WELCOME

We deeply appreciate your attendance at this 18th Annual Goat Field Day of the E (Kika) de la Garza American Institute for Goat Research of Langston University. The Field Day is one of the most important things we do each year. The primary purpose of the Field Day is for education and extension in areas of greatest interest to clientele of the Institute. Thus, please share your thoughts with us on today's activities and suggestions for the Field Day next year. In addition to extension and education, the Field Day provides an excellent opportunity for the staff of the Institute to meet other people that work with goats. Such interaction helps make our program the most appropriate it can be for the people it serves.

The proceedings of the Field Day is a very useful tool for the Institute beyond impact realized from the program today. First, there are reports on Field Day presentations. After this information, there are highlights of research and extension 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. We hope you will take time later to look through this information.

This year's general theme of the program is *"Export Potential, Market Outlook, and Value-Added Processing."* Attention will be given to the major types of goats or goat products, namely dairy and milk, cashmere and mohair, and goat meat. I have looked over the articles on these topics in the proceedings, as well as the others, and it looks like we will all learn a great deal of useful new information today. And remember, we attendees also can learn a lot from each other, so let's all make a point of visiting whenever possible. Here is the exciting program planned for today that has developed from your input.

The morning program consists of:

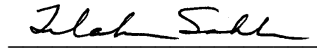
Export Potential, Market Outlook, and Value-Added Processing

Dairy Goats and Dairy Goat Products	*Linda Campbell*
Goat Fiber Products	*Joe David Ross*
Meat Goats and Meat Goat Products	*tatiana Stanton*

The afternoon workshops are:

Basic Goat Husbandry I	*Jerry Hayes*
Basic Goat Husbandry	*Lionel Dawson*
Adventures in Cheese-Making	*Pure Luck*
Dewormer Resistance	*Terry Gipson*
Goat Farm Budgeting	*Roger Sahs*
Financial Statements and Analysis	*Clark Williams*
International Activities	*Roger Merkel*
Goat Production and Quality Assurance	*Terry Gipson*
Forage Based Dairy Goat Management	*Steve Hart*
Goat Nutrition - Minerals	*Steve Hart*

Please let us know your wishes for the 2004 field day, and we will do our best to again provide a quality program with requested and timely topics. 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

DAIRY GOATS AND DAIRY GOAT PRODUCTS: EXPORT MARKET POTENTIAL, MARKET OUTLOOK, AND VALUE-ADDED PROCESSING

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Export Market Potential

The demand for breeding goats from the United States has been steadily increasing over the past 20 years, although as with any commodity there are cycles with peaks. In some cases, the total quantity has decreased somewhat, while prices per head have increased. We are in competition with breeders in New Zealand, Australia, Canada, and parts of Europe. The U.S. industry has had the advantage of organized programs such as DHIR testing and Linear Appraisal, but others are following our lead. We must work to keep this edge by continuing to promote and encourage these programs as much as possible. These tools help us to track our progress and identify animals that can provide improved genetics for the countries desiring to purchase our breeding stock. The most frequently requested breeds are Alpines, Saanens, and Nubians.

My first goat export was in the early 1970's, and since then I have been personally involved with the exportation of over 100,000 goats to 30+ countries. The vast majority of these have been dairy goats, although meat goat breeding stock demand has grown steadily.

General Information Regarding Exporting

Some have the mistaken impression that exporting can be a real 'get rich quick' scheme. While it can be profitable, with the many risks involved, it is a business to approach with appropriate planning and consideration. Even experienced exporters can loose significant amounts of money when problems occur.

- Cost Factors in Pricing Export Sales

Let's assume an individual desires to begin providing goats to buyers in other countries. Setting the purchase cost is one of the first necessary steps. The obvious costs include the cost of purchasing animals, and the transportation (freight). There are many other potential costs that could include personnel and equipment needed to establish and maintain an export operation; translation costs; fees charged by consultants and freight forwarders (individuals whose specialty is arranging transporting and delivery of animals to foreign buyers); health testing; and payments to regulatory

agencies such as APHIS (Animal Plant and Health Inspection Service). Additional costs are incurred for loading and unloading animals (including overtime for weekend and holidays); air conditioning for loading during summer months; quarantine facility charges; commissions for agents in other countries; and other related costs. Of course, there could be additional feed and veterinary costs for keeping the animals longer than you anticipated. And somewhere in the quotation you need a profit factor. If you are selling your own breeding stock, you have to consider your own levels desired. If you are marketing for others, this can typically run from $5-25.00 per head.

- Terms of Sale

It is very important to understand the delivery terms. FOB is "Free on Board." If your price is FOB the port of export of Houston, it would include all costs of getting the animals to the quarantine station at Houston. If you have FOB to a named port and aircraft, it would include prices of delivery upon an aircraft provided by the buyer. This would then include costs of quarantining at the port of export.

C and F or CNF means cost and freight to named overseas port of import. This would include the price for the animals (and all incidentals) and the cost of transportation to the named port where the animals are delivered.

CIF means cost, insurance, and freight. Using this term means the seller quotes a price for everything. The insured value is 100% or 110% of the total net invoice value. This could include insurance that is either Farm-to-Farm or Farm-to-Farm plus 30 days after delivery. This should also specify whether mortality or abortions are included.

A Proforma Invoice is the official name of the "quote" and would specify the buyer/seller names, status of insurance, method of shipping, method of payment, description of animals, specific charges, period of validity (how long your offer is valid), and approximate shipping date.

- Methods of Payment

CIA or Cash in Advance is the most desirable of all and is the usual method for domestic sales. However, unless it is a very small order, it would probably not be acceptable to a foreign buyer. The most common method is a Letter of Credit. This is a document that is issued by a bank at the buyer's request in favor of the seller. It promises to pay the specified amount upon receipt by the bank of certain documents. This is usually an "irrevocable" Letter of Credit, but these can actually still be revoked! To "confirm" the Letter of Credit means that a U.S. bank accepts responsibility to pay regardless of the financial situation of the buyer or foreign bank. This is desirable but also carries a charge.

- Next Steps

Now that you and the buyer have agreed on the terms and specifics of the sale, the buyer may want to come to your farm and personally select the stock. This has advantages and disadvantages. It helps that the buyer sees the animals and is satisfied with them, but it can mean tremendous organizational efforts to coordinate the travel plans for visiting other herds if numerous people are involved. This could mean spending a great deal of time on the road as an escort, and could be an important factor in your pricing scheme. Once a buyer has established working relationships with you and is satisfied with what you have located, it often means that future deals can be conducted without his having to personally select. It is important to maintain the level of quality expected by the buyer.

With an average of 10-25% of the animals being rejected by various health testing requirements, it is wise to prescreen animals before bringing them into quarantine. This is yet another risk and cost. You could work with an approved facility for quarantine at some site away from your farm, or perhaps you have a facility that meets the requirement. An accredited USDA veterinarian must inspect the facility each time quarantine begins. During this time, no visitors are allowed in the facility, and cleaned and disinfected boots and coveralls are expected to be worn by those working with the animals. Remember that bringing new goats onto your farm will increase your risk of disease within your own herd.

On the specified day, an accredited veterinarian draws the blood samples for the necessary testing (which varies by country). Within a few days, the results will be known. If there was a statement in your Letter of Credit that prohibited partial shipment, then you cannot ship the animals or collect the money if there is even one animal less than the number specified! This stresses the importance of testing a sufficient number of animals, and for requesting to remove any prohibitions or penalties for partial shipment.

Even if all goes well with the blood testing, there can be delays in the shipment from the buyer's end. You could be feeding and caring for the animals much longer than you planned. If the time limit for the health testing expires, you may have to start all over.

If the animals are ready to be shipped finally, then transportation to the port of embarkation is next, after the animals are again inspected by the USDA veterinarian. One animal with a sign of disease could prohibit the entire shipment from leaving.

All the paperwork must be absolutely complete and accurate and endorsed by a Federal Veterinarian. The animals need to be identified by tattoo and sometimes by ear tag as well.

Other Methods of Exporting

Another choice is to simply work with someone who is putting together an order, and just sell them your goats! This certainly has the least risk and is what most breeders prefer to do.

Arrangements for the various deals can vary significantly. For example, the health requirements vary by country. Tests could include CAE, Bluetongue, Johnes, Vesicular Stomatitis, Brucella abortus, Brucella ovis, and Leptospirosis. The tests have to be conducted within specific time frames such as within 15 or 30 days of shipment. Some countries require vaccinations for diseases such as contagious ecthyma (soremouth), and some require 4 weeks or more of isolation. Frequently, a TB test is conducted at the farm, and a prescreening test for CAE is done at the same time. Then, those that pass these tests are eligible to be purchased. At the specified time, the animals are either picked up or the owner delivers them to the quarantine area. With our exports, we typically cover the cost of the CAE test, while the owner covers the cost of the TB and blood drawing. This can vary, but is specified in information provided to the seller, along with other instructions.

If you have good breeding stock and want to market your animals for export, here are some suggestions:

- Don't expect export sales to be a "dumping ground" for animals of poor quality. Selling poor animals hurts all of us and could reduce export markets in general.

- Expect delays. Often there is a "hurry up and wait" syndrome as the process begins. We hurriedly work to identify and locate animals, and then the usual delays happen. Try to anticipate delays.

- Realize that deals aren't guaranteed sales until the animal leaves the farm. Many things can happen that could jeopardize the final closing of a sale.

- Be willing to accept reasonable prices. In some cases you may be given a deposit first, and final payment after you provide all the appropriate documents (such as registration papers, interstate shipping papers, production and appraisal records, etc.). Final payment may also be held until animals are shipped.

- Follow directions carefully! If you are told to have your veterinarian draw blood on a specific day, make sure this is followed carefully. Otherwise, it could risk your potential to sell animals and put the entire shipment in jeopardy if the expected number of animals cannot be sent.

- Check tattoos. If the papers and tattoo do not match, the animal cannot be sent.

- Trim feet.

- Be willing to be flexible in delivering or having your goats picked up at all hours of the day and night!

- Participate in performance testing programs. Most of our buyers are now requiring DHI dam records on purchased stock. Generally, there are minimum levels stated, and usually the levels are based on ME's (Mature Equivalents). We've seen an increase in levels of required milk, fat and protein levels as foreign buyers become more educated about our programs and more serious about improvements.

Being part of a successful export program can be satisfying to the goat breeder. Handling the comprehensive details of working directly with foreign buyers certainly isn't for everyone. Even with years of experience in anticipating potential risks, there will be problems. Like any other business, there are risks and rewards.

Market Outlook

Based on current interest levels, the market appears to continue to be good. Demand continues from Asia, South & Central America, Mexico and some European countries. It will be important for us to work within a framework of meeting necessary health protocol of importing countries, and continue to supply an acceptable quality level.

Value Added Processing

Cheese/Cultured Products

The US has a net deficit goat milk cheese product inventory (we aren't producing the volume demanded by the market). Importation of goat milk cheeses continues at a high level, especially from France. We are seeing growing demands for domestic products as producers make more efforts in product improvement, marketing and promotion. The variety of goat cheese now available is nothing short of tremendous. I have seen the quality improve significantly over the past 30 years, and many of our goat cheese producers are truly artisans to be admired for their skill in developing new products with a quality that easily competes with those from countries where those skills have been honed over several thousand years. From fresh cheeses to aged products, cheese production is currently probably the most profitable return on fluid milk, although it is still a perishable product, so surplus amounts not sold could become a concern, and make it a challenge for transportation logistics. Yogurt and kefir drinks are becoming more popular, and these are ideal uses for goat milk.

Confections

Goat milk fudge is often made in kitchen batches and sold at farmers' markets and commercial productions also make it to the mainstream as well. Other candies and confections such as truffles are popular products as well.

Powdered/Dried

Powdered goat milk produced in the US is being exported to a number of countries, and in addition to its use in the human diet, is can be used for livestock and pet milk replacers. Higher dollar returns will likely come from pet use. The pet market is virtually untapped at this point, although Esbilac, a popular milk replacer for dogs and cats, is now available in a formula made with goat milk. One online supplier has it advertised for $43.99 for a five pound package. (http://www.sanctuarysupplies.com). With some marketing efforts, it is possible that we could see more goat milk usage for additions to pet foods for adult animals as well. Goat milk is a considered a healthy protein source for humans as well as pets, and the use of goat milk in pet products could give a boost to the goat milk industry. The following discussion pertains to herbal and other supplements, but with the right marketing approach could also be reflective of including products such as goat milk or even goat milk colostrum.

"According to a recent report released by the market research firm Business Communications Company, Norwalk, CT, pet supplement sales are predicted to reach at least US $1 billion by 2005, with growth projected at 17-22%. Fueling this growth is the demand of pet owners for the same type of health foods, herbal remedies, holistic medicine and organic products that they use themselves. A study released by Ralston Purina in 2000 stated that twenty-nine percent of pet owners have sought or considered nutritional supplements as an alternative health remedy for their pet. Seven percent of pet owners have sought herbal remedies. Based on a rough estimate of the dog and cat populations in the US and Canada using a formula taken from the American Veterinary Medical Association's website this could mean a total of 1.7 million dogs in Canada plus 16.3 million dogs in the US could be receiving nutritional supplements. The number of cats receiving supplements in Canada could be 4.1 million plus 40 million in the United States. Four hundred and four thousand dogs in Canada and 3.9 million in the United States could use herbal remedies. The cat population receiving herbs could be nine hundred and ninety-nine thousand in Canada and 9.6 million in the States." (http://www.agric.gov.ab.ca/economic/market/pet.html)

Colostrum

Colostrum is now readily available in tablet and capsule forms and is quickly gaining favor as a human dietary supplement. One commercial product made from goat milk is Goatein™. The following comments from a marketing company offer uses for dietary colostrum supplements:

"Each serving of GOATEIN™ IG contains probiotics in a base of lacto fermented goat's milk protein combined with goat's milk colostrum. Fermentation by lactic acid bacteria creates biologically active lactic acid that plays a major role in energy production and fat burning. This lactic acid is also essential for proper pH balance of the gastrointestinal tract and other bodily tissue. Many of the healthiest and longest living people in the world have consumed lacto-fermented dairy products and attribute their longevity to this remarkable food. Research has shown that regular consumption of cultured (lacto-fermented) dairy products lowers cholesterol and protects against bone loss. Medical studies have shown that growth factors in Colostrum can help the body:

- Regenerate normal growth of muscle, bone, cartilage, skin, collagen and nerve tissue
- Burn fat for fuel instead of muscle tissue during dieting
- Build and retain lean muscle
- Synthesize DNA and RNA
- Balance and regulate blood sugar levels
- Heal burns, cuts, abrasions and mouth sores with topical application
- Regulate blood glucose levels and "brain chemicals" providing alertness and better concentration

Immunoglubulins (found in colostrum) are able to neutralize even the most harmful bacteria, viruses, and yeasts, states Dr. Per Brandtzaeg; Annals of the New York Academy of Sciences. GOATEIN™ IG contains a virtual army of immunoproteins, including PRP (Proline-Rich Polypeptide) which supports and regulates the thymus gland, Lactoferrin a protein that transports essential iron to the red blood cells and prevents harmful bacteria from utilizing the iron they require to grow and flourish, and Lactalbumins which research indicates may be highly effective against numerous viruses." (http://www.prohealthsolutions.com/goatein-ig.html)

Cosmetics

Perhaps the fastest growing of all processing options is the use of goat milk in skin care products. It has the value of offering a product that is not perishable and can be produced on a small scale or large commercial scale. Soaps are the primary product, but bath soaks and lotions are also top sellers. Artisan-made goat milk soaps are seen at craft events, farmers markets, and are now available in every high-end department store as well. Natural ingredient based products will likely continue to enjoy the popularity it sees today. Facial skin care products alone accounted for $5 Billion sales last year, and with more marketing efforts, goat milk products could make a significant component of that industry.

"From ancient times until today, milk and milk products have been used as an excellent source of nutrition and for medicinal and cosmetic purposes. Goat Milk protein contains all the known and essential amino acids, including a much higher content of medium chain fatty acids (MCT) {which have become of considerable interest to the medical profession, because of their unique benefits in many metabolic diseases of humans (Babayan, V.K., 1981. Medium chain length fatty acid esters and their medical and nutritional applications. Journal American Oil Chem. Society. 59: 49A-51A}. It also contains vitamin A, B vitamins, and minerals such as calcium, potassium, magnesium, and phosphorus. With its natural emollients, goat milk soap can relieve dryness and restore a silky softness to the skin. Goat Milk has long been known for being effectively utilized by people who have sensitivities to cow milk. It nourishes our bodies - inside and out!" (http://getyourgoatsoap.com).

Summary

Unlike many industries facing declines, the goat industry has the potential to expand and become a more profitable business. There are many challenges, but the potential is there. One of the most challenging difficulties for many producers is the fact that they are frequently the producer, processor, distributor, and marketer for their products. It can be difficult to excel in each of these areas, and often this is where the producer falls short of making a good profit. Unlike most producers of cow milk, it is necessary to do much more than just manage an efficient animal and harvest that product. More research on the health benefits of goat milk and more mainstream marketing of goat products in general could increase its acceptance and help increase the success for all. Increases in cooperatives or other collective efforts for marketing could also help facilitate a profitable business.

Unlike the export market for our breeding stock, which is definitely well established, the export market development for many of our goat milk products has barely begun. The potential is indeed there, and in the years to come, we will see this become a more important component, and thus an incentive for those who choose to work with this unique species that has offered food and clothing for mankind for thousands of years.

The proper citation for this article is:

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EXPORT POTENTIAL, MARKET OUTLOOK, AND VALUE-ADDED PROCESSING OF GOAT FIBER PRODUCTS

Joe David Ross

Cashmere America
Sonora, Texas

Introduction

Dr. Joe David Ross, manager of the Cashmere America Co-Operative, is our featured speaker for export potential, market outlook, and value-added processing of fiber goat products. Cashmere America Cooperative was started in 1991 by a small group of dedicated cashmere producers. Cashmere America Cooperative recognizes that consistency in quality makes for a premium finished product. That is just one of the reasons dedicated growers all across America joined together in the Co-op to establish high and consistent grading standards for their fiber. Dr. Ross is the owner of Ross Builta Farm in Sonora, Texas. Recently, Ross Builta Farm received the 2002 Outstanding Forage Producer award from the Texas Forage and Grassland Council.

From http://www.carylldesigns.com/cashmere_america.htm

Cashmere America's Story

"Cashmere America Cooperative is owned and operated by those in America raising the Cashmere producing goats. It is an organization set up for the purpose of processing and marketing American Cashmere.

Started in 1991 by a small group of dedicated farmers and ranchers in Colorado and Texas, the Co-Op has since grown to include farms from Maine to Washington, and from Canada to New Mexico. Cashmere goats have found their niches in America, from pasture management and weed control to providers of meat in specialty markets, to 4H youth projects, and especially as a source of one of the most luxurious fibers in the world, with American Cashmere the rarest.

As an organization, Cashmere America Cooperative recognizes that consistence in quality makes for a premium finished product. That is just one of the reasons dedicated growers all across America have joined together in the Co-Op to establish high and consistent grading standards for their fiber.

The word "cashmere" does not describe a breed, it defines the fiber. Cashmere is the downy undercoat of goats. With careful selection for fiber traits, many types of goats including dairy breeds and pygmy goats can be used in cashmere development programs. Cashmere is expensive partially because its remarkable softness and warmth place it among the world's great luxuries and partially

because the goat to garment process is complicated and expensive. While sheep and mohair goats produce pounds of fleece, a cashmere goat's annual output is calculated in ounces. To create a world-class product, each fleece must be classed by color, fiber length, and fineness, then the cashmere down must be separated from the coarse guard hair which surrounds it. The de-hairing must be complete but gentle so that the delicate fibers are not damaged. Because of the small size of individual American cashmere herds, pooling fiber is a logical method of creating useable products from raw fleece. Cashmere America is the national grower's cooperative which makes it happen. With experienced fiber classers on staff and access to the world's most sophisticated de-hairing equipment, Cashmere America can ensure that the cashmere which reaches the user is a product of consistently high quality, handled professionally throughout the production process.

We hope you will notice our care in the garments you make from our yarns."

Caring for Cashmere

"The key to caring for handmade Cashmere treasures is in the hand washing, using the SAME water temperature in the wash as well as in the rinse. You may use a Hot with a Hot, a Warm with a Warm, a Cool with a Cool...do not change water temperatures mid-process.

Mild soaps are recommended such as Dawn or Ivory. Gently swirl the garment through the water, carefully press the water out, then roll in a towel, give a quick shake or two to remove wrinkles, and lay flat to dry.

Like wool, Cashmere is also a favorite of moths. Protect your garment with herbed moth repellants or store in a secure environment."

From http://www.capcas.com/Cashmere_Characteristics.html

Cashmere Characteristics

The cashmere goat is a member of the species Capra hircus, as are all goats. A cashmere goat is one that produces commercial quantities of cashmere, but a "cashmere" goat cannot now be characterized as "PUREBRED" or even "REGISTERED", as those terms imply the presence of a Herd Book that records the progression of a "line." Because environment plays such a major role in determining the quality of the cashmere produced, it is very difficult to identify truly superior genetics. And even when you find a superior goat, it may or may not produce superior offspring, which is what registering a purebred animal is all about. The quality of the offspring may vary widely; some may be excellent while the twin brother is a cull. For this reason, there is no way to "GUARANTEE" the quality of a cashmere goat. You must be willing to learn how to sort through your kid crop every year and cull accordingly. Luckily, this results in more animals sold to the meat market or the weed control market, a lucrative proposition. Expect to cull half of your doe kid crop and 80% of your buck kid crop. Expect to rely upon your own judgment to decide which is which. It is very important to associate yourself with more than one mentor as there are still many opinions

out there which are in cases, diametrically opposed.

Cashmere Goats can be characterized as follows: "A cashmere goat is one which produces a fine undercoat of any commercially acceptable color and length. This down should be less than 19 microns (μ) in diameter, crimped as opposed to straight, non-medullated (not hollow) and low in luster. It should have a clear distinction between the coarse, outer guard hair and the fine underdown and should have good handle and style." CaPrA, Concerning Cashmere, 1989

Fiber color ranges from deep brown to white, with most of the intermediate colors falling into the grey category. Color of the guard hair is a not a factor when assessing cashmere fiber color, but guard hair colors that vary wildly (such as pintos) can make sorting the fiber difficult. Any length over 1¼ (30mm) after shearing is acceptable. Shearing will reduce the length of the fiber by at least 1/4" if done correctly, more if the hated "second cut" occurs. After processing, the longer fibers (over 70mm) go to spinners for manufacture into fine, soft yarns, and the shorter fibers (50-55mm) to the weaving trade to be blended with cotton, silk, or wool to produce a superior quality woven fabric. A single fleece may contain some long fibers, usually grown on the neck and midside, as well as some shorter fibers, present on the rump and belly. Also, quality of fiber usually improves with distance from the usually coarser neck; midside fiber is usually the best, with rump fiber being finer, crimpier and, unfortunately, shorter, although some goats have coarser rumps. All of these different types of fiber contained within a single raw fleece must be carefully sorted. The price of these differing types varies from $40/lb to $7.50 a pound of dehaired fiber, so sorting must be done carefully by experienced personnel. There is no way to estimate the dollar yield from a raw fleece by just taking a glance. Processing the fiber to separate the guard hairs also removes some of the down and you will not be paid for down lost in processing.

Fiber character, or style, refers to the natural crimp of each individual fiber and results from the microscopic structure of each fiber. The more frequent the crimps, the finer the spun yarn can be and therefore the softer the finished product. "Handle" refers to the feel or "hand" of the finished product. Finer fiber generally has better crimp, although this is not necessarily so. It is very easy for the human eye to be deceived by a well crimped, but coarser fiber. For this reason, estimating micron diameter is best left to the fiber testing experts. Very fine fiber which lacks the requisite crimp should not be categorized as quality cashmere. It is the crimp of quality cashmere fiber that allows the fiber to interlock during processing. This in turn allows it to be spun into a very fine, usually two-ply yarn, which remains lightweight yet retains the loft (tiny air spaces trapped between the individual fibers) that characterizes quality cashmere sweaters. This loft retains heat and is what makes cashmere different from wool, mohair and especially, man-made fibers.

Income Potential

Goats are wonderfully resourceful animals. They are very efficient feeders, converting rough browse and at times, noxious weeds into marketable products. If the manager can learn how to take advantage of the goats' natural abilities, they can use a low cost. low maintenance farm animal to add to the bottom line.

First, it is very easy to use goats to maximize range utilization on marginal land. If your land is choked with leafy spurge, for example, goats will thrive there and control the spurge. It is important to differentiate between the word "control" and the word "eradicate". Goats will not eradicate spurge. But they will happily feast upon it and prevent it from reproducing sexually. They also slow down asexual reproduction of the spurge by continuously taxing the plant by nibbling away at its above ground parts. As the spurge expends energy to regrow its above ground parts, it cannot put as much energy into its below ground parts. Hence, it can be said to be controlled.

Meat market sales are the most significant portion of cashmere goat income sources. Fat wethers will sell for $1 a pound on the hoof in the right markets. Putting pen to paper, if five or six goats are equal to one cow in terms of how much they eat every year then it can be said that 5.5 goats + 1 cow. One cow will have one calf every year and that calf is worth maybe $500 at the end of the season (in a good year). Five and a half goats will have 11 kids and those kids are worth $80 each at the end of the season. The math comes out to $880 gross income from the goats, but you need to subtract for some kid mortality and also for the cost of transporting those kids to a market which may not be very close. But the potential is there!!. Add the fact that cattle and goats will choose to use different parts of your rangeland and things start to make sense... dollars and cents.

The best way to make money from this industry is to value add the fabulous fiber that these goats produce. If you are a handspinner or weaver, the products made from cashmere will be worth a lot more than the raw fiber. Enough even to pay for your time in making the items. If this is something you enjoy or if you have an entrepreneurial underpinning yearning to be free, goats are the way to go.

From http://www.texascashmere.com/four%20fold%20advantage.htm

The Four-Fold Advantage - Raising Cashmere Goats Provides Four Income Opportunities

Breeding Stock: Cashmere goats are in high demand and will continue to be as small farms look for alternative means to provide income on their farms. The cashmere industry in the United States is relatively new and there is still tremendous opportunity to improve upon cashmere genetics and develop first class animals for sale.

Cashmere Fiber: The fiber arts are enjoying a tremendous resurgence in the United States; knitting, hand spinning, and weaving. This year you may have already noticed that many popular clothing catalogs have entire sections devoted specifically to cashmere garments. This attention and rapid resurgence in popularity will do your marketing for you.

Meat Goat Sales: Goat meat is the most eaten meat in the world. Goats are able to survive in lands where other livestock cannot and are therefore a staple in the diets of huge portions of the world’s population. The cultural make-up of the United States is rapidly changing with Ethnic populations making up a greater and greater part of our society. Many of these cultures are accustomed to eating goat meat and not only prefer it, but are required to serve it during sacred

meals. As a result, the demand for goat meat in much of the country currently outweighs the supply.

These Cashmere goats are stocky, well muscled and make an excellent meat goat. Considering Boer goats? The breeders in our region tell us that they get their best meat goats from a Boer/Spanish cross. These cashmere-producing Spanish Meat Goats offer versatility if you want to take advantage of the rapidly growing meat market.

Brush Clearing: Goats are browsers and are able to eat plants that other animals do not. They often prefer "weeds" and thistles to grass. Goats are able to rid pastures of many unwanted species of plants including; multi-flora rose, autumn olive, leafy spurge, and many others. A herd of goats can make short work of clearing your pastures and may provide you with the opportunity to sell, or even rent goats to neighbors to clear their land and pastures. Furthermore, goats make excellent grazing companions to cattle, as they will eat unwanted, competitive plant species, allowing for diversity in your pastures and a potential increase in cattle forage.

Cashmere producing goats are an excellent alternative for small farmers who want to make the best use of their land. These goats are not "exotics" but rather an important part of the new agriculture to meet the already established demands of a new marketplace. They just so happen to also grow the most luxurious fiber in the world! If you were already considering goats for your farm, consider the versatility of the Cashmere goat.

The proper citation for this article is:

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EXPORT POTENTIAL, MARKET OUTLOOK, AND VALUE-ADDED PROCESSING OF MEAT GOATS AND MEAT GOAT PRODUCTS

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Introduction

The survivability of our US meat goat industry is dependant on improving its accessibility and desirability to the huge base of goat meat enthusiasts right here in the US. Goat meat consumption in the US has grown sharply in the last 10 years. The goat slaughter rate at USDA inspected facilities climbed from 207,893 goats in 1991 to 560,300 goats in 2001. Imports from our largest importer, Australia, increased from approximately 3 million tons in 1990 to 12.6 million tons in 2001. Assuming a 40 lb carcass, which is the largest carcass popular with most importers, this equals a minimum of 315,000 more goats.

Who is Our Customer?

Increased consumption is driven by the popularity of goat meat with the diverse ethnic groups that immigrate yearly to the US. The popularity of goat meat with immigrants is not new. In the past, many of us emigrated here from countries where goat meat was popular. However, the perceived scarcity of goat meat in the US and the melting pot mentality discouraged us from holding on to our goat meat traditions. In recent years, we've seen a switch in philosophy to one that encourages people to celebrate their diverse cultural backgrounds. The introduction of Boer goats into the US received major publicity and helped make city dwellers more aware of the availability of goat meat. Approximately 10% of the US population is foreign born, with ~51% of these first generation immigrants coming from Latin American and a substantial percentage of the remainder identifying themselves as Muslim. In 2001, 1.6 million applications were approved for immigration into the US. Most immigrants settle initially in metropolitan areas making it relatively easy to concentrate goat meat marketing in these areas. For example, 41% of the population of NYC is foreign born. The low income base of many newly immigrated families, particularly refugees, may suggest that pursuing these markets will tie us into a low price/low value product. People on a tight income may be attracted more to cull animals and to frozen, imported goat meat.

Australian and New Zealand supply a major portion of the goat meat sold commercially in the US. This market has been growing at an annual rate >30% since approximately 1990 and has been able to piggy- back on the backs of the Australian and NZ lamb industries. With the help of

US investors who felt that the US lamb industry no longer held promise, Australia and NZ have been able to develop highly professional, centralized in-country slaughterhouses specifically for lamb export purposes. Companies like Australian Meat Holdings have been able to hold farmers to a consistent product, while compulsory government health programs have helped encourage some uniformity of management. It has been easy to include goats in these same processing and marketing enterprises. Furthermore, as part of the British Commonwealth, Australia and NZ have previous experience establishing substantial goat meat export markets to other Commonwealth nations (for example, Jamaica and India).

We might ask, why we in the US can't also break into these export markets. One obvious answer, besides the absence of a powerful lamb industry, is the consistent strength of the US dollar. Unfortunately, exchange rates reliably favor Australian, NZ, and Canadian meat goat producers exporting goat meat to our markets rather than us competing with them for overseas markets. As more of their export slaughterhouses are approved for USDA federal inspection and as the availability of cryovaxed fresh carcasses and retail cuts from them increases, we need to come up with serious rational for why our own "homegrown" consumers should choose us over them.

Luckily, many families become upwardly mobile as they establish themselves in the US. Even people on a tight budget prefer to splurge for locally slaughtered goats for weddings and special feasts. There is also a strong trend in the US for the consumption of farm fresh product. Much of the focus of the US goat meat industry should be on making it easier for consumers and processors to obtain the goat meat product they desire year round. We need to insure that the children of immigrants are encouraged to continue these dietary preferences. It is counterproductive if goat meat is available only sporadically, specific carcass preferences are ignored, people are made to feel unwelcome when seeking out goat meat through established channels, or if our marketing infrastructure collapses in on itself and offers all of us fewer marketing choices. We do not need to limit ourselves to seeking out only an "ethnic" market but we better make sure that we nourish and acknowledge this market as the base of our existing demand. Let me add that the story is probably different when we consider exporting breeding stock. The health status and genetics of our US meat goat population makes this a promising avenue for some producer associations.

Improving Our Accessibility

How do we make product available year round? Right now, we are probably lucky to have a supply of Australian goat meat for consumers to fall back on when US meat is scarce. However, this encourages distributors to abandon the US industry completely and market exclusively imported product. If we plan on expanding our US goat herd (and as we all know, goats multiply quite easily), we need to develop a base of producers who are willing to manage their herds more intensively either through accelerated breeding cycles or staggered kiddings to provide product more reliably year round. This is hard to do. Most of us are inclined to target peak demand times with their accompanying higher (sometimes) prices.

How do we make product easy to find? The events of September 11th and subsequent compulsory check-ins for immigrant men from certain countries have inadvertently resulted in many ethnic customers maintaining a very low profile. Where people might have felt comfortable stopping unannounced at your farm to ask if those goats in the front pasture are for sale, the same families may be very reticent today. We need to be assertive about finding new ways to contact different cultures about local availability of goat meat. Visiting mosques and foreign student associations, handing out business cards at auctions, sending press releases about your farm to cultural news journals, and establishing on-farm live animal markets are some actions producers have taken.

How do we provide sufficient supply even for special holidays? As producers, more of us need to group together to pool animals for sale. These groupings do not need to be formal cooperatives if you are targeting one particular distributor and your products are live, slaughter goats. In order to easily locate dealers, distributors, packers, processors, and transportation, we need to encourage the accumulation of web based marketing services directories across more regions than just the NE US. The number of smaller USDA slaughterhouses willing to slaughter sheep and goats are decreasing at an alarming rate. Helping to publicize these USDA slaughterhouses is crucial. Having easy places for producers to find contact information for buyers also increases our accessibility. However, many producers do not have the time to seek out buyers and investigate their credit status. Many buyers are also hesitant to deal direct. The development of large, graded sales where goat kids are grouped according to weight, age, and condition for a multitude of buyers is also very important. As part of this we need more sales willing to sell goats by the pound and more sales where prices paid are put on public record by a disinterested third party.

Improving Our Desirability

Bob Herr, a popular order buyer at the New Holland Sale, likes to say that there is a customer for every goat, a goat for every customer. It is important that producers educate themselves about the types of goats that are popular for various seasons. It is also important for producers to communicate well with their buyers to make sure they are accurately representing their animal and matching the animal to the market demand. This does not mean that the market is stagnant or does not appreciate some education from producers themselves. Many of us who market direct have experienced customers who initially were leery of meatier, possibly fatter, Boer × carcasses and then became more impressed upon seeing the carcasses hung next to a dairy breed or Spanish carcass. Many immigrant customers desire for tender meat increases once both the husband and wife are working and faster cooking dinners become a priority. However, knowing how to contact and communicate with buyers and educating yourself about the market is a first step in meeting customer desires.

Many ethnic customers are proud of their ability to judge the carcass suitability of a live animal. New York City has a long history of live poultry markets and in recent years many of these have expanded to include small ruminants. An animal can be purchased at them and then slaughtered at the on-site custom slaughterhouse. This is one market that Australia cannot take from us. However, your statewide USDA Division of Ag & Markets can. Organizing annual meetings

between Ag & Market officials and representatives from statewide lamb and goat producer associations may potentially help these agencies stay in touch with industry priorities. In NY, we were fortunate in being able to express our positive view on live animal markets and their benefits for NY lamb and goat producers right before Ag & Markets got too committed to a program to eradicate them. This does not mean they will not eventually close but at least Ag & Markets will be aware of our views if they do. Live animal markets generally provide a wide range of animals to satisfy the diverse market demands of various cultures. In states where they are permitted, they provide a way for city dwellers to insure their own quality standards.

Desirability and acceptability of goat meat products for the general US public will be improved if slaughterhouses with religious exemptions handle animals as humanely as possible. As producers, we need to exert pressure on Halal slaughterhouses to adopt humane restrainers based on Temple Grandin designs.

Marketing Strategies to Get a Bigger Piece of the Pie

There are many marketing strategies that producers can adopt to reap more of the market share on their goats. Almost all of these require an investment in extra labor and(or) capital on the part of the producer. One of the least painful is market pooling. This is the pooling of animals from several farms together at one centralized pick-up point so that you can offer a buyer a sufficient supply of animals. Generally you need to arrange for one person to represent all of you in negotiating price and assign or pay a person to grade animals (i.e., insure that each animal meets the quality standards of your buyer.

Another way to deal directly with buyers is to organize on-farm live animal markets. These work when you are in commuting distance to metropolitan areas with large meat goat consuming populations. They are dependant on your state having a relaxed interpretation of the exemption for custom slaughtering of farmer owned livestock. Similar to the NYC live animal markets, customers come on farm, purchase an animal, and as the animal's "owner" have it slaughtered at the on-farm slaughterhouse. Custom slaughterhouse facilities are inspected using county health guidelines. The requirements for each of them can vary widely between counties even within the same state.

