WELCOME

We deeply appreciate your attendance at this 20th 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, extension, and international activities of the Institute in the past year. This section is an aid to assess our recent progress, display current activities, and contemplate future directions to be followed. We hope you will take time later to look through this information. This year's general theme *"Quality Assurance: Delivering a Wholesome Product to Market."* This is the subject of a number of recent projects of the Institute, which will be highlighted today. In addition, we have other experts who will address this area. 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.

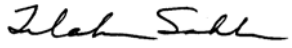
The morning program consists of:

- **Why Have A Quality Assurance Program for the Goat Industry?** *Roger Merkel*
- **Herd Health and Quality Assurance** *Ann Wells*
- **Quality Assurance for Goat Nutrition** *Steve Hart*

The afternoon workshops are:

- **How to Help Your Vet Help You** *Ann Wells*
- **Sustainable Parasite Management for Goats** *Ann Wells*
- **A Meat Goat Quality Assurance Program** *Roger Merkel*
- **Livestock Guardian Dogs** *Paula and Dan Lane*
- **Interactive Nutrient Calculator** *Steve Hart*
- **Quality Assurance from Milking to Processing** *Steve Zeng*
- **A Guide to Drug Usage in Goats** *Lionel Dawson*
- **Administration of Injectable Drugs and Vaccines in Goats** *Lionel Dawson*
- **Basic Goat Husbandry - I** *Jerry Hayes*
- **Basic Goat Husbandry - II** *Lionel Dawson*
- **Body Condition Scoring for Improved Management** *Mario Villaquiran*
- **Soapmaking Overview** *Cindy Sterling*
- **Benefits of Government Programs** *Dwight Guy*
- **General Youth Activities** *Sheila Stevenson*
- **Fitting and Showing** *Kay Garrett*

Please let us know your wishes for the 2006 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

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Why have a Quality Assurance Program for the Goat Industry?

Roger Merkel

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

Quality Assurance and Food Safety

Today's U.S. meat supply is the safest it has been in history, yet consumers still have concerns about the quality and safety of the products they purchase. News of food recalls due to the presence of potentially harmful bacteria, other contaminants, or other disease-causing agents, such as BSE, raise fear in consumers leading to lowered confidence in the nation's food supply. While food safety may be at an all time high, the perception of many consumers is that there is genuine risk in consuming many of the products purchased at grocery stores. The rise in consumption of organically produced foods, foods purchased directly from the farm, or from a farmer's market are indicators of this perception and of a "back to nature" mentality among consumers.

The Food Safety Inspection Service (FSIS) of the USDA is the government organization that has as one of its responsibilities the testing of our food supply to ensure its safety. According to the FSIS, food safety refers to the conditions and practices that preserve the quality of food to prevent contamination and food-borne illnesses. Detecting the presence of disease organisms, chemical residues, or foreign material in foods and recalling those foods are examples of some of the work conducted by the FSIS to safeguard the nation's food supply. These quality control measures evaluate the final product prior to sale and prevent potentially harmful food from being distributed or consumed by the public. However, while quality control detects harmful substances, it cannot correct or refine the production practice that was at fault leading to the presence of those substances. That is the role of quality assurance.

The presence of drug residues in meat can serve as an illustration of the difference between quality control and quality assurance. Tests can be performed to detect the presence of unacceptable levels of drug residues in meat necessitating it be condemned and destroyed. This quality control process identifies the problem, high levels of drug residues, but cannot pinpoint where in the production process the problem occurred. Quality assurance programs, on the other hand, set forth guidelines to prevent failures in quality from occurring and, when problems are detected, provide the framework to identify and correct the production practices that led to compromised product quality. Thus, a producer following a quality assurance program can trace back in his or her production system and identify where the failure occurred to allow the sale of an animal prior to completing the recommended withdrawal period for the drug in question. Protocols and procedures can be evaluated, corrective actions taken, and records kept to prevent future occurrence.

The goal of quality assurance programs is to consistently produce a high quality product. This is done by establishing production practices to prevent problems from happening. In the drug residue example, that production practice is proper administration of all drugs and adherence to withdrawal times. Supporting each production practice are standard procedures that must be followed. For drug usage, the standard procedure is to record the date of all injections and then calculate and record the

date when the withdrawal time has been fulfilled. When failures in following standard procedures occur, product quality can suffer. Failures should be examined and corrected to prevent future problems and maintain product quality. In the drug example, this could be through training and better record-keeping.

Pre-harvest vs Post-harvest Quality Assurance

The drug residue scenario provided an example of how livestock production practices pre-harvest, or from birth to abattoir door, could affect "post-harvest" processing and sale of meat. Obviously, there are many aspects of livestock slaughter and subsequent post-harvest processing that affect final meat quality and safety over which a producer has no control. Conversely, the abattoir and meat processors have no control, except that exerted through market channels, on the product they receive for processing. The responsibility of delivering an animal that can yield high quality, and high value, edible product belongs to the producer. The role of a quality assurance program for production, therefore, is to devise and implement pre-harvest production practices that ensure quality standards for marketed animals.

Increasingly, consumers are becoming concerned not only with the immediate safety of food, but with all aspects of food production and consumption. The public is becoming better educated and more aware of nutritional implications of food consumption on long-term health and disease incidence. The trend to consume cuts of meat lower in fat and cholesterol to combat potential atherosclerosis and heart disease is a prime example. Consumers are also concerned with the presence of other contaminants or diseases, such as BSE, that can arise during the production, or pre-harvest, phase. Further, consumers are becoming increasingly concerned with the conditions in which animals are raised and their welfare. Are animals raised in total confinement? Do animals graze or do they consume an all-grain diet that puts them in direct competition with man for food? Are the animals treated humanely? Do they receive antibiotics whose use could result in drug-resistant strains of microbes that could have potentially lethal effects in humans? These issues have put pressure on the livestock industry to respond and formulate production practices and protocols to assuage consumer concern about its product and the pre-harvest conditions under which animals are raised.

Importance of Quality Assurance to the Meat Goat Industry

The demand for goat meat in the U.S. is increasing. In 1990, 1,361 metric tons of goat meat were imported into the U.S. and 1,581 metric tons of goat meat were exported. In 2000, 5,642 metric tons of goat meat were imported and exports fell to 104 metric tons. In 2004, imports grew to 9,551 metric tons with a value of more than $28 million while exports dropped further to only 84 metric tons (USDA Foreign Agricultural Service database). In response to increased demand, U.S. producers are raising more goats for slaughter. In 1990, only 229,600 goats passed through USDA inspected slaughter facilities. This number increased to more than 548,700 in 2000 and to 634,500 in 2003 (USDA National Agricultural Statistical Service database). With this increase in production comes the need for implementation of a standardized, formal framework of practices and procedures to assure the public of the safety and wholesomeness of all goat products produced in the U.S. These types of frameworks are already used in other livestock industries such as beef - Beef Quality Assurance, pork - Pork Quality Assurance, and sheep - The Sheep Safety and Quality Assurance Program.

The need for a Meat Goat Quality Assurance Program (MGQA) is not only to show the public that

the goat industry is working to produce safe, wholesome products, although that is one objective, it is also needed to assist producers in making production decisions and guiding them through the production process. The dramatic increase in goat slaughter in the U.S. indicates that production is rapidly expanding. This expansion has come about through both herd growth or a shift in focus from fiber to meat production, and through new producers entering the goat industry. Many producers new to raising goats have extensive experience with raising other livestock species such as cattle or sheep; however, some new producers have little to no livestock experience. Further, as goats are considered a "minor species," few drugs are approved for the treatment of diseases and parasites and education is needed in this area. Many inexperienced producers, as well as some established producers, have a need for current, correct information on how to raise goats and produce safe, wholesome products in demand by the public. An MGQA program, with recommended production practices and procedures, can assist both experienced and inexperienced producers in making sound production decisions that result in animals that meet or exceed industry and federal standards for meat quality. Thus, MGQA is a valuable production tool.

A second benefit of MGQA is its usefulness in a long-term approach to industry development. All meat goat producers should understand that they are part of a growing meat goat industry whose goal is to have goat meat considered alongside other red meats such as beef, pork, and lamb in the marketplace. Production of poor quality animals affects the image of the industry as a whole. A standard MGQA adopted by the main meat goat associations in the U.S. will unify producers in working toward an industry standard, i.e., wholesome goat meat products. A standard MGQA will still allow for differences in approach or strategies for different production groups, breed organizations, or regions. This would be in much the same way that individual state beef quality assurance programs utilize and tailor the main quality assurance guidelines given from their national organization to their local conditions and production systems.

Another aspect of an MGQA program is its use as a marketing tool. The overwhelming majority of goat meat sold in the U.S. is imported. With many meat safety issues in the minds of the public, such as BSE, growth hormone use, etc., many consumers wish to know where their meat was produced. There likely exists a segment of the U.S. population that would purchase and consume more goat meat if they were assured that the product was U.S.-grown and conforms to all laws governing domestic meat production. Adoption of an industry-wide MGQA program would be a large step in the promotion of U.S.-grown goat meat to the consuming public. A quality assurance statement, coupled with the natural benefits of goat meat compared to other red meats in terms of fat and cholesterol content, could be the basis for a very effective marketing campaign.

A final benefit of MGQA is to safeguard the industry. As the industry grows and additional producers enter the marketplace a wider variety of production systems, and potential problems, will emerge. Further, future developments in the livestock industry, such as animal identification allowing the tracing of diseased animals back to their farm of origin, will affect all meat animal producers. Having an industry approach to quality assurance can assist producers in complying with federal regulations and avoid problems that could drastically, negatively affect the entire industry.

An added safeguard benefit of adopting MGQA is to demonstrate to the public that producers in the meat goat industry do all they can to protect the welfare of their stock. While goat producers are very caring toward their animals, misunderstandings can arise with the general public. As fewer and fewer people are involved in direct animal production, there is a growing lack of understanding of

animals, production systems, and the management actions involved in producing this nation's food. It is true that there are poor animal managers whose harmful actions are often publicized. Many people hearing these accounts wish to take action to protect the well-being of animals. In some countries of the world, this has led to establishment of government regulations to protect the welfare of farm animals. These acts outline required management actions, facility type, and procedures that can be conducted by producers. Some of these acts can be very restrictive. For example, the Codes of Recommendations for the Welfare of Livestock: Goats established by the Department of Environment, Food and Rural Affairs in the United Kingdom states that all disbudding and dehorning must be carried out by a veterinary surgeon. It further states that it is an offence to castrate a goat over two months of age without using an anaesthetic. Adoption of MGQA and adherence to its standards are one way that meat goat producers can send a message to the public about the ways they care for and uphold the welfare of their stock.

Preferred Production Practices and HACCP

A pre-harvest quality assurance program should include recommendations on any production aspect that can affect the quality of the animal produced. This would include practices from basic herd management to herd health to nutrition and feeding. Recommendations take the form of production or management practices that are considered optimum for both production and quality maintenance. In MGQA these are referred to as "Preferred Production Practices" or PPP. On-farm evaluation and use of PPP are based upon the *Hazard Analysis Critical Control Points* (HACCP) principles.

Hazard Analysis Critical Control Points was developed by the Pillsbury Company in the late 1950's to ensure the safety of food produced for NASA and the U.S. space program. The key to the HACCP system is the analysis of potential production hazards and the pinpointing of places in production, called critical control points, where preventive measures can be taken. The HACCP system, therefore, has the ability to assure quality throughout the entire production process.

