supplementation is inadequate. However, a nutrition program designed to provide adequate dietary selenium is preferable to providing injections. Provide other vaccinations or boosters for diseases causing abortion. Monitor fecal egg counts or FAMACHA score and deworm as needed.

Parturition (kidding)

While most meat goat does kid on pasture, there may be times when animals are brought indoors for kidding. The doe should kid in a clean environment; either a well-drained clean pasture or a 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 kidding stall or pasture should be located near a well-traveled area so that the doe can 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.

Signs of impending kidding include udder engorgement, swelling of the vulva, restlessness, and mucous discharge. The ligaments in the pelvic area will relax and the udder secretion's will change from clear honey-like to thick white milk (colostrum). The doe may also lose appetite. There are three stages of parturition. Stage 1 consists of uterine contraction and cervical dilation. This stage may last from three to six hours or more. The water bag ruptures at the end of this stage. Abdominal contractions will occur in Stage 2 and the fetus should be born within one hour. If the doe is having to provide undue straining or birth is delayed then examination and assistance may be needed; particularly if the doe is straining hard for 15 minutes or more. A veterinarian may need to be called. Stage 3 consists of expulsion of the placenta and usually occurs within a few hours after the last fetus is born.

Problems in parturition

Most does will kid with little to no assistance required; however, problems can occur. Many of these problems revolve around either incorrect presentation of the fetus or a kid that is to large for the mother's pelvis. In a normal birth presentation the forefeet will enter the birth canal first, the hooves will be pointed downwards, and the head will be between the legs. Another presentation that is sometimes seen that usually causes little problem is when the rear legs enter the birth canal first. In this case, the kid's hooves will be pointed upwards. Abnormal presentations include the rump first (breech) or any of the legs or the head bent backwards. In these cases, assistance is required.

When assisting birth, it is important to clean the area around the vulva with disinfectant soap and warm water and to have clean hands. Wear gloves. There are certain diseases that can be transmitted to humans during this time period. Pregnant women should not assist with the kidding process. Lubricate the hand prior

to entering the vagina. Feel and identify the parts of the kid. Try to ensure that all body parts felt belong to the same kid and not to two separate bodies. If you feel only one leg or no legs at all, reach further and try to determine the exact position of the fetus. Arrange the legs and/or head gently in a proper position for birth. The fetus may have to be pushed forward towards the doe's head until a leg can be grasped and repositioned. Once the limbs are in a proper position, the kid should be gently pulled out and downwards using only your hands. Clear the mouth and nasal passages of the kid with straw or a towel and ensure it is breathing. Rubbing the body with a piece of cloth can sometimes stimulate breathing. Never pull on any presentation other than a normal presentation of two front legs and a head or a presentation of two hind legs and a tail. Pulling on any other arrangement of limbs and body parts will only make the problem worse.

If the anticipated kidding problems appear severe, call for a veterinarian immediately.

Kid management at birth

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 (7% iodine solution) to prevent entry of disease-causing organisms through the navel cord and directly into the body of the kid. Make sure the entire cord is immersed in the iodine solution. If necessary, a long navel cord can be cut to 3 or 4 inches in length. Dipping 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.

Another critical practice is the feeding of colostrum as soon after birth as possible. The colostrum, or first milk, contains antibodies, which the doe does not pass to the fetal kid in the womb. Consumption of colostrum must occur as early as possible, ideally within 2-4 hours of birth. At 24 hours after birth there is a rapid reduction in the permeability of the intestinal wall to colostral antibodies. If a newborn kid does not or cannot nurse, the colostrum should be bottle-fed or the kid should be tube fed 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 milk and transmission might be avoided through the use of extra colostrum frozen from does tested and shown to be CAE-free or by feeding pasteurized colostrum. CAE is not considered to be a problem on most meat goat farms.

Kids should receive colostrum equal to 10% of their body weight during the first 24 hours of life. For example a six pound kid (96 ounces) should receive 10 ounces (roughly 300 ml) of colostrum within 24 hours of birth. This should be divided into at least 3 feedings. If fresh or frozen goat colostrum is not available, a commercial goat, sheep or cow colostrum replacement could be used. Fresh cow colostrum may also be used if necessary.

Under certain conditions newborn kids may benefit from injections of vitamins A and D approximately four days after birth. An iron dextran injection can be given but care is needed as iron is potentially toxic. A vitamin E/selenium injection may be beneficial in areas of selenium-deficient soils. These injections should be planned with your veterinarian as part of your herd health calendar. In general injection of vitamins and minerals is not necessary. If supplementation is necessary it is done more safely by dietary supplements. Realize that the fat soluble vitamins and minerals are toxic if given in excess.

Kids should be checked carefully at birth for any physical deformities or abnormalities. Pneumonia is a major killer of young kids. A clean, dry, draft-free environment is an excellent preventative measure.

Artificial raising of kids

Milk is the principal component of the diet of the pre-weaning kid. Most meat goat kids will nurse their dam until weaning. However, for orphaned kids or for kids of does that have lactation problems it may be necessary to use a milk replacer. Goat milk replacers are commercially available. If necessary, a lamb milk

replacer may be used as a substitute for goat milk. Typical lamb milk replacers contain 22 to 24 % protein and 28 to 30% fat (on a dry matter basis). If no other milk replacer is available whole cows milk or calf milk replacers can be used. Maintaining milk replacer quality after mixing is particularly important when kids are fed ad libitum (all they can consume).

Milk can be fed by using bottles, pails, or 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 4 to 5 times daily for the first and second week and 2 to 3 times 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.

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 (40°F) that will limit intake by the kid at any one time. Small, frequent feedings increase digestibility and decrease digestive disturbances. Rapid consumption of large quantities of milk may lead to fatal bloat due to entry of milk into the reticulo-rumen. Rapid passage of milk through the abomasum and small intestines can result in diarrhea or nutritional scours.

The biggest problem with kids bottle fed lamb milk replacer occurs with the feeding schedule. Frequently kids become "pets" and there is a tendency to feed them as much milk as they will consume each feeding. Unfortunately, this may result in bloat and sudden death due to enterotoxemia or diarrhea. A restricted feeding schedule and amount is necessary.

Feeding schedule and amount for bottle fed kids.

Age	Amount of Fluid/Feeding	Feeding Schedule
1 to 3 days	4 ounces	5 times a day
3 days to 2 weeks	8 to 12 ounces	4 times a day
2 weeks to 3 months	16 ounces	3 times a day
3 months to 4 months	16 ounces	2 times a day

Dam raised kids

Most meat goat kids will be raised with their dams on pasture. While this removes the need for feeding milk replacer, these kids should not be forgotten in terms of nutritional and health needs. Producers must remember that since these kids are raised in the same environment as their dams, they are also exposed to the same health, disease, management, and grazing conditions. If internal parasites are a problem in the dams, expect the same in the kids and take management steps to reduce exposure to internal parasites through pasture rotation or other means. Crowding should be avoided and, if housed at any time, clean bedding and adequate ventilation are a must. Kids are naturally curious and will begin nibbling on items in their surroundings early in life. If there are toxic substances or plants, plastic, or other harmful materials lying about chances are some kids will eat them. If pasture is of very poor quality, kids beginning to nibble on grass or hay will not receive much nutritional benefit. This can slow down early growth.

Medications Commonly Used in Goats and Approximate Withdrawal Times

Dr. Seyedmehdi Mobini, Georgia Small Ruminant Research & Extension Center, Fort Valley State University, Fort Valley, GA

The drugs listed in this table are commonly used in goats. There are only a few drugs approved by the FDA to be used in goats. ***Use of drugs listed as "extra-label" is legal only if prescribed by your veterinarian in the context of a valid client-patient relationship.*** The withdrawal times for various drugs were compiled from different sources. The listed dosages and withdrawal times, as well as drug status and legality of use, is subject to change. Your veterinarian will prescribe the latest, most up-to-date drugs, dosages, and provide the correct withdrawal period. ***Consult your veterinarian before beginning any treatment!***

I. Antibiotics:	**Brand Name**	**Approval**	**Dosage**	**Route**	**Frequency**	**Withdrawal Time**	
						Meat	Milk
Ceftiofur	Naxcel®	APPROVED	0.5-1 mg/lb	IM	Once a day	0 days	0 days
Neomycin	Biosol® and other products	APPROVED	5 mg/lb	PO	Twice a day	3 days	NA
Amoxicillin	Amoxi-inject®	extra-label	5 mg/lb	SQ	Once a day	26 days	120 hours
Ampicillin	Polyflex®	extra-label	5 mg/lb	SQ	Once a day	10 days	72 hours
Benzathine Pen G	Pen BP-48®	extra-label	20,000 IU/lb	SQ	Every 48 hours	30 days	NA
Erythromycin	Erythro-200®	extra-label	1 mg/lb	SQ	Once a day	5 days	96 hours
Florfenicol	Nuflor®	extra-label	9 mg/lb	IM	Every 48 hours	28 days	120 hours
Oxytetracycline	LA-200®	extra-label	9 mg/lb	SQ	Every 48 hours	29 days	144 hours
Procaine Pen. G	Crysticillin®	extra-label	10,000-20,000 IU/lb	SQ	Once a day	16-21 days	120 hours
Sulfadimethoxine	Albon®	extra-label	25 mg/lb Day 1, 12.5 mg/lb Days 2 - 5	PO	Once a day	12 days	5 days
		EXTRA-LABEL USE IS PROHIBITED IN LACTATING DAIRY COWS. DO NOT USE IN LACTATING DAIRY DOES.					
Tylosin	Tylan®-200	extra-label	10 mg/lb	IM	Once a day	30 days	96 hours
Chloramphenicol	Chloramphenicol	EXTRA-LABEL USE IS PROHIBITED					
Enrofloxacin	Baytril® 100	EXTRA-LABEL USE IS PROHIBITED					
Furacin, nitrofurantoin	Furox®	EXTRA-LABEL USE IS PROHIBITED					
Gentamicin	Gentocin®	DO NOT USE					
Tilmicosin	Micotil®	DO NOT USE – TOXIC TO GOATS					

II. Anti-inflammatory Drugs:	Brand Name	Approval	Dosage	Route	Frequency	Withdrawal Time	
						Meat	Milk
Aspirin	Aspirin	extra-label	100 mg/kg	PO	Once a day	1 day	24 hours
Flunixin meglumine	Banamine®	extra-label	1.1-2.2mg/kg	IV or IM	Once a day	10 days	72 hours
Phenylbutazone	Bute	extra-label	10-20 mg/kg	PO	Once a day	60 days	DNU
		DO NOT USE IN LACTATING ANIMALS					
Dipyrone	Dipyrone	EXTRA-LABEL USE IS PROHIBITED					

III. Prevention of Coccidiosis:	Brand Name	Approval	Dosage	Withdrawal Time	
				Meat	Milk
Decoquinate	Deccox®	APPROVED	13-91 gm/ton of feed	0 days	24 hours suggested minimum, DNU
Monensin	Rumensin®	APPROVED	15-20 gms/ton of feed	0 days	96 hours suggested minimum, DNU
Amprolium	Corid®	extra-label	25-50 mg/kg BW in feed or water	2 days	48 hours
Lasalocid	Bovatec®	extra-label	20-30 gms/ton of feed	0 days	24 hours

IV. Anthelmintics:	Brand Name	Approval	Dosage	Route	Withdrawal Time	
					Meat	Milk
1. Avermectins:						
Doramectin	Dectomax®	extra-label	0.3 mg/kg	SQ	56 days	40 days
Eprinomectin	Eprinex®	extra-label	0.5 mg/kg	PO	NA	NA
Ivermectin	Ivomec® Drench	extra-label	0.3 mg/kg	PO	14 days	9 days
Ivermectin	Ivomec® 1%	extra-label	0.3 mg/kg	SQ	56 days	50 days
Moxidectin	Quest®, Cydectin®	extra-label	0.5 mg/kg	PO	23 days	56 days
	Cydectin® drench	extra-label	0.3 mg/kg	PO	14 days	NA
	Cydectin® Injectable	extra-label	0.2 mg/kg	SQ	30 days	DNU

2. Benzimidazoles:						
Albendazole	Valbazen®	extra-label	10 mg/kg	PO	7 days	120 hours
Fenbendazole	Panacur®/ Safeguard®	APPROVED at 5 mg/ Kg, extra-label as recommended	10 mg/kg	PO	14 days	120 hours
Oxfendazole	Synanthic®	extra-label	10 mg/kg	PO	14 days	120 hours
3. Cholinergic Agonists:						
Morantel Tartrate	Rumatel®	APPROVED	10 mg/kg	PO	30 days	0 days
Levamisole	Levasole®	extra-label	8 mg/kg	PO	10 days	4 days

V. Anesthetics and Tranquilizers	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Ketamine	Ketaset®	extra-label	5-10 mg/kg	IV or IM	3 days	48 hours
Lidocaine	Lidocaine	extra-label	Variable for local anesthesia use, 1% in goats			
Thiamylal Na	Biotal	extra-label	10-20 mg/kg	IV	1 day	24 hours
Xylazine	Rompun®	extra-label	0.05-0.1 mg/kg	IV or IM	5 days	72 hours
Yohimbine	Yobin	extra-label	0.25 mg/kg	IV	7 days	72 hours

VI. Hormones:	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Cloprostenol	Estrumate®	extra-label	125 microgram	IM	0 days	0 days
Dexamethasone	Azium®	extra-label	20-25 mg	IM	14 days	4 days
Dinoprost	Lutalyse®	extra-label	5-10 mg	IM	1 day	24 hours
Oxytocin	Oxytocin	extra-label	10-20 IU	IM	0 days	0 days

VII. Electrolytes	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Calcium	Calcium borogluconate	extra-label	60 to 100 ml of 20 to 25% Solution	IV	0 days	0 days
Calcium	Calcuim gluconate	extra-label	50 to 100 ml 10 to 23% calcium ion solution	IV	0 days	0 days

NOTE: In the table above PO = oral administration; SQ = subcutaneous injection; IM = intramuscular injection; IV = intravenous injection. DNU = insufficient data available to make WDI estimation, this drug is not approved for lactating goats.

Early access to a creep feed or creep pasture containing lush, nutritious forage will benefit kids becoming accustomed to solid feed, the development of their gastrointestinal tract, and in their early growth. Entry into the area containing creep feed or pasture should be restricted to kids by fencing or gates that prevent the entry of adult animals.

Weaning

In raising goat kids, increases in size and weight are not the only measure of success. A well-formed skeleton and proper development of internal organs are often neglected when the emphasis is on rapid gains. Dry feed consumption is important in developing body capacity. By increasing body capacity, feed intake and digestion increase.

In bottle fed kids over two weeks of age, limiting daily milk consumption to about 48 ounces will encourage daily consumption of dry feed. No later than three to four weeks of age a goat/lamb creep feed, other suitable creep feed, or even a calf starter should be offered. As the hay and grain consumption increases, gradually reduce the milk being fed. When the kid is eating ¼ pound of grain per day plus some hay and is drinking water from a bucket, it is time for weaning. 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.

Kids on pasture should be consuming forages such as pasture grass or hay by two weeks of age and grain within four. Careful attention needs be given to formulation of a concentrate supplement for the pre-weaning kid. Palatability is of primary concern. Molasses at the rate of 10% of the total dry matter, corn (preferably chopped or rolled) and whole or rolled oats make up the energy "core" of a good pre-weaning 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 5% or less to provide additional stimulation for reticulo-ruminal development.

Several factors need to be considered when making the decision as to weaning. 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.

Vaccination Schedule for Meat Goats

Other disease preventive measures

Dam – 1 month prior to kidding

- CDT vaccine to help increase antibodies against enterotoxemia and tetanus in the colostrum. In areas deficient in Se and where supplementation is inadequate, BoSe® to raise selenium levels and prevent white muscle disease in kids and retained afterbirth in dam. Providing a proper mineral nutrition program to ensure adequate consumption of all minerals is preferable. Get local veterinary advice on selenium injections as the need and dosage level depend upon how much selenium is in the soil in the region, as well as on the dietary supplementation.

Kid – birth to first week

- BoSe® + vitamins A&D – use depends on soil in the region and the diet of the dam.

Kid – 3 weeks – begin coccidiosis prevention

- 4 and 8 weeks – CDT series.
- 4 to 8 weeks - BoSe® - repeat if in selenium deficient area.
- 6 to 8 weeks – begin monitoring for parasites and deworm as needed, especially if kid has access to outdoors.

Period	Time to Vaccinate	Disease	Booster
Kids	4 and 8 weeks of age.	C. perfringens C&D*. C. tetanus – toxoid.	Prebreeding.
	Between 8 and 12 weeks of age (single vaccination).	Contagious ecythma.	If a problem in herd.
	8 and 12 weeks of age.	Caseous lymphadenitis.	If a problem in herd.
	16 weeks of age.	Rabies.	Given if there is a rabies concern. Yearly booster.
Prebreeding			
Doelings and bucklings	60 and 30 days prior to breeding.	Chlamydia. Campylobacter. Leptospirosis.	If a problem in herd.
Does and bucks	30 days prior to breeding.	Chlamydia. Campylobacter. Leptospirosis. C. perfringens C&D*. C. tetanus - toxoid.	If a problem in herd.
Gestation			
Does	30 days prior to kidding.	C. perfringens C&D*. C. tetanus - toxoid.	

-8-way clostridials like Covexin 8 could be used instead of C. perfringens C, D &T.

Herd Health Calendar

A custom designed calendar is an excellent way to ensure the health of the herd is maintained. A calendar can be designed based upon your specific herd's production cycle. Consult with a veterinarian on the timing and need for vaccinations and other management procedures related to the health and well-being of your herd.

Planning Calendar for Meat Goat Herd Health

Stage	Suggested Health Practices	Additional Practices
Pre-breeding (30-60 days)	*Bucks* • Be aware of heat stress. • Breeding Soundness Evaluation done. • Vaccinate for Clostridium perfringens type C&D, plus Tetanus Toxoid. • Vaccinate for Chlamydia, Campylobacter and Leptospirosis, if necessary. • Trim feet. • Body Condition Score and adjust management accordingly. • Deworm based upon fecal egg counts or FAMACHA score. *Does* • Vaccinate for Chlamydia, Campylobacter, and Leptospira if necessary. • Vaccinate for Clostridium perfringens type C&D, plus Tetanus Toxoid. • Trim feet. • Body Condition Score and adjust management accordingly. • Deworm based upon fecal egg count or FAMACHA score at least two weeks before breeding. • Final cull of does based on production records, udders, feet, and type.	• Vitamin E and selenium given to does 30-45 days before breeding in selenium-deficient areas. • See Vaccination Schedule for Meat Goats • Put bucks next to doe pens. The "buck effect" will bring transitional does into heat.

Breeding	*Bucks* • Provide additional feed. • Be aware of heat stress, provide shade. *Does* • Observe for heat or use marking harness on bucks • If desired, check for pregnancy at 45-60 days with ultrasound.	• Make sure cats are not defecating in feed to prevent Toxoplasmosis. • Perform fecal egg count or check FAMACHA score and deworm if necessary. • Treat for flukes if a problem in the herd.
Pre-kidding (15-30 days)	*Does* • Booster Clostridium perfringens type C&D, plus Tetanus Toxoid. • Deworm based upon fecal egg counts or FAMACHA score. • Body Condition Score, adjust management accordingly • Watch for pregnancy toxemia.	• Perform fecal egg count or check FAMACHA score and deworm if necessary. • Begin to collect supplies for kidding.
Kidding	*Does* • Observe 3-5 times per day. • Assist if needed. *Kids* • Clip, dip, and strip: • Clip navel cord to 2-4”, • Dip navel in 7% iodine, • Strip small amount of milk to make sure teat ends are open.	

Nursing/Lactation	*Does* • Feed extra feed to does with multiple kids. *Kids* • Observe daily for signs of diarrhea or respiratory disease. • Vaccinate – Clostridium perfringens type C&D and Tetanus, revaccinate at four weeks after first injection. • Castrate males before three months of age. • Start creep feeding by two weeks of age.	• See Vaccination Schedule for Meat Goats
Weaning	• Weaning at three to five months or when marketed as young kids. • Check for internal parasites and deworm if needed.	• May want to use coccidiostat in creep feed and post-weaning feed.
Post-weaning/Drying	• About every four weeks, check for internal parasites and deworm as needed. • Reduce feed to does just before weaning. • May want to reduce water availability for a day or two after weaning.	

Goat Guideline for Anthelmintic Dosages (internal parasite dewormers) July 2006

Important --- Please read notes on the following page before using this chart

		Oral dosing. Note: 1 ml = 1 cc						Subcutaneous injection
		Valbazen Albendazole[1]	SafeGuard Fenbendazole[2]	Ivomec Ivermectin[3]	Levasole Levamisole[4]	Cydectin Pour-on Moxidectin[5]	Cydectin Drench Moxidectin[6]	Cydectin *Injectable* Moxidectin[7]
Animal Weight		20 mg/kg	10 mg/kg	0.4 mg/kg	12 mg/kg	0.5 mg/kg	0.3 mg/kg	0.2 mg/kg
lbs	kg	2 ml/ 25 lb	1.1 ml/ 25 lb	6 ml/ 25 lb	3 ml/ 25 lb	1.1 ml/25 lb	3.4 ml/25 lb	1 ml/ 110 lb
20	9.1	1.6	0.9	4.8	2.4	0.9	2.7	0.2
25	11.4	2.0	1.1	6.0	3.0	1.1	3.4	0.2
30	13.6	2.4	1.4	7.2	3.6	1.4	4.1	0.3
35	15.9	2.8	1.6	8.4	4.2	1.6	4.8	0.3
40	18.2	3.2	1.8	9.6	4.8	1.8	5.4	0.4
45	20.5	3.6	2.1	10.8	5.4	2.1	6.1	0.4
50	22.7	4.0	2.3	12.0	6.0	2.3	6.8	0.5
55	25.0	4.4	2.5	13.2	6.6	2.5	7.5	0.5
60	27.3	4.8	2.7	14.4	7.2	2.7	8.2	0.5
65	29.5	5.2	3.0	15.6	7.8	3.0	8.8	0.6
70	31.8	5.6	3.2	16.8	8.4	3.2	9.5	0.6
75	34.1	6.0	3.4	18.0	9.0	3.4	10.2	0.7
80	36.4	6.4	3.6	19.2	9.6	3.6	10.9	0.7
85	38.6	6.8	3.9	20.4	10.2	3.9	11.6	0.8
90	40.9	7.2	4.1	21.6	10.8	4.1	12.2	0.8
95	43.2	7.6	4.3	22.8	11.4	4.3	12.9	0.9
100	45.5	8.0	4.6	24.0	12.0	4.6	13.6	0.9
105	47.7	8.4	4.8	25.2	12.6	4.8	14.3	1.0
110	50.0	8.8	5.0	26.4	13.2	5.0	15.0	1.0
115	52.3	9.2	5.2	27.6	13.8	5.2	15.6	1.0
120	54.5	9.6	5.5	28.8	14.4	5.5	16.3	1.1
125	56.8	10.0	5.7	30.0	15.0	5.7	17.0	1.1
130	59.1	10.4	5.9	31.2	15.6	5.9	17.7	1.2
140	63.6	11.2	6.4	33.6	16.8	6.4	19.0	1.3
150	68.2	12.0	6.8	36.0	18.0	6.8	20.4	1.4

Footnotes:

1. **Valbazen** Suspension (11.36 % or 113.6 mg/ml): ***Do NOT use in pregnant does in the first trimester of pregnancy.*** Meat withdrawal time is 9 days and 7 days for milk (FARAD).
2. **Safe-Guard/ Panacur** Suspension (10% or 100 mg/ml): Approved in goats at 5 mg/kg with meat withdrawal time of 6 days and no withdrawal period for milk. Although the label dose in goats is 5 mg/kg, it is generally recognized that 10 mg/kg dosage is required for good efficacy. At 10 mg/kg dosage, meat withdrawal is 16 days and 4 days for milk (FARAD).
3. **Ivomec Sheep Drench** (0.08% or 0.8 mg/ml): Protect from light. Coughing may occur during and following drenching. Meat withdrawal time is 14 days (FARAD).
4. **Levasole Soluble Drench Powder (Sheep)**: Oral solution ONLY. To prepare use 1 packet (13 gm/11.7 gm active ingredient) dissolved in 262 ml [8.9 oz.] water (44.7 mg/ml) {or 52 gram packet dissolved in 1048 ml water [35.4 oz.].} NOTE: This is different dilution from the label directions for administration. Meat withdrawal time is 4 days (FARAD).
5. **Cydectin Pour-on for cattle** (0.5% or 5 mg/ml): Meat withdrawal time is 23 days. ***Not for use in lactating dairy goats.***
6. **Cydectin Drench for sheep** (.1% or 1 mg/ml): Meat withdrawal time is 14 days. ***Not for use in lactating dairy goats***.
7. **Cydectin Injectable for cattle** (1% or 10 mg/ml): GIVE SQ. Meat withdrawal time is 30 days. ***Not for use in lactating dairy goats.***

NOTE for Guideline for Anthelmintic Dosages in Goats

The attached chart was developed by Ray M. Kaplan, D.V.M., Ph.D. (University of Georgia) and modified by Patty Scharko D.V.M., M.P.H. (University of Kentucky) and Lionel Dawson D.V.M., M.S. (Oklahoma State University). It is provided as a possible guideline for anthelmintic (deworming) dosages for goats. Producers should consult their veterinarian for advice on their specific management situation for determining dosages for their herd. ***With the exception of fenbendazole administered at the 5 mg/kg dose, these drugs are not approved by the Food and Drug Administration (FDA) for use in goats, and when used in goats are considered extra-label use (fenbendazole at the recommended dose rate of 10 mg/kg is considered extra-label usage). The FDA regards extra-label use of drugs as an exclusive privilege of the veterinary profession and is only permitted when a bona fide veterinarian-client-patient relationship exists and an appropriate medical diagnosis has been made. The chart is intended to serve as guideline for improving accuracy when dosing goats with an anthelmintic, but these drugs should be used in goats only when appropriate veterinary advice has been received.***

Drug resistance in parasites of goats is extremely common. The effectiveness of an anthelmintic should always be tested before being used by performing a FECRT (Fecal Egg Count Reduction test) or larval development (DrenchRite) assay if available.

*** The current recommendation is to use the Cydectin cattle **injectable** formulation and **NOT** the **pour-on** formulation (orally) or the sheep oral drench. When administered by subcutaneous injection, moxidectin provides improved drug levels as compared to oral administration.*

Meat Goat Nutrition

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Introduction

Proper nutrition is essential for the health and productivity of all animals and is the basis of successful production systems. A well planned and executed preventive health program cannot overcome problems that are created by poor nutrition. Nor can advanced reproductive technologies overcome nutritional limitations of reproduction. Therefore, nutrition of the goat is of paramount importance for successful goat production. Nutrition is the science of providing nutrients to animals in adequate amounts and in forms that the animals will consume. For sustainable and profitable production, these nutrients must also be provided in a cost-effective manner.

The ruminant stomach

Goats are ruminants, animals with a four-compartment stomach, as are cattle, sheep, and deer. The compartments are the reticulum, rumen, omasum, and abomasum (true stomach). Monogastric or simple-stomached animals such as humans, dogs, and cats consume food that undergoes acidic breakdown in the stomach and enzymatic digestion in the small intestine where most nutrients are absorbed. In ruminants, feed first undergoes microbial digestion in the reticulum and rumen (together often called the reticulo-rumen) prior to acidic digestion in the abomasum and enzymatic digestion and nutrient absorption in the small intestine. It is the microbial digestion in the reticulo-rumen that enables ruminants to consume and utilize grass, hay, leaves, browse, etc.

The reticulum and rumen form a large fermentation vat that contains microorganisms, mainly bacteria, that breakdown and digest feedstuffs, including the fibrous component of grass, forbs, and browse that cannot be digested by monogastric animals. Some of the breakdown products produced through digestion of feed by bacteria are absorbed by the animal through the rumen wall and can supply a large part of the energy needs. The rest of the byproducts of digestion, undigested feed, and ruminal microorganisms flow out of the reticulo-rumen into the omasum where large feed particles are trapped for further digestion and water is reabsorbed. Material then flows into the abomasum where acidic digestion takes place and then to the small intestine for further enzymatic digestion and nutrient absorption.

The rumen provides several advantages to the goat in addition to digestion of dietary fiber. The bacteria in the rumen are capable of synthesizing all B vitamins needed. Bacteria can also synthesize protein from nitrogen recycled in the body, which may be advantageous on low protein diets. For proper ruminal function, goats require a certain level of fiber (measured as crude fiber, acid detergent fiber, or neutral detergent fiber) in the diet. Goats have bacteria in the rumen that can detoxify antinutritional factors, such as tannins. This enables goats to better utilize feedstuffs containing high tannin levels such as those found in browse. There are very few situations in which a goat will not consume adequate fiber, but one is when a very high grain diet is being fed. Inadequate fiber consumption can then lead to several disease conditions. The most important disease condition is acidosis or an extremely low pH in the rumen, causing decreased feed consumption.

When ruminants are born, the first three compartments of the stomach are underdeveloped and the stomach functions similar to that of a monogastric animal. This enables absorption of antibodies in colostrum and efficient utilization of nutrients in milk. As the young ruminant consumes solid feed, especially high in fiber, and the microbial population is established, the rumen is stimulated to develop. The rumen must have an acceptable degree of development for successful weaning.

The greatest asset of goats is the ability and tendency to utilize woody plants and weeds, not typically consumed by other species of animals (e.g., cattle and sheep), converting them into a saleable product. Therefore, these plant species can be inexpensive sources of nutrients and make for a very profitable goat enterprise. Goats typically consume a number of different plant species in any one day and can utilize some poisonous plants because they do not consume enough to be toxic. Similarly, goats are believed to have a relatively high ability to detoxify absorbed anti-nutritional factors. Goats are more resistant to bloating than other ruminants, and after a brief adaptation may graze alfalfa without bloating.

Nutrients

Nutrients are defined as substances that aid in the support of life. The six classes of nutrients include protein, carbohydrate, fat, vitamins, minerals, and water. Nutrients are often classified as organic (carbon-containing) or inorganic (minerals).

Energy is not considered a nutrient, but can be derived from the breakdown of several nutrients including fat, protein, and both simple and complex carbohydrates. Energy is required to propel the biochemical processes that are necessary to sustain life. A deficiency of energy will cause weight loss, low productivity, and ultimate death of an animal. An oversupply of energy will usually result in excessive fatness, which is also unhealthy. A simple unit of measurement of energy is pounds of total digestible nutrients (TDN). A lb of TDN, equivalent to a pound of digested carbohydrate, equals 2,000 Kilocalories (or Calories as used in human nutrition) of digestible energy. There are a number of other measures of energy used, but they are less easily understood.

Water

Water is an essential nutrient for all animals and is sometimes overlooked. While goats require less water than cattle, they do need water and require additional quantities when lactating or coping with hot weather. A 110 lb goat will require 1 to 3 gallons of water per day depending upon diet, intake, and weather, toward the lower range in winter and toward the upper range in the hottest days of summer. A lactating goat will require an additional 1 quart of water for every 1 pint of milk produced. If a goat is producing 5 pints of milk at peak lactation while raising twins, 2.5 gallons of water are required each day. If goats are eating green material, a substantial part of their water requirement can be met by water contained in the plant material. However, if dry feed such as hay is consumed, water must be supplied to meet the requirement.

Water should be kept clean to encourage intake. This usually involves regular cleaning of the waterer. It is important that the area around the waterer not be muddy, as this is a good environment to spread foot rot and internal parasites. Placing some rock or gravel around the waterer can help keep feet dry and reduce disease problems. Water cleanliness is especially important for bucks on high grain diets. Their water needs to be shaded in summer and warm in the winter to encourage intake and reduce the risk of urinary calculi.

Carbohydrates

Carbohydrates usually provide the majority of energy to goats. Carbohydrates can be classified as simple, such as sugars (easily identified by their sweet taste; maybe 1, 2, or 3 sugar molecules linked together), or complex, such as starch (found in grains) or cellulose (i.e., fiber). Grass, forb, and browse plant species generally contain high levels of cellulose, which must be digested by rumen bacteria to provide energy.

Cellulose is often referred to as fiber, although the term fiber also pertains to other substances such as hemicellulose and lignin. Fiber in young plants may be highly digestible and provide a high level of energy, but fiber in older, mature plants is often poorly digested and may only provide half the energy of other carbohydrates. Fiber in the diet may be characterized chemically in several ways, such as crude fiber (CF), acid detergent fiber (ADF), and neutral detergent fiber (NDF). These abbreviations are used in hay analysis

and may appear on feed tags. In general, the lower the fiber level, the higher the level of digestible energy. However, a certain minimum fiber level is required for healthy rumen function.

Goats do not adapt as easily to high concentrate diets as cattle and sheep and are more likely to get acidosis, founder, urinary calculi, and enterotoxemia. To avoid these problems, very gradually increase the concentrate level in the diet when placing goats on high concentrate diets and maintain a minimum of 12% crude fiber in the diet or about half of the diet as grass, browse, or hay. Goats are typically not feed efficient, except for some rapidly growing Boer goats, and may require 7 lbs or more of feed per pound of gain. Also, one must be very alert for health problems with goats on high grain diets.

Fats

Fats, also called lipids, are very high in energy, providing more than twice the energy of carbohydrate on a weight basis. The fat content of ruminant diets is generally low, as plants have a low fat content. Plant waxes are fats that goats consume as they graze and browse, but they are not digested. Fat may be added to diets to increase the energy content. However, high levels of added fat depress fiber digestion unless treated to be inactive in the rumen. These fat sources are termed "bypass" and may be used in dairy goat diets but are generally not used in meat goat diets.

Protein

Protein is composed of building blocks called amino acids that the body uses to produce all of the different proteins required for growth, production, and maintenance. Protein is required in the diet for accumulation of new body mass (growth) and for replacing protein lost by normal wear and tear.

Ruminant animals are usually fed supplemental protein to make up for dietary shortfalls. In the rumen, bacteria degrade much of the consumed protein and use the amino acids to form bacterial protein. Bacteria can also form protein from nonprotein sources such as urea and, if provided with sufficient energy, can form significant quantities of protein. To prevent breakdown and digestion by ruminal bacteria, some protein sources are protected from degradation by coating or other means. Some natural proteins are also resistant to ruminal degradation by bacteria. These types of proteins are referred to as "bypass protein" as they bypass digestion in the rumen. Other common terms for bypass protein are "ruminal escape" and "rumen undegraded." Bypass protein sources are very important in dairy cow nutrition, but have lesser significance in most meat goat production systems.

Urea is the main nonprotein nitrogen source fed to ruminants. However, goats are not commonly fed urea as frequently as cattle. This may be because goats are more subject to urea toxicity than cattle. Goats appear more efficient than other species at recycling nitrogen in the body to the rumen where it can be used to form microbial protein, given that sufficient energy is available. This recycling of urea to the rumen helps to reduce the amount of protein required in the diet. When animals are consuming a low quality forage, a grain supplement may also improve protein status by providing additional energy for protein synthesis by ruminal microbes.

Vitamins

Vitamins function as critical chemicals in the body's metabolic machinery and function as co-factors in many metabolic processes. A deficiency of a vitamin will slow or block the metabolic process in which that vitamin is involved, resulting in deficiency symptoms. Vitamins are divided into those that are fat soluble (i.e., A, D, E, and K) and those that are water soluble (i.e., B vitamins and C).

The bacteria in the rumen of the goat can synthesize adequate amounts of the water soluble vitamins. Thiamine, or vitamin B1, may become deficient under some conditions (e.g., feeding a high concentrate diet, especially those with high sulfur which may come from a high level of molasses) and cause the disease polioencephalomalacia. Sometimes, however there are other unexplained causes of polioencephalomalacia.

Another situation that could lead to thiamine deficiency is improper feeding of the coccidiostat Corid®. The coccidiostat ties up thiamine, making the coccidia unable to reproduce. Feeding Corid® longer or at higher levels than recommended could lead to polioencephalomalacia. Polioencephalomalacia is a nervous disorder where the animal becomes blind, depressed, presses with his head, and the pupil slit in the eyes becomes up and down rather than the normal side to side profile. Treatment requires immediate injection of large quantities of thiamine.

Fat soluble vitamins must be supplied to the goat because the body cannot directly make them. The recommended levels of vitamins in formulated feed is 5,000 IU (international units, a measure of the potency of vitamins) of vitamin A per lb, 2,000 IU/lb of vitamin D, and 80 IU/lb of Vitamin E. The liver can store significant amounts of the fat soluble vitamins.

Vitamin A can be synthesized from carotene, the pigment that gives grass and hay their green color. As long as sufficient green feed is consumed, vitamin A intake will be adequate. Vitamin A is necessary for normal epithelium (skin) development and vision. A deficiency of vitamin A causes many symptoms, including tearing of the eyes, diarrhea, susceptibility to respiratory infection, and reproduction problems. Vitamin A is often supplied to animals not consuming green forage such as in winter months. Many mineral and vitamin supplements contain vitamin A.

Vitamin D is called the sunshine vitamin because animals can synthesize the vitamin with the help of the sun. Ultraviolet light in sunshine converts pre-vitamin D found in the skin to a pro-vitamin D form that is used by the animals. Usually, even limited sunlight exposure is adequate to provide a day's supply of vitamin D. Sun-cured hay contains Vitamin D. Vitamin D is necessary for calcium absorption and metabolism by the body. A deficiency of vitamin D, called rickets, results in lameness, weak bones, and bowed and crooked legs. The liver is the main Vitamin D storage site in the body. Vitamin D is normally present in mineral supplements and often added to complete feeds.

Vitamin E functions as an antioxidant in conjunction with the mineral selenium. The requirements for one can be partially met by the other. Thus, vitamin E is very important in areas with marginal or deficient levels of selenium. A common vitamin E deficiency disease, particularly in newborn or young animals, is white muscle disease, where white spots are seen in the heart and skeletal muscle due to oxidation damage. A marginal deficiency of vitamin E can depress the immune system and cause reproductive failure. Green grass and green sun-cured hay have high levels of vitamin E. Most mineral supplements and complete feeds contain vitamin E, especially in areas that are deficient in selenium. Vitamin E is expensive and minimal supplemental levels are used in contrast to vitamins A and D that are less expensive and often included at generous levels.

Vitamin K is technically required by animals and functions in the clotting of blood. Vitamin K is produced by bacteria in the lower digestive tract and absorbed. Generally, goats do not need to be supplemented with vitamin K.

Minerals

The inorganic nutrients are called minerals. Minerals are further subdivided into macrominerals, those required at 0.1% or more in the diet (macro means large), and microminerals, those required at the part per million (ppm) level (micro means small). A ppm is the weight of a paperclip in a thousand pounds of feed. A hundred ppm is equal to 1.6 ounces in a thousand pounds of feed. Macrominerals include calcium, phosphorus, sodium, potassium, chloride, sulfur, and magnesium. Microminerals include iron, copper, cobalt, manganese, zinc, iodine, selenium, molybdenum, and others. Minerals function in many ways in the body. Some such as calcium and phosphorus are major structural components of bones and teeth, as well as having other functions. Other minerals facilitate nerve functioning or fulfill a role as electrolytes. The mineral requirements

for goats are not as well known as they are for other livestock species and have often been extrapolated from sheep or cattle requirements due to a lack of studies in goats. As such, mineral recommendations for goats often have a wide range because of lack of accurate goat-specific information.