Cuisine from goat consuming cultures has grown in popularity with an increasingly cosmopolitan U.S. mainstream population. The healthy profile of goat meat is also attractive to today's consumer. The goat cheese industry has done a lot to destroy the public's inhibitions against goat products and many people who pride themselves on a discerning palate are interested in trying goat meat. Producers can opt to market retail cuts direct to restaurants and consumers. A disadvantage of selling particular cuts to restaurants is the need to get rid of the rest of the carcass. However, many ethnic restaurants prepare recipes that use the whole carcass. Selling direct to businesses is very labor consuming. It is best done either by producers who raise a diverse range of products and thus save time by marketing a multitude of products to each of their customers, by large producers raising goats fulltime, or by formal cooperatives. Even when done by a cooperative, it is recommended that each farm label their product regardless of the overall brand. Many of the

restaurants and retail stores interested in buying direct from farmers want to emphasize the actual farm source. A farmer or cooperative that breaks into the retail market or markets a branded product to distributors needs to insure that the price received will compensate them for the extra time needed to coordinate slaughter, processing, transportation, and regular communication with buyers.

Heat-and-serve meals or introduction of goat meat into large-scale retail grocery stores requires substantial capital investment. Marketing trim as sausage is a more simple process but the common incorporation of pork fat excludes the Muslim or Halal market. Given our reliable customer base, it is generally important to arrange Halal certification through the Islamic Food Nutrition Council of America (IFANCA) if introducing a product over a wide region.

The amount of capital needed to introduce new or branded products generally is more obtainable by a very large producer or a "new generation" marketing cooperative. Funding to initially help such cooperatives with their product development may be available through USDA value-added grants, Sustainable Agriculture Research and Education (SARE) grants, and state grants promoting local agriculture. Feasibility studies in areas where the demand for goat meat has already established are probably not cost effective. However, simple surveys of price sensitivity and testing out what proposed products are of most interest to focus groups and distributors is well advised. Rarely does a co-op have the money to discard one processed product and develop another if the wrong product is invested in initially. Focus groups can be picked from goat cheese connoisseurs, patrons of upscale ethnic restaurants featuring lamb and goat, and representatives of goat-consuming cultures with an interest in ready-made meals. To ease coordination, it helps if a cooperative initially forms from a small nucleus of producers that communicate well together. Extra animals can be purchased from nonmembers as long as there is a quality assurance program and the cooperative expanded later from this pool of reliable non-members.

Conclusion

The health of the goat meat industry hinges on our ability to sustain and expand a strong "cultural" market from our diverse base of US citizens rather than putting the majority of our marketing resources into trying to build an overseas export market. The interest of an increasing portion of the general public in "ethnic" foods, goat products, lean meats, and farm-fresh product can build upon this strong, already present demand.

Anything we can do to make it easier for producers and buyers to find each other and to arrange necessary market logistics will help to maintain and expand our meat goat industry. Regional Marketing Service Directories can help. We need an industry-wide association focused on goat meat marketing issues. Such an association could also determine how to effectively interact with the American Sheep Industry (ASI) on marketing and governmental issues that impact both lamb and meat goat producers.

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BASIC GOAT HUSBANDRY

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Introduction

Interest in goats has mushroomed over the past fifteen years. Increased interest in goats and the value of these animals has made us do a better job in managing them. Kid management from birth to breeding is an essential component of the dairy goat enterprise. The kid management along with the nutritional management of the doe herd has the greatest effect on the long-term productivity of the goat herd. The dairy goat kid at birth represents a genetic resource necessary to replenish the herd gene pool, which has a changing composition due to death, culling, and sales for breeding stock. While the genetic characters of the kid are determined at the hour of conception, survival to lactation, and an adequate body size are necessary to realize inherent genetic potential for lactation. Kid mortality has a direct effect on genetic progress and, thus, we need to maintain low mortality from birth to weaning.

Pre-Parturition

The kid management program should actually begin prior to parturition, with attention to the nutritional needs of the gestating doe in late lactation and during the day period. The tendency is to regard the late-lactation and dry doe as a non-productive part of the milk-producing system. On the contrary, however, an adequate diet for the dry doe is essential to reproduce healthy kids. Pregnant does should receive plenty of exercise. An obese doe should be avoided, but the high-producing doe needs to recover body weight lost during the previous lactation. Clean, cool water and free-choice trace mineralized salt should be available.

Vaccination booster for Clostridium perfringens C and D and tetanus toxoid should be given not less than 3 weeks prior to kidding. Vitamin E/selenium injections are given during the dry period to prevent white muscle disease in the kids, especially in areas where soils are selenium deficient. Does should be wormed at dry off and also before kidding.

Parturition

The doe should kid in a clean environment, either a well-rotated pasture or stall bedded with straw or other absorbent material. The kid prior to birth has been existing in a germ-free

environment and parturition represents exposure to common disease organisms to which the mature animal has developed resistance. The location of the kidding stall or pasture should be near a well-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.

Kid Management

At birth, two management practices are critical to the future health and survival of the newborn kid. The navel cord should be dipped in a solution of tincture of iodine to prevent entry of disease-causing organisms through the navel cord and directly into the body of the kid. If necessary, a long navel cord can be cut to 3 or 4 inches in length. A bleeding cord should be tied with surgical suture material. Dipping of the cord in iodine not only prevents entry of organisms but promotes rapid drying and the eventual breaking away of the cord from the navel.

The second critical practice is the feeding of colostrum milk as soon after birth as possible. The colostrum, or first milk, contains antibodies which the doe did not pass to the fetal kid *in utero*. Consumption of colostrum must occur as early as possible and prior to 18 hours after birth, as there is a rapid reduction in the permeability of the intestinal wall of the newborn to the antibodies. The colostrum milk should be bottle-fed to the newborn to insure adequate consumption. Excess colostrum can be frozen for use in orphan or bonus kids. Recent research indicates that disease organisms, especially caprine arthritis encephalitis (CAE), may pass from doe to kid through the milk; transmission might be avoided through the use of extra colostrum frozen from does tested and shown to be CAE-free or heat treated colostrum. An additional practice at birth that enhances the health of the newborn kid is to give 3 injections of iron dextran and vitamins A and D after birth. A vitamin E/selenium injection may be beneficial in areas of selenium-deficient soils.

Kids should be checked carefully at birth for any deformities or abnormalities. Pneumonia is a major killer of young kids. A dry, draft-free environment is an excellent preventative measure. Kids should receive colostrum 10% of their body weight within 24 hours. For example, a six pound kid will receive 300 mL of colostrum within 12 hours. Kids could be left on does to nurse or started on a good quality milk replacer after they get their colostrum. A lamb milk replacer may be the best substitute for goat milk. Typical lamb milk replacers contain 22 to 24 % protein and 28 to 30% fat. Casein, a protein in lamb milk replacer, can be completely replaced with whey protein concentrate, which allows acidification. Acidification helps maintain the quality of the unused milk and reduces the incidence of diarrhea. Maintaining milk replacer quality after mixing is particularly important when kids are fed ad libitum.

The biggest problem with using lamb milk replacers occurs with the feeding schedule. Frequently, kids become “pets.” 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 from diarrhea. A restricted feeding program is beneficial.

Age	Amount of Fluid	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

Kids will nibble at fine-stemmed leafy hay at one or two weeks of age. At three to four weeks, 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.

Birth to Weaning

Milk is the principal component of the diet of the pre-weaning kid. There are numerous ways to feed milk including the use of bottles or pails, suckling the dam or nurse does, and self-feeder units. The method chosen will depend upon such factors as the size of the herd and available labor, as well as personnel preference. With any system, the health of the kid, sanitation, and available labor are the major factors to consider. Under natural suckling, kids consume small amounts of milk at very frequent intervals. Ideally, artificial rearing should mimic natural suckling, but the constraint of available labor precludes frequent feeding. Nevertheless, kids should be fed two to four times daily for the first week or two and twice daily thereafter. Bottle feeding is more labor intensive, but kids receive more individual attention and are easier to handle post-weaning than kids that are allowed to suckle does. Pail or pan feeding may reduce labor somewhat, but body weight 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 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. Consumption of large quantities of milk may lead to bloat due to entry of milk into the reticulo-rumen or rapid passage of milk through the abomasum and small intestines, resulting in diarrhea or nutritional scours.

In raising dairy goat kids, increases in size and weight are not the only measures of success. A well-formed skeleton and proper development of internal organs are often neglected when the emphasis is on rapid gain. An average daily gain of 250 g during the first weeks of life should be the goal. By limiting daily milk consumption to about 2 quarts, daily consumption of dry feed will be encouraged. Dry feed consumption is important in developing body capacity. By increasing body capacity, feed intake and digestion increase. Research has shown that at two months of age a weaned kid has a reticulo-ruminal capacity five times as large as suckling kids of the same age.

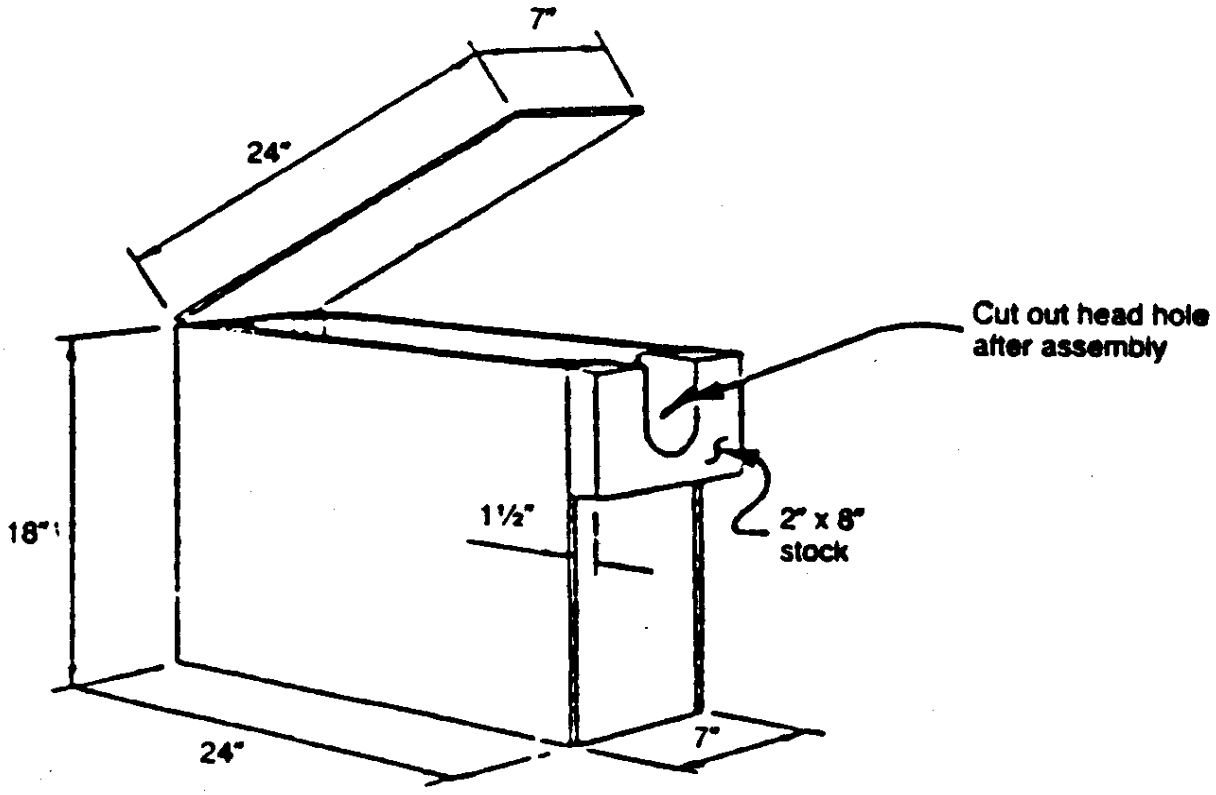
Kids should be consuming forages such as pasture grass or hay by two weeks of age and grain within four. Careful attention needs to be given to formulation of a concentrate supplement for the pre-weaning kid. Palatability is of primary concern. Molasses at the rate of 10% of the total dry

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 to 18%. Ground alfalfa may be added at 5% or less to provide additional stimulation for reticulo-ruminal development.

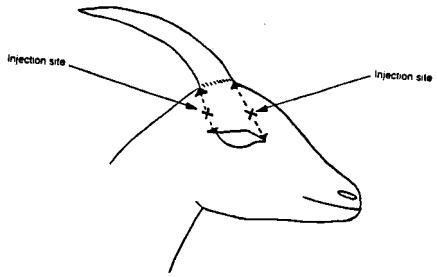
Several factors need to be considered when making the decision as to when to wean dairy goat kids. The most important consideration is whether or not the average daily consumption of concentrate and forage is adequate for growth and development to continue in the absence of milk. Fixed weaning ages are less desirable than weight goals such as 2.0 to 2.5 times birth weight. Many producers who have an erratic or marginal market for their milk delay weaning for longer periods than necessary. While milk feeding may promote more rapid growth than a concentrate-forage diet, maintaining kids on milk may delay the attainment of the dry feed intake level necessary for weaning and also leaves the kid disposed to diarrhea.

Disbudding

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. Disbudding a buck kid is the true test of proficiency and many fail it, judging by the number of scurs seen on adult bucks. If you try to de-horn a buck kid whose horn base is wider than a regular de-horning iron, you will get re-growth of the horn in a crown outside the burned area. If you try to de-horn a small kid with a wide calf de-horner, you may get re-growth of the horn from the center of the ring. If one person is doing the job, a de-horning box offers the best and safest restraining.

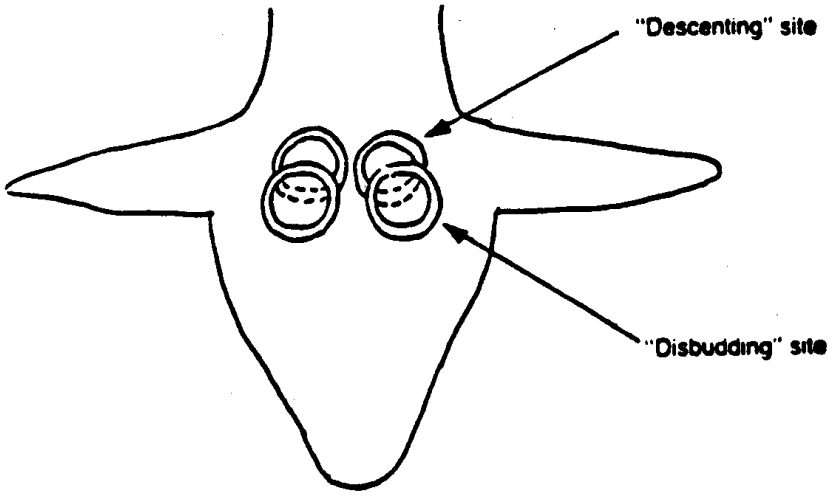

7"
24"
Cut out head hole
after assembly
18"
1½"
2" x 8"
stock
24"
7"

Although local anesthetic is commonly advocated, 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.



Goats are more sensitive than other ruminants to local anesthesia, which results in adverse reactions as a result of overdosing. If kids are brought to the clinic, the easiest and fastest technique is masking them down with halothane and oxygen. However, remove the mask and gas flow during cautery; otherwise a flash of fire in the goat hair may result. Xylazine at 0.3 to 0.4 mg/kg is commonly used for injection anesthesia, and kids should be kept warm during the prolonged recovery period.

The equipment most commonly used is an electric-heated metal rod with a hollowed-out end. None of the irons can be relied upon to maintain a constant temperature, and it is extremely important to match temperature and time. Underburning will result in scurs and overburning will lead to brain damage or death. The horn bud is located over the sinus close to the cranium in kids. After the dehorning iron is hot, apply the de-horner 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. Descenting could be done at the same time if necessary. Inject the kids with 150 IU tetanus antigen. Although the risk of tenanus after disbudding is not great, it is a good practice to do it.



Dewattling

Many goat breeders believe that wattles detracts from the appearance of a show goat, and it is difficult to show clip the hair evenly and smoothly, so wattles are removed at birth.

Castration

Dairy and pygmy goats should be castrated if they are intended to be companion animals. This will reduce the smell and aggressive behavior. Angora goats are castrated so they can be run in either flocks for mohair production. Angora goats are usually castrated at 6 to 12 months of age so that they can develop bigger horns.

Rubber ring
Burdizzo
Surgical

Reproduction

Doelings are usually bred when they reach a weight of 80 to 95 pounds. Breeding season is usually September to February but some does, particularly Nubians, will breed at any time of the year. They are seasonably polyestrous and cycle every 20 to 21 days. Estrus lasts about two days and is detected by frequent urination, tail erect and swishing, drop in milk production, riding and being ridden by other goats, and hanging around the buck pen. Ovulation is usually towards the end of estrus and gestation is 144 to 157 days.

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ADVENTURES IN CHEESE-MAKING

Sara Bolton, Gretchen Stolfo, and Amelia Sweethardt

Pure Luck Grade A Goat Dairy
Dripping Springs, Texas

Introduction

Welcome to the Langston University Cheese-Making workshop in conjunction with Langston's *Goat Field Days*. This is the third year we at Pure Luck Grade A Goat Dairy have been invited to share our cheese-making adventures. We appreciate the opportunity and thank you for coming.

The most basic requirement of yummy cheese is the best milk available. The best milk is a direct product of your animals' health, i.e., diet, environment and sanitation practices.

Goats are browsers and will be most happy and healthy when allowed to roam and nibble leaves of trees and shrubs, grasses, and herbs. Fresh air and exercise make for healthy goats. A diet, rich in natural ingredients, such as whole grains, seeds, and fresh legume hay, make for rich, tasty milk. Goats will produce well when provided with plenty of clean fresh water. They also thrive on a consistent rhythm with plenty of love.

Cleanliness cannot be stressed enough. Your goats need a warm, dry, well-ventilated place to bed down. It's very important to thoroughly wash and dry the udder before milking. Always squeeze the first few squirts of milk into a strip cup to insure that your goat's udder is in good health. After milking thoroughly, always use a post milking teat dip to prevent any undesirable organisms from entering through the dilated orifices of the teat.

With this said, we can now proceed to cheese-making.

Always start with clean equipment and fresh supplies. As a licensed dairy, we are required to sanitize all of our equipment before use. We use Clorox brand bleach at a rate of 100 ppm with an exposure time of one minute. To maintain sanitation we drain rather than wipe dry. Clorox is the least expensive sanitizer, literally pennies per day.

To pasteurize or not? Again, as a licensed dairy, we are required to pasteurize any cheese not aged over sixty days. Since most of our cheese is very fresh, we pasteurize. Pasteurization gives you a point at which you know all bacteria have been killed, a point from which you will be able to detect any contamination-based cheese problems. There is a lot to be said for not pasteurizing and of course it is a debatable point. Any of the following cheeses can be made successfully from raw milk given that strict sanitation is practiced from the goat milking process forward.

PURE LUCK'S CHEVRE

- American Cheese Society (A.C.S.) Blue Ribbon Winner in 2000 in the Category of *Fresh Goat Cheese*.
- A.C.S. Blue Ribbon Winner in 2001 and Red Ribbon Winner in 2002 in the Category of *Farmstead Produced Cheese.*

Batch: 4 gallons of milk at 72 degrees.

Culture: Mesophyllic.

Rennet: 5 drops liquid rennet diluted in 1/4 cup of water. Stir well.

- Cover and allow to set for 18 to 24 hours.
- Scoop curd into individual molds or larger perforated containers lined with cheesecloth. Cheese will drain to 1/5th original volume.
- Allow to drain for 24 hours after which, the curd will be ready to be salted.
- Salt individual cheeses by shaking salt over entire surface. Lay on cheese mat over some kind of rack and allow to drain another 12 to 24 hours. Curd drained in larger containers will have salt blended in at a rate of 1% per total weight of curd. The salt encourages complete draining, flavors the cheese, and inhibits growth of undesirable airborne molds.
- Soft fresh goat cheeses can be flavored with chopped fresh or dried herbs or spices. The cheeses can be coated with herbs or blended into curd.

PURE LUCK'S STE. MAURE

- A.C.S. Red Ribbon Winner in 1999 in the Category of *American Made - International Style*.
- A.C.S Red Ribbon Winner in 2001 in the Category of *Soft Ripened Goat Cheese*.

Batch: 4 gallons of milk at 72 degrees.

Culture: Mesophyllic.

Rennet: 5 drops liquid rennet diluted in 1/4 cup of water. Stir well

- Ste. Maure is an A.O.C. cheese; a cheese designated by the Government of France for its region and make process.
- Ste. Maure is made exactly like Chevre until it is scooped. Ste. Maure is scooped into long cylindrical, open-bottomed molds. At Pure Luck, we fit four open bottomed cylindrical molds into a large p.v.c. cylinder to hold them upright. They are placed on a cheese mat over draining trays. We scoop four gallons of curd to 16 molds.
- The Ste. Maure is allowed to drain overnight. In the morning it is flipped (not easy) and allowed to drain another few hours.
- The molds are then removed revealing lovely log shaped cheeses about 5 inches long.
- The logs are thoroughly salted and allowed to drain for another 24 hours. At this time the cheeses are carefully inoculated with pennicillium candidum and placed in a high humidity moderately cool environment to age and develop its thick white mold. The density of the cheese with the white mold gives the cheese its sharp pungent flavor.
- Under proper conditions the cheese will take two weeks to develop.

PURE LUCK'S **FETA**

- A.C.S. Red Ribbon Winner in 2001 and 2002 in the Category of *Goat Feta*

Batch: 4 gallons of milk at 90 degrees.

Culture: Mesophillic.

Rennet: 1-1/2 tsp for 4 gallons at 90 degrees. Dilute liquid rennet in ¼ cup cool water. Stir into milk

- Let curd set for one hour or until it passes clean break test.
- Cut curd into ½ cubes.
- Let rest ten minutes.
- Stir every ten minutes for 1-1/2 to 2 hours.
- Scoop into cheesecloth lined container and allow to drain for 12 to 18 hours.
- Cut into Feta sized pieces (approximately 2" to 3") and brine. Brine is made by dissolving 2/3 of a cup of salt in one gallon cold water, and submersing cheese.
- Feta will last a minimum of one month in the salt brine.

PURE LUCK'S HOPELESSLY BLEU

Batch: 10 gallons of milk at 90 degrees.
Culture: Mesophillic. Add at 90 degrees. Allow to ripen one hour.
Rennet: Dilute 6 tsp liquid rennet in ½ cup of cool water and stir thoroughly into cultured milk. Allow to set undisturbed for 45 to 60 minutes until curd breaks clean.

- Cut curd into ½ inch cubes. Allow to rest 10 minutes so cubes form a little "hide."
- After a 10 minutes rest, stir curd gently every 10 minutes for one to 1-1/2 hours until curd feels somewhat 'raspy."
- Let sit 5 minutes so curd settles and whey rises.
- Pre-drain curd through cheesecloth lined container.
- Return curd to tub and mix gently so curd pieces are not matted.
- To the pre-drained curd add ½ to ¾ cup coarse salt.
- Dilute ¼ tsp liquid pennisillium roquefortii in ¼ cup water and add to curd. Mix well.
- Scoop curd into cheesecloth lined perforated container. Turn every ½ hour or so for 3 hours.
- Leave to drain overnight.
- Day 2, morning, salt all surfaces well and leave to drain on opposite side from previous night.
- Day 2, evening, turn cheese again and store on cheese mat in a semi air-tight plastic container. *Sterlite* works well and is available at Target, Wal-mart, etc.
- Store in refrigerator or walk-in cooler. Pennicilium roquefortii will grow at 45 degrees.
- Turn and salt daily for 3 days, shaking off excess salt each time.
- At the end of a week, use an ice pick, wooden shishkabob stick or knitting needle to poke holes through cheese, top to bottom. Pennicilium roquefortii needs oxygen to grow. This will insure nice bleu veining in your cheese.
- Turn weekly. Your cheese will need to age for at least 3 months, during which time it will be necessary to scrape off reddish-brown smear, which will develop on the surface. The scraping of the smear should take place every three weeks.
- Your Bleu may be ready to eat after 3 months, however, if you like a stronger cheese, it can age up to 6 months.
- Continue to turn weekly.

PURE LUCK'S HOMEMADE GOUDA

Batch: 2 gallons of milk at 90 degrees.

Culture: Mesophyllic

Rennet: 1 teaspoon.

- Heat 2 gallons of milk to 90 degrees. Add ¼ tsp mesophyllic culture and allow milk to ripen for 15 minutes.
- Dilute 1 tsp liquid rennet in a small amount of cool water and into cultured milk. Cover again allow curd to set undisturbed for one hour or until "clean break."
- Cut curd into ½ inch cubes and let set for 5 minutes.
- Drain off 1/3 of whey. While stirring, add enough water at 175 degrees to raise curd temperature to 92 degrees (approximately 3 cups).
- Stir occasionally over next 10 minutes. Drain whey to level of curd.
- Again, add 175 degrees water to bring curd temperature to 100 degrees. Stir constantly. Maintain at 100 degrees for 15 minutes stirring often to keep curds from matting.
- Allow curd to set for 30 minutes.
- Drain off remaining whey.
- Carefully place curd in 2# cheese mold lined with cheesecloth.
- Press at 20# of pressure for 20 minutes.
- Remove cheese from mold, turn, redress and press at 20# of pressure for 12 hours.
- After 12 hours, remove, redress and press at 20# of pressure for 12 more hours. Remove from press.
- Soak cheese in saturated brine for 5 hours.
- Remove and air dry cheese for 3 weeks at 50 degrees. Rub chevre daily in solution of 2 tsp salt to 1 cup water.
- Wax cheese and age for 3 to 4 months.

Resources

Caprine Supply
P.O. Box Y
DeSoto, Ks 66018
800-646-7736
www.caprinesupply.com

American Cheese Society
304 W. Liberty St. Suite 201
Louisville, Ky 40202
502-583-5783
www.cheesesociety.org
(specialty cheese industry association, conferences & judgings)

Crystal Creek
N9466 Lakeside rd
Trego, Wi 54888
888-376-6777
(organically approved medicines for dairy animals)

7M Farms Herbals
P.O. Box 40
Mona, Ut 84645
435-623-5798
www.7mfarm.com/herbs.html
(chemical free natural alternatives for health and care of livestock)

Dairy Connection
8616 Fairway Place #101
Middleton, Wi 53562
608-836-0464
(cultures and rennets)

Diversy Lever
3630 East Kemper Rd.
Sharonville, Oh 45241-2046
800-233-1000
(dairy soaps, acids, sanitizers)

New England Cheesemaking Supply Co.
292 Main St.
Ashfield, Ma 01330
413-628-3808
www.cheesemaking.com

Books and Publications

The following are available through New England Cheesemaking Supply or are on our web site: www.purelucktexas.com, or www.amazon.com booksellers.

Acres USA
P.O. Box 91200
Austin, Tx 78709
www.acresusa.com
(sustainable farming, animal and ag management)

Goats: Homeopathic Remedies
By George Macleod

Goatkeeping 101
Caprine Supply

Goat Health Handbook
By Thomas R Thedford, DVM

Natural Goat Care
By Pat Coleby

Dairy Goat Journal
Countryside Publications
Lake Mills, WI

Cheesemaking Made Easy
By Rikki and Rober Carroll

New American Cheese
By Laura Werlin

The Fabrication of Farmstead Goat Cheese
By Jean-Claude Le Jaouen

Goat Cheese - Small-Scale Production
By the Mont-Laurier Benedictine Nuns

The proper citation for this article is:

Bolton, S., G. Stolfo, and A. Sweethardt. 2003. Adventures in Cheese-Making. Pages 26-33 in Proc. 18th Ann. Goat Field Day, Langston University, Langston, OK.

RESULTS OF A DEWORMER RESISTANCE SURVEY IN OKLAHOMA GOAT HERDS

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Introduction

Nematodes are a major health problem for goats, which seem to be less resistant than sheep. Because of their browsing habits, normally goats are unlikely to come into contact with infective larvae, but when forced to graze, as is the common practice on commercial ranches, goats can become heavily infected. The common response on the part of the producer is the use of anthelmintics. These frequent and irregular treatment intervals select for development of parasite resistance to anthelmintics. In the summer of 2003, goat producers in Oklahoma were requested to participate in a dewormer resistance survey. Nine goat producers with sufficient numbers of animals were selected to participate in the dewormer resistance survey (Figure 1).

Procedure

On the initial visit groups of 15 goats were treated orally with either levamisole, albendazole or ivermectin or left untreated (control). The animals were weighed on a livestock scale at the time of treatment and individual fecal samples were collected to determine eggs per gram (EPG). One to two weeks later a second visit was made to collect the follow-up samples. The producers were asked about their parasite control program and the source of their animals.

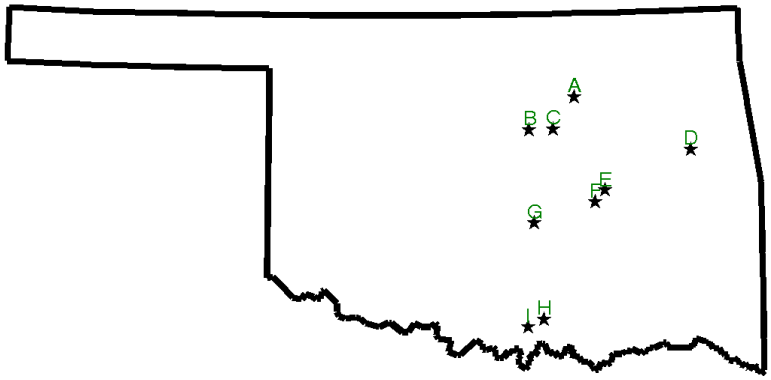


Figure 1. Locations of farms participating in the dewormer resistance survey.

In all cases the initial mean EPG were more than sufficient to provide adequate comparisons (> 500 EPG). The breeds were mostly Boer and Boer crosses although in one herd there were some LaManchas, in another there were sheep, and a third was composed of Spanish cashmere goats. Ages ranged from yearlings to aged, but in each group an attempt was made to equalize the ages as much as possible. In every case some of the goats had been purchased within the last two years, usually at an auction, but also from private breeders, so that there was always the possibility that in each farm, we were dealing with parasites from different sources.

The EPG were determined by a modified McMaster's test with a sensitivity of 50 EPG. Fecal egg count reduction results were analyzed using arithmetic means and percent reduction was calculated (TRT = treated animals; CONT = control animals):
% reduction = 100{1 – (TRTfinal/TRTGinitial) × (CONTinitital/CONTfinal)}.

Discussion


Dr. Miller conducts fecal egg counts.

The evidence indicates that in Oklahoma, ivermectin and the benzimidazoles are ineffective, even at increased doses. Only levamisole and moxidectin seem to show any promise as effective anthelmintics, a situation that severely restricts the producers' options in parasite control because annual rotation of anthelmintics is one of the primary methods of retarding resistance development. Having only one option, or at the most two, does not lend itself well to rotation.

The situation will only get worse in the future as the effective anthelmintics are used excessively, stimulating the development of resistance to them as well. To postpone that day it would be advisable for the producers to begin now with other control measures that reduce the need for chemical control of worms.

The resistance patterns on all the ranches were very homogenous. This suggests that there is a similarity of control programs among the producers as well as a significant amount of animal movement among herds. Because meat goat raising on an intensive scale is relatively new in Oklahoma, and since the Boer breed is also new to the area, to acquire the numbers of goats present, there is a lot of buying and selling with a resultant transfer of nematodes. Most of the purebred raisers supplying the market are in Texas where resistance to all anthelmintics was shown to already be present more than ten years previously, so the transfer of resistant parasites is very likely to have occurred without the necessity to develop indigenous resistant strains. None of the herds that we examined were closed herds.

Table 1. Efficacy of anthelmintics against internal parasites of goats in Oklahoma.

Farm	IVM	ALB	LEV	MOX	MOR
A	-57.78	43.37	99.04	-	-
B	18.25	85.31	97.58	-	-
C	-	3.65	98.54	-	-
D	54.28	91.42	99.95	-	-
E	61.74	59.77	92.96	-	1.48
F	57.36	53.98	98.71	-	-
G	38.20	74.41	87.66	-	-
H	-	68.75	99.48	100.00	-
I	44.20	-	92.08	-	-

IVM – ivermectin, ALB – albendazole, LEV – levamisole, MOX - moxidectin, MOR - morantel

An area of hope was that the resistant parasites would not be the most pathogenic (*Haemonchus contortus*), so that the anthelmintics that appeared to be ineffective might actually have use against this species even if the other relatively nonpathogenic species were resistant. This was not the case. *Haemonchus contortus* was the most common resistant nematode, a result not unexpected given its reproductive prolificacy compared with the other common species. Because of this, the use of nonanthelmintic control measures is even more necessary than ever.

Conducting a Fecal Egg Count Reduction Test

To detect resistance in your herd, a standardized fecal egg count reduction (FECRT) test must be conducted. This section outlines how to conduct a FECRT.

How to conduct a FECRT

1. Begin with a minimum of 24 animals.
2. Divide animals into a control group and a treatment group
3. Weigh all animals
4. Collect fecal samples on all animals
5. Dose treatment group according to weight
6. Conduct fecal egg counts on samples from step 4; see training manual below
7. Collect fecal samples on all animals 7 to 10 days post-treatment.
8. Conduct fecal egg counts on samples from step 7

Source: World Assoc. Advancement Vet. Parasitol., 1992

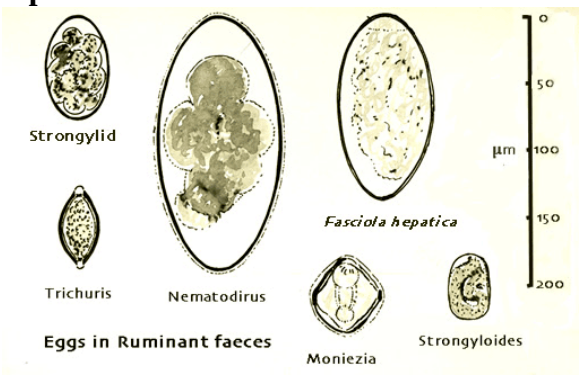
Diagnosis of Internal Parasitism in Goats

Dr. Bill Pomroy
Visiting Scholar
Langston University

Also avalible on the Internet at:

http://www2.luresext.edu/goats/library/goat_library.htm

Step #1



Fecal Egg Counts

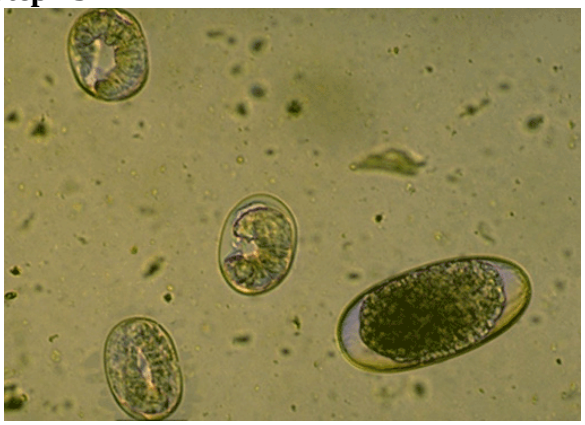
- There is a relationship between the number of worms and the number of their egg in feces.
- Different types of worms produce different types of eggs.
- All the trichostrongylid worms produce similar eggs which we can't tell apart.

Step #2

Normal strongylid egg

- The main egg type we are interested in when doing counts

Step #3



Normal strongylid egg with smaller Strongyloides eggs

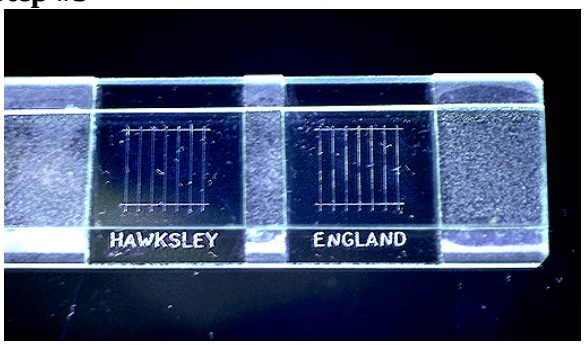
- The smaller Strongyloides eggs contain a first stage larvae when they are passed in faeces

Step #4

McMaster Egg counts

- Most common technique used
- Relies on the use of a floatation fluid in which eggs float and heavier debris in faeces sinks
- Floatation fluid needs to be at least Sp. Gravity of 1.2
- Common floatation media are various salt solutions including
    - Saturated common salt (NaCl)
    - Sodium nitrate (specific gravity of 1.2)
    - Sugar

Step #5



McMaster slide

- The other key to this technique is the use of a special counting chamber called a McMaster slide

Step #6

Tea strainer

- 2g of feces is added to 28ml of floatation fluid within the coarse sieve (tea strainer)

Step #7

Mixing solution

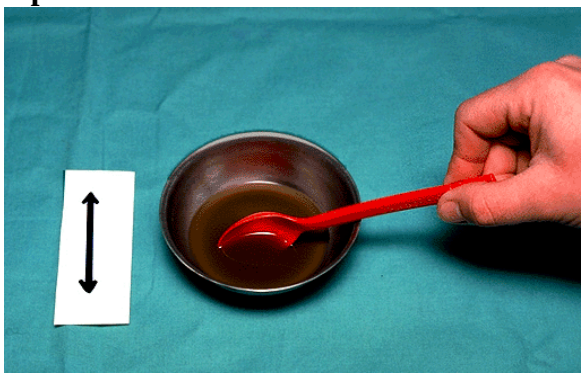
- The feces and fluid are mixed until all the lumps are broken down and the eggs "liberated"

Step #8

Tea strainer removed

- The sieve containing coarser material is then removed leaving the floatation media and smaller fecal material including eggs

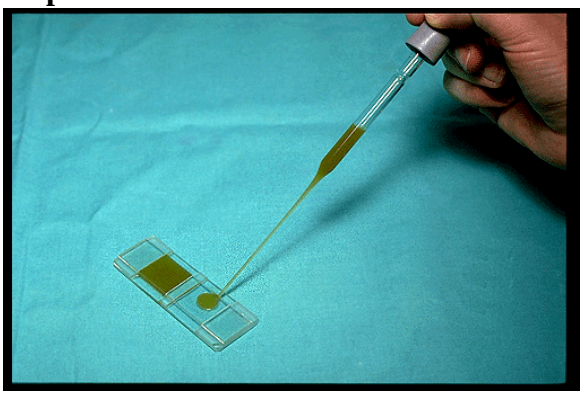
Step #9



Stirring solution

- The fluid is then thoroughly stirred with a back and forth motion. If not evenly stirred the eggs come to the surface and you do not end up with a representative count

Step #10



Filling chambers

- Fill each chamber of the counting slide separately going back and refilling the pipette each time.