HACCP systems are extensively used in the food processing and preparation industry, i.e., post-harvest processes, as a major means of assuring food safety. The three main hazards in food processing are biological (microbial contamination), chemical (toxins or drug residues), and physical (foreign material in food, e.g., glass or plastic). As an example of HACCP's impact on the food industry, the U.S. Department of Agriculture mandated that meat and poultry processing establishments begin using HACCP by January 1999 to improve product safety. Many other industries use HACCP or HACCP-like principles to increase production efficiency and product quality. Quality assurance programs such as those mentioned for the beef, sheep, and pork industries are pre-harvest programs that use HACCP-like procedures to assist in the production of animals giving safe, wholesome products.

There are seven HACCP principles that assist producers and industry to identify, evaluate, control, and, finally, prevent food safety hazards and assure quality.

HACCP Principles

1. Conduct a hazard analysis. Review management procedures in your production system that could allow for damage resulting in a lesser quality product or a means of introducing biological, chemical or physical contamination.

2. Determine critical control points. Critical control points are production areas where problems could happen resulting in lower quality products and where changes or interventions should occur to prevent problems.

3. Establish critical limits for control points. Set limits to prevent problems from occurring, e.g., follow recommended drug withdrawal times.

4. Establish monitoring procedures for control points. These procedures assist in adherence to established critical limits.

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

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

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

These seven principles, or procedures similar to them, can be used in virtually all aspects of production. For instance, in the drug residue example the seven HACCP principles would be as follows:

1. *Hazard analysis* - potential presence of drug residues
2. *Control point* - withdrawal time prior to sale
3. *Critical limit* - zero drug residues in meat
4. *Monitoring procedures* - records kept on all animals treated on-farm, including animal number, drugs used, treatment dates, and withdrawal periods
5. *Corrective action* - improved record keeping, employee training in drug use and record keeping
6. *Effective record keeping* - check treatment documents to ensure proper, correct, and current information
7. *Verification procedures* - periodic review of all records, no further reports of residues in meat

While it may appear difficult to follow the seven steps of HACCP, in reality most producers are already using HACCP-like procedures to solve and prevent problems. Diagnosing problems and taking corrective action are common occurrences on farms. The advantage of HACCP is that it provides a formal, proven framework of procedures whereby a producer can objectively evaluate current production systems, identify flaws, and put into place evaluation and corrective action plans prior to the occurrence of a problem. Using HACCP-like principles represents a shift from being *reactive* to events that cause production or quality loss, to being *proactive* by working to prevent those occurrences from happening. Further, by using HACCP-like procedures, if a problem does occur the necessary planning for corrective actions are already in place saving time and eliminating other potential

mistakes. Ultimately, preventing problems and production loss will result in an enhanced production environment with fewer problems that will lead to increased profit. That is the goal of all quality assurance programs.

Components of a Quality Assurance Program

A quality assurance program for animal production should focus on not only production and product safety issues, but also on the total production environment. The program should set standards that address issues directly concerned with product safety and quality along with animal welfare and well-being. A quality assurance program combining these elements will be one that not only results in products that meet federal meat safety standards, but that also gives confidence to consumers that products they purchase are produced in a wholesome environment.

Using HACCP-like principles, a quality assurance program should identify those critical points in the production system that can affect the quality of the final product. The Texas Cow-Calf and Stocker Beef Safety and Quality Assurance Handbook lists three main control points where problems could arise that compromise the quality of animals and the products derived from them. These three areas are: Food Safety Control Points - to prevent presence of injection site lesions, drug residues and foreign objects; Quality Control Points - to ensure proper care, nutrition, genetic selection, use of animal health products, and culling management; and Environmental Control Points - proper use of pesticides and herbicides to prevent feed contamination, proper forage and soil management, attention to and maintenance of water quality, and proper disposal of dead animals. Other livestock quality assurance programs target similar production activities as critical points where actions can be taken to prevent problems and assure quality.

Areas targeted by MGQA as critical points in the production of quality goat meat include: Herd Health, Nutrition/Feedstuffs, Management and Proper Care, Record Keeping, and Biosecurity. Preferred Production Practices in each area have been developed by Langston University through a grant awarded by the Food Safety Inspection Service.

Preferred Production Practices in Herd Health

- Establish and follow a herd health program
- Establish a valid veterinarian - client - patient relationship and use any off-label drugs in accordance with guidelines for their use within such a relationship
- Store and administer drugs according to labeled use or veterinarian authorized off-label use and follow all withdrawal periods
- Use proper injection technique including proper injection site (in front of the point of the shoulder)
- Provide training to all persons treating animals on proper drug usage and administration techniques

Preferred Production Practices in Nutrition/Feedstuffs

- Provide proper nutrition to all animals according to age and stage of production
- Ensure that feed and water are free of contaminants
- Comply with FDA regulations on the ban of feeding ruminant-derived protein supplements to other ruminants
- Take proper care in the use of medications and other feed additives
- Record use of chemicals on pastures to prevent harvest and feeding of feed containing a chemical residue

Preferred Production Practices in Management and Proper Care

- Provide proper care to all animals
- Use proper gathering and handling techniques to reduce animal stress
- Provide training in proper goat handling techniques to all people working on the farm
- Inspect facilities periodically to maintain them in good working condition

Preferred Production Practices in Record Keeping

- Properly identify each animal
- Keep and maintain records on all animals on pertinent production parameters, vaccinations given, and other drug treatments
- Periodically review records for completeness and accuracy

Preferred Production Practices in Biosecurity

- Establish a biosecurity plan for your farm
- Minimize or avoid contact between your animals and animals not on your farm
- Establish a quarantine protocol for animals entering your herd
- Establish a protocol for visitors to your farm
- Do not allow persons who have traveled to foreign countries on your farm, or bring clothing or other items from them to your farm, for a period of five days after their arrival in the U.S.

Long-term Benefits to the Meat Goat Industry

Adoption and use of MGQA sends a signal to the livestock industry and to consumers that the production of meat goats has grown from being a "backyard project" to an economically viable nationwide industry. Sustaining and enhancing this growth takes increasing the availability of goat products in the marketplace and earning and keeping the consumer purchasing dollar by consistently providing a high quality product. This can be achieved through MGQA. MGQA provides a framework allowing for quality assurance throughout the entire pre-harvest production process. Adherence to MGQA guidelines will benefit all aspects of the meat goat industry from pre-harvest production of animals yielding high quality, edible products through post-harvest processing and sale. This embodies a total quality management approach to the meat goat industry assuring consumers of the wholesomeness and quality of U.S.-produced goat meat products.

Resources

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Herd Health for Quality Control

Ann Wells, D.V.M.

Springpond Holistic Animal Health
Prairie Grove, AR

Quality control means different things to different people. This presentation will discuss quality control for breeding stock and for commercial slaughter stock. While similar, there are some distinct differences which should help producers make the decision of what kind of production system fits best for their operation.

Quality control means animals are prepared to handle stresses and remain healthy. These animals have the ability to pass their positive traits onto their offspring. To ensure quality control, the producer must monitor animals and the farm constantly. It helps to have veterinarians, or other producers visit the farm periodically to keep get other opinions of how animals look. Things can change slowly, which can be missed by the producer.

Breeding Stock

Breeding stock are animals that are usually purebred and which commercial producers will purchase to produce slaughter stock from and probably some replacement breeding stock. From a quality control standpoint, these animals need to have good conformation with no faults that would affect their breeding capabilities. They need to be free of diseases, in good condition and have a high level of vitality.

While many producers look for particular genetics to bring into their herds, environmental conditions are equally as important. Many purebred breeders have wonderful, well-known genetics, yet also have pampered animals who may not do well in a commercial operation. Producing animals that are raised in an environment similar to the buyers will provide animals that will smoothly transition to the new ranch or farm.

Slaughter Stock

Slaughter stock are young animals, both male and female, that are raised for the meat market. These animals are usually under a year of age, can be crossbred and are produced under a variety of feeding systems. From a quality control standpoint, these animals need to produce a high quality meat product, and be free of diseases that would affect their ability to grow well to a marketable weight. They need to be finished to the desired weight as efficiently as possible on pasture with few purchased feed inputs.

Disease prevention and elimination

Breeding stock breeders have a responsibility to produce and sell animals that are free of infectious, contagious diseases. Commercial producers must produce animals that will produce a carcass with no evidence of disease. These different goals mean differences in production methods. Diseases which are detrimental to the marketability of breeder stock may not be as critical in a commercial slaughter stock herd.

It can be hard to determine the level of quality control in breeding stock by a buyer unless all animals in a herd can be seen. Quality control of slaughter stock, on the other hand, is easier to determine as the animal and the carcass will show signs if affected by diseases that affect the carcass. Other diseases, which can certainly be a problem, may not affect the final product.

To ensure quality, breeders should vaccinate for certain diseases, have good sanitary practices and cull animals that are highly prone to parasites, foot problems, and other disease problems that would hurt the profitability of a commercial breeder.

Farm Assessment

Now that we have defined quality control, it's time to assess the farm. The producer must be very honest in this assessment. A series of questions to ask might include:

- What are the goals for my farm and where am I in reaching my goals?
- Do I have the quality of animals to sell for breeding stock that someone would want to buy?
- What disease, nutrition or stress problems do I have?
- What can I do to address these problems?
- Do I have the experience needed to sell high quality breeding stock?
- Is my slaughter stock a consistent quality?
- What does my farm provide in the way of nutrition and health benefits?
- How can I improve my farm that would improve my animals?

Once you have assessed your farm, then you can begin to address the issues that are of most concern for the type of operation you have or wish to have.

Herd Health for Breeding Stock

Breeding stock needs to be free of infectious and contagious diseases. To start with, vaccinate for diseases most likely to cause a problem. This would include Clostridium perfringens, types C and D and tetanus at a minimum. Other diseases for which there are vaccines include caseous lymphadenitis, soremouth, footrot, Chlamydia, Vibrio and lepto. None of these vaccines are 100% effective, and these diseases are best avoided. If a producer has some of these diseases, then eliminating them is important, especially with very expensive goats. The higher the quality of the genetics, and thus, the higher the price, the more important this will be.

Chlamydia, Vibrio and Lepto can all cause abortions. If the latter two are truly problems in your area, then vaccination will be the best solution. Chlamydia is not as much of a problem in goats as it is in sheep, and is mainly due to bringing in goats which were affected the previous year. Goats with chlamydia will have abortions or weak kids, and then have no further problems in subsequent years

because they have acquired immunity against the disease.

Soremouth and footrot are introduced with new additions to the herd. Therefore, it is essential to quarantine new animals for a minimum of two weeks and then carefully examine them before moving them out of the quarantine area and into the herd. Little scabs from soremouth can be overlooked quite easily and they can contaminate a farm for years. Some animals are carriers of the footrot bacteria and show few signs. However, examination of the feet, including trimming will uncover the rot.

Caseous lymphadenitis, also known as CL, is a disease that many are very fearful of. Some animals will develop internal abscesses, but these animals usually have some kind of immune system dysfunction. These animals would not be a good part of any breeding program. Other animals may develop external abscesses, usually around the jaw line or in front of the shoulders. They are contagious and the bacteria will also contaminate the farm for years. While not as serious as internal abscesses, breeding stock producers need to determine the level of infection in their herds, and decide how important it is to take the measures needed to rid themselves of the disease. Abscesses must be treated when they are ready to rupture, not before. All treatment materials and surrounding hay, straw and other environmental materials must be collected and burned.