Macrominerals

The macrominerals are listed below, followed by the abbreviation, normal dietary range, function, deficiency symptoms, and major dietary sources.

Calcium (Ca) 0.3 - 0.8%

The major biological function of calcium is for bones. Bones contain 99% of the calcium in body. Calcium is also necessary for muscle contraction, nerve conduction, and blood clotting. The main deficiency symptoms are seen in the skeletal system. Bones can become soft and weak and may be deformed resulting in lameness. This condition is called rickets or osteomalacia. Vitamin D deficiency causes similar symptoms due to the role of vitamin D in the absorption and metabolism of calcium. Calcium is relatively high in milk and lactating goats need adequate levels of calcium for milk production. Does can get hypocalcemia (milk fever) while lactating due to a metabolic disorder which results in a shortage of calcium in the blood due to calcium being used for milk production. Urinary calculi is a condition brought about in part by an imbalance in the calcium to phosphorus ratio in the diet. Generally, about twice as much calcium as phosphorus should be in the diet of ruminant animals. An excess of calcium can cause abnormal bone growth. Major common dietary sources of calcium include forages, limestone and dicalcium phosphate.

Phosphorus (P) 0.25 - 0.4%

Approximately 80% of the body's phosphorus is found in bones, with the remainder in the blood and other tissues. In addition to skeletal structural functions, phosphorus is essential in energy metabolism, acid-base balance, and is a constituent of enzymes and genetic material. The major symptoms of phosphorus deficiency include reduced growth, listlessness, unkempt appearance, depressed fertility, pica (depraved appetite-eating wood, rocks and bones), and decreased serum phosphorus. Phosphorus is the most commonly encountered mineral deficiency and also the most expensive macromineral. Sources of phosphorus include protein supplements, cereal byproducts, mineral supplements, and dicalcium phosphate.

Sodium (Na) 0.2%

Potassium (K) 0.8 - 2.0%

Chloride (Cl) 0.2%

All three of these minerals function as electrolytes in the body. Electrolytes are mineral ions, carrying a positive or negative charge that the body uses for osmotic balance, pH balance, and water movement. They are also essential in transmission of nerve impulses. These minerals are highly water soluble and are easily lost with diarrhea. Electrolyte solutions used to treat animals with diarrhea contain all three of these minerals. A deficiency of potassium could occur on high concentrate diets, with symptoms including poor appetite, urinary calculi, body stiffness progressing from front to rear, and pica (depraved appetite as described above). A deficiency of chloride depresses growth. A deficiency of sodium causes reduced growth and feed efficiency. Salt provides both sodium and chloride. Most forages have adequate levels of potassium.

Sulfur (S) 0.2 - 0.32%

The major biological function of sulfur is as a component of sulfur-containing amino acids. Therefore, sulfur is important in protein synthesis, milk and hair production, enzymes, hormones, hemoglobin, and connective tissue, and is a component of the vitamins biotin and thiamine. The major deficiency symptoms include poor animal performance, hair loss, excessive salivation, tearing of eyes, and weakness. Major source of sulfur is protein which contains sulfur as a component of some of the amino acids. Therefore, sulfur is important in

diets where nonprotein nitrogen (e.g., urea) is used to substitute for some protein. Sulfur-containing mineral blocks are often used for control of external parasites in goats. Excessive sulfur in high concentrate diets can contribute to polioencephalomalacia as discussed for the water soluble vitamin thiamine.

Magnesium (Mg) 0.18 - 0.4%

Magnesium is found in bones (60 to 70% of that in the body), liver, muscle, and blood. It is required for normal skeletal development, and nervous and muscular system functions, as well as for enzyme systems. It is also closely associated with metabolism of calcium and phosphorus. In ruminants, a major magnesium deficiency disease is grass tetany, often seen in animals grazing fast-growing, lush, cool season pastures. Affected animals have low blood magnesium levels, exhibit a loss of appetite, are excitable, stagger, have convulsions, and may die. High fertilization rates, cool temperatures, and high levels of plant potassium and(or) rumen ammonia may contribute to the disease. A major supplemental source of magnesium is magnesium oxide, which is often supplemented on winter wheat pasture and mixed with a protein source to encourage consumption.

Micro or trace elements

The first level after the mineral name is what is thought to be the minimum requirement in the diet, while the second is the value above which the element can become toxic. Most supplemental trace minerals are provided by trace mineralized salt or mineral mixes that are designed to provide 25 to 50% of requirements. This is adequate if the animal's diet is marginal in a mineral but inadequate if that mineral is severely deficient. Unless a documented deficiency exists, it is best not to provide 100% of a trace mineral, because an excess of one mineral may depress the absorption of another creating a deficiency. Excess supplementation of some minerals can cause toxicity problems, especially with copper and selenium.

Iron (Fe) 35 - 500 ppm

The major function of iron is as a component of hemoglobin, required for oxygen transport. It is also a component of certain enzymes. The major iron deficiency symptom is anemia. Anemia can also be caused by blood loss due to several factors, including injury, internal parasites (barberpole worm or liver fluke), and a bad case of external parasites such as lice. Iron is stored in the liver, spleen, and bone marrow. Milk is very low in iron; therefore, kids raised for a long time on milk alone will develop anemia. Soil contamination on forages can provide significant levels of dietary iron. Iron sulfate is a common means of adding iron to the diet. Forages in some areas have excessively high levels of iron that suppress utilization of other trace minerals.

Copper (Cu) 10 - 50 ppm

Copper is essential in formation of red blood cells, hair pigmentation, connective tissue, and enzymes. It is also important in normal immune system function and nerve conduction. Deficiency symptoms include anemia, "bleached" looking (lighter color) and rough hair coat, diarrhea, and weight loss. Young goats may experience progressive incoordination and paralysis, especially in the rear legs. High dietary molybdenum can depress absorption of copper and cause a deficiency. There should be at least four times as much copper as molybdenum in the diet.

Sheep (both hair and wool types) are sensitive to copper toxicity, whereas goats require copper levels similar to beef cattle. Angora goats may be more sensitive to copper toxicity than meat and dairy goats. There are differences in copper requirements for several sheep breeds, and this could be true for meat goats, but no data are available. Although most of the United States has adequate copper levels (Figure 7), many areas have high levels of molybdenum (Figure 6) due to soil geology and, therefore, require copper supplementation. The liver stores copper, which can protect against toxicity in the short term. However, when liver capacity is exceeded, animals can die rapidly from a hemolytic crises caused by stress, such as being chased.

Cobalt (Co) 0.11 - 25 ppm

The only well accepted biological function of cobalt is as a component of vitamin B_{12}. Rumen microbes utilize cobalt for growth and produce vitamin B_{12}. Cobalt deficiency symptoms include loss of appetite, anemia, decreased production, and weakness. Most natural feedstuffs contain adequate levels of cobalt. There are cobalt-deficient areas in the United States (Figure 1).

Zinc (Zn) 40 - 500 ppm

Zinc is found in all animal tissue and is required by the immune system and for normal skin growth. Zinc is also essential for male reproduction. Deficiency symptoms include dermatitis (thick, dry patches of skin), hair loss, skin lesions, swollen feet, and poor hair growth. The bran and germ of cereals contain high levels of zinc.

Manganese (Mn) 40 - 1000 ppm

Manganese is important for bone formation, reproduction, and enzyme functioning. Deficiency symptoms include a reluctance to walk, deformity of forelegs, delayed onset of estrus, poor conception rate, and low birth weight. It is unusual to have a manganese deficiency.

Selenium (Se) 0.1 - 20 ppm

Selenium functions with vitamin E as an antioxidant, protecting cell membranes from oxidation. Selenium also affects reproduction, metabolism of copper, cadmium, mercury, sulfur, and vitamin E. Deficiency symptoms include poor growth rate, kids being unable to suckle, white muscle disease (cardiac and skeletal muscles have white spots), sudden death by heart attack, progressive paralysis, and retained afterbirth. Selenium is deficient in many areas because of low soil levels (geological factors; Figure 8); however, there are a few regions of high selenium soils leading to high to toxic levels in plants. Toxic levels of selenium cause shedding of hair, diarrhea, and lameness. Most plants that are not grown in selenium deficient soils will have adequate selenium levels. It is more effective to provide selenium supplementation through feed than by injection.

Molybdenum (Mo) 0.1 - 5 ppm

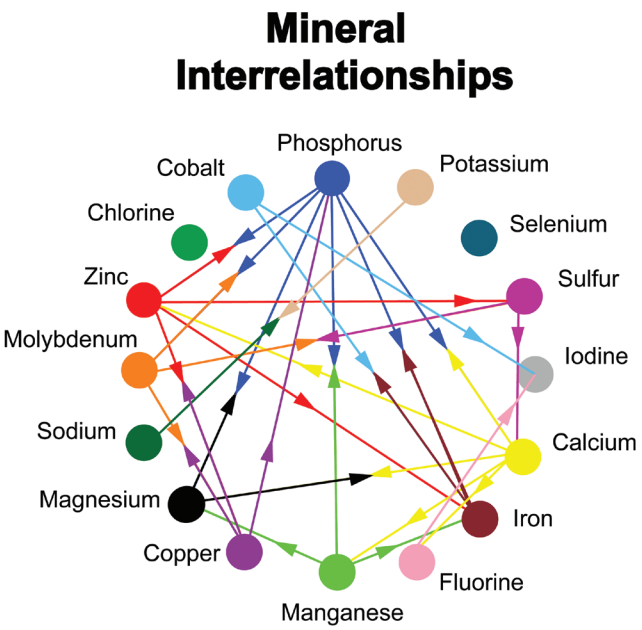
Molybdenum deficiencies are very rare. Toxicity occurs above 3 ppm due to reduced copper absorption, resulting in a copper deficiency. The copper level must be four times the molybdenum level to overcome this effect. High dietary levels of molybdenum are usually related to soil content. Molybdenum (as ammonium tetrathiomolybdate) is often used to treat copper toxicity in animals (Figure 6).

Iodine (I) 0.5 - 50 ppm

The only proven biological function of iodine is as a component of thyroid hormones that regulate energy metabolism and reproductive function. The major iodine deficiency symptom is goiter - a swelled or enlarged thyroid gland in the neck. This should not be confused with the thymus gland in the neck on young animals (the thymus gland is especially pronounced in Nubian kids, but shrinks after several months of age). Also, iodine deficiency causes reduced growth and milk yield, pregnancy toxemia, and reproductive problems such as late term abortion, hairless fetus, retained placenta, and weak kids. Most of the southern U.S. has adequate iodine in the soil and most minerals and trace mineralized salts contain iodine. A number of areas in the northern U.S. are deficient in iodine due to soil geology.

Mineral nutrition considerations

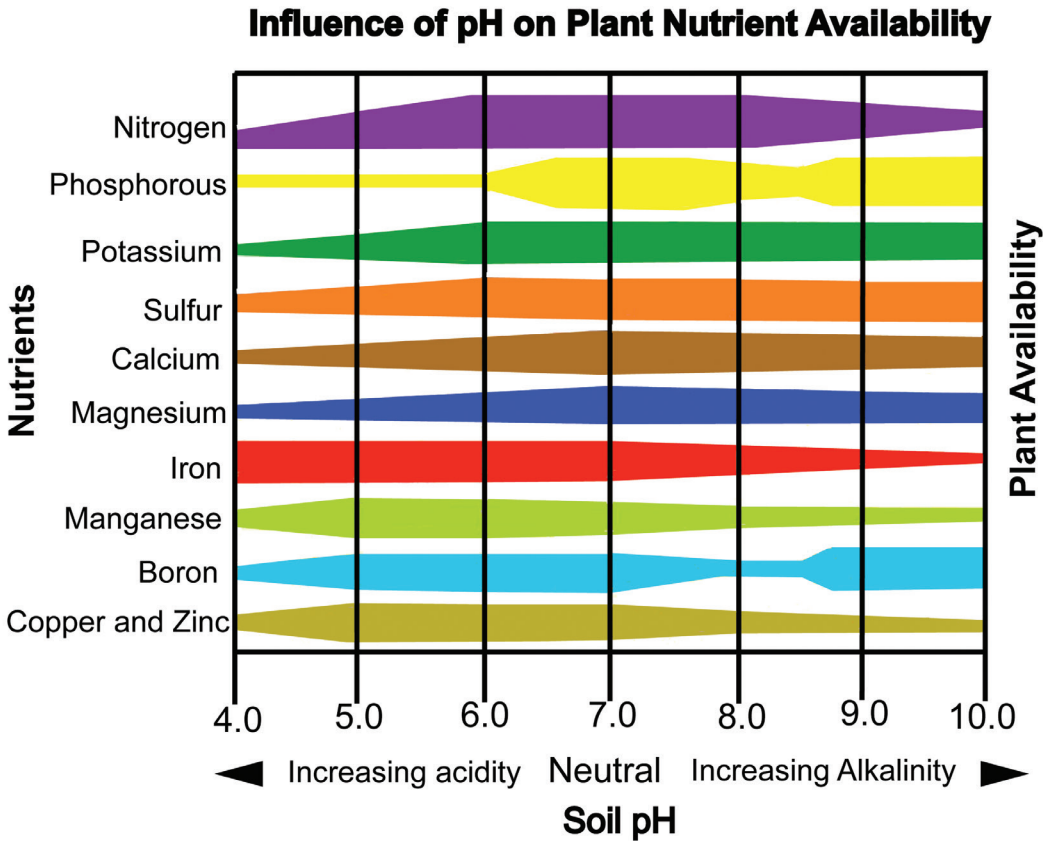
Plants are a major source of minerals for the goat, requiring all minerals that goats require except iodine. However, plant requirements for minerals, such as cobalt and selenium, may be much lower than the level required for animals. Some soils are inherently deficient in some minerals such as iodine and selenium due to soil geology. Plants grown on soils deficient in a mineral are likely to be deficient in that mineral. However,



Drawing by K. Williams.

some plants have an ability to concentrate the minerals available in the soil. Maps of mineral deficient areas of the U.S. are available. However, consulting local extension agents is a better method of determining soil mineral deficiencies or toxicities that could affect mineral levels in local forages. Soil maps showing deficient areas of selenium, copper, molybdenum, and cobalt are located at the end of this article.

Various factors other than soil mineral level can interact to influence the mineral content of forages. Soil pH is one factor that affects mineral uptake by plants. Under acidic soil conditions, many trace minerals are less available for plant uptake. Environmental temperature at certain times of the year may also affect mineral uptake. Interactions among minerals after soil fertilization can also affect their availability for incorporation into plant material. Season of the year affects plant mineral concentrations, mainly due to a



Influence of pH on availability of plant nutrients.
Redrawn from S.S.S.A.P., 1946. 11:305 by K. Williams.

dilution effect, with decreasing mineral levels as plants mature. Different plant species will also have varying contents. Browse and forb plant species may have higher mineral concentrations than do some grasses. As goats eat a variety of plants, they are less likely to have mineral deficiencies than other species of animals that eat predominantly one plant species.

To determine plant mineral content a producer can collect and send samples for analysis. Parts of plants that are being consumed throughout the day and growing season should be sampled. Analysis of a sample will cost a minimum of $25.00. To obtain enough data to formulate a custom mineral supplement would require sampling several times over a growing season and over more than 1 year if possible. This could be worthwhile for a large goat herd but too expensive for most producers. The alternative is to use a commercially prepared mineral block or loose supplement. Some mineral mixes are formulated for regions and are more appropriate to use than a mineral formulated for the whole United States. Many state extension specialists know what minerals are likely to be deficient in given areas of a state and know what levels of calcium and phosphorus are appropriate for beef cattle production. Those recommendations are a good place to start for goat mineral nutrition.

Mineral supplements should not be overfed. Mineral supplements are formulated for goats to consume a sufficient quantity. Many minerals interact with one another (interactions shown on opposite page) and excess consumption of one mineral may decrease absorption and(or) utilization of another. For example, it is well known that excess iron depresses absorption of zinc, copper, manganese, and selenium. There are several regions of the United States that have high enough levels of iron to depress absorption of these other minerals, requiring them to be supplemented. Feeding a regional mineral with no supplemental iron would be preferable to feeding an all-purpose mineral containing high levels of iron that would further depress absorption of these minerals.

The range between safe supplementation and toxic levels is narrow for many of the trace minerals. Do not overfeed trace minerals or mix additional minerals in a diet if another source of trace minerals, such as a trace mineral block, is present. Formulation of mineral supplements requires considerable expertise since the addition of high levels of one mineral may depress the utilization of another, causing a deficiency. Also, some trace minerals can be toxic in excess.

Calculation of supplemental levels for feed formulas requires a certain amount of technical expertise and specialized scales for weighing, along with sophisticated mixing equipment. Most common farm mixing methods are inadequate, resulting in “pockets” of dangerously high mineral levels in a batch of feed.

Choosing a mineral supplement

The most important consideration in choosing a mineral supplement is the level of calcium and phosphorus. Some mineral mixes are designated 12 - 8, which means they contain 12% calcium and 8% phosphorus. The levels of these two minerals should be the same that is being fed to cattle in your area (contact your county agent or livestock extension specialist). Phosphorus is expensive, so a 12 - 12 mineral will cost more than one that is 12 - 8. However, most forages are low in phosphorus, making it the most common mineral deficiency.

The mineral supplement should also contain trace minerals that are deficient in the area. Levels of trace minerals used in local cattle supplements can provide a guide for goats. Most mineral supplements are formulated to provide less than half the trace mineral requirements due to toxicity concerns. A mineral supplement should be provided in the loose form to maximize consumption. The salt level in the mineral drives intake; therefore, no other sources of salt should be available. A mineral feeder should be used to protect from rain and keep the supplement clean. Replenish minerals frequently to keep them fresh.

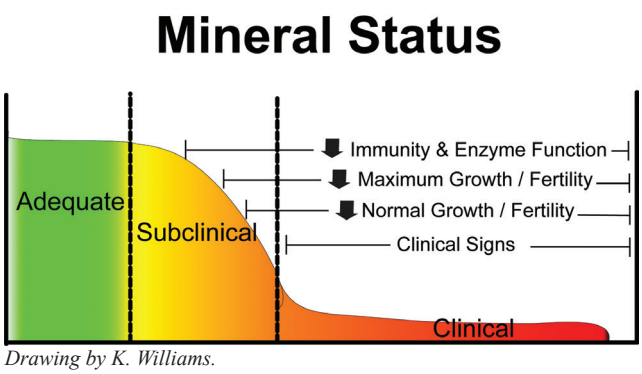
Current approximate wholesale costs for supplying 100% of mineral needs of a 150 lb goat for various minerals in 1 year are as follows:

Calcium	$1.15
Phosphorus	$4.50
Salt	$0.40
Magnesium	$1.11
Potassium	$1.50
Trace minerals	$0.45
Other minerals	$0.65
Total	$9.70

Feedstuffs will normally provide at least half of all minerals and in some cases all required. It should be noted that phosphorus alone accounts for half the mineral cost.

Diagnosing mineral deficiencies or toxicities

The proper procedure for diagnosing a mineral deficiency or toxicity depends on which mineral is being considered. Secure the assistance of a local veterinarian and extension animal nutritionist in the state who are familiar with minerals in the region.



Drawing by K. Williams.

1. Deficiency or toxicity symptoms usually provide initial indications of mineral status (e.g., manganese and "knuckling over"). However, deficient animals do not always show classic symptoms and the major symptom may only be a 'poor doing' animal.
2. Blood tests are adequate for some minerals such as magnesium, calcium, and phosphorus, and for other blood factors that give an indication of mineral status. Examples of these factors include: glutathione peroxidase for selenium, hemoglobin for iron, zinc binding protein for zinc, and thyroid hormones for iodine.
3. Hair analysis has been used for zinc and selenium but in general is a poor diagnostic test.
4. The liver is a good tissue to test for iron and copper adequacy. Liver samples can be obtained via biopsy or from animals that are slaughtered or die.

Take home lessons on mineral nutrition

1. The diet should contain adequate levels of calcium and phosphorus and have close to a 2:1 calcium to phosphorus ratio.
2. Provide a free-choice loose mineral supplement with appropriate levels of calcium and phosphorus that contains trace minerals deficient in the region.
3. Monitor intake of the mineral to make sure the animals are eating an appropriate amount.
4. Avoid excessive feeding of any supplementation.

Body Condition Scoring

The adequacy of a nutritional program can be assessed by observing changes in body weight and condition of the animal. If animals lose weight, body condition will be reduced (animal is thinner), alerting an observant manager to a problem. Body condition is particularly responsive to energy and protein adequacy.

Body condition scoring is a system of assigning a numerical score based on physical characteristics indicative of fatness. These include the amount of muscle and fat covering the spine in the loin area and ribs and fat pad at the sternum. Body condition scores range from 1 (very thin) to 5 (obese) in one-half score increments. Langston University has information on the American Institute for Goat Research website describing Body Condition Scoring of Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcshowto.html) and Examples of Body Condition Scores in Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcs.html).

Animals should achieve a certain body condition during specific periods of the production cycle. For example, animals should have a body condition of at least 2.5 but no more than 4.0 at the beginning of the breeding season. Prior to entering the winter a minimum score of 3.0 is desirable. Also, if body condition score is 4.5 or greater, pregnancy toxemia prior to kidding is likely, as also is the case with a score of less than 2.0.

Using the Langston Interactive Nutrient Calculator

Practical goat nutrition involves providing sufficient nutrients for a desired level of productivity (milk, meat, or kids) at a reasonable cost. Nutrients are supplied via a combination of pastures, hay, supplements, and other feedstuffs; adequate amounts are required for animals to produce at an economically viable level. For commercial meat goat production, the economics of nutrition are of paramount importance due to their great impact on cost of production and subsequent profit. For show, purebred, and companion goats, the economics of nutrition may be of lesser importance.

Applied nutrition involves determining nutrient requirements and then working with available feedstuffs, including pasture, hay, or supplemental feeds, to provide the required nutrients in proper amounts. Nutrient requirements are affected by an animal age, weight, and production type and stage. For example, pregnancy, number of fetuses, etc. will affect the amount of nutrients needed by a doe.

Calculating nutrient requirements by hand can be difficult, but the Langston Interactive Nutrient Calculator (LINC) makes the task easy, only requiring answering several questions. In addition, it is linked to a nutrient balancer program that allows selection and use of pastures and feeds to meet the requirements. The calculator will determine not only protein and energy requirements, but also calcium and phosphorus needs.

Getting started

To teach you to use LINC, we will go through an example. Here is the assignment, calculate the nutrient requirements for a nonpregnant 3 year old mature ½ Boer cross doe that had twins 6 weeks ago. The doe has a 32 inch heartgirth and is under intensive grazing management. Her body condition score is 2.5.

First, go to the Langston web site http://www2.luresext.edu/goats/research/nutritionmodule1.htm.

Question 1 asks the biotype of goat. A drop down menu will give the choices of Boer, Boer cross, Spanish or indigenous (native) goat, dairy goat, or Angora goat. For Kiko goats, use the selection for Spanish and indigenous. Select "Boer cross."

Question 2 asks the class of goat, and selections include suckling, growing goat less than a year and a half of age, mature goat including late gestation, and lactating goat including meat and dairy goats. If a lactating goat is selected, another drop down menu asks information needed to predict milk production. This information includes litter size (number of kids), week of lactation (weeks since she kidded), and age of doe at kidding in years. Milk production, along with fat and protein percentages, are then predicted. These figures can be edited, which is useful for dairy goat producers who are more likely to know the amount of milk produced and its fat and protein contents.

For the example, select "lactating goat". Then in the subsequent menu, select the number of kids (twins) and input week of lactation (6) and age at kidding (2 - 3 years). The program predicts that the doe will produce 3.6 lbs of milk containing 3.6% fat and 3.3% protein.

Question 3 asks the gender of the goat, and the drop down menu has choices of doe, buck, and wether. Select "doe."

Question 4 asks the body weight of the goat. If the weight is known or a good estimate is available, it should be entered in the box. If the weight is unknown, the heartgirth (chest circumference) can be measured to predict body weight. Check the box to estimate weight via heartgirth and enter heartgirth in inches. A menu will appear with choices of genotype (breed) of goat (Alpine, Angora, Boer, ½ or less Boer, ¾ or ⅞ Boer, LaMancha, Nubian, Oberhasli, Saanen, Toggenberg, and Spanish). Some breeds require input of body condition score. Body weight is then estimated. Input "32" inches for a "½ or less Boer" and the estimated weight of the doe is 105 lbs. This can be used for estimating bodyweight for medicine dosage or weights for management purposes.

Question 5 asks the desired amount of weight gain or loss expected in a 1 month period, with selections ranging from losing 5 pounds (-5) to gain of 30 pounds. This gain is in addition to any pregnancy weight gain. Select 0 lbs per month.

Question 6 adjusts nutrient requirements for the energy expended during grazing if goats have access to pasture. The drop down menu includes choices of stable feeding, intensive management, semi-arid grazing (goats on extensive ranges), and arid (desert) grazing. For the sample calculation select "intensive management, temperate or tropical range." This selection will be used in all the examples that follow.

Question 7 asks the percentage TDN of the diet being fed and uses a default value of 60. If the TDN level in the feed is known, this value can be adjusted. For dairy goats, the default value is 65%. Use the default of 60%. If you know the value of the feed you plan to use put it in here. This value is important in prediction of intake.

Question 8 asks the percent protein in the diet and the default is 10%. For dairy goats, the default is 14%. Use the default of 10%. If you know the value of the feed you plan to use, put it in here. This value is used to help predict intake.

Click on the "Calculate Requirements" button to calculate the energy and protein requirements, estimated dry matter intake, and calcium and phosphorus requirements. In this example, the requirements should be 2.5 lbs of TDN for energy, 0.34 lbs of crude protein, 6.65 grams of calcium, and 4.65 grams of phosphorus, with a predicted intake of 3.65 lbs of dry matter.

Providing needed nutrients

After calculating the nutrient requirements for goats, those nutrients must be provided using feedstuffs such as pasture, hay, concentrate, and minerals. For most goats throughout much of the year, nutrient requirements can be met by available pasture, a mineral supplement, and water. During times of limited forage availability or quality such as winter, or feeding poor quality hay or stockpiled forage, a supplement will be needed to supply deficient nutrients. The level of supplemental feeding should be adjusted with changes in animal requirements, such as increased needs of late pregnancy. Sometimes it may be preferable to put an animal in a lot and feed a complete diet or one high in concentrate such as with dairy goats.

There may be periods when nutrient requirements cannot be met, resulting in loss of body weight. This is acceptable at certain times in the production cycle if body condition is sufficient for the animal to draw upon body reserves and maintain the desired production level. An example would be weight loss during early lactation because sufficient nutrients cannot be consumed. However if the doe is in poor body condition, is a growing yearling, or has severe weight loss during this time, milk production will be depressed. During a

drought, it may be acceptable for open or early pregnant animals that are not lactating to lose weight. During late pregnancy, inadequate nutrition can have adverse effects on pregnancy outcome and subsequent lactation. We can estimate what the projected bodyweight losses would be by reducing the bodyweight gains in question five and then calculating nutrient requirements until the energy and protein requirements match intake of those nutrients. Severe undernutrition can cause abortion, reduced livability of the kid(s), reduced milk production and adversely affect maternal behavior.

Feeding Different Classes of Goats

The feeding suggestions that follow are oriented to commercial goat producers. Purebred, show, and companion animals are often fed more for larger frames and better body condition, but excessive body condition can be deleterious to the animal health.

Feeding bucks

Mature bucks can obtain most of their nutrients from pasture. However, yearling and 2 year old bucks have greater nutrient requirements since they are still growing. Bucks need to be in good body condition (BCS greater than 3) before the breeding season because feed intake may be relatively low during that time, with loss of body weight. Thus, body condition should be evaluated 3 months before the breeding season. Decisions can then be made on the supplemental nutrition needed for the buck to achieve the desired BCS.

Whenever bucks cannot meet nutritional needs from pasture, supplementation is necessary. Under most conditions, whole shelled corn or sweet feed at 0.25 to 0.5% of body weight will be adequate (0.5 to 1 lb of feed for a 200 lb buck). Feeding bucks high levels of grain (greater than 1.5% of body weight) for a long period of time makes them prone to urinary calculi. The levels of grain recommended above are safe for bucks. When pasture is scarce, bucks can be fed medium quality hay free-choice (all they can eat).

Using LINC, calculate the nutrient requirements for a 3 year old, 200 lb Boer cross buck, gaining no weight, and on pasture (intensive management). The calculated requirements are 2.39 lbs of TDN, 0.26 lbs of crude protein, 5.05 grams calcium, and 4.09 grams phosphorus, with predicted dry matter intake of 3.55 lbs. However, it is important to note that the estimated dry matter intake is influenced by the dietary TDN and CP concentration inputs. Therefore, if the default values are used and a forage, which makes up all or most of the total diet other than a mineral supplement, has different levels, then the predicted dry matter intake may not be close to the actual amount. In the example above, default values were assumed. To determine if these nutrient requirements can be met by native range with a mineral supplement, click on "Select Feed Ingredients" at the bottom of the page. A page listing different feeds will appear. In the "Forages" section below "Concentrates," click on "range, early summer," and under "Minerals" choose a 12-12 mineral supplement. Go to the bottom and click on "Input These Feed Ingredients into the Ration."

The ration window will appear that lists each ingredient chosen. Intake figures should be entered in the column labeled "Amount, lbs as fed." The estimated intake for this buck is 3.55 lbs dry matter (lbs of diet not including the water content of the feedstuffs), whereas in this window the consumption amount is entered as the "as fed" form. Because feedstuffs vary in water content (compare the water content of fresh, green pasture to the same forage dried and harvested as hay), nutrient requirements and intake estimations are calculated on a "dry matter basis." Dry matter basis means that all water has been removed. However, animals eat feed in an "as-fed" form. This calculator will determine the amount of dry matter intake for each ingredient from the as-fed figures entered. This relieves the producer from having to estimate dry matter, allowing the amount fed to the animal to be entered, with the program performing the needed dry matter calculations.

The mineral supplement bag label predicts intake of 0.5 to 1 lb/month/hundred lbs of body weight. At that rate, the 200 lb buck will consume 2 lbs/month or 0.067 lbs/day (2 lbs ÷ 30 days), roughly 1 ounce. Some supplements estimate an intake such as 1 to 1.5 oz/day, but this can vary with the size of the goat. Enter 0.07

lbs for the mineral. Therefore, in this example it can be assumed that forage dry matter intake is 3.55 lbs. The value of 3.55 is entered into the "Amount, as-fed" column for range forage. Clicking in the "Amount, lbs DM" column will calculate the amount of DM and nutrients provided (Running total) compared with the Requirements. The amount of as-fed native range grass provided should be increased until the forage dry matter provided equals the 3.55 lbs previously calculated. This is done by trial and error method until a correct answer is found. In this case, the correct amount is 3.95 lbs of as-fed native range, which will provide 3.55 lbs of dry matter. Therefore, the estimated daily ration for this buck is 3.95 lbs of native range grass hay, or an equivalent amount of pasture, on a dry matter basis plus 0.07 lbs of mineral per day.

Comparing the Running total with the Requirements shows that this diet did not meet the requirement for TDN (2.12 lbs provided vs a requirement of 2.39; 89%). Crude protein, calcium, and phosphorus are supplied in excess of requirements. Because the equations used in these predictions include a small safety margin (i.e., requirements are most likely slightly greater than actual), if the deficiency is not marked the diet could be used as is with careful monitoring of performance measures, most notably BCS. In addition, one should consider that the diet actually consumed could be higher in quality than the 'book' composition values used. In this regard, when taking plant samples, plants are often cut at the ground level, such as for hay. Conversely, goats select certain plant parts (especially leaves) that have higher nutrient contents. Therefore, the composition analysis used in the calculations might not have matched what was actually eaten. For example, if a TDN concentration in consumed forage of 65% and a crude protein level of 12% are assumed, the predicted TDN intake is 95% of that necessary to satisfy the TDN requirement.

Accurate and abundant data on the nutrient content of plant parts consumed by goats are lacking. When hay is fed and animals are 'forced' to consume most of it, the hay analysis will closely match what is consumed. The same applies to supplemental feeds that are totally consumed. One way to more accurately determine the true composition of diets of grazing goats is to follow the animals for a couple of hours and hand pluck the portions of plants consumed and send the sample in for analysis. However, plant composition and plant parts selected vary over time, making it desirable to sample plants monthly or more frequently.

In the absence of feed nutrient analysis, it is important to try to match the description of feeds or pasture as closely as possible to that in the LINC feed tables. If actual analysis has been determined, it can be entered into LINC at the bottom of the feed library. Information required includes concentrations of TDN, crude protein, calcium, and phosphorus. Hopefully in the future, more applicable data will be available for herbage grazed by goats.

Feeding replacement bucks and does

Replacement bucks and does must gain sufficient weight from weaning to breeding to be of adequate size and sexually mature. A Spanish doe weaned at 12 weeks of age would be expected to weigh 40 lbs and gain 5 lbs per month to achieve a minimum breeding size of 60 lbs at 7 months of age. A Boer doe weaned at 12 weeks of age would be expected to weigh 50 lbs and would need to gain 7.5 lbs per month to be 80 lbs at breeding. These are minimum weights, and it is advantageous for animals to be slightly heavier. Some purebred breeders wait to breed their doelings at 19 months of age because a doe with a bigger frame size is desired. Most commercial goat producers cannot afford the cost of an extra year of maintaining an animal with no production.

Does will generally gain sufficient weight if an adequate amount of a moderate quality forage is available. If doelings are not gaining adequate weight (as measured by a scale or through the heartgirth conversion program), they could be supplemented with whole shelled corn at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb doeling). Feeding excessive grain to does causes an overly fat condition. Fat may be deposited in the udder, leading to reduced formation of milk secretory tissue. The doe is also more likely to have pregnancy toxemia and birthing problems. If sufficient good quality pasture is not

available, growing doelings will need good quality hay and a supplement such as whole shelled corn, sweet feed, or range cubes or pellets at 0.5 to 1.0% of body weight.

Bucklings must gain more weight than doelings to reach puberty. While there are no available recommendations for weight of meat goat bucklings at first breeding, these animals need to reach an adequate size to achieve puberty. Like doelings, body condition should be monitored and supplemented at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb buckling). Most bucks do not let a lack of body weight interfere with breeding, but some body reserves are necessary to maintain fertility and mating activity throughout the breeding season.

Feeding does throughout their life cycle

The four production periods of does are dry nonpregnant, pregnant, late gestation, and lactating. Does that are open (nonpregnant) or in the early stage of pregnancy (< 95 days) have fairly low nutrient requirements. For open does, the goal is to gain a little weight to be in good condition for breeding. A medium quality pasture, such as in late summer, or a medium quality hay is sufficient to prepare for breeding and the early stage of pregnancy. However, adequate quantities of feed are necessary.

Use the LINC to calculate the nutrient requirements for a 130 lb nonpregnant, mature Boer doe without change in body weight and with intensive pasture grazing. The requirements are 1.50 lbs of TDN, 0.18 lbs of crude protein, 4.03 grams of calcium, and 2.82 grams of phosphorus, with an estimated dry matter intake of 2.31 lbs (based on the composition of fall bermudagrass; 50% TDN and 9% CP). Feeds used are fall bermudagrass and a mineral supplement. A 130 lb doe is expected to consume the mineral at 0.1% of body weight per month = 1.3 lbs/30 days = 0.04 lbs of mineral per day. The estimated 2.27 (2.31-0.04 = 2.27) lbs dry matter intake of fall bermudagrass (3.25 lbs as-fed) provides 1.14 lbs of TDN (76% of requirement) and 0.20 lbs of crude protein (111% of requirement). In this example, it appears questionable as to whether or not body weight of the doe could be maintained with this forage (i.e., 50% TDN). The goat's ability to select higher quality plant parts, as noted above, might enable them to maintain their body weight. In this regard, if they are able to select a diet with a TDN concentration of 60% rather than 50% then the amount of TDN supplied is (2.27 × 0.60 = 1.36 lbs) which is 91% of the required amount, somewhat close to her requirements. Again, it is important to monitor body condition.

Calculate the nutrient requirements for a Boer doeling weighing 70 lbs, gaining 5 lbs per month, and with intensive pasture grazing, using LINC. The requirements are: 1.3 lbs TDN, 0.25 lbs crude protein, 2.98 grams of calcium, and 2.08 grams of phosphorus with a dry matter intake estimate of 2.06 lbs. If we adjust estimated TDN and estimated protein for the forage (questions 7 and 8 in LINC) since the 50% TDN of fall Bermudagrass is different than the 60% assumed, and use 9% CP instead of the 12% assumed, predicted dry matter intake is 2.32 lbs. Using the same feeds, fall bermudagrass and mineral, with a mineral consumption of 0.02 lbs (1% of body weight /month, divided by 30) and using fall bermudagrass for the remainder of her intake (3.3 lbs as fed), both TDN (1.16 lbs intake, 89% of requirement) and crude protein (0.21 lbs intake, 84% of requirement) are inadequate. To achieve the desired growth rate, supplementation may be necessary. By trying sweet feed as a third feedstuff it is determined, through trial and error, that 0.75 lbs of sweet feed along with 2.0 lbs of fall pasture will provide most of the energy requirement but only 0.19 lbs of crude protein (76% of requirement), which is inadequate. By deleting the sweet feed and changing to a 16% dairy ration to supply the needed crude protein, it is finally determined that 0.75 lbs of a 16% crude protein dairy ration, 2.0 lbs pasture, and 0.02 lbs of mineral will provide 1.3 lbs of TDN (100% of requirement) and 0.25 lbs of protein (100% of requirement). The weight gain to achieve adequate breeding size should continue to be monitored with possible feeding adjustments made. The lesson here is that this doeling, because of the need for growth, has higher requirements than a mature doe and needs extra nutrition.

Flushing meat goats

Some people advocate "flushing" of meat goats prior to breeding. Flushing refers to the practice of providing extra nutrition to does approximately 2 weeks prior to breeding and for a variable portion of the breeding period (e.g., 1-2 weeks) to increase the number of ovulations and have a greater proportion of twins and triplets. This is widely advocated with sheep producers and Angora goat producers. Producers have extrapolated the practice to meat goats. However, several controlled studies with Spanish goats in reasonable body condition (BCS 2.5 – 3.5) have shown no response in kidding or conception rate of meat goats to flushing with extra protein, energy, or both. The practice may have utility for meat goats in poor body condition, but there does not appear to be justification for flushing does in acceptable body condition.

Winter feeding of does

Early to mid-winter is a time when does should be in early pregnancy. The goal of a wintering program is to economically provide the necessary nutrients to maintain a reasonable body condition, lose no weight, and keep them warm. In general, most wintering programs consist of both forage and supplement components. The forage component can consist of hay, stockpiled forage, or a cheap byproduct roughage feed. The supplement usually contains energy, protein, and often vitamins and minerals, although these may be provided separately as a mineral mix. Commonly utilized supplements include whole shelled corn (inexpensive source of energy), range cubes (inexpensive source of energy and protein), sweet feed, protein blocks, molasses blocks or tubs, and liquid feed.