Step #11

Counting chambers

- Focus on the gridlines in the chamber which are on the underside of the top slide
- Use the 4X objective lens first and then change to the 10X
- It should then be possible to see a line of each grid on each side of your field of view
- Strongylid eggs are about the same length as the gridlines are wide (don't confuse with coccidial oocysts
- Count the number of strongylid eggs in each chamber, add them together and multiply by 50 to give you a count of egg per gram of feces

Recommendations • US recommendations are that a cut-off value of 1000 eggs/g indicates the goats need treating • Goats can die with egg counts of only 2000 eggs/g so be careful • Haemonchus is a very prolific egg layer with about 6000 per day but Trichostrongylus only produces about 600 per day and Nematodirus many fewer than this • The immune response can reduce the ability of individual worms to produce eggs so more eggs per worm in young than old, especially with sheep.	

The proper citation for this article is:

Miller, D. and T. Gipson. 2003. Results of a Dewormer Resistance Survey in Oklahoma Goat Herds. Pages 34-41 in Proc. 18th Ann. Goat Field Day, Langston University, Langston, OK.

GOAT FARM BUDGETING

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Introduction

Management is the most important factor in the success of any farm operation. Profit maximization is traditionally assumed to be the overriding goal in most management decisions. In reference to the economic feasibility of a goat enterprise, producers should understand the probable cost and returns of such an operation, the profit equation, financial and production risk, and potential alternatives. Questions may arise as to whether goats will help supplement farm income or if a larger goat operation is even technically feasible. Enterprise budgets are designed to provide a decision framework for assessing both short- and long-range economic analyses of production agriculture.

Three basic types of budgets can assist with the farm and financial planning process. Each type of budget provides different information to the manager for use in the decision making process. Like a puzzle, each budget brings to the table an important piece that will help address how available resources best fit together on the farm. Specific questions such as how and what to produce, production levels, and achieving goals can then be answered once the puzzle is completed.

Whole-Farm Budgets

How to best organize and manage the farm business in a manner that is consistent with the goals and objectives of the family are vital issues in charting the future direction of the farm organization. The decision as to whether the enterprise in question will help achieve goals rests on the farm family acting as managers. OSU Circular E-887, "Goal Setting for Farm/Ranch Families", can help with the process of farm and family goal creation, prioritization, and the maximization of resources owned or controlled by the operator.

The whole-farm budget is a summary of the major physical and financial components of the entire farm business. The budget identifies the resources available to the farm business and assists in the selection of overall management strategies that complements the goals in mind. More information on whole-farm budgeting can be found in OSU F-139, "Budgets: Their Use in Farm Management".

Enterprise Budgets

An enterprise budget incorporates information about the specific resources, management practices, and technology used in the production process. More specifically, an enterprise budget illustrates the expected costs and returns, inputs and production, and timing for a particular farming activity. Among the various uses for enterprise budgets are:

1. Evaluating options before a commitment of owned or controlled resources.
2. Estimating potential income for a particular farm.
3. Estimating the size of farm needed to earn a specified return.
4. Uncovering costs that have not been previously considered.
5. Providing the documentation necessary to obtain/maintain creditworthiness.
6. Learning how to better organize and reorganize.
7. Comparing the profitability of two or more different systems of production.
8. Estimating the amount of rent that can be paid for land or machinery.
9. Identifying production and financial risks and whether they may be managed.
10. Projecting cash flows for a specific period of time.

Enterprise Budgets - Components and Concepts

Budgets estimate the full economic costs and returns projected to accrue to an enterprise. The goat budgets (Tables 1 and 2) are provided to assist goat producers in estimating their costs of production. Unless costs of production are known, you will not even realize if you are making a profit. And like the old adage says, "Nobody ever went broke while making a profit". Profit is shown as residual earnings in these budgets and will be discussed in greater detail later. An individual may use the column at the right of the budget (Your Value) to make planning adjustments.

The front-page summary of the Oklahoma State University livestock enterprise budget contains information on operating inputs, fixed costs, and production. These values represent the economic outcome expected for a production period.

Three general types of costs comprise the total cost of producing any type of farm commodity. They are variable (operating), fixed, and overhead expenses. Overhead expenses are difficult to allocate among individual enterprises. Examples include telephone, electricity and accounting services. Overhead expenses are included in whole-farm budgets, but are generally excluded (as shown in the goat examples) in enterprise budgets. Variable costs are illustrated in operating input section while fixed expenses are shown in the fixed cost section.

TABLE 1.
DAIRY GOATS 100 HEAD UNIT
CLASS #2 GRADE HERD, PER DOE BASIS — STATE

OPERATING INPUTS	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
MIXED FEED	CWT.	9.050	7.200	65.16	
ALFALFA HAY	TONS	100.000	0.900	90.00	
VET MEDICINE	HD.	10.000	1.000	10.00	
SUPPLIES	HD.	12.000	1.000	12.00	
UTILITIES	HD.	18.000	1.000	18.00	
DOE REPL FEED	HD.	32.800	1.000	32.80	
KID FEED	HD.	22.000	1.000	22.00	
BREEDING FEES	HD.	10.000	1.000	10.00	
MISC. EXPENSE	HD.	6.000	1.000	6.00	
MARKETING EXPENSE	HD.	2.000	1.750	3.50	
MACHINERY LABOR	HR.	7.50	0.847	6.35	
EQUIPMENT LABOR	HR.	7.50	1.630	12.23	
LIVESTOCK LABOR	HR.	7.50	7.692	57.69	
MACHINERY FUEL, LUBE, REPAIRS	DOL.			5.32	
EQUIPMENT FUEL, LUBE, REPAIRS	DOL.			12.57	
TOTAL OPERATING COSTS				363.62	

FIXED COSTS		AMOUNT	VALUE		YOUR VALUE
MACHINERY					
INTEREST AT	6.750%	11.80	0.80		
DEPR, TAXES, INSURANCE			2.38		
EQUIPMENT					
INTEREST AT	6.750%	209.71	14.16		
DEPR, TAXES, INSURANCE			26.31		
LIVESTOCK					
DOE GOAT		105.00			
BUCK GOAT		5.25			
REPL DOE-GOAT		37.50			
INTEREST AT	6.750%	147.75	9.97		
DEPR, TAXES, INSURANCE			18.90		
TOTAL FIXED COSTS				72.52	

PRODUCTION	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
GOAT MILK	CWT.	24.00	20.00	480.00	
MALE KIDS	HD.	20.00	0.90	18.00	
FEMALE KIDS	HD.	50.00	0.65	32.50	
CULL DOEGOATS	HD.	50.00	0.20	10.00	
TOTAL RECEIPTS				540.50	

RETURNS ABOVE TOTAL OPERATING COST	176.88	
RETURNS ABOVE ALL SPECIFIED COSTS	104.36	

5% DOE DEATH LOSS, 200% KID CROP — SAHS
10% KID DEATH LOSS, 25% DOE REPL RATE — 03/27/03

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OKLAHOMA STATE UNIVERSITY

TABLE 2.
MEAT GOATS 100 HEAD UNIT, MARGINAL LAND WITH
HEAVY BRUSH/WOODLANDS GRAZING, PER DOE BASIS STATE

OPERATING INPUTS	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
GRAIN	CWT.	3.600	1.288	4.64	
ALFALFA HAY	TONS	90.000	0.100	9.00	
VET MEDICINE	HD.	1.500	1.000	1.50	
SALT & MINERALS	LBS.	0.080	10.000	0.80	
MARKETING EXPENSE	HD.	2.000	1.256	2.51	
ANNUAL OPERATING CAPITAL	DOL.	0.068	6.038	0.41	
MACHINERY LABOR	HR.	7.50	0.787	5.90	
EQUIPMENT LABOR	HR.	7.50	0.570	4.28	
LIVESTOCK LABOR	HR.	7.50	1.000	7.50	
MACHINERY FUEL, LUBE, REPAIRS	DOL.			5.32	
EQUIPMENT FUEL, LUBE, REPAIRS	DOL.			2.01	
TOTAL OPERATING COSTS				43.86	

FIXED COSTS		AMOUNT	VALUE		YOUR VALUE
MACHINERY					
INTEREST AT	6.750%	11.80	0.80		
DEPR, TAXES, INSURANCE			2.38		
EQUIPMENT					
INTEREST AT	6.750%	77.99	5.26		
DEPR, TAXES, INSURANCE			8.35		
LIVESTOCK					
DOE GOAT		62.25			
BUCK GOAT		4.50			
REPL DOE-GOAT		15.00			
INTEREST AT	6.750%	81.75	5.52		
DEPR, TAXES, INSURANCE			5.70		
TOTAL FIXED COSTS				28.01	

PRODUCTION	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
MALE KIDS	HD	60.00	0.65	38.88	
FEMALE KIDS	HD.	55.00	0.45	24.64	
CULL DOEGOATS	HD.	50.00	0.16	8.00	
TOTAL RECEIPTS				71.52	

RETURNS ABOVE TOTAL OPERATING COST	27.66	
RETURNS ABOVE ALL SPECIFIED COSTS	-0.36	

4% DOE DEATH LOSS, 144% KID CROP
10% KID DEATH LOSS, 20% DOE REPL RATE

SAHS
03/27/03

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OKLAHOMA STATE UNIVERSITY

Variable Costs

Variable costs are those operating inputs that vary as the level of production changes. They are items that will be used during one operation year or one production period. They would not be purchased if production were not undertaken. Variable costs may also be classified as cash or non-cash in nature. For instance, labor expenses are included in the operating input section. An assumption is made where there is no differentiation made between owner supplied or hired labor. If the farm operator or his family supplies labor, a wage rate that represents a salary if employed elsewhere would be shown.

Fixed Costs

Fixed costs are those that do not change with the level of production. Generally, fixed costs are those ownership costs associated with buildings, machinery, and equipment that are pro-rated over a period of years. Fixed costs may also be cash or non-cash in nature. Real estate taxes, personal property taxes, and insurance on buildings are examples of cash fixed costs. Non-cash costs such as depreciation and interest on capital investment result in foregone opportunities. A closer inspection of the fixed costs in a typical livestock budget follows.

The interest charge for durable assets such as machinery, equipment, and breeding livestock used in the goat operation is based on the average amount of capital invested over the ownership period, usage per year, and an interest rate. Money that is tied up in these capital assets could have earned a return in an alternative use. This foregone opportunity is what economists define as opportunity costs and reflects a payment to the farmer's owned resources.

Depreciation represents an attempt to spread the investment costs or purchase price of durable assets over their productive lifetime. It is typically the largest cost associated with ownership. For example, when a tractor is worn out, it should be completely "paid for" by depreciation. A producer must, in effect, save this much every year or reinvest it in machinery and equipment, or he will eventually find himself with worn out items and no cash reserves to replace them.

Taxes vary by region but are generally a function of average value. In the goat budgets, the annual charge for taxes is based on 1% of the purchase price.

Insurance policies are usually carried on more expensive machines while the farmer generally assumes the risk of loss on the simpler, less expensive assets. The insurance costs are based on the average amount of capital invested times an insurance rate.

Production

The total quantity of production is multiplied by the actual or expected price to determine a value for production. In the goat budgets, the expected returns to the 100 doe unit are averaged for reporting on a per doe basis. This averaging process yields a realistic estimate of per doe returns to

the herd given death loss, replacement rates, and kidding percentages.

Returns Above Total Operating Costs

The returns to fixed cost, land, risk, and management is computed by subtracting total operating costs from total receipts. As long as returns are greater than total operating costs, production is economically rational for an enterprise already in production.

Returns Above All Specified Costs

In determining overall enterprise profitability, fixed costs also have to be part of the profit equation. Returns to management, land, and risk is calculated by subtracting total variable and fixed costs from operating revenues. This amount is residual earnings to the producer for management and to land (because land/pasture costs can have a large variation within a region, the goat budgets show no land cost). Each individual must decide whether this return is a sufficient reward for management skills, risk taking, and land devoted to the enterprise. It should be noted that since non-cash items may be included in fixed costs, profits as shown here are not the same as net cash or operating receipts as shown in a cash flow statement.

Dairy Goat Operations

Most dairy goat enterprises supplement income and milk consumption for home use. If a dairy goat operation is primarily viewed as a hobby, the discussion of economics may be of lesser importance than a commercial dairy. That is not to say that an enterprise budget as a decision tool is not needed for home dairies. A small herd producing milk is sometimes an expensive hobby and an enterprise budget will help illustrate why.

The whole economic emphasis changes when the discussion turns to a commercial dairy. If plans are to go public with milk sales or sell to a commercial processor while building the herd to over 50 head, the farm manager is faced with a different set of resource requirements needed to develop a productive and profitable enterprise system. An enterprise budget would be an essential tool in evaluating whether such an alternative would be to the manager's financial advantage. Farm management skills and knowledge are a very integral aspect of success with commercial dairies. The ability to bear losses from business risk, a large capital base, and well-trained labor are also important considerations.

As illustrated in Table 1, the producer is faced with a decision whether a return of $10,000 per 100 goats is satisfactory. Does it contribute enough revenue to general farm maintenance and family living? Is it adequate compensation for management efforts? If the returns are high enough, then resources may be committed to the operation in the long term.

The budget in Table 1 allows break-even analysis for the defined enterprise. Break-even analysis is a useful technique in balancing demand (revenue) and cost factors. Revenue per output

is found in terms of price times production volume. If one revenue component were kept constant, what would the other part need to be for that item's revenues to equal costs? For example, the break-even costs for producing 20 hundredweight (cwt.) of milk per doe when considering only operating inputs (and leaving other receipts constant) would be $15.16 per cwt. In other words, this is the market price of milk one would need just to cover variable costs in the operation while separating out other revenue items from consideration. The break-even price is found by subtracting other revenues per doe unit ($60.50) from total variable costs ($363.62) and then dividing by the production level of 20 cwt. Revenues of $303.20 (20 cwt. x $15.16/cwt.) is equal to $303.20 (adjusted operating costs) and net returns above total operating costs are zero. To determine the break-even production level needed to cover operating inputs, one would divide the adjusted variable costs ($303.20) by the budgeted milk price per cwt. of $24 to get approximately 12.60 cwt. of milk required. Similar calculations using total variable and fixed costs may be made when determining break-evens to cover all specified costs.

Risk assessment recognizes that production and price parameters are subject to considerable variation. Production and market uncertainty exist in goat operations due to the inability to accurately forecast productivity and prices. The producer should consider a range of outcomes in addition to average or expected values. Scenarios that produce unfavorable returns will jeopardize cash flow and financial solvency.

Table 3 provides a sensitivity of expected returns above operating costs at various milk price and production combinations. Each producer would need to evaluate their options given individual financial strengths, track record/experience, price outlook, and wiliness to assume risk.

Table 3. Sensitivity of Milk Production versus Price on Per Head Net Returns above Total Operating Costs for a 100 Head Commercial Dairy Goat Herd. *

Milk Prod. (cwt.)	-10% $21.60	-5% $22.80	Expected Price/cwt. $24.00	+5% $25.20	+10% $26.40
-20% 16.0	$42.48	$61.68	$80.88	$100.08	$119.28
-10% 18.0	$85.68	$107.28	$128.88	$150.48	$172.08
Expected 20.0	$128.88	$152.88	$176.88	$200.88	$224.88
+10% 22.0	$172.08	$198.48	$224.88	$251.28	$277.68
+20% 24.0	$215.28	$244.08	$272.88	$301.68	$330.48

Break-even milk production/cwt. above total operating costs is 12.63 using the $24.00 price of milk.
Break-even milk price/cwt. above total operating costs is $15.16 using a production of 20 cwt.
*** As shown in Table 1. Break-even price and production are calculated to cover total operating costs only while keeping revenues from kid and cull sales constant.**

Meat Goat Operations

Although meat may be produced from Angoras and dairy goats, other goats are raised exclusively for this purpose. Income from meat goat production may not generate as much income as other livestock, except in areas where land areas will not support other grazing livestock such as beef cattle. Many herds are utilized for smaller land areas where brush or weeds are a problem. As with dairy goat operations, there are a number of management practice considerations that influence profitability more than perhaps buildings and equipment.

Due to a lack of a developed nationwide marketing system in the United States, prices tend to vary widely and fluctuate seasonally. However, goat meat is favored by a number of ethnic groups in this country and many producers cater to these populations on an individual basis. Improved production practices and management techniques will be needed to insure profitability within the commercial production sector. On the demand side, meat quality standards will need to be in place before national distribution systems develop.

In Table 2, revenues are sufficient to cover variable and a portion of the fixed costs. Returns above all specified costs are negative. The enterprise would not be self-supporting in the long run and is not rewarding the operator financially for management skills. If meat goats are viewed as a hobby or for home consumption, then once again, economics may play a lesser role in deciding whether to produce or not. Many producers in this situation realize that the operation may not "pay for itself", but that is a sacrifice they are willing to make. However, if long-run returns appear unsatisfactory, the best decision may be to exit the enterprise and employ resources in a different enterprise or investment.

The meat goat budget also allows a break-even analysis for this enterprise. One could determine a break-even cost above operating cost when separating fed kid revenues from culled does. For example, when considering only male kid production (and keeping other receipts constant), the break-even price per male kid would be just $17. This is found by dividing adjusted operating costs ($43.86-$32.64=$11.22) by .65. Once again, revenues of approximately $11 ($17.32/hd. x .65) equals total operating costs (adjusted by subtracting other revenues not in consideration). Therefore, net returns above total operating costs are zero.

Production and price uncertainty will also impact a meat goat operation. Several "what-if" scenarios consisting of male kid prices and overall kidding percentages are shown with their effects on net returns above operating costs in Table 4.

Table 4. Sensitivity of Kid Crop Percentage versus Male Kid Price on Per Head Net Returns above Total Operating Costs for a 100 Head Meat Goat Herd. *

Kid Crop %	-10% $54.00	-5% $57.00	Expected Price/hd. $60.00	+5% $63.00	+10% $66.00
0.8 of Exp. 115%	$10.16	$11.72	$13.27	$14.83	$16.38
0.9 of Exp. 130%	$16.96	$18.71	$20.46	$22.21	$23.96
Expected 144%	$23.77	$25.71	$27.66	$29.60	$31.54
1.1 of Exp. 158%	$30.57	$32.71	$34.85	$36.99	$39.13
1.2 of Exp. 173%	$37.38	$39.71	$42.04	$44.37	$46.71

Break-even kid crop percentage above total operating costs is 89%using the $60.00 price per male kid.
Break-even male kid price per head above total operating costs is $17.32 using the 144% kid crop.
*** As shown in Table 2. Break-even price does take into account adjustments in female sales while keeping other production parameters constant. Break-even kid crop percentage assumes a constant price structure from other revenue sources with respect to male kid prices.**

Partial Budgets

The third type of budget that is useful in farm management and planning is the partial budget. Partial budgets reveal the effects of a specific change from an existing operation. It only considers the net economic effects of a proposed change and its impact on the total farm budget.

For example, one may consider kid sales at weaning versus at 90 days postweaning. Will the cost savings more than offset a loss in revenues? A partial budget format as shown below helps determine the positive and negative economic effects.

If I Sell Kids at Weaning Instead of 90 Days Later.

Additions to Income		*Subtractions from Income*	
Added Receipts Kid sales at weaning weight of 15-20 lbs.		**Added Expenses** None, assuming marketing expenses are constant.	
Reduced Expenses Expenses associated with feeding kids 90 more days.		**Reduced Receipts** Kid sales at heavier weights, approx. 65 lbs.	
Total Additions	$$$	***Total Subtractions***	$$$
		Net Change of selling weaned vs. heavier kids	

For more information, please refer to OSU F-139, “Budgets: Their Use in Farm Management”.

Sources of Budget Information

To enhance their use as a decision aid, goat budgets should be based on the best information possible. And many times, that begins with the operator's own records. The sample budgets previously discussed may be tailored to fit an individual producer's operation. Their reliability as a planning tool is only as good as the quality of the data. Keep in mind that experiences from one year is only an indicator and not a guarantee of a future occurrence.

Several informational systems are available to goat producers in Oklahoma. The record-keeping system that a farm manager should use depends on the cost – time, effort, and cash – of obtaining a system, maintaining it, and the value of the output as a decision tool. Farm record systems vary in the amount of information collected, the method of entering data, and the structure of final reports. Goat producers should choose the method appropriate to the size and complexity of their operation.

For smaller and less complex operations, hand-kept record books may be the most practical and most efficient system. Two alternatives offered by the OSU Cooperative Extension Service are:

1. Oklahoma Farm Family Account Book (Circular E-823, $2). Production and financial items by income and expense item may be recorded. Copies may be obtained from University Mailing Services, Publishing and Printing East, N. Monroe St., Stillwater, OK 74078-0505.

2. The Oklahoma Looseleaf Enterprise Record Book ($8). In addition to farm receipts, expenses, depreciation, and inventory, separate enterprise accounting allows the user to determine the relative profitability of crop and livestock enterprises. Copies can be purchased from the Department of Agricultural Economics, 515 Agricultural Hall, Stillwater, OK 74078-0505.

3. A number of computerized record-keeping systems (e.g., Quicken) are now available and are becoming more affordable. Although a computer probably won't reduce the amount of time spent keeping records, whole-farm and enterprise analysis of a large volume of transactions will be more efficient. A few keystrokes is all it takes to generate income and expense summaries, and a wide variety of financial statements. For more information on using Quicken or reviewing other commercial software packages, contact:

   Damona Doye
   Extension Farm Management Specialist
   Department of Agricultural Economics
   529 Agricultural Hall
   Stillwater, OK 74078
   405-744-9836

Other sources of information are:

1. Books on goat husbandry and industry.
2. Goat organizations.
3. Other goat producers/breeders.
4. University specialists, educational materials, and meetings.
5. Goat websites on the Internet.

Oklahoma State University crop and livestock enterprise budget software will soon be available via the Internet or CD-Rom. The CD-Rom contains all selected enterprise budgets, instruction manual, and supporting information references in Adobe Acrobat. Media and mail fees are included in the purchase price. Online purchasers will be notified via email as to their login name and password needed to access budget files and other supporting information. Purchases include periodic material updates for one year after which annual update subscriptions will be available for a fee. For more information, go to: http://www.agecon.okstate.edu/budgets/ or contact:

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Budget Limitations

Budget projections may become incomplete or unrealistic resulting in little or no value to the producer or lender if adequate farm records are not available. It is also important to understand that "best estimates" are influenced by production and price uncertainty. Everything doesn't always proceed just like you planned it. Identifying the potential sources of risk and reducing potential unpleasant surprises will result in fewer repayment problems in the future.

Budget preparation is also time consuming and hard work. Who has time to do budgets when work has to be done outside? Sitting down and documenting creditworthiness through budget planning can generate major dividends. Not only is it important to work hard, but to work smart.

Summary

Budgets, whether they are whole-farm, enterprise, or partial, are a management tool that is invaluable when evaluating the profit potential of the farming business. Although managers lack the information needed to make perfect decisions, they are forced to make decisions on the basis of information available and must accept the risk associated with that decision. Knowledge of budgeting and the ability to use them will help them make the right decision.

Two goat budgets developed at Oklahoma State University were shown to demonstrate basic economic concepts and components of an enterprise budget. Their apparent profitability or lack thereof was not meant to mislead individuals into believing that dairy goats are always more successful than meat producing ones. They should only be used as guidelines for the kinds of expected costs and returns typical with these operations. Alternatives that appear profitable for one producer may not work for another. Every goat producer's experience levels, managerial abilities, and willingness to assume risk is different. Because of these variations, each budget will need to be examined in detail to see if it is representative of his unique situation. The budgeting process is a continuous one and requires hard work. But it has become a prerequisite for survival in the goat industry.

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FINANCIAL STATEMENTS AND ANALYSIS

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Importance of Financial statements

The development of accurate financial statements is an important process for the farm/ranch manager. Financial statements not only help in meeting the documentation requirements for loan requests, but are also valuable management tools. Using financial statements, the manager can examine the financial health of the operation.

From the balance sheet, the financial position of the operation can be determined by examining the relationships between assets, liabilities, and owner's equity. The income statement indicates the performance of the operation by showing how much income was generated, how expenses were incurred, and how well debt payments were met. The cash flow statement indicates future cash surpluses and shortfalls that are necessary for planning.

Sources of Financial Information

The first step in completing financial statements is knowing where to find the financial information that is needed. Several possible sources of information are listed below. However, each individual manager may have a better idea of where to look for the appropriate information.

- Income tax returns
- Recordbooks or accounting systems
- Depreciation schedules
- Bank statements
- Financial lenders
- End of year inventories

The Balance Sheet

The **balance sheet** is a financial statement that provides information about the producer's assets (what is owned), liabilities (what is owed), and equity (net worth) and their relationships with each other at a specific point in time.

Assets are those items that are owned and provide a beneficial economic resource to the farm operator. They are normally classified as either current or non-current.

Current assets are composed of cash and items that can be converted into cash with little difficulty. They also include items that will turn into cash within the normal operating cycle of business, which is usually one year. Current assets are listing according to their liquidity (how easily they are converted to cash) with the most liquid, cash and checking, appearing first. The following is a description of several common categories that make up the current assets in the balance sheet.

Cash and checking – consists of a physical count of cash on hand and checking account balance assuming all checks written have cleared as of the date of the balance sheet.

Savings and time deposits – includes all savings accounts and certificates of deposit (CD's).

Investments and securities – includes stocks, bonds, and mutual funds.

Accounts receivable – refers to any money owed the farm operator from others.

Feed and supplies – includes feed, hay, grain, fertilizer, medicine, etc. that has been purchased but not used.

Livestock to be sold – includes livestock that will be sold in the next 12 months.

Growing crops – should equal the costs that have been spent on a crop that has not yet been harvested.

Non-current assets are things that are owned having economic lives greater than one year. All depreciable assets are considered non-current. The following is a description of common non-current assets that are found on the balance sheet.

Breeding livestock – includes bulls, cows, and replacement heifers for cattle and the same equivalents for other species of livestock.

Machinery and equipment – includes tractors, trucks, farm implements, etc.

Buildings and improvements – includes buildings, drainage systems, fences, storage bins, etc.

Real estate – includes all land that the producer is the titleholder of or land that the producer is making payments to acquire the title.

Liabilities represent everything that the farm operator owes whether in the form of cash, products, or services. Like assets, liabilities are categorized as being either current or non-current.

Current liabilities are those liabilities that will become due within one year and will be paid with a current asset or the creation of another current liability. The following is a description of common current liabilities that are found on the balance sheet.

Accounts/notes payable – includes the amounts owed to creditors (banks, credit cards, and charge accounts) for goods or services provided but not paid for.

Current portion of non-real estate loans – includes the principal and interest due in the upcoming year on loans that are for longer than one year.

Current portion of real estate loans – same as for non-real estate loans.

Non-current liabilities are those liabilities that have a maturity greater than one year. Only the principal balance of non-current loans needs to be included because the accrued interest was included in the current section. The main categories of non-current liabilities are the principal balance on non-real estate and real estate loans.

The **owner's equity or net worth** is calculated by taking total assets minus total liabilities. Equity represents the portion of the farm operator's ownership in the business. If assets increase more than liabilities, equity will increase in value. In a balance sheet, the assets must equal liabilities plus equity.

The Income Statement

The **income statement** (also called a profit and loss statement) is a summary of income and expenses for the fiscal year normally matching the tax year. It includes both cash and non-cash values and is used to help analyze the financial performance of the business. It is used as a means by which to measure profit for a business in a given year.

The income statement is divided into revenues and expenses. **Farm revenues** are derived from the normal operations of the business. Such items might include the sale of crops, feed, livestock, livestock products, and government payments. **Farm expenses** are also derived from the normal operations of the business. The cash operating expenses are broken down into a number of different categories. Most common expense categories correspond to the list of expenses on Schedule F of the IRS tax form.

Net farm income is what is left after subtracting total expenses from total revenue. It is the amount of income made from farm production for the year.

Cash Flow Statement

The **cash flow statement** is a recorded projection of the amount and timing of all cash inflows and outflows expected to occur throughout the planning period, usually one year. Inflows and outflows can be projected on a monthly or yearly basis. Breaking the cash flow statement into months will identify which months have cash surpluses and deficits and enable the manager to predict future operating loan needs.

Importance of Financial Analysis

Over time, agriculture has changed from subsistence production to modern, sometimes complex businesses utilizing land, labor, and capital with the expectation of making a profit. The need to measure financial position and performance increased when agricultural producers began to rely more on capital and less on labor and land.

Financial measures enable farm operators to analyze past performance versus present performance, present performance versus budgeted performance, and a multi-year performance trend. The user must identify which measures are most beneficial to their own situations.

Ratio Analysis

Financial ratios are an excepted method to measure both financial position and financial performance. Financial ratios are simply the result of a comparison using two elements of financial data. They can be expressed as either a percent or as a comparison to one.

There are several reasons why ratio analysis is commonly used to analyze financial data. A few of these reasons are:

- Easy to calculate
- Easy to make comparisons with other business's
- Simple to interpret
- Understood by others outside of management

Ratio analysis also has some limitations. Unfortunately, a farm business does not exist in a perfect world where everything can be quantified precisely. Consequently, reliance upon financial measures as a sole determinant of financial position and performance is cautioned. Some common limitations of ratio analysis are:

- Ratios can warn you of a problem, but they can't specifically identify the problem.
- Ratios are only as good as the data source. Ratios derived from poor financial statements can be misleading.
- Ratios should not be a substitute for good judgement and common sense.

Financial Measures Categories

There are four broad categories of financial measures that will be discussed: Liquidity, Solvency, Profitability, and Financial Efficiency. All measure either financial position or financial performance. For each category, there will be an explanation of what is being measured, a commonly used ratio, and an interpretation. All of the data needed for the ratios are found on either the balance sheet or the income statement.

Liquidity

Measures the ability of a farm business to meet financial obligations as they come due in the ordinary course of business.

Current Ratio = Total Current Assets / Total Current Liabilities

This ratio indicates the extent to which current farm assets, if liquidated, would cover current farm liabilities. The higher the ratio, the greater the liquidity. A ratio of 1:1 is marginal. A ratio of 2:1 is considered good.

Solvency

Measures the amount of debt relative to the amount of owner's equity in the business. It provides an indication of the firm's ability to repay all financial obligations if all assets were sold. This measure is very important to lenders.

Debt/Equity Ratio = Total Liabilities / Net Worth

This ratio measures financial position and reflects the extent to which farm debt is being combined with farm equity. This ratio should be less than 1:1. Lower ratios represent increased solvency.

Profitability

Measures the extent to which a business generates a profit from the use of land, labor, capital, and management.

Return on Assets = Net Income / Total Assets

This ratio measures the rate of return on farm assets and is often used as an overall index of profitability. This ratio is normally expressed as a percent. The higher the value, the more profitable the farming operation.

Efficiency

Measures the intensity with which a business uses its assets to generate gross revenues.

Turnover Ratio = Total Revenue / Total Assets

This ratio is a measure of how efficiently farm assets are being used to generate revenue. The higher the value, the more efficiently the assets are being used.

Analyzing Trends

Trend analysis is another simple and excepted way to measure financial performance. A trend indicates a direction or movement over time. To determine a trend, you make a comparison of the same measure over a period of time. In terms of financial analysis, this time period is two or more years.

Trends can be used to analyze ratios and data from past, present, and future financial statements. The following is a list of data that is commonly analyzed using trends:

- Total assets
- Total liabilities
- Net worth
- Total revenue
- Total expenses
- Net income
- Liquidity ratios
- Solvency ratios
- Profitability ratios
- Efficiency ratios

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INTERNATIONAL ACTIVITIES OF THE E (KIKA) DE LA GARZA AMERICAN INSTITUTE FOR GOAT RESEARCH OF LANGSTON UNIVERSITY

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Objectives

The E (Kika) de la Garza American Institute for Goat Research (AIGR) has as its mission to develop and transfer enhanced goat production technologies at local, state, national, and international levels. The Institute has many strong ties with research and academic institutions around the world and has hosted visiting scientists from over 20 foreign countries for the purpose of conducting research and demonstrations. More recently, international activities with foreign institutions have expanded to include more aspects of training and agricultural development. These activities provide 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. The objectives of AIGR'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(or) extension; 3) Increase the involvement of Langston University and the Institute in agricultural development and impact on human welfare; and 4) Enhance the Institute's knowledge of development and development issues.

Memorandums of Understanding and Research Grants

Over the past 10 years, AIGR has been involved in research, training, and development projects with universities around the world. Memorandums of Understanding have been signed with the Dairy Goat Research Laboratory at Northwestern Agricultural University of China (1992); West Visayas State University, Iloilo City, Philippines (1996); Alemaya University, Dire Dawa, Ethiopia (1999); and Debub University, Awassa, Ethiopia (1999). Collaborative activities have also been conducted with the Facultad de Medicina Veterinaria y Zootecnia de la Universidad Autonoma de Nuevo Leon, Monterry, Mexico with whom Langston University signed a Memorandum of Understanding in 1988. These memorandums of understanding have led to scientific exchanges and the conduct of research grants such as "Mimosine and Dihydroxypyridine Toxicity and Leucaena Utilization in Goats" conducted with West Visayas State University; "Strategic Use of of *Leucaena leucocephala* and Molasses/Urea Block for Feeding Dual-purpose Goats" conducted with Awassa College of Agriculture and Alemaya University; and "Anthelmintic Plants for Internal Parasite Control in Goats" conducted with Awassa College of Agriculture. These grants explored the use of

locally available feedstuffs for both nutritive and medicinal purposes with the goals of improving utilization of such feeds, determining efficacy of plant medicinal compounds, and increasing the scientific understanding of the nutritive and medicinal mechanisms involved.

More recent grants have included activities in agricultural development and extension along with human capacity building through training and research. This is exemplified by a grant project conducted in Armenia, a multinational grant with countries in the Middle East, and several grants conducted with Ethiopian universities.

Armenian activities

Since 2001, AIGR has collaborated with the USDA Marketing Assistance Project (MAP) in Armenia on a Goat Industry Development Project (GIDP). The USDA MAP is implementing the project that has ultimate goals of increasing farmer income through increased goat cheese production via enhanced milk yield. Goat cheese produced by participating cooperatives is sold in Armenia and exported to Russia, with plans to export to the US in 2003. AIGR has provided technical assistance and training to both Armenian and USDA staff and has sent short-term consultants to Armenia to assist in the project.

Collaborative efforts between AIGR and the USDA MAP began in 2001 when AIGR was awarded a USDA Innovation Grant entitled "Fostering Future Collaboration between US Institutions and the Armenian Academy of Agriculture through Training and Information Exchange." The goals of this grant were to provide training in dairy herd improvement techniques, artificial insemination and semen collection and freezing, and to increase AIGR's knowledge of Armenian animal production systems as well as foster future collaboration among the institutions. In August/September 2001, four Armenian scientists, one translator, and one USDA employee from Armenia spent three weeks training at AIGR. In addition to fulfilling the grant objectives stated above, AIGR scientists and staff also provided information and training on research sampling and laboratory techniques, farm management, and animal health. The Armenian scientists also visited goat farms in Oklahoma and talked to producers. Staff of the Institute traveled to Armenia in 2001 and 2002 to visit the Armenian Improved Dairy (ARID) Center to learn more about Armenian goat production and the USDA project implemented there. During their time in Armenia, AIGR staff toured many of the goat farms participating in the USDA's GIDP project and made production and management recommendations.