CAE and Johne's are two other diseases which are contagious. The blood tests for these are not 100% accurate. There is also controversy about how important it is to test for these. For breeding stock producers, especially those who are selling very high priced goats, they need to be very aware of these diseases. If any signs of these diseases should ever appear in their herd, then they must have a plan on how to deal with them. Heat treating colostrums and pasteurizing milk is an effective way to control CAE as well as Mycoplasma. This is a routine practice in many purebred dairy goat herds. Purebred meat goat herds may find this is a helpful practice but will have to weigh the time and labor involved to determine its economic necessity.

Herd Health for Commercial Stock

Commercial stock producers should vaccinate for Clostridium perfringens, C&D and tetanus. Beyond that, they need to carefully assess the health status of their goats and determine what other disease problems they have. Buying stock from reputable and clean breeding stock producers is the best and most economical way to manage herd health. This is what I personally have always done. By having animals that do not start out with any major infectious diseases, I do not have to spend time and money treating these diseases.

The goal of commercial goat producers is to have a marketable goat in as short a time period as possible. Having unhealthy animals will slow that process down, plus require time and money to treat, all of which reduce profit and personal satisfaction with the goat enterprise.

Sanitation

Sanitation is an important part of herd health. However, many producers seem to forget the importance of good sanitation. Clean animals and clean living conditions prevent many disease problems. Even goats with infectious and contagious diseases will be less likely to cause problems if areas are clean and dry.

Wetness and mud are a stress on animals which weakens their immune system and increases susceptibility to disease problems. Cleaning barn areas on a regular basis to rid areas of soiled and wet bedding will keep goats drier and cleaner, which will also lessen stress. Nutritional requirements are also increased when goats are stressed, and when they are wet and muddy. This means they will eat more or will lose more weight if not fed more.

In barns and areas where goats regularly lie, ammonia buildup is the other problem that occurs with poor sanitation. A producer needs to get down at the level of the goat to make sure there are no ammonia odors. Ammonia can weaken the respiratory system, increasing the chances of pneumonia.

There are times when goats will be wet and muddy, especially commercial goats. The key is to keep these times to a minimum. Healthy goats will be able to handle these times with little problem. It's the duration of these times that is important.

Nutrition

The nutritional level of both breeding and commercial stock is the cornerstone of any herd health program. Nutrition of goats can also be one of the most puzzling and difficult issues to deal with. What is fed to a goat is usually different depending on whether producers are raising mainly purebred breeding stock or commercial stock.

Breeding stock producers often feed many different types of supplemental feed, in an attempt to create and maintain "bloom", the term for a healthy, shiny, good condition goat. Commercial producers raise goats on browse or other fresh forages, perhaps supplementing with some grain or grain byproducts. There is no reason for commercial goats not to have bloom also.

Body condition scoring will help producers determine if their feeding program is good. Physical appearance is another aspect to consider, including whether or not the rumen is full. Goats need to have a shiny, smooth hair coat. They need to have bright eyes, with an alert condition.

Simply looking at pasture is not always effective if the producer is unaware of what the goats will eat and whether or not they are eating what is fed to them. Producers need to be with their animals on a regular basis, observing their feeding behavior. Many pastures are full of green grass that they think is great pasture for their goats, only to find that the goats aren't eating it.

Parasites

Parasites are probably going to end up being the disease condition with the most impact for both breeding stock and commercial producers. As more herds end up with internal parasites resistant to all the currently available chemical dewormers, the more important knowing and understanding management strategies for parasites will become.

For breeding stock producers, this could end up being the difference between success and complete failure. As more producers become aware of the problems with dewormer resistance, the more they will be asking questions about parasite management and what the current program is of an individual breeding stock producer.

It is critical that breeding stock producers know what dewormers their goats may be resistant to. They need to carefully plan for how they will manage against internal parasites in the coming years. Culling animals that show the most problems with parasites, along with their offspring, may help them the most. This may be very difficult to do, especially if the culled animal is one which has a conformation or pedigree that brings top dollar. But by doing this, the herd will be strengthened in the long run.

FAMACHA testing needs to be carried out on all goats. Deworming animals before they leave the farm of purchase, possibly with two dewormers, will help a new farm avoid pasture and farm contamination with resistant worms.

Conclusion

Much of herd health for quality control is common sense. It's easy to get caught up in using the latest and greatest gadgets. It can also be very confusing to hear ten different things that a producer should be doing to ensure high quality animals. But it's essential that producers assess their animals, their farm and their abilities and knowledge first. If things are going well, then producers are at the fine-tuning stage. Don't mess with success. If animals don't look like what a producer knows what they should look like, then the assessment should help them know what aspects of the operation needs the most focus.

Disease free animals are something to strive for but rarely a reality. However, management, good nutrition and genetics will help to achieve this goal.

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Quality Assurance for Goat Nutrition

Steve Hart

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

Quality assurance is a proven set of voluntary, sensible management practices that will ensure that goat meat is safe and wholesome, enhance environmental quality, and increase efficiency of production. It is a way for goat producers to make their own rules to ensure that production practices result in safe goat products (meat, milk, cheese, etc.) rather than having defective goat products cause consumer problems that could lead to government-imposed regulations on the goat industry. Most quality assurance practices are common sense; problems arise due to not thinking things through, which may happen under management pressures. Quality assurance is a tool that assists in organizing common sense-thinking into a systematic method for evaluating practices. Quality assurance provides guidelines on production practices that can simplify management decisions.

There are five Preferred Production Practices in Nutrition/Feedstuffs in the quality assurance program for meat goat production:

1. Provide proper nutrition to all goats according to stage of production
2. Ensure that feed and water are free of contaminants
3. Comply with the FDA ban on feeding of ruminant-derived protein supplements
4. Take care in the use of feed medications and other feed additives
5. Record use of chemicals on pastures to prevent harvest and feeding of feed containing chemical residues

Provide Proper Nutrition to All Goats According to Stage of Production

The first and most important of these areas is providing proper nutrition to all goats according to stage of production. Good nutrition goes a long way towards good animal health. It seems like common sense to feed animals properly, and yet if you attend an auction, you will see some animals come into the ring that are very skinny and malnourished. Goats have a habit of multiplying and owners find it easy to become attached to them. The end result is an overcrowding problem and, with resources usually limited, this may result in animals being underfed. Match the number of animals to available facilities, feed, and financial resources. Limit the number of animals that you become attached to. You are abusing your animals if you have more goats than space to care for or resources to feed properly. However, another nutritional problem sometimes seen in goats is that they are too fat, making them susceptible to pregnancy toxemia at kidding, overheating during the summer, and less resistant to diseases. More goats suffer from obesity than undernutrition. Overfattening animals is harmful to their health. It may please you to feed your animals more feed, but by doing so you are increasing their health problems.

An indicator of the nutrition level of animals is their body condition. Body condition scoring is a method of describing the fleshiness of goats with a numerical score, 1 being extremely thin and 5 being overly fat. There is a body condition scoring program on the American Institute for Goat Research

website at http://www2.luresext.edu/goats/research/bcs.html. The web page has a series of pictures of animals from the side, top, short ribs, and breast bone along with descriptions that enable you to match your goats body shape to the correct body condition. The American Institute for Goat Research has also published a brochure with color pictures and written descriptions.

Ideally, a goat should be in body condition score of 3 with some exceptions. Animals need to have a body condition score of 3.5 in the fall to ensure body reserves and flesh covering to help keep them warm in the winter. Animals should have a body condition score of 3 before kidding, since they may lose weight while kids are nursing, but they should not go below a body condition score of 2. If does are in body condition score greater than 4.5, they are in danger of pregnancy toxemia as kidding time approaches. Also, animals that are less than body condition score of 2 are susceptible to pregnancy toxemia. If goats have an adequate amount of green grass or browse that is of reasonable quality, they will keep themselves in adequate condition. Goats get too fat from too much feed. They are too thin when there is not an adequate amount to eat. This is especially a problem when goats kid during the late fall or winter when often no green material is available.

There are a number of resources to assist you in feeding your animals properly. There is a ration balancer on the Institute website at http://www2.luresext.edu/goats/research/nutritionmodule1.htm. By inputting information on your animal such as breed type, weight, stage of pregnancy, etc., the program will calculate nutrient requirements for energy, protein, calcium, and phosphorus and predict dry matter intake. If you do not know the weight, there is a calculator to estimate body weight from measuring the heartgirth (distance around the chest) and breed type. This may be useful if you need to know the weight of a goat for administering the proper dose of medicine. The ration balancer will also calculate the nutrients required for gaining weight or obtaining a desired body condition score in a period of time. The ration balancer will assist you in determining if your pasture/hay is nutritionally adequate and allow you to select a supplement to adjust the level of supplementary nutrition to meet the goat's nutrient requirements.

Grazing management plays a role in providing for the nutrient requirements of the animal, as well as contributing to the control of toxic plants and parasite problems. Grazing animals on pastures with inadequate forage results in loss of body condition. In addition, when the amount of forage available to animals is limited, they are forced to eat more of the less desirable plants, which may contain toxins that can poison the animal. Some plant toxins may enter into the meat and affect humans. Grazing too close to the ground also results in increased levels of internal parasites. Preventing overgrazing will assist in having adequate forage to meet nutrient requirements and keep animals from grazing too close to the ground, thereby ingesting fewer parasitic larvae (worms) and lessening the need for deworming. Using less dewormer reduces the risk for dewormer residues in the meat, slows down the increase in anthelmintic resistance, and saves money. Good nutrition promotes good health, reducing the need for antibiotics and potential for antibiotic residues in the carcass. Grazing in areas that flood or have standing water can result in infection by liver flukes and result in liver condemnation as well as reduced animal performance.

Ensure Feed and Water are Free of Contaminants

Most contaminants enter the goat through the mouth. We must be careful about what is available for the goat to eat and drink. The source of drinking water must be safe and the water offered in a manner that prevents contamination by feces, urine, feed, and filth. Water should be tested by the

health department with the same tests that apply for human consumption. The presence of coliforms would indicate a water supply contaminated by feces. Nitrates in water can be toxic depending on the level. There is a case of giardia mastitis in goats being caused by a contaminated water source. Animals watering from natural sources such as streams can pick up infections from other animals miles upstream. Livestock waterers should be difficult for animals to defecate or urinate in. They should also be difficult for wildlife to use to reduce the spread of germs and prevent contamination of the water by wildlife carcasses. Waterers should be cleaned out regularly.

You can be assured that when you purchase a sack of feed from a reputable company that it is free of contaminants and toxic substances. Companies realize that they can be held liable for those problems and have established manufacturing practices to prevent the production of contaminated feed. You only need to store the feed and get it fed without contamination. However, if you have a large herd of goats and purchase individual commodities or byproduct feeds there are many more management considerations. You must ensure that the purchased feed or feed ingredients are free from mycotoxins, such as aflatoxins. Mycotoxins can end up in goat products, especially milk, with serious consequences. Corn can be contaminated with aflatoxins depending on the weather conditions at harvest and storage conditions. Most feed ingredient dealers will guarantee their feed to be free of aflatoxins or other toxins. However, if you buy a truckload of whole shelled corn from a neighbor, you have no such guarantee. Commodities and byproduct feeds purchased through a feed ingredient dealer will usually come with some implied warranty on quality. However, if you buy a commodity directly from a company or a salvage company, the quality may not be known. Protect feed from contamination from baling twine or plastic that can cause serious digestive problems in animals.