Stockpiled forage is forage that is grown during the summer or fall upon which animals are not allowed to graze, reserving it for the winter months. In drier areas, the forage is well preserved, but in a more humid climate quality declines rapidly, making the practice less satisfactory. Stockpiled forage is a very inexpensive forage source since it does not have to be mechanically harvested (baling forage doubles the cost of forage); animals harvest stockpiled forage by grazing. Animals make much more efficient use of stockpiled forage when strip grazed (using temporary electric fence to limit animal access to an area containing a 1 to 3 day supply of forage) to minimize trampling. Fescue is used in many temperate regions for stockpiling and retains its quality well into late winter even in humid areas. Most recommendations for stockpiling fescue include late summer fertilization, clipping, and deferred grazing. Warm season grasses such as native range and bermudagrass can be stockpiled. The amount of deterioration is dependent on grass species and rain. If local cattlemen are using stockpiled forage it will probably work for certain classes of meat goats. Consult your state forage extension specialist for further information.

Calculate the requirements for wintering a 95 lb mature Kiko doe (use Spanish biotype) in early pregnancy gaining no weight and with intensive pasture grazing, using LINC. The requirements are 1.19 lbs TDN, 0.14 lbs protein, 3.13 grams of calcium, and 2.19 grams of phosphorus, with 1.86 lbs of dry matter intake estimated (based on default dietary TDN and CP levels). Feedstuffs that can be used include stockpiled (winter) bermudagrass and a 16% molasses lick. The estimated intake from the molasses lick label is 4 ounces or 0.25 lbs. Assume the remainder of dry matter intake is from the stockpiled bermuda pasture.

The molasses lick is not in the feed library so must be entered manually as a new feedstuff. Click on "Add/ Delete Ingredient to Feed Library," to bring up a table to be filled out. First, the feedstuff class is selected. This molasses lick is in the "concentrate" class. Then the name "16% molasses lick" is entered, and remaining values are entered. These values can be obtained from the feedstuff tag or label or by calling the manufacturer. If a value is unknown, leave it blank. For this example, enter dry matter of 85%, 16% crude protein, 75% TDN, 2.8% calcium, and 0.45 % phosphorus. Click on "Add Feed Ingredient to Library" and the Select Feed Ingredient page appears. If needed, click on refresh feed library and 16% molasses lick appears under "Your Feed Ingredient Library." If you have a dry hay or feed, 85% dry matter is a good assumption.

To continue formulating the ration, select the 16% molasses lick and winter bermudagrass, then click on "Input these Feed Ingredients to the Ration." Enter 0.25 lbs for the 16% molasses lick under the "Amount, as-fed" column and guess at 1.5 lbs of winter bermudagrass. Through trial and error a total of 2.0 lbs bermudagrass is selected to fulfill intake requirement. The table shows that this diet provides 0.91 lbs of TDN (76% of requirement), 0.12 lbs CP (86% of requirement), 4.74 grams of calcium, and 1.52 grams of phosphorus (deficient). The diet is quite deficient in energy. To provide additional energy, add whole shelled corn. The diet is then reformulated to contain 0.6 lbs whole shelled corn, 1.4 lbs winter bermudagrass, and 0.25 lbs of lick molasses. This provides 1.15 lbs TDN (97% of the energy requirement) and meets the CP needs. Phosphorus is slightly deficient (13%), but if the bermudagrass is better than average the requirement can be satisfied. Mineral supplements vary in their phosphorus levels as phosphorus is an expensive ingredient. If a mineral supplement with a high phosphorus level is selected for feeding, the requirement would be met but likely at a high monetary cost.

Feeding does in late gestation

Energy requirements increase dramatically in late pregnancy (Figure 4). Using LINC, calculate the nutrient requirements for a 130 lb mature Boer doe, 140 days pregnant (10 days from kidding), gaining no weight, other than that due to pregnancy, and carrying twins. Under question 3, after clicking on the box for greater than 95 days pregnant, a form drops down for pregnancy number (twins), breed (predicts birth weight, can enter yours if known), and days of pregnancy (140). The requirements are 2.45 lbs TDN, 0.45 lbs crude protein, 3.97 lbs intake, 6.03 grams calcium, and 4.22 grams phosphorus.

A ration can be balanced using bermudagrass hay and 20% range cubes to meet the requirements by feeding 1.5 lbs of range cubes and 3.0 lbs of bermudagrass hay. This illustrates the high level of nutrition that is needed, especially in the last 3 weeks of pregnancy. High quality hay as well as supplementation is usually required. The range cubes contain a mineral supplement so no additional mineral mixture is needed.

Doelings require more supplementation than mature does, as the doelings are still growing. The nutrient requirements for a 95 lb growing Boer doeling with a predicted intake of 3.37 lbs, gaining 1 lb per month in addition to pregnancy weight gain and 140 days pregnant with a single kid are 1.77 lbs TDN, 0.36 lbs CP, 5.23 grams calcium, and 3.66 grams of phosphorus. If the same ingredients are used as those for the mature doe, how much of each will be required? The doeling could be fed 3.8 lbs of bermudagrass hay alone to meet the nutrient requirements for pregnancy with a single kid. However, if the doeling is carrying twins and is 140 days pregnant, her requirements are 2.27 lbs TDN and 0.47 lbs CP. This doeling will require 1.0 lbs of range cubes and consume 3.3 lbs of hay. If an abundance of high quality pasture is not available, the doeling will need some type of supplementation. If the forage (or hay) of adequate quality is available, only 1 to 1.5% of body weight of whole shelled corn may be needed as an energy supplement. This is important in that feed intake may be reduced in the last 4 to 6 weeks of gestation by the growing kids that reduce available abdominal space.

Feeding the lactating doe

The lactating doe has very high nutrient requirements. Calculate the requirements for a 4 year old 110 lb Boer cross doe nursing twins in week 4 of lactation. When lactating is selected under question #2 on LINC, a form drops down. Select litter size (twins), week of lactation (4), and age at kidding (4). The program then predicts production of 4.5 lbs of milk per day with 3.6% fat and 3.3% crude protein. Nutrient requirements are 2.65 lbs of TDN, 0.41 lbs of protein, 7.61 g of calcium, and 5.33 grams of phosphorus, with 4.14 lbs of dry matter intake predicted (based on default dietary TDN and CP concentrations). During lactation, the doe can consume nearly enough nutrients if an abundant supply of high quality pasture is available, such as in spring or early summer. If "Range, early summer" is selected and fed at 4.7 lbs, the diet meets protein and calcium requirements, and 90% of energy requirement. However, phosphorus is deficient (3.76 vs. 5.33)

and needs to be supplemented. However, does will likely lose some bodyweight due to the high demands of peak lactation (weeks 3 to 8 of lactation) and an inability to consume an adequate quantity of feed. Kidding should take place when there is an adequate supply of high quality pasture. If there is not adequate pasture, supplemental feed will be required. Inadequate nutrition will decrease body condition, reduce milk production, reduce kid weaning weight, and increase kid mortality.

If feeding bermudagrass hay and a 16% dairy ration, 2.6 lbs of hay and 2.0 lbs of the ration are required to fulfill requirements. However, the doe will still lose 2.0 lbs of bodyweight per month. When feeding high levels of grain such as the amount in this example, the animal should go through an adjustment period of two to three weeks during which time the grain portion of the diet is gradually increased to prevent digestion and other problems from occurring. Feeding a dairy ration and hay to a doe during late gestation and the lactating period will cost approximately $30 per animal. Utilizing available pasture as a feed source is a much cheaper alternative.

Kids are usually weaned at about 12 weeks of age. Milk production of the doe begins to decrease after the 6th week of lactation and is quite low by the 12th week. Nutrient requirements decline as stage of lactation advances, enabling the doe to maintain or even increase body condition on pasture alone. Kids may be creep fed while nursing to increase growth rate of the kids and reduce nutrient demands on the doe for milk production.

Creep feeding

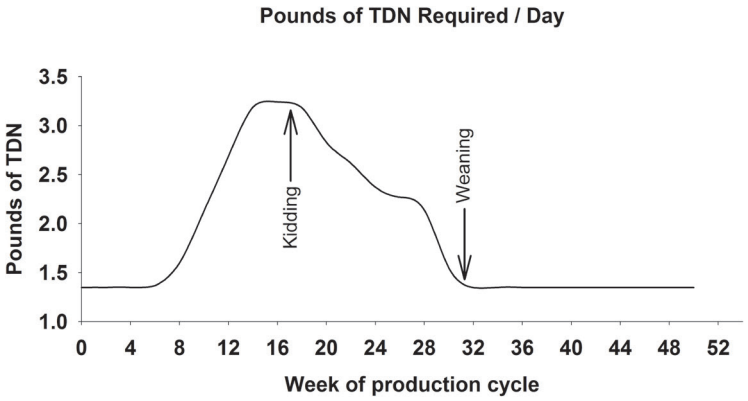
Creep feeding is a method of providing feed for the kids only. This is accomplished by fencing around a feeder and using a creep gate that has holes about 5 inch wide by 1 ft high. These holes are small enough so that kids can enter the feeder, but adults are excluded because they are too big to go through the hole. Creep feeding will provide extra growth for the kids and train them to eat feed, facilitating weaning. A commercial creep feed with at least 16% crude protein that is medicated with a coccidiostat should be used. It requires about 6 lbs of feed to produce 1 lb of animal gain. The more rapid growth from creep feeding may be beneficial for producing show prospects.

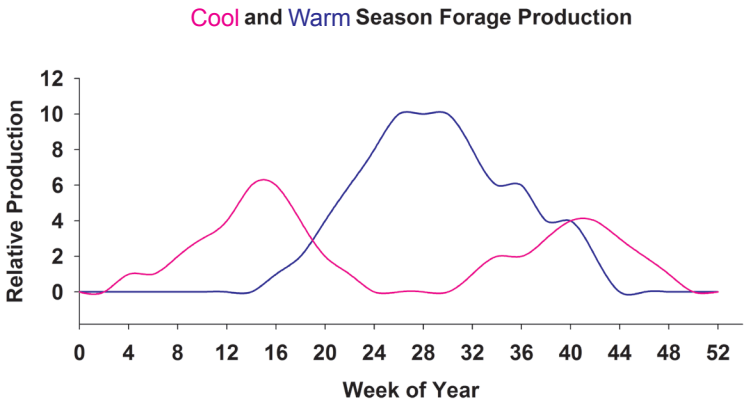
An alternative to grain-based creep feeds that is used in the beef cattle industry is to creep graze calves, using a creep gate that allows calves access to ungrazed high quality pasture. This may have application for goats using high quality pastures (crabgrass or sudangrass that is planted for the kids). In rotational grazing of cattle, the calves are often allowed to creep graze the next pasture before cows so that they have relatively high nutrient intake. Those pastures often have less parasites and disease organisms because of the time since last grazing.

Effect of Kidding Season on Nutrient Requirements

Nutrient requirements of does change dramatically with stage of production. Requirements increase dramatically the last 6 weeks of gestation due to increasing fetal growth and remain high in early lactation (kidding occurred on week 18 in chart). During the month prior to kidding and for the following 3 months (assuming weaning at 12 weeks of age), the doe will consume nearly as much nutrients as in the remaining 8 months of the production cycle. Thus, during that time it makes sense to supply nutrients from an inexpensive source, typically pasture. The cost of providing the same nutrients as hay is more than twice that of pasture, and supplying through purchased feeds may be four to five times greater than for pasture.

Kidding should be planned for a time when pasture is rapidly growing. This period corresponds to late spring for pastures comprised of warm season forages such as bermudagrass or native range, browse, and forbs, but could be either fall or early spring for cool season grasses such as ryegrass, wheat, orchardgrass, and fescue. Cool season grasses usually produce less forage per acre than warm season forages, but generally are higher in energy and protein. The accompanying figure shows the relative production of cool and warm





season forages for central Oklahoma. Consult a local pasture extension specialist or livestock extension specialist for local forage growth patterns. Rapidly growing pasture is high in protein and energy. A major consideration in determining the date to kid is level of forage production at that time. However, there are other considerations in selecting kidding date, such as parasites and market opportunities. Some markets provide a substantial price premium from kidding at a specific time of the year, such as producing prospect show wethers or registered animals. However, it may take a considerable market premium to cover the cost of purchased feed, so general reliance on pastures and forages is best.

Artificial Raising of Kids

Sometimes it is necessary to bottle feed young kids due to death of the mother or the mother refusing to take them. Milk feeding of commercial meat goats is usually not economical. It may be avoided by cross-fostering kids onto another doe as described under the goat management section. If a bottle raised kid is with other kids and does, they may learn to 'steal' sufficient milk to raise themselves. Kids can be raised on cow milk replacer, goat milk replacer (expensive) or, if none is available, cow milk from the store may be used.

It is very important that kids receive colostrum within 12 hours of birth. After 12 hours, antibodies absorption decreases. Colostrum may be milked from another doe that recently kidded. Colostrum contains antibodies that strengthen the immune system for the first months of life. A kid should be fed one ounce of colostrum per lb of weight (average birthweight 7 lbs, therefore, 7 ounces of colostrum) at each of three feedings in the first 24 hours. If the kid is too weak to nurse, it is appropriate to provide the colostrum via stomach tube. This does take some practice, but obtaining colostrum is critically important to kid survival.

Initially kids can be fed using a baby bottle or a nipple such as the Pritchard teat which fits on a plastic soda bottle. Kids can be bottle fed twice a day, although three times a day the first 4 to 6 weeks of life may increase growth rate. Kids are very susceptible to bloating and other gastrointestinal problems from milk replacers that contain a high level of lactose due to use of dried whey in their formulation. Reduced lactose milk replacers will reduce bloating problems.

A calf starter feed (with a coccidiostat such as Rumensin or Deccox, sometimes called medicated) and high quality hay should be made available the second week of life. Deccox can be used in the milk from week 2-6 to prevent coccidiosis. After 4 weeks of life, kids can be limit fed milk at one pint in the morning and also in the afternoon. This will stimulate consumption of starter feed and facilitate weaning.

Kids can be weaned after 8 weeks of age if they are consuming 2 ounces of starter per day and weigh two and a half times their birth weight (about 18 lbs). Weaning shock can be reduced by going to once a day milk feeding for several days to encourage consumption of the starter.

Considerations in Ration Formulation

Rations should be balanced not only for protein and energy, but calcium and phosphorus contents should be calculated, macrominerals supplemented, and a trace mineralized salt used to provide microminerals. A vitamin premix should be used to provide at least vitamin A and E.

If the diet is being fed at high levels to bucks or wethers, there is risk of urinary calculi. To prevent urinary calculi, the ration should be formulated with a minimum of phosphorus, over twice as much calcium as phosphorus, and a urine acidifier such as ammonium chloride at 0.5-1.0 % of the diet. Salt can also be included in the diet, such as at 1%, to reduce incidence of urinary calculi.

If the ration is being fed at high levels, sufficient fiber should be included in the diet to prevent acidosis. Dried brewers yeast and probiotics are often used in rations fed to animals at high levels to help prevent them from going off feed.

Feeds may have a coccidiostat included in the formulation to prevent coccidiosis. There are a number of coccidiostats, but Food and Drug Administration approved drugs commonly used include Deccox and Rumensin. Since goats are very susceptible to coccidiosis when stressed, such as at weaning or shipping, many starters and show feeds contain coccidiostats and have the term 'medicated' on the feed tag. Management considerations to reduce coccidiosis incidence include sanitation, cleanliness, and dry housing.

Feeding Systems

There are many methods of feeding goats. Feeds should be offered in such a way to minimize mold growth or fecal contamination that reduces intake. Mineral mixes must remain dry and should be replenished at 2 week intervals to avoid caking. Feed troughs should be designed to facilitate removal of feces and leftover feed. Troughs generally require a bar running above the length of the trough to keep goats from defecating in them.

Self feeders can be used for feeds containing sufficient roughage for use as a complete feed or for feed that has a built-in intake limiter. For large range operations, feeds such as whole shelled corn or range pellets or cubes are often fed on the ground. The feeding area is moved each day to have clean ground upon which to feed.

Round hay bales should be fed in a rack off the ground. Feeding round hay bales on the ground results in hay wastage and leaves a mess that is difficult to clean. Hay can be fed in a manger or hay feeder with keyhole slots, but horns may cause problems preventing access to feed. For large operations, unrolling round bales on the ground works well.

Nutritional Disorders

There are several diseases associated with nutritional management. These include acidosis, founder, enterotoxemia, pregnancy toxemia/ketosis, polioencephalomalacia, and urinary calculi.

Acidosis, founder, and enterotoxemia are all related to either feeding high levels of grain or a rapid increase in the level of grain in the diet. Acidosis is associated with the production of high levels of lactic acid in the rumen from a large supply of starch that the animal consumed. Endotoxins may also be produced by ruminal bacteria that exacerbate the problem.

Founder refers to problems that occur with the feet of the animal as a consequence of acidosis. The blood vessels in the hoof constrict and in the long-term cause the hoof to grow rapidly, necessitating weekly hoof trimming.

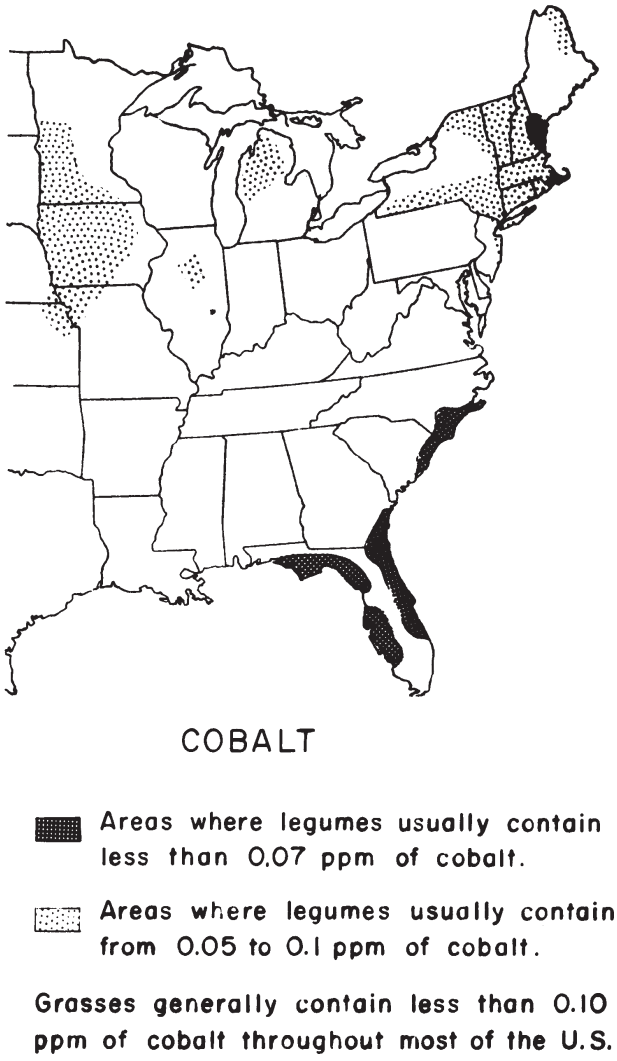
Enterotoxemia is caused by bacteria in the intestine that grow rapidly and produce an endotoxin in response to high levels of starch (grain) in the diet. Animals are in extreme pain from the effect of the endotoxin and often die quickly. Vaccination will help prevent this disease.

High levels of grain in the diet and stress are associated with polioencephalomalacia, which is a thiamine deficiency. High dietary levels of sulfur (such as from molasses in the diet) can increase incidence of the condition. The animals appear drunk, may not be able to stand, become blind, and slowly die. There is often a dramatic response to a large dose of thiamine (5 mg/lb), which may need to be repeated. These diseases can be best prevented by increasing the grain level in the diet slowly and maintaining 50% forage in the diet. Thiamine can be added to high concentrate diets at 0.25 lb/ton to aid in the prevention of polioencephalomalacia.

Pregnancy toxemia is a metabolic disease usually caused by animals being too fat (body condition score greater than 4) prior to kidding; although very thin animals (body condition score less than 2) are subject to the disease also. It is caused by a high demand for nutrients by the growing fetus in late pregnancy that is not being met (excess fat in the body and the growing fetus limit room in the stomach for food, reducing intake of the diet). This unmet nutrient demand causes a rapid breakdown of fat reserves, forming ketone bodies at high levels which are toxic. Treatments include administration of propylene glycol, large doses of B vitamins, glucose given intravenously and possibly Caesarian-section (to remove the fetuses and immediately reduce energy demand; see the Goat Health section). Prevention of the disease is far easier and more effective than treatment. Simply monitor animal body condition and adjust nutrition, especially energy, to manipulate body condition. Do NOT sharply reduce feed in late gestation as this may cause pregnancy toxemia. Also, pregnant goats in the last third of pregnancy will need a more nutrient dense diet (higher quality) due to fetal growth and reduced intake because of reduced stomach capacity. Exercise will help. Does can be encouraged to exercise by separating hay, feed and water at a substantial distance, forcing them to walk more.

Soil-Related Nutritional Problem Areas for Grazing Animals

Figure 1. Geographical distribution of Co-deficient areas in the eastern United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota and Allaway, 1972, by permission Soil Science Society of America.



All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

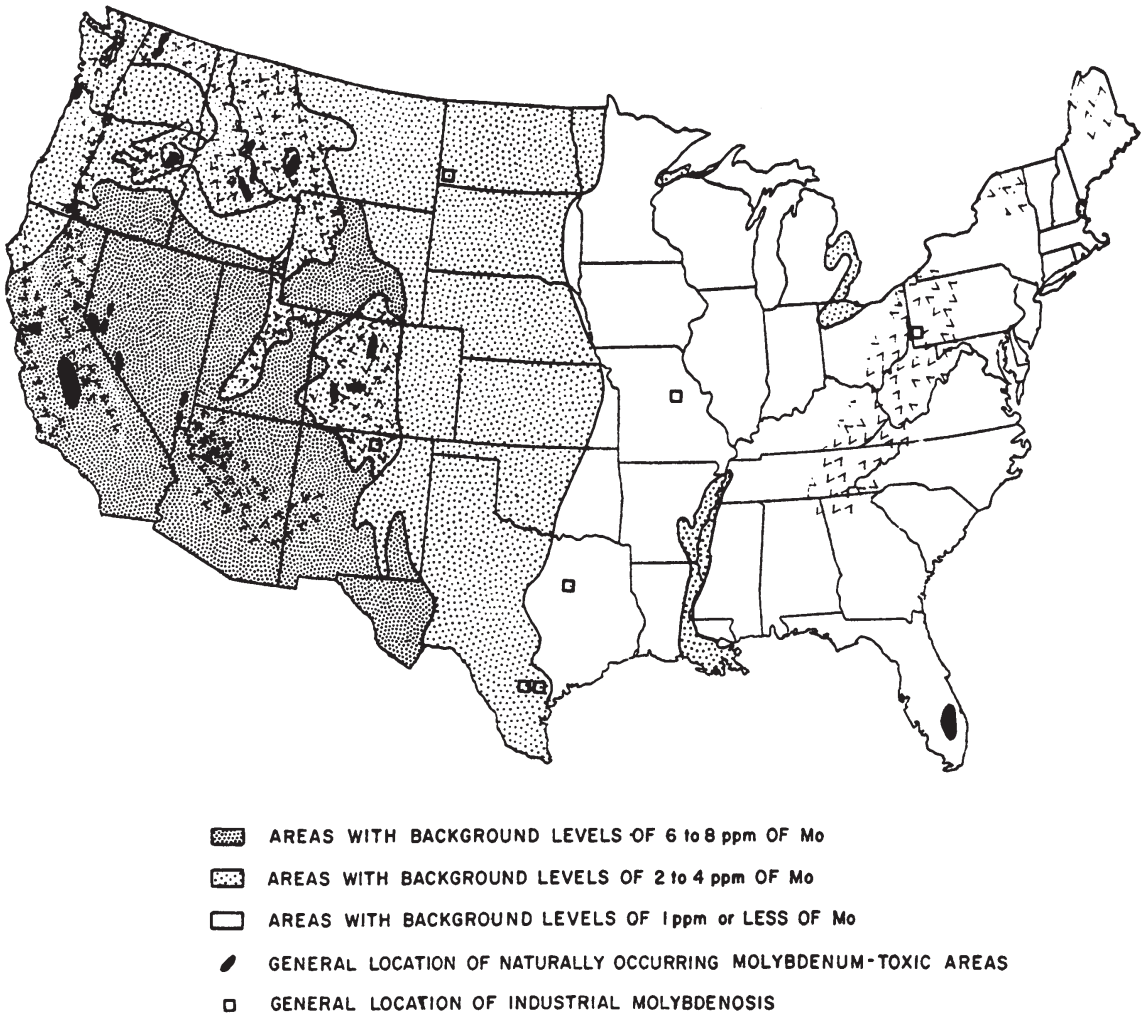


Figure 6. Generalized regional pattern of molybdenum concentration in legumes of the United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota, 1977, by courtesy Marcel Dekker, Inc.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

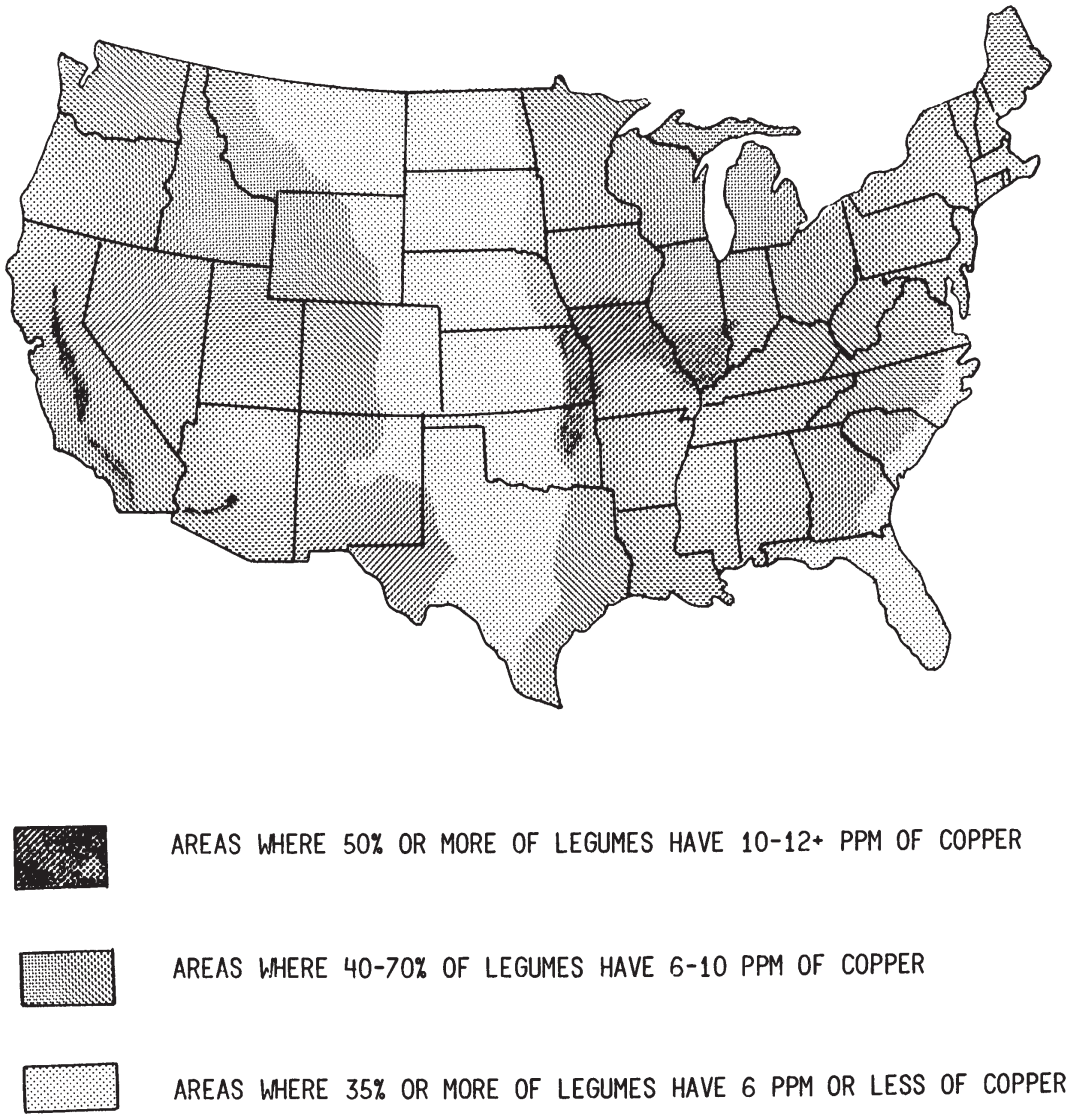


Figure 7. Generalized distribution of copper concentration in legumes of the United States (ppm = 1 μg/ g^{-1}). From Kubota, 1983a, by permission Amer. Society of Agronomy.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

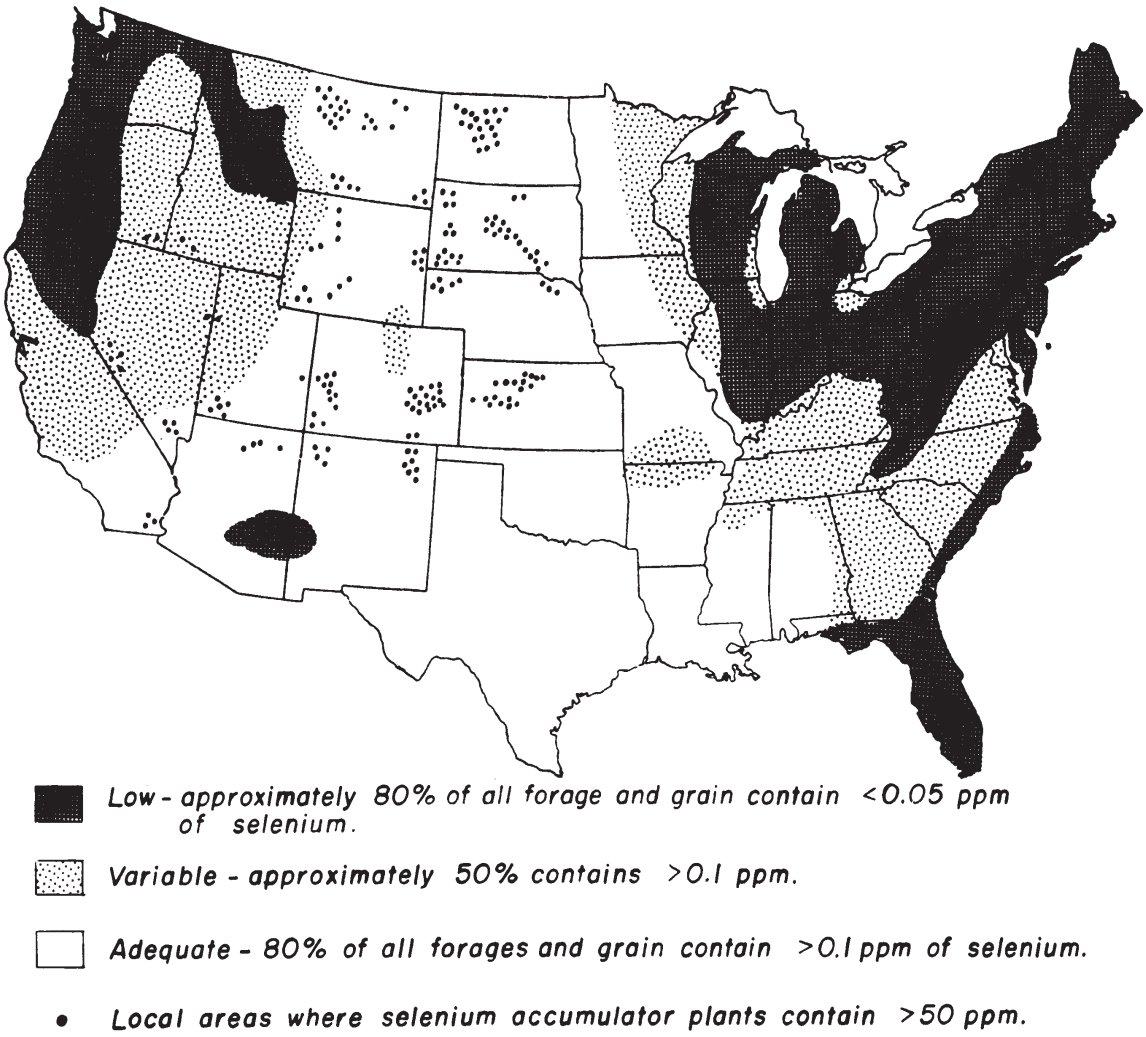


Figure 8. Geographical distribution of low-, variable-, and adequate-Se areas in the United States (ppm = 1 μg/g). From Kubota and Allaway, 1972, by permission Soil Science Society of America.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

Definitions useful for this section

Acidosis - A disease usually caused by feeding too much grain or increasing the level of grain in the diet too rapidly. It results in the rumen having very acid conditions, and endotoxins may be produced that adversely affect various parts of the body.

Body condition score - Abbreviated BCS. Applying a numerical score to describe the amount of muscle and fat cover on an animal. Usually performed by feeling along the backbone in the loin area, over the ribs, and at the breastbone (sternum). Scores range from 1 (extremely thin) to 5 (extremely obese).

Browse - Vegetative parts of woody plants, primarily leaves and twigs, that typically contain high levels of tannins.

Carbohydrates - The major energy source found in most feedstuffs. Carbohydrates contain twice as many hydrogen atoms as carbon and as many oxygen atoms as carbon, commonly designated as CH_2O. They include substances such as sugar, starch, fiber, cellulose, and hemicellulose.

Cellulose - A major structural carbohydrate in plants. A component of fiber that is poorly digested by nonruminant animals. Cellulose is composed of glucose molecules chemically linked by a "beta" linkage that is only digested by bacteria such as those in the rumen and(or) cecum.

Coccidiosis - An infectious intestinal disease caused by protozoan organisms (coccidia). The disease causes diarrhea and damages the lining of the intestine. Moisture, stress, and unsanitary conditions are conducive to coccidiosis.

Concentrates - A feed with less than 20% crude fiber and usually more than 60% TDN on an as fed basis. Often a mixture of feedstuffs with added minerals and vitamins.

Crude fiber - The more fibrous, less digestible portion of a plant primarily consisting of cellulose, hemicellulose, and lignin. A method of estimating the fiber content of a feedstuff through sequential extraction with acid and alkaline solutions.

Enterotoxemia - A disease caused by an overgrowth of bacteria (*Clostridia perfringens*) in the intestine usually due to fermentation of a large quantity of starch, with production of endotoxin. Usually causes rapid death of animals.

Fiber - A component of the feed that consists of cellulose, hemicellulose, and lignin. It is necessary for normal rumen health.

Forage - The edible part of the plant, other than separated grain, that can provide feed for grazing animals.

Founder - Refers to a consequence of acidosis, resulting in rapid growth of the hoof.

Mineral - The inorganic group of nutrients including elements such as calcium, phosphorus, copper, etc.

Nutrient - One of six classes of chemical compounds having specific functions in the nutritive support of animal life.

Nutrient requirements - The level of specific nutrients required to keep an animal healthy and productive.

Nutrition - The study of nutrients, determining what nutrients are required, what levels of nutrients are necessary for various levels of productivity, and how to provide those nutrients.

Polioencephalomalacia, PEM, or 'polio' - A neurological disease of goats caused by thiamine deficiency. The rumen normally produces adequate levels of thiamine, but under some conditions such as a high grain diet, high sulfur in the diet, stress, or being 'off feed,' the thiamine is degraded, thus causing the disease.

Stockpiled forage - Forage that is allowed to accumulate for grazing at a later time.

Supplement - A feed designed to provide nutrients deficient in the animal's main diet.

TDN - Total Digestible Nutrients, a measure of digested energy. A lb of TDN equals 2,000 Calories (kilocalories).

Vitamins - Specific organic substances required for various metabolic functions.

DHI Training

Ms. Eva Vasquez
Langston University

STANDARD OPERATING PROCEDURES FOR DAIRY GOAT PRODUCTION TESTING

Effective January 1, 2004

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STANDARD OPERATING PROCEDURES

1.0 SCOPE & APPLICATION

1.1 This Standard Operating Procedure (SOP) is applicable to the systematic collection of data documenting milk yield including the measuring milk fat and protein for participants in DHI. The application of these procedures is to provide the framework for a uniform, accurate record system to be used for (1) making farm management decisions; (2) educational programs and research, including the genetic evaluation of does and sires; (3) breed association(s); and (4) the promotion and sale of animals.

2.0 SUMMARY OF PROGRAM

2.1 Sampling should be done in accordance with the National DHIA Uniform Operating Procedures (UOP). All UOP procedures, unless specific to dairy cows only, are to be followed. For purposes of compliance, the use of the terms “cows and heifers” is synonymous with “goats and kids”.

2.2 Procedures outlined in this document are specific to dairy goat production testing only. These basic and minimum standards are to be uniformly followed. They serve to ensure that records will provide the accuracy, uniformity, and integrity essential to dairy goat production records.

3.0 AUTHORITY

3.1 A Memorandum of Understanding exists between the ADGA and the Agricultural Research Service of the United States Department of Agriculture (USDA) to ensure the flow of DHIA records for industry purposes including genetic evaluation programs.

4.0 RESPONSIBILITY

4.1 DHIA dairy goat test supervisors and herd owners as well as persons in their employ are individually and collectively responsible for adherence to these Procedures.

4.2 To participate in this dairy record keeping program, herdowners must agree to conform to these procedures, registry requirements, the NDHIA Uniform Operating Procedures and the associated Code of Ethics.

5.0 DEFINITIONS

5.1 **Dairy Goat -** any goat from which milk production is intended for use or sale, or which is kept for raising replacement dairy kids and is an integral part of the dairy herd.

5.2 **Test Supervisor (TS) –** Any person authorized to collect milk weights and samples for inclusion in the Goat Genetic Evaluation Program (interchangeable with ‘tester’, ‘field sampler/technician’ or ‘supervisor’).

5.3 **Group Testing** – Must meet registry requirements. Each member of the test group is trained to perform supervisor responsibilities when weighing and sampling milk in the herds of other group members. All group testing is conducted under the jurisdiction and supervision of the DHIA.

6.0 PERSONNEL QUALIFICATIONS

6.1 All Test Supervisors are required to be approved by the DHIA of record prior to engaging in any field collection activities.

6.2 Training should be done in accordance with the Council on Dairy Cattle Breeding (CDCB) QCS Field Service requirements with the following being specific to dairy goat testing.

7.0 MINIMUM PERSONNEL TRAINING REQUIREMENTS

7.1 The minimum requirements for new test supervisors (TS) to test non-commercial herds (as determined by the herd's DHIA) without immediate supervision include demonstrated knowledge of (1) barn and parlor techniques, (2) data entry, (3) the *Code of Ethics* and *Uniform Data Collection Procedures, and (4) the Standard Operating Procedures for Dairy Goat Testing*. Commercial herds must have testers meeting the criteria of the CDCB auditing guidelines.