As a followup to that grant, in 2002 AIGR was awarded a 15-month grant for additional collaboration with the USDA in Armenia entitled "Strengthening Collaboration between the E (Kika) de la Garza Institute for Goat Research of Langston University and the USDA MAP Project in Armenia". The goals of this grant were to continue to provide technical expertise to the USDA goat project in Armenia and to provide further training in management, health, cheese making and product sanitation and safety, nutrition, and artificial insemination as well as semen collection and freezing. These objectives were accomplished through short-term visits to Armenia by AIGR staff and other experts. A further activity of the grant was to provide training to an advisor to the goat

project in Armenia. This person spent 10 days at AIGR in February 2002 prior to his travel to Armenia to take over duties in the GIDP project. In addition to providing training and technical expertise, AIGR acted as a source of information and assistance for the USDA in supplies procurement and problem solving.

Middle East Research Grant

In 2000, AIGR was awarded funding from USAID's Middle East Regional Cooperation Program for a grant entitled "Multinational Approaches to Enhance Goat Production in the Middle East" involving the Desert Research Center and Animal Production Research Institute of Egypt, the Volcani Center in Israel, the Agricultural Extension Department of the Palestinian Authority, and the Jordan University of Science and Technology. The objective of this grant is to revitalize and develop the Middle East goat industry via research and technology transfer to increase income and improve the standard of living. Some of the recent specific objectives and activities include:

1) Training in goat milk technologies for project participants
2) Training in goat health management, diseases, and production
3) Characterization of chemical quality and bacteriological status of goat milk in Middle East production systems
4) Characterization of goat production systems in the Middle East with emphasis on specific technology transfer needs
5) Transfer of enhanced technology packages to goat farmers in the Middle East

A 2-week training function on milk technologies was held in June, 2002, at AIGR, with trainees from each participating location attending. The activity was carried out to aid project activities associated with milk sampling, analyses, and processing in Jordan, Egypt, and Israel locations.

In Israel, research is being conducted on goat milk quality and properties, especially as related to its suitability for production of consumable products. It has been noted that bacterial quality of goat milk on the tank level is poor. To gain a better understanding of the bacteriological status on Israeli dairy goat farms, a program has been started with treatment of individual animals in herds to determine the prevalence of bacterial infection that might influence milk quality and thereby dairy products. Results of this work indicated that there is a relatively large number of infected udder-halves (52%) in Israeli goat herds. This situation is of major importance in respect to milk quantity and quality for product production. Milk tends to bacteriologically deteriorate faster, to develop off-flavors due to enzymatic activity, and to result in poor cheese due to high number of somatic cells.

In Jordan, data on milk chemistry and microbiology have been collected, including chemical composition and numbers and types of microorganisms in goat milk in various stages of lactation. Some traditional products such as white soft cheese, labaneh (concentrated yogurt balls preserved in olive oil), and cheddar cheese were made and evaluated for yield and chemical and microbiological composition in addition to organoleptic properties. Goat breads (Shami, Baladi, and

Hybrid) were investigated for milk production, chemical composition, and microbiological characteristics at 18 locations. Currently, milk manufacturing technologies are being transferred to farmers via the extension program, through live demonstration at the milk laboratory of the Jordan University of Science and Technology, and on the premises of the farmers during field days. Also, there was a workshop held in September, 2002, concerning goat health management, diseases, and production.

Recent activities in Egypt include characterization of current goat production systems via a questionnaire and the close measuring and recording of the production performance of goats through monthly visits to selected sample flocks representing different production systems in the region. There have been a number of technology packages introduced to Bedouin farmers to minimize costs of raising goats under the local conditions. These activities include meat goat production with a high concentrate diet, making silage with crop residues, and formulation and production of supplemental feed blocks.

Ethiopian Connection

Langston University and AIGR have had a long and fruitful relationship with universities in Ethiopia that began with the aforementioned research grants conducted with Awassa College of Agriculture and Alemaya University. In 1998, a three-year grant from the Association Liaison Office for University Cooperation in Development (ALO) using funding from the United States Agency for International Development (USAID) was awarded to Langston University for an institutional partnership with Awassa College of Agriculture of the newly-formed Debub University in Awassa, Ethiopia entitled "Enhance Food Security and Income Generating Potential of Families in Southern Ethiopia Through Improved Goat Production and Extension." In 1999, AIGR received a three-year grant for a partnership with Alemaya University, called "Enhancing Institutional Research and Extension Capabilities for Increased Food Security Through Improved Goat Production" from the United Negro College Fund Special Programs (UNCFSP) with USAID funding. Goals of these grants were to: enhance the ability of Debub and Alemaya University staff in meeting the development needs of Ethiopia; strengthen the capacity of all institutions in achieving their educational missions of research, teaching and extension; enhance food security in regions surrounding the Ethiopian universities; increase AIGR's involvement in international activities and impact on agricultural development; and increase the internationalization of staff at all institutions. These goals were achieved through a program of collaborative research, training of Ethiopian scientists at AIGR, and the establishment of village development projects designed to enhance household food security, income generating potential, and family health status through increased goat productivity. Increased goat production was accomplished via the provision of goats and appropriate technology to women's groups for goat production in villages near both universities.

Training Activities

In the conduct of these two grants from 1999 through 2001, six Ethiopian scientists, three each from Debub University and Alemaya University, spent between four and six months at AIGR for training in research methodologies and extension. Langston University faculty made a total of seven visits to the Ethiopian universities to present seminars, assist in collaborative research, and to monitor and evaluate the projects. In November 2000, Drs. Art Goetsch and Roger Merkel of AIGR held a special training in the surgical insertion of ruminal cannulas for staff members of both Ethiopian universities. Also in November 2000, as a part of grant activities, a conference on goat production was held at the Debub University campus entitled "The Opportunities and Challenges of Enhancing Goat Production in East Africa." The goals of the conference were to: 1) review the current state of small ruminant production in East Africa; 2) identify the major production constraints and areas for research and extension; and 3) create a closer relationship among animal industry, research organizations, and development/extension efforts to increase animal production. The conference was well-attended and brought together individuals from government agencies, academic institutions, national and regional livestock research centers, private industry, and non-governmental development agencies to discuss current problems and constraints to goat production and to try and develop institutional linkages to work to overcome such constraints. This conference was the first of its kind to be held in Ethiopia.

Village Development

The village development projects were begun in 1999 and 2000 at Debub and Alemaya Universities, respectively. Participating villages and women were identified and goats, production training, and forage seeds/seedlings were provided. Participating women were selected based upon criteria developed by Debub and Alemaya University staff members with input from local government officials and village elders. Selection criteria included:

- Interest in participating in the goat production project. Selected women were expected to voluntarily participate in every aspect of the project.
- Family size and livestock ownership. Large families owning few, or no, livestock had a better chance of being selected to receive goats. This was done to better achieve the objective of enhancing household food security of resource poor households.
- Priority was given to women-headed households, provided the women had time to care for the goats and that goats would not be an additional burden to them.
- Willingness to devote some area for forage production
- Low to average farm size (depending on average landholding of the area)
- Be innovative and willing to try new ideas

In return for the provision of goats, each woman agreed to return 2 young goats to the project to form the basis of "goat packets" to be provided to new participants. In 1999, 40 women near Debub University received goats and the following year 100 women near Alemaya University began the project. Since that time the numbers of women participating at each university has more than

doubled to near 100 and over 200 at Debub and Alemaya Universities, respectively. Since its inception in the Alemaya region, the project has distributed roughly 300 does and 50 bucks. Over 125 kids have been born to distributed does and over 60 animals have been returned to the project as repayment of debt. In the Awassa region, over 200 goats have been distributed. One woman who received two goats has increased her herd size to 11 animals.

The impact that the development project has had on village families has been great and will continue in the future. While it is still too early to determine the ultimate impact raising goats will have on family nutritive status and income, there are some early positive indicators. Some families have begun to milk their goats to provide their families, and particularly children, with milk to consume. Some families are also beginning to fatten excess males for sale. One woman fattened a male kid and sold it for 200 Ethiopian birr (approximately 25 USD) and used the funds to begin a small scale merchandising business. She now has capital of roughly 1000 birr (118 USD). Another woman has sold two kids and purchased corrugated tin roofing for her house, replacing the old thatch roof. Another woman has sold a portion of her goats and purchased a cow capable of plowing her fields thus saving her and her family backbreaking work and improving farm efficiency. These activities, while modest to date, show the promise that goats hold in being able to improve the lives and offer better nutrition for these families. Thus, the first steps are being realized in fulfilling the goals of the development project of enhancing family nutritive status, particularly that of children, and of increasing household income through the sale of livestock.

Furthermore, distributed goats are a resource that families can use during times of extreme stress and food insecurity. This proved to be the case during the recent drought in Ethiopia, where many families were forced to either sell goats for cash to purchase food or to consume some of their animals. While this may be considered an unfortunate end to many of the project animals, the provision of goats to these families allowed them to better withstand these abject conditions and provided a degree of food security hitherto lacking in the past. The ability to assist families in dealing with natural disasters and times of potential food shortages is a very rewarding aspect of the development program.

Enhancing Technology

In 2000, Langston University was awarded a sustainability grant entitled "Enhanced Education and Computer Capabilities: The Foundation for Sustained Collaboration" from ALO and the Education for Development and Democracy Initiative for further activities with Debub University and a new institution, Oklahoma State University was added to the partnership. During the conduct of the sustainability grant, one Debub University faculty member spent one semester in Oklahoma State University's Department of Agricultural Education, Communications & 4-H Youth Development. This was followed by a curriculum development workshop held at Debub University that was jointly conducted by an Oklahoma State University faculty member and Debub University faculty. Grant funding also provided for the training of Debub University staff in computer networking and maintenance. This grant is scheduled to terminate in June 2003.

Concomitant with the awarding of the sustainability grant, Langston University was awarded a companion Technology Enhancement grant from USAID's Leland Initiative to establish a student computer laboratory and network on the Debub University campus. In November 2001, Drs. Roger Merkel and Terry Gipson traveled to Debub University to assist with the computer laboratory setup and installation. The laboratory consists of twelve student computers, two instructor computers, one server, and three laptop computers linked to the laboratory via a wireless network. Additional equipment and software was purchased to increase the utility of the laboratory and provide resources for presentations and computer training.

Since its installation, AIGR staff have used the computer laboratory and associated equipment to provide seminars and training in computers and multimedia. Training has been done on the basics of HTML and web page design and the use of PowerPoint for presentations. Debub University staff have used the laboratory for classroom instruction and for materials and document preparation. The laboratory also provides internet connectivity for many Debub University staff.

Future Work

While the above grants have either terminated or will end in the near future, AIGR is participating in new grants with both Debub and Alemaya University. Activities with Debub University are continuing in a collaborative grant involving Fort Valley State University, Fort Valley, Georgia entitled "Improving Ethiopian Household Food Security and Enhancing the Teaching, Research and Extension Ability of Awassa College of Agriculture, Debub University, Ethiopia" funded by UNCFSP/USAID. This grant began in 2002 and will run through 2005. Also in 2002, a grant for continued collaboration with Alemaya University involving Oklahoma State University was awarded by ALO/USAID for activities through 2004 entitled "Improving Ethiopian Household Food Security and Enhancing the Teaching, Research and Extension Ability of Awassa College of Agriculture, Debub University, Ethiopia." While the first grants with these universities concentrated on goat nutrition, these followup grants focus more on reproduction and herd health, particularly artificial insemination and internal parasites. Training at AIGR and collaborative research at Ethiopia institutions are again cornerstones of partnership activities. Also included are workshops on internal parasites and control methods at both Ethiopian universities to be presented by a team of scientists from both the Ethiopian and US-based institutions. Further activities will occur in the area of artificial insemination and breeding. Boer goat semen will be collected and frozen in the US and shipped to both universities. Does will be inseminated and resulting progeny tested for production traits and used in the village development project. These activities represent the first importation and artificial insemination using Boer genetics in Ethiopia.

The End Result

Through its international activities, AIGR strives to enhance human and institutional capacity, positively impact development at the village level, and assist farmers in better providing for their families. Collaborating institutions benefit from enhanced resources and through personnel who have received training. Visiting scientists to AIGR contribute greatly to the research and knowledge generated through research activities. Through the conduct of international grants, AIGR staff have unique opportunities to learn about foreign goat production systems and constraints. Further, they learn about foreign cultures, peoples, and customs. Knowledge gained through these grants greatly assists AIGR staff in carrying out their missions of teaching, research and extension. Finally, these grants allow AIGR staff the potential to have a positive impact on the lives of village families in lesser-developed countries of the world.

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GOAT PRODUCTION AND QUALITY ASSURANCE

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Introduction

The general public has a growing concern over the safety of food products purchased and consumed due to issues such as food-borne illnesses due to pathogens, the use of drugs in animal production, and the possibility of drug or chemical residues in food products. Quality assurance programs to ensure a safe, sanitary food supply using the Hazard Analysis and Critical Control Points Analysis Program (HACCP) have been implemented by the beef, pork, and other food industries. Adoption and use of HACCP-like principles and programs in the goat industry can assist in ensuring that goat products are as safe as possible.

The HACCP system addresses food safety beginning at production and continuing through processing and marketing. In the area of processing, the U.S. Department of Agriculture mandated that meat and poultry processing establishments begin using HACCP by January 1999 to improve product safety. Small processing establishments were given a period until January 2000 for implementation.

The issue of a safe, wholesome food product is important for all goat producers. For the goat industry to successfully implement a HACCP-like program, it will take effort and commitment during all stages of production from farm to table. There are seven HACCP principles that assist producers and industry to identify, evaluate, control, and, finally, prevent food safety hazards.

HACCP Principles

1. Conduct a hazard analysis. Identify potential hazards in your production system that could allow for damage resulting in a lesser quality product or a means of introducing chemical or drug contamination.

2. Determine critical control points. Critical control points are those times in production or processing where hazards could occur resulting in lower quality products and where production changes or interventions should occur.

3. Establish critical limits for control points. Set limits to prevent problems from occurring, e.g., follow manufacturers limits on feed additives or drug withdrawal times.

4. Establish monitoring procedures for control points. These procedures assist in determining if critical limits have been adhered to.

5. Establish corrective actions. Actions to be taken when monitoring procedures indicate a problem.

6. Establish verification procedures. These procedures verify that proper corrective measures were taken and have been effective.

7. Establish record-keeping and documentation procedures. Records should be kept on identified problems, corrective steps taken, effectiveness, and methods to prevent future occurrences.

Education and Training

The key to a successful HACCP system and the assurance of a safe food supply begins with education and training. Proper information and training in management practices must be available to producers. Producers should understand the HACCP process and be able to adapt the seven principles to their production system. Owners and managers should ensure that all persons working in their production system have access to HACCP guidelines and information on proper management practices. Proper equipment appropriate to each task must be provided to all employees. This will assist in ensuring proper workplace procedure and implementation of HACCP guidelines. Importantly, each person must be aware that they are working with food-producing animals and that the production of safe goat products begins with them.

General Management

Production of safe goat products begins with the management and treatment of animals on farm. Proper management of goats decreases the stress placed on animals and results in healthier, more efficient livestock with reduced incidence of disease. Obvious benefits include decreased veterinary and drug costs, decreased labor requirements to isolate and treat sick animals to a healthier total herd. Less obvious results include a reduced chance of the appearance of drug residues in goat products and easier adherence to HACCP-like guidelines. Therefore, some general management concerns for quality goat production are outlined below.

Housing

Most meat and fiber producing goats are raised on pasture in extensive production systems. In these systems, natural shelter may be sufficient. However, goats do need shade during hot, summer months and a place to escape rain and wind at other times. A simple, three-sided shed is sufficient in most cases. Dairy goats in the U.S. are raised in a variety of systems ranging from pasture to total confinement in specially built barns. Cleanliness and manure handling are important to maintain herd health and reduce disease. Milking facilities should be easy to clean and meet all federal and state dairy standards. Hay can be fed off the ground, although this usually results in

some wastage. In general, goats prefer to eat feeds fed off of the ground and the use of feeders may improve feed efficiency and reduce possibility of transmission of parasites and other diseases.

Kidding Housing

Kidding during the cold months may be necessary to target special holiday kid markets or to facilitate year round kidding schedules. If so, the use of kidding pens under sheds or in barns will usually improve kid survival and early doe and kid performance. Special facilities may not be necessary when kidding during warmer months.

Identification

The proper identification of animals is essential for all aspects of efficient livestock production. There are two basic types of identification: permanent and temporary. Tattooing is the best method of permanent identification. Ear tags are a very commonly used form of identification.

Hoof Trimming

Goats need to have strong feet and legs to survive. Overgrown hooves can cause goats pain and suffering. Goats with overgrown hooves may not be able to move to where the feed may be located resulting in poor nutrition. An inadequately fed goat is more at risk for disease occurrence.

Premature or Weak Kids

At birth, two management practices are critical to the future health and survival of the newborn kid. The navel cord should be dipped in a solution of tincture of iodine to prevent entry of disease-causing organisms through the navel cord and directly into the body of the kid. The second critical practice is the feeding of colostrum as soon after birth as possible. The colostrum, or first milk, is rich in antibodies. Kids should receive colostrum equal to 10% of their body weight within 24 hours. For example, a six pound (3 kilogram) kid should receive 300 mL of colostrum within 12 hours. Excess colostrum can be frozen for use with orphaned kids. If no goat colostrum is available, it is better to substitute cow colostrum than provide none.

Castration

Buck kids that will not be used for breeding should be castrated. Kids should be castrated at less than fourteen days of age as castration becomes more traumatic with age. Two very efficient, and low cost methods are elastration and the knife.

Disbudding

If disbudding is a practice to be followed, it should occur within 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. The equipment most commonly used is an electric-heated metal rod with a hollowed-out end.

Fencing

Fencing is an important key to successful goat production. Correct fencing will make management easier and reduce loss of livestock. There are many types of fencing suitable for goats.

Outlined below are some of the fencing types used by goat producers.

1. Goat Net Wire Fence
2. Barbed Wire - 10-12 strand
3. Converted 5-Strand Barbed Wire Fence with Addition of 4 Strands of Barbed Wire
4. Converted 5-Strand Barbed Wire fence by Addition of 8-35 Net Wire Fence
5. Converted 5-Strand Barbed Wire Fence with Addition of 1 or 2 Strands of Electric Fence
6. Temporary Electric Fence
7. Permanent Electric Fence
8. Gallagher Electric Fence

Predator control

Goat owners recognize that a profitable goat enterprise must keep losses from predators to a minimum. Coyotes, feral dogs, packdogs, seemingly harmless neighboring dogs, foxes, eagles, owls, etc. can be killers of kids and adult goats. Control measures used are special fencing, guns, snares, traps, poisoned baits, cyanide guns, toxic collars, guard dogs, donkeys, llamas, night penning and stabling. The three most-used breeds of guard dogs are Great Pyrenees, Kommondor and Anatolian. Check with local officials prior to using poisoned baits, cyanide guns, etc.

Herd Health

A healthy herd will keep expenses to a minimum and provide greater efficiency of production. Perhaps the number one piece of equipment needed is a thermometer. You should use it whenever an animal is acting abnormal as body temperatures usually rise 24-36 hours before clinical signs appear. Normal body temperature of a goat is 101.5-103^{o}F. Anything over 104^{o}F should be considered a fever and immediate action must be taken to lower the body temperature. Outlined below are some of the common diseases encountered by goat producers.

Common Diseases

1. Acidosis
2. Bloat or Ruminal Tympany
3. Caprine Arthritis Encephalitis (CAE)
4. Caseous Lymphadenitis

5. Colibacillosis
6. Contagious Ecthyma
7. Enterotoxemia
8. Enzootic Abortion
9. Floppy Kid Syndrome
10. Johne's Disease
11. Milk fever (Parturient paresis, Hypocalcemia)
12. Pinkeye
13. Polioencephalomalacia
14. Pregnancy Toxemia (Ketosis)
15. Ringworm
16. Tetanus
17. Urolithiasis

Some of these common diseases can be prevented by vaccination. They are:

1. Contagious Ecthyma
2. Entertoxemia
3. Tetanus

Injection Methods and Sites

Medications are to administered either intramuscularly (IM), subcutaneously(SQ), intravenously (IV) or intraperitoneally (IP). IM and SQ injections are the most common and IP the rarest that a goat producer will encounter. IM injections are directly into the muscle, the best site being the heavy neck muscle. The muscles of the hindquaters are to be avoided as this could result in injection site blemish that may have to be trimmed from this high quality wholesale cut. SQ injections are given between the skin and the underlying muscular tissue. Preferred SQ site for the injection is generally anywhere over the rib cage or shoulder, near the point of the elbow. IV injections are directly into the jugular vein in the neck and require training. IP injections are directly into the peritoneal cavity or abdominal cavity and in general should only be done by a veterinarian.

Parasite Control

Parasites of goats are often shared with sheep even though the two species are different in their dietary selection and ability to extract nutrients from forages. There is no one answer as to how to control parasites of goats. However, there are several approaches that may be taken when one has an idea of when and where parasites are being acquired and how parasites survive in the environment. Losses caused by parasitic disease varies considerably from death to that of a minor annoyance. The differences may be due to geographic, genetic, or husbandry variability. Control methods should not rely on drug use alone but should be combined with management practices such as pasture rotation to ensure maximum effectiveness. The ever-increasing rise in anthelmintic resistance to common wormers has increased the importance of management in parasite control.

Milk Production and Handling

Goat milk, as stated in the U.S. Grade A Pasteurized Milk Ordinance (PMO), is the normal lacteal secretion, practically free of colostrum, obtained by the complete milking of one or more healthy goats (USDHHS/FDA, 1993). Although the National Conference on Interstate Milk Shipments (NCIMS) recognizes the differences in composition and somatic cell count (SCC) between cow milk and goat milk, sanitary requirements for Grade A cow milk in the PMO apply to goat milk.

The PMO is governed by the Food and Drug Administration and enforced by the State Department of Health or the State Department of Agriculture, specifically by the Milk Sanitation Division. To produce Grade A goat milk, a dairy goat farmer must obtain a permit from the regulatory agency and use an approved facility for milk production and handling.

Mastitis

Mastitis is defined as an inflamation of the mammary gland and is nearly always caused by bacteria. Bacteria infecting the mammary gland are classified into two major categories, contagious or environmental pathogens. Contagious pathogens are spread from an infected udder to a noninfected udder during the milking process. Environmental pathogens are present in the goat's surroundings, including feces, soil, and bedding. Transmission of pathogens from the environment to the udder mainly occurs between milking, but can also occur during milking.

A sound herd health management program is needed to be successful in the control and prevention of mastitis. This would include the implementation of an udder health monitoring program such as the Dairy Herd Improvement (DHI) testing for milk somatic cell counts. There are six basic elements of an effective mastitis control program. They include: 1) proper milking procedures and milking machine function, 2) teat dipping after milking, 3) providing the goats a clean, comfortable, and dry environment between milking, 4) use of an antibiotic therapy at dry off to eliminate existing infection, 5) cull chronically infected goats to prevent the spread of infection, and 6) keep accurate production and health records of individual goats. Monitoring and control programs will be successful only if the farmer diligently manages the herd and maintains accurate records on each animal.

Handling and Transport

Goats are highly social animals and should be maintained in groups to minimize stress. They generally are responsive to handling by humans, and adapt well to routines. Whenever possible, goats should be habituated slowly to new routines. It is important that all handling experiences are as positive as possible. Handling animals in a manner that excites or provokes them can result in harm to the animal and(or) personnel.

Transportation places stress upon goats that should be minimized. Transportation should be planned to minimize length of time to minimize stress. Appropriate handling pens and facilities will also reduce stress. It is also important to provide adequate water and feed at interim facilities where goats may spend considerable time awaiting sale or further transport.

Record Keeping

As noted in many of the above sections, proper record keeping is essential. Proper records facilitate the implementation of HACCP-like guidelines and are a useful management tool.

The above information will be incorporated into a future manual on quality assurance and HACCP-like procedures for goats. Further information can be obtained from the E (Kika) de la Garza American Institute for Goat Research.

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FORAGE BASED DAIRY GOAT MANAGEMENT

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Introduction

Pastures have not typically been utilized for milk production with dairy goats. Well, goats have been put on pastures, but for the most part, pastures have not been managed to be the major source of high quality forage for the dairy goats. Often, pastures were not fertilized and allowed to mature. Goats were usually fed hay and they nibbled some pasture as they wanted to. There is little published information about pastures for goats - a little from Mexico on brushy pastures with low levels of milk production and some from France which is in French. Nonetheless, there are a few goat producers in the US who are utilizing pasture for their milking goats.

Most of the information available for dairy production on pastures comes from dairy cow research. There has been a renaissance in pastures for dairy cows, mostly with the smaller dairies. The chief reason for going to pastures is reduced feed costs and increased profitability of the operation even though milk production levels are often reduced. One economic study showed that pasturing dairy cows improved profitability as much as using bovine growth hormone. Another benefit of pasturing has been improved animal health and reduced health expenses. This is probably a consequence of reduced production level and animal stress and the benefit of sunshine and fresh air. However, the level of management required is much higher because the pastures must be managed as intensively as the animals. An additional benefit is less barn cleaning and less time required to take care of animals since the time required for feeding is reduced.

Some international literature has shown that pasture can affect the quality and flavor of cheese made from cow milk. There is virtually no work on this subject in dairy goats. Another potential benefit is that the concentration of conjugated linoleic acid in cow milk is increased by pasture. The less grain used, the greater the concentration of conjugated linoleic acid. Conjugated linoleic acid is a compound in milk that has been identified as being anticarcinogenic (prevents cancer)and antiatheroschlerotic (prevents the clogging of arteries). It is the only animal product that has been identified as an anticarcinogen. Also, since organic grain is very expensive, organic goat milk could be produced cheaper on organic pasture since a minimum of grain would be required.

Pasture Management

Pasture management is of paramount importance if milk production from pastures is to succeed. The goal of pasture management is to supply high quality pasture starting at the beginning of lactation and maintain high quality forage in sufficient quantities throughout the lactation. The forage must be high in quality and be available when animals are lactating. Unless you are quite far south, you are unlikely to have any pasture growing between mid-December and mid-March. Therefore, it would be difficult to have pasture for kidding in February. For most of Oklahoma, cool season annuals such as wheat start producing in mid-March and kidding should be timed accordingly. Wheat and other cool season annuals (rye, oats) have the high quality that is necessary for high levels of milk production. Alfalfa is a good high quality pasture, but has the disadvantage of being later in the season (grazing beginning mid-April) and high cost of pasture establishment. Outside of alfalfa, goats like few legumes. In our experience, goats eat little of white, red, crimson, or arrowleaf clover. However, they seem to love Berseem clover, which can be overseeded with wheat. Berseem clover provides high quality forage between wheat and crabgrass. We have multiple pastures of wheat and Berseem clover. In late spring, we disk a pasture every week or two and overseed crabgrass/sudan grass into them. By staggering the planting, we can have an uninterrupted supply of high quality forage. Crabgrass is one of the highest quality warm season grasses. There are a number of other warm season grasses that are appropriate, including Johnsongrass, millet, and sudangrass. We are planning on including annual lespedeza into our warm season pastures. We have begun using cowpeas for late summer grazing. They grow well in the hot dry summer and provide high quality forage that the goats relish.

Goats need to get adjusted to pasture. Initially, when goats were put to pasture, they bawled for the barn and alfalfa hay. After 4 or 5 days, they finally decided to accept their fate and put their heads down to graze. We have had to learn which forages dairy goats do well on and which ones are not appropriate. Initially, the goats did not like the cowpeas, but after 4 or 5 days, they decided they loved them. Goats love the Berseem clover. Water is provided in each pasture. It would be good if the water could be shaded in the hot summer to keep the water and goats cooler. A portable shade is provided. It was built on a hay wagon undergear and has a corrugated metal roof about 8' off the ground and is 12 × 24', which provides sufficient shade for 50-60 goats. It was our intent to put a mineral box on the portable shade. We are experimenting with other crops for milking goats such as Puna chicory. This forage would help fill the forage gap between cool- and warm-season forages in both the spring and the fall. Orchardgrass, a cool-season perennial grass, would improve sustainability and reduce tillage needs.

2 Years of Research

We have conducted two years of research grazing dairy goats. This study also involved different levels of grain supplementation. Milk production for these two years are shown in Figure 1. This is averaged over all levels of grain which will be discussed later. The lactation curves look fairly normal, but milk production is much lower for the first year than the second year. This can be attributed to three factors. First, goats were in lower body condition when they kidded in year 1

and did not have adequate body reserves for the following lactation. Another factor was that we had some gaps in our forage system, i.e., there were some times that we did not have adequate amounts of high quality forage available for grazing. Also, we had problems with internal parasites the first year that surprised us. The problem was that the dewormer that we used did not work. Since animals in the confinement part of our operation are on concrete during lactation, they do not pick up many internal parasites and therefore we did not realize that the dewormer was not working. Does were pastured October through early March when cold weather reduced parasite problems. We did not realize that our dewormer was not working until we grazed goats during the warm, moist spring. We learned from our mistakes the first year and had much better levels of milk production the second year.

Internal parasites are one of the biggest problems in using pastures for dairy goats. The first problem is that you are limited in which dewormers can be used for lactating animals (Panacur, Valbazen, Eprinex, and Rumatel). We have dewormer resistance to the first two dewormers, but the latter two dewormers are quite effective for us. Ivermectin and Cydectin are secreted in the milk for a long time and should never be used in lactating animals. Fecal egg counts must be done every 3 weeks to stay on top of the parasite problem. Dairy does should be dewormed when fecal egg counts exceed 800 eggs per gram. Pasture rotation and the tillage of pastures helps to reduce pasture contamination. Another practice that would be useful is grazing another animal species (such as horses or cattle) on the pasture following the goats. These animals would consume the larvae and clean up the pastures. Another practice that reduces larva contamination is to make hay after grazing.

Table 1 shows the effect of different levels of grain supplementation on milk production. We calculated that animals should be able to consume enough pasture to produce about 3.3 lb of milk per day and planned on three levels of grain supplementation for milk produced above this amount. One treatment had no supplemental grain such as one may use if organic milk or high CLA milk is to be produced (treatment D). The second grain level was 1/3 lb of grain for every lb of milk over 3.3 lb (treatment C), and the third level was 2/3 lb of grain for every lb of milk over 3.3 lb (treatment B). Treatment A is our control where animals are in the barn and fed alfalfa hay and grain at the same level as treatment B. We fed an additional pound of grain to treatments A, B, and C the first 8 wk of lactation as lead feeding. Does were limited to no more than 4.4 lb of grain per day to prevent acidosis. In the first year, milk yield declined with grazing and grain level, although as discussed previously, prekidding body condition was an important factor. In the second year, milk production of grazing goats with the lower level of grain supplementation was similar to control animals in the barn. It is not known why the higher level of grain supplementation produced lower levels of milk. Also in Table 1, the lactation curve characteristics for each treatment and year are shown. Does in year 1 had lower peak yields, especially with lower levels of grain because the peak yield occurred earlier than in the second year. Milk yields peaked earlier because does exhausted body reserves sooner since they had lower body condition. Persistency (ability to sustain milk production) was also lower for goats fed lower levels of grain. In the second year when does were in better body condition, milk yield peaked at similar levels for all treatments. Peak yield tended to occur earlier in the goats being fed pasture alone, probably a consequence of energy limitation.

Persistency of all treatments was similar during the second year. Milk production responded to grain, but not dramatically. Figure 2 shows that milk production increased by 1.7 lb for every added pound of grain supplement fed. Also, it shows that animals were able to produce about 3.3 lb of milk with no grain, although, some animals on the study did much better.

Fat percentage of milk tended to be lower for animals with no grain supplementation (Table 1), probably reflecting the energy restriction of animals on this diet. Protein and lactose followed a similar trend presumably for the same reason. Despite this limitation, cheese made from milk produced on pasture alone or with the low level of grain was shown to have higher flavor scores.

Conclusions

In conclusion, dairy goats on pasture can have acceptable levels of milk production with some minor changes in milk composition, especially where grain supplementation is absent. Grazing dairy goats requires additional management demands, especially for the pasture. In areas with quite dry summers, irrigation may be necessary to insure an uninterrupted supply of forage. Internal parasites need to be monitored and controlled. For the production of organic milk or high milk high in conjugated linoleic acid, goats may produce significant levels of milk from high quality pasture alone. Pasture may offer potential for producing cheese with unique flavors.

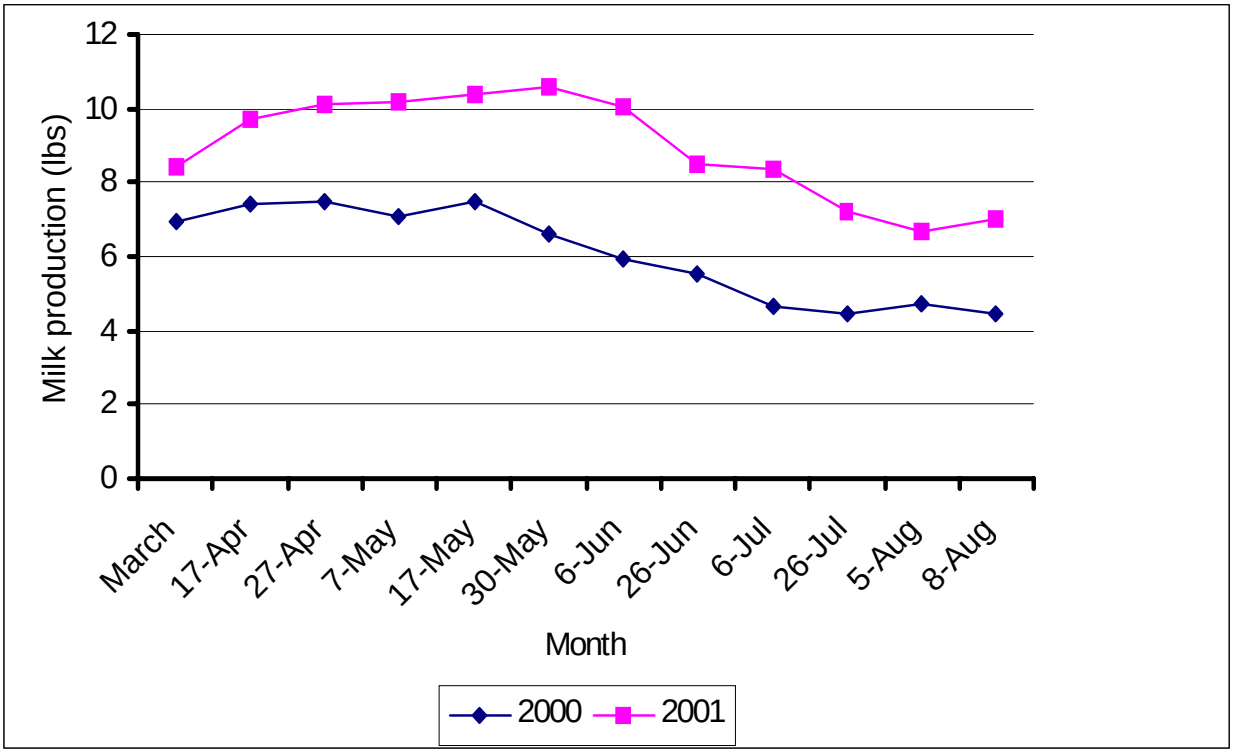

Figure 1. Lactation curve for dairy goats over two years

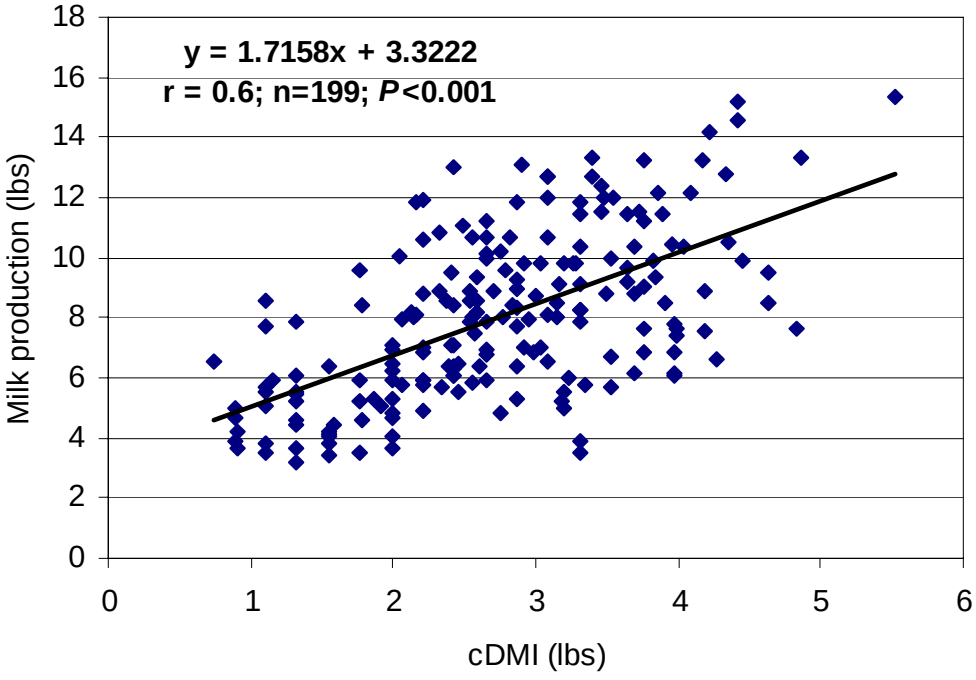

Figure 2. Effect of level of grain supplementation on milk production

Table 1. Milk production of grazing goats with different levels of grain supplementation

Item	Year	Treatment A	B	C	D
Milk production (lb/day)	1	7.55[a]	6.47[b]	5.65[c]	4.73[d]
	2	8.91[a]	8.05[b]	9.17[a]	7.74[b]
Lactation peak (lb/day)	1	8.8[a]	8.1[b]	7.7[b]	7.3[b]
	2	12.1	10.3	11.2	10.1
Days to peak	1	44[a]	32[b]	32[b]	22[c]
	2	41	37	40	36
Persistency	1	6.52[a]	6.18[b]	6.06[b]	5.64[c]
	2	6.34	6.32	6.37	6.22
Composition					
Milkfat (%)	1	3.11	3.16	3.17	3.03
	2	3.23[a]	3.16[a]	3.11[a]	2.99[b]
Protein (%)	1	3.05[a]	3.12[b]	3.19[b]	3.04[a]
	2	3.18[a]	3.07[b]	3.01[b]	2.80[c]
Lactose (%)	1	4.09[a]	4.14[a]	4.10[a]	3.99[b]
	2	4.16[b]	4.24[a]	4.19[b]	4.00c

[*]Treatment A = control group confined in the barn and fed alfalfa hay supplemented with 2/3 lb of grain for each pound of milk over 3.3 lb/day; Treatment B = grazed on pasture and supplemented with 2/3 lb of grain for each pound of milk over 3.3 lb/day; Treatment C = grazed on pasture and supplemented with 1/3 lb of grain for each pound of milk over 3.3 lb/day; Treatment D = grazed on pasture alone, no grain supplementation.