Feed must be stored where it will be dry and not overly hot. If feeds get wet, it will mold or ferment. Mold may result in mycotoxins being formed in the feed. Excessive heat can decrease vitamin potency and protein quality. Storage of feed in bins requires more management for keeping moisture out. If a bin is not completely fed out in several months, condensation can be a problem if the feed is not aerated. Keep records on feed such as where it was purchased and dates fed. If there is a problem with your animals, these records may provide useful information on tracing the source of contamination. The feed storage area should not contain herbicides, pesticides, rat poisons, or bird poisons. There should be no foreign objects that can contaminate your feed, such as a can of nails or bolts. Murphy's law says that anything stored in the same room will somehow, despite your best efforts, ooze over to anything else in the same room. Rats and mice should be controlled to prevent spread of diseases through the feed. Transmission fluid and electrical transformer fluid are potential problems in that they contain polychlorinated hydrocarbons which, if consumed, result in contamination of the meat with a carcinogen. Another potential source of contamination in feed is transmission/hydraulic or radiator fluid leaking from farm equipment and contaminating feed. Lead and other heavy metals may be picked up through spills and leaks. Batteries and paint may contaminate feed. Animals may lick toxic levels of lead off of a car battery. Animals may sample paint from paint cans. Good housekeeping will go a long way toward preventing problems.

It does little good to buy quality feed and store it properly, only to feed it in a manner that allows for contamination. Every effort should be made to offer animals feed in a trough constructed to prevent goats from entering and standing or defecating on feed. Also, the trough should be easy to clean. Feed should not dribble out of the trough on the ground for animals to eat. Some feeders can be readily tipped over while others have the ends left off so they can be easily swept out. Both types can result in goats consuming contaminated feed. Goats can be kept out of troughs by using keyhole feeders or

a bar running down the center. Protect the feed trough from contamination by chemicals, foreign materials, and feces. Protection against contamination with fecal material from wild animals or birds may be difficult. Minerals, likewise, should be fed in mineral feeders that prevent contamination by feces and urine. There are a number of suitable mineral feeders for goats, from those made from PVC sewer pipe to some made from used car tires to cattle feeders covered by a flap of material. Only a 1-week's supply of mineral should be put in the feeder at a time so that fresh mineral is available to reduce the nutrients in the mineral being degraded by heat or moisture.

Purchase hay that is free of mold. Also, know the quality of your hay. Silage should be free of mold and have a good silage smell. Avoid silage that smells of butyric acid since it may be infected with listeria. Goats are quite susceptible to listeriosis and treatment of the disease is difficult with only moderate success. Stocking rate is important in that too high of a stocking rate will reduce the nutrition available for your animals and limit their performance. Good pasture management should consider nutrition of the animals as well as prevention of internal parasites.

Comply with the FDA Ban on Feeding of Ruminant-Derived Protein Supplements

There is a Food and Drug Administration ban on feeding ruminant-derived proteins to other ruminant animals feed. This is to provide an extra layer of protection from Bovine Spongiform Encephalopathy or mad cow disease. There is a disease similar to BSE called Creutzfeldt-Jacob Disease (CJD) that is found in people. A variant form of CJD (vCJD) is believed to be caused by eating contaminated beef products from BSE-affected cattle. This FDA ban is to prevent having any animals eating feeds that could result in this disease. There are certain exceptions to this rule. Feed companies know this and comply with the ban. However, this may be a problem at the farm level. For instance, if goats are fed poultry litter from poultry farm, the poultry feed may have been formulated with mammalian protein. Other prohibited feedstuffs include meat meal, meat and bone meal, and other byproduct meals made from ruminant species. Pet food should also not be available for goats as it may contain prohibited feedstuffs.

Take Care in the Use of Feed Medications and Other Feed Additives

The term "medicated feed" includes all medicated feed products intended to be a substantial source of nutrients in the diet of an animal. There are only four drugs licensed by the FDA for use in goat feed. No other feed additives are allowed to be used in feed for goats. Deccox and Rumensin are approved for prevention of coccidiosis. Fenbendazole and Morantel tartrate are approved for use as dewormers in goats. Feed additives must be used according to the label. No one, including a veterinarian, can legally prescribe the use of any additives in feed other than as directed on the product label. If you have a tetracycline responsive disease in your goats, you cannot legally feed tetracycline medicated feed even though it is labeled for that use in sheep or cattle. However, the FDA has realized this practical problem and will, in general, not take regulatory action if medicated feeds are used in this manner. A veterinarian can prescribe water medications in an extra label drug use manner. Observe the withdrawal period on the label. Keep records of animals treated, drug, batch, date, dose administered, and how administered. There are problems sometimes in medicated feeds with the addition of drugs at the wrong level, resulting in toxicity. However, feed manufacturers have programs in place to prevent this problem due to the liability considerations. If you mix feeds containing these additives, ensure compliance with the authorized practices of the FDA.

Record Use of Chemicals on Pastures to Prevent Harvest and Feeding of Feed Containing Chemical Residues

Records need to be kept of all herbicides, insecticides, and fungicides that are applied to forages. For the most part, few chemicals are used on forages consumed by goats. Herbicides are sometimes used to clean under electric fences, to treat plants that goats don't eat, or may have been accidentally applied. How about your neighbor spraying and your goats getting out on his property? The labels of these chemicals usually state the number of days before it is safe to graze treated areas. Also, alfalfa hay often has herbicides and pesticides applied during production. Hopefully, most hay producers adhere to stated withdrawal periods when using these chemicals.

High levels of nitrogen fertilizer coupled with the right environmental conditions can cause nitrate levels in forages to increase to toxic levels. Test soil to determine fertilizer requirements. If high levels of nitrogen are required, use a split application of fertilizer. Also, remember that heavy applications of manure or fertilizer can result in water contamination. Record all applications of fertilizer or manure to the land. Soil pH affects trace mineral availability. Geology determines the levels of trace minerals in the soil. Plants differ in their ability to extract nutrients from the soil. These three factors, soil pH, geology, and plant species, determine which trace minerals need to be supplied. Phosphorus is often the most deficient mineral in animal production systems. Monitoring the phosphorus level in forages and using a mineral supplement with the appropriate levels of calcium and phosphorus is important.

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How to Help Your Vet Help You

Ann Wells, D.V.M.

Springpond Holistic Animal Health
Prairie Grove, AR

Many goat producers have a hard time finding a veterinarian who is knowledgeable about goats. Many veterinarians do not get much education themselves on goat medicine, although that varies from state to state and depends on where the vet received his or her veterinary medical degree. Other goat producers find it difficult to locate a vet who is interested in working on goats.

But there are things that goat producers can do that will allow them to find a vet and to help their vet help them.

Finding a Veterinarian

Many producers wait until they have a problem to locate a vet. This is the wrong time to be looking for one. Their animals are sick, they are upset, and it is more difficult to be objective.

Instead, talk with a veterinarian before or as soon as you get livestock. You are looking for one who has an interest in goats, even if not much knowledge. They need to be interested in helping you learn. The more you know, the better your animals will be cared for.

You need to find out the hours they are available and whether they take after hours calls. The latter is important because livestock don't always tend to get sick or have problems between 8 and 5 Monday through Friday.

Find out if they make farm calls or if they expect you to bring your animals to their clinic. More veterinarians want animals to be brought to a clinic because they have the needed facilities and equipment. Animals may be easier to treat and are in a setting that often allows for better and quicker healing.

Finally, you need to ask about fee structure. This prevents surprises on both ends.

Whatever you do though, don't wait until you have an emergency! One reason some producers have a problem finding a vet to work with them, is that they never call except in an emergency.

Where to Find a Veterinarian

There are different ways to find a veterinarian to work with you and your goats. The first and probably best source is local farmers who also raise goats. This also allows you to meet other goat producers. Local clubs, such as 4H and goat associations, are an easy way to find these goat producers. County Cooperative Extension Service and county Natural Resources Conservation Service offices (NRCS) can help you locate these farmers and these clubs. There are two websites that have listings of veterinarians who are interested in working with goat producers. The first one is the website for the American Association of Small Ruminant Practitioners, www.aasrp.org. The other website is the Cybergoat website and the location for the listing of vets is www.cybergoat.com/goat_vet.htm. The

Maryland Small Ruminant page is another good website. While not having any veterinary listings, it, along with the other two websites, is good sources of information for veterinarians and producers alike.

Once again, the most important thing is to find one!

Schedule a Farm Visit

You need to schedule a farm visit with the veterinarian you wish to use. There are several reasons to do this. You are allowing the veterinarian to see your operation. This enables them to understand your management priorities and to determine your strengths and weaknesses. In order for you to have a good working relationship, the vet needs to know what your goals are, how you expect your animals to be treated and to know where they may need to help you the most.

Scheduling a farm visit lets the vet view your farm in a calm setting before there something happens that requires attention. It also allows you both to get to know one another.

Ideally you should schedule a farm visit one to four times a year. Many times the veterinarian will notice something during these visits that will just help your operation. It's easy to miss things when you see your own animals every day. Even though something may not be causing a problem at the time, later on it might.

What Does a Veterinarian Provide that You Need

Many goat producers have never raised goats before and sometimes have never raised livestock. A food animal veterinarian will be able to help you with basic animal husbandry practices along with assisting you in determining your livestock management priorities. A knowledge of basic animal husbandry will prevent many health problems.

New producers especially will need basic animal health care from their vet. The vet can and should be willing to provide training in routine tasks such as vaccinations. Animal wellness programs are important to get set up. They will include vaccination and parasite programs, but should also include stress prevention and other ways to keep animals healthy. Some veterinarians can also help with nutritional problems, and setting up a nutritional program.

Sooner or later, producers will have a sick animal. While the goal is to keep these to a minimum, having a vet to call on for treatment of sick animals is essential. Some producers only call on a vet after hours with an emergency. These are the ones who often complain the most about having trouble finding a vet to work with them. There may be some veterinarians who don't mind being called for emergencies only, but this needs to be determined ahead of time. Most producers will find that a veterinarian is much more likely and willing to help them in an emergency if they also have relationship with the producer in non-emergency times. It's important to think about your expectations of your vet and decide if they are realistic or not.

What will you provide your veterinarian

It's very important when calling a veterinarian about a sick animal to have as much information about the animal as possible. This will help the vet to determine the best course of action. If you don't

have this information, you may have to get the information and call the vet back. This wastes time needlessly. The information to have ready to tell your vet includes:

- Eating
- Drinking
- Ruminating
- Urinating/defecating
- Temperature
- How long signs have been going on
- Treatment already tried

Having this information available also helps you, the producer, learn to observe your animals. Observation is the key to healthy animals.

If your vet decides it is best to come out to examine and treat the animal, save time and frustration by having the animal easily accessible with good working conditions. This also holds true with working the whole herd of animals. Don't wait until the vet gets there to get the animals up and to round up needed equipment.

A sick animal will need to be in a dry and well-lit place. Have warm water available for handwashing. Providing these things will make it a more pleasant experience for everyone.

Emergency Situations

We all hope we don't ever have an emergency situation but it's best to plan for the time that one may occur. First of all, it's important for you to decide what you can handle and what you can't. Everyone has different levels of experience and different comfort levels. When a situation reaches the point that you think you can't handle it, call as soon as possible. Do not wait. It's human nature to hope that things will get better, but many times things don't get better. It's easier to deal with a situation while it's still light, than to wait later into the night. This is certainly true during bad weather.

Finally, having the facilities and equipment listed above are even more important in an emergency situation. Having a plan in place will keep things calmer at a time when everyone is more stressed.