7.2 Documentation of the initial training must include (1) the name and date of training of the new TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.3 Continuing Education (CE) or refresher sessions should be provided in accordance with the CDCB Auditing guidelines. In addition, newsletters, videos, attendance at an ADGA annual meeting training session can serve as meeting CE requirements. Documentation must include (1) the name of each TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.4 TS other than those approved to test cowherds or commercial herds (as determined by the herd's DHIA) must obtain CE or attend an initial or a refresher session every 3 years. This is an exception to the CDCB auditing guidelines as it applies to those testers supervising herds using 'pail and scale' techniques. This exception is allowed as this type of test plan is subject to little change over time. Documentation of CE/Refresher must include (1) the name of each TS, (2) the name and credentials of the evaluator, (3) a list of the topics covered during the evaluation, and (4) a performance assessment based upon the CE/Refresher information provided.

8.0 EQUIPMENT AND SUPPLIES

8.1 Equipment needed for collection of dairy goat milk samples includes:

- sample vials or whirl paks*
- approved meter*, or
- sampling device (dipper) and scale*
- sample preservative
- field data sheets

*The appropriate sampling and measuring devices must be of proper composition. See Section 10 for SOP Meters and Scales

9.0 SAMPLE COLLECTION – PREPARATION

9.1 Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.

9.2 Obtain necessary sampling and/or weighing equipment.

9.3 Coordinate with herdowner and partner agencies, if appropriate.

10.0 SAMPLE COLLECTION - METHOD OPTIONS

10.1 Meters **-** All portable weighing and sampling devices being used for the generation of certified data must be of a National DHIA approved type. Meters for goat milk sampling must be calibrated in conformance to manufacturer specifications.

GOAT METERS

Manufacturer	Device	ICAR Approved	DHIA Approved
Tru-Test Limited - New Zealand	Goat Meter model 50000		Yes
Waikato - New Zealand	Goat Meter		Yes

10.2 Scales being used for the generation of milk weights to be included in the *Goat Genetic Evaluation Program* must meet the following weight tolerance ranges at each specified weight:

Pounds	Minimum	Maximum
1	0.9	1.1
2	1.9	2.1
5	4.8	5.2
10	9.7	10.3
20	19.4	20.6

10.3 All scales must be checked for calibration by a certified meter technician or an individual approved by the DHIA prior to being placed in active service. The field technician or the herdowner may own Scales. Approved individuals must calibrate scales using certified weights.
10.4 Scales should be identified with a unique identification number.
10.5 All scales must be submitted for an approved routine calibration check by a certified meter technician or an individual approved by the local DHIA on an annual basis.
10.6 All scales receiving repairs that may have affected accuracy must be checked for calibration by a certified meter technician or an individual approved by the local DHIA before returning to active service.
10.7 Each scale must be identified with a tag, sticker, engraving, or other marking indicating the last calibration year and meter center used.
10.8 Documentation of scales must include (1) the make and unique identification number of the scale, (2) the meter technician's or approved individual's name, (3) the meter center used, (4) the date of calibration check, and (5) the final calibration check readings.
10.9 Dip Sampling must be done in a manner that assures a representative sample from the entire milk volume collected.

11.0 SAMPLE HANDLING AND PRESERVATION

11.1 Use pre-preserved sample vials.
11.2 Samples should be kept at room temperature and out of direct sunlight.
11.3 Keep samples in control of the tester – ***EXCEPTION*** – for group tests, samples may also be in control of the group leader, or person designated to ship the samples/data to the laboratory.
11.4 Record all pertinent data on a field data sheet.
11.5 Samples should be shipped so that they arrive at the lab no later than 6 days after the test is performed.

12.0 DATA COLLECTION AND RECORDS MANAGEMENT

12.1 When a breeding date is available, and a doe freshens less than 10 days prior to the expected kidding date, it will be considered a normal kidding and the record initiated will be used for buck and doe evaluations. Does freshening 10 days or more prior to the expected kidding date, whether in milk or dry, will be coded as abnormal and the record initiated will not be used for buck and doe evaluations.
12.2 If a doe aborts while in milk and has carried a kid less than 80 days, her current record will continue without interruption. If a breeding date is not available, and the doe aborts while in milk for less than 240 days, her current record shall continue without interruption. Except for specific situations stated above, the current record shall end and a new lactation will begin.
12.3 Verification tests may be a required condition of test type plan or registry recognition level. It is the herdowner's and/or test supervisor's responsibility to arrange for such tests dependent on registry or regional requirements. Verification testing should be done in accordance with registry policies.
12.4 All data and information must be documented on field data sheets
12.5 Minimum Suggested Record Retention

- Field Sheets – 2 years
- Record Center sheets – 2 years
- Verification Sheets – 2 years

13.0 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)

All field QC requirements of the ADGA QA Project must be followed.

14.0 REFERENCES

Dairy Goat Registry Guidelines, 2003
Uniform Operating Procedures, June 2002
California DHIA, Dairy Goat QC Program
Council on Dairy Cattle Breeding, Auditing Guidelines, June 2002

Herd Data For Next Test

Date of Test			Technician	Net Per CWT		%	Fat Differential		%	Pro Differential	
Month	Day	Year	Number	$	Cents	Fat	Cents	10ths	Pro	Cents	10ths

Bulk Tank Weights	# Milkings	Total Lbs	SCC	MUN	
Pickup 1					Entire Herd Milked 3X
Pickup 2					_____
Pickup 3					

Milking	Start Time	End Time	Sampled	Weighed	Previous Test		
					Samp.	Wgh	Start Time
1st Milking (Prior for AM/PM)	: AM PM	: AM PM	Y N	Y N			
2nd Milking (Weigh for AM/PM)	: AM PM	: AM PM	Y N	Y N			
3rd Milking (3X Herd)	: AM PM	: AM PM	Y N	Y N			

HERD CODE ____-____-_____

TRANSFER DOES

DOE				CODE	COMPLETE THIS SECTION IF COW TRANFERS FROM ANOTHER HERD ON TEST			
					OLD HERD CODE			
INDEX NO.	REGISTRATION OR EARTAG NO.	BR	BARN NAME		STATE	COUNTY	HERD NO.	INDEX NO.
				T				
				T				
				T				
				T				

BREED CODES FOR NEW AND TRANSFER DOES

A - ALPINE	**E - EXPERIMENTAL**	**S - SAANEN**
B - OBERHASLI	**L - LA MANCHA**	**T - TOGGENBURG**
C - SABLE	**N - NUBIAN**	**M - MIXED**
D - NIGERIAN DWARF	**P - PYGMY**	

A-RECORD AN "A" IF ADDING 1ST LACTATION DOE WITH DRPC COMPUTER REF. NUMB.
C-RECORD A "C" IF CORRECTING EXISTING DOE.

NEW DOES ENTERING THE HERD OR IDENTITY CORRECTION

DOE				DATE OF BIRTH			SIRE		DAM			KID'S SIRE IDENTITY		CODE	DRPC COMPUTER REFERENCE NUMBER
INDEX NO.	REGISTRATION OR EARTAG NO.	BR	BARN NAME	MONTH	DAY	YEAR	UNIFORM AI CODE NUMBER REGISTRATION OR EARTAG	BR	REGISTRATION OR EARTAG NO.	BR	BARN NAME	SIRE CODE EARTAG OR OTHER NUMBER	BR		

SUPERVISOR'S BARN SHEET

DHI-201

Supervisor's Signature

Herd Code _____ - _____ - _____

Test Date		
Mo	Day	Yr

Type Test		Sched. Day		Assoc.		Supv.		Cows In Herd		Cow Months		Total Fees	

String	Old Status: Code / Brd	Old Status: Date / Reg/Tag Number	Old Status: Last Milk	Cow Index	Milk Weights: Milking 1st	2nd	3rd	Feed Prg or Conc. Fed 2	CAR	Conc. Fed 1	Sample No.	Batch	Barn Name	New Status: Code	New Status: Date Changed Mo	Day	New Repro Status: No. Br.	Repro Code	Bred or Heat Date Mo	Day	Calf Identity or Service Sire: Calf: Tattoo, Tag, or Other / Sire: Reg No. or Bull Code	Sex	Disp	Calf Number	Body Wt.	Birth Diff.	Old Repro Status: No. Br.	Repro Code	Due Date / Bred or Heat Date	Error Code

Status Codes
2. Calved
3. Dry
5. Left Herd
6. First Lact
7. Entered Herd
8. Aborted
9. Induced Lact

Condition Affecting Record (CAR)		
1. Sold Feet/Legs	6. Died	A. Abnormal
2. Sold Dairy	7. Sold Mastitis	H. In Heat on Test Day
3. Sold Low Prod.	8. Sold Disease	E. Milk Weight Missed
4. Sold Repro.	9. Sold Udder	I. Injected on Test Day
5. Sold Injury/Other	X. Sold Reason Not Rprtd.	F. Sample Missed

Repro. Codes
1-9 No. Breedings
C. DNB (Do Not Breed)
H. In Heat
K. Checked OK to Breed
N. Open
P. Diagnosed Pregnant

Birth Difficulty
1. No Problem
2. Slight Problem
3. Needed Assistance
4. Considerable Force
5. Extreme Difficulty

Disposition Codes	
B. Died, Birth	4. Died, Other
E. Died, 1st 24 Hrs	5. Sold, Dairy
1. Died, Scours	7. Sold, Other
2. Died, Respiratory	T. Embryo Transplant
3. Died, Disease	

Condition Codes From Previous Test	
1. Bred Date Removed	6. Cow ID Missing
2. Calving Date Missing	7. Reported Sire of Cow Invalid
3. Dry Date Missing - Estimated	8. Calving Dates Less Than 200 Days Apart
4. Milk Weights Missing - Estimated	9. New Cow ID Invalid
5. Milk Weights Abnormal	

Calf Sex
F. Female
M. Male
7. Unknown

Date_____ 2015 Langston DHI Supervisor Test

(Must return by Mar. 1, 2015 if you want a certificate)

Were you previously certified by Langston to be a supervisor?

Yes No

Name:_____

Address:_____

City:_____ **State:**_____ **Zip:**_____

Telephone:_____

Who do you test for:_____ **E-mail** _____

1. A transfer doe is….
   A: A doe from another herd on test, that is entering your herd.
   B: A doe in your herd that has just freshened.
   C: A doe coming into your herd who has not been on test before.
   O: None of the above.

2. A verification test consist of how many milkings?
   A: 1
   B: 2
   C: 3
   O: 1 AM& 1PM

3. If I have a milk weight entered for a doe, and she has a O in the second column on the barn sheet (OMS 201) there is no problem.

   True _____False

4. Before sending the paperwork, I always ensure that I have put down fresh dates for does that have freshened and dry dates for does that have since the last test.

   True False

5. If I have not put down a milk weight for a doe who has an I in the second column on the barn sheet (OMS 201) there is no problem.

   True False

Langston DHIA
Invoice

Herd Code # _____

Herd Owner _____

Verification Test YES NO

Service Affiliate Fee
DMS 201 _____x $.08 _____

Herd Processing Fee 01 – 20 does = $6.00 _____
21 – 40 does = $7.00
41 – 60 does = $8.00
61 – 80 does = $9.00
81 – 100 does = $10.00

Milk Analysis Fee
Total Samples _____ x $1.15 _____

Accounting Fee ……..$2.00

No Cash. Check or Money Order Only Please

Total _____

HERD OWNERS:
YOU MUST RETURN THIS SHEET BEFORE YOUR HERD WILL BE PROCESSED!
THIS SHEET MUST BE FILLED OUT BY THE HERDOWNER!

Number of Does dried this month _____

Number of Does freshened this month _____

Does Dried:

INDEX # DRY DATE

Does Freshened:

INDEX # FRESH DATE

(COPY THIS SHEET IF MORE SPACE IS NEEDED)

Langston University Goat DHIA
Agriculture Research & Cooperative Extension

E.L. Holloway Agriculture Research, Extension, and Education Center
Langston University
PO Box 1730
Langston, OK 73050
405-466-6207
dhi@langston.edu

Acknowledgement of Membership Agreement
in the Langston University Goat DHIA

As the owner of dairy goats and being interested in making my herd more efficient and more profitable through the use of herd management records as provided to members of this association, I hereby apply for membership of the above organization and desire DHIA-like testing services.

Should my membership be accepted, I agree:

1. To comply with all rules, regulations, administrative procedures and policies now in effect or established by the association during my continued membership, and I acknowledge receipt of a copy of existing rules, regulations, and policy manual which I have read and understand;
2. To comply with the National Dairy herd Improvement Program Uniform Operating Procedures as approved by the Council on Dairy Cattle Breeding and requests from Dairy Records Management Systems, and to be responsible equally with the supervisor in seeing that all rules and regulations are complied with in obtaining production records for my herd;
3. To cooperate with the supervisor if a supervisor is used in the testing plan which I am enrolled in and to provide him/her access to whatever information I control or have so as to enable him/her to keep complete records for my herd, specifically including but not limited to freshening and dry dates, purchase and sales dates, identification of all animals and plant delivery weights on milk sold.

_____ _____
Date Signature of Applicant

Applicant name:

Name: _____

Address: _____

City State Zip: _____

Phone: _____ Email: _____

Agreement accepted this _____day of _____ 20__ as a member, the applicant is entitled to all rights, benefits and privileges of this organization.

_____
Langston University Goat DHIA Representative

Marketing Strategies for Meat Goat Operations

Mr. Cole Snider

Livestock Market Reporter

USDA, AMS, LPS, Market News

Introduction

As a producer your main goal is to maximize profitability of your product. In this session we will go over s some marketing strategies that have been used to increase the value of your animals at market as well as discuss the pros and cons of different market venues.

Market Strategies

The most common strategy is to market around specific ethnic holidays. However, thought and consideration must be given. Like, when is the best time to market your animals before the holiday? And, what type of animal is desired for which holiday?

- **Western Roman Easter:** *Type of goat wanted* - Fleshy, milk fed kids with relatively light colored meat, 3 months old or younger. Suckling kids weighing less than 20 lbs are generally disappointing to buyers due to low meat to bone ratios and high carcass drying losses now that they must be marketed with the hide off. Kids gaining less than 10 lbs per month or 1/3rd pound per day after accounting for birth weight are generally not fleshy enough to be considered prime. Prime Easter kids are generally gaining at least 1/2 lb daily. There generally is a slight price (per lb of live weight) penalty for kids weighing over 40 lbs. Acceptable weights generally range from 20 to 50 lbs with 30 lbs considered optimum by most buyers. Cull adult animals are also popular for stews and curries at this time.
- **Eastern Orthodox Easter:** *Type of goat wanted* - Similar to Western Easter kids. A slightly larger milk fed kid (i.e. averaging 35 lbs) is considered optimum.
- **Mother's Day:** *Type of goat wanted* - Suckling kids are in demand as well as 45 to 60 lb weaned market kids. Because of the shortage of market kids weighing 60 lbs or more in mid May, prices are sometimes high for these larger young animals as well.
- **Start of Ramadan:** *Type of goat wanted* -male and female kids with all their milk teeth (i.e. not older than @ 12 months). Males can be whole or castrated. Overly fat kids are discriminated against. Optimum live weight is about 60 lbs but weaned kids from 45 - 120 lbs. are accepted by different buyers.
- **Id al Fitr (The Festival of the Breaking of the Ramadan Fast):***Type of goat wanted* -same as for Ramadan.
- **Navadurgara, Navratra Dashara, Dassai or Dashain:** *Type of goat wanted* -Hindu holiday honoring the goddess Durga. In Nepal the holiday runs for 15 days while in India it runs for 10 days. Goats are generally slaughtered during the latter part of the holiday after which families meet together and celebrate with curried goat while receiving family blessings. Female goats are not acceptable for this holiday. Relatively tender male goats are generally used. Size of carcass depends on number of people expected to be fed. Weaned, market kids or yearling wethers are most in demand.
- **Id al Adha (Islamic Festival of Sacrifice, Eid):** *Type of goat wanted* - Prefer yearlings (i.e. animals with one set of adult teeth) that are blemish free. Large kids 60 - 100 lbs also in demand. Animals with broken horns, open wounds, torn ears or physical injuries generally do not meet the criteria. In some cases, castrated animals or lambs with docked tails are frowned upon.

- **Muharramn (Islamic New Year):** *Type of goat wanted* - same as for Ramadan.
- **The Christmas and New Year's market:** *Type of goat* - milk fed kids and lambs. These young animals are rare, because they must be produced by out-of-season breeding in April/May for Sept/ October births. Kids and lambs as light as 18 lbs may be readily accepted. Cull adult animals are also popular for stews and curries.
- **Cinco de Mayo and Hispanic market:** *Type of goat wanted* - 15 to 30 lb live wt suckling kids for cabrito, and large weaned market kids for seco de chivo and barbecues.
- **July 4th weekend:** *Type of goat wanted* - animals suitable for barbecue, generally suckling kids for small parties and weaned market kids 55 to 120 lbs. for large celebrations.
- **Caribbean holidays:** *Type of goat wanted* - young, smelly 60-80 lb bucks. However, older animals of all sexes are often in demand and customers may prefer to buy them rather than pay the extra price for prime young bucks.
- **Chinese New Year and Chinese market:** *Type of goat wanted* - 60 to 80 pounds live, and goats in good health are required

Comingling or combining your animals with other local producers in a CO-OP type setting, where all the animals are raised in a similar fashion, would provide a larger number of animals to take to market. The greater the number of quality animals on offer in a single lot the more value is placed on that lot.

Adding value to your herd by enrolling them in a program such as the Organic program would place a premium on your animals and could help insure a higher price at market.

Using USDA Market News reports to determine the ups and downs of the market should allow you to make an informed decision about the best time to market your animals and provide price discovery information to help you set a base price for your animals. To learn more about and view USDA Market News reports, please visit www.ams.usda.gov and click on USDA Market News link on the top left side of web page.

Market Venues

- **MARKETING GOATS THROUGH A PUBLIC LIVESTOCK AUCTION:**
  - **Pros:** Convenient; Regular sales (weekly, bi-weekly, etc.); Requires minimal effort; Sell based on a "certified" weight; Prompt payment; Guaranteed payment.
  - **Cons:** Price is not known in advance; No control over price - "price-taker"; Wide fluctuations in price; Must pay sales commission, yardage, and other fees (up to $5/ head); Transportation costs; Shrink (weight loss during transport); Goats may be sold on a per-head basis; Stressful to livestock.
- **DIRECT ON-FARM MARKETING OF GOATS:**
  - **Pros:** You set/negotiate price with buyer; Maximum price potential; Sell by the pound or head; Cash sales; No transportation costs; No sales commission, yardage or other fees; Repeat customers; Less stress to livestock
  - **Cons:** Time consuming; Cultural differences; Customers like to bargain; Possible language barrier; Loss of privacy; Buyers may need place to slaughter; May be stressful to producer, family ;
- (**On-farm slaughter**): "Facility" for slaughter; Need to dispose of offal; Need for discretion; Legalities.
- **MARKETING GOATS TO MIDDLEMEN:** (i.e. dealer, broker, order buyer, buying station):
  - **Pros:** Price known ahead of time; No sales commission, yardage, or other fees; No transportation costs (if animals are picked up by buyer on-farm).

- **Cons:** Transportation costs (if you must deliver animals to a pick-up point or buying station); May have to pay a "pencil" shrink; No grading or weighing (varies); Payment/credit risk.

- **MARKETING GOATS DIRECT TO A MEAT PROCESSOR:**
  - **Pros:** Price known in advance; Less fluctuation in price; Year-round pricing possible; Can re-negotiate price periodically; Sell carcass instead of live animal; **value-based marketing**; Less stressful to livestock.
  - **Cons:** Must guarantee supply; Must guarantee quality; Prices may be higher elsewhere; Hard for small producers(unless they form a marketing CO-OP or alliance)
- **MARKETING COOPERATIVES/ALLIANCES/ASSOCIATIONS:**
  - **Pros:** Gives small producers more clout; Can share transportation costs; Can organize special sales; Can purchase inputs in bulk; Democratic.
  - **Cons:** Cooperative needs money to operate (e.g. membership fee, shares, sales commission);Need to have similar genetics and management to market cooperatively.

(Schoenian, 2007);

USDA Farm Bill

Mr. Phil Estes
USDA FSA

USDA

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

2014 Farm Bill

FACT SHEET

March 2014

What's In the 2014 Farm Bill for Farm Service Agency Customers?

The Agricultural Act of 2014 (the Act), also known as the 2014 Farm Bill, was signed by President Obama on Feb. 7, 2014. The Act repeals certain programs, continues some programs with modifications, and authorizes several new programs administered by the Farm Service Agency (FSA). Most of these programs are authorized and funded through 2018.

OVERVIEW

The Direct and Counter-Cyclical Program and the Average Crop Revenue Election programs are repealed and replaced by two new programs, Price Loss Coverage (PLC) and Agricultural Risk Coverage (ARC). Upland cotton is the only covered commodity that is no longer eligible to participate in these programs, but rather, becomes eligible for the new Stacked Income Protection Plan (STAX) offered by the Risk Management Agency (RMA). Until STAX becomes available, upland cotton is eligible for transition payments made by FSA for 2014 and 2015 crops.

The Marketing Assistance Loan program and sugar loans continue mostly unchanged. The Milk Income Loss Contract Program continues through Sept. 1, 2014, unless it is replaced by the Dairy Margin Protection Program prior to that date.

The Conservation Reserve Program (CRP), USDA's largest conservation program, continues through 2018 with an annually decreasing enrolled acreage cap. The contract portion of the Grassland Reserve Program enrollment has been merged with CRP. The Biomass Crop Assistance Program is extended and funded at $25 million per year.

The Noninsured Crop Disaster Assistance Program has been expanded to include protection at higher coverage levels, similar to buy-up provisions offered under the federal crop insurance program. The Livestock Forage Disaster Program, the Livestock Indemnity Program, the Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish, and the Tree Assistance Program are continued, with modifications starting in October 2011, and succeeding years. The Supplemental Revenue Assistance Program (SURE), which covered losses through Sept. 30, 2011, is not reauthorized.

The credit title of the Act continues and improves the direct and guaranteed loan programs that provide thousands of America's farmers and ranchers the opportunity to obtain the credit they need to begin and continue their operations. The changes in the act provide FSA greater flexibility in determining eligibility including expanded definitions of eligible entities, years of experience for farm ownership loans, and allowing youth loan applicants from urban areas to access loans. FSA's popular microloan and down payment loan programs, important to furthering the Administration's objective of assisting beginning farmers, have been improved by raising loan limits and emphasizing beginning and socially disadvantaged producers. The act also provides greater enhancements for lenders to participate in the guaranteed conservation loan program and eliminates term limits for the guaranteed operating program, allowing farmers and ranchers the opportunity for continued credit in cases where financial setbacks may have prevented them from obtaining commercial credit.

ADJUSTED GROSS INCOME

Adjusted gross income (AGI) provisions have been simplified and modified. Producers whose average AGI exceeds $900,000 during a crop, fiscal, or program year are not eligible to participate in most programs administered by FSA and the Natural Resources Conservation Service (NRCS). Previous AGI provisions distinguished between on-farm and nonfarm AGI.

PAYMENT LIMITATIONS

The total amount of payments received, directly and indirectly, by a person or legal entity (except joint ventures or general partnerships) for Price

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What's In the 2014 Farm Bill for FSA Customers March 2014

Loss Coverage, Agricultural Risk Coverage, marketing loan gains, and loan deficiency payments (other than for peanuts), may not exceed $125,000 per crop year. A person or legal entity that receives payments for peanuts has a separate $125,000 payment limitation.

Cotton transition payments are limited to $40,000 per year. For the livestock disaster programs, a total $125,000 annual limitation applies for payments under the Livestock Indemnity Program, the Livestock Forage Program, and the Emergency Assistance for Livestock, Honey Bees and Farm-Raised Fish program. A separate $125,000 annual limitation applies to payments under the Tree Assistance Program.

ACTIVELY ENGAGED IN FARMING

Producers who participate in the Price Loss Coverage or Agricultural Risk Coverage programs are required to provide significant contributions to the farming operation to be considered as "actively engaged in farming." The act requires the Secretary to promulgate regulations to define "significant contribution of active personal management" as part of this determination.

COMPLIANCE

The Act continues to require an acreage report for all cropland on the farm. The acreage report is required to be eligible for Price Loss Coverage; Agriculture Risk Coverage; transition assistance for producers of upland cotton; marketing assistance loans; and loan deficiency payments.

Compliance with Highly Erodible Land Conservation (HELC) and Wetland Conservation (WC) provisions continues to be required for participation in most FSA and NRCS programs. These provisions place restrictions on the planting of an agricultural commodity on highly erodible land or wetlands. Further, they prohibit the conversion of a wetland to make possible the production of an agricultural commodity.

The Act adds premium assistance for crop insurance as a benefit subject to compliance with HELC and WC provisions. New provisions are created for determinations, administration, and penalties relating to HELC and WC provisions that are unique to crop insurance. FSA will make HELC/WC eligibility determinations for crop insurance participants based on NRCS technical determinations of HELC/WC compliance.

PRICE LOSS COVERAGE (PLC) AND AGRICULTURAL RISK COVERAGE (ARC)

Base Reallocation and Yield Updates: Owners of farms that participate in PLC or ARC programs for the 2014-2018 crops have a one-time opportunity to: (1) maintain the farm's 2013 bases through 2018; or (2) reallocate base acres (excluding cotton bases). Covered commodities include wheat, oats, barley, corn, grain sorghum, rice, soybeans, sunflower seed, rapeseed, canola, safflower, flaxseed, mustard seed, crambe and sesame seed, dry peas, lentils, small chickpeas, and large chickpeas. Upland cotton is no longer considered a covered commodity, but the upland cotton base acres on the farm are renamed "generic" base acres. Producers may receive payments on generic base acres if those acres are planted to a covered commodity.

A producer also has the opportunity to update the program payment yield for each covered commodity based on 90 percent of the farm's 2008-2012 average yield per planted acre, excluding any year when no acreage was planted to the covered commodity. Program payment yields are used to determine payment amounts for the Price Loss Coverage program.

Price Loss Coverage: Payments are issued when the effective price of a covered commodity is less than the respective reference price for that commodity established in the statute. The payment is equal to 85 percent of the base acres of the covered commodity times the difference between the reference price and the effective price times the program payment yield for the covered commodity.

County ARC: Payments are issued when the actual county crop revenue of a covered commodity is less than the ARC county guarantee for the cov-

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ered commodity and are based on county data, not farm data. The ARC county guarantee equals 86 percent of the previous five-year average national farm price, excluding the years with the highest and lowest price (the ARC guarantee price), times the five-year average county yield, excluding the years with the highest and lowest yield (the ARC county guarantee yield). Both the guarantee and actual revenue are computed using base acres, not planted acres. The payment is equal to 85 percent of the base acres of the covered commodity times the difference between the county guarantee and the actual county crop revenue for the covered commodity. Payments may not exceed 10 percent of the benchmark county revenue (the ARC guarantee price times the ARC county guarantee yield).

Individual ARC: Payments are issued when the actual individual crop revenues, summed across all covered commodities on the farm, are less than ARC individual guarantees summed across those covered commodities on the farm. The farm for individual ARC purposes is the sum of the producer's interest in all ARC farms in the state. The farm's ARC individual guarantee equals 86 percent of the farm's individual benchmark guarantee, which is defined as the ARC guarantee price times the five-year average individual yield, excluding the years with the highest and lowest yields, and summing across all crops on the farm. The actual revenue is computed in a similar fashion, with both the guarantee and actual revenue computed using planted acreage on the farm. The individual ARC payment equals: 65 percent of the sum of the base acres of all covered commodities on the farm, times the difference between the individual guarantee revenue and the actual individual crop revenue across all covered commodities planted on the farm. Payments may not exceed 10 percent of the individual benchmark revenue.

Election Required: All of the producers on a farm must make a one-time, unanimous election of: (1) PLC/County ARC on a covered-commodity-by-covered-commodity basis; or (2) Individual ARC for all covered commodities on the farm. If the producers on the farm elect PLC/County ARC, the producers must also make a one-time election to select which base acres on the farm are enrolled in PLC and which base acres are enrolled in County ARC. Alternatively, if individual ARC is selected, then every covered commodity on the farm must participate in individual ARC. The election between ARC and PLC is made in 2014 and is in effect for the 2014 – 2018 crop years. If an election is not made in 2014, the farm may not participate in either PLC or ARC for the 2014 crop year and the producers on the farm are deemed to have elected PLC for subsequent crop years, but must still enroll their farm to receive coverage. If the sum of the base acres on a farm is 10 acres or less, the producer on that farm may not receive PLC or ARC payments, unless the producer is a socially disadvantaged farmer or rancher or is a limited resource farmer or rancher. Payments for PLC and ARC are issued after the end of the respective crop year, but not before Oct. 1.

In 2015, producers in PLC have an additional option. Producers enrolling in PLC, and who also participate in the federal crop insurance program, may, beginning with the 2015 crop, make the annual choice whether to purchase additional crop insurance coverage called the Supplemental Coverage Option (SCO). SCO provides the producer the option of covering a portion of his or her crop insurance deductible and is based on expected county yields or revenue. The cost of SCO is subsidized and indemnities are determined by the yield or revenue loss for the county or area.

COTTON TRANSITION

For the 2014 crop year, transition payments are provided to cotton producers on farms that had cotton base acres in 2013. For the 2015 crop year, transition payments will only be offered in counties where STAX is unavailable.

MARKETING ASSISTANCE LOANS (MALS) AND SUGAR LOANS

The Act extends the authority for sugar loans for the 2014 – 2018 crop years and nonrecourse marketing assistance loans (MALs) and loan deficiency payment (LDPs) for the 2014 – 2018 crops of wheat, corn, grain sorghum, barley, oats, upland cotton, extra-long staple cotton, long grain rice, medium grain rice, soybeans, other oilseeds (including sunflower seed, rapeseed, canola,

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safflower, flaxseed, mustard seed, crambe and sesame seed), dry peas, lentils, small chickpeas, large chickpeas, graded and nongraded wool, mohair, honey, unshorn pelts and peanuts. Provisions are mostly unchanged from the 2008 Farm Bill, except marketing loan gains and loan deficiency payments are subject to payment limitations.

DAIRY PROGRAMS

The Act extends the Milk Income Loss Contract Program (MILC) from Oct. 1, 2013, through the earlier of the date on which the Secretary certifies that the Dairy Margin Protection Program is operational or Sept. 1, 2014. Dairy producers who were enrolled in 2013 do not need to re-apply. MILC payments are issued when the Boston Class I milk price falls below $16.94 per hundredweight (cwt), as adjusted by a dairy feed ration formula.

The Dairy Margin Protection Program replaces MILC and will be effective not later than Sept. 1, 2014, through Dec. 31, 2018. The margin protection program offers dairy producers: (1) catastrophic coverage, at no cost to the producer, other than an annual $100 administrative fee; and (2) various levels of buy-up coverage. Catastrophic coverage provides payments to participating producers when the national dairy production margin is less than $4 per hundredweight (cwt). The national dairy production margin is the difference between the all-milk price and average feed costs. Producers may purchase buy-up coverage that provides payments when margins are between $4 and $8 per cwt. To participate in buy-up coverage, a producer must pay a premium that varies with the level of protection the producer elects.

In addition, the Act creates the Dairy Product Donation Program. This program is triggered in times of low operating margins for dairy producers, and requires USDA to purchase dairy products for donation to food banks and other feeding programs.

Dairy Indemnity Payment Program (DIPP)

The DIPP provides payments to dairy producers when a public regulatory agency directs them to remove their raw milk from the commercial market because it has been contaminated by pesticides and other residues.

CONSERVATION RESERVE PROGRAM (CRP)

The Act continues CRP with modifications. The acreage cap is gradually lowered to 24 million acres for fiscal years 2017 and 2018. The requirement to reduce rental payments under emergency haying and grazing is eliminated. Rental payment reductions of not less than 25 percent are required for managed haying and grazing.

Producers also are given the opportunity for an "early-out" from their CRP contracts, but only in fiscal year 2015. The rental payment portion of the Grassland Reserve Program enrollment has been incorporated into the CRP.

The Transition Incentive Program (TIP) continues to allow for the transition of CRP land to a beginning or socially disadvantaged farmer or rancher so land can be returned to sustainable grazing or crop production. TIP now includes eligibility for military veterans (i.e., veteran farmers).

BIOMASS CROP ASSISTANCE PROGRAM (BCAP)

BCAP provides incentives to farmers, ranchers and forest landowners to establish, cultivate and harvest eligible biomass for heat, power, bio-based products, research and advanced biofuels. Crop producers and bioenergy facilities can team together to submit proposals to USDA for selection as a BCAP project area. BCAP has been extended through 2018 and is funded at $25 million per fiscal year.

NONINSURED CROP DISASTER ASSISTANCE PROGRAM (NAP)

NAP has been expanded to include buy-up protection, similar to buy-up provisions offered under the federal crop insurance program. Producers may elect coverage for each individual crop between

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50 and 65 percent, in 5 percent increments, at 100 percent of the average market price. Producers also pay a fixed premium equal to 5.25 percent of the liability. The waiver of service fees has been expanded from just limited resource farmers also to include beginning farmers and socially disadvantaged farmers. The premiums for buy-up coverage are reduced by 50 percent for those same farmers. Grazing land is not eligible for buy-up coverage. NAP is also made available to producers that suffered a loss to a 2012 annual fruit crop grown on a bush or tree in a county declared a disaster by the Secretary due to a freeze or frost.

RTCP FOR GEOGRAPHICALLY DISADVANTAGED FARMERS AND RANCHERS

The Reimbursement Transportation Cost Payment Program (RTCP) is re-authorized to provide assistance to geographically disadvantaged farmers and ranchers for a portion of the transportation cost of certain agricultural commodities or inputs.

EMERGENCY LOANS

A Secretarial disaster designation or a Presidential declaration provides producers with emergency loans to help cover the recovery costs for physical and production losses. Farm bill revisions expand the type of entities eligible for loans.

FARM OPERATING LOANS AND MICROLOANS

Farm Operating Direct and Guaranteed Loan Programs provide low-interest financing for producers to purchase farm and ranch operating inputs. The FSA is authorized to implement the program through the Consolidated Farm and Rural Development Act, also known as the Con Act. The 2014 Farm Bill revisions expand the types of entities eligible, provide favorable interest rates for joint financing arrangements, increase loan limits for microloans, make youth loans available in urban areas, and eliminate term limits for guaranteed operating loans.

FARM OWNERSHIP LOANS

Farm Ownership Direct and Guaranteed Loan Programs provide low-interest financing for producers to purchase farms and ranches and other real estate related needs. The FSA is authorized to implement the program through the Consolidated Farm and Rural Development Act, often referred to as the Con Act. The 2014 Farm Bill revisions expand the types of entities eligible, provide favorable interest rates for joint financing arrangements, provide a larger percent guarantee on guaranteed conservation loans, increase the loan limits for the down payment program, and authorize a relending program to assist Native American producers purchase fractionated interests of land.

DISASTER PROGRAMS

The following four disaster programs authorized by the 2008 Farm Bill have been extended indefinitely (beyond the horizon of the Act). The programs are made retroactive to Oct. 1, 2011. Producers are no longer required to purchase crop insurance or NAP coverage to be eligible for these programs (the risk management purchase requirement) as mandated by the 2008 Farm Bill.

Livestock Forage Disaster Program (LFP): LFP provides compensation to eligible livestock producers that have suffered grazing losses due to drought or fire on land that is native or improved pastureland with permanent vegetative cover or that is planted specifically for grazing. LFP payments for drought are equal to 60 percent of the monthly feed cost for up to five months, depending upon the severity of the drought. LFP payments for fire on federally managed rangeland are equal to 50 percent of the monthly feed cost for the number of days the producer is prohibited from grazing the managed rangeland, not to exceed 180 calendar days.

Livestock Indemnity Program (LIP): LIP provides benefits to livestock producers for livestock deaths in excess of normal mortality caused by adverse weather or by attacks

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by animals reintroduced into the wild by the federal government. LIP payments are equal to 75 percent of the average fair market value of the livestock.

Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish (ELAP): ELAP provides emergency assistance to eligible producers of livestock, honeybees and farm-raised fish for losses due to disease (including cattle tick fever), adverse weather, or other conditions, such as blizzards and wildfires, not covered by LFP and LIP. Total payments are capped at $20 million in a fiscal year.

Tree Assistance Program (TAP): TAP provides financial assistance to qualifying orchardists and nursery tree growers to replant or rehabilitate eligible trees, bushes, and vines damaged by natural disasters.

FEEDSTOCK FLEXIBILITY PROGRAM (FFP)

FFP is continued through fiscal year 2018. Congress authorized the FFP in the 2008 Farm Bill, allowing for the purchase of sugar to be sold for the production of bioenergy in order to avoid forfeitures of sugar loan collateral under the Sugar Program.

NON-FARM BILL PROGRAMS

The following programs continue under laws other than the 2014 Farm Bill.

Emergency Conservation Program (ECP)
ECP is authorized by Title IV of the Agricultural Credit Act of 1978, Section 401 (P.L. 95-334)(16 U.S.C. 2201). ECP provides emergency cost-share assistance to farmers and ranchers to help rehabilitate farmland and ranchland damaged by natural disasters and to carry out water conservation measures during periods of severe drought. Cost-share assistance may be offered only for emergency conservation practices to restore land to a condition similar to that existing prior to the natural disaster.

Emergency Forest Restoration Program (EFRP)
EFRP is authorized by Title IV of the Agricultural Credit Act of 1978, Section 407 (16 U.S.C. 2206). EFRP was established to provide financial and technical assistance to owners of non-industrial private forest land damaged by natural disaster to carry out emergency measures to restore damaged forests and rehabilitate forest resources.

Farm Storage Facility Loan Program (FSFL)
FSFL provides low-interest financing for producers to build or upgrade farm storage and handling facilities.

Sugar Storage Facility Loan Program (SSFL)
SSFL provides low-interest financing for processors to build or upgrade farm storage and handling facilities for raw or refined sugar.

2011 Montana FSA Farmer & Rancher Handbook

Farm Service Agency

USDA United States Department of Agriculture

Fact Sheet

February 2008

Rural Youth Loans

Overview

The U.S. Department of Agriculture's Farm Service Agency (FSA) makes operating loans of up to $5,000 to eligible individual rural youths age 10 through 20 to finance income-producing, agriculture-related projects. The project must be of modest size, educational, and initiated, developed and carried out by rural youths participating in 4-H clubs, FFA, or a similar organization.

The project must be an organized and supervised program of work. It must be planned and operated with the assistance of the organization advisor, produce sufficient income to repay the loan, and provide the youth with practical business and educational experience in agriculture-related skills.

Who May Borrow

To qualify for a loan, the applicant must:

- comply with FSA's general eligibility requirements;
- reside in a rural area, city or town with a population of 50,000 or fewer people; and
- conduct a modest income-producing project in a supervised program of work.

How Loan Funds May Be Used

These loans can finance many kinds of income-producing agricultural projects. The loan fund may be used to:

- buy livestock, seed, equipment and supplies;
- buy, rent or repair needed tools and equipment; and
- pay operating expenses for the project.