[a,b,c]Means without a common superscript are significantly different ($P < 0.05$).

The proper citation for this article is:

Hart, S. and B. R. Min. 2003. Forage Based Dairy Goat Management. Pages 75-80 in Proc. 18th Ann. Goat Field Day, Langston University, Langston, OK.

MINERALS AND MICRONUTRIENTS FOR GOATS

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Objectives

1. Learn that most minerals in the goat's diet come from plants and therefore, mineral levels in the diet are dependent on the plant species and the fertility of the soil.

2. Understand that minerals in the diet interact and an excess of one may depress the utilization of another.

Introduction

Mineral contents of the diet may be deficient, resulting in reduced animal production or deficiency symptoms, if really low, in which case we supplement to overcome the deficiency to restore optimal performance. Minerals are often adequate but at times may be excessive, which results in toxicity. Nutrition is the science of determining the nutrients required by animals and how to provide those nutrients to the animal.

Plants require all the minerals for growth that goats do except for iodine. However, the mineral requirements for plants may be much lower for plants than for animals such as for cobalt and selenium.

Many Factors Affect Mineral Concentrations in Plants

1. Legumes tend to be richer in minerals than grasses.

2. Browse and weeds usually have higher mineral contents.

3. Some minerals which are excess in the soil can result in high levels in plants, especially potassium and calcium.

4. Different species of plants will have different concentration of minerals when grown in the same soil. Therefore, since goats eat a variety of plants, it probably makes them less likely to have mineral deficiencies.

5. Some soils are inherently deficient in some minerals due to parent material the soil was formed from, e.g., iodine and selenium.

6. Plants grown on soils deficient in a mineral may be deficient in that mineral. Some plants however can concentrate available minerals.

7. Phosphorus fertilizer reduces potassium in plants and potassium fertilizer reduces calcium content.

8. Soil pH is a factor in that the farther from neutrality, trace mineral availability to the plants is reduced.

9. Temperature-grass tetany, a deficiency symptom for magnesium, usually happens under cool soil temperatures which may reduce root uptake of magnesium.

10. Seasonal variation, which may be an affect of maturity of the plants.

Can analyze plants for mineral content, but you need to get a sample of what the goats are eating throughout the day and take several samples throughout the growing season. Is expensive and not likely worth the expense for most producers. Many state extension specialists know what minerals are likely to be deficient in given areas of their state i.e. Se, and I. Goats have similar mineral requirements to beef cattle.

Macrominerals

Macrominerals are required in fractions of percentages, and include calcium, phosphorus, sodium, potassium, chloride, sulfur, and magnesium

Calcium 0.4%

Biological function
- Bones-contain 99% of calcium in body
- Necessary for muscle contraction, nerve conduction, blood clotting

Deficiency symptoms
- Rickets, bowing of limbs, lameness
- Vitamin D deficiency causes similar symptoms
- Urinary calculi if not 2:1 calcium to phosphorus ratio

Toxicity - metabolic bone disease-bent legs

Sources of calcium
- Legumes, limestone, bone meal, dicalcium phosphate

Phosphorus

Biological function
Soft tissue and bone growth
Energy metabolism and acid-base balance

Deficiency
Reduced growth, pica, decreased serum phosphorus

Sources of phosphorus
Protein supplements, cereal byproducts, mono and dicalcium phosphate

Sodium 0.2%

Potassium 0.8-2.0%

Chloride 0.15%

Biological function
All three function as electrolytes in the body
Lost in diarrhea

Deficiency
Potassium is deficient in high concentrate diets-poor appetite, urinary calculi, stiffness progressing from front to rear, pica
Chloride deficiency depressed growth
Sodium deficiency reduced growth and feed efficiency

Sources
Salt block, potassium is adequate in most forages

Sulfur 0.2-0.32%

Biological function
Protein synthesis, including milk production and hair production Production of amino acids enzymes, hormones, hemoglobin, connective tissue, and vitamins

Deficiency symptoms
Poor performance, hair loss, excessive saliva, excess tearing of eyes, weakness

Sources
Protein therefore, may be a problem on NPN diets. Water can contain sulfur
Sulfur blocks used for ticks

Magnesium 0.18-0.4%

Biological functions

Proper function of nervous and muscular systems, enzyme systems
Closely associated with metabolism of calcium and
phosphorus. Essential component of bones and teeth

Deficiency symptoms

Death, loss of appetite, excitability, staggering, convulsions, deficiency on fast growing lush pasture, especially cool season grasses called grass tetany

Sources

Forages, magnesium oxide fed with protein supplement to prevent grass tetany

Micro or Trace Elements

Microminerals are required at the ppm level, and include iron, copper, cobalt, zinc, iodine, manganese, selenium, and molybdenum.

Iron 50-1000 ppm

Biological function

Component of hemoglobin, required for oxygen transport
Component of certain enzymes

Deficiency symptom

Anemia lack of hemoglobin (contains iron) Seldom deficient because of soil

Sources

Iron is stored in the liver, spleen and bone marrow
Iron is very low in milk, kids raised for a long time on milk alone will develop anemia

Copper 10- 80 ppm

Biological function

Essential for formation of hemoglobin
Component of enzymes

Deficiency symptoms

Anemia, rough "bleached coat", diarrhea and weight loss

Toxicity

Angora goats are sensitive, meat and dairy goats are similar to beef cattle

Sources

Forages, Grains, mineral supplements, trace mineralized salt, organic copper

Cobalt 0.1-10 ppm

Biological function

Essential for formation of vitamin B-12
Rumen microbes utilize cobalt for growth

Deficiency symptoms

Loss of appetite, anemia, decreased production, weakness

Sources

Most natural feedstuffs

Zinc 40-500 ppm

Biological function

Found in all animal tissues
Required for the immune system function

Deficiency symptoms

Dermatitis, thick dry patches of skint hair loss, lesions
Swollen feet, poor hair growth,loss of hair
Essential for male reproduction

Sources

Bran and germ of cereals

Manganese 40-1000 ppm

Biological function

Bone formation reproduction enzyme functioning

Deficiency symptoms:

Reluctance to walk, deformity of forelegs,
Delayed onset of estrus, poor conception rate
Low birth weight

Source
Difficult to get a deficiency

Selenium 0.2-3 ppm

Biological function- requires vitamin E
Reproduction
Metabolism of copper, cadmium, mercury, sulfur, and vitamin E

Deficiency symptoms
Poor growth rate, kids unable to suck
White muscle disease
sudden death by heart attack progressive paralysis
Retained afterbirth

Toxicity in a few regions
Shedding of hair, diarrhea, lameness

Sources
most plants which are not grown is selenium deficient soils

Molybdenum 0.1-3 ppm

Deficiency very rare
Toxicity above 3 ppm due to reduced copper absorption

Iodine 0.5-50 ppm

Biological function
Formation of thyroid hormones which regulate energy metabolism
Reproductive function

Deficiency Symptoms
Goiter-swelled or enlarged thyroid. Do not confuse with the thymus gland on young animals
Reproductive problems-late term abortion, hairless fetus, weak kids

Source
Iodized salt

Deficiencies or Toxicities

Diagnosing mineral deficiency or toxicity - procedure used is dependent on which mineral you are looking at.

1. Blood tests for some may be mineral level such as magnesium calcium or phosphorus or another factor in the blood such glutathione peroxidase for selenium, hemoglobin for iron, zinc binding protein for zinc, or thyroid hormones for iodine.
2. Hair analysis has been used for zinc and Selenium
3. Tissue tests such as liver for iron and copper
4. Deficiency or toxicity symptoms are important-manganese and knuckling over.

Summary

Adequate levels of calcium and phosphorus in 2:1 ratio.
Free-choice mineral supplements contain macrominerals, microminerals and vitamins
Use trace mineralized salt if macrominerals are adequate.
Avoid going overboard on any supplementation.

Sources of mineral information

Goat Medicine by Smith and Sherman
Merck Veterinary Handbook
State Livestock Extension Specialist

The proper citation for this article is:

Hart, S. 2003. Minerals and Micronutrients for Goats. Pages 81-87 in Proc. 18th Ann. Goat Field Day, Langston University, Langston, OK.

EXTENSION OVERVIEW

Dr. Terry A. Gipson

Goat Extension Leader

Introduction

The year 2002 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 a quarterly newsletter. They have also been busy with several major extension activities. These include the annual Goat Field Day, Langston Goat Dairy Herd Improvement (DHI) Program, grazing research/demonstration activities, the fifth annual meat buck performance test, and various goat workshops on artificial insemination and on internal parasite control.

Goat Field Day

Our annual Goat Field Day was held on Saturday, April 27, 2002 at the Langston University Goat Farm. This year's theme was Creating Your Own Market. This year, we heard from goat entrepreneurs who have created their own markets in weed control, meat, and dairy. Ms. Lani Lamming is owner/operator of Ewe4ic Ecological Services of Alpine, WY. Ms. Lamming owns a herd of more than 600 goats and provides an environmentally friendly alternative to herbicides. Mr. John Edwards, noted Boer goat producer and judge, spoke on delivering a quality meat goat to market. Mr. Denny Bolton, of Pure Luck Texas, handles the marketing, packing, deliveries, customer relations, and paperwork for that goat cheese business, which has captured first place at the American Cheese Society's annual contest for four consecutive years. Afternoon workshops included: 1) marketing weed control, 2) marketing meat goats, 3) marketing dairy products, 4) scrapie control information, 5) basic goat husbandry I, 6) basic goat husbandry II, 7) inbreeding in dairy goats, 8) goat production and quality assurance, 9) forage-based dairy goat management, and 10) pedigree analysis. For youth, there was a Fitting and Showing for Meat Goats workshop in the morning. Each youth had the opportunity to fit and show a goat during this workshop. We had a show ring and a judge to assess showmanship.

Goat DHI Laboratory

The Langston Goat Dairy Herd Improvement (DHI) Program is housed at the dairy farm, west of campus, operates under the umbrella of the Texas DHIA. In February 1998, 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. Dairy goat clientele had to deal with records written in cow language. This meant that they could not

get accurate information on delivery dates, and that all the pages reflected cows, bulls, and calves rather than does, bucks, and kids. Additionally, research has shown that when the laboratory instruments are calibrated with a cow milk standard and then goat milk is tested, there is a 29% increase in somatic cells, a 0.27% decrease in protein, and a 0.04% decrease in butterfat from the actual values. The records produced by the DHI labs across the country are used to identify high producing does. These records are also useful for the exportation of these does to foreign countries. These incorrect records were costing goat producers on the resale value of their does and offspring. Langston University established a certified DHI laboratory that calibrates the instruments using a goat milk standard. We have also worked in cooperation with Texas A&M University to write a program that utilizes goat language. This program produces records with the any of the dairy goat breeds along with correct sex identification and expected delivery dates for pregnant does. The Langston DHI program has been very popular with dairy goat producers and has grown significantly since its establishment in 1996. Figures 1and 2 show the growth of the Langston DHI lab in terms of number of herds and doe records processed and compared with other record processing centers. Generally, there is a decrease nationwide in number of herds and does enrolled in the national DHIA program, except for the Langston DHI program. Goat producers are now able to get records for there animals that reflect accurate information with the correct language. These records not only reflect higher fat and protein values for a doe, but also are easier to understand when dealing with importers from foreign countries. Currently we are serving a 27 state area that includes a majority of the eastern states. We have over 80 herds in these 27 states enrolled in the Langston Goat Dairy DHI Program. This is an increase of 28% in herds and 32% in animals from 2001. Even though Langston University is one of the smallest certified DHIA laboratories, it recorded the largest increase in herds and numbers of the six certified DHIA processing centers that process goat records. In fact, only two processing centers showed an increase in these two categories; all the other four recorded a decrease in the number of herds and the number of animals processed. Langston University continues to serve the very small-scale dairy goat producer. The average herd size on test with Langston University is 10 animals (Figure 3). This is significantly smaller than the herd size average for the five other processing centers.

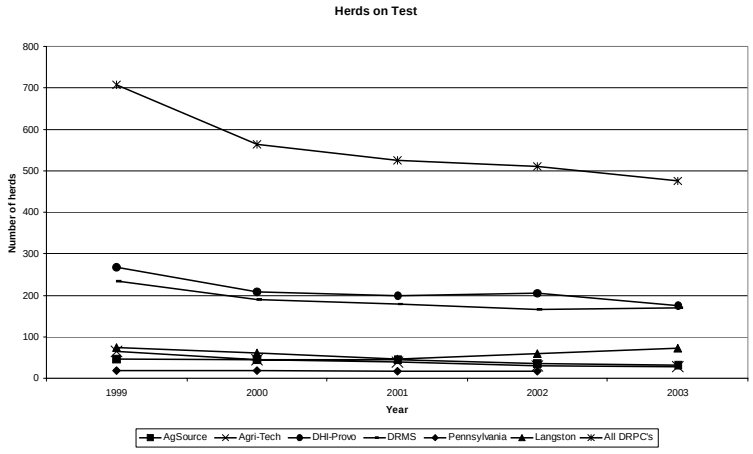


Figure 21. Number of goat herds on DHIA test by processing centers.

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. 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.

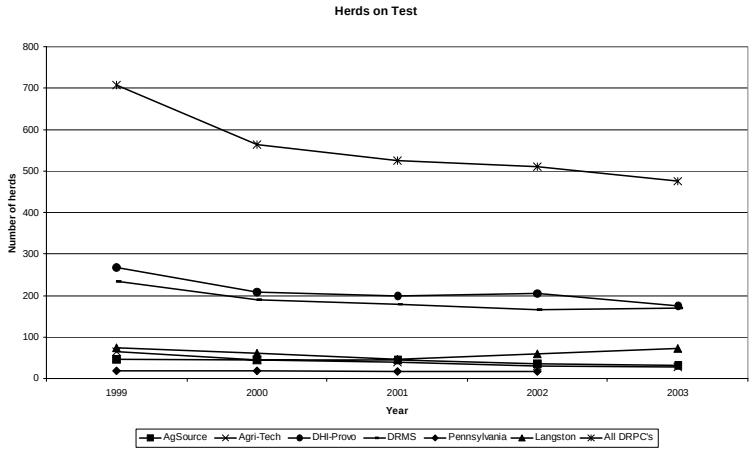


Figure 22. Number of does on DHIA test by processing center.

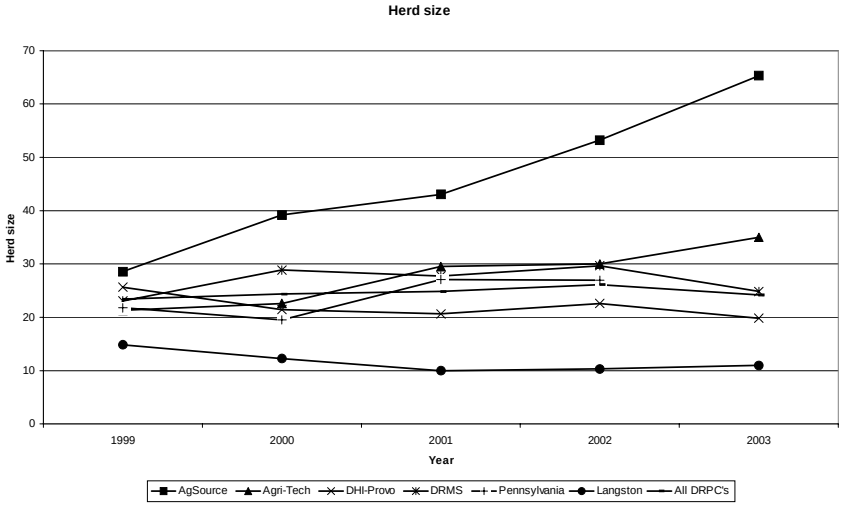


Figure 23. Average herd size by processing center.

Goat Newsletter

The Goat Extension program published four issues of the Goat Newsletter in 2002. Interest in the newsletter has grown and we currently have over 3,400 subscribers to our free quarterly Goat Newsletter. The Goat Newsletter is mailed to every state in the nation and to 10 countries overseas.

Grazing Research/Demonstration Activities

In 2001, Langston University was awarded an USDA Sustainable Agriculture Research and Education grant to study the efficacy of using goats to eliminate invasive vegetation. Caddo, Cherokee, Choctaw, Osage, Sac and Fox, and Greater Seminole Nations are collaborators, with a vegetation management site on tribal lands or land of a tribal member. Vegetation conditions and treatments being imposed vary among sites. At the Caddo demonstration site, we are examining effects of goats and sheep. At the Cherokee site, we are comparing effects of goats with those of mechanical and chemical controls. At the Chotaw site, we are grazing goats alone versus goats plus cattle or cattle alone. At the Osage and Greater Semionle sites, there are different stocking rates of goats. The Sac and Fox site also involves different stocking rates, but in addition includes a rotational grazing treatment. The first year of grazing was in 2002, and the second is in 2003. Workshops were held at each site in the fall of 2002, and will also occur in 2003. In addition to results of this project, we also presented information on basic goat husbandry.

Figure 24. Location of the SARE research/demonstration grazing sites.

Artificial Insemination Workshop

A workshop on Artificial Insemination was held on Saturday, September 14, 2002 at the South Barn on the Langston University campus. Twenty participants attended the workshop. In the morning session, Dr. Terry Gipson gave a presentation on basic anatomy and physiology of female reproduction. Dr. Lionel Dawson gave an overview about small ruminant reproduction, emphasizing estrus detection and estrus synchronization, and Mr. Les Hutchens of Reproductive Enterprise gave an instructional presentation on AI kit contents and directed the examination of real female reproductive tracts. After a lunch of goat burgers, baked beans, and potato salad, Mr. Les Hutchens gave instructional presentations on semen tanks, semen handling, breeding soundness exams, and the practical hands-on insemination of live animals.

After the AI workshop concluded, Dr. Dan Miller conducted an abbreviated internal parasite workshop. All twenty of the AI workshop participants stayed for the internal parasite workshop and an additional two participants arrived for this session.

In an effort to move the university to the producers, Langston University conducted it's second hands-on artificial insemination workshop off-campus in Tahlequah,

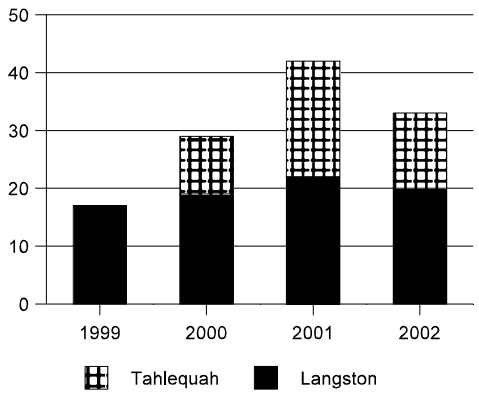


Figure 25. Number of participants enrolled in AI workshops.

OK on October 12, 2001. Thirteen participants attended the artificial insemination workshop at the Cherokee County Fairgrounds hosted by Ms. Candice Howell, Langston University Youth Specialist. The same format and personnel were involved in the Tahlequah workshop as in the Langston workshop except that Mr. Mark Mouttet replaced Mr. Les Hutchens. After the AI workshop concluded, Dr. Dan Miller conducted an abbreviated internal parasite workshop. Twelve of the thirteen AI workshop participants stayed for the internal parasite workshop and an additional three participants arrived for the session.

Controlling Internal Parasites Workshop

In 2002, Langston University was awarded an USDA Risk Management Education grant to conduct workshops on controlling internal parasites. Controlling internal parasites is the number two cost of production for goat producers. Many of the anthelmintics on the market are not labeled for goats and there is considerable confusion among goat producers about effective control programs. Goat producers tend to underdose and overuse anthelmintics; both hasten anthelmintic resistance. Langston University initiated a workshop to help goat producers develop a sustainable control program for internal parasites. In the workshops, goat producers learn about the life cycles of the most common and the most pathogenic parasites, various families of anthelmintics, correct dosage and dosing procedures, how to collect fecal samples, and how to conduct fecal egg counts. Every year, one workshop is held at Langston and one is held at various locations in-state. Also in 2002, producers were identified who wanted to participate in an anthelmintic resistance survey, one of the most pressing problems for small ruminant producers.

An understanding of life cycles enables the goat producer to devise seasonal control strategies. An understanding of anthelmintics enables the goat producer to rotate them for more efficacious control and to follow withdrawal times. An understanding of correct dosage and dosing procedures enables the goat producer to administer anthelmintics to achieve optimal efficacy. The ability to conduct fecal egg counts allows producers to deworm their goats on an as-needed basis instead of a calendar or other equally unreliable basis. A decrease of just one deworming will save the goat producer $1.20 per goat, slow anthelmintic resistance, and better ensure a wholesome product. Over a four-year period, 134 participants have learned new management skills for controlling internal parasites. Due to the hands-on nature of the workshops, they are limited to twelve participants. In 1999, twelve participants attended the workshop and in 2000, seven attended. In 2001, three workshops were held; six participants attended the workshop at Langston University, four participants attended at McAlester, and eight attended at Tahlequah. In 2002, two workshops were held; ten participants attended the workshop at Langston University and eight attended at Atoka. In 2002, abbreviated workshops were held in conjunction with the Summer Institute (39 participants) and the artificial insemination workshops (40 participants). In 2002, a survey of anthelmintic resistance was conducted on nine cooperators' farms. Widespread resistance was found to benzimidazoles and ivermectins. Levamisole appeared to be the most efficacious.

Junior Oklahoma Boer Goat Association Show

Following the midpoint report of the buck performance test, at 12:00 (noon), the Junior Oklahoma Boer Goat Association held their annual fund-raising show at Langston University. There were 60 entries with 28 exhibitors with four classes of does, five classes of wether market goats, and two buck classes. The were also three classes of showmanship. The judge for the second year in a row was Mr. Marvin Shurley of Sonora, TX. Mr. Shurley is the president of the American Meat Goat Association. The JOBGA show was a huge success and the JOBGA was very appreciative of the major role that Langston University played in providing the opportunity for the youth of Oklahoma to gain experience in showing and exhibiting livestock.

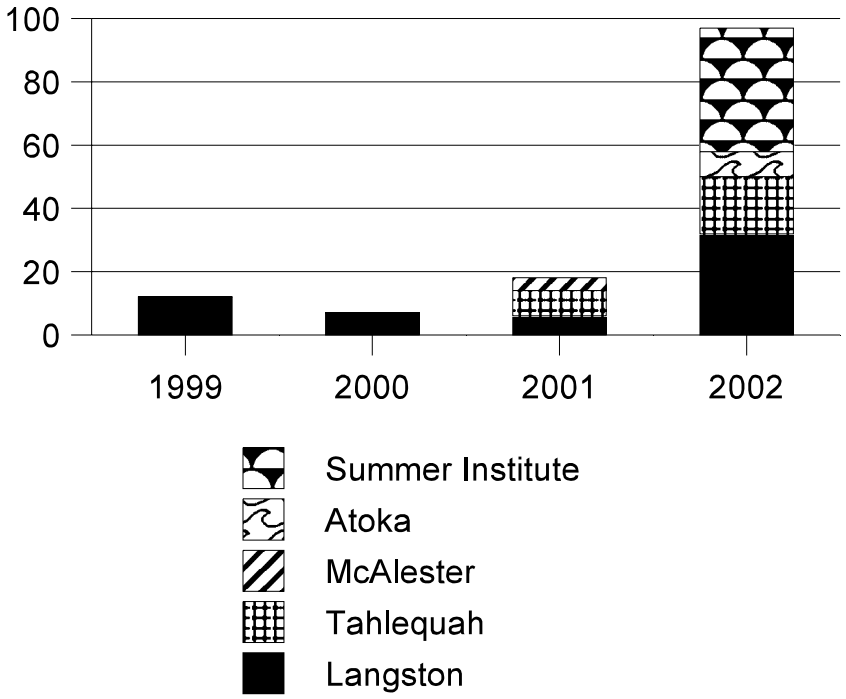


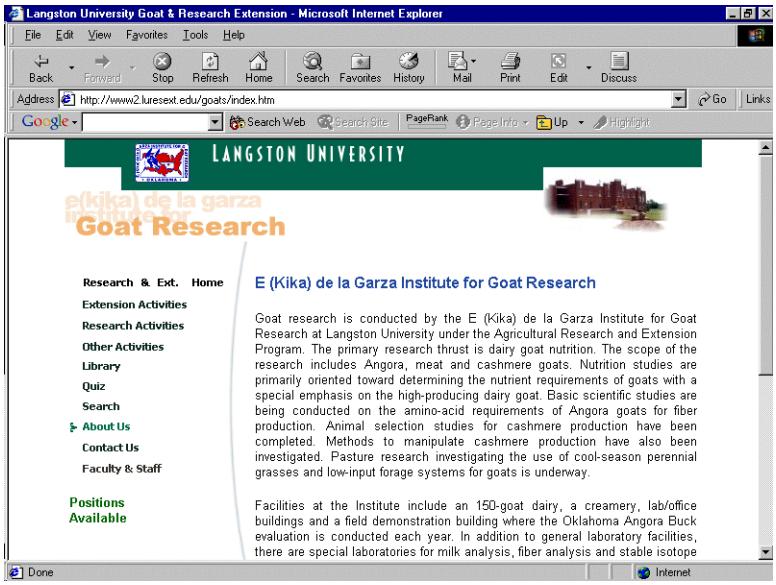
Figure 26 Number of participants enrolled in Internal Parasite workshops.

Internet Website

http://www2.luresext.edu

The Agricultural Research and Cooperative Extension program of Langston University recently unveiled a new and improved Internet web site. The Internet address (URL) of the new web site is http://www2.luresext.edu.

Capabilities of the new web site include a document library with the complete proceedings of the annual Goat Field Day for the past three years and the quarterly newsletter for the past two 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 are able to take a Virtual Tour of the research farm and laboratories, complete with digital photos and narrative. A digital Photo Album can be browsed, and the site also allows for subscription to our free quarterly newsletter online. Knowledge about goats can be tested 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 can their own to be included in the database. And, research interests of faculty are presented, along with Email addresses for faculty and staff.

Summer Institute

Introduction

In 2002, Langston University was awarded an USDA Risk Management Education grant entitled "Establishment of a Summer Institute Promoting Farm Security and Diversification among African-American & Native American Small Farmers." Between 1920 and 1978, the number of white-operated farms in the United States declined by 63%. In the same period, the number of black farmers in the US fell from 925,710 to 18,816, or by 98%. During the same period, the number of Native American operated farms fell from 1,108 to 600, a drop of more than 45%. Today, land African-Americans hold is irreversibly slipping away, leaving an entire race of people dispossessed and excluded from the production end of the food system. The continent's first farmers, the indigenous people who first domesticated the crops that now comprise 58% of the world food supply, have not only lost a huge majority of their ancestral lands, they have seen their peoples devastated (Rural Coalition, 2002; Decline in Minority Farmers). Since the 1960's, black farmers have lost 27 million acres of privately owned farmland, and as acreage shrank, so did the number of black farmers. In 1920, there were nearly one million black farm operators in the United States. Today, there are fewer than 17,000. That means black farmers are going out of business at a rate three times that of white farmers (Public Broadcasting Service, 1999; Discrimination on the Farm).

Background

Seven Langston University Outreach Specialist service 27 of 77 counties or 35% of all of Oklahoma. Although, these 27 counties constitute 64% of the African Americans and 52% of the Native Americans living in Oklahoma (U.S. Census Bureau, 2000a). If Tulsa County is included, which abuts Wagoner, Okmulgee, and Creek Counties (two counties serviced by the Langston University Outreach Specialists), then 87% of the African-American and 63% of the Native American population is serviced. According to the U.S. Census Bureau (2000b), Oklahoma's population of 3.5 million is 76.2% white, 7.9% Native American, 7.6% African-American, and 8.3% other races. Although these estimates are slightly below the national average of 12.3% for African-American, they are well above the national average of 0.9% for Native Americans. Oklahoma is unique in the nation in having almost an equal population of these two minority groups.

Summer Institute

The Summer Institute was an all-day workshop held approximately every other week over the course of the summer (24 workshops total). The topics of the Summer Institutes were:

1. fencing and housing, which provided hands-on fencing training on electrified and non-electrified fencing, shelter construction, and other considerations;

2. acquisition and selection of stock, which provided sources and the judging of animals on structural soundness and conformation, and other considerations;

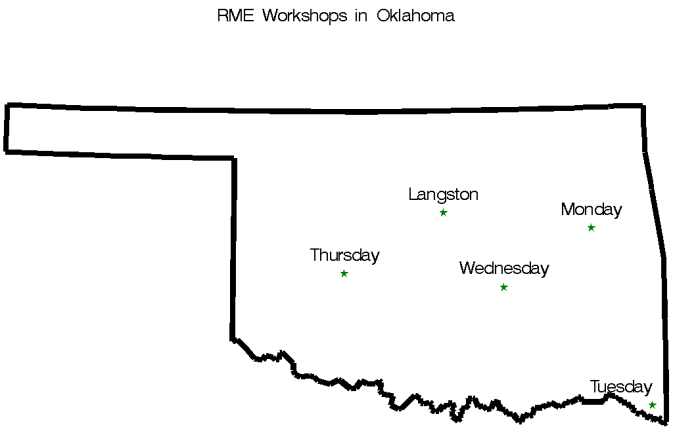
3. herd health and general management concerns, which provided hands-on training in vaccinations, dewomers, drug use, drug residue avoidance, injections sites, and other health considerations;

4. feeding and nutrition, which provided hands-on training in forages and grass identification, hay making, feed tag ingredients, ration balancing, and other nutritional considerations;

5. breeding and kidding management, which provided hands-on training in breeding soundness examination, selection of breeding stock, allocation of breeding groups, heat detection, ear tagging, navel dipping, record maintenance, and other considerations; and

6. marketing and record keeping, which in provided financial and herd record keeping tips, spreadsheets, understanding of the demand for product, marketing channels, broker intervention, consumer preference, and other marketing considerations.

Each topic workshop was be repeated four times according to the map at the right.



Tulsa State Fair

At the 2002 Tulsa State Fair, Langston University participated in the Birthing Center program with five pregnant Spanish does. Dr. Carey Floyd of the Oklahoma Department of Agriculture coordinated the birthing center and said that the goats were the highlight. The eight does gave birth to four sets of twins and four sets of singles. This was a huge success and plans are underway to provide pregnant does for 2003.

Oklahoma Black Historical Association

In 2001, Langston University signed a memorandum of understanding with the Oklahoma Black Historical Association to conduct a goat grazing demonstration. The objective of the memorandum was to conduct a vegetation management demonstration and appropriate goat management workshops to complement the demonstration project. In late June, 24 Alpine wethers and doelings were transported to the Oklahoma Black Historical Association site near Nobletown. Goats were returned to Langston University in late August after they had eliminated the brush on the 8-acre parcel, and workshops were held in the Wewoka area.

Meat Buck Performance Test

Meat goat production represents the most rapidly growing animal industry in the US today, and is becoming a mainstream livestock enterprise. To further the genetic progress through the identification of superior sires in the industry, Langston University and the Oklahoma Meat Goat Association established a meat goat performance test in 1997.

Entry

The sixth annual meat buck performance test started May 4, 2002 with 51 bucks enrolled from 17 different breeders. Forty-six of the bucks were fullblood Boers, three Kiko bucks, one Kiko-cross, and one Boer-cross buck. Twenty-eight bucks were from Texas, 17 from Oklahoma, and 6 from Illinois. The test was open to purebred and crossbred bucks born between December 1, 2001 and March 31, 2002.

Bucks were given a thorough physical examination by Dr. Lionel Dawson, dewormed with Valbazen (albendazole), foot bathed with Nolvasan, deloused with Atroban De Lice, given a preemptive injection of Nuflor for upper respiratory infections, and, when needed, a booster or an initial and booster vaccination for enterotoxemia and caseous lymphandinitis were given. All bucks were retagged by Extension staff after admission to the performance test. Four weeks after check in, all bucks were given a booster vaccination for enterotoxemia and caseous lymphandinitis. On May 4, the entrance weight for the 51 bucks averaged 51.8 lbs with a range of 31.0 to 82.5 lbs.

Adjustment Period

All bucks underwent an adjustment period of eighteen days immediately after check in. During the adjustment period, bucks were acclimated to the test ration and to the Calan feeders. Nine bucks were assigned to each 20' x 20' inside pen equipped with nine Calan feeders. Each pen also had a 20' x 20' outside run. Inside pens and outside runs were separated by overhead doors, which were raised or lowered as the weather dictated. Every other pen was also equipped with a fan to circulate air in the barn complex whenever needed. The grass in the outside pens was mowed often, and grazing was negligible. Each buck wore a collar with an electronic "key" encased in hard plastic. The key unlocks the door to only one Calan feeder, thus enabling the buck to eat out of his individual feeder. Each morning, the feed remaining in the Calan feeder from the day before was weighed and removed from the Calan feeder. Fresh feed was weighed and placed into the Calan

feeder. The difference in weights between the fresh feed place in the Calan feeder one morning and the remaining feed the next morning is the amount consumed. Because only one goat is capable of opening the Calan door and eating, it is possible to calculate the feed intake of the individual bucks. The area immediately around the Calan feeders and waterers is concrete; however, the large majority of the inside pen is earth and is covered by pine shavings. Pine shavings were periodically added as needed to maintain fresh bedding. Bucks had free access to float-valve raised waterers.

Unfortunately, on 5/12/02, Buck #1019 was found dead. The buck was taken to Oklahoma State University's Diagnostic Laboratory. The post mortem report indicated that the animal had died of asymptomatic polioencephalomalacia. No other animal has shown any sign of major illness and to date the health problems of the bucks on-test have been minimal.

Diet

Nutritionists at Langston University formulated the following diet. In 1999, amounts of salt and ammonium chloride were increased due to problems with urinary calculi the previous year. Except for these changes, the diet is the same as used in the first two meat buck performance tests. The diet was fed free-choice during the adjustment period and during the 12-week test.

Ingredient	Percentage (as fed)
Cottonseed hulls	29.07%
Alfalfa meal	19.98%
Cottonseed meal	15.99%
Ground corn	15.99%
Wheat midds	9.99%
Pellet Partner (binder)	5.00%
Ammonium chloride	1.00%
Yeast	1.00%
Calcium Carbonate	0.95%
Salt	0.50%
Trace mineral salt	0.50%
Vitamin A	0.02%
Rumensin	0.01%
TOTAL	100.00%

The crude protein content of the diet is 16%, with 2.5% fat, 20.4% fiber, and 60.6% TDN. Calcium phosphorus and sodium levels are 0.74, 0.37, and 1.07%, respectively. Zinc concentration is 33.04 ppm, copper is 17.15 ppm, and selenium is .21 ppm.