Veterinarians unfamiliar with goats

If your veterinarian has an interest in goats, but not enough knowledge, there are many places for them to go for more information. The American Association of Small Ruminant Practitioners is a professional veterinary association for those interested in sheep, goats, llamas, and other small ruminants. Membership includes a quarterly newsletter as well as a professional listserv. It is a wonderful association for a veterinarian, giving access to small ruminant experts around the world.

Two textbooks that are available are Sheep Medicine by Mary Smith, D.V.M. and Sheep and Goat Medicine, by D.G. Pugh, D.V.M. A good farmer friendly book, which is also good for veterinarians interested in pasture based systems, is Small Scale Livestock Farming by Carol Ekarius. See the resource list at the end of this article.

Many producers will purchase these books for their vets to help them learn more about small ruminants. There are also professional meetings available for veterinarians interested in learning more about small ruminants.

When to Call Your Vet

One of the more difficult decisions producers have to make is when to actually call the vet. Some will call at the first sign of any trouble, but many others wait until it's too late. There are many reasons for this, but probably the most important one is that they just don't know how to tell if one of their animals is sick.

To be able to tell when an animal is sick, you must first spend time observing your animals. People buy livestock because they like them. But they too often get caught up in doing things and fail to realize that they need to spend time just being with and watching their animals. Twenty or thirty minutes daily just being out with their animals will teach a producer more about their animals than all the books and all the talking with others can do. After spending time doing this, you will be able to tell when one of your animals isn't acting quite right. Continuing to observe that animal may be all that is needed. But if things don't get better quickly, it's best to call the vet then, rather than waiting until the animal might become seriously ill.

Listservs

A brief word about listservs. There are many listservs available on goats, and more seem to start every week. Listservs can be a great thing. There are many people writing on them who know a lot and are willing to share their knowledge. But they can also be a terrible thing. For every knowledgeable person sending messages, there are two more who send misleading or just plain wrong information. Conditions and diseases that are rarely seen by most producers become magnified when posted on a listserv. This causes unnecessary anxiety in many producers, especially if they have few people locally they can turn to.

Too many producers turn to listservs instead of calling a vet. No one can tell anything about an animal or the farm it is being raised on over the Internet. It can be dangerous to rely solely on a listserv for your veterinary care. The listservs can be useful to learn about different aspects of goat production. Talking to others about experiences is also useful. Just be very careful of how much emphasis you place on what you read on a listserv. Knowing your farm and your animals is the crucial element to determining the validity of issues discussed on a listserv.

Conclusion

A veterinarian can help a goat producer to achieve their goals. It's important to find one you can work with. Veterinarians have chosen this profession because they like animals. But they are also in business to make money. You can help them to help you by treating them in a businesslike manner. This will foster a good working relationship that will benefit both you and your vet.

Resources

Ekarius, Carol. 1999. Small scale livestock farming. Storey Publishing. 192 pages

Mitcham, Stephanie. 2000. Crane Creek Publications. 264 pages.

Pugh, D.G. 2001. Sheep and Goat Medicine. W.B. Saunders Company. 468 pages

Smith, Mary. 1994. Goat medicine. Lippincott Williams & Wilkins. 620 pages

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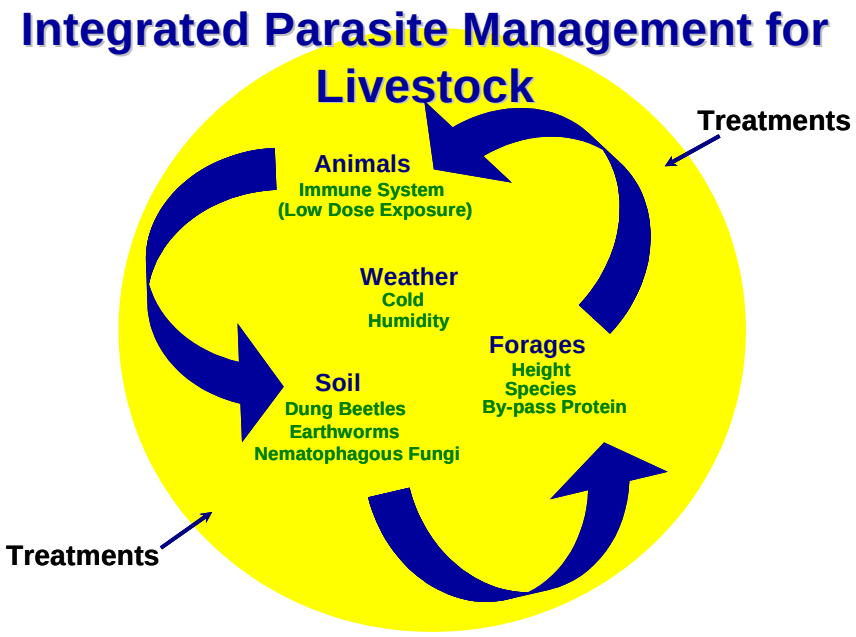
Sustainable Parasite Management for Goats

Ann Wells, D.V.M.

Springpond Holistic Animal Health
Prairie Grove, AR

Introduction



Internal parasites are considered by some to be one of the most economically important constraints in raising livestock. Confinement and pasture-based animals are almost certain to be exposed to worms at some point in their life. This is certainly true for goats.

Most producers are aware of the problems that worms cause, which range from decreased productivity of their animals to death. Animals are usually routinely dewormed with different commercial chemicals by owners using a variety of deworming schedules. Every dewormer on the market has had some resistance built up to it by the internal parasites that infest livestock. This resistance means that not all the worms are killed during deworming. The surviving worms pass that genetic resistance on to offspring.

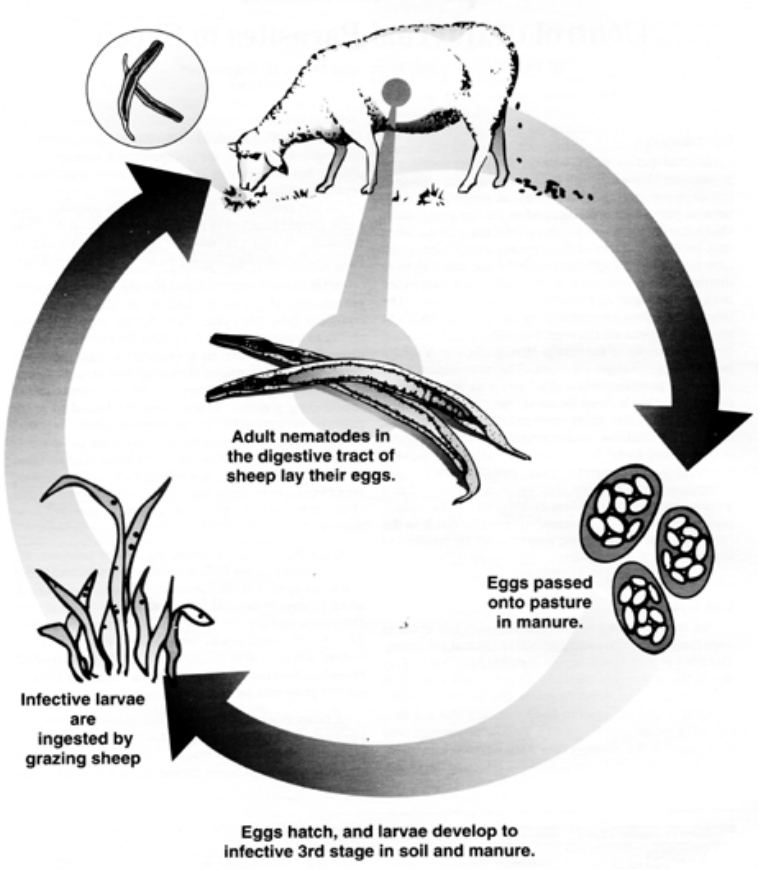
The seriousness of the issue cannot be stressed enough, especially with goats. More and more goat herds are finding they have no chemical dewormers left to use. The worms are resistant to every one of them. This has changed the strategy of dealing with internal parasites. We are no longer as interested in killing all the worms as we are in preserving the susceptible worms. This is such a different way of thinking that it takes a while to adjust the way a producer deals with worms in their herd. But it will become ever more important if we are to retain any chemical dewormers for emergency use.

As a result, this problem has caused people to look for alternatives. Much attention both in the research community and on the farm is being devoted to discovering ways to prevent and treat internal parasites without relying on heavy doses of chemical dewormers. Many people claim this treatment or that control measure works, but there are more questions than answers. There is no simple alternative way of preventing or treating worms, nor will there be. By looking at the whole farm as an interrelated system, it becomes apparent that there are parts of the system that can be managed to decrease internal parasites and their effects. These management adjustments not only postpone the day when chemical controls no longer work, but they also may decrease costs and increase the overall health of the animal.

Parasite Life Cycle

Goats and sheep are infested by the same species of worms. Cattle are mainly infested by other species. The barber pole worm, *Haemonchus contortus*, is a stomach worm that can severely affect goats and sheep. It is a bloodsucking worm, which can cause severe anemia and death. The cattle parasite of most concern is *Ostertagia ostertagi*, the brown stomach worm.

Both of these parasites have a simple life cycle, as illustrated here.



http://www.ext.vt.edu/pubs/sheep/410-027/figure1.html

Nutrition

Nutrition plays a major role in how well animals are able to overcome the detrimental effects of internal parasites. In fact, the signs of parasitism can often be used as a symptom of some other problem, usually poor nutrition. In an article in the Journal of the American Veterinary Medical Association in 1943, researchers showed that sheep placed on a high plane of nutrition were able to reduce their worm burden significantly and many of the sheep were even able to cure themselves (Whitlock et al., 1943).

By-pass Protein

Researchers in New Zealand have been studying the effects of by-pass protein on parasitized sheep (Stear et al., 1997). They have found that by increasing the amount of protein that is not degraded or broken down in the rumen, animals lose less weight than those animals that were not fed the increased level of by-pass protein. These researchers used fish meal as their source of by-pass protein. However, there are forages that also have an increased level of by-pass protein because they contain tannins. These include birdsfoot trefoil and lespedeza. The protein in native warm season grasses also has a higher level of by-pass protein.

This research is now extending into the U.S. The research done by the American Institute for Goat Research of Langston University on goats browsing sericea lespedeza has been breakthrough research (Min et al., 2004). It showed that fecal egg counts went down to zero while the goats were browsing the sericea. The egg counts rebounded when the goats were removed. The next step is to see how this information can be used to decrease egg and larval pasture contamination.

FAMACHA Testing

The FAMACHA test, imported from South Africa, is a system of testing sheep and goats for the level of anemia due to *Haemonchus* infestation. The eyelids are each pulled down to expose the conjunctiva or pink part of the eyelid which is then compared to an eye color chart. Goats which have a score of 3, 4 or 5 are at risk of dying from *Haemonchus* and should be dewormed. Those with a score of 1 or 2 should not be dewormed. Research has shown that this system is very effective in identifying those animals at highest risk from dying due to parasites (Kaplan et al. 2004). The research has also shown that about 20% of a herd will have 80% of the worm problems. It's important to identify those 20%, and cull them and their offspring from the herd.

This test should be used so that animals that show no signs of parasites are not dewormed. This keeps a level of refugia, those worms still susceptible to chemical dewormers, out on pastures, barnyards and in animals. It is also useful to help determine how well the strategies outlined in the rest of this article are working for the producer.