What Details to Know

To apply, the applicant must submit completed plans and budgets signed by the project advisor and parent or guardian along with the FSA application for loan assistance. These loans:

- have a maximum loan amount of $5,000 (total principal balance owed at any one time cannot exceed this amount);
- have an interest rate which is determined periodically, based on the cost of money to the federal government,
  - after the loan is made, the interest rate for that loan will not change;
- will be secured, in addition to promissory notes, by liens on the products produced for sale and on chattel property, including livestock, equipment and fixtures purchased with loan funds; and
- have a repayment schedule which varies depending on the type of project for which the loan is made,
  - for example, if it involves raising livestock or crops, the loan is paid when the animals or produce are normally sold.

For More Information

To apply or find out more, visit your local USDA Service Center. A listing of centers, and more information about youth and other loan programs, are available on the FSA website at http://www.fsa.usda.gov. USDA Service Center offices are also usually listed in telephone directories under "U.S. Department of Agriculture.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

October 2013

Loans for Beginning Farmers and Ranchers

Overview

The U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA) makes and guarantees loans to beginning farmers who are unable to obtain financing from commercial lenders. Each fiscal year, FSA targets a portion of its direct and guaranteed farm ownership (FO) and operating loan (OL) funds to beginning farmers.

A beginning farmer is an individual or entity who:

- Has not operated a farm for more than 10 years;
- Meets the loan eligibility requirements of the program to which he/she is applying;
- Substantially participates in the operation and;
- For FO purposes, does not own a farm greater than 30 percent of the median size farm in the county.

(Note: All applicants for direct FO loans must have participated in the business operations of a farm for at least three years out of the 10 years prior to the date the application is submitted). If the applicant is an entity, all members must be related by blood or marriage, and all entity members must be eligible beginning farmers.

Maximum Loan Amounts

- Direct FO: $300,000
- Direct OL: $300,000; Microloan: $35,000
- Guaranteed FO or OL: $1,355,000 (Amount varies annually based on inflation).

Downpayment Program

FSA has a special loan program to assist socially disadvantaged (SDA) and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.
- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm to be acquired; (b) the appraised value of the farm to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).
- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent.
- The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.
- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Joint Financing Arrangement

Beginning farmers may choose to participate in a joint financing arrangement. With this arrangement FSA lends up to 50 percent of the amount financed and another lender provides 50 percent or more. The applicant will use funds from the joint financing arrangement along with FSA funds for any authorized FO purpose. The interest rates for such arrangements can be obtained from the local FSA office. The term of the loan will not exceed 40 years or the useful life of the security.

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Loans for Beginning Farmers and Ranchers

October 2013

Land Contract Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or SDA farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Sale of Inventory Farmland

FSA advertises inventory property within 15 days of acquisition. Eligible SDA and beginning farmers are given first priority to purchase these properties at the appraised value. If one or more eligible SDA or beginning farmer offers to purchase the same property in the first 135 days, the buyer is chosen randomly.

Where to Apply

Applications for direct loan assistance may be submitted to the local FSA office serving the area where the operation is located. Local FSA offices are listed in the telephone directory under U.S. Government, Department of Agriculture or Farm Service Agency. For guaranteed loans, applicants must apply to a commercial lender who participates in the Guaranteed Loan Program. Contact your local FSA office for a list of participating lenders.

For More Information

Further information about this and other FSA programs is available from local FSA offices or on the FSA website at www.fsa.usda.gov.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

August 2013

Microloans

Overview

The Farm Service Agency (FSA) developed the Microloan (ML) program to better serve the unique financial operating needs of beginning, niche and the smallest of family farm operations by modifying its Operating Loan (OL) application, eligibility and security requirements. The program will offer more flexible access to credit and will serve as an attractive loan alternative for smaller farming operations like specialty crop producers and operators of community supported agriculture (CSA). These smaller farms, including non-traditional farm operations, often face limited financing options.

Use of Microloans

Microloans can be used for all approved operating expenses as authorized by the FSA Operating Loan Program, including but not limited to:

- Initial start-up expenses;
- Annual expenses such as seed, fertilizer, utilities, land rents;
- Marketing and distribution expenses;
- Family living expenses;
- Purchase of livestock, equipment, and other materials essential to farm operations;
- Minor farm improvements such as wells and coolers;
- Hoop houses to extend the growing season;
- Essential tools;
- Irrigation;
- Delivery vehicles.

Simplified Application Process

The application process for microloans will be simpler, requiring less paperwork to fill out, to coincide with the smaller loan amount that will be associated with microloans. Requirements for managerial experience and loan security have been modified to accommodate smaller farm operations, beginning farmers and those with no farm management experience. FSA understands that there will be applicants for the ML program who want to farm but do not have traditional farm experience or have not been raised on a farm or within a rural community with agriculture-affiliated organizations. ML program applicants will need to have some farm experience; however, FSA will consider an applicant's small business experience as well as any experience with a self-guided apprenticeship as a means to meet the farm management requirement. This will assist applicants who have limited farm skills by providing them with an opportunity to gain farm management experience while working with a mentor during the first production and marketing cycle.

Security Requirements

For annual operating purposes, microloans must be secured by a first lien on a farm property or agricultural products having a security value of at least 100 percent of the microloan amount, and up to 150 percent, when available. Microloans made for purposes other than annual operating expenses must be secured by a first lien on a farm property or agricultural products purchased with loan funds and having a security value of at least 100 percent of the microloan amount.

Rates and Terms

Eligible applicants may obtain a microloan for up to $35,000. The repayment term may vary and will not exceed seven years. Annual operating loans are repaid within 12 months or when the agricultural commodities produced are sold. Interest rates are based on the regular OL rates that are in effect at the time of the microloan approval or microloan closing, whichever is less.

Obtaining Forms and Submitting an Application

FSA Microloan application forms can be obtained from the local FSA office or can be downloaded and printed from the USDA website. Applicants who are having problems gathering information or completing forms should contact their local FSA office for help. After completing the required paperwork, an applicant should submit the farm loan application to the local FSA office.
The following form must be completed:

FSA 2330 – Request for Microloan Assistance

(Instruction Form for FSA 2330)

FACT SHEET

Microloans

August 2013

What Happens After a Loan Application is Submitted?

After a loan application is submitted, FSA reviews the application and determines if the applicant is eligible for the requested loan. The applicant will receive written notification of each step in the process, such as when the application is received, when more information is needed, when an eligibility determination is made, and when a final decision is made. If the application is approved, FSA makes the loan and funds are distributed as needed. If the application is denied, the applicant is notified in writing of the specific reasons for the denial, and provided reconsideration and appeal rights.

Eligibility Criteria and Additional Information

To qualify for assistance, the applicant must not be larger than a family-sized farmer, have a satisfactory history of meeting credit obligations, be unable to obtain credit elsewhere at reasonable rates and terms, and meet all other loan eligibility requirements. Additional information on the FSA microloan program may be obtained at local FSA offices or through the FSA website at www.fsa.usda.gov.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

September 2013

How to Complete an FSA Loan Application

Overview

This fact sheet describes how farmers can apply for a direct farm loan with the U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA). FSA must follow all relevant federal credit, environmental, and debt collection laws and policies when making farm loans.

Applying for a Loan

Farmers interested in applying for a loan should contact their local FSA office. FSA employees determine loan eligibility and approval. FSA direct farm ownership and operating loan funds can assist farmers with such needs as purchasing farmland, livestock, equipment, feed and other materials essential to farm operations; paying normal operating and family living expenses; and refinancing certain debts. FSA loans cannot be used to refinance personal debts, buy personal vehicles, or start and operate ineligible enterprises.

FSA employees at the local office can explain what information is needed and how to obtain it. In some areas, FSA can arrange for an outside organization to help the applicant gather the information and complete the forms. If available, this help is provided at no cost to the applicant. Providing all of the following information will help the loan application process flow smoothly. (Please note that other information may be required depending on each individual situation).

FSA Forms

The following forms must be completed:

- FSA 2001: Request for Direct Loan Assistance
  If the applicant is a cooperative, corporation, partnership, joint operation, trust, or limited liability company, additional information will be required of each member of the entity. Applicants will need to discuss the structure of the business with an agency official. (Applicants will need to provide a credit report fee, which will vary in amount depending on how many individuals are applying and/or the business structure).
- FSA-2002: Three Year Financial History
- FSA-2003: Three Year Production History
- FSA-2004: Authorization to Release Information
- FSA-2005: Creditor List
- FSA-2006: Property Owned and Leased
- FSA 2037: Farm Business Plan Worksheet-Balance Sheet
- FSA 2038: Farm Business Plan Worksheet-Projected Income and Expense
- FSA-2302: Description of Farm Training and Experience.

Additional Information

In addition to forms, an applicant must provide FSA the following information as part of the loan process (Note: If the applicant is already an FSA borrower, this information should be on file with the FSA):

- Proof that the applicant cannot obtain credit from private sources at reasonable rates and terms. A referral letter from a bank or other local lending institution serves as proof and may or may not be necessary depending on the applicant's financial situation.
- Three years of federal income tax returns.
- Copies of any leases, contracts or agreements.
- Documentation showing compliance with regulations governing certain environmental programs. The local FSA office can assist the applicant with meeting this requirement.

For information on the Microloan operating loans, see the Microloan fact sheet.

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How to Complete an FSA Loan Application

September 2013

Emergency Loans (EM)

EM loans help cover production and physical losses for producers in counties declared as disaster or quarantine areas. Applicants requesting an EM loan based on losses in declared areas should also provide the following forms:

- FSA 2309: Certification of Disaster Losses
- FSA 2310: Request for Lender's Verification of Loan Application

Actual Production History (APH) yields must be established by a producer's crop insurance company and will be used to calculate losses. If APH yields are not available, three years of the producer's production history will be used.
Obtaining Forms and Submitting Loan

Obtaining Forms and Submitting Loan Applications

FSA forms can be obtained from the local FSA office or can be downloaded and printed from USDA's E-forms website at http://forms.sc.egov.usda.gov/eForms/.

Applicants who are having problems gathering information or completing forms should contact their local FSA office for help. After completing the required paperwork, an applicant should submit the farm loan application to the local FSA office.

What Happens After a Loan Application is Submitted?

After a loan application is submitted, FSA reviews the application and determines if the applicant is eligible for the requested loan. The applicant will receive written notification of each step in the process, such as when the application is received, when more information is needed, when an eligibility determination is made, and when a final decision is made. If the application is approved, FSA makes the loan and funds are distributed as needed. If the application is denied, the applicant is notified in writing of the specific reasons for the denial, and provided reconsideration and appeal rights.

More Information

Visit FSA's website, www.fsa.usda.gov, for details on the types of loans and loan amounts offered, as well as for information about all FSA programs.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

November 2012

Loans for Socially Disadvantaged Farmers and Ranchers

Overview

The U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA) makes and guarantees loans to eligible socially disadvantaged farmers (SDA) to buy and operate family-size farms and ranches. Each fiscal year, the Agency targets a portion of its direct and guaranteed farm ownership (FO) and operating loan (OL) funds to SDA farmers. Non-reserved funds can also be used by SDA individuals.

An SDA farmer or rancher is a group whose members have been subject to racial, ethnic or gender prejudice because of their identity as members of a group without regard to their individual qualities. These groups consist of American Indians or Alaskan Natives, Asians, Blacks or African-Americans, Native Hawaiians or other Pacific Islanders, Hispanics and women.

The agency:

- Helps remove barriers that prevent full participation of SDA farmers in FSA's farm loan programs;
- Provides information and assistance to SDA farmers to help them develop sound farm management practices, analyze problems and plan the best use of available resources essential for success.

Types of Loans and Uses of Loan Funds

Direct farm ownership loans (FO) and farm operating loans (OL) are made by FSA to eligible farmers. Guaranteed FO and OL loans are made by lending institutions subject to federal or state supervision (banks, savings and loans, and units of the Farm Credit System) and guaranteed by FSA. Typically, FSA guarantees 90 percent of any loss the lender might incur if the loan fails. FO funds may be used to purchase or enlarge a farm or ranch, purchase easements or rights of way needed in the farm's operation, erect or improve buildings, implement soil and water conservation measures and pay closing costs. Guaranteed FO funds also may be used to refinance debt.

OL funds may be used to purchase livestock, poultry, farm equipment, feed, seed, fuel, fertilizer, chemicals, insurance, and other operating expenses. The funds also may be used for training costs, closing costs and to reorganize and refinance debt.

Terms and Interest Rates

Repayment terms for direct OL depend on the collateral securing the loan and usually run from one to seven years. Repayment terms for direct FO vary but never exceed 40 years.

Interest rates for direct loans are set periodically according to the government's cost of borrowing.

Guaranteed loan terms are set by the lender. Interest rates for guaranteed loans are established by the lender.

Downpayment Program

FSA has a special loan program to assist socially disadvantaged and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.
- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm or ranch to be acquired; (b) the appraised value of the

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Loans for Socially Disadvantaged Farmers and Ranchers November 2012

farm or ranch to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).

- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent. The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.
- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Land Contract (LC) Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or socially disadvantaged farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Sale of Inventory Farmland

FSA advertises inventory property within 15 days of acquisition. Eligible SDA and beginning farmers are given first priority to purchase these properties at the appraised market value. If one or more eligible SDA or beginning farmer offers to purchase the same property in the first 135 days, the buyer is chosen randomly.

Where to Apply

Applications for direct loan assistance may be submitted to the local FSA office serving the area where the operation is located. Local FSA offices are listed in the telephone directory under U.S. Government, Department of Agriculture or Farm Service Agency. For guaranteed loans, applicants must apply to a commercial lender who participates in the Guaranteed Loan Program. Contact the local FSA office for a list of participating lenders.

For more information

More information is available from local FSA offices or on the FSA website at www.fsa.usda.gov.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

October 2013

Farm Loans

Overview

The U.S. Department of Agriculture's Farm Service Agency (FSA) makes and guarantees loans to family farmers and ranchers to promote, build and sustain family farms in support of a thriving agricultural economy. FSA maintains its headquarters in Washington, DC, with offices located in each state, usually in a state capital or near a state land-grant university, as well as in most agriculturally productive counties. Farmers may apply for direct loans at local FSA offices. Guaranteed loans may be available from commercial lenders who apply for loan guarantees from FSA. Although general information may be obtained from headquarters and state offices, all programs are administered through local offices.

The goal of FSA's farm loan programs is to graduate its borrowers to commercial credit. Once a farmer is able to obtain credit from the commercial lending sector, the Agency's mission of providing temporary, supervised credit is complete.

FSA Farm Loans

FSA's loan programs are designed to help family farmers to start, purchase or expand their farming operation. In many cases, these are beginning farmers who need additional financial and business acumen to qualify for commercial credit. In other cases, they are farmers who have suffered financial setbacks from natural disasters, or who need additional resources with which to establish and maintain profitable farming operations.

Some farmers obtain their credit needs through the use of loan guarantees. Under a guaranteed loan, a commercial lender makes and services the loan, and FSA guarantees it against loss up to a maximum of 90 percent in most cases. In certain limited circumstances, a 95 percent guarantee is available. FSA has the responsibility of approving all eligible loan guarantees and providing oversight of lenders' activities.

For those not yet meeting the qualifications for a loan guarantee from a commercial lender, FSA also makes direct loans, which are serviced by an FSA official. FSA has the responsibility of providing credit counseling and supervision to its direct borrowers by making a thorough assessment of the farming operation. FSA helps applicants evaluate the adequacy of the real estate and facilities, machinery and equipment, financial and production management, and the applicant's goals. FSA assists the applicant in identifying and prioritizing areas needing improvement in all phases of the operation. An FSA official then works one-on-one with the applicant to develop and to help strengthen the identified areas that ultimately result in the applicants graduation to commercial credit.

Unlike FSA's commodity loans, most farm loans must be fully secured and can only be approved for those who have repayment ability.

Farm Ownership Loans

Eligible applicants may obtain direct loans up to a maximum indebtedness of $300,000. Maximum indebtedness for guaranteed loans is $1,355,000 (amount adjusted annually for inflation). The maximum repayment term is 40 years for both direct and guaranteed farm ownership loans. In general, loan funds may be used to purchase a farm, enlarge an existing farm, construct new farm buildings and/or improve structures, pay closing costs, and promote soil and water conservation and protection.

Farm Operating Loans

Eligible applicants may obtain direct loans for up to a maximum indebtedness of $300,000 and a direct operating Microloan for up to a maximum indebtedness of $35,000. Maximum indebtedness for a guaranteed loan is $1,355,000 (amount adjusted annually for inflation). The repayment term may vary, but typically it will not exceed seven years for intermediate-term purposes. Annual operating loans are generally repaid within 12 months or when the commodities produced are sold. In general, loan funds may be used for

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Farm Loans

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normal operating expenses, machinery and equipment, minor real estate repairs or improvements, and refinancing debt.

Targeted Funds to Socially Disadvantaged and Beginning Farmers

Each year Congress targets a percentage of farm ownership and farm operating loan funds to socially disadvantaged (SDA) and beginning farmers. For more information, refer to the FSA Fact Sheet, "Loans for Socially Disadvantaged Farmers."

Downpayment Program

FSA has a special loan program to assist SDA and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.

- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm to be acquired; (b) the appraised value of the farm to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).

- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent.

- The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.

- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Rural Youth Loans

These are available as direct loans only and have a maximum loan amount of $5,000. Rural youth loans may be made to individuals who are sponsored by a project advisor, such as a 4-H Club, FFA or local vocational instructor. Individuals must be at least 10 but not more than 20 years old to be eligible and reside in a town or city with a population of 50,000 or fewer people.

Emergency Loans

These loans are available only as direct loans from FSA. Emergency Loans assist farmers who have suffered physical or production losses in areas declared by the President as disaster areas or designated by the Secretary of Agriculture as disaster or quarantine areas (for physical losses only, the FSA Administrator may authorize Emergency Loan assistance). For production loss loans, applicants must demonstrate a 30 percent loss in a single farming enterprise. Applicants may receive loans up to 100 percent of production or physical losses.

Loan purposes include operating and real estate, restoring/replacing essential property, production costs for disaster year, essential family living expenses, reorganization and refinancing certain debts.

The maximum indebtedness under the Emergency Loan program is $500,000.

Conservation Loans

Conservation loans are available as guaranteed loans only. Eligible applicants may use Conservation Loan funds to complete any conservation activity included in a conservation plan or Forestry Management Plan, and may be used to refinance debts related to implementing any conservation activity if refinancing will result in additional conservation benefits. Maximum indebtedness is $1,355,000 (amount adjusted annually for inflation) and the maximum repayment term is 30 years.

Note: The family farm and test for credit requirements are not applicable to Conservation Loans.

Land Contract Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or socially disadvantaged farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

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Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Loan Servicing and Supervised Credit

FSA's mission is not limited to providing just credit - it is to provide supervised credit. This means that FSA works with each direct loan borrower to identify specific strengths and opportunities for improvement in farm production and management, and then works with the borrower on alternatives and other options to address the areas needing improvement to achieve success. Learning improved business planning and financial acumen through supervised credit is the difference between success and failure for many farm families.

To help keep borrowers on the farm, FSA may be able to provide certain loan servicing benefits to direct loan borrowers whose accounts are distressed or delinquent due to circumstances beyond their control. These benefits include:

- Reamortization, rescheduling, and/or deferral of loans;
- Rescheduling at the Limited Resource (lower interest) rate;
- Acceptance of conservation contracts on environmentally sensitive land in exchange for reduction of debt; and
- Writing down the debt (delinquent borrowers only).

If none of these options results in a feasible farm operating plan, borrowers may be offered the opportunity to pay off their debt at the current market value of the security. If this is not possible, other options include:

- Debt settlement based on inability to repay.
- In some cases, where a feasible operating plan cannot be developed, FSA works with commercial lenders to help the borrower retain the homestead and up to 10 acres of land.

Farms that come into FSA ownership are sold at market value, with preference given to SDA and beginning farmers.

Who May Borrow

To qualify for assistance, applicants must meet all loan eligibility requirements including:

- Be a family farmer;
- Have a satisfactory history of meeting credit obligations;
- For direct OL loans, have sufficient education; training, or at least 1-year's experience in managing or operating a farm or ranch within the last 5 years. For direct FO loans, all applicants must have participated in the business operations of a farm for at least three years out of the 10 years prior to the date the application is submitted;
- Be a citizen of the United States, including Puerto Rico, the U. S. Virgin Islands, Guam, American Samoa, Commonwealth of the Northern Mariana Islands, Republic of Pallau, Federated States of Micronesia and the Republic of Marshall Islands, a U.S. non-citizen national, or a qualified alien under federal immigration law;
- Be unable to obtain credit elsewhere at reasonable rates and terms to meet actual needs;
- Possess legal capacity to incur loan obligations;
- Not be delinquent on a federal debt;
- Not have caused FSA a loss by receiving debt forgiveness (certain exceptions apply) and;
- Be within the time restrictions as to the number of years they can receive FSA assistance.

In the case of an entity, certain eligibility requirements apply. The entity must:

- Meet applicant eligibility requirements;

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- Be authorized to operate a farm in the state where the actual operation is located and;

- Be owned by U.S. citizens, U.S. non-citizen nationals or qualified aliens.

For SDA members, they must hold a majority interest in the entity applicant to receive SDA benefits.

If the individuals holding a majority interest in the entity are related by blood or marriage, at least one member or partner must operate the family farm. If they are not related by blood or marriage, the member holding a majority interest must operate the farm.

For More Information

Additional information may be obtained at local FSA offices or through the FSA website at www.fsa.usda.gov.

Oklahoma Sheep and Goat Report

Mr. Will Hundl

USDA, NASS

United States Department of Agriculture
National Agricultural Statistics Service

Oklahoma Sheep and Goat Report

Southern Plains Regional Field Office
Cooperating with the Oklahoma Department of Agriculture, Food and Forestry
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February 13, 2015

Oklahoma's sheep producers had 53,000 head of all sheep and lambs on hand January 1, 2015, down 10 percent from last year. The 2014 lamb crop was 36,000 head, down 12 percent from the previous year. Many thanks to all sheep and goat producers who responded to this survey. These are the results from that survey.

Sheep, Lambs, and Goats: Inventory by Class, Oklahoma and United States, January 1, 2014-2015

Class	Oklahoma			United States		
	2014	2015	Percent of Previous Year	2014	2015	Percent of Previous Year
	1,000 Head	*1,000 Head*	*Percent*	*1,000 Head*	*1,000 Head*	*Percent*
All Sheep and Lambs	**59**	**53**	**90**	**5,245**	**5,280**	**101**
Market Sheep and Lambs	11	11	100	1,345	1,345	100
Market Sheep	1	1	100	81	85	105
Market Lambs	10	10	100	1,264	1,260	100
Under 65 Pounds	6	7	117	340	327	96
65 to 84 Pounds	2	1	50	148	163	110
85 to 105 Pounds	1	1	100	323	267	83
Over 105 Pounds	1	1	100	453	503	111
Breeding Sheep and Lambs	48	42	88	3,900	3,935	101
Ewes 1 Year+	36	31	86	3,090	3,110	101
Rams 1 Year+	3	3	100	175	175	100
Replacement Lambs	9	8	89	635	650	102
Lamb Crop [1]	41	36	88	3,370	3,440	102
Goats						
Angora	([2])	([2])	([2])	148	160	108
Milk Goats	5.9	6.9	117	358	365	102
Meat and Other Goats	75.0	95.0	127	2,105	2,150	102

[1] Lamb crop refers to lambs born the previous year.
[2] Not published for Oklahoma.

Wool: Sheep Shorn, Weight per Fleece, Production, Price, and Value, Oklahoma, 2012-2014

Year	Number of Sheep Shorn	Weight per Fleece	Wool Production	Price per Pound	Value of Wool Production [1]
	Head	*Pounds*	*Pounds*	*Dollars*	*Dollars*
2012	27,000	5.0	135,000	0.70	95,000
2013	24,000	5.6	135,000	0.60	81,000
2014	21,000	5.5	115,000	0.70	81,000

[1] Production multiplied by marketing year average price.

Tanning Goatskins

Dr. Roger C. Merkel
Langston University

Introduction

Many people are interested in tanning goat or other skins such as deer. Learning the art of tanning skins can be very rewarding, through acquisition of new skills and the attractive products resulting from the endeavor. The supplies needed to tan skins can be purchased or much of it can be fashioned from items found around households or farms. Tanning chemicals are readily available from many suppliers and kits can be purchased that will tan one or two skins. The art of tanning skins is a learning process that requires effort and labor to produce a soft, attractive product and your skills will improve through practice. Although home tanning may not match the quality of a professional tannery, good quality, long-lasting products can be made. However, if you do have a special skin, it is best to send it to a professional rather than attempting to tan it yourself. This is particularly true if you are new to the art of tanning.

Hand-tanned goat, deer, and elk hides.

This chapter deals with tanning skins leaving the hair on. The techniques discussed are intended for those persons wishing to try tanning a skin for hobbyist use. However, skinning and preparing hides for taxidermy are not covered. Consult a taxidermist should you wish to have an animal skinned and the skin or cape tanned and mounted.

Tanning Methods

Many of the tanning methods suitable for home tanning are used in the taxidermy industry to prepare deer capes and other skins for mounting. Tanning agents are available in powder, liquid, or cream form. Most liquid and cream tanning agents are designed to be applied directly to the prepared skin using a paint brush or by hand wearing gloves. The powdered forms, and some liquid forms, require mixing the chemical into a water and salt solution and immersing the prepared skin for a specified length of time. There are advantages and disadvantages to both paint-on and immersion tanning systems.

Paint-on tans are easy to use, result in a well-tanned skin, and are preferred by many tanners and hobbyists. Paint-on tans require fewer solutions to prepare and dispose than do immersion systems. All areas of the skin must be covered with the paint-on tanning agent but care is needed around skin edges as the solution may be oily and could stain the fur or hair requiring later cleaning. The amount of paint-on tan to use may be difficult to gauge. Too heavy an application on thin skins may result in the tanning liquid being absorbed through the skin potentially discoloring the hair and leaving it feeling somewhat greasy or oily. Solvents and detergents can be used to clean the hair, but care is needed. Examples of paint-on tans sold by various distributors include[1]: Liqua-Tan™, Rittel's Kwiz-n-Eze, McKenzie Tan, Tannit Solution™, Bollman's Mammal Tanning Cream, Rinehart Tanning Cream, Curatan®, and Trapper's Hide Tanning Formula™. Other products are also available.

Immersion tanning methods require making solutions, monitoring pH, and safely disposing spent solutions. Through soaking, the tanning agent has access to both sides of the skin, although the skin should be stirred occasionally while in the tanning solution to ensure even and adequate chemical penetration. Please note that the hair of deer is hollow and deerskins will float so stirring may need to be more frequent. If tanning is done correctly, weighting a deerskin to keep

[1] *Listing of trade names, proprietary products, or vendors does not imply endorsement by Langston University of the products or vendors named or criticism of similar products or vendors not mentioned.*

it submerged in the solution is not necessary. Goatskins do not have this problem. There are many kinds of immersion tanning agents. Examples are Rittel's EZ-100, Rittle's Kwik-Tan, and Lutan® FN.

For initial attempts at tanning, it is beneficial to purchase a kit complete with tanning chemicals, instructions, and a list of the needed supplies. Some kits come with instructional videos. Many distributors sell kits using either the immersion or paint-on tanning methods. Examples of some kits include EZ 1000 Kit that includes EZ-100 powder, Saftee Acid, and tanning oil; Liqua-Tan™ Tanning Kit with Liqua-Tan™, acid, and tanning oil; and McKenzie Tan Tanning Kit with McKenzie Tan, acid, and oil. Kits using other chemicals, e.g., Para Tan, Curatan®, Krowtann 2000, Kwik-Tan, Lutan® FN, etc., are available or one can purchase tanning chemicals individually. Finally, while not covered in this article, chemicals and kits are available for tanning birds and reptiles.

Basic Tanning Steps

Whatever method is chosen to use in tanning a skin - immersion or paint-on, kit or purchase of separate chemicals - many of the basic steps are the same: skinning the animal, preserving the skin, fleshing the skin, pickling and neutralizing, the actual tanning process, oiling, drying and softening, and finishing. As with any craft there are many variations on the main themes and different texts will provide different tanning recipes, order of steps, chemicals to use, and tips on how to successfully follow their method. It is a good idea to read through several methods and speak with someone knowledgeable on tanning skins before selecting a particular one. As each method or tanning recipe is slightly different, it is best to follow the instructions and learn the basics. One can then experiment in the future.

It is not the goal of this chapter to address all of the tanning procedures and variations available. Rather, only some pertinent information on each of the basic steps will be given. More detailed information can be found in the sources listed at the end of this chapter or websites listed for some of the companies that sell tanning chemicals. Finally, the information presented is designed for the hobbyist tanner and, as such, no use of tanning machinery is required.

Skinning

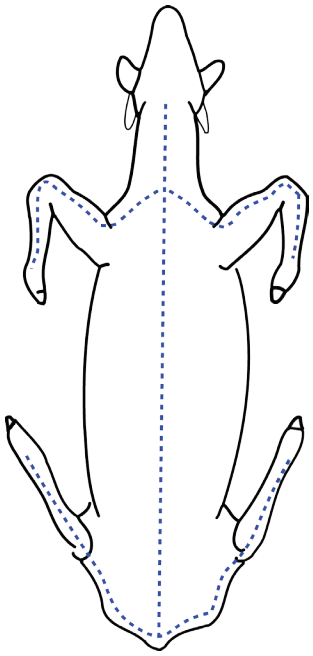
Most people who want to tan a skin will also use the carcass for meat and will take the animal to a meat locker or abattoir for processing. Inform the facility that you wish to tan the skin and that extra care should be taken when skinning. Make arrangements to pick up the skin as soon as it is removed from the carcass.

If you wish to skin an animal, be sure the carcass is fresh as decay begins immediately upon death. Bacteria become active breaking down tissue, damaging the skin, and causing hair slippage. Also, ligaments under the skin can shrink as the carcass cools making skinning more difficult. If you do your own butchering, ensuring that a carcass is fresh is no problem; however, if an animal is found dead caution is warranted. In addition to possible problems with skinning and hair loss, you may be in danger of contracting a disease. Diseases such as tuberculosis, rabies, tetanus, and anthrax can be transmitted to humans through contact with infected animals. Animals that are ill, acting strangely, or found dead from an unknown cause should be buried or disposed and not skinned, even when wearing gloves.

For people who hunt or raise deer and elk and wish to tan their skins, Chronic wasting disease (CWD) is of concern. CWD is a transmissible spongiform encephalopathy (TSE) of which bovine spongiform encephalopathy, BSE or mad cow disease, is the most well-known. Scrapie in sheep and goats is also a TSE. There is currently no evidence that CWD can be transmitted to humans but wearing gloves when skinning and butchering deer has been recommended. Hunters are advised not to consume meat from suspect animals. As the disease agent is found in central nervous tissue, the practice of brain tanning has been discouraged in some areas. Information on CWD can be found at the USDA Animal Plant Health Inspection Service CWD website (http://www.aphis.usda.gov/animal_health/animal_diseases/), the Chronic Wasting Disease Alliance Website (http://www.cwd-info.org/), and state wildlife departments and websites.

Finally, caseous lymphadenitis or abscesses is a common disease of goats that can be transmitted to humans. Take care when skinning goats as abscesses not apparent on the live animal can be found under the skin. Abscesses contain greenish, cheesy pus that should be trapped on paper towels and burned or buried. Use gloves when skinning goats suspected of having abscesses. Try to avoid using skins of goats having an abscess. In addition to disease concerns, the skin at the abscess site is thin and weak and can tear during the tanning process.

Many people who hunt or butcher at home have experience skinning and have their own favorite tools and methods. Skinning can be done with the carcass hanging or lying. Initial cuts should be made down the midline of the belly from



Proper placement of initial cuts.
Illustration by K. Williams.

Well-shaped skin after skinning.

the anus to neck and from the legs inwards. Cuts on the legs should be done on the side where the hock and knee bend, the rearmost portion of the hind leg and the foremost portion of the front leg. This will result in a more rectangular shaped skin.

It is easier to skin a hanging rather than lying carcass as the skin can be pulled downwards and "fisted" away from the body by using your fist to push between the skin and carcass. This lessens the need to use a skinning knife. A skinning knife should be very sharp and used sparingly to decrease the chance of cutting the skin and causing holes that mar the skin and must be sewn later. Skins can also be removed using mechanical means. No matter how the skin is removed, a large amount of fat or meat should not be left on the skin as this material must be removed as it can impede salt penetration when preserving. Any obvious blood spots or dirt should be washed off. A good job in skinning will make the initial tanning steps easier.

Preserving

If the skin will not be tanned immediately it must be preserved. The goal of preservation is to stop the decay begun by bacteria immediately upon death. Never leave fresh skins rolled up or stacked. The heat remaining in them will encourage bacterial growth and increase the possibility of hair slippage. If skinning takes place in a different location than preservation, try to cool the skin as quickly as possible by laying it open. If available, place ice on the flesh side. While plastic garbage bags may be useful in handling a wet, bloody skin do not leave skins in a closed bag. This traps the heat allowing decay to start. Begin your preservation technique as quickly as possible.

The main methods of preservation are salting and freezing. Salt removes moisture from the skin and creates an unfavorable environment for bacterial growth. Use only non-iodized salt such as table or pickling and curing salt. Rock salt should never be used as it has impurities. A fine grain salt is preferred and penetrates the skin more readily than large grain products.

To salt a skin, lay it flat on a plastic tarp or piece of wood and pour a generous amount of salt, approximately one pound salt per pound skin, on the skin and rub in thoroughly covering every portion. Fold the skin flesh to flesh, roll it up, and place it on a slanted board to drain. The following day check the condition of the salt and add new salt if needed. If the salt is dirty or bloody, shake off the wet salt, and resalt with new salt. After the second day, continue in the tanning process or, if tanning will take place at a later date, resalt and lay the skin flat to dry. Drying may take several days or

To salt, rub a generous amount of salt into the skin, covering every portion. Then fold the skin down the midline, roll, and place on a slanted board to drain.

longer depending upon the weather. Skins should not be dried in direct sunlight or where temperatures are very high. Dried skins can be stored in a dry place until tanning. However, salted skins should be tanned within a reasonable time frame as salt-tolerant bacteria can grow on salted skins and do damage.

When preserving by freezing, the goal is to reduce skin temperature quickly. Immediately after skinning lay the skin flat, flesh side up, in a freezer. When it begins to stiffen, fold it flesh to flesh, roll, and place inside a plastic bag. A well-packaged, frozen skin can last for months with no damage to the skin. However, it is best to tan the skin within a reasonable time frame.

To begin the tanning process, the preserved skin must be rehydrated in preparation for fleshing. Frozen skins should be soaked in water to thaw. Salt and a bactericide can be added to prevent bacterial growth. Submerge salted skins in a brine solution of 1 to 2 pounds salt for each gallon of water needed to completely cover the skin. Use plastic barrels and wooden or plastic poles, such as old broom or shovel handles, for all tanning procedures. Skins should be soaked until they are like a wet dishrag. Relaxing agents are available that can assist in preparing the skin for fleshing and tanning.

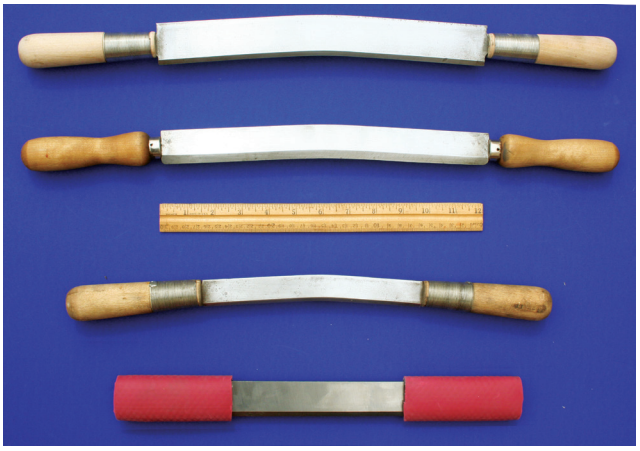
Dirty skins can be washed of obvious blood, manure, and other dirt after thawing. A more thorough washing is done after fleshing. If slaughtering one of your own animals, you can minimize dirt by care prior to slaughter and during the slaughter process. Angora skins can be a problem if excessively dirty and have hay or grass matted in the mohair.

Fleshing

To flesh a skin means to scrape all fat, meat, and membrane from the skin in preparation for the actual tanning process. This can be done before the skin is salted to allow easier salt penetration. Fleshing is most easily done by using a fleshing beam and fleshing knife. A fleshing beam is a structure over which the skin is draped for scraping and can be made from wood, logs, or PVC pipe. Wooden fleshing beams are commonly made from a 2″ × 6″ or 2″ × 8″ board 5 or 6 feet long. Hardwood is recommended. One end should be cut to a blunt point and all edges rounded and smoothed. Legs are attached near the pointed end so that the fleshing beam slants upward from the ground to waist level. Unused or scrap PVC pipe 4 to 8 inches in diameter works well and is very sturdy.

A fleshing knife is a blade with a handle on both ends allowing even pressure to be exerted as the blade is pushed down the skin. The knife edge of the blade should be dull as the goal is to push and scrape off all fat, meat, and membrane, leaving only the skin. A blade that is too sharp can cut the

A PVC pipe fleshing beam.



Different styles and sizes of fleshing knives (above).
To flesh a hide, drape it over the fleshing beam with the tail nearest you. Lean into the beam to hold skin and scrape off all meat, fat, and membrane.

skin exposing hair roots leading to subsequent hair loss. Fleshing knives can be purchased from many taxidermy supply stores at a reasonable cost. Most fleshing knives have a single beveled edge, others are double beveled. Even a square-edged piece of metal can be used. Mill planer blades can be fashioned into fleshing knives and these types of knives are available on the internet.

To flesh a skin, pull the skin from the rehydration bath and drape it, flesh side up, over the pointed end of the fleshing beam with the neck farthest from you. Lean into the beam with your midsection to hold the skin in place while you are scraping. Push the fleshing knife down the skin scraping off unwanted material. To make fleshing easier and lessen the chance of cutting the skin, flesh with the lay of the hair. Begin by fleshing the legs towards the tail and midline, then from the rear pushing towards the neck. Wear gloves while fleshing. This protects your hands and is essential if abscesses are suspected.

Fleshing takes practice and, initially, can be time consuming but must be done properly; removing even the thin membrane held tightly onto the skin. The thin membrane on the flesh is shiny and feels slippery; after removal the skin will look duller and lose the slippery feeling. Keep the skin wet when fleshing. If it becomes too dry, soak in water before proceeding.

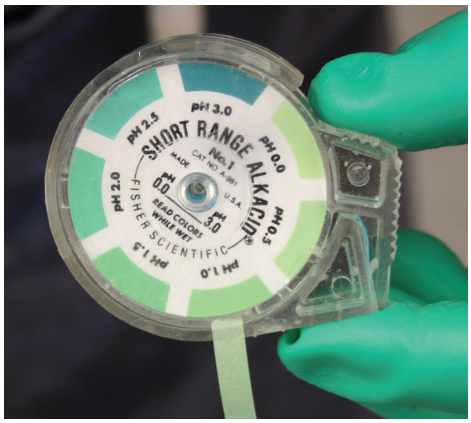
After fleshing, plunge the skin up and down in water mixed with a small amount of dish detergent to remove remaining dirt, blood, and some of the grease on the skin. Then rinse thoroughly to remove all soap. There are commercial products to remove blood and other stains, if desired. Once the skin is fleshed, it should be salted to draw out fluids and substances not wanted in the tanning process. This salting occurs even if the skin was salted originally for preservation. For frozen skins, fleshing occurs upon thawing and is then followed by salting.