ABGA Approved Performance Test

In early 2000, the Oklahoma performance test was designated by the American Boer Goat Association Board of Directors as an ABGA Approved Performance Test. Qualified fullblood or purebred Boer bucks will be eligible to earn points towards entry into the "Ennobled Herd Book." Candidate bucks must pass a pre performance test inspection conducted by one (1) or more ABGA approved breeders.

Ten (10) points will be awarded a Boer buck who shows an average daily weight gain (ADG) in the top five percent (5%) of the animals on test. Five (5) points will be awarded a Boer buck who shows an average daily weight gain (ADG) in the next fifteen percent (15%) of the animals on test. All bucks must gain at least three tenths (0.3) of a pound per day to be awarded any points.

The Oklahoma performance test continues to grow and to serve the meat goat industry.

Gain

The official performance test started on May 23 after the adjustment period was finished. Weights at the beginning of the test averaged 58.3 lbs with a range of 36.3 to 91.4 lbs. Weights at the end of the test averaged 105.8 lbs with a range of 72.7 to 150.9 lbs. Weight gains for the test averaged 47.5 lbs with a range of 20.9 to 67.2 lbs.

Average Daily Gain (ADG)

For the test, the bucks gained on averaged 0.57 lbs/day with a range from 0.25 to 0.80 lbs/day.

Feed Efficiency

For the test, the bucks consumed an average of 338.6 lbs of feed with a range of 168.5 to 548.8 lbs. For the test, the bucks averaged a feed efficiency of 7.2 (feed efficiency is defined as the number of lbs of feed needed for one lb of gain), with a range of 4.5 to 10.3.

Muscling

The average loin eye area as determined by ultrasonography was 1.65 square inches with a range of 1.22 to 2.17 square inches, and the average right rear leg circumference was 20.2 inches with a range of 16.0 to 20.2 inches.

Index

For 2002, the index was calculated using the following parameters:

- 30% on efficiency (units of feed per units of gain)
- 30% on average daily gain
- 20% on area of longissimus muscle (loin) at the first lumbar site as measured by real time ultrasound adjusted by metabolic body weight:

$$\frac{\text{area of longissimus muscle (loin)}}{BW^{0.75}}$$

- 20% circumference around the widest part of the hind right leg as measured with a tailor's tape adjusted by metabolic body weight:

$$\frac{\text{circumference of hind left leg}}{BW^{0.75}}$$

The adjustment to metabolic body weight gives lighter weight goats a fair comparison of muscling to heavier goats.

The deviation from the average of the parameters measured from the goats in the performance test was used in the index calculation. Thus, the average index score for bucks on-test was 100%. Bucks that are above average have indices above 100% and those below average have index scores below 100%.

Congratulations

The Oklahoma Meat Goat Association and the Agricultural Research and Extension Program at Langston University congratulate:

- Mr. Martin Peters of Barksdale, TX
  for having the Top-Indexing buck
  in the 2002 Oklahoma Meat Buck Performance Test

Also, deserving congratulations are:

- Mr. Dan Wagner of Sonora, TX
  for having the #1 (tie) Fastest-Gaining buck
- Ms. Judy Hollis of Sonora, TX
  for having the #1 (tie) Fastest-Gaining buck

- Mr. Al Paul of Aubrey, TX
  for having the #3 Fastest-Gaining buck

- Ms. Lynn Farmer of Mullin, TX
  for having the #4 Fastest-Gaining buck

- L&W Boer Goats of Freedom, OK
  for having the #5 (tie) Fastest-Gaining buck

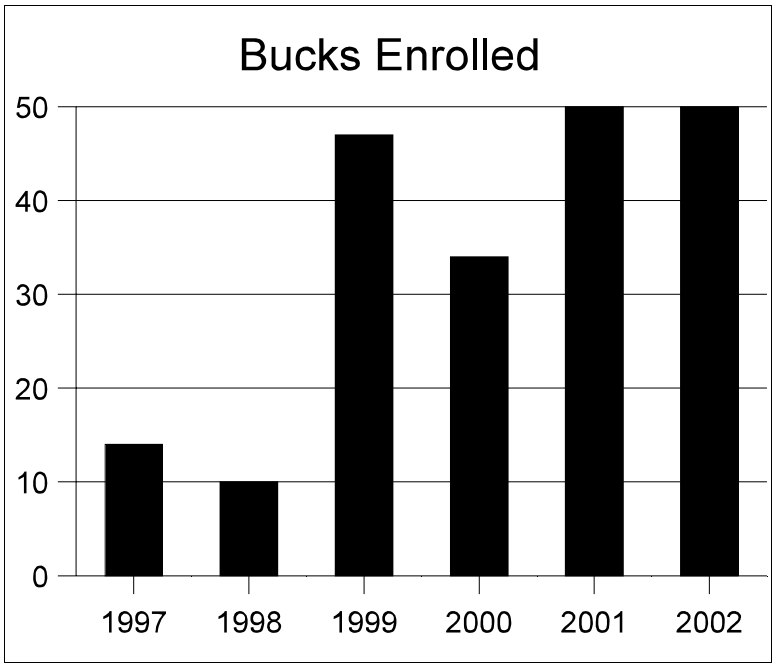
- L&W Boer Goats of Freedom, OK
  for having the #5 (tie) Fastest-Gaining buck

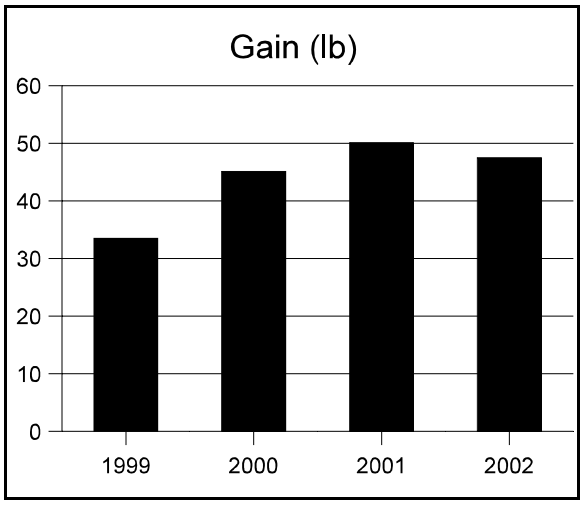
- South Forty Farms of Mt. Olive, IL
  for having the Most-Feed-Efficient buck

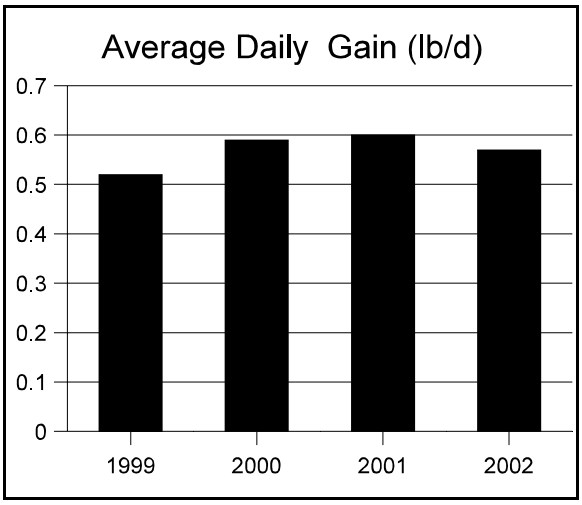
- Mr. Jim Rosenbaum of Gainesville, TX
  for having the Most-Heavily-Muscled buck

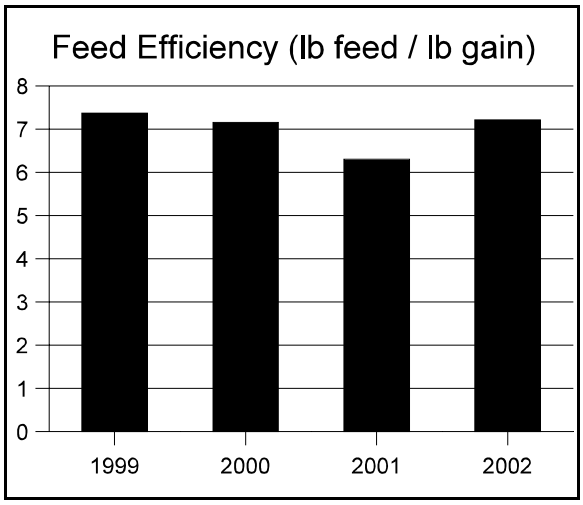
Acknowledgments

The Buck Test supervisor wishes to acknowledge Dr. Lionel Dawson of Oklahoma State University for his contributions as the admitting and on-call veterinarian, Ms. Hong Gou for her management and oversight of the day-to-day activities, Dr. Mario Villaquiran and Mr. Jerry Hayes of Langston University for aid and supervision, Mr. Les Hutchens and his associates at Reproductive Enterprises, Inc. for conducting the ultrasound measurements for the loin eye area and the breeding soundness exams, and Stillwater Milling for custom mixing the feed.


Bucks Enrolled
50
40
30
20
10
0
1997
1998
1999
2000
2001
2002


Gain (lb)
60
50
40
30
20
10
0
1999
2000
2001
2002


Average Daily Gain (lb/d)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1999
2000
2001
2002


Feed Efficiency (lb feed / lb gain)
8
7
6
5
4
3
2
1
0
1999
2000
2001
2002

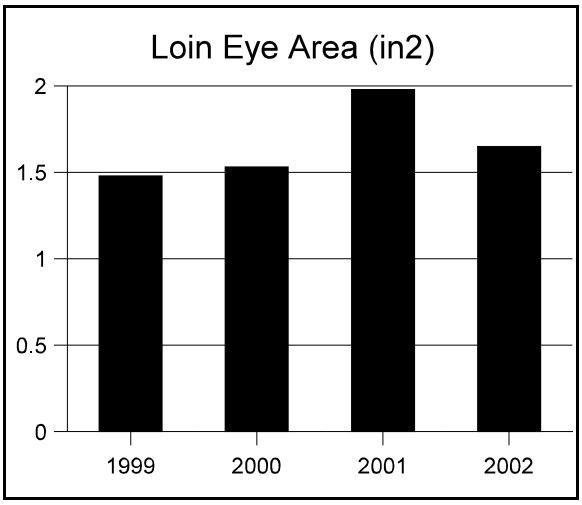

Loin Eye Area (in2)
2
1.5
1
0.5
0
1999
2000
2001
2002

Table 1. Bucks sorted by Index score.

LU ID	Breed	Beg Wt (lbs)	End Wt (lbs)	Gain (lbs)	ADG (lbs/day)	Intake (lbs)	FE*	LEA (in^2)	Rear Leg (in)	index
1031	Boer	69.4	127.8	58.4	0.695	412.09	7.06	2.17	22.50	100.86
1025	Boer	47.4	111.2	63.9	0.760	362.18	5.67	1.67	19.75	100.81
1022	Boer	51.8	118.9	67.2	0.800	427.14	6.36	1.68	21.00	100.78
1032	Boer	61.7	114.5	52.9	0.629	346.32	6.55	1.91	22.00	100.69
1049	Boer	61.7	112.3	50.7	0.603	322.33	6.36	1.77	22.75	100.64
1024	Boer	44.1	100.2	56.2	0.669	349.82	6.23	1.58	21.25	100.63
1018	Boer	36.3	79.3	43.0	0.511	282.74	6.58	1.87	19.00	100.62
1026	Boer	72.7	134.4	61.7	0.734	485.42	7.87	2.05	23.00	100.60
1007	Boer	56.2	110.1	54.0	0.642	376.78	6.98	1.93	21.00	100.58
1028	Boer	47.4	96.9	49.6	0.590	292.50	5.90	1.59	21.00	100.56
1014	Boer	80.4	141.0	60.6	0.721	447.90	7.39	1.87	23.50	100.53
1047	Boer	62.8	110.1	47.4	0.564	294.25	6.21	1.67	22.75	100.51
1020	Boer	83.7	150.9	67.2	0.800	517.58	7.70	2.00	21.25	100.43
1012	Boer	51.8	112.3	60.6	0.721	357.25	5.90	1.57	18.50	100.38
1046	Boer	55.1	102.4	47.4	0.564	317.38	6.70	1.65	22.00	100.37
1035	Boer	46.3	103.5	57.3	0.682	334.98	5.85	1.47	19.00	100.35
1004	Boer	58.4	110.1	51.8	0.616	378.83	7.32	1.68	22.00	100.27
1030	Boer	65.0	123.3	58.4	0.695	425.48	7.29	1.76	20.25	100.21
1040	Boer	48.5	101.3	52.9	0.629	328.17	6.21	1.39	20.25	100.21
1052	Boer-X	58.4	100.2	41.9	0.498	295.59	7.06	1.95	19.25	100.17
1021	Boer	62.8	109.0	46.3	0.551	347.71	7.52	1.70	22.00	100.09
1029	Boer	44.1	89.2	45.2	0.538	289.65	6.41	1.49	19.00	100.05
1011	Boer	77.1	131.1	54.0	0.642	417.93	7.74	2.03	19.50	100.05
1016	Boer	62.8	109.0	46.3	0.551	382.09	8.26	1.77	22.50	100.01
1009	Boer	61.7	106.8	45.2	0.538	291.76	6.46	1.56	20.00	100.00
1027	Boer	91.4	149.8	58.4	0.695	548.81	9.40	2.05	23.50	99.99
1010	Boer	48.5	87.0	38.5	0.459	215.40	5.59	1.34	19.50	99.99
1006	Boer	39.6	77.1	37.4	0.446	168.46	4.50	1.22	17.25	99.98
1042	Boer	56.2	105.7	49.6	0.590	364.98	7.36	1.44	21.75	99.96
1036	Boer	52.9	103.5	50.7	0.603	352.00	6.95	1.55	18.75	99.92
1017	Boer	67.2	102.4	35.2	0.420	313.66	8.90	2.05	22.50	99.91
1041	Boer	56.2	104.6	48.5	0.577	325.35	6.71	1.45	19.50	99.88
1013	Boer	43.0	80.4	37.4	0.446	213.22	5.69	1.34	18.00	99.85
1044	Boer	52.9	106.8	54.0	0.642	380.46	7.05	1.45	18.75	99.84
1005	Boer	60.6	105.7	45.2	0.538	333.08	7.38	1.65	19.50	99.80
1048	Boer	78.2	126.7	48.5	0.577	402.29	8.30	1.75	22.00	99.79
1039	Boer	56.2	106.8	50.7	0.603	371.15	7.33	1.42	20.00	99.78
1037	Boer	54.0	102.4	48.5	0.577	363.01	7.49	1.55	19.00	99.74
1015	Boer	39.6	72.7	33.0	0.393	208.02	6.30	1.26	19.00	99.70
1008	Boer	60.6	100.2	39.6	0.472	307.78	7.76	1.67	19.50	99.63
1038	Boer	57.3	98.0	40.7	0.485	326.70	8.02	1.62	20.00	99.63
1043	Boer	61.7	105.7	44.1	0.524	327.78	7.44	1.51	19.50	99.60
1033	Boer	66.1	111.2	45.2	0.538	386.92	8.57	1.92	17.75	99.48
1045	Boer	61.7	101.3	39.6	0.472	320.40	8.08	1.60	18.00	99.27
1034	Boer	58.4	96.9	38.5	0.459	332.78	8.63	1.65	18.50	99.27
1050	Kiko	54.0	80.4	26.4	0.315	214.38	8.11	1.50	19.00	99.20
1003	Kiko	56.2	96.9	40.7	0.485	331.50	8.14	1.58	16.00	99.07
1023	Boer	71.6	106.8	35.2	0.420	276.04	7.83	1.35	18.50	98.94
1002	Kiko	45.2	72.7	27.5	0.328	244.78	8.89	1.24	18.50	98.75
1051	Kiko-X	59.5	80.4	20.9	0.249	214.80	10.27	1.66	18.50	98.60
	Avg	58.3	105.8	47.5	0.565	338.55	7.21	1.65	20.16	100.00

* lbs of feed for one lb. of gain.

Table 2. Bucks sorted by Gain (ADG).

LU ID	Breed	Beg Wt (lbs)	End Wt (lbs)	Gain (lbs)	ADG (lbs/day)	Intake (lbs)	FE*	LEA (in^2)	Rear Leg (in)	index
1022	Boer	51.8	118.9	67.2	0.800	427.14	6.36	1.68	21.00	100.78
1020	Boer	83.7	150.9	67.2	0.800	517.58	7.70	2.00	21.25	100.43
1025	Boer	47.4	111.2	63.9	0.760	362.18	5.67	1.67	19.75	100.81
1026	Boer	72.7	134.4	61.7	0.734	485.42	7.87	2.05	23.00	100.60
1014	Boer	80.4	141.0	60.6	0.721	447.90	7.39	1.87	23.50	100.53
1012	Boer	51.8	112.3	60.6	0.721	357.25	5.90	1.57	18.50	100.38
1031	Boer	69.4	127.8	58.4	0.695	412.09	7.06	2.17	22.50	100.86
1030	Boer	65.0	123.3	58.4	0.695	425.48	7.29	1.76	20.25	100.21
1027	Boer	91.4	149.8	58.4	0.695	548.81	9.40	2.05	23.50	99.99
1035	Boer	46.3	103.5	57.3	0.682	334.98	5.85	1.47	19.00	100.35
1024	Boer	44.1	100.2	56.2	0.669	349.82	6.23	1.58	21.25	100.63
1007	Boer	56.2	110.1	54.0	0.642	376.78	6.98	1.93	21.00	100.58
1011	Boer	77.1	131.1	54.0	0.642	417.93	7.74	2.03	19.50	100.05
1044	Boer	52.9	106.8	54.0	0.642	380.46	7.05	1.45	18.75	99.84
1032	Boer	61.7	114.5	52.9	0.629	346.32	6.55	1.91	22.00	100.69
1040	Boer	48.5	101.3	52.9	0.629	328.17	6.21	1.39	20.25	100.21
1004	Boer	58.4	110.1	51.8	0.616	378.83	7.32	1.68	22.00	100.27
1049	Boer	61.7	112.3	50.7	0.603	322.33	6.36	1.77	22.75	100.64
1036	Boer	52.9	103.5	50.7	0.603	352.00	6.95	1.55	18.75	99.92
1039	Boer	56.2	106.8	50.7	0.603	371.15	7.33	1.42	20.00	99.78
1028	Boer	47.4	96.9	49.6	0.590	292.50	5.90	1.59	21.00	100.56
1042	Boer	56.2	105.7	49.6	0.590	364.98	7.36	1.44	21.75	99.96
1041	Boer	56.2	104.6	48.5	0.577	325.35	6.71	1.45	19.50	99.88
1048	Boer	78.2	126.7	48.5	0.577	402.29	8.30	1.75	22.00	99.79
1037	Boer	54.0	102.4	48.5	0.577	363.01	7.49	1.55	19.00	99.74
1047	Boer	62.8	110.1	47.4	0.564	294.25	6.21	1.67	22.75	100.51
1046	Boer	55.1	102.4	47.4	0.564	317.38	6.70	1.65	22.00	100.37
1021	Boer	62.8	109.0	46.3	0.551	347.71	7.52	1.70	22.00	100.09
1016	Boer	62.8	109.0	46.3	0.551	382.09	8.26	1.77	22.50	100.01
1029	Boer	44.1	89.2	45.2	0.538	289.65	6.41	1.49	19.00	100.05
1009	Boer	61.7	106.8	45.2	0.538	291.76	6.46	1.56	20.00	100.00
1005	Boer	60.6	105.7	45.2	0.538	333.08	7.38	1.65	19.50	99.80
1033	Boer	66.1	111.2	45.2	0.538	386.92	8.57	1.92	17.75	99.48
1043	Boer	61.7	105.7	44.1	0.524	327.78	7.44	1.51	19.50	99.60
1018	Boer	36.3	79.3	43.0	0.511	282.74	6.58	1.87	19.00	100.62
1052	Boer-X	58.4	100.2	41.9	0.498	295.59	7.06	1.95	19.25	100.17
1038	Boer	57.3	98.0	40.7	0.485	326.70	8.02	1.62	20.00	99.63
1003	Kiko	56.2	96.9	40.7	0.485	331.50	8.14	1.58	16.00	99.07
1008	Boer	60.6	100.2	39.6	0.472	307.78	7.76	1.67	19.50	99.63
1045	Boer	61.7	101.3	39.6	0.472	320.40	8.08	1.60	18.00	99.27
1010	Boer	48.5	87.0	38.5	0.459	215.40	5.59	1.34	19.50	99.99
1034	Boer	58.4	96.9	38.5	0.459	332.78	8.63	1.65	18.50	99.27
1006	Boer	39.6	77.1	37.4	0.446	168.46	4.50	1.22	17.25	99.98
1013	Boer	43.0	80.4	37.4	0.446	213.22	5.69	1.34	18.00	99.85
1017	Boer	67.2	102.4	35.2	0.420	313.66	8.90	2.05	22.50	99.91
1023	Boer	71.6	106.8	35.2	0.420	276.04	7.83	1.35	18.50	98.94
1015	Boer	39.6	72.7	33.0	0.393	208.02	6.30	1.26	19.00	99.70
1002	Kiko	45.2	72.7	27.5	0.328	244.78	8.89	1.24	18.50	98.75
1050	Kiko	54.0	80.4	26.4	0.315	214.38	8.11	1.50	19.00	99.20
1051	Kiko-X	59.5	80.4	20.9	0.249	214.80	10.27	1.66	18.50	98.60
	Avg	58.3	105.8	47.5	0.565	338.55	7.21	1.65	20.16	100.00

* lbs of feed for one lb. of gain.

Table 3. Bucks sorted by Feed Efficiency.

LU ID	Breed	Beg Wt (lbs)	End Wt (lbs)	Gain (lbs)	ADG (lbs/day)	Intake (lbs)	FE*	LEA (in^2)	Rear Leg (in)	index
1006	Boer	39.6	77.1	37.4	0.446	168.46	4.50	1.22	17.25	99.98
1010	Boer	48.5	87.0	38.5	0.459	215.40	5.59	1.34	19.50	99.99
1025	Boer	47.4	111.2	63.9	0.760	362.18	5.67	1.67	19.75	100.81
1013	Boer	43.0	80.4	37.4	0.446	213.22	5.69	1.34	18.00	99.85
1035	Boer	46.3	103.5	57.3	0.682	334.98	5.85	1.47	19.00	100.35
1012	Boer	51.8	112.3	60.6	0.721	357.25	5.90	1.57	18.50	100.38
1028	Boer	47.4	96.9	49.6	0.590	292.50	5.90	1.59	21.00	100.56
1040	Boer	48.5	101.3	52.9	0.629	328.17	6.21	1.39	20.25	100.21
1047	Boer	62.8	110.1	47.4	0.564	294.25	6.21	1.67	22.75	100.51
1024	Boer	44.1	100.2	56.2	0.669	349.82	6.23	1.58	21.25	100.63
1015	Boer	39.6	72.7	33.0	0.393	208.02	6.30	1.26	19.00	99.70
1022	Boer	51.8	118.9	67.2	0.800	427.14	6.36	1.68	21.00	100.78
1049	Boer	61.7	112.3	50.7	0.603	322.33	6.36	1.77	22.75	100.64
1029	Boer	44.1	89.2	45.2	0.538	289.65	6.41	1.49	19.00	100.05
1009	Boer	61.7	106.8	45.2	0.538	291.76	6.46	1.56	20.00	100.00
1032	Boer	61.7	114.5	52.9	0.629	346.32	6.55	1.91	22.00	100.69
1018	Boer	36.3	79.3	43.0	0.511	282.74	6.58	1.87	19.00	100.62
1046	Boer	55.1	102.4	47.4	0.564	317.38	6.70	1.65	22.00	100.37
1041	Boer	56.2	104.6	48.5	0.577	325.35	6.71	1.45	19.50	99.88
1036	Boer	52.9	103.5	50.7	0.603	352.00	6.95	1.55	18.75	99.92
1007	Boer	56.2	110.1	54.0	0.642	376.78	6.98	1.93	21.00	100.58
1044	Boer	52.9	106.8	54.0	0.642	380.46	7.05	1.45	18.75	99.84
1031	Boer	69.4	127.8	58.4	0.695	412.09	7.06	2.17	22.50	100.86
1052	Boer-X	58.4	100.2	41.9	0.498	295.59	7.06	1.95	19.25	100.17
1030	Boer	65.0	123.3	58.4	0.695	425.48	7.29	1.76	20.25	100.21
1004	Boer	58.4	110.1	51.8	0.616	378.83	7.32	1.68	22.00	100.27
1039	Boer	56.2	106.8	50.7	0.603	371.15	7.33	1.42	20.00	99.78
1042	Boer	56.2	105.7	49.6	0.590	364.98	7.36	1.44	21.75	99.96
1005	Boer	60.6	105.7	45.2	0.538	333.08	7.38	1.65	19.50	99.80
1014	Boer	80.4	141.0	60.6	0.721	447.90	7.39	1.87	23.50	100.53
1043	Boer	61.7	105.7	44.1	0.524	327.78	7.44	1.51	19.50	99.60
1037	Boer	54.0	102.4	48.5	0.577	363.01	7.49	1.55	19.00	99.74
1021	Boer	62.8	109.0	46.3	0.551	347.71	7.52	1.70	22.00	100.09
1020	Boer	83.7	150.9	67.2	0.800	517.58	7.70	2.00	21.25	100.43
1011	Boer	77.1	131.1	54.0	0.642	417.93	7.74	2.03	19.50	100.05
1008	Boer	60.6	100.2	39.6	0.472	307.78	7.76	1.67	19.50	99.63
1023	Boer	71.6	106.8	35.2	0.420	276.04	7.83	1.35	18.50	98.94
1026	Boer	72.7	134.4	61.7	0.734	485.42	7.87	2.05	23.00	100.60
1038	Boer	57.3	98.0	40.7	0.485	326.70	8.02	1.62	20.00	99.63
1045	Boer	61.7	101.3	39.6	0.472	320.40	8.08	1.60	18.00	99.27
1050	Kiko	54.0	80.4	26.4	0.315	214.38	8.11	1.50	19.00	99.20
1003	Kiko	56.2	96.9	40.7	0.485	331.50	8.14	1.58	16.00	99.07
1016	Boer	62.8	109.0	46.3	0.551	382.09	8.26	1.77	22.50	100.01
1048	Boer	78.2	126.7	48.5	0.577	402.29	8.30	1.75	22.00	99.79
1033	Boer	66.1	111.2	45.2	0.538	386.92	8.57	1.92	17.75	99.48
1034	Boer	58.4	96.9	38.5	0.459	332.78	8.63	1.65	18.50	99.27
1002	Kiko	45.2	72.7	27.5	0.328	244.78	8.89	1.24	18.50	98.75
1017	Boer	67.2	102.4	35.2	0.420	313.66	8.90	2.05	22.50	99.91
1027	Boer	91.4	149.8	58.4	0.695	548.81	9.40	2.05	23.50	99.99
1051	Kiko-X	59.5	80.4	20.9	0.249	214.80	10.27	1.66	18.50	98.60
	Avg	58.3	105.8	47.5	0.565	338.55	7.21	1.65	20.16	100.00

* lbs of feed for one lb. of gain.

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RESEARCH OVERVIEW

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 2002 and 2003, abstracts for 2003, and summaries of scientific articles that were published in 2002 or will appear in 2003 journals.

Standard Abbreviations Used

BW = body weight
cm = centimeters
CP = crude protein
d = day
dL = decaliter
DM = dry matter
DMI = dry matter intake
g = gram
kg = kilogram
L = liter
M = mole
mL = milliliter
mm = millimeters
mo = month
ng = nanogram
NDF = neutral detergent fiber
OM = organic matter
P = probability
SE = standard error
TDN = total digestible nutrients
wt = weight
vol = volume
vs = versus

USDA/CSREES RESEARCH PROJECTS

Title: *Goat Nutrient Requirements, Management Practices, and Production Systems*
Type: CSREES project
Project Number: OKLX-SAHLU
Period: 2001-2006
Investigators: T. Sahlu, A. L. Goetsch, R. Puchala, and S. P. Hart
Institution: Langston University
Objective:

- Study goat nutrient requirements, management practices, and production systems 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: *Enhanced Goat Production Systems for the Southern United States*
Type: USDA Initiative for Future Agriculture and Food Systems
Project Number: 2011-52101-11430
Period: 2001-2006
Investigators: T. A. Gipson[1], A. L. Goetsch[1], S. P. Hart[1], L. J. Dawson[2], Harvey Blackburn[3], Stephan Wildeus[4], Joseph Tritschler[4], Jean-Marie Luginbuhl[5], Matt Poore[5], Marcos Fernandez[6], Will Getz[7], Tom Terrill[7], Mack C. Nelson[8], and Ken Turner[8]
Institutions: [1]Langston University, [2]Oklahoma State University, [3]National Seed Storage Lab Animal Germplasm, [4]Virginia State University, [5]North Carolina State University, [6]Louisiana State University, [7]Fort Valley State University, and [8]USDA ARS Appalachian Farming Systems Research Center
Objectives:

- Develop a vehicle to appraise use of available resources and production conditions with goat production systems.
- Project most appropriate production systems for goat-producing regions based on compatibility with presently available resources and production conditions, and evaluate changes in resources or production conditions necessary for employment of alternative, preferred systems.
- Disseminate and provide training in use of the developed-decision support vehicle.

Title: *Use of Goats for Sustainable Vegetation Management in US Grazing Lands*
Type: USDA Sustainable Agriculture Research and Education
Project Number: LS01-119
Period: 2001-2004
Investigators: A. L. Goetsch, S. P. Hart, T. A. Gipson, and R. C. Merkel
Institution: Langston University
Collaborators: Caddo Nation, Cherokee Nation, Choctaw Nation, Greater Seminole Nation, Osage Nation, and Sac and Fox Nation
Objectives:

- Increase appropriate employment of goats in sustainable vegetation management in grazing lands of the south-central US, with particular emphasis on Native American Nation tribal lands or lands of tribal members.
    - Investigate effects of various goat management methods for vegetation rehabilitation/control in different grazing land settings in the south-central US.
    - Demonstrate and display appropriate means of vegetation management with goats, as well as to provide education in other related management areas.
    - Develop an information package on optimal use of goats for grazing land vegetation management to ensure long-term, sustainable, and widespread project impact.

Title: *The Detection of Mastitis in Dairy Goats*
Type: Oklahoma Center for the Advancement of Science and Technology - Oklahoma Applied Research Support Program
Project Number: AR01.1-110
Period: 2001-2003
Investigator: G. Tomita
Institution: Langston University
Objectives:

- Identify a method of mastitis detection in dairy goats.
    - Extensively test various methods of mastitis detection assays that were developed for the bovine dairy industry to determine the applicability of those methods to detect mastitis in dairy goats.
    - Determine the suitability of the appropriate mastitis detection method(s) identified by the first objective for use as a regulatory standard to monitor milk quality and goat udder health under field conditions.

Title: *Energy for the Productive Caprine*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX0003833
Period: 2000-2003
Investigators: T. Sahlu[1], A. L. Goetsch[1], H. C. Freetly[2], and G. E. Carstens[3]
Institutions: [1]Langston University, [2]USDA ARS Meat Animal Research Center, and [3]Texas A&M University
Objective:

- Determine key energy requirements for different classes of goats reared in the US (maintenance energy requirements; energy costs for live weight gain or growth; energy use in gestation with different litter sizes; energy required for lactation; energy demands for mohair fiber growth).

Title: *Diet Selection and Performance by Sheep and Goats Grazing Mixed Pastures*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX-0003832
Period: 2000-2003
Investigators: A. L. Goetsch[1], G. E. Aiken[2], T. Sahlu[1], and M. Powell[3]
Institutions: [1]Langston University, [2]USDA ARS Dale Bumpers Small Farms Research Center, and [3]Winrock International
Objectives:

- Evaluate stocking rate effects on pastures that contain various forbs and grasses being co-grazed by goats and sheep.
    - Measure growth performance of kids and lambs on pastures containing a complex mixture of grasses and forbs, and pastures that are alley cropped with mimosa.
    - Determine the quality and productivity of mimosa as browse in pastures co-grazed with goats and sheep.
    - Study the interaction between stocking rate and time in affecting the quantity and quality of major botanical components, animal weight gain, and diet selectivity.
    - Determine the most suitable stocking rate that provides the highest gain per unit land area with the least amount of change in botanical composition.

Title: *Metabolic Changes Affecting Utilization of Poor Quality Diets by Goats*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX-1999-04159
Period: 1999-2003
Investigators: R. Puchala[1], A. L. Goetsch[1], S. W. Coleman[2], and T. Sahlu[1]
Institutions: [1]Langston University and [2]USDA ARS Grazinglands Research Laboratory
Objective:

- Determine influences of supplementation of poor-quality forage diets with rumen-protected betaine on energy and nitrogen metabolism in goats.

Title: *Quality Characteristics and Yield Predictive Models of Goat Milk Cheeses*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX-1999-04114
Period: 1999-2003
Investigators: S. S. Zeng[1], E. N. Escobar[1], D. L. Van Hekken[2], and S. E. Gilliland[3]
Institutions: Langston University, USDA ARS Dairy Products Research Unit, and Oklahoma State University
Objectives:

- Determine the effects of milk composition and somatic cell counts on the quality and yield of goat cheese and develop yield predictive models for goat cheeses.
- Characterize different goat cheeses in terms of composition, microstructure, rheological properties, protein profiles, and sensory characteristics as affected by seasonal variations of milk composition and property changes during cheese storage.

Title: *Sustainable Dairy Goat Milk Production from Forages*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX-1999-04146
Period: 1999-2003
Investigators: S. P. Hart[1], T. Sahlu[1], and L. D. Satter[2]
Institutions: [1]Langston University and [2]Dairy Forage Research Center
Objectives:

- Study milk production, composition, animal health, and inputs for a grass-based dairy system as compared with a conventional confinement dairy.
- Determine the response in milk production of grass-based dairy goats to different levels of concentration supplementation.
- Model the effect of forage intake and concentrate supplementation on milk production and changes in body weight.

Title: *Nutrient Requirements of Goats: An Update and Reevaluation*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX-9803092
Period: 1998-2003
Investigators: A. L. Goetsch[1], T. Sahlu[1], M. L. Galyean[2], C. L. Ferrell[3], F. N. Owens[4], and Z. B. Johnson[5]
Institutions: [1]Langston University, [2]Texas Tech University, USDA ARS Meat Animal Research Center, [4]Pioneer Hi-Bred International, and [5]University of Arkansas
Objective:

- Develop a database of available data from publications on goat feeding and nutrition to develop accurate expressions of energy and protein requirements of goats.

Title: *Postruminal Nitrogen Supply for Fast Growing Meat Goats*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX-9803144
Period: 1998-2002
Investigators: M. R. Cameron[1], T. Sahlu[1], R. Puchala[1], A. L. Goetsch[1], S. W. Coleman[2], and L. J. Dawson[3]
Institutions: [1]Langston University, [2]USDA ARS Grazinglands Research Laboratory, and [3]Oklahoma State University
Objectives:

- Determine the level of dietary crude protein required for goat kids of different growth potential.
    - Determine the influence of both level and source of supplemental protein on ruminal fermentation, postruminal nitrogen supply, and performance of rapidly growing goat kids.
    - Determine the influence of dietary level of ruminally undegraded protein on ruminal fermentation and postruminal nitrogen supply as well as performance of kids with different growth potential.

Experiments

Recently Conducted, In Progress, or Soon to be Initiated

Title: *Training Goats for Cedar Consumption*
Experiment Number: GA-02-01
Project Number: OKLX-SAHLU
Investigators: G. Animut, A. L. Goetsch, R. C. Merkel, L. J. Dawson, R. Puchala, and T. Sahlu
Objective: Determine effects on later eastern red cedar consumption of stepwise increases in the dietary level of cedar, as compared with an abrupt dietary introduction of a set level of cedar or no prior cedar exposure

Title: *Energy for Growth of Meat Goats*
Experiment Number: CTZ-02-02
Project Number: OKLX0003833
Investigators: C.-T. Zheng, I. Tovar-Luna, R. Puchala, G. Detweiler, A. L. Goetsch, and T. Sahlu
Objectives: Determine effects and interactions of goat genotype and diet quality on:

- Fasting heat production.
- Maintenance energy (ME) requirements.
- Efficiency of ME utilization for maintenance.
- ME requirement for growth.
- Efficiency of ME utilization for growth.

Determine the relationship between heart rate and heat production determined via indirect calorimetry, measured with ad libitum and maintenance feeding of different qualities of diets and when fasting.