In many instances the only dewormer still effective is Cydectin. Therefore, do not use that dewormer at all if another dewormer is still effective on your farm.

Training on the use of the FAMACHA system is offered around the country. More information on this system, and where to find a training, can be found on the website of the Southern Consortium on Small Ruminant Parasite Control at www.scsrpc.org

Pasture Management

Management of animals, pastures and any loafing areas is the key to reducing the amount of internal parasite problems in livestock. An understanding of the life cycles of the different parasites within the whole soil-plant-animal system will help show the interrelationships between these three components. Managing internal parasites is just like managing fleas in dogs and cats. The major part of the parasite life cycle is outside of the animal. This point will help the producer to choose management strategies that reduce parasite levels on his or her farm and decrease the usage of chemical dewormers. The same principle is used in integrated pest management for vegetables and other crops.

Many farmers closely monitor their animals but pay little attention to the plants and soil. Pasture contamination by infective larvae is the primary factor to deal with. If you start with an understanding of the interrelationship between the animal, the plants it eats and the soil on which those plants grow, then it becomes clearer how parasites infect the animal and how they can be managed so as not to cause as many problems. Everything a farmer does to his or her animals, including the grazing management, has an impact on the numbers of internal parasites their animals will have.

By looking at the whole farm as an interrelated system, it becomes apparent that there are parts of the system that can be managed to decrease internal parasites and their effects. For example, animals that continuously graze a pasture eat the grass into the ground, while contaminating the soil with so many parasites that nothing outside of regular deworming with chemicals will control them. This can especially be disastrous for goats, as they quit grazing when the pasture forage height falls to a level of three to five inches. By using controlled grazing methods that allow pastures to rest and soil life to function well, contamination can be reduced. This reduction occurs because soil organisms, including earthworms, dung beetles, and nematophagous fungi will destroy or keep many of the parasite eggs and larvae from developing. Keeping the grass in a more vegetative stage, and tall enough to provide the animal with adequate forage, will provide better nutrition to keep the animal healthier, thereby strengthening the immune system to prevent the adult worms from producing eggs. Parasites do not cause as much harm to a healthy, well nourished animal. The parasites that are present will not deplete the host as much as in an animal that is malnourished. Parasite loads affecting wildlife generally do not cause the death of the host, because the parasites need the host to survive. The same principle applies to livestock.

Pasture contamination can be reduced through management. Livestock will avoid manure piles and the grass surrounding them. This behavior also helps them avoid eating larvae. The height of the pasture sward can affect parasites. The majority of worm larvae crawl only one inch from the ground onto plants, so not allowing animals to graze below that point will cut down on infestation. This is one reason sheep tend to have more problems with internal parasites. They eat much lower to the ground than cattle do, picking up higher numbers of larvae. Therefore, it is important to monitor grazing sheep closely so they don't graze too low. Larvae migrate from the manure no more than 12 inches from the manure pile. If livestock are not forced to eat close to their own manure, they will eat fewer larvae. This holds true even for goats and sheep which scatter the manure "berries" as they walk.

With sheep and goats, the most important time to control pasture contamination is during the periparturient rise, which is the sudden release of infective larvae and eggs within the ewe's intestinal tract. This occurs right after kidding, and is due to the doe's immune system becoming temporarily less

effective. By treating animals at this time, the exposure to newborn and young lambs (those most susceptible to parasites) is minimized.

Good grazing management includes the use of clean pasture to minimize re-infection. Clean pasture is pasture that has not been grazed by the host animal (in this case, goats) for 12 months, and therefore, is not contaminated with worm larvae. It may be new pasture, pasture grazed by livestock such as cattle or horses which do not share parasites with sheep (goats do share parasites with sheep), or pasture that has been hayed, renovated, or rotated with row crops. There is some killing of parasites on pasture during the winter due to freezing and thawing; however, snow cover insulates the larvae. Summer is the time in the Southern states when most larval kill will occur on pastures. Sunlight will kill them, and this occurrence can be used to determine which pastures can be used in the fall and into the winter. Grazing down to 2-4 inches from the ground allows more sunlight to get to those larvae and increases their chances of drying out and being killed.

Warmth, oxygen and moisture are the three most important things that increase the chances that larvae will survive on pasture (Barrell, 1997). Knowing when your pastures are apt to be driest and hottest will help you manage them better for parasite control.

Good sanitation is a defense against parasites. Feed troughs and water sources located where they can be contaminated with feces will increase the chances of livestock infestation. This is only one reason not to water directly from ponds, or to allow animals continuous access to water sources. Feeders should be cleaned and elevated. Kidding areas, as well as other holding areas, should be clean and dry. Prevent the transmission of infestations from new arrivals to the herd or flock by deworming them before arrival and again three weeks later.

Immunity

While it is usually neither possible nor advisable to completely eliminate internal parasites in sheep or other livestock, reduction of parasite load can be achieved. Many people have found, and research has shown, that adult animals rarely need to be wormed (Barrell, 1997). Most animals develop immunity against internal parasites, though not to the level that is developed against viruses and bacteria. This immunity keeps the parasites from reproducing but rarely kills them. An example of an effective parasite control program can be found in Tennessee. Dennis Onks, superintendent of the Highland Rim Experiment Station in Springfield, Tennessee, has not wormed the adult cattle on the farm in eight years. They are wormed at weaning and then not again. They have never shown any signs of internal parasites and their condition is excellent. These animals are on a high plane of nutrition, have a low stress level, and are strictly culled on production. All these things work together to produce an animal that shows no signs of internal parasites. This can be applied to goat herds also, selecting those animals and their offspring who rarely if ever show signs of parasitism.

It is the young animal whose immune system is not fully mature and the animal whose immune system is compromised by disease, inadequate nutrition, or other stress, which is most adversely affected by worms. Animals brought from western rangelands, for example, where the arid conditions keep parasites from surviving, have no immunity and are even more easily overwhelmed by worms.

Every farm is different. The parasite load of the animal depends on many variables - such as stocking density, time of year, the reproductive state of the animal, etc. Good nutrition plays a big part

in how well the animal's immune system mounts the proper defenses, and in the animal's overall ability to tolerate the presence of some worms. Healthy and well-nourished animals will be able to develop resistance and resilience to worms and other parasites much better than thin animals that do not have good availability of quality feed (Barrell, 1997). Resistance is the ability of an animal to prevent the establishment and maintenance of a parasite population within the gastrointestinal tract. Some individuals and some breeds show more resistance to parasitic infection than others. Research to identify characteristics in such individuals is a hot area. Culling susceptible animals can take advantage of this. Resilience is the ability of an animal to reduce production loss during a parasite infestation. Both of these traits are being looked at as ways of selecting animals that will be less susceptible to parasite effects. Animals that possess some genetic resistance or resilience can still be infected with worms. Therefore, you must keep in mind that this is just one more measure that will help control worm problems, not a cure by itself.

Soil Organisms

There are several soil organisms that can have an impact on parasites. Managing pastures to favor populations of beneficial soil organisms will decrease parasite levels on pastures.

Oxygen is the primary requirement for worm eggs and larvae to survive and develop. Earthworms have been shown to ingest worm eggs and larvae, either killing them or carrying them far enough below ground to keep them from maturing. Dung beetles ingest and disperse manure, taking it to their burrows, thus keeping eggs and larvae from developing. There are also nematophagous fungi that produce "traps" that engulf and kill parasitic larvae. These fungi are more delicate than other fungi, so there are rarely great numbers of them in the soil. If the soil is depleted or out of balance, other, more dominant microorganisms will replace these fungi. Research in Louisiana at LSU has been done very successfully using nematophagous fungi. Spores were fed to sheep that passed through into manure before developing into fungi. These fungi then eliminated the eggs from those manure piles extremely well. There are hopes that this will be available to producers as a commercial product in 2006.

The amount of time that feces remain on the pasture has an effect on the number of parasite larvae that survive and mature. Anything that hastens the breakdown of the feces will lessen the number of larvae. This can include the soil organisms mentioned above, mechanical dragging of pastures, poultry or other animal disturbance and the consistency of the feces themselves.

Effect of Ivermectin on Dung Beetles

Resistance development by worms is not the only problem with ivermectin. There is concern today about the effects of ivermectin on soil organisms, especially dung beetles. Research has shown that the use of ivermectin kills dung beetle larvae for up to 45 days through residue in the manure (Herd, 1996; Strong, et al., 1996.). Manure from livestock treated with ivermectin does not break down as fast, either. Other dewormers, including cydectin, don't appear to have the same effect.

Strategic Deworming

There will be times when chemical dewormers are the best treatment. The situation, time of year and location will help determine which chemical dewormer to use. These dewormings should be strategically carried out in order to reduce the number of times needed. There are three main classes

of wormers: the benzimidazoles, such as fenbendazole or Safeguard (white); the imidazothiazoles, such as levamisole (yellow); and the avermectins, of which ivermectin or cydectin (clear) is a member. Rotating these three classes yearly is an accepted rule for decreasing resistance buildup by the parasites themselves. It is critical to retreat three weeks later, especially with newly weaned animals. This kills those worms that were ingested and matured following the initial deworming. This has been shown to significantly reduce pasture contamination.

It does little good to deworm livestock and return them to the same infected pasture. Do not deworm and immediately move animals to a clean pasture. All the dead worms, with very viable eggs in them, will be passed to contaminate the pasture. Instead, deworm, hold animals in their same location for 12-24 hours, and then move them to a clean pasture.

Appropriate management minimizes re-infection. There are several ways to utilize multiple animal species to control the worm population. Many producers raise goats and cattle. One technique that appears to work well is dividing your farm in half, with cattle on one half and goats on the other half. Midway through the grazing season, switch halves of the farm. Having one species of livestock follow another one will have a benefit. Letting the goats browse where they want to, but keeping the cattle rotating through pastures with just one strand of electric fence is yet another way of using cattle and goats together. The different livestock species will break up manure of other species and will not avoid those areas of pastures. This will break the life cycles of the parasites because their natural host will not be present.

Make sure that your dewormer is effective. If you are concerned that it isn't, have a veterinarian check the egg count in the feces of about 15 animals before treatment. After 10 days, check the egg count again. There should be at least an 85 percent kill. You may need to consult your veterinarian about the most effective dewormers for your area. If parasites become resistant to a particular family of dewormers, then you will have to switch families. Alternating families of wormers is a good way of slowing resistance to the dewormer. Many people alternate every time they worm. Research does not recommend this. Instead, use the same dewormer for a whole year before switching.

To implement any type of integrated parasite control program it is essential to know when loads will be highest, such as at kidding; where the young animals stay at those highest egg production times; how pastures can be divided and how long they can be rested in order to let eggs and larvae die. In addition, grazing height for goats is crucial. Goats will quit grazing when pastures fall below 3-5 inches in height. This lowers the animal’s nutritional status and, if they have many worms in them, they will show signs of worms even more quickly. This means the producer must have plenty of forage available for the goats, or else be supplementing with some other kind of feed. It is also essential to fully identify those animals having the most clinical signs through the use of the FAMACHA test and fecal egg counts.

If the producer has some idea of how much parasite infestation exists, this will also help in determining whether, and how often, chemical deworming should be given. Some scientists and producers say that rotationally grazed pastures do not aid in parasite control, because the rest period is usually not long enough to break the life cycles of parasites. Most pastures are rested between 21-30 days during the growing season, which is also the length of time it takes for infective stage larvae to develop. The goal is to lower the number of infective larvae that are ingested by the animal. The less time that animals are on a particular pasture, the less the pasture is contaminated with manure. If even

one thing can be done to lower these parasite numbers, it will help reduce the need for chemical dewormers. Managing the length of time animals remain on a pasture is also important to remember. This is just one other item that has to be figured in when doing pasture planning for a season. Don't let those pastures be grazed too short!