Fleshing machines, found in taxidermy supply catalogs, are available for fleshing and shaving skins. The cost is usually prohibitive for the hobbyist tanner. Even with machines, some professionals still do initial fleshing with a traditional fleshing knife and beam. Fleshing machines do have distinct advantages in shaving skins. Shaved skins are thinner, use less tanning chemicals due to reduced weight, and result in a softer finished product. This is especially true for skins from large animals such as elk that have thick skins. Whilst shaving can be tried by using a very sharp knife, it is difficult to achieve a consistent thickness and avoid cutting through the skin. Generally, goatskins can be tanned and softened adequately without shaving.

Pickling and neutralizing

Pickling is the use of an acid solution to acidify and temporarily preserve a skin while physically and chemically preparing it for tanning. Most tanning recipes will use an acid pickle, though it may be included in the tanning process itself and not a separate step. Some paint-on tans, such as Tannit™ solution and Liqua-Tan™, can be applied directly to the fleshed skin without the skin undergoing a pickle.

Pickling solutions are mixtures of water, salt, and acid made in a plastic barrel. There are a number of acids and formulations used in pickling and the tanning recipe followed will have specific instructions. Enough pickle solution should be made to completely submerge the skin without overcrowding if several skins are pickled together. At a minimum, make 2 quarts of pickling solution for every pound of wet, drained skin. The pH must be carefully monitored and eye protection, a protective apron, and rubber gloves should be worn when using acids. Monitoring pH can be done using simple pH paper and adjustments made using the recommended acid or an alkaline substance such as sodium bicarbonate (baking soda). Acids should be added slowly to the pickle, pouring them along the side of the container so as to run gently into the solution. Use a wooden stick and mix slowly. For example, the EZ-100 tanning kit recommends 0.5 fluid ounces Saftee Acid (included in the kit) and 1 pound salt per gallon water resulting in a pickle solution of approximately pH 1.0.



Use pH paper to check pickle pH.

Skins should remain in the pickling solution for a minimum of 3 days, stirred occasionally. Skins can be temporarily stored in a pickle for up to 2 weeks with pH monitored and adjusted if needed.

After being in the pickle, skins must be neutralized. Neutralizing raises the pH of the skin through soaking in a solution containing an alkaline substance such as sodium acetate, sodium formate, sodium bicarbonate, or other similar compound. A common neutralizing solution is one made up of 1 ounce sodium bicarbonate per gallon water, making enough to submerge the skin. If a scale is not available, use one heaping tablespoon of baking soda per gallon water as a neutralizing solution. The tanning recipe or kit should have complete instructions on the neutralization method.

Neutralization is generally brief, 20 to 30 minutes, after which the skins should be rinsed with clean water, drained, and tanned. After draining and prior to tanning, any holes in the skin should be sewn closed using nylon thread. Dental floss can be used. This will prevent further ripping of the skin during softening.

Dispose of pickling and neutralizing solutions properly. Acid pickles should be raised to a pH of 7.0 before dumping. Do not dump or dispose of solutions where they can contaminate streams or ground water. Dispose via drains leading to sewage treatment plants, not storm water runoff drains. If in a rural area and no other disposal means is available, neutralized solutions should be dumped in a driveway or other area where vegetation does not grow. Chemical and salt water solutions should never be put into septic systems as these can kill the microflora needed to break down waste. Contact local authorities about proper disposal methods.

Tanning

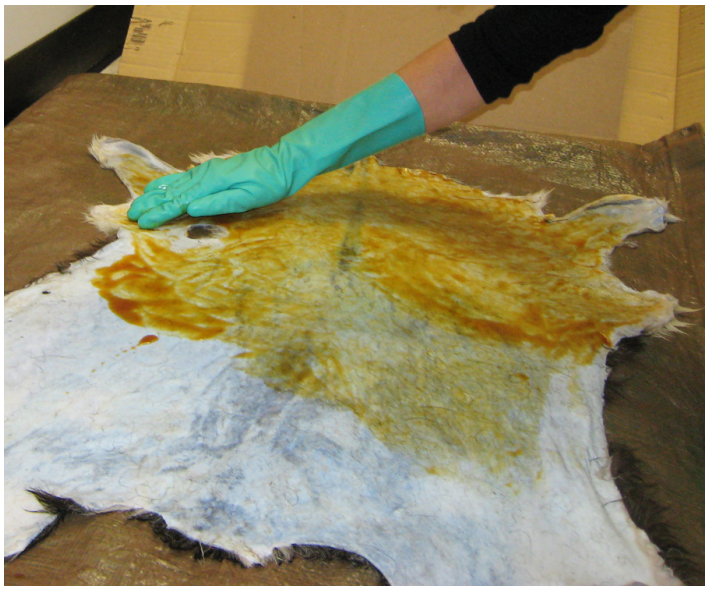
There are many tanning recipes and methods found in various books, taxidermy supply, or tanning chemical dealer catalogs and websites, and in the instructions included with tanning kits or chemicals. The main tanning process may be as simple as one of the paint-on tans mentioned earlier or a more complex immersion tan entailing the application of chemicals in a tanning soak or bath. To illustrate these tanning processes, examples are given of a paint-on tan and an immersion tan.

Paint-on tan

Some paint-on tans, such as Liqua-Tan™ and Tannit™ solution, among others, do not require the use of an acid pickle. McKenzie Tan recommends using a pickle solution and acid pickles can be used with other paint-on products. In either case, prior to tanning the skin is soaked in a rehydrating (if salted only) or neutralizing (if pickled) solution, rinsed, and drained. Remove excess moisture to get the skin in a damp state. This is commonly done by rolling the skin in a towel.

After the excess moisture is removed, lay the skin flat on a plastic tarp or piece of wood and apply the tanning solution. Using a gloved hand or paint brush, apply an even coat of the tanning solution on the skin, covering every portion while taking care around edges and holes. It is best to warm the tanning solution slightly prior to applying.

After several hours, or overnight, work the excess solution into the skin. Some paint-on tans recommend rinsing the skin in cool water after tanning. Softening oil is then applied. Some paint-on tans state that oils are included in the tanning solution. Knobloch's recommends applying Liqua-Soft™ softening oil the day following application of Liqua-Tan™ if the tanned skin will be used for a flat skin or rug. Stains and greasiness left on the hair after rinsing can be removed during drying and softening by washing the area with a grease-cutting dish detergent or by using odorless mineral spirits poured on a rag and rubbed on the hair.



Apply paint-on tans carefully using gloves.

Immersion tan

Different powder and liquid tans are available that require application using an immersion or tanning bath. The following example describes using Rittel's EZ-100 synthetic tanning powder. Just prior to tanning, the skin should be removed from the acid pickle and placed in the neutralizing solution. After neutralizing, the skin should be drained for up to 45 minutes and then weighed. Rittel's EZ-100 instructions state that for every pound of wet, drained skin use 4 ounces salt, 0.5 ounces EZ-100, and 2 quarts lukewarm water. Dissolve the EZ-100 powder in a small amount of hot water and bring to volume to make a lukewarm solution. After mixing with the salt, check the solution pH. An EZ-100 tanning solution must have a pH of 4.0. If the pH is too high, lower it using small amounts of Saftee Acid. If the pH is too low, raise it using an alkaline substance such as sodium bicarbonate (baking soda). Immerse the skin into the tanning solution and recheck the pH after 30 minutes. Adjust to pH 4.0 if needed. Skins should be stirred occasionally while in the tanning solution to ensure proper penetration of the tanning agent. Skins will tan in 16 to 20 hours after which they should be removed, rinsed, and drained for 20 minutes prior to oiling. Do not leave skins in the tan longer than recommended.

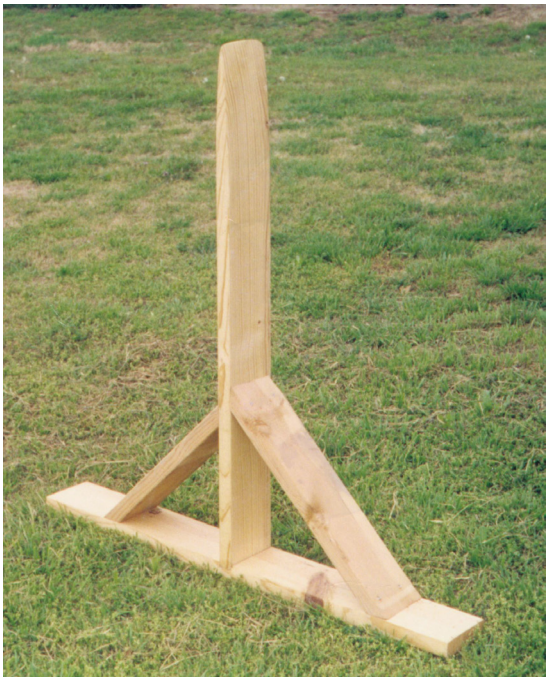
Oiling

Oiling is done to increase the softness of the finished product and many oils are available in the marketplace. If a tanning kit is purchased, the recommended oil will be included. Some oils, such as Liqua-Soft™, are ready to use from the bottle. Others require mixing one part oil to two parts hot water before use. To oil the skin, lay it flat with the flesh side up. Liberally apply the oil being careful around the edges of the skin. Fold the skin flesh to flesh and allow it to absorb oil for 4 to 6 hours or even overnight. Then, hang the skin to begin drying.

The drier, white areas on this skin mean this skin is ready to soften.

Drying and softening

Drying methods range from simple hanging to tacking on wood or tying in a frame. Allow skins to air dry, using a heat source dries the skin too fast making softening difficult. Check the skin as it dries to determine when softening should begin. If the skin is stretched



A staking beam looks like an inverted "T" with the top sanded to a blunt point (left). To soften the skin, pull it back and forth over the point of the beam (right).

and pulled when too wet it can become misshapen. If one waits too long, the skin stiffens and is difficult to soften. As the skin dries, it will become white and less pliable. The thinner edges will dry more quickly than the thicker center line and edges are usually worked first.

If the skin is drying too fast or time constraints prohibit you from working on the skin, you can place the skin in a plastic bag for several hours or overnight to slow down the drying process. You can also wrap the skin around damp towels and place it in a plastic bag overnight to partially rehydrate the skin. Continue working the skin as it dries.

Softening involves stretching and bending the skin to break up fibers in the skin. The time and effort spent on this step directly determines the suppleness of your final product. Initially, roll the skin in your hands to make the skin more flexible. As the skin dries and becomes stiffer, the skin can be staked and cabled. Staking involves use of a staking beam, boards cut and fashioned in the shape of a braced, inverted "T" with the upright end rounded to a blunt edge. The flesh side of the skin is pulled back and forth over the blunt edge to stretch and break up skin fibers.

Cabling is a more effective method than staking and involves stretching and pulling the skin around a cable. Regular rope can be used but aircraft cable (wire rope) clamped around a pole works very well. Often, both methods are used on the same skin, staking to begin breaking up very stiff areas followed by cabling to finish softening to create a soft, supple skin.

Cabling a goat skin using wire cable.

Finishing

After the skin is softened, the hair should be cleaned and brushed. Most goatskins will only need combing or brushing. If the hair feels greasy, one can use dish detergent or even shampoo to wash the hair. If using this method, try not to get the skin too wet as it may need to be staked or cabled again as it dries to maintain softness. The tanning agent is chemically bound in the skin and will not wash out. Some texts explain how to clean the hair using sawdust or corn cob grit dampened with a solvent or cleaning agent. Taxidermy or tanning chemical supply houses sell sawdust and solvents to be used for cleaning. Locally obtained sawdust may contain pitch and be unevenly grained, rendering it not as useful.

Once the hair is clean and brushed, the skin side can be sanded or rasped to remove rough spots and further soften the skin. Staking may make the skin appear brown and dirty and sanding or rasping will make it look cleaner. Cabled skins generally will not need rasping or sanding.

Skin edges are usually uneven and stiffer than inner portions and trimming these results in a more attractive product. Use a box cutter or similar knife and cut from the flesh side making sure not to cut the hair so as to leave a fringe covering the skin's edge.

Finish the skin by trimming rough edges.

Optional steps

Some tanning recipes include a degreasing step or recommend degreasing certain types of skins, usually carnivores. Degreasing is removing fat in the skin using a detergent or solvent degreasing agent. One example of a detergent degreaser is Kemal-4™ by Knobloch's. Dish soap, such as Dawn®, acts as a degreaser when washing skins and works well with thin goatskins. Solvent degreasers may be more efficient at extracting fats from the skin, one example being Kemsol by Knobloch's. Degreasers can also be added to the pickle solution, as with McKenzie Relaxer/Degreaser. For most hair-on tanning of goatskins, washing with dish soap is sufficient. If a goatskin has a lot of fat, degreasing may help in the tanning process.

Making Leather

Many people wish to make leather from skins. Some of the tanning chemicals used for hair-on tanning can be used for leather, but a dye is needed to give the leather specific colors. Kits using chromium are available to make leather. However, chromium is a heavy metal requiring special disposal. Great care is needed when using chromium-based kits and local authorities should be consulted on proper disposal of tanning solutions. To make leather, skins are salted and fleshed, then unhaired. The kit used will contain unhairing chemicals and explain the steps to follow to remove the hair. The tanning procedure may be different than for hair-on tanning but the oiling and softening steps are similar.

Where to Find Additional Information

The instructions included with any tanning chemical will provide detailed instructions on skin preparation and chemical usage. However, for persons interested in obtaining further information on skin tanning, an internet search will provide many articles, forums, and websites on tanning methods and procedures. Companies selling tanning chemicals provide product information on their websites, some of which have "How to" sections that provide excellent information and videos on skin handling and newer tanning methods. A local taxidermist or sporting goods store is another potential source of information and supplies. Books on home tanning and leather craft are available but most were written many

years ago and do not contain information on newer tanning methods. One recent book, "The Ultimate Guide to Skinning and Tanning" by Monte Burch, 2002, does contain information on some newer techniques and chemicals.

When searching for tanning information on the internet one will come across the art of "brain tanning." This is the traditional method of using animal brains to make buckskin as done by Native Americans and other cultures. This can certainly be done with goatskins. In addition to websites dedicated to "brain tanning," several good texts have been written on the subject.

Partial List of Supplies Needed to Tan Skins

- Skinning knife, if needed.
- Sharpening stone.
- Non-iodized salt, not rock salt.
- Fleshing knife.
- Fleshing beam.
- Plastic barrel (metal containers should never be used).
- Wooden pole or paddle to stir tanning solutions.
- Tanning kit or chemicals.
- Rubber gloves, protective apron, and eye protection for handling chemicals and solutions.
- pH paper, if pH of solutions must be checked.
- Cable, staking beam, or other softening device.
- Comb or brush for hair.
- Scale to weigh skins and chemicals.
- Source of hot water to mix solutions.

Where to Find Tanning Supplies and Chemicals

The following is a partial list of companies and dealers that sell tanning supplies and chemicals. Other companies, dealers, or distributors can be found on the internet at http://taxidermy.net or through using any internet search engine. Local taxidermists and tanneries can also be a source of information and(or) supplies.

Jonas Supply Company
1850 Dogwood St.
Louisville, CO 80027
Phone: 800-525-6397
http://www.jonas-supply.com

Knobloch's
1850 Dogwood St.
Louisville, CO 80027
Phone: 303-666-9045
http://www.knoblochs.com/

McKenzie Taxidermy Supply
P.O. Box 480
Granite Quarry, NC 28072
Phone: 800-279-7985
http://www.mckenziesp.com/

Dan Rinehart Taxidermy Arts Supply
203 S. Main St.
Edgerton, WI 53534
Phone: 866-296-2782
http://www.taxidermyarts.com

Tandy Leather Co.
(Locations throughout the U.S.)
http://www.tandyleatherfactory.com/

Van Dyke Supply Co. Inc.
Phone: 800-737-3355
http://www.vandykestaxidermy.com/

WASCO
1306 West Spring Street
P.O. Box 967
Monroe, GA 30655
Phone: 800-334-8012
http://www.taxidermy.com/

Resources

Churchill, J.E. 1983. The Complete Book of Tanning Skins and Furs. Stackpole Books, Harrisburg, PA. 197 pp.

Hobson, P. 1977. Tan Your Hide! Storey Communications, Inc., Pownal, VT. 135 pp.

Rittel, B. 1994a. Syntans as a tanning agent. Breakthrough 38:26-31.

Rittel, B. 1994b. When fleshing or shaving- the only way is the right way. Breakthrough 36:22-24.

Rittel, B. 1993. The basic principles of pickling and neutralizing. Breakthrough 33:48-52.

List of Some Available Books on Tanning and Taxidermy (check your local library)

Burch, M. 2002. The Ultimate Guide to Skinning and Tanning: A Complete Guide to Working with Pelts, Fur, and Leather. The Lyons Press. Guilford, CT. 240 pp. ISBN 1-58574-670-3.

Churchill, J.E. 1983. The Complete Book of Tanning Skins and Furs. Stackpole Books, Harrisburg, PA. 197 pp. ISBN 0-8117-1719-4.

Edholm, S., T. Wilder and J. Riggs. 2001. Buckskin: The Ancient of Art of Braintanning (Originally titled "Wet-Scrape Braintanned Buckskin"). Paleotechnics, Boonville, CA. 307 pp. ISBN 0-9654965-4-6.

Gibby, E.H. 1991. How to Tan Skins the Indian Way. Eagle's View Publishing, Liberty, UT. 28 pp. ISBN 0-943604-33-8.

Grantz, G.J. 1985. Home Book of Taxidermy and Tanning. Stackpole Books, Harrisburg, PA. 160 pp. ISBN: 0-8117-2259-7.

Hobson, P 1977. Tan Your Hide! Storey Communications, Inc., Pownal, VT. 135 pp. ISBN 0-88266-101-9.

Kelly, T. 1987. Outdoor Life Complete Home Taxidermy. Outdoor Life Books, Danbury, CT. 271 pp.

Kellogg, K. 1984. Home Tanning & Leathercraft Simplified. Williamson Publishing Co., Charlotte, VT. 192 pp. ISBN 0-9135890-4-7.

Richards, M. 2004. Deerskins into Buckskins: How to Tan with Brains, Soap or Eggs. 2nd Ed. Backcountry Publishing, Cave Junction, OR. 240 pp. ISBN 0-9658672-4-2.

Riggs, J. 2003. Blue Mountain Buckskin. 2nd Ed. Backcountry Publishing, Cave Junction, OR. 140 pp. ISBN 0-0-9658674-1-8.

Roberts, N.H. 1979. The Complete Book of Taxidermy. TAB Books, Blue Ridge, Summit PA. 351 pp. ISBN 0-8306-9754-4.

CURRENT PROGRAM SUMMARY

E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, Oklahoma 73050

- **EXTENSION OVERVIEW**
- **INTERNATIONAL OVERVIEW**
- **RESEARCH OVERVIEW**
- **USDA/CSREES PROJECTS**
- **EXPERIMENTS**
- **ABSTRACTS**
- **ARTICLE SUMMARIES**
- **VISITING SCHOLARS, GRADUATE STUDENTS, AND INTERNS**

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Extension Overview

Dr. Terry A. Gipson
Goat Extension Leader

The year 2014 was a busy year for the Langston Goat Extension program. The goat extension specialists have answered innumerable producer requests for goat production and product information via the telephone, letters and e-mail, have given numerous presentations at several state, regional, national and international goat conferences for potential, novice and veteran goat producers, and have produced quarterly newsletters. They have also been busy with several major extension activities. These activities include the annual Goat Field Day, Langston Goat Dairy Herd Improvement (DHI) Program, grazing demonstrations, and various goat workshops on artificial insemination, tanning hides, and on internal parasite control.

Goat Field Day

Our annual Goat Field Day was held on Saturday, April 26, 2014 at the Langston University Goat with more than 375 participants in attendance. This year's theme was Kidding and Kid Management and our featured speakers were Ms. Jan Carlson and Dr. Charlotte Clifford-Rathert.

Ms. Jan Carlson has managed the University of California Davis Goat Facility for the past 14 years, maintaining breeding-teaching-research herds of approximately 140 goats (80 dairy, 40 Boer, and a group of transgenic research goats). She also teaches goat husbandry/animal science classes both in the classroom and at the goat facility.

Ms. Carlson began working with goats in 1979, when she was hired to work on a research project involving a just-discovered goat virus, later named Caprine Arthritis Encephalitis Virus (CAEV). She continued her work as a research associate at Washington State University College of Veterinary Medicine, Department of Microbiology and Pathology, until 1995. From 1995 until 1999 she worked in Texas when the first Boer goats were being imported into the United States, where she programmed numerous embryo transfer groups, showed at the early ABGA National shows and maintained an import quarantine facility in compliance with the USDA Animal Welfare Act.

Ms. Carlson is a member of the American Dairy Goat Association (ADGA) where she serves on a number of committees. She has served as Director on the Board of the American Goat Federation (AGF) since 2012, and is a past Director of the American Boer Goat Association (ABGA). She also is on the Dairy Goat Advisory Committee for DHIA West.

Dr. Charlotte Clifford-Rathert is an Assistant Professor in the College of Agriculture and Natural Sciences, Cooperative Extension and Research of Lincoln University in Jefferson City, Missouri. She serves as the State Small Ruminant Specialist. Her focus involves studying embryonic and fetal losses in goats, vegetation control using goats and sheep, and small ruminant management. Currently her projects are funded by USDA and NRCS. She also contributes to the eXtension Goat Industry Community of Practice Leadership Committee. Her goals are to help promote and maintain a market for today's goat and sheep producers and provide educational answers to health questions that goat and sheep producers may have. She is a contributor to the eXtension Goat Community of Practice (www.extension.org/goats).

Dr. Clifford-Rathert received her Bachelor of Science in Animal Science from the University of Nevada, Reno in 1981. She worked in various fields of Agriculture such as small ruminant management, extension, and research before pursuing a Doctor of Veterinary Medicine from the University of Missouri, Columbia in 1992. She practiced in a mixed animal practice in Central Missouri until joining Lincoln University in November 2007.

In the afternoon session, participants were able to break into small-group workshops. There was a total of fifteen workshops; however, participants had only enough time to attend three.

The afternoon workshops include:

1. Goat Kidding: plan for success with Ms. Jan Carlson (1:30 p.m. ONLY).
2. Goat Kidding: procedures and obstetrics with Ms. Jan Carlson (2:30 p.m. ONLY).
3. Goat Kid Raising: the cold milk feeding program and other options with Ms. Jan Carlson (3:30 p.m. ONLY).
4. Internal Parasite Control - sustainable internal parasite control program with Dr. Charlotte Clifford-Rathert (1:30 p.m. ONLY).
5. Diseases of Concern during Pregnancy and Kidding – diseases that every producer should know and identify especially those that can be transmitted to humans with Dr. Charlotte Clifford-Rathert (2:30 p.m. and 3:30 p.m. ONLY).
6. Abortions and Their Diagnosis – diseases and conditions that provoke abortions and their diagnosis with Drs. Keith Bailey and Lionel Dawson (1:30 p.m. and 2:30 p.m. ONLY).
7. Nutrition for Health and Production - calculation of energy, protein and feed intake requirements with Dr. Steve Hart (2:30 p.m. and 3:30 p.m. ONLY).
8. Goat Farm Budgeting - basics of budgeting and financial recordkeeping with Mr. Roger Sahs.
9. Sketching Goats in the Field - basics of how to draw any type of goat in a natural setting with Mr. Ken Williams.
10. DHI Training - supervisor/tester training for dairy goat producers including scale certification with Ms. Eva Vasquez.
11. Cheesemaking Overview - basics of cheesemaking with Dr. Steve Zeng.
12. USDA Government Programs - overview of USDA Natural Resource Conservation Service's work with goats and its cost-sharing program with Mr. Dwight Guy.
13. Pack Goats - basic goat training as a pack animal and equipment needs with Mr. Dwite Sharp.
14. Mortality Composting – overview of basic composting techniques and equipment for disposing of goat mortalities moderated by Dr. Roger Merkel.
15. Fitting and Showing for Youth and Adults - tips and pointers on fitting and show ring etiquette with Ms. Morgan Hallock (this was a half-day afternoon workshop).

Ms. Sheila Stevenson hosted a full day of activities for youth ages 5-12 in the Fun Tent. This allowed the parents and older teens to enjoy the workshops knowing that their little ones were having fun in a safe environment.

Conference on Mortality Composting

On April 25, 2014, the American Institute for Goat Research of Langston University held a one-day conference entitled "What Farmer Educators Need to Know about Mortality Composting – Beyond the Basics." Nationally-recognized scientists presented information on various topics related to mortality composting to provide information to farmer educators as they work with and answer producer questions. A total of 51 persons attended the conference, 32 males and 19 females. Attendees represented producer organizations, universities, USDA/NRCS, extension organizations as well as individual goat producers. This conference was supported by a USDA NIFA 1890 Institution Capacity Building Grant # OKLXMERKEL2010-0223167. Other institutions collaborating on this grant include Virginia State University and Florida A&M University.

All livestock producers know that if you raise livestock, at some point you will have dead stock. Leaving dead stock to decompose naturally has the potential to pollute ground water, feed predators, and is unlawful. Mortality composting of small ruminants is a lawful, environmentally-friendly method of carcass disposal

that can easily be done on-farm. The basic procedure of mortality composting can be found in a number of on-line resources and requires the same components as backyard vegetative composting, namely a carbon source (sawdust, animal bedding, old hay or straw, etc.), a nitrogen source (carcass), water, and available oxygen for aerobic decomposition. A base layer of carbon source is made, the carcass placed in the middle and the rumen lanced, water added to the surrounding material to achieve approximately 50% moisture content, and a thick layer of carbon source material placed on top. The compost pile should heat and the carcass begin to decompose.

Whereas mortality composting is not difficult, farmer educators and other people who work with producers should have a deeper knowledge about the process to answer questions and concerns that farmers may have. Can I compost an animal that dies of disease? What happens to the drugs used to treat an animal prior to its death? What are the most important things to check or do to ensure the pile is working? Can I use the compost on pastures or cropland? What is the best way to build a pile? Are there pollution or other environmental concerns? Providing information to farmer educators on these and other questions that producers may have is the goal of this conference.

To address these topics the following speakers and presentations were given:

1. Mortality composting resources for extension and conservation educators: Teaching the benefits and opportunities to producers; Mr. Thomas Bass, Livestock Environment Extension Program, Montana State University
2. Pile characteristics for effective animal mortality composting; Dr. Saqib Mukhtar, Department of Biological & Agricultural Engineering, Texas A&M University
3. Mortality compost nutrients and use on farm, ways to enhance nutrient content; Mr. Dean Ross, Agrosecurity Consulting, Bath, Michigan
4. Quality assurance in mortality composting, mortality composting safety; Ms. Mary Schwarz, Cornell Waste Management Institute, Cornell University
5. Management and environmental considerations when siting and managing composting facilities; Dr. Karl VanDevender, Biological and Agricultural Engineering, University of Arkansas
6. Can composting solve specified risk materials issues? Dr. Shanwei Xu, Agriculture and Agri-Food Canada, Lethbridge Research Centre, Alberta, Canada
7. Fate of euthanasia drugs during equine mortality composting; Dr. Josh Payne, Biosystems and Agricultural Engineering, Oklahoma State University

Proceedings from the conference along with the presentations given can be found on the American Institute for Goat Research website at http://www2.luresext.edu/goats/library/fact_sheets/mortality_composting.html.

Cheese Manufacturing Workshop

An Annual Cheese Manufacturing Workshop was held in the pilot creamery at Langston University on April 26, 2014. Because of the tremendous interest in the workshop, more attendants than the original limit of 15 were admitted. In all, seventeen participants from OK, KS and TX enjoyed this hands-on workshop. Dr. Steve Zeng, Dairy Product Specialist, demonstrated basic cheesemaking principles and skills by making Cheddar cheese, Feta cheese, and various soft cheeses (Chevrè, cream cheese, etc.) with our very own wholesome Grade "A" goat milk. This workshop was designed for beginners. Ideas and techniques were also shared with some experienced cheese makers in attendance. In the end, everyone had chance to make cheeses and take some cheeses home for aging. It surely was a fun and learning day for all.

Goat DHI Laboratory

This past year was a year of change for the Langston Goat Dairy Herd Improvement (DHI) Program as it became independent and expanded its record processing capabilities. In 1996, the Langston DHI program launched under the umbrella of the Texas DHIA. That partnership was not mutually beneficial and Langston Goat Dairy DHI elected to operate independently. In addition, the dairy records processing software that had been initially acquired from Texas DHIA had reached well beyond it capabilities and could not be modernized. Thus, Langston Goat Dairy DHI has partnered with Dairy Records Management System (DRMS) of Raleigh, NC to conduct the record processing.

The Langston DHI program became the first DHI program to introduce forms and reports in goat terminology to dairy goat producers in the United States. A national Dairy Herd Improvement Association (DHIA) has been in existence for a number of years. However, until 1996 DHIA catered only to cow dairies. The Langston DHI program has been very popular with dairy goat producers and has grown significantly since its establishment in 1996. Goat producers are now able to get records for their animals that reflect accurate information with the correct language. Currently we are serving a 30 state-area that includes a majority of the eastern states. Currently, we have 102 producer herds in these 30 states enrolled in the Langston Goat Dairy DHI Program. In 2014, the DHI laboratory processed more than 10,000 samples. Langston University continues to serve the very small-scale dairy goat producer. The average herds size on test with Langston University is 10 animals. This is significantly smaller than the herd size average for the five other processing centers.

For those interested in becoming a Langston goat DHI tester, training is available either in a formal classroom setting or through a 35-minute video tape (see additional information in the YouTube section). Every tester is required to attend the DHI training session or view the tape and take a test. Upon completion of the DHI training, the milk tester can start performing monthly herd tests.

State	Number of herds
AL	3
AR	1
AZ	3
CO	1
FL	9
GA	11
IA	1
ID	1
IL	2
IN	2
KS	1
KY	1
LA	1
MA	2
MD	1
MI	18
MN	1
MO	3
MS	3
NC	2
NM	2
OH	3
OK	8
OR	1
TN	1
TX	11
VA	3
WI	1
WV	1
WY	4

Goat Newsletter

To date, the Goat Extension program published four issues of the 8-page Goat Newsletter in 2014. Interest in the newsletter has grown and we currently have over 1,600 subscribers to our free quarterly Goat Newsletter and the subscription list continues to increase every year. The Goat Newsletter is mailed to every state in the nation and to 10 countries overseas. Ninety-seven percent of the mailings go to American households. At least one newsletter is mailed to a household in every state in the nation. Fifty percent of the newsletters are mailed to Oklahoma households. An additional thirty percent of the newsletters are mailed to households to state adjacent to Oklahoma.

Artificial Insemination Workshop

The use of superior sires is imperative in improving the genetic composition of breeding stock. Artificial insemination has long been used in the dairy cattle industry and is a simple technology that goat producers

can acquire. However, opportunities for goat producers to the necessary skills via formal and practical instruction are not widespread. Langston University has instituted a practical workshop for instruction in artificial insemination in goats. Producers are instructed in the anatomy and physiology of the female goat, estrus detection and handling and storage of semen. Producers participate in a hands-on insemination exercise. An understanding of the anatomy and physiology enable the producer to devise seasonal breeding plans and to troubleshoot problem breeders. An understanding of estrus detection enables the producer to effective time inseminations for favorable conditions for conception and to effectively utilize semen. An understanding of semen handling and storage enables the producer to safeguard semen supplies, which can be scarce and costly. The experience of actually inseminating a female goat enables the producer to practice the knowledge that they have gained. The acquisition of these inseminating skill will allow producers the use of genetically superior sires in their herds that they normally would not have access to. It also allows producers to save money by conducting the inseminating themselves instead of hiring an inseminator. In 2014, two AI workshops were held; one in September and one in October at the Langston University campus. Forty-four participants were trained.

Meat Goat Production Handbook

The first edition Meat Goat Production Handbook has been sold-out and the revised second edition is available. Even though Langston University has taken the lead in this revision project, this handbook is not the product of one person nor of a single university. Our collaborating project institutions/organizations, which include Alcorn State University, American Boer Goat Association, American Meat Goat Association, Florida A&M University, Fort Valley State University, Kentucky State University, Langston University, Prairie View A&M University, Southern University, Tennessee Goat Producers Association, Tennessee State University, Tuskegee University, United States Boer Goat Association, University of Arkansas Pine Bluff, and Virginia State University. Handbook contributing institutions/organizations include Allen Veterinary Clinic, American Boer Goat Association, American Meat Goat Association, BIO-Genics, Ltd., Bountiful Farm, Cornell University, Fort Valley State University, Kentucky State University, Langston University, Law Office of Wheeler and Mueller, Louisiana State University, Louisiana State University AgCenter, NCAT / ATTRA National Sustainable Agriculture Information Service, North Carolina State University, Oklahoma State University, Texas A & M University, United States Boer Goat Association, and Virginia State University. The Meat Goat Production Handbook was partially funded by USDA/FSIS/OPHS project #FSIS-C-10-2005.

Meat Goat Production Basics

An illustrated and scaled-down version of the Meat Goat Production Handbook is available. Our collaborating project institutions/organizations include Kentucky State University and the University at Puerto Rico at Mayagüez. Partial funding to develop the Meat Goat Production Basics was from USDA/NIFA grant #2010-38821-21581 (OKLX-GIPSON10).

Controlling Internal Parasites Workshop

Internal parasites (Barberpole worm, *Haemonchus contortus*) is the leading cause of death in goats in the Southern US, accounting for as many deaths as the total of the next three leading causes of death in goats. Several factors contribute to the high mortality caused by internal parasites.

Goats which originated in dry areas where there was no internal parasite challenge have been brought to the humid South where there is great parasite challenge. Only a few animals have good genetic resistance against internal parasites. In addition, goats are forced to graze rather than browse which provides greater opportunity to consume infective larvae and especially so when animals overgraze. Producers are not familiar with monitoring animals for signs of parasitism and do not understand how animals get infected. In addition

internal parasites have developed a high level of resistance to dewormers from the overuse of dewormers in goats. To address these concerns, Langston developed a parasite workshop to educate producers about internal parasites. It includes 3 hours of lecture on biology of the parasite, pasture management to avoid worms and monitoring parasite infection using the FAMACHA chart which assesses the degree of anemia. This is a cooperative effort with OSU Extension Veterinarian who addresses dewormer resistance and correct use of dewormers. Producers get hands-on instruction in use of the FAMACHA card, taking fecal samples and running fecal egg counts.

YouTube Channel

Created in 2005,YouTube is a video-sharing website on which users can upload, view and share videos. YouTube now has over 120 million videos, including movie clips, TV clips, and music videos, as well as amateur content such as video blogging and short original videos. The Goat Program at Langston University has created its own YouTube channel (https://www.youtube.com/user/taglu01) The following are the YouTube videos that are available and you can quickly access them on a mobile device by using the QR (2D barcode) to the right. Additional videos will be added to the channel in the future

Artificial Insemination (AI) in Goats (length 8:47)

This video describes the steps involved in artificial insemination in goats.

AI Kit (length 6:28)

This video describes the equipment needed for artificial insemination in goats.

Basic Hoof Care (length 10:48)

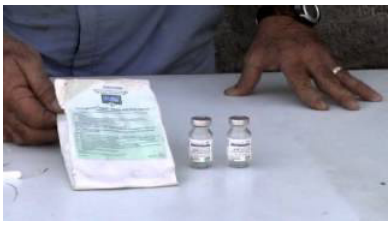
This video explains basic hoof care for goats.

Body Condition Scores in Goats (length 2:11)

This video describes how to evaluate body condition score in goats.

Buck Effect (length 1:53)

This video describes the buck effect and its use in estrus synchronization.

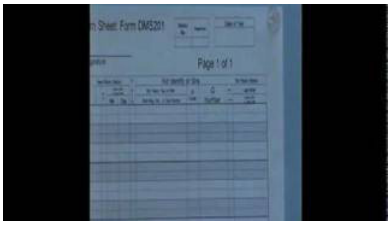


Estrous Synchronization in Goats (length 5:08)

This video explains estrous synchronization for artificial insemination in goats.

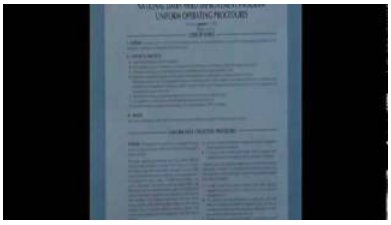
Langston DHI Tester Training - Part 1 (length 9:24)

This video describes how to conduct proper DHIA testing procedures for milk sampling.



Langston DHI Tester Training - Part 2 (length 9:48)

This video describes how to conduct proper DHIA testing procedures for milk sampling.



Langston DHI Tester Training - Part 3 (length 9:19)

This video describes how to conduct proper DHIA testing procedures for milk sampling.

Langston DHI Tester Training - Part 4 (length 8:28)

This video describes how to conduct proper DHIA testing procedures for milk sampling.

Semen Tank (length 6:39)

This video explains semen tank handling and semen storage for artificial insemination in goats.

Signs of Does (female goats) in Estrus (length 0:35)

This video shows an example of signs of estrus (flagging) in goats.

Nutrient Requirements of Goats

Under a research project which developed equations for energy and protein requirements for goats, as well as prediction of feed intake, an extension sub-project developed a website calculation system for "Nutrient Requirements of Goats" (http://www2.luresext.edu/goats/research/nutreqgoats.html). Most calculators were based on studies of the project reported in a Special Issue of the journal Small Ruminant Research. For calculators with score inputs (i.e., grazing and body conditions), pictures are available to aid in determining most appropriate entries. Realistic examples are given, as well as discussion of appropriate and inappropriate usage. However, for the experienced user there is an option to hide text and examples and to view only inputs and outputs.

In 2005, a calculator for calcium and phosphorus requirements was added to the existing calculators for metabolizable energy, metabolizable protein, and feed intake for suckling, growing, mature, lactating, gestating, and Angora goats. Also in 2005, the interface of the calculators was unified into a single calculator with the English measurement system used. This will encourage the use of the calculators by American producers. The least-cost ration balancer was modified so that it incorporates the least-cost feed percentage into the diet. Also, calculators are equipped with printable version commands to obtain inputs and outputs in hard copy format. In 2007, the calculators were continued to be updated.

Langston University's popular web-based nutrient calculator is now available for free on the iPad. To install this version, simply go the App Store and search for "Goat Nutrient Calculator". Once installed on your iPad, you will be able to calculate the nutrient requirements for any goat in any age, breed or stage of production, as well as, calcium and phosphorus requirements.

The original web-based nutrient calculators were developed under a research project and were only accessible via the website (http://www2.luresext.edu/goats/research/nutreqgoats.html). This iPad version is the first stand alone version of the calculators available.

The web-based version has a feed library and a least-cost ration balancer so that rations can be formulated to meet nutrient requirements. Currently, the iPad version does not have these attributes but it is planned to update this version with those capabilities with the next release.

For these calculators to be of value, they must be readily accessible and reasonably simple. It is hoped that this iPad version will enjoy widespread usage and enhance feeding practices for goats.