Title: *Quality Characteristics and Yield Predictive Models of Goat Milk Cheese*
Experiment Number: SZ-02-03
Project Number: OKLX-1999-04114
Investigators: S. Zeng, K. A. Soryal, D. van Hekken, B. Bah, and B. Min
Objectives: 1) Determine the effects of milk composition and somatic cell counts on the quality and yield of goat cheese and develop yield predictive models for goat cheeses (French soft, semi-hard, and hard).
2) Characterize semi-hard and hard cheeses in terms of composition, microstructure, rheological properties, protein profiles, and sensory characteristics as affected by seasonal variations of milk composition and property changes during cheese storage.

Title:	*Flushing of Meat Goats*
Experiment Number:	RM-02-04
Project Number:	OKLX-SAHLU
Investigators:	R. C. Merkel, G. Abebe, A. L. Goetsch, L. J. Dawson, R. Puchala, C. F. Rosenkrans, and T. Sahlu
Objective:	Determine influences of short-term supplementation of meat goat does in low or moderate/high body condition with high levels of protein sources of low ruminal degradability and rich on branch chain amino acids and arginine on reproductive performance.

Title:	*Evaluation of Stocking Rate Effects with Pastures that Contain Various Forbs and Grasses being Co-Grazed by Goats and Sheep and Subsequent Performance with an Energy-Rich Diet - First Grazing Season*
Experiment Number:	GA-02-05
Project Number:	OKLX-0003832
Investigators:	G. Animut, A. L. Goetsch, G. E. Aiken, K. R. Krehbiel, R. Puchala, C.-T. Zheng, G. Detweiler, J. O. Joseph, and T. Sahlu
Objective:	Evaluate stocking rate effects on diet selection and performance of goats and sheep co-grazing pastures containing various forbs and grasses and assess subsequent growth with consumption of a high concentrate diet.

Title:	*Potential Anthelmintic Effects in Goats of Condensed Tannins*
Experiment Number:	BM-02-06
Project Number:	OKLX-SAHLU
Investigators:	B. R. Min, S. H. Hart, D. Miller, and T. Sahlu
Objective:	Determine effects of continuous or intermittent grazing of forage containing condensed tannins (Sericea lespedeza) on internal parasites in goats

Title: *Use of Goats for Sustainable Vegetation Management in Grazing Lands - First Grazing Season*

Experiment Number: JJ-02-07

Project Number: LS01-119

Investigators: J. O. Joseph, A. L. Goetsch, S. P. Hart, T. A. Gipson, R. C. Merkel, and G. Detweiler

Objectives: General: Investigate effects of various goat management methods for vegetation rehabilitation/control in different grazing land settings in the south-central US, demonstrate and display appropriate means of vegetation management with goats, and provide education in other related goat management areas.

Specific: Determine effects of different goat grazing treatments on vegetation conditions and animal performance at six Oklahoma sites, in cooperation with the Caddo, Cherokee, Choctaw, Greater Seminole, Osage, and Sac and Fox Nations. Treatments include different stocking rates, rotational grazing, co-grazing with sheep or cattle, no livestock grazing, herbicides, and mowing.

Title: *Energy Requirements for Lactation by Goats*

Experiment Number: ITL-02-08

Project Number: OKLX0003833

Investigators: I. Tovar-Luna, A. L. Goetsch, C.-T. Zheng, R. Puchala, and T. Sahlu

Objective: Determine energy requirements for milk production by Alpine does in different stages of lactation and consuming diets differing in concentrate level, via respiration calorimetry and heart rate.

Title: *Energy Requirements for Mohair Fiber Production*

Experiment Number: CTZ-02-09

Project Number: OKLX0003833

Investigators: C.-T. Zheng, A. L. Goetsch, I. Tovar-Luna, R. Puchala, and T. Sahlu

Objective: Determine energy requirements for mohair fiber production by Angora goats consuming different quality diets via respiration calorimetry.

Title: *Caseous Lymphadenitis in Dairy Goats*

Experiment Number: EL-02-10

Project Number: OKLX-SAHLU

Investigators: E. Loetz, L. J. Dawson, J. Saluki, and J. Hayes

Objective: Determine predisposing factors for the prevalence of clinical manifestations of *Caseous lymphadenitis* and effectiveness of using vaccination to control *Caseous lymphadenitis* abscesses.

Title: *Gastrointestinal Parasite Control by Grazing Management*
Experiment Number: DM-02-11
Project Number: OKLX-SAHLU
Investigators: D. K. Miller, S. P. Hart, and B. R. Min
Objective: Compare set stocked with rotationally grazed goats for differences in worm burdens as measured by egg per gram counts and by nematode counts in tracer animals.

Title: *Condensed Tannins and Ruminant Methane Production*
Experiment Number: RP-02-12
Project Number: OKLX-SAHLU
Investigators: R. Puchala, B. R. Min, and A. L. Goetsch
Objective: Compare methane production by Angora goats consuming the condensed tannin-containing forage, Sericea lespedeza, with that by goats ingesting forage without condensed tannins via respiration calorimetry.

Title: *Protein Requirements of Goats for Lactation*
Experiment Number: IN-02-13
Project Number: OKLX-9803092
Investigators: I. V. Nsahlai, A. L. Goetsch, J. Luo, J. E. Moore, M. L. Galyean, C. L. Ferrell, Z. B. Owens, T. Sahlu, and F. N. Owens
Objective: Develop a data set of animal performance (e.g., milk production and composition, live weight, and live weight gain) and of crude protein degradability properties and ruminal fermentable energy concentration with numerous dietary ingredients for prediction of ruminal outflow of potentially degradable dietary protein, in order to determine metabolizable protein requirements of goats for lactation.

Title: *Protein Requirements of Goats for Growth*
Experiment Number: IN-02-14
Project Number: OKLX-9803092
Investigators: I. V. Nsahlai, A. L. Goetsch, J. Luo, J. E. Moore, M. L. Galyean, C. L. Ferrell, Z. B. Owens, T. Sahlu, and F. N. Owens
Objective: Develop a data set of animal performance (e.g., live weight and live weight gain) and of crude protein degradability properties and ruminal fermentable energy concentration with numerous dietary ingredients for prediction of ruminal outflow of potentially degradable dietary protein, in order to determine metabolizable protein requirements of goats for growth.

Title: *Energy Requirements of Goats for Maintenance and Growth*
Experiment Number: JL-02-15
Project Number: OKLX-9803092
Investigators: J. Luo, A. L. Goetsch, J. E. Moore, I. V. Nsahlai, M. L. Galyean, C. L. Ferrell, Z. B. Owens, T. Sahlu, and F. N. Owens
Objective: Develop a data set of animal performance (e.g., live weight and live weight gain) and energy intake to determine metabolizable energy requirements for maintenance and growth of preweaning goats, growing goats of three different biotypes, and mature goats.

Title: *Energy and Protein Requirements of Mohair Fiber-Producting Angora Goats*
Experiment Number: JL-02-16
Project Number: OKLX-9803092
Investigators: J. Luo, A. L. Goetsch, J. E. Moore, I. V. Nsahlai, M. L. Galyean, C. L. Ferrell, Z. B. Owens, T. Sahlu, and F. N. Owens
Objective: Develop a data set of animal performance (e.g., live weight, live weight gain, and mohair fiber production) and metabolizable energy and protein intakes to determine metabolizable energy and protein requirements for maintenance, growth, and mohair fiber production by Angora goats.

Title: *Prediction of Feed Intake by Non-Lactating Meat, Dairy, and Indigenous Goats*
Experiment Number: JM-02-17
Project Number: OKLX-9803092
Investigators: J. E. Moore, A. L. Goetsch, J. Luo, I.V. Nsahlai, M. L. Galyean, C. L. Ferrell, Z. B. Owens, T. Sahlu, and F. N. Owens
Objective: Construct a data set of animal and dietary characteristics to develop equations for prediction of feed intake by non-lactating meat, dairy, and indigenous goats.

Title: *The Detection of Mastitis in Dairy Goats - On-Farm Testing (Year 2)*
Experiment Number: GT-02-18
Project Number: AR01.1-110
Investigators: G. M. Tomita and S. P. Hart
Objective: Determine the suitability of the appropriate mastitis detection method(s) for goats identified earlier for use as a regulatory standard to monitor milk quality and goat udder health under field conditions.

Title: *Rumen-Protected Betaine and Low-Quality Forage Diets for Goats*
Experiment Number: VB-02-19
Project Number: OKLX-1999-04159
Investigators: V. Banskalieva and R. Puchala
Objective: Determine effects of rumen-protected betaine on blood metabolite concentrations and nutrient net flux across splanchnic tissues in meat goats consuming low-quality forage.

Title: *Enhanced Goat Production Systems for the Southern United States - Phase 1*
Experiment Number: MV-02-20
Project Number: 2011-52101-11430
Investigators: M. Villaquiran and T. A. Gipson
Objective: Develop a vehicle to appraise use of available resources and production conditions in different goat production systems.

Title: *Pathogenicity of Tapeworms*
Experiment Number: DM-02-21
Project Number: OKLX-SAHLU
Investigators: D. K. Miller, S. P. Hart, T. A. Gipson, and L. J. Dawson
Objective:
1) Determine if tapeworms in goats affect growth.
2) Compare effects, if existent, of tapeworms on growth with those of nematodes.

Title: *Anthelmintic Resistance in Goats in Oklahoma*
Experiment Number: DM-02-22
Project Number: OKLX-SAHLU
Investigators: D. K. Miller, T. A. Gipson, S. P. Hart, and R. C. Merkel
Objective:
1) Survey resistance to anthelmintics on goats farms in Oklahoma.
2) Determine correlations between resistance and management factors.
    a) Closed versus open flocks
    b) Deworming programs (frequency, time, alternation of products)
3) Identify species of nematodes that are resistant and susceptible.

Title: *Energy Requirements for Gestation*
Experiment Number: ITL-03-01
Project Number: OKLX0003833
Investigators: I. Tovar-Luna, A. L. Goetsch, R. Puchala, and T. Sahlu
Objective: Determine energy requirements for gestation for goats with litter sizes of 1, 2, and 3.

Title: *Milk Production by Boer × Spanish and Spanish Does*
Experiment Number: RM-03-02
Project Number: OKLX-SAHLU
Investigators: R. C. Merkel, A. L. Goetsch, T. A. Gipson, L. J. Dawson, and R. Puchala
Objective: Evaluate milk production, energy expenditure, and blood metabolite and hormone levels throughout lactation in Boer × Spanish and Spanish does with one or two kids on a moderate nutritional plane.

Title: *Nutrient Requirements of Goats: Summary - Requirement Tables, Other Considerations, Future Research*
Experiment Number: AG-03-03
Project Number: OKLX-9803092
Investigators: A. L. Goetsch, J. Luo, I. N. Nsahlai, T. Sahlu, J. E. Moore, M. L. Galyean, C. L. Ferrell, Z. B. Owens, and F. N. Owens
Objective: Develop a data set of animal and dietary characteristics to develop equations for prediction of feed intake by goats.

Title: *Evaluation of Stocking Rate Effects with Pastures that Contain Various Forbs and Grasses being Co-Grazed by Goats and Sheep and Subsequent Performance with an Energy-Rich Diet - Second Grazing Season*
Experiment Number: GA-03-04
Project Number: OKLX-0003832
Investigators: G. Animut, A. L. Goetsch, G. E. Aiken, K. R. Krehbiel, R. Puchala, C.-T. Zheng, G. Detweiler, J. O. Joseph, and T. Sahlu
Objective: Evaluate stocking rate effects on diet selection, performance, energy expenditure, and energy accretion of goats and sheep co-grazing pastures containing various forbs and grasses, with or without mimosa, and assess subsequent growth with consumption of a high concentrate diet.

The proper citation for this article is:

Goetsch, A. 2003. Research Overview, Projects, and Experiments. Pages 110-123 in Proc. 18th Ann. Goat Field Day, Langston University, Langston, OK.

INTERNATIONAL PROJECTS

Title: **An Institutional Partnership to Enhance Food Security and Income Generating Potential of Families in Southern Ethiopia Through Improved Goat Production and Extension**

Support: ALO-USAID, Partnering with Higher Education for International Development

Collaborator: Awassa College of Agriculture (ACA) of Debub University in southern Ethiopia

Objectives: Establish ties between Langston University and ACA

Increase the research and extension capabilities of ACA staff

Establish women's groups for goat production

Enhance the internationalization, culture diversity, and gender relevance at ACA and Langston University

Title: **Multinational Approaches to Enhance Goat Production in the Middle East**

Support: USAID Middle East Regional Cooperation Program

Collaborator:

Egypt	Desert Research Center and Animal Production Research Institute
Israel	Volcani Center
Palestinian National Authority	Agriculture Extension Department
Jordan	Jordan University of Science and Technology

Objectives:

Overall: Revitalize and develop the Middle East goat industry via cooperative research and technology transfer to increase income and improve the standard of living of the indigenous people

Specific: Characterize goat production systems of the Middle East region and distribute improve goat genotypes

Increase knowledge of goat milk properties and develop new technologies for production of goat milk products in the Middle East

Transfer appropriate available and developed technologies for goats to Middle Eastern farms/households, in particular proper milk hygiene and processing

Title: **Enhanced Education and Computer Capabilities: The Foundation for Sustained Collaboration**

Support: ALO-USAID, Partnering with Higher Education for International Development, Education for Development and Democracy Initiative

Collaborator: Awassa College of Agriculture of Debub University in southern Ethiopia

Objectives: Upgrade the extension skills of ACA staff through training at Oklahoma State University and through practical presentations in Ethiopia

Upgrade ACA computer capabilities through training in networking and establishment of a student computer laboratory/campus network on the Awassa campus

Title: **Improving Ethiopian Household Food Security and Enhancing the Teaching, Research and Extension Ability of Awassa College of Agriculture, Debub University, Ethiopia**

Support: UNCFSP- USAID International Development Partnership Activity

Collaborator: Fort Valley State University, Fort Valley, GA
Awassa College of Agriculture of Debub University in southern Ethiopia

Objectives: Provide training to ACA staff in research methodology, parasitology, animal breeding, semen collection and freezing and artificial insemination

Transport Boer goat semen to ACA for a crossbreeding program

Strengthen ACA's current extension program and expand its impact on village goat production through formation of new women's groups for goat production and providing more training to existing women's groups

Increase Langston University and GIGR's involvement in and impact on international development

Title: **Improving Ethiopian Household Food Security and Enhancing the Teaching, Research and Extension Ability of Alemaya University, Alemaya, Ethiopia**

Support: ALO- USAID Partnering with Higher Education for International Development

Collaborator: Oklahoma State University
Alemaya University in eastern Ethiopia

Objectives: Provide training to AU staff in research methodology, parasitology, animal breeding, semen collection and freezing and artificial insemination

Transport Boer goat semen to AU for a crossbreeding program

Strengthen AU's current extension program and expand its impact on village goat production through formation of new women's groups for goat production and providing more training to existing women's groups

Increase Langston University and GIGR's involvement in and impact on international development

The proper citation for this article is:

Merkel, R. 2003. International Projects. Pages 106-108 in Proc. 18th Ann. Goat Field Day, Langston University, Langston, OK.

Validation of a goat simulation model using performance test information for young fast growing meat bucks

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As part of a regional project, a computer simulation model for goat production is being updated. However, the model was developed before the recent interest in meat goat production. The objective of this study was to test the simulation model to determine if its biological assumptions and equations are representative of a young fast growing meat goat, typified by the Boer breed. Validation data were weekly body weight and daily feed intake of 180 young Boer bucks enrolled in the Langston University Meat Buck Performance Test. Numbers of bucks enrolled in the test per year were 47, 33, 50, and 50, respectively, for years 1999 through 2002. Components of the simulation model tested were BW and feed intake (air-dry) for 15-d periods.

Table 1. Simulated and actual mean BW (kg)

Age (d)	Simulation	1999	2000	2001	2002
120	30.5	31.7 ± 6.7	31.5 ± 6.2	28.8 ± 7.6	29.6 ± 6.4
135	34.0	34.2 ± 6.8	34.6 ± 6.3	32.9 ± 8.6	33.5 ± 7.3
150	37.8	37.5 ± 6.9	38.0 ± 6.4	37.6 ± 9.2	37.8 ± 7.9
165	42.1	42.3 ± 7.5	42.6 ± 6.0	40.8 ± 9.0	41.3 ± 7.9
180	46.0	44.6 ± 7.3	45.3 ± 7.0	44.7 ± 8.9	45.4 ± 8.3
195	51.0		48.5 ± 6.9	49.2 ± 8.9	48.0 ± 8.0

Prior to 165 d of age, simulated BW was intermediate to actual mean BW; however, later the simulation model slightly overestimated BW, with an average difference of 1.0 kg at 180 d and 2.4 kg at 195 d.

Table 2. Simulated and actual cumulative feed intake (kg)

Age (d)	Simulation	1999	2000	2001	2002
120	18.75	20.7 ± 0.18	19.3 ± 0.18	17.4 ± 0.14	18.6 ± 0.20
135	41.25	42.4 ± 0.30	42.5 ± 0.28	39.4 ± 0.25	41.9 ± 0.33
150	68.25	67.6 ± 0.38	66.1 ± 0.40	65.8 ± 0.33	69.8 ± 0.46
165	98.25	95.2 ± 0.40	93.7 ± 0.41	92.3 ± 0.38	99.6 ± 0.58
180	129.75		121.6 ± 0.52	123.2 ± 0.49	128.9 ± 0.81

Prior to 180 d of age, simulated cumulative feed intake was intermediate to actual means, although later predicted values were greater than observed. Average overestimation at 180 d was 5.2 kg. In summary, the existing simulation model produced accurate estimates of BW and feed intake of young fast growing meat goats; however modifications may be required to improve prediction with age greater than 180 d.

Direct effects of condensed tannins on gastrointestinal nematodes in grazing Angora goats

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The objective of this study was to evaluate effects of condensed tannin-containing, Serica lespedeza (SL; 5.2% condensed tannins (CT)), on fecal egg count (FEC; eggs/g), rate of larva development (RLD), adult worm burden (AWB), and immune response (IMR) compared with a control forage (CF; crabgrass/tall fescue; 0.2% CT) in grazing Angora does and kids. Fifty worm-free does were randomly allocated to three treatments. One treatment (10 does; 45 ± 1.5 kg) was grazed on SL forage from April 25 to July 15, 2002 (81 d), and a second treatment (20 does; 43 ± 1.4 kg) grazed CF. A third treatment (20 does; 44 ± 1.4 kg) was introduced to a sward of SL for 2 wk and then was switched to CF for 2 wk (MIX), fellowed by repeated change every 2 wk. The FEC was determined every 2 wk. RLD was evaluated on d 60. To gauge levels of infective larvae on pasture, three worm-free kids (12 ± 0.98 kg) were randomly selected and introduced into each treatment as tracers. Tracers grazed for 60 d and were euthanized for determination of AWB. The IMR of does was measured by skin thickness reaction after injection of 250 micro g phytohemagglutinin (PHA). Mean FEC for SL and MIX were substantially lower ($P < 0.01$) than for CF in does (186, 428, and 1148, respectively) and kids (550, 2,757, and 3,600, respectively). Total fecal egg output (3.3, 6.0, and 26.9 × 10^5/d, respectively; based on FEC and fecal output) and RLD (242, 263, and 792, respectively) were markedly lower ($P < 0.05$) for SL and MIX than for CF. Tracers on SL and MIX had lower ($P < 0.01$) AWB than CF in the abomasum (100, 333, and 783, respectively) and AWB was lowest among treatments ($P = 0.06$) in the small intestine for SL (117, 433, and 350, respectively). Abomasal worms were dominated by *Haemonchus* (52%), but *Trichostrogylus* were predominant (71%) in the small intestine. The IMR of does was similar among treatments at 0 h. However, IMR was greater ($P < 0.01$) for SL (4.9 mm) and MIX (6.0 mm) than for CF (3.0 mm) at 12 and 24 h after injection of PHA. In conclusion, these results indicate that CT in forages can reduce contamination of pastures with infective larvae. Grazing CT forages reduced FEC, RLD, and AWB, and also appeared to enhance IMR.

The effect of a condensed tannin-containing forage on methane emission by goats

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The objective of this study was to investigate the effect of dietary condensed tannins from Sericea lespedeza (*Lespedeza cuneata*; 6% condensed tannins; SL) on methane emission by goats. The experiment was conducted with Angora does that had grazed SL (n = 6; 43 ± 2.7 kg BW) or crabgrass/tall fescue forage (CF; n = 6; 40 ± 2.7 kg BW) for approximately 4 months. After 5 d of adaptation to metabolism crates, gas exchange was measured for 24 h in an open circuit-calorimetry respiration system with four head boxes (Sable Systems; Henderson, NV). Heart rate (HR) was monitored using Polar S610 heart rate monitors (Polar Electro, Woodbury, NY). Goats began

adaptation periods sequentially in three sets, with two SL and two CF does in each set. During adaptation and measurement periods, freshly cut forages were fed three times daily. Concentrations of CP were 10.3 and 13.0% DM and in vitro DM digestibility (with NDF as the end-point measure) was 64.5 and 75.3% for SL and CF, respectively. Dry matter intake (1.29 vs 0.68 kg/d) and digestible DMI (0.84 vs 0.51 kg/d) were greater ($P < 0.01$) for SL vs CF. Daily energy expenditure (432 vs 439 kJ/kg $BW^{0.75}$) and methane emission (12.4 vs 10.9 L/d for SL and CF, respectively) were similar between treatments. However, daily methane emission relative to DMI (8.5 vs 18.8 L/kg) and digestible DMI (13.2 vs 25.0 L/kg) were considerably lower ($P < 0.01$) for SL than for CF. Treatment had no effect on HR (75.5 vs 74.7) or the ratio of daily EE to average HR per minute (5.73 vs 5.88 kJ/kg $BW^{0.75}$ for SL and CF, respectively). In summary, condensed tannins in forages such as SL may provide a means of decreasing methane emission by ruminants.

Fatty acid composition of Alpine goat milk and Domiati cheese with pasture feeding during a whole lactation

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Forty-four lactating Alpine goats were randomly allocated into four groups in an experiment to investigate the effect of pasture feeding with different levels of concentrates on milk and cheese fatty acid composition during the different stages of lactation. Group A was confined and fed alfalfa hay supplemented with 0.66 kg of concentrate mixture per kg of milk over 1.5 kg/d. Groups B, C, and D were rotationally grazed and received 0.66, 0.33, and 0 kg of concentrate mixture per kg of milk over 1.5 kg/d, respectively. Bulk tank milk samples for studying milk fatty acid composition and for processing into Domiati cheese were collected from each group twice monthly for a 6-month lactation period (April to September, 2001). Cheeses were sampled fresh and at 1 and 2 months of pickling in whey. Milk and cheese fats were extracted and fatty acids were analyzed. Caprilic and capric acids represented 12.7 and 14.2% of milk and cheese total fatty acids, respectively, while lauric acid was 4.3 and 4.1% and myristic acid was 11.3 and 12.0% of milk and cheese total fatty acids, respectively. Palmitic acid was highest in concentration among total fatty acids of both milk and cheese (30.2 and 30.2%, respectively), while oleic acid (23.9 and 22.1% of total fatty acids, respectively) was highest among total unsaturated fatty acids (27.8% and 26.4%, respectively), representing 85.8 and 83.9% of total unsaturated fatty acids in milk and cheese, respectively. Pasture feeding (Group D) significantly decreased caprilic, capric, and lauric acids while concentrate feeding increased concentrations of these acids in milk fat. Concentrate feeding significantly increased levels of these fatty acids in cheese fat, while pasture feeding significantly decreased their concentrations. Pasture feeding reduced saturated fatty acid concentrations in cheese. Caproic, caprilic, and capric acid levels in cheese were significantly higher in mid-lactation, while lauric and palmitic acids tended to be higher in late lactation. In conclusion, pasture feeding reduced levels of some saturated fatty acids in milk and cheese, particularly lauric, myristic, and palmitic acids, which are considered to be cholesterol-raising in human nutrition.

Prediction of metabolizable energy requirements for maintenance, gain, and mohair fiber growth by Angora goats

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A database was constructed for Angora goats to estimate energy requirements for maintenance, gain, and mohair fiber growth. Treatment mean observations were classified into preweaning, growing, mature (not lactating or pregnant), lactating, and pregnant goats; however, due to limited numbers of observations, data for preweaning, lactating, and pregnant goats were removed. Data set 1 (n = 144) was used to estimate ME requirements for maintenance and whole body gain using simple linear regression analysis; data set 2 (n = 89) was employed to estimate ME requirements for maintenance, tissue gain, and mohair fiber growth using multiple regression analysis. Variables were mean BW (kg), ME intake (MEI, kJ/d), ADG (g), tissue gain adjusted for grease fiber weight (TG, g/d), clean fleece growth rate (CFGR, g/d); all variables in the regression analysis were scaled by kg $BW^{0.75}$. Because of differences between growing and mature goats in intercepts and regression coefficients of simple and multiple regressions of MEI ($P < 0.01$ and 0.08 for simple and multiple regressions, respectively), separate regressions were conducted. Linear, quadratic, and cubic effects of ADG on MEI for growing goats were not significant. The simple linear regression equation for mature goats was MEI = 527 (SE = 19.7) + 42.8 (SE = 4.98) × ADG [n = 79; $R^2 = 0.48$]; after removing 2 observations with residuals greater than 2 times the residual standard deviation, the final equation was MEI = 533 (SE = 18.8) + 43.2 (SE = 4.77) × ADG [n = 77; $R^2 = 0.52$]. The coefficient for CFGR in the multiple regression model for growing goats was not significant (P = 0.42). The multiple regression equation for mature goats was MEI = 469 (SE = 52.3) + 33.6 (SE = 7.15) × ADTG + 159 (SE = 55.1) × CFGR [n = 49; $R^2 = 0.45$]. The modified equation after excluding 1 observation with residual greater than 2 times residual standard deviation was MEI = 473 (SE = 49.9) + 37.2 (SE = 6.97) × TG + 157 (SE = 52.5) × CFGR [n = 48; $R^2 = 0.53$]. In conclusion, estimated ME requirements for maintenance of mature Angora goats from simple and multiple regressions were 533 and 473 kJ/kg $BW^{0.75}$ and ME requirements for whole BW gain, TG, and CFGR were 43.2, 37.2, and 157 kJ/g, respectively.

Growth of yearling meat goat doelings with changing plane of nutrition

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Yearling meat goat doelings, 25 Boer × Spanish (BS) and 25 Spanish (S) (27 and 21 kg initial BW, respectively; SE = 0.6), were used in a 16-wk experiment to determine effects on growth of length of nutrient restriction and level of supplementation during realimentation. Doelings consumed prairie hay (6.2% CP, 70% NDF, and 9.1% ADL) ad libitum and received daily supplementation with 0.75% BW of concentrate (30% CP; C treatment), sequential 28-day periods of no supplementation and daily supplementation with 1.50 or 0.75% of concentrate (H-28 and L-28, respectively), or 56 days without supplementation followed by supplementation for 56 days with 1.50 or 0.75% of concentrate (H-56 and L-56, respectively). Ruminal ammonia N concentrations were below 6 mg/dL when concentrate was not supplemented. Body weight of S doelings was similar among dietary treatments throughout the experiment (d 28: 24.1, 24.1, 24.2, 24.6, and 23.8 kg, SE = 0.57; d 56: 24.2, 24.4, 24.0, 23.3, and 22.7 kg, SE = 0.67; d 84: 24.9, 25.3, 24.8, 25.1, and 24.6 kg, SE = 0.79; d 112: 25.2, 25.9, 26.3, 26.9, and 26.4 kg, SE = 0.81, for C, H-28, L-28, H-56, and L-56, respectively). Body weight of BS doelings also was similar among treatments on d 28 (26.2, 24.8, 23.8, 25.0, and 23.9 kg, SE = 0.57), but was greater ($P < 0.05$) for C vs L-28, H-56, and L-56 on d 56 (26.8, 25.7, 24.9, 23.2, and 21.3 kg, SE = 0.67), greatest among treatments ($P < 0.05$) for C on d 84 (29.4, 25.6, 25.2, 26.9, and 24.5 kg, SE = 0.79), and greater ($P < 0.05$) for C than for H-28, L-28, and L-56 on d 112 (31.3, 27.9, 27.5, 29.9, and 27.5 kg, SE = 0.81, for C, H-28, L-28, H-56, and L-56, respectively). In conclusion, maintaining an adequate plane of nutrition for steady growth and development appears more important for BS than for S yearling doelings, with the former possibly requiring longer periods of realimentation than previous nutrient restriction regardless of level of concentrate supplementation.

Heat production by Alpine, Angora, Boer, and Spanish wether goats consuming different quality diets at a maintenance level of intake

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Six Alpine (AL; 38.4 ± 3.0 kg), Angora (AN; 23.1 ± 2.7 kg), Boer (BO; 40.75 ± 4.5 kg), and Spanish (SP; 33.6 ± 2.16 kg) wethers (1.5 yr of age) were used to determine effects of genotype and diet quality on heat production (HP) when fed near maintenance and fasting. The experiment consisted of four simultaneous crossovers, with 21 d for adaptation before measures. Diets were 60% concentrate (CON: 14% CP and 12.04 MJ ME/kg DM) or ground alfalfa hay (HAY: 18% CP and 10.17 MJ ME/kg DM). Heat production was determined from O_2 consumption and production of CO_2 and CH_4 with a head-box respiration calorimetry system (Sable Systems, Las Vegas, NV), along

with urinary N excretion, over 2-d periods in fed and fasting states (4-d fast). Heat production was expressed on the basis of average BW during HP measurement periods. There were no interactions between genotype and diet. Intake of ME was similar among genotypes and between diets. Neither diet (358 and 354 kJ/kg $BW^{0.75}$ for CON and HAY, respectively; SE = 5.7) nor genotype (359, 361, 346, and 358 kJ/ kg $BW^{0.75}$ by AL, AN, BO, and SP, respectively; SE = 8.8) influenced fed HP ($P > 0.10$). Fasting HP was similar between diets but was greatest among genotypes ($P < 0.05$) for AL (253, 227, 219, and 226 kJ/ kg $BW^{0.75}$ by AL, AN, BO, and SP, respectively; SE = 7.25), which may have been due to a greater level of activity exhibited by AL than other genotypes during fasting. Efficiency of utilization of ME for maintenance was similar ($P > 0.10$) between diets (0.68 and 0.67 for CON and HAY, respectively; SE = 0.01). The ME requirement for maintenance, estimated by regressing HP against ME intake, was similar ($P > 0.10$) between diets (341 and 346 kJ/kg $BW^{0.75}$ for CON and HAY, respectively; SE = 10.5) and among genotypes (352, 354, 321, and 346 kJ/kg $BW^{0.75}$ for AL, AN, BO, and SP, respectively; SE = 14.8). In summary, with a level of intake near maintenance, the energy need for maintenance appears similar for AL, AN, BO, and SP 1.5 yr-old wethers goats regardless of diet quality.

Metabolizable protein requirements for maintenance, gain, and mohair fiber growth by Angora goats

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A database of treatment mean observations from the literature was constructed for Angora goats to estimate metabolizable protein (MP) requirements for maintenance, gain, and mohair fiber growth. Observations were categorized as preweaning, growing, mature (not lactating or pregnant), lactating, and pregnant goats; however, due to limited numbers of observations, data for preweaning, lactating, and pregnant goats were removed. Intake of MP (MPI) was estimated from feed intake, diet composition, and protein degradability properties with methods similar to those of AFRC. Data set 1 (n = 124) was used to determine MP requirements for maintenance and whole body gain (i.e., ADG; tissue and fiber) by simple linear regression; data set 2 (n = 88) was employed to estimate MP requirements for maintenance, tissue gain, and mohair fiber growth by multiple regression. Variables, scaled by kg $BW^{0.75}$, were MPI (g/d), ADG (g), non-fiber, tissue gain (TG, g/d), and clean fleece growth rate (CFGR, g/d). Because there were no differences ($P > 0.05$) between growing and mature goats in intercepts or regression coefficients of equations derived from data sets 1 or 2, observations were pooled. Data set 1 was then split into subsets for equation development (n = 73) and evaluation (n = 51). The initial equation for the regression with the development subset was MPI = 4.52 (SE = 0.349) + (0.336 (SE = 0.0568) × ADG) [n = 73; $R^2 = 0.33$]; the final equation after removing five observations with residuals greater than 1.5 times the residual SD was MPI = 4.30 (SE = 0.286) + (0.318 (SE = 0.0471) × ADG) [n = 68; $R^2 = 0.41$]. Regressing observed against predicted values with the evaluation subset resulted in an intercept and slope not different ($P > 0.05$) from 0 and 1, respectively. The equation with data set 2 was MPI = 3.63 (SE = 0.475) + (0.292 (SE = 0.0538) × TG) + (1.49 (SE = 0.430) × CFGR) [n = 88; $R^2 = 0.41$]. Similarly, after removing observations with residuals greater than 1.5 residual SD, the final equation was MPI = 3.35 (SE =

0.440) + (0.281 (SE = 0.0486) × TG) + (1.65 (SE = 0.394) × CFGR) [n = 83; R^2 = 0.46]. In conclusion, the predicted MP requirement for maintenance of Angora goats was 4.30 and 3.35 g/kg $BW^{0.75}$ with 0 ADG and) TG and CFGR, respectively, and MP requirements for ADG, TG, and CFGR were 0.318, 0.281, and 1.65 g/g, respectively.

Effects of diet quality and age of meat goat wethers on early subsequent growth while grazing wheat forage

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Thirty-six meat goat wethers (3/4 Spanish and 1/4 Boer), born in the previous Spring (initial age and BW of 8.5 mo and 17 ± 0.6 kg) or Fall (initial age of 2.5 mo and 13 ± 0.8 kg), were used to determine effects of ad libitum consumption of different quality diets and age on early subsequent growth while grazing wheat forage. The experiment was 14 wk long, with 9 wk in the winter consuming prairie hay (5% CP and 71% NDF) supplemented with 0.125% BW of soybean meal (PH), alfalfa pellets (AP), or a 70% concentrate diet (CD), and 5 wk in the spring grazing wheat forage. Average daily gain in Period 1 (28, 54, and 81 g/d; SE = 14.0) and Period 2 (123, 137, and 100 g/d for PH, AP, and CD, respectively; SE = 13.8) was similar among dietary treatments and greater for Spring vs. Fall wethers (Period 1: 72 vs 37 g/d, P < 0.05; Period 2: 131 vs 108 g/d, P < 0.09). There was not a discernible pattern of change in ADG as week of grazing wheat forage advanced (wk 1: 65 and 22 g/d; wk 2: 236 and 188 g/d; wk 3: 65 and 105 g/d; wk 4: 49 and 23 g/d; wk 5: 249 and 215 g/d for Spring and Fall, respectively). Body composition (estimated from shrunk BW and urea space) on d 42 and 98 and composition of gain were similar among dietary treatments. Differences between ages (P < 0.05) in protein mass on d 42 (2.92 and 2.65 kg for Spring and Fall, respectively) and 98 (3.72 and 3.36 kg for Spring and Fall, respectively) were similar in magnitude, although that in fat mass on d 98 (4.60 and 3.31 kg) was considerably greater than on d 42 (2.39 and 1.96 kg for Spring and Fall, respectively). In accordance, protein accretion from d 42 to 98 was similar between ages (14.3 and 12.6 g/d for Spring and Fall, respectively; SE = 0.86), whereas rate of fat accretion was greater (P < 0.05) for Spring vs Fall wethers (39.6 vs 24.1 g/d). In conclusion, the nature of the diet consumed ad libitum did not impact subsequent growth by 3/4 Spanish wethers, regardless of age, when grazing wheat forage.

Effects of method of exposure of crossbred Boer wether goats to Eastern red cedar foliage on cedar consumption

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This study was conducted to determine effects on present and future consumption of Eastern red cedar (*Juniperus virginiana*) foliage (CF) by goats of stepwise increases in dietary level of CF compared with a constant relatively high level and subsequent availability of low-quality forage. Twenty-four yearling wethers (23.5 ± 2.31 kg initial BW) were penned individually in Phases 1 and 3. In Phase 1 (8 wk), a concentrate-based diet (12.6% CP and 35.5% NDF) was offered at approximately 85% of the maintenance energy requirement alone (Control) or with weekly stepwise (Step) increases in substitution of CF for concentrate (0, 1.25, 2.5, 5, 10, 15, 20, and 25% in wk 1-8, respectively; DM basis) or substitution of 25% CF in wk 2-8 (Set). Wethers grazed grass pasture in Phase 2 (6 wk). In Phase 3 (2 wk), all wethers were offered the 75% concentrate, 25% CF diet, without or with separate free-choice offering of prairie hay. CF was harvested weekly from male trees and refrigerated; CF and concentrate were hand-mixed prior to feeding. In Phase 1, average total DMI was similar among treatments. Intake of CF as a percentage of that offered was greater ($P < 0.05$) for Step vs Set in wk 3-8 (wk 3: 86 and 48; wk 4: 89 and 56; wk 5: 94 and 71; wk 6: 96 and 81; wk 7: 93 and 63; wk 8: 96 and 84), although CF intake as g/d was greater ($P > 0.05$) for Set vs Step in all but wk 7 and 8. In Phase 3, concentrate intake was similar among treatments, and hay intake when offered averaged 149, 134, and 124 g/d for Step, Set, and Control, respectively. For wethers not receiving hay, CF intake as g/d for Step was greatest among treatments ($P < 0.05$) but was not different from treatments offered hay (67, 37, 30, 55, 53, and 56 g/d for Step, Set, Control, Step+hay, Set+hay, and Control+hay, respectively; SE = 7.1). Similarly, CF intake as a percentage of offered CF ranked ($P < 0.05$) Step > Set > Control without hay, but was not different between Step without hay and treatments with hay (78, 41, 34, 61, 57, and 60% for Step, Set, Control, Step+hay, Set+hay, and Control+hay, respectively; SE = 7.6). In conclusion, gradual increases in dietary level of CF deserve further research as a potential means of elevating present and future CF consumption, with attention also directed to type and level of other feedstuffs offered.