Alternative Dewormers

Most alternative dewormers have not been shown by scientific research to have any effect on numbers of worms. Diatomaceous earth (DE) has been promoted by some for controlling internal and external parasites in livestock. Almost pure silica, DE is the finely ground fossilized remains of diatoms, tiny sea organisms that accumulate on the sea floor and can be mined from deposits. The diatom remains have microscopic cutting edges that are said to pierce the outer protective layer of parasitic worms and insects, causing dehydration and death. There is little scientific data on the effectiveness of DE for internal parasites, but researchers have seen a decrease in flies on animals when using DE. A report from The Leopold Center showed no statistical difference between the use of DE and the control group. I have talked to Dan Morrical, Sheep Extension Specialist at Iowa State, who told me that they had a hard time even getting the lambs infested with worms, which was necessary to test to the effectiveness of DE. I bring up this point to make you aware that farmers must know if their animals even have worms in order to know whether control measures are needed, are effective, or how to effectively change them.

Many producers have claimed that they have had good results with DE, but their management is usually very good. They may be giving credit to the DE when they should be giving it to themselves. Although I have nothing to back me up, I've often wondered if it isn't the minerals in the DE that provide the benefit. Worm egg count also naturally falls at the end of summer and the beginning of fall. People who are doing fecal egg counts (FEC) may be thinking the DE is lowering the egg counts, instead of realizing that it is the natural cycle. I haven't talked to any producer who uses DE without significantly changing and then watching their management. Using DE is not just a simple substitute for a chemical dewormer. This is another problem with the scientific research that has been done on DE. Researchers have simply substituted DE for their conventional wormer and done everything else exactly the same. This is component research, whereas to really prove that DE has an effect, systems research needs to be done, using the same or similar management techniques that producers use. This type of research is much more difficult to do. If you still want to use DE, one dosage that I've seen used is ten to twenty pounds per ton of mineral supplement. Every animal must be fed a dose every day to be effective.

Deworming alternatives exist in herbal and folk medicine used for centuries in other cultures. Herbs such as garlic work not by killing the worms, but by making the intestinal tract healthier. Since worms and other intestinal parasites have evolved to thrive in the unhealthy digestive tract, anything that will make that environment healthier will be detrimental to their survival. Dr. Susan Wynn (1996), writing in the Journal of American Holistic Veterinary Medical Association, discusses alternative dewormers in great detail and points out that much more research needs to be done to determine the effectiveness of herbs and other natural substances traditionally used as dewormers. Her article also states that many herbs can be toxic to animals, so great care should be taken in giving them. There are veterinarians who use herbs as part of a parasite control program. The AHVMA has a list of veterinarians practicing complementary and alternative medicine in every state.

Herbal dewormers are being used more and more by goat producers. Some of these producers get complacent. Others are in parts of the country where worms are not as much of a problem. Still others have low numbers of goats on a large enough area of land, which is low stock density. These animals are unlikely to be exposed to enough worm eggs and larvae to have a problem. The herbal dewormers need to be researched more because there is very probably a place in a management strategy. However, they will not be a direct substitute for chemical dewormers.

Copper oxide wire particles have been fed to Katahdin hair sheep in Arkansas and found to kill *Haemonchus* worms (Burke et al., 2004). This research will be continued with goats this year. As little as 0.5 g of the wire particles have been effective in reducing worm numbers. Even though goats have a high requirement for copper, the risk of this treatment is in not knowing what, if any, the toxic level of these particles might be.

Conditions with Signs Similar to Parasitism

Keep in mind that there are other conditions that can mimic the signs of parasites. It is easy to assume that any unthrifty or thin animal with a rough hair coat or diarrhea is wormy. Internal parasites may be present, but the clinical signs are secondary or a symptom of some other, more insidious disease or condition. Any stressful condition, such as a weather extreme, can cause borderline clinical parasitism to become severe. If animals do not have enough forage or other feed in the fall so that they go into winter in good condition, this lack of condition will cause additional stress on the animal in other ways. This animal will be more apt to show extreme clinical signs of parasitism, including blood loss and death, than an animal which might have some internal parasites but is in good physical condition and is on a high plane of nutrition. In this case, poor nutrition is the cause of the animal's disease and worms are the symptom.

Conclusion

There is no one thing that can be given or done to replace chemical dewormers. It will take a combination of extremely good management techniques and possibly some alternative therapies. Do not think you can just stop deworming your animals with chemical dewormers. It is something you will need to change gradually, observing and testing animals and soil, in order to monitor your progress. Alternative parasite control is an area that is receiving a lot of interest and attention. Programs and research will continue in the pursuit of parasite control, using alternative and more management-intensive methods.

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Resources

American Holistic Veterinary Medical
Association (AHVMA)
2214 Old Emmorton Road
Bel Aire, MD 21015
(410) 569-0795

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A Meat Goat Quality Assurance Program

Roger Merkel

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

A Meat Goat Quality Assurance program (MGQA) provides guidelines for goat producers on how best to ensure the quality of animals they produce. It does this by recommending production practices that assist producers in raising healthy, productive animals. The use of MGQA is an assurance that the U.S. meat goat industry is doing all it can to provide a high quality product to consumers.

Practices recommended for use in MGQA are called "Preferred Production Practices" and provide guidelines on many aspects of goat production and care. Following these PPP helps assure the safety of goat meat products and promotes a safe, wholesome production environment that has concern for the welfare of animals. MGQA does not contain the detail found in a production handbook. For example, MGQA defines guidelines for drug usage, such as injection site, needle selection, and storage. MGQA does not provide a list of drugs nor dosages to use. MGQA also recommends that all animals have some sort of identification, but it does not explain the method of ear tagging or tattooing. That type of detailed information can be found in a production handbook.

The American Institute for Goat Research of Langston University is currently working on two projects funded by the USDA Food Safety and Inspection Service to provide more detailed information to goat producers. In the first project, Langston University is leading a group of institutions in developing a web-based certification program for goat producers. Information on different production aspects will be provided in module format and individuals who wish for certification can take tests to ascertain knowledge gained. This project is scheduled for completion in the fall of 2005. The second project is to develop and publish a meat goat production handbook. Both of these projects involve many other U.S. universities with established small ruminant programs. Producer groups are also involved in developing the information needed to devise the web-based modules and handbook information.

Preferred Production Practices - The HACCP Approach

Preferred Production Practices represent critical points in goat raising where problems or issues may arise that could lead to reduced product quality and safety or compromised welfare of the animal. One example would be proper injection techniques and the issue of broken needles. A needle that breaks off inside an animal represents more than a foreign object that could be found in the meat. It also affects the welfare of that animal. Unless immediate action is taken to locate and remove the needle, the broken point could migrate inside the animal causing pain, infection, and death. Thus, a critical point in herd health is proper injection technique.

Practical use of PPP involves utilizing Hazard Analysis Critical Control Points (HACCP) or HACCP-like procedures. HACCP is a tool that evaluates a production system looking for points where mistakes can occur or where interventions should take place to prevent problems in the production

process. While it may sound complex, use of HACCP-like procedures is commonplace on farms. In their simplest form, HACCP-like procedures mean having a plan to deal with problems and prevent future occurrences.

There are seven HACCP principles that assist producers identify, evaluate, control, and, finally, prevent food safety hazards and assure quality.

HACCP Principles

1. Conduct a hazard analysis. Review your production system for procedures or places that could allow for harm to animals, compromise production, or introduce biological (microbial), chemical (toxins or drug residues) or physical contamination.

2. Determine critical control points. Critical control points are those areas in production where problems could happen resulting in lower quality products and where production changes or interventions should occur to prevent problems.

3. Establish critical limits for control points. Set desired limits on identified hazards.

4. Establish monitoring procedures for control points. Decide how to monitor and determine if critical limits have been met.

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

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

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

Many portions of the HACCP system or using HACCP-like principles are done intuitively. As an example, exposed nails or sharp wire can cut a goat's skin. Injuries can occur that lead to increased use of antibiotics, potential production loss from slower growth rates, damage to hides, etc. Thus, exposed nails and wire are a hazard and when noticed these are repaired or removed. Using HACCP-like principles does not change the basics of what is performed, that is the prevention of cuts. What using HACCP-like principles does, is to assist in structuring a method of checking on the hazard and deciding what to do in the future to prevent another occurrence. To illustrate, the hazard is exposed nails or sharp wires. The control points are those portions of your pens and buildings where nail points could be exposed or where goats can damage facilities resulting in exposure. A desired critical limit is zero nails or wire exposed that could cause harm. Looking at facilities when feeding is one method of monitoring those control points. Corrective actions would be repairing fences or buildings to prevent nails from protruding or perhaps installing a shield in prone areas. Repairs or shield installation should be recorded in your farm records, particularly if any expense was involved. Finally, a regularly scheduled, periodic walkthrough of your facilities to inspect repairs and current condition would be a method of verifying that monitoring and corrective actions have worked. Thus, using HACCP-like principles can assist establish not only immediate corrective steps, but also monitoring and verification steps to prevent future occurrences.

Preferred Production Practices of MGQA

Five areas have been targeted by MGQA as critical points in the production of quality goat meat. These five critical areas are: Herd Health, Nutrition/Feedstuffs, Management and Proper Care, Record Keeping, and Biosecurity. Preferred Production Practices in each area have been developed by Langston University through a grant awarded by the USDA Food Safety and Inspection Service. A brief description of the major points in each PPP is given.

Preferred Production Practices in Herd Health

Herd Health PPP #1 - Establish and follow a herd health program

A herd health calendar specific to your production system should be formulated upon consultation with a veterinarian. All vaccinations should be given at proper times to appropriate groups of animals. Management techniques that can impose stress on an animal, such as castration, should be done properly to prevent health complications. All kids should receive colostrum and receive proper care to prevent disease problems. The environment surrounding the animals should be taken care of to minimize exposure to pathogens, for example, through regular manure removal.

Herd Health PPP #2 - Establish a valid veterinarian - client - patient relationship and use any off-label drugs in accordance with guidelines for their use within such a relationship

Having a good relationship with your veterinarian will assist in forming and following a comprehensive herd health program. Furthermore, only a veterinarian can authorize the use of any drugs not specifically cleared for use in goats. There are few drugs cleared by the Food and Drug Administration for use in goats. Many drugs used to treat diseases in goats are used in an "off-label" manner, meaning that they are administered in a manner not according to their labeled use. This is referred to as ELDU (extra-label drug use) and can only be authorized by a veterinarian in the context of a valid veterinarian - client - patient relationship. In general this means that 1) the veterinarian has been to the farm, examined the animal(s) in question and determined that no approved drug exists to treat their condition or that the dosage prescribed for an approved drug is ineffective; 2) the veterinarian instructs the producer on proper use and administration of the drug and determines an appropriate withdrawal period; and 3) the veterinarian is available in the case of adverse reaction to the drug and for follow-up examination and treatment. All three conditions must be met for ELDU. Further, complete records of animal number, drug given, dosage, route of administration, date, and specified withdrawal period must be maintained for all ELDU.