Tanning Goat Hides

People express interest in tanning skins for a variety of reasons. Some sheep and goat producers wish to tan skins of animals they raise. Other people are hunters who wish to tan deerskins. Reasons for this interest include: wanting to use as much of the animal as possible, disliking the waste of an animal's skin; ownership of an exceptionally pretty goat that they wish to tan after harvest for home use; learn new skills; wish to use tanning skills on other mammals such as deer; wishing to learn "old-time" skills, and some producers see a source of potential income through tanning goat skins and selling handicrafts. Some attendees already

tan skins but want to expand their knowledge. All of these producers wish to learn to tan skins. There is no other tanning skins course in the nearby area. Langston University instituted a tanning goat skins course that teaches tanning skills to persons wishing to tan skins as a hobby. The workshop uses readily available chemicals and all processes are done by hand. Thus, it is a low cost process that producers can try at home. The hands-on nature of the course whereby participants work with actual skins in most of the tanning steps ensures skill transfer. This format allows students to work with and learn from each other and receive practical knowledge of the tanning process that will help them when trying tanning skins at home. In 2014, one tanning goatskins workshop was held at Langston University in March.

Internet Website

http://www2.luresext.edu

Capabilities of the new web site include a document library with the complete proceedings of the annual Goat Field Day and the quarterly newsletter for the past several years. Both the proceedings and newsletters are also available in portable document format (pdf), which allows for the viewing and printing of documents across platform and printer without loss of formatting.

Information, recent abstracts and scientific articles of completed and current research activities in dairy, fiber and meat production are available for online viewing and reading. Visitors will be able to take a Virtual Tour of the research farm and laboratories, complete with digital photos and narrative. Visitors will also be able to browse a digital Photo Album. Visitors will also be able to subscribe to our free quarterly newsletter online. Visitors will be able to test their knowledge of goats with the interactive goat quiz which covers nearly all aspects of dairy, fiber and meat goat production. For those questions that are lacking in the interactive quiz database, visitors will be able to submit a question to be included in the database. Visitors will be able to read about research interests of faculty and will be able to contact faculty & staff via email.

Web-based Training for Meat Goat Producers

Meat goat production is one of the fastest growing sectors of the livestock industry in the United States. New producers, as well as some established ones, have an expressed need for current, correct information on how to raise goats and produce safe, wholesome products in demand by the public. As the meat goat industry grows and evolves, a quality assurance program is essential. Such a QA program ensures the production of a wholesome product that satisfies consumers and increases profit for the meat goat industry.

Langston University was awarded funding by the Food Safety and Inspection Service of USDA to develop training and certification for meat goat producers. Langston University organized and led a consortium of 1890 universities and producer associations in this project. The consortium identified the subject topics most pertinent and pressing for the instructional modules. The consortium then identified experts on the selected subject topics and pursued these experts as module authors. These authors represent the most qualified persons in their field in academia as well as in the industry. Langston University translated the sixteen instructional modules into web pages with accompanying images, and pre- and post tests for those producers wishing to pursue certification. All modules are also available in pdf for easy printing and the introductory module is available as a podchapter for downloading and listening on your favorite mp3 player. The web-site (http://www2.luresext.edu/goats/training/qa.html) was unveiled in late 2005.

Even though this web-site (http://www2.luresext.edu/goats/training/qa.html) was only unveiled in 2007, more than 1,500 producers have enrolled for certification and 292 have completed the certification process. These instructional materials will best serve meat goat producers in assisting them to produce a safe, wholesome, healthy product for the American consumer. Funding source for this project was USDA/FSIS/OPHS

project #FSIS-C-10-2004 entitled "Development of a Web-based Training and Certification Program for Meat Goat Producers."

State/Country	***Number Certified***
UNITED STATES	
AL	5
AR	9
AZ	1
CA	6
CO	2
CT	1
FL	24
GA	15
IA	5
ID	1
IL	5
IN	8
KS	11
KY	6
LA	3
MA	1
MD	2
MI	9
MN	4
MO	12
MS	2
MT	2
NC	10
NE	3
NH	1
NJ	2
NV	3
NY	6
OH	6
OK	33
OR	7
PA	8
SC	5
SD	2
TN	13
TX	33
UT	2
VA	9

State/Country	***Number Certified***
VT	1
WA	5
WI	3
WV	6
WY	3
CANADA	
AB	2
BC	4
MB	3
NS	1
ON	3
BOTSWANA	1
INDIA	1
MALAYSIA	4
MEXICO	1
PAKISTAN	1
SAUDI ARABIA	1
SOUTH AFRICA	1
SURINAME	1
UK	2
ZIMBABWE	2
Total	***323***

Current Extension Projects

Title:	Enhancing Capabilities of Socially Disadvantaged and Underserved Farmers via Low Literacy Materials in English and Spanish
Type:	USDA 1890 Institution Capacity Building Grants Program
Project Number:	OKLX-GIPSON10
Period:	2010-2015
Investigators:	T.A. Gipson[1], R.C. Merkel[1], M. Simon[2], J. Fernandez Van Cleve[3]
Institution:	[1]Langston University; [2]Kentucky State University; [3]University of Puerto Rico - Mayaguez
Objective:	1) utilize existing core chapters from the Meat Goat Production Handbook to develop a low-literacy training manual for meat goat production; 2) translate the low-literacy meat goat production training manuals into Spanish; 3) develop supplemental explanatory and "how to" demonstration materials to the English and Spanish manuals in video format (DVD and web-based) for use by extension agents, outreach specialists and individual farmers.

Title:	Extension Education Delivery Tools for Dairy Goat Producers: A Web-Based Certification Program and E-Book
Type:	USDA 1890 Institution Capacity Building Grants Program
Project Number:	OKLXMERKEL11
Period:	2010-2014
Investigators:	R.C. Merkel[1], T.A. Gipson[1], S. Hart[1], Y. Park[2], C.M. Mikolayunas[3]
Institution:	[1]Langston University; [2]Fort Valley State University; [3]University of Wisconsin
Objective:	1) develop scientific-based content for a dairy goat web-based certification program and e-book 2) design and construct a web-based certification program based upon the developed content 3) develop a printed handbook based on the web-based program 4. Develop an e-book version of the handbook

Title:	Rehabilitation of Urban And Suburban Landscapes: An Eco-Friendly Partnership Between Langston University and Tribal and Munincipal Governments
Type:	USDA Renewable Resources Extension Act Program
Project Number:	OKLXRREA
Period:	2014-2017
Investigators:	T.A. Gipson[1], S. Hart[1]
Institution:	[1]Langston University
Objective:	1) establish partnerships between Langston University and tribal and municipal governments, and will establish demonstration sites using goats for biological control with Langston University providing technical assistance.

Research Overview

Dr. Arthur Goetsch
Goat Research Leader

There has been and is a wide array of research areas addressed by our program. All major types of goats produced in the US are considered, i.e., ones raised for meat, milk, and(or) fiber, both cashmere and mohair. The increasing demand for goat meat and decline in the mohair industry in recent years have resulted in an expansion of research topics with meat goats, but because the future is unknown, all goat industries will continue to receive attention. The Institute has and will in the future conduct research to increase levels and efficiencies of goat production, enhance utilization of goat products, and improve use of goats for specific purposes such as vegetation management. There is intent to increase economic returns to those raising goats or processing their products, as well as providing other benefits such as enhanced sustainability of livestock production systems.

A large proportion of the Institute's research program is made possible by grants, many of which are through USDA programs. Although dissemination of information generated from all of these projects occurs, some entail strong extension components. Likewise, there are projects listed in our international section that entail significant research components.

To provide an idea about our research program since the last Field Day, listed below are research projects and experiments we have been involved with in 2014 and 2015, abstracts for 2015, and summaries of scientific articles that were published in 2014 or currently are "in press."

Standard Abbreviations Used

BW = body weight
CP = crude protein
dL = decaliter
DMI = dry matter intake
kg = kilogram
M = mole
MEI = ME intake
mm = millimeters
ng = nanogram
OM = organic matter
SE = standard error
wt = weight
vs = versus
cm = centimeters
d = day
DM = dry matter
g = gram
L = liter
ME = metabolizable energy
mL = milliliter
mo = month
NDF = neutral detergent fiber
P = probability
TDN = total digestible nutrients
vol = volume
μ = micro

2014 and Current Research Projects

Title:	Factors Influencing Goat Production and Products in the South-Central U.S.
Type:	USDA NIFA Evans-Allen
Project Number:	OKLXSAHLU2012
Period:	2012-2017
Investigators:	T. Sahlu, A. L. Goetsch, R. Puchala, R. C. Merkel, T. A. Gipson, S. P. Hart, S. Zeng, and Z. Wang
Institution:	Langston University
Objective:	Study goat feeding and management, relevant health issues, and milk product technologies in order to increase the level and efficiency of goat productivity for increased profitability from goat production and lower costs to consumers of goat products.

Title:	Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats
Type:	USDA 1890 Institution Capacity Building - Research
Project Number:	OKLXWANG10
Period:	2010-2015
Investigators:	Z. Wang[1], A. L. Goetsch[1], S. P. Hart[1], T. Sahlu[1], and G. Chen[2]
Institutions:	[1]Langston University and [2]Oklahoma State University
Objectives:	Investigate immune regulation by *H. contortus* and reversing this regulation by nutritional components in small ruminants

Title:	Establishing a Langston University Testing Center for Electric Fence Modifications of Cattle Barb Wire Fence for Goat Containment
Type:	USDA 1890 Institution Capacity Building - Research
Project Number:	OKLXGOETSCH10
Period:	2010-2014
Investigators:	A. L. Goetsch[1], T. A. Gipson[1], T. Sahlu[1], and J. Burke[2]
Institutions:	[1]Langston University, and [2]USDA ARS Dale Bumpers Small Farms Research Center
Objectives:	Develop a repeatable method of testing effectiveness of the various means of cattle fence modifications with electric fence for goat containment

Title:	Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites
Type:	USDA 1890 Institution Capacity Building - Integrated Extension and Research
Project Number:	OKLXSAHLU12
Period:	2012-2015
Investigators:	T. Sahlu[1], A. L. Goetsch[1], T. A. Gipson[1], S. P. Hart[1], Z. Wang[1], R. Mateescu[2], and E. DeVuyst[2]
Institutions:	[1]Langston University, and [2]Oklahoma State University
Objectives:	1) Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-station' and 'on-farm' 2) Characterize changes performance due to selection; develop and implement a new second generation central sire performance test for small ruminants at Langston University 3) Develop early-life genetic indicators of resistance and assess changes in physiological conditions affected by selection 4) Evaluate economic and management considerations of whole herd/flock selection; disseminate potential benefits of selection and associated economic and management considerations for adoption by small ruminant producers

Title: Handbook for Livestock Research on Smallholder Farms in Developing Countries
Type: USDA Foreign Agriculture Service (FSA) Scientific Cooperation Research Program (SCRP)
Period: 2012-2014
Investigators: A. L. Goetsch[1], T. A. Gipson[1], R. C. Merkel[1], G. Abebe[2], A. Patra[3], D. Zhou[4], K. Al-Qudah[5], M. Huerta-Bravo[6], T. Sahlu[1], A. Degen[7], W. Getz[8], and Y. Tsukahara[1,9]
Institutions: [1]Langston University, [2]Hawassa University, [3]West Bengal University and Animal and Fishery Sciences, [4]Northeast Institute of Geography and Agroecology, [5]Jordan University of Science and Technology, [6]Universidad Autónoma Chapingo, [7]Ben-Gurion University of the Negev, [8]Fort Valley State University, and [9]Kyoto University
Objectives: A handbook for livestock research on smallholder farms in developing countries will be developed. Emphasis will be given to experimental design and data analysis. Input will be received from experts in different areas of the world (i.e., Ethiopia, India, China, Jordan, and Mexico), including regional cultural and social considerations.

Title: Enhancing Capacity for Research, Extension, and Teaching Activities with Small Ruminants of Bunda College of Agriculture in Malawi and Egerton University in Kenya
Type: USAID, with administration by USDA Foreign Agricultural Service
Period: 2012-2014
Investigators: T. Sahlu, A. L. Goetsch, T. A. Gipson, K. Tesfai, L. J. Dawson, and S. Zeng
Objectives: Bunda College of Agriculture (BCA): 1) improve the analytical capacity of the Department of Animal Science animal nutrition laboratory of BCA to determine the nutritive value of livestock feedstuffs, inclusive of equipment and supply procurement and associated training and 2) increase knowledge in areas of animal science to enhance the quality of undergraduate and graduate student teaching and increase capacity for research and extension activities.
Egerton University (EGU): 1) create capacity at EGU in artificial insemination of goats, encompassing use of fresh and frozen semen and to collect and store frozen semen, by establishing an artificial insemination center and provide relevant training; 2) import live animals of three dairy goat breeds to use in natural breeding and artificial insemination for multiplication of purebreds as well as crossbreeding in a community development program; and 3) provide training in areas of animal science relative to management of exotic dairy goat breeds, such as breeding and record-keeping, health and internal parasite management, preparation of teaser bucks for heat detection, and dairy goat product technology.

Title: Genomics of Resilience in Sheep to Climatic Stressors
Type: USDA 1890 Institution Capacity Building
Project Number: OKLXGOETSCH13
Period: 2013-2016
Investigators: A. L. Goetsch[1], T. A. Gipson[1], R. Mateescu[2], S. Zeng[1], R. Puchala[1], M. Rolf[2], T. Sahlu[1], and P. Oltenacu[2]
Institutions: [1]Langston University and [2]Oklahoma State University
Objectives: 1) Gain a better understanding of the genetic basis of adaptation in sheep to change in climate
2) Through a landscape genomics phase, document that some allele frequencies of otherwise genetically similar populations vary as a function of environmental climatic conditions
3) Evaluate traits expected to be important for resilience to climatic stressors under identical conditions with sheep of four breeds randomly selected from four different locations with varied environmental conditions
4) In a genome-wide association phase, ascertain if these resilience traits are genetically based and heritable
5) Compare and rank genomic breeding values for these resilience traits of oldest sheep of each location and bred to elucidate how different environmental climatic conditions affect the importance of these traits to fitness
6) Investigate change in the mean value of each resilience trait along environmental gradients, possibly consistent with climatic variation

Title:	Comparison of Biological Control of Red Cedar with Goats to Conventional Methods of Control
Type:	USDA 1890 Institution Capacity Building – Research and Extension
Project Number:	OKLXHART14
Period:	2014-2017
Investigators:	S. P. Hart[1], T. A. Gipson[1], R. C. Merkel[1], J. Pennington[2], C. Clifford-Rathert[2], and C. Williams[1]
Institutions:	[1]Langston University and [2]Lincoln University
Objectives:	1) Learn more about factors affecting red cedar consumption by goats so that they can be more effectively for control red cedar 2) Compare the degree of control and cost of use of goats versus alternative methods of clipping, burning, and herbicide

Title:	Enhancing Wellbeing and Productivity of Dairy Goats Using Smart Technology
Type:	USDA 1890 Institution Capacity Building - Research
Project Number:	OKLXGIPSON14
Period:	2014-2017
Investigators:	T. A. Gipson[1], S. P. Hart[1], R. Puchala[1], E. Loetz[1], L. J. Dawson[2], and B. Ardrey[2]
Institutions:	[1]Langston University and [2]Smartsock
Objectives:	1) Validate the appropriate use of a rumen bolus for real-time monitoring of rumination and ruminal temperature 2) Model rumination time and rumen movement using the rumen bolus 3) Examine temperature and rumination time in relation to estrus using the rumen bolus 4) Examine temperature and rumination time in relation to mastitis using the rumen bolus

Title:	Sustainable Control of Greenhouse Gas Emission by Ruminant Livestock
Type:	USDA 1890 Institution Capacity Building - Research
Project Number:	OKLXGOETSCH14
Period:	2014-2017
Investigators:	A. L. Goetsch[1], R. Puchala[1], T. Sahlu[1], M. Flythe[2], and G. E. Aiken[2]
Institutions:	[1]Langston University and [2]USDA ARS Forage-Animal Production Research Institute
Objectives:	Characterize long-term effects of lespedeza condensed tannins in combination with other substances potentially reducing ruminal methane emission by sheep and goats

2014/2015 Experiments

Title:	Applied model for evaluating resilience of sheep and goats to a limited nutritional plane
Project Number:	OKLXGOETSCH2013
Experiment Number:	AG-13-11
Investigators:	A. L. Goetsch, R. Puchala, A. Tera, T. A. Gipson, Z. Wang, T. Sahlu, and L. J. Dawson
Objectives:	Establish an applied model for evaluating resilience of sheep and goats to a limited nutritional plane.

Title:	Applied model for evaluating resilience of sheep and goats to a restricted water availability
Project Number:	OKLXGOETSCH2013
Experiment Number:	MU-14-01
Investigators:	M. Urge, A. L. Goetsch, R. Puchala, I. Portugal, T. A. Gipson, Z. Wang, T. Sahlu, and L. J. Dawson
Objectives:	Establish an applied model for evaluating resilience of sheep and goats to restricted water availability

Title:	Investigation of efficacy of Rumatel and copper oxide wire particles for control of anthelmintic resistant worms
Project Number:	OKLXSAHLU12
Experiment Number:	SH-14-03
Investigators:	S. P. Hart, T. A. Gipson, Y. Tsukahara, A. L. Goetsch, Z. Wang, T. Sahlu, and Y. Guo
Objectives:	1) Investigate if feeding Rumatel for an extended period is an essential component of a protocol of removing highly resistant worms from goats 2) Investigate the potential of copper oxide wire particles for component of a protocol to remove highly resistant worms from goats

Title:	Sustainable small ruminant production through selection for resistance to internal parasites – on-farm and on-station selection and use of a small ruminant central performance test in year 2
Experiment Numbers:	YT-14-04
Project Number:	OKLXSAHLU12
Investigators:	Y. Tsukahara, A. L. Goetsch, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, and T. Sahlu
Objectives:	General: Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-farm' and 'on-station' in the southeast and south-central US; characterize 'on-farm' and 'on-station' performance due to selection of small ruminants for resistance to internal parasites; and develop and implement a new second generation central sire performance test for small ruminants, focusing on resistance to internal parasites, but also retaining attention to feed intake, average daily gain, and efficiency of feed utilization Specific: Determine phenotypic diversity of resistance to internal parasitism, such as through FEC, FAMACHA score, and immunoglobulin concentrations in serum and growth performance among the resistant groups for each flock/herd established in the preceding year, in addition to implementation of the second generation central performance test including larval challenge, female selection 'on-farm' and 'on-station,' establishment of breeding groups, and the first and second year breeding

Title:	Evaluating the use of trash barrels as a vessel to compost kid mortality
Experiment Number:	RM-14-05
Project Number:	OKLXSAHLU2012
Investigators:	R. C. Merkel and T. A. Gipson

Title:	Effects of restricted periods of diet access on production by dairy goats in mid- to late lactation
Project Number:	OKLXSAHLU2012
Experiment Number:	NS-14-06
Investigators:	N. C. D. Silva, T. A. Gipson, R. Puchala, T. Sahlu, I. Portugal, A. Manley, E. Loetz, Y. Tsukahara, L. J. Dawson, and A. L. Goetsch
Objectives:	Determine effects of different types of restricted feed access on feed intake, milk yield and composition, efficiency of feed utilization, and feeding behavior of Alpine dairy goats in mid- to late lactation

Title:	Effects of Haemonchus contortus antigen on eosinophil reactive oxygen species generation and cytokine gene expression in goats in vitro
Project Number:	OKLXWANG10
Experiment Number:	YG-14-07
Investigators:	Y. Guo, Z. Wang, A. Goetsch, and T. Sahlu
Objectives:	Determine whether Haemonchus contortus antigens can directly induce reactive oxygen species generation by peripheral blood eosinophils and characterize the profile of cytokine gene expression in eosinophils stimulated by *H. contortus* antigens.

Title:	A method of evaluating resilience of sheep and goats to high heat load
Project Number:	OKLXGOETSCH2013
Experiment Number:	MU-14-08
Investigators:	M. Urge, A. L. Goetsch, R. Puchala, I. Portugal, T. A. Gipson, T. Sahlu, and L. J. Dawson
Objectives:	Establish an applied model for evaluating resilience of sheep and goats to high heat load index

Title:	I. Efficiency and quality profile of retrieved goat embryos from double short estrus synchronization protocol II. Reproductive performance of embryos retrieved non-surgically compared to standard surgical procedures and transferred using a modified mini-laparotomy or laparoscopic technique
Program:	USDA Foreign Agriculture Service (FAS) Borlaug Fellow
Experiment Number:	EL-14-09
Investigators:	E. Loetz, B. S. Muasa, L. J. Dawson, and B. Morris
Objectives:	1) Determine the effect of the double short estrus synchronization procedure and the multiple ovulation protocol on the cervix response 2) Compare the double short estrus synchronization to the standard surgical procedure on the method efficiency and quality profile of retrieved embryos 3) Compare the reproductive performance of goats receiving embryos generated by the double short estrus synchronization or the standard surgical procedure 4) Determine the effect of the mini laparotomy or laparoscopic embryo deposition on reproductive efficiency of embryo recipients.

Title:	Reproductive performance of synchronized goats inseminated laparascopically, transcervically, or by natural service in the absence of a large ovarian follicle
Program:	USDA Foreign Agriculture Service (FAS) Borlaug Fellow
Experiment Number:	EL-14-10
Investigators:	E. Loetz, B. S. Muasa, L. J. Dawson, A. Manley, and B. Morris
Objectives:	1) Determine the effect on reproductive performance of day 0 hormonal synchronization of non- superovulated goats bred by AI (i.e., transcervically or laparoscopically-aided intrauterine) compared to natural service 2) Compare reproductive performance of goats not induced for multiple ovulation and bred using the ‘day 0’ or the traditional intermediate progesterone exposure protocols for estrus/ovulation synchronization.

Title:	Intake of red cedar by goats
Project Number:	OKLXHART14
Experiment Number:	SH-15-01
Investigators:	S. Hart and T. A. Gipson
Objectives:	Develop a near-infrared reflectance spectrophotometry method of predicting red cedar intake from fecal samples

Title:	Effects of initial body condition and diet nutritive value on performance by lactating dairy goats
Project Number:	OKLXSAHLU2012
Experiment Number:	LR-15-02
Investigators:	L. P. S. Ribeiro, R. Puchala, T. A. Gipson, T. Sahlu, I. Portugal, A. Manley, E. Loetz, L. J. Dawson, and A. L. Goetsch
Objectives:	Determine effects and interactions of initial body condition and diet nutritive value on performance and associated conditions by Alpine goats in early and mid-lactation

Title:	Effects of method of intermittent supplementation of growing meat goat kids with the tree legume mimosa (Albizia julibrissin)
Project Number:	OKLXSAHLU2012
Experiment Number:	SL-15-03
Investigators:	S. P. Lama, R. Puchala, T. A. Gipson, I. Portugal, T. Sahlu, Z. Wang, J. D. Hayes, G. E. Aiken, and A. L. Goetsch
Objectives:	Determine effects of supplementation with the tree legume mimosa (Albizia julibrissin) by periodic access to pastures with live trees compared with a cut-and-carry approach on performance, nutrient utilization, and behavior of young growing meat goats

Title:	Quantifying IgG in goat colostrum using a Brix refractometer
Program:	Oklahoma State University, Center for Veterinary Health Sciences
Experiment Number:	RO-15-04
Investigators:	R. Oman, R. Streeter, and L. J. Dawson
Objectives:	Validate the use of a digital Brix refractometer for quantifying IgG in first-milking goat colostrum samples

Title:	Effects of restricted periods of diet access on production by dairy goats in mid- to late lactation
Project Number:	OKLXSAHLU2012
Experiment Number:	NS-15-05
Investigators:	N. C. D. Silva, T. A. Gipson, R. Puchala, T. Sahlu, I. Portugal, A. Manley, E. Loetz, Y. Tsukahara, L. J. Dawson, and A. L. Goetsch
Objectives:	Determine effects of different types of restricted feed access on feed intake, milk yield and composition, efficiency of feed utilization, and feeding behavior of Alpine dairy goats in early to mid-lactation

Title:	Sustainable small ruminant production through selection for resistance to internal parasites – on-farm and on-station selection and use of a small ruminant central performance test in year 3
Experiment Numbers:	YT-15-06
Project Number:	OKLXSAHLU12
Investigators:	Y. Tsukahara, A. L. Goetsch, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, and T. Sahlu
Objectives:	General: Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-farm' and 'on-station' in the southeast and south-central US; characterize 'on-farm' and 'on-station' performance due to selection of small ruminants for resistance to internal parasites; and develop and implement a new second generation central sire performance test for small ruminants, focusing on resistance to internal parasites, but also retaining attention to feed intake, average daily gain, and efficiency of feed utilization Specific: Determine phenotypic diversity of resistance to internal parasitism, such as through FEC, FAMACHA score, and immunoglobulin concentrations in serum and growth performance among the resistant groups for each flock/herd established in the preceding year, in addition to implementation of the second generation central performance test including larval challenge, female selection 'on-farm' and 'on-station,' establishment of breeding groups, and the second and third year breeding

Abstracts

2015 Southern Sectional (Atlanta, Georgia, February) and National (Orlando, Florida, July) Meetings of the American Society of Animal Science (The American Society of Animal Science has copyright ownership and the Journal of Animal Science is the source of this information.)

Effects of supplemental concentrate level and forage source on intake and digestion by growing and yearling Boer goat wethers and evaluation of a method of predicting negative feedstuff associative effects

A. T. Dolebo[1,2], R. Puchala[1], T. A. Gipson[1], L. J. Dawson[1,3], T. Sahlu[1], and A. L. Goetsch[1]

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[3]Center for Veterinary Health Sciences, Oklahoma State University, Stillwater, OK

Negative associative effects between supplemental concentrate and forage were investigated with 12 growing (24 kg BW; SE = 0.48) and 12 yearling (47 kg; SE = 1.0 kg) Boer wethers in eight simultaneous 3 × 3 Latin squares, four with each animal type. Treatments in the different squares were 0, 15, 30, and 45 g/kg $BW^{0.75}$ (DM) of supplemental concentrate (primarily ground corn), and in periods within squares three sources of grass hay were consumed ad libitum (Low: 5% CP, 79% NDF, and 13% ADL; Moderate: 8% CP, 71% NDF, and 9% ADL; High: 12% CP, 69% NDF, and 12% ADL). Forage intake in g/kg $BW^{0.75}$ was similar between animal types (34.9 and 30.8 for growing wethers and yearlings; SE = 1.96), highest ($P < 0.05$) among forages for Moderate (29.7, 42.9, and 25.9 for Low, Moderate, and High, respectively; SE = 3.92), and ranked ($P < 0.05$) 0 and 15 > 30 > 45 g/kg $BW^{0.75}$ of concentrate (48.5, 41.8, 25.9, and 15.2; SE = 2.77). There was an interaction ($P = 0.026$) in forage intake in g/d between animal type and level of supplementation (458, 449, 345, and 199 for growing wethers and 810, 730, 383, and 22 for yearlings with 0, 15, 30, and 45 g/kg $BW^{0.75}$; SE = 59.1). There also was an animal type by concentrate level interaction ($P = 0.021$) in NDF digestibility (57.3, 60.6, 61.4, and 58.4% for growing wethers and 56.6, 62.9, 56.8, and 30.0% for yearlings with 0, 15, 30, and 45 g/kg $BW^{0.75}$ of concentrate; SE = 3.41). Based on NDF digestibility without concentrate, the decrease in basal forage NDF digestibility in yearlings given 45 g/kg $BW^{0.75}$ of concentrate was substantial compared with moderate effects of 45 g/kg $BW^{0.75}$ with growing wethers and 30 g/kg $BW^{0.75}$ with yearlings and no depressions with other treatments. The web-based goat nutrient calculation system of Langston, available at www2.luresext.edu/goats/research/suppcon.html, includes a system to address negative and positive associative effects between feedstuffs. The system was accurate in predicting TDN (total digestible nutrients) intake, particularly with the low level of supplementation and the moderate level with growing wethers. These production scenarios would be much more common than with the highest level of supplementation wither either animal type or the moderate level with the yearling wethers and their relatively low nutritional requirements.

Effects of level and length of water restriction on body weight, feed intake, and plasma osmolality of Katahdin sheep and Boer and Spanish goat wethers

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Thirty-six yearling Katahdin sheep and Boer and Spanish goat wethers were used to evaluate effects of level and length of water restriction. Moderate quality grass hay was consumed ad libitum with concentrate (80% corn, 20% soybean meal) at 0.5% BW. Baseline values with ad libitum water intake, used as covariates during restriction, were 26.9, 33.6, and 20.5 kg BW (SE = 0.90), 489, 812, and 491 g/d DMI (SE = 33.2), 969, 1,714, and 926 g/d water intake (SE = 100.3), and 305 mosmol in plasma (SE = 1.1; mean of samples at 07:00 h before feed and water were offered and at 13:00 h) for Boer, Katahdin, and Spanish, respectively. After the baseline phase, water availability was decreased by 10% every 1 (1X) or 2 wk (2X) to 40%, but also with 2 wk at 40% for 1X. There was an interaction in BW (measured three times weekly) between restriction treatment and

level ($P < 0.05$), with less loss early and more later for 1X vs. 2X regardless of animal type (26.3, 25.9, 25.3, 24.7, 24.6, and 23.6 kg for 2X and 26.6, 26.4, 25.3, 25.3, 24.0, and 23.0 kg for 1X with 90, 80, 70, 60, 50, and 40% levels, respectively (SE = 0.343). Restriction level and animal type interacted ($P < 0.05$) in DMI, with the magnitude of change ranking Katahdin, Boer, and Spanish from greatest to least (564, 552, 486, 495, 453, and 394 g/d for Boer, 605, 600, 505, 547, 434, and 354 g/d for Katahdin, and 540, 527, 435, 466, 456, and 398 g/d for Spanish as restriction degree increased, respectively; SE = 25.8). There was an interaction ($P < 0.05$) in plasma osmolality between restriction treatment and level, with greater change over time for 1X vs. 2X (310, 311, 311, 314, 316, and 314 mosmol for 2X and 310, 309, 309, 312, 317, and 319 mosmol for 1X as degree of restriction increased, respectively; SE = 1.2). In summary, BW and plasma osmolality suggest less appropriateness of 1X than 2X for evaluating resilience of sheep and goats to water restriction, but also that more than 2 wk at set levels would be necessary for stable conditions. The changes that occurred with each stepwise decrease in water availability imply potential to lessen the number of steps and a lowest level greater than 40%.

Effects of mixing different breeds to evaluate electric fence strand additions to barb wire fence to contain meat goat does

Y. Tsukahara, T. A. Gipson, J. Hayes, R. Puchala, M.–E. Brassard, T. Sahlu, and A. L Goetsch

American Institute for Goat Research, Langston University, Langston, OK

Eighty Boer (B, 3.9 ± 0.17 yr and 56.3 ± 1.11 kg) and 80 Spanish (S) does (3.5 ± 0.18 yr and 37.6 ± 0.52 kg) were used to evaluate effects of method of grouping, single breed (SGL) and breeds combined (COM), on behavior (e.g., pen exit and shock) when exposed to barb wire fence with different electric strand additions. Five 2.4 × 3.7 m evaluation pens had 1 side of barb wire strands at 30, 56, 81, 107, and 132 cm from the ground. Fence treatments (FT) were electrified strands (6 kV) at 15 and 43 (LH), 15 and 23 (LM), 15 (L), 23 (M), and 43 cm (H). For adaptation, does were exposed in evaluation pens to no electric strands (NES), M at 0 kV, M at 0 kV, M at 4 kV, and NES in wk 1, 2, 3, 4, and 5, respectively. Then does were divided into 2 replication sets per grouping (2 B-SGL, 2 S-SGL, 2 B-COM, and 2 S-COM); each of the 5 pens held 4 does for 1-h exposure to FT while observing behavior visually and with video surveillance. Data were analyzed with the GLIMMIX procedure of SAS. There were significant main effects of grouping and FT and interactions ($P < 0.01$) between grouping and FT in the percentage of does exiting pens (0.0, 50.0, 50.0, 75.0, and 87.5% with B-COM, 0.0, 12.5, 12.5, 62.5, and 50.0% with B-SGL, 25.0, 87.5, 100.0, 100.0, and 100.0% with S-COM, and 75.0, 100.0, 62.5, 62.5, and 100.0% with S-SGL for LH, LM, H, L, and M, respectively; SEM = 14.28) and exiting without being shocked (0.0, 25.0, 25.0, 62.5, and 75.0% with B-COM, 0.0, 0.0, 0.0, 37.5, and 12.5% with B-SGL, 12.5, 75.0, 62.5, 87.5, and 75.0% with S-COM, 62.5, 100.0, 37.5, 62.5, and 75.0% with S-SGL, respectively; SEM = 14.91). In summary, COM decreased exit for S with LH and had no effect with B, whereas COM increased exit by B with LM and H. Similarly, COM increased exit without shock for B with M and decreased values for S with LH. In conclusion, presence of one breed of mature meat goats can affect behavior of another when evaluating effectiveness of various electric strand additions to barb wire fence, commonly used with cattle, for goat containment.

Effects of method of determining heat energy:heart rate of confined and grazing Boer goats

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Heat energy (HE) of 11 yearling Boer goat wethers (43.4±1.4 kg) consuming fresh Sudangrass ad libitum while confined in 1.2 × 1.2 m pens (C) or grazing a 0.8-ha pasture (G) was determined in a crossover from heart rate (HR) measured over 24 h and the ratio of HE to HR (HE:HR) estimated two ways. The BARN method involved a prior period in metabolism cages with head-boxes of an indirect calorimetry system measuring oxygen production and emission of carbon dioxide and methane for 24 h (i.e., 96 individual measurements) while consuming a moderate quality grass hay. The SPOT method entailed a portable face mask system measuring oxygen consumption and carbon dioxide production for 5 min while standing near grazing and confinement areas at 08:00, 12:00, 16:00, and 20:00 h, after 30 min of adaptation. With both methods, HR, HE, and HE relative to $BW^{0.75}$ (HEMBW) were greater ($P<0.01$) for G vs. C. There was no difference ($P>0.05$) between methods for C in

HR (76.4 and 70.0 beats/min; SE=2.68), HE (8.4 and 7.9 MJ/d; SE=0.20), HEMBW (485 and 455 kJ/kg $BW^{0.75}$; SE=10.7), or HE:HR (6.420 and 6.573 kJ/kg $BW^{0.75}$ per heart beat for BARN and SPOT, respectively; SE=0.1939). For G, HR (100.9 and 92.5 beats/min; SE=2.35; P <0.01), HE (11.2 and 9.7 MJ/d; SE=0.38; P<0.01), HEMBW (646 and 566 kJ/kg $BW^{0.75}$; SE=17.4; P<0.01), and HE:HR (6.335 and 6.114 kJ/kg $BW^{0.75}$ per heart beat/min; SE=0.1540; P=0.046) were greater for BARN vs. SPOT (P<0.01). There was a treatment × time interaction (P<0.01) in HR, HE, and HEMBW with SPOT, as well as a trend (P=0.100) in HE:HR. In accordance with greater (P<0.01) HE at 16:00 vs. 08:00 and 12:00 h (C; 7.5, 7.6, 8.2, and 7.9; G: G: 9.2, 8.9, 10.7, and 10.3 MJ/d at 08:00, 12:00, 16:00, and 20:00 h, respectively; SE=0.33), HE:HR tended to be greatest at that time (C: 6.390, 6.643, 6.847, and 6.375; G: 5.988, 5.795, 6.562, and 6.158 kJ/kg $BW^{0.75}$ per heart beat/min at 08:00, 12:00, 16:00, and 20:00 h, respectively; SE=0.2299). In conclusion, though HE:HR differed between methods, the relatively small magnitude (i.e., 4.7%) indicates that both could be used to estimate HE based on HR in grazing or confined settings; however, multiple measurements would be beneficial with SPOT to address potential differences among times of the day.

Determination of the grazing activity energy cost in Boer goat wethers using a portable indirect calorimety method

M.-E. Brassard[1,2], R. Puchala[1], T. Sahlu[1] and A. L. Goetsch[1]

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Ten yearling Boer goat wethers (44.4±0.95 kg) were used to determine heat energy (HE) and the grazing activity energy cost (GAEC) while standing or grazing Sudangrass pasture with a portable indirect calorimetry system. The method entailed the use of a partial face mask that allowed unrestricted grazing to measure oxygen consumption and carbon dioxide emission for 30 min while restrained in a stanchion near the grazing area, followed by 60 min while grazing with other members of the group. The face mask of the animal was attached to a 15-m tether along with a corrugated plastic hose through which exhaled air was passed to FlowKit Mass Flow Generator and FoxBox Respirometry System (Sable System, Las Vegas, NV) that were carried by a researcher who allowed unrestricted goat movement. Prior to measurements animals were trained to become accustomed to presence of personnel and use of the equipment, with grazing behavior similar among all animals of the group. Measurement periods were during morning and afternoon grazing bouts. Heat energy while restrained was 18.7 kJ/kg $BW^{0.75}$/h or 446±10.7 kJ/kg $BW^{0.75}$/d. Heat energy while grazing increased to 35.1 kJ/kg $BW^{0.75}$/h or 843±39.3 kJ/kg $BW^{0.75}$/d, implying that the grazing activity energy cost (GAEC) was 16.4 kJ/kg $BW^{0.75}$/h. While on the pasture goats spent 8.5 h/d grazing; therefore, the daily GAEC was 138±17.3 kJ/kg $BW^{0.75}$. A very similar GAEC of (165±10.4 kJ/kg $BW^{0.75}$/d) was determined from the difference in HE estimated indirectly from heart rate between times when grazing a 0.8-ha pasture and confined in nearby 1.2 × 1.2 m pens and fed fresh forage. In conclusion, this method offers promise for relatively simple and direct estimates of the sizable fraction of total HE comprised by GAEC.

Behavior of Boer goat wethers grazing high quality forage and effects of two methods of determining energy used for activity

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Ten yearling Boer goat wethers (44.4±0.95 kg) consuming fresh Sudangrass ad libitum while grazing a 0.8-ha pasture or confined in nearby 1.2 × 1.2 m pens were used in a crossover experiment. Heat energy (HE) was estimated from heart rate (HR) measured over 24 h in 5-min intervals and the ratio of HE to HR previously determined for each animal with a stationary calorimetry system for 24 h while consuming a moderate quality grass hay. A GPS collar and leg activity monitor were used when HR was measured to classify activity as resting-lying (L), resting-standing (S), grazing (G), and walking (W), each with different HE averages. Behavior in confinement was assessed with the leg activity monitor as L or S. The grazing activity method (GAM) was based on time spent in the different activities multiplied by their corresponding HE values, with the grazing activity energy cost (GAEC) assumed the sum of differences between S, G, and W relative to L. The confinement method

(COM) entailed subtracting total HE while confined from that when grazing. For goats while grazing, percentages of the day (33.8, 53.9, 11.4, and 0.9%; SE = 2.44) and daily HE attributable to the activities differed ($P < 0.01$; 241, 322, 75, and 6 kJ/kg $BW^{0.75}$ for G, L, S, and W, respectively; SE = 17.9), although HE per unit time only tended ($P = 0.099$) to vary (707, 598, 472, and 636 kJ/kg $BW^{0.75}$ on a daily basis for G, L, S, and W, respectively; SE = 65.8). Total daily HE (642 and 482 kJ/kg $BW^{0.75}$; SE = 17.2) and HE while lying on a daily basis (598 and 450 kJ/kg $BW^{0.75}$; SE = 18.1) were greater for grazing vs. confinement ($P < 0.01$). The daily GAEC was considerably greater ($P < 0.01$) for COM vs. GAM expressed in kJ/kg $BW^{0.75}$ (165 and 46; SE = 14.0) and relative to HE when confined for COM and of L on a daily basis for GAM 35 and 8%; SE = 3.5). In conclusion, method of estimating the GAEC can have substantial impact. Greater L HE per unit time for grazing than confinement may contribute to lower GAEC for GAM than for COM, although factors such as dietary and environmental conditions will influence accuracy of COM.