Effects of genotype, diet, and feed intake on the relationship between energy expenditure and heart rate in goats

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Heart rate (HR) holds promise as an indirect means of estimating energy expenditure (EE) by ruminants. Therefore, an experiment was conducted to determine effects of genotype, diet, and feed intake on the ratio of EE:heart rate in yearling wether goats. Six Alpine (41 ± 6.3 kg), Angora (23 ± 4.0 kg), 7/8 Boer (39 ± 4.4 kg), and Spanish (36 ± 1.3 kg) wethers (1.5 yr of age) were fed chopped alfalfa hay (18% CP and 10.2 MJ ME/kg DM) or a 60% concentrate diet (14% CP and 12.0 MJ ME/kg DM) at a level of intake near maintenance followed by a 4-d fast in a crossover design experiment. Energy expenditure was measured in a head box respiratory calorimetry system (Sable System, Las Vegas, NV) based on O_2 consumption and production of CO_2 and CH_4 with the Brouwer equation in 2-d periods while being fed and at the end of fasting. To monitor HR, stick-on ECG electrodes were attached to the chest just behind and slightly below the left elbow and at the base of the jugular groove on the right side of the neck. The human S610 HR monitor (Polar Electro, Woodbury, NY) was used to record HR at 1- min intervals. Heart rate per minute was affected by level of intake (60.7 and 38.9 for maintenance and fasting, respectively; SE = 0.9; $P < 0.05$) and a genotype x feed intake interaction (maintenance: 60.8, 63.6, 59.0, and 59.2; fasting: 42.1, 39.6, 38.3, and 35.6 for Alpine, Angora, Boer, and Spanish, respectively; SE = 1.7; $P < 0.05$). The ratio of daily EE (kJ/kg $BW^{0.75}$) to average HR per minute was not affected by genotype (6.01, 5.72, 5.87, and 6.24 for Alpine, Angora, Boer, and Spanish, respectively; SE = 0.22), diet (5.96 and 5.96 for hay and concentrate, respectively; SE = 0.13), level of intake (5.90 and 6.01 for maintenance or fasting, respectively; SE = 0.13), or their interactions. The absence of these effects on EE:HR suggest potential use of HR to estimate EE by goats.

Effects of different quality diets consumed continuously or after a lower quality diet on characteristics of growth of young Spanish goats

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Spanish wether and doeling kids (4.5 mo of age; 13.4 kg initial BW) were used to determine influences of different quality diets consumed continuously or after a lower quality diet on characteristics of growth. The experiment consisted of two 9-wk periods. Diets were low quality forage (L; prairie hay supplemented with soybean meal), high quality forage (H; dehydrated alfalfa pellets), and 70% concentrate (C). Kids on two treatments consumed L in Period 1, with half switched to C and half to H in Period 2 (LC and LH, respectively). The CC treatment entailed C consumption in both periods, and HH kids were fed H in both periods. For HC, H was fed in Period 1 followed by C in Period 2. Dry matter intake ranked ($P < 0.05$) LC and LH < CC < HC and HH

in Period 1 (502, 352, 386, 610, and 636 g/d) and CC and LC < LH, HC, and HH in Period 2 (652, 621, 833, 808, and 836 g/day for CC, LC, LH, HC, and HH, respectively). Average daily gain was lowest among treatments ($P < 0.05$) for LC and LH in Period 1 (78, 1, -1, 84, and 80 g/d) and was 53, 82, 112, 92, and 73 g/d in Period 2 for CC, LC, LH, HC, and HH, respectively (SE = 11). Empty body fat concentration at the end of Period 1 was greatest for the C diet and lowest for L ($P < 0.05$; 12.2, 6.4, and 9.0% for C, L, and H, respectively), and protein concentration was greatest among treatments ($P < 0.05$) for L (16.8, 20.1, and 18.1% for C, L, and H, respectively). At the end of Period 2, empty body fat concentration was 22.0, 15.9, 14.4, 20.1, and 15.2% (SE = 1.94), and protein concentration was 16.8, 16.9, 17.9, 16.5, and 17.6% (SE = 0.35) for CC, LC, LH, HC, and HH, respectively). In summary, kids on the L diet in Period 1 mobilized fat to accrete a small amount of protein. Continuous consumption of C resulted in high fat accretion relative to H in both periods. Consumption of H in Period 1 followed by C in Period 2 resulted in growth characteristics slightly different from those with continual intake of C, with a lower concentration of protein in accreted tissue for HC. The diet in Period 2 for kids previously consuming L did not markedly affect tissue accretion. In conclusion, the nature of the diet consumed by young Spanish goats can impact current and subsequent rate and composition of BW gain.

Growth performance by Alpine, Angora, Boer, and Spanish wether goats consuming 50 or 75% concentrate diets

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Forty-six weaned wether goats (12 Alpine, 12 Angora, 10 Boer [87.5%], and 12 Spanish) were used to determine differences in growth performance with consumption of a 75% concentrate diet for 24 wk (75C) or for 12 wk subsequent to 12 wk of feeding a 50% concentrate diet (50C). Initial BW was 20.2, 12.2, 20.7, and 19.2 kg (SE = 0.73) for Alpine, Angora, Boer, and Spanish, respectively. There were no interactions between genotype and dietary treatment in DM intake, ADG, or gain efficiency in wk 1-12 or 13-24. Dry matter intake in wk 1-12 ranked ($P < 0.05$) Alpine and Boer > Spanish > Angora (703, 436, 689, and 567 g/d) and in wk 13-24 was greater ($P < 0.05$) for Alpine and Boer vs Angora and Spanish (712, 515, 702, and 456 g/d for Alpine, Angora, Boer, and Spanish, respectively). Dry matter intake as g/d was similar between dietary treatments. Average daily gain in wk 1-12 was greatest among genotypes ($P < 0.05$) for Boer (59, 59, 90, and 49 g); in wk 13-24 ADG was lowest among genotypes ($P < 0.05$) for Spanish and tended to be greater ($P < 0.10$) for Boer vs Alpine (58, 63, 82, and 25 g for Alpine, Angora, Boer, and Spanish, respectively). Gain efficiency (ADG:DM intake) was greater ($P < 0.05$) for Angora and Boer than for Alpine and Spanish in wk 1-12 (85, 132, 127, and 85 g/kg), and in wk 13-24 was lower ($P < 0.05$) for Spanish than for Angora and Boer (80, 121, 104, and 51 g/kg for Alpine, Angora, Boer, and Spanish, respectively). Average daily gain and gain efficiency were greater ($P < 0.05$) for 75 vs 50% dietary concentrate in wk 1-12 (ADG: 73 and 55 g; gain efficiency: 122 and 92 g/kg), and tended to be greater ($P < 0.11$) for 50C than for 75C in wk 13-24 (ADG: 49 and 65 g; gain efficiency: 77 and 101 g/kg for 75C and 50C, respectively). In conclusion, a moderate vs high dietary concentrate level

did not impact differences among Alpine, Angora, Boer, and Spanish wether goats in growth performance.

Evaluation of goat eye mucous membrane scoring for determination of the need for anthelmintic treatment

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The major gastrointestinal parasite of goats in the southern U.S. is *Haemonchus contortus*, which is hematophagus, causes anemia, and therefore affects eye mucous membrane color (EMMC). The objective of this study was to evaluate EMMC as an indicator of the need for anthelmintic treatment. EMMC on the inside of the lower eyelid was scored using a color chart with four gradations of color (1 = dark, 4 = pale). EMMC was also captured with a digital camera with the values for red, blue and green determined from a selected digital picture area. Goats (n = 167) on a variety of pasture studies were evaluated for packed cell volume (PCV; microhematocrit) and fecal egg count (FEC; eggs/gram [epg]; McMaster). Data were analyzed by χ^2 analysis and GLM procedures. Fecal egg counts were different for eye scores ($P < 0.001$), with an average of 212, 596, 816, and 2,077 epg for the scores 1 through 4, respectively. FEC were greater ($P < 0.01$) for a score of 4 than for other scores. EMMC scores correctly identified 22 of 30 animals with FEC greater than 2,000 (sensitivity 73%) but included 47 animals with FEC less than 2,000 (specificity 70%). The red, blue, and green digital values from the image were poorly correlated to FEC or PCV ($R^2 < 0.11$). Goats with a score of 4 had lower PCV than scores of 3 or less ($P < 0.01$; 23, 26, 29, and 29%, respectively). Eye scores of 4 correctly identified 19 of 25 animals with PCV < 20% (sensitivity of 76%), but also included 50 animals with PCV > 20% (specificity of 75%). In conclusion, scoring EMMC with a chart correctly identified most animals needing anthelmintic treatment, but included a significant proportion not requiring treatment.

Spatial-temporal relationships of grazing goats and sheep and their guardian dog monitored by global positioning system collars

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Guardian animals such as dogs, donkeys, and llamas are commonly used to protect small ruminants from predators. However, data on their spatial relationships are lacking. The objectives of this research were to examine spatial relationships of goats (G), sheep (S), and guard dogs (D) over time and to determine circadian rhythms. In a group of 12 G and 12 S confined in a 1.6 ha pasture, Global positioning system (GPS) collars were fitted to three G, two S, and the sole D. GPS fixed longitude and latitude every 30 min for 2 wk. After post-differential correction, minimum distance traveled between consecutive fixes (4,097 observations) and distance between any two animals at the same fix time (7,097 observations) were calculated using spherical geometry. The repeated measures, mixed model included animal identity, species, and fix time, with identity nested within species as a random effect. At night, S traveled least between fixes (17.2 ± 1.30 m) and D most (21.9 ± 1.94 m) with G intermediate (17.6 ± 1.10m). However, during day, D traveled least (29.0 ± 1.64 m) and G most (48.3 ± 0.87 m) with S intermediate (41.0 ± 1.02 m). For distances among species at the same fix, closest were at night among G (11.2 ± 1.21 m) and greatest distance at night between the D and S (93.0 ± 1.45 m), which was not different ($P > 0.10$) from the distance during day between D and S (91.5 ± 1.21 m) or distance at night between G and S (90.2 ± 0.81 m). Distance among G was greater during day (14.8 ± 1.01 m) than at night (11.2 ± 1.21 m). Distance between S was greater during day (28.6 ± 1.40 m) than at night (14.1 ± 1.80 m). Distance between G and D during day was 52.6 ± 1.04 m and at night was 17.5 ± 1.21 m. During day distance between G and S was 66.9 ± 0.66 m. The three species exhibited definite spatial relationships and preferences; however, further study is needed to ascertain causal effects for these preferences.

Global positioning system for monitoring spatial relationships of grazing goats within and across pastures

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Herd dynamics for goats is not as well understood as for other grazing species, especially how differing genotypes affects spatial aspects or how herds in adjacent pastures interact spatially. The objective of this study was to investigate spatial relationships in a herd of mixed genotype goats. In one 2-ha pasture (East, E) containing 30 Angora (A) and Boer-cross (B) goats, global positioning system (GPS) collars were fitted to one A, two B, and their guard dog (D). In the adjacent 2-ha pasture (West, W) also containing 30 A and B, GPS were fitted to one A and one B. GPS fixed longitude and latitude every 30 min for 2 wk. D had access to both pastures. After post-differential correction, minimum distance traveled between consecutive fixes (3,922 observations) and distance between any two animals at the same fix time (4,265 observations) were calculated using spherical

geometry. The repeated measures, mixed model included animal identity, genotype, pasture location, and fix time with identity nested within genotype as a random effect. During day, D traveled most (60.9 ± 2.32 m), A and B least (36.4 ± 1.58 m) and (36.9 ± 1.26 m), respectively. At night, A, B, and D traveled less than during day (22.5 ± 2.07 m), (18.3 ± 1.67 m) and (21.7 ± 2.85 m), respectively. Within pasture, A-B goat distance (19.9 ± 3.91 m) was not different from the B-B distance (12.7 ± 6.79 m). During day, distance among goats was 21.5 ± 3.55 m and 16.6 ± 3.54 m at night. Distances of D with goats in W were greatest during day (100.7 ± 2.17 m) and least at night (75.1 ± 2.08 m) and distances of D with goats in E were greatest during day (40.4 ± 1.98 m) and least at night (35.2 ± 1.82 m). Genotype of goat did not affect spatial relationships; however, time of day did, with distance traveled and distance between animals greater during day than at night.

Effects of level of broiler litter in diets containing wheat straw on performance of Alpine doelings

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Residues from cereal grain production are important feedstuffs for ruminants throughout the world. They are, however, low in protein and high in fiber, which limit feed intake and digestibility. The nutritive value of cereal crop residues can be improved by various processing methods, such as treatment with alkalis like sodium hydroxide or ammonia. Another means of improving nutritive value of cereal crop residues is supplementation with other feedstuffs, particularly ones high in crude protein. Broiler litter is a low-cost agricultural byproduct available in many areas of the world. The crude protein concentration in broiler litter is usually between 15 and 35% of dry matter, and the available energy concentration in broiler litter is moderate. Thus, objectives of this experiment were to compare feed intake, average daily gain, and gain efficiency of growing Alpine doelings consuming diets based on wheat straw supplemented with different levels of broiler litter to wheat straw supplemented with a conventional protein source or ammoniated through urea treatment. Treatments were feeding of a corn-based concentrate at 1.5% of body weight (dry matter basis) with treated wheat straw and this supplement plus approximately 0.4% body weight of soybean meal or 0.8 or 1.6% body weight of broiler litter with untreated wheat straw. Soybean meal supplementation of wheat straw supported average daily gain as great as urea-treated wheat straw, and with less total feed consumption. Dietary inclusion of broiler litter also resulted in gain similar to that with urea treatment of wheat straw and soybean meal supplementation of untreated straw, but with greater feed input particularly for the highest level of litter. Hence, availabilities and costs of urea for ammoniation and crude protein supplements such as soybean meal and broiler litter, along with practical considerations including labor and facilities, would dictate the choice between urea treatment of low quality forages such as wheat straw and different supplemental sources of crude protein.

Performance effects of preweaning concentrate supplementation of meat goats

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The market weight for meat goats in the US is quite variable; however, sale weights near those typical of weaning time are common, possibly relating to the amount of disposable family income and yield of a quantity of meat suitable for consumption in a convenient period of time such as 1 or 2 weeks. Also, some consumers may prefer meat from young animals. Thus, means of enhancing growth of meat goat kids preweaning and in the early postweaning period is of interest to increase income for meat goat producers. In this experiment, Spanish does with Boer × Spanish or Spanish kids were used to determine effects of preweaning feeding of concentrate-based supplement on preweaning and early postweaning growth. In mid-April, from approximately 6 to 14 weeks after

birth, animals grazed wheat forage (Phase 1), followed by 5 weeks on native grass pasture (Phase 2) and an 8-week postweaning period with a moderate level of supplemental concentrate (Phase 3). Forage availability was moderate to high throughout the experiment. Treatments were no supplementation in Phases 1 and 2 (C), ad libitum consumption of a concentrate-based supplement in Phases 1 and 2 (A), no supplementation in Phase 1 and ad libitum consumption of supplement in Phase 2 (A-2), and limit feeding of supplement (approximately 1% of body weight, dry matter basis) in Phases 1 and 2 (L). Results indicated that with ample availability of forage of at least moderate quality as in Phase 1, suckling meat goat kids may not quickly achieve high levels of consumption of concentrate-based supplement. In accordance, preweaning supplementation did not enhance preweaning growth while grazing wheat forage or later when on warm-season grass pasture, regardless of growth potential as influenced by Spanish and Boer sires. However, preweaning supplementation generally did improve growth in the early postweaning phase with a greater level of supplementation than previously. Nonetheless, preweaning supplementation did not impact overall gain in the entire experiment.

Effects of different feeding methods on growth and harvest traits of young Alpine kids

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Compared with beef, lamb, and pork, chevon, particularly from young dairy kids, is quite lean, with little subcutaneous or intramuscular fat. Prior to the introduction of Boer goats, male kids from dairy goats harvested at a very young age provided much of the goat meat consumed in the U.S. In addition to feeding for early age slaughter, effective and economical feeding systems for dairy kids are needed for development of replacement doelings and with slaughter for meat at heavier weights and greater ages. Therefore, objectives of this experiment were to compare effects of ad libitum milk intake and limited milk consumption, with or without supplemental concentrate, on growth and carcass traits of Alpine kids at two harvest ages (10 and 13 weeks). Thirty wether kids (2 weeks of age) were given ad libitum (A) or limited (1 kg/day) access to milk, with (LC) or without (L) ad libitum supplemental concentrate. Average daily gain was lowest among dietary treatments for L and similar between A and LC at 10 weeks but greater for LC at 13 weeks (151, 55, and 149 g at 10 weeks and 110, 49, and 144 g at 13 weeks for A, L, and LC, respectively). Similar differences were observed in carcass weight (7.0, 3.7, and 6.1 kg at 10 weeks, and 6.8, 4.4, and 7.9 kg at 13 weeks for A, L, and LC, respectively). The ratio of kidney and pelvic fat to bone-free muscle was lowest among dietary treatments for L, similar between A and LC at 10 wk, and lower for LC versus A at 13 weeks (2.1, 0.5, and 2.0 at 10 wk and 2.7, 0.5, and 1.8 at 13 wk for A, L and LC, respectively). In summary, up to 10 weeks of age, either ad libitum consumption of milk or restricted milk intake with supplemental concentrate can be used to raise Alpine kids. However, with slaughter at ages greater than 10 weeks, body weight and carcass weight may be greater when concentrate is supplemented compared with ad libitum milk intake alone. Likewise, internal fat deposition can be elevated with extended ad libitum milk intake without supplemental concentrate.

Effects of small peptides or amino acids infused to a perfused area of the skin of Angora goats on mohair growth

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Until recently, it was commonly believed that gastrointestinal digestion of proteins is complete and that only free amino acids enter circulation. However, a considerable body of evidence for absorption of peptides from the digestive tract has accumulated. Also, there are some reports suggesting effects of small peptides on fiber growth. Therefore, an experiment was conducted to compare effects of infusing a defined area of skin of Angora goats with small quantities of a mixture of dipeptides (methionine-leucine and lysine-leucine) or free amino acids on mohair fiber growth. Supplying small peptides or their amino acids directly to the skin equally increased mohair production compared with a control saline solution. Similar blood concentrations of various hormones and metabolites suggest that small peptides were utilized by skin for mohair fiber growth via supplying limiting free amino acids directly to the fiber follicle for protein synthesis.

Effects of prolactin administered to a perfused area of the skin of Angora goats

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Decreased fiber growth by some breeds of sheep and Angora goats in early lactation has been attributed to a regulatory role of prolactin on increased nutrient use by the mammary gland. In addition to indirect influence, direct effects of prolactin on follicles are possible. Therefore, effects of infusing prolactin on mohair growth were investigated use a skin perfusion technique. Prolactin decreased mohair fiber growth in a perfused area of skin of Angora goats, implying a direct effect on skin metabolism and fiber growth. The decrease in mohair fiber growth was accompanied by a decrease in mohair staple length, indicating that all or a substantial portion of change in fiber growth was because of actions on active follicles rather than an increased number of inactive follicles. Decreased amino acid use by follicles of Angora goats when prolactin is elevated, such as in late pregnancy and early lactation, may contribute to partitioning of nutrients to other tissues.

Goat husbandry: feeding management

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Goats are ruminant animals with an inquisitive and enterprising grazing-browsing behavior. Three general types include dairy, Angora (mohair), and meat goats. Nutrient requirements for goats are determined as the sum of the requirements for different physiological processes that are carried out simultaneously (e.g., maintenance, pregnancy, and lactation). The lactating dairy goat is the most productive and requires the highest levels of nutrients. The Angora is the most sensitive to dietary and environmental changes. Nutrient requirements and an example ration are presented in this review and discussed. Certain periods of the annual cycle are critical, especially for the Angora, and require special managerial attention. Many other management considerations either involving nutrition or having nutritional implications are very important in goat production. Among these are facilities, feed and water sanitation, parasitism, protection from adverse climate, predation, diseases, product quality, and marketing.

Effects of separate offering of forage and concentrate on feed intake and growth of Alpine doelings

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Of all classes of animals on dairy farms, growing replacements often receive the least attention, which is of concern given the considerable expense in rearing without milk output. Simple and effective feeding management practices for replacement dairy goat doelings after weaning have not been extensively explored. Therefore, 44 weaned Alpine doelings (16 ± 0.19 kg initial BW) were used in a 16-wk experiment to determine how separate free-choice offering of concentrate and forage (wheat hay, 14.2% CP and 62% NDF) affects performance compared with consumption of mixed diets of different proportions of concentrate and forage. An increasing level of concentrate (i.e., 25, 50 and 75%) in diets with moderate to high quality forage increased ADG by young Alpine doelings though did not influence feed intake. Separate and limited offering of concentrate (approximately 2% BW) resulted in performance as expected based on the resultant dietary concentrate level and responses to mixed diets. Overall ADG and ADG:DM intake in the 112-day experiment were slightly greater for doelings given separate free access to concentrate and forage than for doelings consuming a 75% concentrate mixed diet, even though dietary concentrate levels were similar, suggesting potential use of separate feeding for decreased feed mixing and labor inputs without sacrifice of animal performance.

Effects of diet quality and age of meat goat wethers on early subsequent growth while grazing wheat forage

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Annual wheat is a major source of nutrients for many ruminants in the south-central US, including a significant number of meat goats. However, performance of cattle and sheep in the first few weeks of wheat grazing is lower than expected based on concentrations of chemical constituents such as crude protein and neutral detergent fiber. Responsible factors have not been identified, although possible ones include digestive upset associated with an abrupt transition to highly digestible forage, low herbage mass and time required for adaptation by the ruminal microflora or tissues or organs, such as the digestive tract and liver, and tissues sensing the taste and texture of wheat forage. Therefore, 36 meat goat wethers (3/4 Spanish and 1/4 Boer), born in the previous Spring (initial age and BW of 8.5 months and 17 ± 0.6 kg) or Fall (initial age of 2.5 months and 13 ± 0.8 kg), were used to determine effects of *ad libitum* consumption of different quality diets and age on early subsequent growth while grazing wheat forage. The experiment was 14 wk long, with 9 wk in the winter consuming prairie hay (5% CP and 71% NDF) supplemented with 0.125% BW of soybean meal (PH), alfalfa pellets (AP), or a 70% concentrate diet CD), and 5 wk in the spring grazing wheat forage. An obvious period of adaptation to grazing of wheat forage after consuming *ad libitum* different diets on pasture in the winter was not apparent with 3/4 Spanish wethers less than 1 year of age. The nature of diets consumed ad libitum did not impact subsequent growth, regardless of age, when grazing wheat forage. Overall ADG was greater in Period 2 when grazing wheat forage than earlier in Period 1, which contributed to greater differences in body composition, notably fat concentration, between wethers at approximately 5.5 vs 11.5 months of age than earlier at 4 vs 10 months.

Effects of different quality diets consumed continuously or after a lower quality diet on characteristics of growth of young Spanish goats

T. Wuliji, A. L. Goetsch, T. Sahlu, R. Puchala, S. Soto-Navarro, R. C. Merkel, G. Detweiler, and T. Gipson

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There are several feeding options available to goat producers with fall-born kids. One for kids weaned in the winter is to graze or be fed harvested low-quality forage, such as prairie grass or prairie hay, which is usually abundant in winters. For many producers, this might be followed by consumption of relatively high quality forage or browse in the spring or, for others, there could be immediate or delayed placement on high grain diets. Therefore, the objective of this study was to elucidate effects of consuming different quality diets continuously or with an increase in diet quality during the latter part of the growing period on characteristics of growth by fall-born Spanish kids.The experiment consisted of two 9-wk periods. Diets were low quality forage (L; prairie hay

supplemented with soybean meal), high quality forage (H; dehydrated alfalfa pellets), and 70% concentrate (C). Kids on two treatments consumed L in Period 1, with half switched to C and half to H in Period 2 (LC and LH, respectively). The CC treatment entailed C consumption in both periods, and HH kids were fed H in both periods. For HC, H was fed in Period 1 followed by C in Period 2. Results indicated that diets high in concentrate may yield ADG similar to that for high quality forage but with greater fat deposition in both carcass and noncarcass components. Switching from a high quality forage to a concentrate-based diet resulted in ADG similar to that with continuous intake of both diets, but with increased fat and decreased protein deposition compared with continuous intake of high quality forage. Little or no BW change for kids consuming low quality forage, with fat mobilization to accrete a small amount of protein, resulted in smaller differences in subsequent fat and protein accretion when changed to high quality forage or a concentrate-based diet compared with continuous intake of high quality forage or a concentrate-based diet. In conclusion, the nature of the diet consumed by young Spanish goats can impact rate and characteristics of tissue accretion.

Relationships between body composition and shrunk body weight and urea space in growing goats

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In order to accurately estimate nutrient requirements of livestock, it is desirable to know the composition of tissue accreted or lost. Much less information on body composition of goats is available relative to that for other ruminant species such as cattle and sheep. The cost and labor associated with harvest and the determination of chemical composition of the whole body or carcass and noncarcass components are high. Furthermore, such measures are terminal, necessitating assumptions of similar composition of other animals at later times in serial slaughter experiments. Therefore, there is need for simple, inexpensive and non-terminal means of assessing body composition of goats. In this regard, growing Spanish wethers and doelings (31; initial age of 3.5 mo) consumed ad libitum diets differing in quality continuously for 18 wk or with an increase in quality after 9 wk. Urea space (US), shrunk body weight (SBW) and chemical composition of the whole body were determined at the beginning, middle and end of the experiment. In addition, at the beginning of the experiment the same determinations were made with two yearling Boer × Spanish doelings that had consumed a high quality diet ad libitum for 12 wk. SBW accounted for most variation in body composition of growing goats of this experiment. Nonetheless, small improvements in explained variability resulted from inclusion of US in equations for water and fat. Equations yielding best prediction of body composition of weaned goats were: water (kg) = 1.274 + (0.1546 × US, kg) + (0.5782 × SBW, kg) - (0.0043 × SBW^2, kg); fat (kg) = -0.921 - (0.1520 × US, kg) + (0.1564 × SBW, kg) + (0.0064 × SBW^2, kg); protein (% water) = 34.696 - (0.1175 × predicted water, %); and ash (% water) = 0.0448 × predicted water, %. However, utility of such equations at present may primarily be for within experiment treatment comparisons or for assessing changes in composition.

Effects of melatonin and bromocryptine administration for Spanish goats on spring breeding performance, kidding rate and fleece weight

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The demand for meat goats in the USA increasing particularly in Christmas - Easter holiday seasons. Manipulation for spring breeding in goats could accelerate productivity of goat flocks, enhance profitability of producers, and increase the supply of meat goats value in high demand. In this regard, four Spanish bucks were conditioned for 2 months to long-day photoperiod (16-hour light: 8-hour dark), followed by a single melatonin implant (18 mg, 6-week release period). Eighty Spanish does were allotted to five treatments: control (C); melatonin implant (MI); melatonin and bromocryptine (225 mg, 60-day release period) implants (MIB); oral administration of melatonin (MO, 3 mg/day); and oral administration of melatonin and bromocryptine implant (MOB). After the fifth week of melatonin administration, does were randomized and bred in three single-sire groups for two estrus cycles. The artificial long day light conditioning and melatonin supplementation for bucks stimulated breeding behavior, libido, buck effect, and fertility during spring mating. Melatonin treatment and the buck effect induced out of season breeding in anoestrus does. Although there were not a large number of variables with significant treatment effects, these results suggest that melatonin implanted or orally administered daily would be necessary to achieve a high percentage of does bred and a large number of fall born kids. Furthermore, these findings imply that an accelerated out of season breeding system with goats, scheduling kidding twice both in the fall and spring is feasible. Such a system should increase total annual meat goat production as well as increasing meat goats available during the Christmas-Easter holiday season when prices are generally elevated. However, for rapid growth of fall born kids, it may be necessary to utilize high quality forages productive in the fall-winter period, such as cool season annuals. Out of season breeding also offer potential to decrease age of first breeding and concomitantly improve lifetime reproductive efficiency.

Effects of melatonin and bromocryptine administration for Spanish goats on seasonal cashmere growth, yield and fiber characteristics

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Manipulation for spring breeding in Spanish goats could improve reproductive efficiency, kidding rate, and cashmere production. Therefore, 80 Spanish does were used to determine effect of melatonin treatment on cashmere fiber growth rate, length, and characteristics during spring breeding. Treatments control (C); melatonin implant (18 mg; Regulin, Schering Pty. Ltd., Australia) without (MI) and with bromocryptine (225 mg) implants (MIB) (Innovative Research of America, Sarasota, FL); and oral administration of melatonin (3 mg/day) (Sigma Chemical Co., St. Louis, MO) without (MO) or with bromocryptine (MOB). Results of this experiment suggest that melatonin administration for spring breeding is an effective means of increasing cashmere production from

Spanish goats. Melatonin, given by oral or a slow release implant, increased fiber growth rate, fiber elongation, fiber diameter, and cashmere yield in spring months. These changes were accompanied by a delay in the initiation of fall growth, but this did not influence annual fleece weight. Manipulation of seasonal breeding in cashmere growing goats, such as Spanish, in the USA could both increase production of goat meat and extend the cashmere growth phase in spring.

Effects of ruminally degraded nitrogen source and level in a high concentrate diet on site of digestion in yearling Boer × Spanish wether goats

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The quantity and quality of protein reaching the small intestine are influenced by ruminally undegraded intake N or protein and microbial protein synthesized in the rumen. There have been few determinations of microbial protein synthesis in goats. Similarly, ruminal degradability of feed CP in goats has not been extensively studied, with some estimates based on in situ disappearance and assumed or measured ruminal digesta passage rate. Although differences between goats and other ruminant species in ruminal digesta passage rates are not well agreed upon, potential for differences with some diets raises the possibility that extent of ruminal digestion of protein differs between goats and cattle or sheep. Results of this experiment support suggestions that goats have considerable ability to recycle N to the rumen. For goats with ample tissue protein stores available for mobilization, this permits high microbial protein production and efficiency of microbial growth with high concentrate diets containing as little as 9.3-9.6% CP and with a ruminally degraded intake protein(DIP) to TDN ratio of 0.073. In such instances, only small increases in ruminal and total tract OM and NDF digestibilities can be achieved by supplying additional DIP, such as with a dietary CP concentration of 11.5-13.5% and a DIP to TDN ratio of 0.104-0.113. When ruminal ammonia availability is not limiting, with a high quality, high concentrate diet, it is unlikely that benefits in microbial growth or digestion will occur with use of a true protein source compared with a source of non-protein N such as urea.

Tannins for suppression of internal parasites

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This article is a review of published research that has been done with tannins on their possible use for controlling gastrointestinal parasites (worms), especially in goats. Gastrointestinal parasites in goats are developing resistance to dewormers and in the near future, dewormers will lose their effectiveness in controlling worms. Some laboratory studies have shown that tannins in plants may be effective in controlling worms and a few field studies have shown good results. Sericea lespedeza and oak species are examples of plants containing tannins. There are two mechanisms by which tannins may help to control worms. They may have an indirect mechanism in that they improve protein nutrition of the animal which helps the animal's immune response. Protein nutrition is

improved by the tannin binding the protein in the rumen, preventing its degradation by rumen microorganisms, and stomach acids cause the tannins release the protein for digestion. This has been shown to improve protein supply of the animal by 20-40%. Tannins may also have direct effects on the parasites themselves. In some cases, egg production by the worms is reduced by more than 40%, causing a reduction in pasture contamination. One study showed that one type of worm is killed by tannins, but this species is not our most common worm in the South. Also, there is some evidence that tannins reduce hatch and development of worm eggs in the feces. From this review, it appears that research should be done on the use of tannins to control worms in goats.

The effect os short-term consumption of a forage containing condensed tannins on gastrointestinal nematode parasite infections in grazing wether goats

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Some laboratory and small scale research has indicated that plants containing tannins may reduce hatching and development of internal parasite eggs. Tannins appeared to kill one species of worm in sheep. The present investigation was a short, preliminary study of the effect of sericea lespedeza, a common forage plant in Oklahoma which contains tannin, on internal parasites in goats. Wether goats with fecal egg counts greater than 1200 eggs/gram (wormy animals) were used in this study. Fecal egg counts were taken at the beginning of the study and at 5, 10, and 15 days of each period. One group of six wethers grazed crabgrass/ryegrass and one group grazed sericea lespedeza (height maintained at 7-9 inches). After 15 days (first period) the groups were switched to the other forage and data collected again. The major species of worm was the barber pole worm (*Haemonchus contortus*). During both periods, fecal egg counts on lespedeza started to decreased in only 5 days and by 10 and 15 days were significantly lower than for wethers grazing the sericea lespedeza pasture. Fecal egg counts increased in both periods for animals grazing the crabgrass/ryegrass. Fecal egg counts averaged 2,500 per gram for the crabgrass/ryegrass pasture and 700 eggs/gram for sericea lespedeza. Total daily production of fecal eggs was reduced from 1,730,000 to 450,000 eggs/day (a 74% reduction) by sericea lespedeza. In addition, the percentage of eggs in feces developing to L-3 infective larvae decreased from 99 to 58%. Sericea lespedeza helped to reduce pasture contamination by eggs and larvae and has great potential to help control internal parasites of goats.

Effect of feeding treatments and lactation stages on composition and organoleptic quality of goat milk Domiati cheese

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To investigate the effect of pasture feeding with different levels of concentrate on the milk composition and quality of Domiati cheese, 20 lactating Alpine goats were randomly allocated to four groups. Group A was confined and fed alfalfa hay with 0.66 kg/d of concentrate mixture per 1.5 kg of milk (conventional confinement system with feeding). Groups B, C, and D were

rotationally grazed and received 0.66, 0.33, and 0 kg/d of concentrate, respectively. Milk from each group was processed into Domiati cheese twice monthly for a 6-month lactation period. Cheeses were sampled fresh and at 1 and 2 months of pickling in whey. Results of the present study indicate that feeding system of dairy goats with different levels of concentrate supplementation did not affect the composition (fat, protein, and total solids) of Domiati Cheese. Pasture-grazing without concentrate supplementation (Group D) resulted in a lower short-chain fatty acids content and a higher flavor score of Domiati cheese than the confined feeding system (Group A). Cheese age during pickling did not change flavor score but increased the total sensory score due to a smoother, creamier body and texture of cheese. As lactation advanced, contents of total, short- and long-chain fatty acids and the sensory scores of the cheese fluctuated markedly. Further research is needed to investigate the effect of fatty acids in diets on the profile of fatty acids in goat milk and cheese, and to correlate the individual fatty acids in diet, milk and cheese to establish the sensory quality of goat cheese.

Fatty acid profiles of goat milk and Domiati cheese as affected by pasture feeding and stage of lactation

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Twenty lactating Alpine goats were randomly allocated to four groups to investigate the effect of feeding regimes with concentrate on fatty acid profiles of goat milk and Domiati cheese at different stages of lactation. Pooled milk from each group was collected twice monthly for Domiati cheese making. Cheese was sampled fresh and at 1 and 2 months of pickling in whey. Caproic, caprilic, and capric acids in goat milk were recorded at 1.9, 5.5, and 25.1 µg/g of fat, respectively, and accounted for 13.3% of total fatty acids. Total unsaturated fatty acids represented 28.9% of total fatty acids. In Domiati cheese, caproic, caprilic, and capric acids were 4.2, 7.4, and 31.4µg/g of fat, respectively, and accounted for 11.2% of total fatty acids. Total unsaturated fatty acids represented 26.8% of total fatty acids. Fatty acid composition of both milk and cheese was affected by feeding treatments and stages of lactation. All fatty acids of milk and cheese were lower when goats were pasture-fed compared with other groups except linolenic and stearic acids in goat milk and linolenic acid in cheese. Concentrations of caproic, caprilic, capric, palmitic, myristic, and oleic acids fluctuated throughout lactation with the highest values at mid-lactation. The above observations indicate that pasture feeding during mid-lactation could result in improved quality and nutritionally healthy goat milk and cheeses.