Effects of mixing different breeds to evaluate electric fence strand additions to barbed wire fence to contain growing meat goat kids

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A total of 159 kids, consisting of 38 Boer (B) wethers (6.3 ± 0.06 mo of age and 22.1 ± 0.95 kg BW initially), 41 B doelings (6.3 ± 0.06 mo and 21.4 ± 0.52 kg), 40 Spanish (S) wethers (6.7 ± 0.05 mo and 17.8 ± 0.53 kg), and 40 S doelings (6.8 ± 0.05 mo and 18.4 ± 0.46 kg), were used to evaluate effects of grouping, single breed (SGL) and breeds combined (COM), on behavior (e.g., pen exit and shock) when exposed to barbed wire fence with different electric strand additions. Five 2.4 × 3.7 m evaluation pens had 1 side of barb wire strands at 30, 56, 81, 107, and 132 cm from the ground. Fence treatments (FT) were electrified strands (6 kV) at 15 and 43 (LH), 15 and 23 (LM), 15 (L), 23 (M), and 43 cm (H). For adaptation, kids were exposed in evaluation pens to no electric strands (NES), NES, LH at 0 kV, LH at 6 kV, and NES in wk 1, 2, 3, 4, and 5, respectively. Then kids were divided into 2 replication sets per grouping (2 B-SGL, 2 S-SGL, 2 B-COM, and 2 S-COM); each of the 5 pens consisted of 4 or 3 animals for 1-h exposure to FT while observing behavior visually and with video surveillance. There were no main effects of grouping. Fence treatment affected ($P < 0.01$) the percentage of animals receiving a shock (59.4, 44.5, 34.4, 22.8, and 6.2%; SE = 8.53), exiting with shock (37.5, 35.8, 31.3, 19.6, and 3.1%; SE = 7.63), and exiting without shock (0.0, 14.9, 50.0, 67.7, and 76.3% for LH, LM, L, M, H, respectively; SE = 7.56). There was an interaction ($P = 0.01$) between FT and grouping in pen exit (50.0, 25.0, 75.0, 85.7, and 42.9% with B-COM, 12.5, 77.8, 87.5, 75.0, and 100% with B-SGL, 62.5, 62.5, 75.0, 87.5, and 75.0% with S-COM, and 25.0, 37.5, 87.5, 100.0, and 100.0% with S-SGL for LH, LM, L, M, and H, respectively; SE = 14.83). In conclusion, in contrast to previous findings with mature does, these results do not provide clear evidence supporting notable effect of method of grouping growing meat goat kids for evaluating effectiveness of various electric strand additions to barb wire fence for goat containment, indicating appropriateness of either method.

Multi-scale straightness index analysis of goat behavior

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Multi-scale straightness index (MSSI) has been proposed for determining behavioral states such as resting, grazing, or commuting in wildlife but its suitability in livestock is not known. Therefore, the objective of this study was to apply MSSI to a herd of grazing goats. On a random sample of 13 mature Boer-cross females from a herd of 120, GPS collars that recorded a fix every 5 min were fitted for 3 consecutive days in August, 2012. The study area was a 40-hectare unimproved hill pasture. The fix records were post-processed and imported into ArcMap. Boundaries of the pasture, including a 7-m external buffer, were constructed as shapefiles. Only fixes (average of 804 ± 15.2 fixes/goat) within the boundary and buffer shape-files were exported to a spreadsheet for the calculation of MSSI using granularity (g) from 1 to 12 and window (w) from 1 to 36 with the constraint that w/g must be an integer, yielding a total of 110 g-w combinations. Within daytime (D) and nighttime (N) periods,

MSSI were calculated for each g-w combination yielding 868,707 MSSI for D and 541,599 MSSI for N. LSmeans for each g-w combination were estimated using mixed model analysis with collar as random effect and day (1, 2, or 3) as repeated measure. A linear-linear-linear grafted polynomial analysis was conducted to ascertain ridge points for g-w combinations (between two break points). The first linear segment before the first break point for both D and N was always when g = w for a g/w ratio of 1 and accounted for 11% of the MSSI. The last linear segment after the second break point represented highly tortuous travel indicating most probably grazing or resting. This segment was 81% and 85% of the MSSI with an average MSSI of 0.17 ± 0.083 and 0.08 ± 0.050 for D and N, respectively. The middle linear segment represented targeted travel and accounted for 8% and 4% of the MSSI with an average MSSI of 0.53 ± 0.108 and 0.41 ± 0.119 for D and N, respectively. For the targeted travel segment, g averaged 1 for both D and N and w averaged 5 and 3 for D and N, respectively. Even in a herd of goats familiar with the terrain, targeted travel account for a small percentage of behavior and was only for a short duration.

Effects of high heat load on BW, DMI, rectal temperature, and respiration rate of Katahdin sheep and Boer and Spanish goat wethers

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Thirty-three yearling Katahdin sheep (K) and Boer (B) and Spanish (S) goat wethers were used to evaluate effects of stepwise increases in heat load index (HLI) to develop a method of evaluating resilience of individual animals. Moderate quality grass hay was consumed ad libitum with concentrate (80% corn, 20% soybean meal) at 0.5% BW. After a baseline period (1) with thermo-neutral conditions, target HLI were 80, 90, 95, and 100 (e.g., 42.0° C, 40% relative humidity) during the day and 70, 77, 81, and 85 at night in subsequent 1-wk periods (2-5). Actual values averaged 66, 80, 92, 97, and 101 during day (0700 to 1900 h) and 66, 75, 84, 86, and 89 at night in periods 1-5, respectively. At the end of periods, BW was not markedly affected by HLI (100.2, 99.7, 103.1, and 101.3% of baseline; SE=0.74), and hay DMI also was generally similar to the baseline (95.0, 72.4, 93.6, and 96.4% in periods 2, 3, 4, and 5, respectively; SE=3.69). Rectal temperature measured at 0600, 1300, and 1700 h was lowest for Katahdin in periods 3 (39.4, 39.2, and 39.6°C) and 4 (39.9, 39.6, and 40.0°C for Boer, Katahdin, and Spanish, respectively; SE=0.07) but similar at other times. There was an interaction in respiration rate between animal type and period (71, 105, and 105 in period 2, 93, 101, and 104 in period 3, 121, 139, and 129 in period 4, and 105, 126, and 109 breaths/min in period 5 for B, K, and S, respectively; SE=4.75). Rectal temperature and respiration rate were much lower at 0600 h (38.7, 38.9, and 38.8°C and 34, 77, and 56 breaths/min) than at 1300 (39.7, 39.6, and 39.9°C and 127, 137, and 135 breaths/min) and 1700 h (40.1, 39.7, and 40.2°C, SE=0.07, and 131, 139, and 144 breaths/min for B, K, and S, respectively, SE=4.4). In conclusion, in some periods K exhibited greater ability than B and S to increase respiration rate and minimize rectal temperature at high HLI; periods longer than 1 wk at high HLI are required for evaluating changes in BW and DMI; and variables such as rectal temperature and respiration rate may be more meaningful when measured in the afternoon than morning after lower nighttime HLI.

Effects of restricted diet access on intake and performance by dairy goats in mid- to late lactation

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Fifty lactating Alpine goats (15, 25, and 10 of parity 1, 2, and 3 or more, respectively) with an initial BW of 55.2 kg (SE = 0.95) and 125 DIM (SE = 3.0) were used to determine influences of different periods of restricted feed access on intake and performance. A 40% forage loose diet (20% alfalfa pellets, 10% cottonseed hulls, and 10% coarsely ground grass hay) was given free-choice in Calan gate feeders during a 3-wk preliminary period, with means in the final 2 wk used as covariates, followed by four 3-wk periods. Treatments were feed access continuously (Cont), during the Day for 8 h or Night for 16 h, and for 2 or 4 h/d with equal lengths after milking in the morning and afternoon. Neither DMI (2.05, 1.87, 2.08, 1.91, and 1.87

kg/d; SE = 0.107) nor milk yield (1.77, 1.75, 1.67, 1.64, and 1.68 kg/d for Cont, Day, Night, 2Hour, and 4Hour, respectively; SE = 0.098) were influenced by treatment (P > 0.05), with milk yield (1.83, 1.84, 1.60, and 1.54 kg/d in periods 1, 2, 3, and 4, respectively; SE = 0.051) but not DMI differing among periods. Treatment also did not influence ADG (32, 22, 49, 9, and 20 g; SE = 13.0) or body condition score during the study (2.35, 2.32, 2.24, 2.26, and 2.34; SE = 0.052) and at the end (2.49, 2.39, 2.32, 2.33, and 2.42; SE = 0.054). However, there were treatment effects on milk concentrations of fat (3.78, 3.64, 3.54, 3.75, and 3.21%; SE = 0.126) and protein (2.91, 2.88, 2.88, 2.84, and 2.58% for Cont, Day, Night, 2Hour, and 4Hour, respectively; SE = 0.049). Energy-corrected milk (3.5% fat, 3.2% protein) in kg/d (1.70, 1.66, 1.58, 1.53, and 1.52 kg/d; SE = 0.101) and relative to DMI (0.79, 0.84, 0.78, 0.81, and 0.81 kg/kg for Cont, Day, Night, 2Hour, and 4Hour, respectively; SE = 0.073) were similar among treatments. In conclusion, lactating dairy goats in mid- and late lactation possess considerable flexibility in eating behavior that may allow for incorporation of limited feed access regimes in management systems for most efficient facility utilization.

Effects of breed and resistance classification of sire on progeny growth performance and response to artificial infection with Haemonchus contortus in a central performance test

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Fifteen Dorper (D; 3.8 mo of age, 29 kg), 14 St. Croix (C; 3.9 mo, 18 kg), 14 Kiko (K; 4.0 mo, 19 kg), 13 Boer (B; 3.2 mo, 22 kg), and 17 Spanish (S; 3.1 mo, 18 kg) males were used to investigate effects of classification for resistance to *H. contortus* of sire and among and within breed differences in the second year of a central test at Langston University (LU) for growth performance and response to artificial infection with infective larvae. In the first year of the test, males were randomly selected from 4 commercial farms in KS, MO, and OK and LU B and S goat herds. Animals used in this study were progeny of the sires (i.e., High and Moderate, with no progeny of susceptible males) selected in the first year. For both years, the test entailed an adjustment period of 2 wk followed by 8 wk of data collection. Animal groups were housed separately in adjacent pens with automated feeders allowing free-choice access to a 15% CP (DM) and 50% concentrate pelletized diet. During adaptation, anthelmintic treatment resulted in low fecal egg count (FEC; < 600/g), after which 10,000 larvae were administered orally. Packed cell volume (PCV) was measured weekly and FEC was determined 4 times in wk 6-8. For analysis, initial BW, PCV, and FEC were covariates, and the logarithmic transformation ln(x + 2,000) was used for mean FEC. Breed affected ($P \leq 0.01$) ADG (307, 286, 159, 247, and 142 g; SEM = 13.8), DMI (2.2, 1.6, 1.3, 1.5, and 1.3 kg; SEM = 0.12), FEC (2,098, 1,278, 1,419, 1,335, and 716 eggs/g, original scale; SEM = 80.9), and PCV (27.2, 31.7, 31.6, 28.1, and 25.6% ; SEM = 0.76 for D, C, K, B, and S, respectively). Means of resistance classification of sires were similar (P > 0.10) for FEC, PCV, ADG, and DMI. Correlation coefficients of sire and progeny FEC within breed were nonsignificant (P > 0.10). In conclusion, with only one generation of selection, there was no detectable relationship in resistance to internal parasite between selected sires and progeny based on FEC after an artificial challenge with *H. contortus* larvae in a standardized environment.

Growth performance and resistance to internal parasitism of small ruminant males from the south-central US in a centralized test

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Performance of young male sheep and goats from different farms and of various breeds was determined in a centralized test at Langston University (LU), which included artificial infection with Haemonchus contortus. Year 1 included 2 Katahdin flocks (KS-A, n = 17, 3.5 mo of age, 35 kg; KS-B, 18, 4.0 mo, 19 kg), 20 Dorper (DS; 8.2 mo, 45 kg), 13 St. Croix (CS; 4.4 mo, 21 kg), 2 Boer herds (BG-A; 16, 3.8 mo, 21 kg; BG-B, 17, 19 kg) 16 Kiko (KG; 3.1 mo, 20 kg), and 14 Spanish (SG; 4.4 mo, 19 kg). In year 2, animals were progeny from breeding groups classified in year 1 as of high and moderate resistance, with 15 DS (3.8 mo, 29 kg), 14 CS (3.9 mo, 18 kg), 14 KG (4.0 mo, 19 kg), 13 BG-A (3.2 mo, 22 kg), and 17 SG (3.1 mo, 18 kg). Thus, the test included males from 8 flocks/herds, 6 commercial farms in AR, KS, MO, and OK and 2 herds of LU (i.e., B-A and S). There was 2 wk for adaptation and an 8-wk test period, with automated feeders allowing free-choice access to a 50% concen-

trate pelletized diet. During adaptation, anthelmintic treatment resulted in low fecal egg count (FEC; < 600/g), after which 10,000 infective larvae were administrated orally. Packed cell volume (PCV) was measured weekly and FEC was determined 4 times in wk 6 to 8. Breed affected ($P \leq 0.01$) FEC in year 1 (1,512, 2,196, 3,072, 1,229, 1,069 2,713, 3,575, and 1,182 eggs/g for KS-A, KS-B, DS, CS, BG-A, BG-B, KG, and SG, respectively; SE = 100.0) and year 2 (2,621, 1,368, 1,413, 1,669, and 884 eggs/g for DS, CS, BG-A, KG, and SG, respectively; SEM = 48.1). Animals were placed in 3 categories of resistance (i.e., high, moderate, low) within flocks/herds based primarily on FEC but also considering RFI and ADG using cubic clustering criterion. Resistance category means were similar ($P > 0.05$) for ADG and ADG:DMI in both years. In conclusion, based on FEC after an artificial challenge with *H. contortus* larvae in a standardized environment, there was considerable variability among flocks/herds of small ruminants in resistance to internal parasitism due to multiple factors such as species, breed, and genetic differences within breed.

Summaries of Recent Journal Articles and Book (2014 and In Press)

Supplements of lactating meat goat does grazing grass/forb pastures

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Journal of Applied Animal Research 42:16-26. 2014

Lactating Boer does grazing grass/forb pastures were used in a 16-wk study starting 22 days after birth. Treatments were no supplementation (CO), access to a 20% crude protein supplement block (SB), and placement in a supplement pasture with mimosa (Albizia julibrissin) trees for 6 h 1 day/wk (1X) or twice weekly for 3 h/day (2X). Available forage dry matter in non-supplement pastures ranged between 2423 and 3477 kg/ha. Treatment did not affect doe average daily gain (ADG), although kid ADG in the first 12 wk differed ($P < 0.05$) between type of supplement and frequency of supplement pasture access (121, 111, 120, and 134 g for CO, SB, 1X, and 2X, respectively). Lactating Spanish does were used in a 12-wk study starting 66 days after kidding. The same CO and SB treatments were employed, but access to supplement pastures was for 24 h 1 day/wk (1X) or 2 days for 6 h/day (2X). Forage dry matter ranged only from 750 to 1530 kg/ha; thus, 0.6 kg/day (as fed) per doe of grass hay was fed after 4 wk. Kid ADG in wk 1-8 was not affected by treatment. Doe ADG was affected by supplementation ($P < 0.05$) and supplement type ($P < 0.09$) (-44, -33, -23, and -12 g for CO, SB, 1X, and 2X, respectively). In conclusion, use of the SB was not beneficial, and infrequent access to supplement pastures had relatively small effects on ADG, perhaps because forage availability and nutritive value were not severely limiting.

Use of a web-based nutrient requirement calculation system to assess potential influences of various factors on nutrient needs of goats while grazing

A. L. Goetsch and T. A. Gipson

Professional Animal Scientist 30:192-214. 2014

Many factors affect the nutrition of goats while grazing, and their influences can be assessed with an interactive web-based nutrient requirement calculation system to determine the quantity and composition of supplement required for desired levels of performance. Among areas identified as being of special importance to goats in grazing settings are the activity energy cost and lack of methods to predict forage intake. Relatedly, goats can consume diets very different in nutritive value than the average of vegetation available, and there been insufficient research to accurately predict the quality of the actual diet ingested. Equations to project associative effects between feedstuffs have been proposed but not evaluated. Previous nutritional plane can have a substantial effect on energy requirements, with greater fluctuations in the nutritional plane and maintenance energy need during the year for grazing relative to confinement settings. Likewise, based on some findings with sheep, internal parasitism influences both energy and protein requirements, the impact of which may increase as the problem of anthelmintic resistance worsens. There are many plant secondary metabolites consumed by goats in varying quantities that can affect feed intake, digestion, metabolism, and other physiological conditions, with the nature of changes influencing nutritional conditions most limiting to performance. In summary, special attention should be given in future research to conditions affecting nutrition

that differ between grazing and confined goats, although factors important to both grazing and confined animals also should be considered.

Effects of levels of Boer goats and Dorper sheep on feed intake, digestibility, growth, and slaughter characteristics in the central highlands of Ethiopia

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Objectives of this experiment were to compare feed intake, digestibility, growth performance, and slaughter characteristics of local genotypes of small ruminants in the central highlands of Ethiopia with Boer goat (B) and Dorper sheep (D) blood levels of 0%, 25%, and 50%. Male goats (27; 6-9 months of age) and sheep (27; 3-5 months) were housed individually in confinement during 90-day experiments. Grass hay (6% crude protein and 64% or 67% neutral detergent fiber) was consumed ad libitum together with concentrate (46% noug seed cake, 28% wheat bran, 24% sorghum grain, and 2% salt) supplemented at 2% of their body weight. Initial body weight was 18.1, 20.8, and 24.9 kg for Local, 25% B, and 50% B, respectively, and 14.8, 20.3, and 17.9 kg for Local, 25% D, and 50% D, respectively. Total dry matter (DM) intake by goats ranked Local < 25% B < 50% B, and hay intake was greatest for 50% B. Intake of hay and total DM by sheep ranked Local < 50% D < 25% D. Average daily gain by goats was greatest for 50% B and by sheep was least for Local. Empty body weight of goats at slaughter and carcass weights ranked Local < 25% B < 50% B. Body and carcass weights of sheep were lowest for Local. In addition to the difference between 25% B and Local goats, these results clearly show potential for greater meat yield with the 50% than 25% level of B. The findings also depict considerable opportunity to increase meat production by crossbreeding with D, although greater benefit was not realized with 50% than 25% D.

Effects of creep grazing and stocking rate on forage selection and nutritive value of the diet of meat goat does and kids on grass/forb pastures

M. D. Yiakoulaki, A. L. Goetsch, G. D. Detweiler, and T. Sahlu

Small Ruminant Research 117:119-124. 2014

The effects of creep grazing and stocking rate (SR) on forage selection and nutritive value of the diet selected by of Spanish does with Boer × Spanish kids and Boer × Spanish does with 3/4 Boer–1/4 Spanish kids were determined using grass/forb pastures. There were four treatments, each replicated, with three stocking rate (SR) treatments and one treatment involving creep grazing. Goats of both types were equally represented in all treatments. Each group of does and kids was allocated to 0.4 ha pastures divided into four paddocks that were rotationally grazed in two cycles over a total of 76 days. The three SR were 4 does plus 8 kids (L), 6 does plus 12 kids (M), and 8 does plus 16 kids (H) per 0.4 ha pasture. The creep grazing treatment (C) was at the high SR relative to the pasture area common to the does and kids. In this treatment, however, the kids had access to an additional area of a similar 0.4 ha pasture sub-divided into four paddocks containing the leguminous tree mimosa (Albizia julibrissin Durazz) planted in rows. A direct observation and simulation method was used to characterize the diet selected by does and kids and obtain representative samples. These samples were evaluated in terms of their CP, NDF, ADF, and ADL concentrations and in vitro true DM digestibility (IVTDMD). There were no significant effects ($P > 0.10$) of stocking rate on botanical composition of the diet selected or its nutritive value. Does and kids selected diets of similar botanical composition and nutritive value for the three treatments without a creep area. When kids were in a creep grazing area, 52.8% of their diet consisted of mimosa leaves leading to an improvement in the overall nutritional value of the diet relative to times when in the base grass/forb pasture (CP 21.9 vs. 19.8%, NDF 34.1 vs. 53.8%, ADF 21.4 vs. 27.5%, and IVTDMD 85.7 vs.79.9%). It was concluded that stocking rate had no impact on diet selection and the nutritive value of the diet of does or kids when grazing forage of low to medium quality. Kids with access to creep areas including mimosa trees, however, preferentially consumed mimosa leaves, thus improving the nutritive value of their diet.

Effects of the number of animals per automated feeder and length and time of access on feed intake, growth performance, and behavior of yearling Boer goat wethers

Y. Tsukahara, T. A. Gipson, R. Puchala, T. Sahlu and A. L. Goetsch

Small Ruminant Research 121:289-299. 2014

Effects of the number of Boer goat wethers with initial age of 285 days (SEM = 5.1) and 34.4 kg body weight (SEM = 0.90 kg) per automated feeder and length and time of feeder access on feed intake, growth performance, and behavior were determined in a 10-wk experiment. Treatments were 6 and 12 wethers per 6 × 6 m pen and feeder with continuous access (Cont-6 and Cont-12, respectively); 2 and 4 wethers per feeder with 8 h/day access during daytime (Day-2 and Day-4, respectively); and 4 and 8 wethers per feeder with 16 h/day access at night (Night-4 and Night-8, respectively). Therefore, maximal potential feeder occupancy time per wether was 2 or 4 h/day. Dry matter intake was greater for continuous vs. restricted feeder access ($P = 0.001$) and for night vs. daytime access ($P = 0.025$) (2.04, 2.01, 1.45, 1.50, 1.92, and 1.76 kg/day), and feeder occupancy time per wether tended ($P = 0.071$) to be greater for continuous access (1.83, 1.55, 1.23, 1.34, 1.51, and 1.25 h/day for Cont-6, Cont-12, Day-2, Day-4, Night-4, and Night-8, respectively). Rate of dry matter intake (DMI) was similar among treatments. There were effects of continuous vs. restricted ($P = 0.012$) and day vs. night ($P = 0.051$) access on average daily gain (ADG), as well as a tendency ($P = 0.078$) for an interaction between time and length of restricted access (237, 252, 174, 207, 247, and 211 g for Cont-6, Cont-12, Day-2, Day-4, Night-4, and Night-8, respectively). The ratio of ADG:DMI was not affected by treatment other than a tendency for an interaction ($P = 0.070$) between time and length of restricted access (116, 126, 120, 138, 130, and 121 g/kg), although residual feed intake (RFI) was greater ($P < 0.001$) for continuous vs. restricted access (49, -25, -167, -257, -81, and -112 g for Cont-6, Cont-12, Day-2, Day-4, Night-4, and Night-8, respectively). In summary, continuous feeder access allowed high ADG, but resulted in relatively inefficient feed utilization as assessed by RFI. Restricting feeder access to daytime minimized DMI compared with continuous access, which was due to factors other than feeder occupancy time and rate of DMI; however, efficiency of feed utilization for daytime access based on RFI, particularly for Day-4, was high relative to continuous access. In conclusion, restricting feeder access influenced feed intake, growth performance, and behavior, with results impacted by time of access.

Effects of supplementation and body condition on intake, digestion, performance, and behavior of yearling Boer and Spanish goat wethers grazing grass/forb pastures

A. R. Askar, T. A. Gipson, R. Puchala, K. Tesfai, G. D. Detweiler, A. Asmare, A. Keli, T. Sahlu, and A. L. Goetsch

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Sixteen Boer and 16 Spanish (Span) yearling wethers were used, with eight of each breed in different initial body condition (IBC; High and Low). Initial BW was 40, 25, 29, and 22 kg (SE = 1.4) and body condition score (BCS; 1 = extremely thin and 5 = very obese) was 3.9, 2.4, 3.6, and 2.7 (SE = 0.12) for Boer-High, Boer-Low, Span-High, and Span-Low, respectively. There was one wether per breed × IBC treatment in each of eight 0.4-ha grass/forb pastures. Wethers in four control (Con) pastures were not supplemented with concentrate, whereas those in supplement (Sup) pastures received 0.9% BW (DM basis) of concentrate. The experiment was 126 days, with four periods 39, 28, 37, and 22 days in length. Forage mass was 2466, 2496, 3245, and 2495 kg/ha for Con and 2226, 2378, 3100, and 2724 kg/ha for Sup in periods 1, 2, 3, and 4, respectively (SE = 199.0). The difference in intake of digested OM between breeds was much greater with than without supplemental concentrate (485 and 741 g/day for Boer and 413 and 561 g/day for Span without and with supplementation, respectively; SE = 23.2). In accordance, supplementation increased ($P < 0.05$) ADG by Boer but not Span wethers (6, 32, 82, and 51 g for Boer-Con, Span-Con, Boer-Sup, and Span-Sup, respectively; SE = 13.1). There was a trend ($P = 0.070$) for greater ADG by Low vs. High IBC wethers (56 vs. 30 g; SE = 0.4), in agreement with overall greater ($P < 0.05$) total DM intake relative to BW by Low IBC wethers (3.16 and 2.78% BW; SE = 0.065). However, converse to the breed comparison, IBC and supplement treatment did not interact in ADG. Grazing time was less ($P < 0.05$) with than without supplementation (5.8 vs. 6.9 h; SE = 0.22) and greater ($P < 0.05$) for Boer vs. Span in period 1 (8.0, 6.9, 6.3, and 7.2 h for Boer and 4.7, 5.9, 5.7, and 6.4 h for Span in periods 1, 2, 3, and 4, respectively; SE = 0.45), although IBC did not influence grazing time (6.2 and 6.6 h for High and Low, respectively; SE = 0.22) despite the difference in ADG and greater total DM intake relative to BW. In conclusion, supplementation increased

ADG by Boer but not Spanish wethers and lessened grazing time, low IBC resulted in compensatory growth with increased DM intake relative to BW and ADG without affecting grazing time, and supplementation interacted with breed though not IBC.

Methods of Livestock Research on Smallholder Farms

A. L. Goetsch

American Institute for Goat Research, Langston University, Langston, Oklahoma, USA. Available at: //http://www2.luresext.edu/goats/library/OFR_Handbook.pdf. 336 pages. 2014

Resources for on-station livestock research in many developing countries are limited, and it is common for researchers to have little direct interaction with smallholders. On-farm research offers considerable attributes, which include attention to most significant production constraints, opportunities for meaningful studies, and greater adoption by smallholders of advantageous technologies. However, few researchers perform on-farm livestock research, at least partially because of inadequate training and knowledge of the design and conduct of on-farm experiments, statistical analyses and interpretation of resultant data, and preparation of reports suitable for peer-reviewed journals. Thus, a publication was developed as a resource for training in methods of applied livestock research, with special attention to treatments, design, implementation, analysis, interpretation, and peer-reviewed articles. The target audience is junior to mid-level professionals (e.g., MSc) and graduate students in developing countries. In addition to US participants in the publication project, there are foreign collaborators and evaluators from Ethiopia, India, China, Jordan, Mexico, Israel, and Japan. Major sections of the publication include: introduction; on-station vs. on-farm research; topic identification; protocols; experimental design; treatment considerations; experiment implementation; statistical analyses; dissemination with an emphasis on preparation, review, and revision of scientific manuscripts; and literature cited. Furthermore, a key component is the design and analysis of numerous example study scenarios, such as: farmer research groups – missing data, nature of the data; individual smallholder households – household animals on one treatment, household animals on each treatment, missing data and household animals on one vs. each treatment, households with subplots; group or village as fixed vs. random; studies in different seasons or years; year-round performance monitoring – continuous and categorical variables; and crossovers, switchbacks, and Latin squares. There are also comparisons of P values from different analyses (e.g., SAS® GLM and MIXED and GenStat®). Appendices contain the relevant statistical analysis statements and inputs, results, and simulated data sets. Workshops based on the publication were held during 2013 and 2014 in Kenya, Ethiopia, China (two sites), Jordan, Malawi, Mexico, and India (two sites) to create awareness of the resource, train junior researchers, and receive feedback for publication enhancement, with well over 200 attendees. After external peer-review, in the fall of 2014 the publication was placed on the Institute's website (www2.luresext.edu), also with distribution in hardcopy and memory stick formats.

Visiting Scholars, Graduate Student, and Undergraduate Student Research Intern (2014 and 2105)

Dr. Yoko Tsukahara

- Visiting Scholar
- Native of Japan
- Research Projects: Establishing a Langston University Testing Center for Electric Fence Modifications of Cattle Barb Wire Fence for Goat Containment; Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites
- Experiments: YT-14-04 and YT-15-06

Dr. Yongqing Guo

- Visiting Scholar
- Native of China
- Research Project: Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats
- Experiment: YG-14-07

Ms. Amanda Manley

- Graduate Student (MS; cooperative with Oklahoma State University
- Research Project: Boer Goat Selection for Residual Feed Intake

Ms. Nhayandra C. D. Silva

- Visiting Graduate Student (PhD; Sandwich program; cooperative with Universidade Estadual Paulista)
- Native of Brazil
- Research Project: Restricted Feed Access Regimes for Lactating Dairy Goats
- Experiments: NS-14-06 and NS-15-05

Mr. Asrat Tera Dolebo

- Visiting Scholar
- Native of Ethiopia
- Research Project: Feedstuff Associative Effects
- Experiment: AT-13-07

Dr. Mengistu Urge Letta

- Native of Ethiopia
- Visiting Scholar (Sabattical)
- Research Project: Resilience in Sheep and Goats to Climatic Stress Factors
- Experiments: MU-14-01 and MU-14-08

Dr. Mohammed Sawalhah

- Visiting Scholar
- Native of Jordan
- Research Project: Red Cedar Control with Goats

Dr. Bridgit S. Muasa

- Borlaug Fellow
- Native of Kenya
- Research Project: Assisted Reproductive Technologies in Goats
- Experiments: EL-14-09 and EL-14-10

Dr. Chrilukovian B. Wasike

- Borlaug Fellow
- Native of Kenya
- Research Project: Residual Feed Intake in Lactating Dairy Goats
- Experiment: NS-14-06

Ms. Luana P. S. Ribeiro

- Visiting Graduate Student (PhD; Sandwich program; cooperative with Federal University of Bahia, UFBA)
- Native of Brazil
- Research Project: Effects of Body Condition at Kidding on Performance of Lactating Dairy Goats
- Experiment: LR-15-02

Visiting Scholars, Graduate Student, and Undergraduate Student Research Intern (2014 and 2105)

Dr. Sebastian Lama

- Visiting Scholar
- Native of Argentina
- Research Project: Method of Supplementing Meat Goat Kids While Grazing with Tree Legume Leaves
- Experiment: SL-15-03

Mr. Worede Zinabu Gebremariam

- Graduate Student (PhD; cooperative with Oklahoma State University)
- Native of Ethiopia
- Research Project: Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites

Ms. Courtney Jones

- Graduate Student (MS; cooperative with Oklahoma State University, Agricultural Economics)
- Research Project: Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites

Mr. Mesfin M. Gobena

- Graduate Student (MS; cooperative with University of Florida)
- Native of Ethiopia
- Research Project: Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites and Resilience in Sheep and Goats to Climatic Stress Factors

International Overview

Dr. Roger Merkel
International Program Leader

Goats and goat products are part of the livelihood of a majority of the world's population and are an important resource for poor farmers in many countries of the world. Part of the mission of the American Institute for Goat Research is to effect positive change in goat production throughout the world. To fulfill this aspect, the Institute has developed and maintains many strong ties with research and academic institutions around the world. In addition to collaborative work with foreign institutions, the Institute has hosted visiting scientists from over 30 foreign countries to conduct research activities. Training for foreign livestock workers and scientists as well as for U.S.-based persons who will travel and work overseas are other ways in which the Institute is active in the international arena.

International research and training, hosting foreign scientists, and training those who will teach others are internationally-focused activities that give the Institute unique opportunities to not only increase knowledge of foreign production systems and constraints, but also to positively impact agricultural development in foreign countries and help alleviate poverty and hunger. General objectives of the Institute's international program are to: 1) increase our knowledge of goat production systems worldwide and current constraints to increased production; 2) build human capacity through training foreign scientists and agricultural workers in goat production, thereby allowing them to more effectively carry out their missions of teaching, research, and extension; 3) increase Langston University and the Institute's involvement in agricultural development and impact on human welfare; and 4) enhance the Institute's knowledge of development and development issues.

2014 Projects

Title:	Handbook for Livestock Research on Smallholder Farms in Developing Countries
Type:	USDA Scientific Cooperation Research Program
Period:	2012-2014
Investigators:	A. L. Goetsch[1], T. A. Gipson[1], R. C. Merkel[1], G. Abebe[2], A. Patra[3], D. Zhou[4], K. Al-Qudah[5], M. Huerta-Bravo[6], T. Sahlu[1], A. Degen[7], W. Getz[8], and Y. Tsukahara[1,9]
Institutions:	[1]Langston University, [2]Hawassa University, [3]West Bengal University and Animal and Fishery Sciences, [4]Northeast Institute of Geography and Agroecology, [5]Jordan University of Science and Technology, [6]Universidad Autónoma Chapingo, [7]Ben-Gurion University of the Negev, [8]Fort Valley State University, and [9]Kyoto University
Objectives:	A handbook for livestock research on smallholder farms in developing countries will be developed. Emphasis will be given to experimental design and data analysis. Input will be received from experts in different areas of the world (i.e., Ethiopia, India, China, Jordan, and Mexico), including regional cultural and social considerations.
Current Status:	Final draft developed and sent to collaborators for internal and external review for final publication and distribution.

Title:	Enhancing Capacity for Research, Extension, and Teaching Activities with Small Ruminants of Bunda College of Agriculture in Malawi and Egerton University in Kenya
Type:	USAID, with administration by USDA Foreign Agricultural Service
Period:	2012-2014
Investigators:	T. Sahlu, A. L. Goetsch, T. A. Gipson, K. Tesfai, L. J. Dawson, and S. Zeng
Objectives:	Bunda College of Agriculture: 1) improve the analytical capacity of the Department of Animal Science animal nutrition laboratory of BCA to determine the nutritive value of livestock feedstuffs, inclusive of equipment and supply procurement and associated training and 2) increase knowledge in areas of animal science to enhance the quality of undergraduate and graduate student teaching and increase capacity for research and extension activities. Egerton University: 1) create capacity at EGU in artificial insemination of goats, encompassing use of fresh and frozen semen and to collect and store frozen semen, by establishing an artificial insemination center and provide relevant training; 2) import live animals of three dairy goat breeds to use in natural breeding and artificial insemination for multiplication of purebreds as well as crossbreeding in a community development program; and 3) provide training in areas of animal science relative to management of exotic dairy goat breeds, such as breeding and record-keeping, health and internal parasite management, preparation of teaser bucks for heat detection, and dairy goat product technology.
Current Status:	Bunda College of Agriculture: Laboratory equipment and supplies have been ordered and shipped to Malawi. The laboratory has been set up and officially handed over to the university by USDA representatives. Staff have received training in standard operating practices. Egerton University: Animal were procured in South Africa, shipped to Kenya, and are actively involved in the crossbreeding program. Training activities in cheese making and artificial insemination have been conducted.

Title:	Applied Reproductive Technologies for Caprine Embryo and Gamete Management:Langston University's Expression of Interest for Borlaug Fellow (Kenya)
Type:	USDA Foreign Agricultural Service
Period:	2014-2015
Investigators:	T. Sahlu and E. Loetz
Objectives:	Provide training in effective assisted-reproductive technologies.
Current Status:	A 12-week training course was accomplished at Langston University and the mentor follow-up visit will soon occur.

Title:	Genomic Selection in Dairy Goats: Langston University's Expression of Interest for Borlaug Fellow (Kenya)
Type:	USDA Foreign Agricultural Service
Period:	2014-2015
Investigators:	T. Sahlu and T.A. Gipson
Objectives:	Provide training in effective genomic-enhanced selection
Current Status:	A 12-week training course was accomplished at Langston University and the mentor follow-up visit will soon occur.

Training Extension Personnel in the Philippines

In September, Dr. Roger Merkel traveled to the Philippines to be a Resource Person and lecturer for the training entitled "International Training of Trainers on Meat and Dairy Goat Production Technologies and Infrastructure for Smallhold Farms." This training was conducted by the International Training Center on Pig Husbandry, Agricultural Training Institute, Department of Agriculture, Republic of the Philippines as part of the agreement regarding the Association of Southeast Asian Nations (ASEAN) Working Group on Agriculture and Training Extension. This training on goat production was attended by 20 participants representing the countries of Indonesia, Viet Nam, Laos, and the Philippines. Participants included extension personnel, university lecturers, goat farmers, and the Deputy Director of Livestock Management Division, Department of Agriculture and Fisheries, Laos.

Dr. Merkel gave lectures on female and male reproductive anatomy as well as breeding schemes, artificial insemination, and estrus synchronization. Dr. Merkel also presented on farm business planning and farm records and on organic goat production, comparing organic regulations from the U.S. with those from the Philippines and Thailand. During his trip, Dr. Merkel visited several goat dairies ranging from commercial operations to smallholder village units. One of the commercial dairies, JSJ Goat Farm, has a website you can visit to see their animals, buildings, and products, http://jsjgoatfarm.com/. Another dairy was vermicomposting its animal manure and feed waste and selling the resulting vermicompost to create an additional income stream. Two interesting things seen on the farm tours were the use of plastic flooring in elevated barns for sanitation and using old plastic soda bottles as mineral feeders. Rock salt is mixed with a little molasses and put into a plastic bottle in which holes are poked near the bottom. Other producers use sections of bamboo in a similar manner. The goats lick the bottles or bamboo to consume the salt.

Two days of the training were spent at Central Luzon State University (CLSU) doing practical sessions of forages, dairy goats, artificial insemination, castration, disbudding, silage making, and internal parasite detection. The Small Ruminant Center of CLSU has upgraded native goats with dairy breeds and Boer goats to enhance milk and meat production. In addition to artificial insemination, the center has also conducted embryo transfer in goats.

Dr. Merkel thanks Dr. Ruth Miclat-Sonaco of the International Training Center on Pig Husbandry of the Agricultural Training Institute for the invitation to attend the training and Dr. Asterio Saliot, Director of the Agricultural Training Institute, and Mr. Manuel Jarmin, Executive Director of the Philippine Livestock Development Council for their support of the invitation.

Notes