Herd Health PPP #3 - Store and administer drugs according to labeled use or veterinarian authorized off-label use and follow all withdrawal periods

Drugs should be stored securely away from curious animals and unauthorized persons. Some drugs require refrigeration. When administering drugs, follow recommended dosages and administration guidelines or follow veterinarian instructions regarding ELDU. Protect drugs from sunlight and heat during use to prevent reducing their effectiveness. Do not use drugs past their expiration date. Record the date and amount of drug administered and the date when the prescribed withdrawal period has been fulfilled. As an example, the dewormer Safe-Guard® states that "Goats must not be slaughtered for food within 6 days following treatment. Because a withdrawal time in milk has not been established,

do not use in lactating goats." Instructions such as these should be followed for all drugs administered on-farm.

Herd Health PPP #4 - Use proper injection technique including proper injection site (in front of the point of the shoulder)

Use the correct injection method when administering injectables. Subcutaneous (SC) administration is preferred to intramuscular (IM) or intravenous (IV) injections. When administering drugs SC, use proper "tenting" technique to avoid entering the muscle. If IM injections must be given, ensure that all injections are given in front of the point of the shoulder. Lesions can form from injection sites and injecting in the neck prevents damaging the more valuable cuts of meat. Also, when giving IM injections, proper technique calls for pulling back slightly on the plunger after entering the muscle to make sure a vein or artery has not been penetrated. Injections given in muscle allow for slower absorption of the active drug than IV injections. If, in an IM injection, a vein has mistakenly been penetrated, the rate of drug absorption will be dramatically increased. This can cause shock, seizures, or worse to an animal. Intravenous injections should only be given by experienced individuals.

Proper injection technique also includes proper needle selection, depending upon the viscosity or thickness of the drug given, injection method, and age of the animal. Generally, 18 to 20 gauge needles are sufficient for most injections. Lengths of 1 to 1½ inches should be used for IM or IV injections, while shorter lengths of ½ to ¾ inch are suitable for SC injections. To prevent hurting animals through using dull needles, change needles at a maximum of every 10 animals. If a blood-borne disease is suspected to be present in the herd, needles should be changed after every animal. If a needle becomes bent, replace it immediately. Have an appropriate "sharps" container where you perform injections to dispose of used needles.

Herd Health PPP #5 - Provide training to all persons treating animals on proper drug usage and administration techniques

All persons who work on the farm should be trained in proper herd health care including drug use and storage, injection techniques, and in completing the record keeping system used. Training should be kept up to date and reviewed when new drugs are introduced.

Preferred Production Practices in Nutrition/Feedstuffs

Nutrition/Feedstuffs PPP #1 - Provide proper nutrition to all animals according to age and stage of production

Proper nutrition is essential in the well-being and productivity of all farm animals. Properly fed animals are healthier and will exhibit greater production efficiency than underfed or overfed animals. Good nutrition and health begin with ensuring that all kids consume colostrum to receive needed nutrients and antibodies. Body condition scoring provides producers with information on the nutritional status of their herd and the need for feeding adjustments. Using a nutrient calculator, such as the web-based calculator developed by the American Institute for Goat Research found at www2.luresext.edu, can help producers determine the amount of energy and protein needed for animals at different ages and production stages.

Nutrition/Feedstuffs PPP #2 - Ensure that feed and water are free of contaminants

Feed should be stored in areas that are free of the risk of contamination from foreign substances, such as motor oil, chemicals, baling twine, etc. Storage conditions should also ensure that no fermentation or mold growth occurs that could lead to the presence of mycotoxins. Purchased feed should be free of aflatoxins and other harmful substances. Water should not contain high levels of dissolved salts, chemical residues, feces, or urine. Feeders and waterers should ensure that animals cannot defecate or urinate in feed and water. Control rodents from entering your feed supplies. Purchased feed and hay should be free of chemical, biological, and foreign material hazards.

Nutrition/Feedstuffs PPP #3 - Comply with FDA regulations on the ban of feeding ruminant-derived protein supplements to other ruminants

The Food and Drug Administration has published regulations prohibiting the feeding of goats feed or feedstuffs containing proteins derived from other ruminant species. This has been mandated to prevent potential cases of Bovine Spongiform Encephalopathy (BSE), commonly called mad cow disease, from occurring in ruminants in the U.S. Banned feeds include all protein supplements of ruminant origin including ruminant-derived meat meal, meat and bone meal, bone meal, blood and blood by-products, glandular meal, etc. Also prohibited is the feeding of broiler litter to ruminants as poultry feed may contain ruminant-derived protein supplements and spilled feed may be present in the litter. Pet food may contain substances banned from ruminants, thus, food for guard dogs should not be available for goats to eat. Other prohibited substances include human plate waste processed for livestock feed.

Nutrition/Feedstuffs PPP #4 - Take proper care in the use of medications and other feed additives

Few medications and feed additives are approved for use in goats. To find the current status of drugs, additives, and medications approved for goats, consult a veterinarian or go to the Food and Drug Administration "Green Book" that lists approved drugs for livestock. This searchable on-line database can be found at http://www.fda.gov/cvm/greenbook/greenbook.html. As of this writing, April 2005, only 23 drug products have been approved for use in goats. Consult a veterinarian concerning any possible use of medicated feeds in an off-label manner.

Nutrition/Feedstuffs PPP #5 - Record use of chemicals on pastures to prevent harvest and feeding of feed containing chemical residues

A major issue in food safety is chemical residue avoidance. Chemical residues (drug residues or chemical toxins) are one of the three contaminants that affect meat safety, the others being biological (microbial) and foreign substances (such as broken needles, glass, plastic, etc.). Anytime a pesticide or herbicide is applied there is potential for that chemical to enter the food chain. Appropriate sprayer cleaning procedures and proper disposal of used containers is essential. Care should be taken during application to prevent chemical runoff that will contaminate water supplies. Drift from a sprayer could mean that unwanted chemicals contaminate hay or grazing areas. Cutting and baling hay, or allowing animals to graze too soon after application, could result in animals consuming chemicals whose residues could potentially be found in meat. Appropriate care needs to be taken when applying chemicals on farmland and training should be provided to persons doing the work. Records need to be kept on the application date and type of pesticide, herbicide, or fertilizer used. Labels should be read

or professionals consulted to determine time limits prior to harvest. When purchasing hay or leasing grazing areas, the seller should be asked about chemical usage.

Preferred Production Practices in Management and Proper Care

Management PPP #1 - Provide proper care to all animals

Goats should have daily observation and care to lead healthy, productive lives. Observing animals during feeding and learning their normal behavior allows a producer to immediately sense when something is "wrong" and extra attention is needed. Proper care of goats begins with care of pregnant does, including nutrition, housing, vaccination, and avoiding stress. Properly cared for does will have healthier kids with fewer future health problems. Care should be matched to animal age and expected production level. Trim hooves regularly to prevent foot and leg problems. At all times, the welfare of the goats should be considered and efforts made to not inflict undue pain or stress on the animals. This promotes a healthy production environment and reduces the need for medicines and veterinary costs.

Management PPP #2 - Use proper gathering and handling techniques to reduce animal stress

The herding behavior and flight zone of goats should be learned to make gathering and catching them easier. In a pasture setting, a small catch pen should be made and goats fed a small supplement in that area to accustom them to entering it, making catching them easier. The use of a catch pen or similar arrangement is much less stressful, and tiring, to both goat and owner than trying to catch untrained animals on pasture. When herding goats, move calmly and let goats go at their own pace. Goats should not be caught or held by grasping the hair or skin, or by catching a leg or tail. The preferred method of holding is to place one hand under the chin and the other on the back of the head. Animals should not be subjected to undue stress.

Management PPP #3 - Provide training in proper goat care and handling techniques to all people working on the farm

All persons who care for or manage animals on your farm should receive training in goat care and handling. This will pay dividends in better animal productivity and reduced injuries and disease incidence. If many people are employed or the production system is complex, a training manual providing information on the management and care practices used on-farm could be devised and available for employee use.

Management PPP #4 - Inspect facilities periodically to maintain them in good working condition

Buildings and fencing should be inspected periodically and repairs made. The condition of buildings and facilities can affect the welfare and productivity of goats. Injuries due to poorly maintained facilities can leave an animal open to infection, necessitating additional expenditures for veterinary care and(or) long-term problems. In extreme cases, death can result from inadequately cared for buildings or fencing. As an example, predators can enter animal pens or pastures through holes in fencing or walls and kill animals. In general, any money spent in maintaining facilities will be recouped in reduced veterinary costs and death losses.

Preferred Production Practices in Record Keeping

Record Keeping PPP #1 - Properly identify each animal

Proper identification of animals is essential for good record keeping and all animals should have a unique identifying number. Some breed registries may require a tattoo be applied and have their own policies concerning placement and numbering. Ear tags or neck ropes may be used as identification. Ear tags are preferable to neck chains for goats in grazing situations. If used, neck chains should be moderately strong allowing them to break if the chain gets caught in brush or on fencing where it could be a choking hazard. Ear tags should be applied properly between the cartilage ribs on the ears. If clip type ear tags are used on young animals, the tag should be placed allowing for future growth of the ear. Ear notching is an acceptable form of identification if performed on animals less than two weeks of age. However, breed organizations may not allow ear notching. Ear notching pliers should be disinfected between animals to prevent transmitting blood-borne diseases. Goats should never be hot or freeze branded.

Record Keeping PPP #2 - Keep and maintain records on all animals on pertinent production parameters, vaccinations given, and other drug treatments

Complete, accurate records of animals on your farm will assist in making management decisions regarding breeding, culling, and sale. Records of health treatments given to animals are necessary to prevent the sale of animals prior to completion of withdrawal periods, to prevent multiple doses of a drug being given to a particular animal, and to check on treatment progress. Records on chemical use, feed and drug purchase, etc. can also help safeguard your operation should questions arise concerning animals you may have sold. Breeding records are necessary for registration purposes. Keep written records in a safe place and ensure backup copies are made of any electronic files kept on a computer.

Record Keeping PPP #3 - Periodically review records for completeness and accuracy

Records are most useful when complete and accurate. A periodic review of records and record keeping methods will help catch mistakes and oversights while they can still be easily corrected. This review should happen at least annually. Ensure that all new employees are trained in record keeping to prevent mistakes from occurring.

Preferred Production Practices in Biosecurity

Biosecurity PPP #1 - Establish a biosecurity plan for your farm

Consider your production operation and devise a plan to ensure your animals are protected from diseases entering your herd. Potential ways in which diseases could enter your farm include: visitors, feed deliveries, new animal acquisition, show animals returning to the herd, stray animals, rodents, birds, and others. The potential risk from these various areas should be examined in the context of your production situation. Plans should be made to protect animals from identified risks and to deal with animals who become ill so that diseases occurring on your farm are not transmitted beyond your farm gate.

Biosecurity PPP #2 - Minimize or avoid contact between your animals and animals not on your farm

Many diseases are transmitted through animal to animal contact. Avoiding contact with animals not on your farm will reduce disease outbreaks. Consider the location of pastures and grazing areas in relation to your neighbors' animals. If new facilities are planned, consider the location of neighboring livestock barns and pens. Do not build facilities in or near drainage areas from livestock facilities. If your animals are very valuable, for example breeding males whose semen is collected for sale, consider double fencing along adjoining property lines to further protect them from neighboring animals. At exhibitions, house animals using solid partitions to minimize contact. Control stray animals, both domestic and wild. Maintain quarantine procedures. Do not haul other animals with your own and clean mud and manure from livestock trailers.

Biosecurity PPP #3 - Establish a quarantine protocol for animals entering your herd

Preventing diseases entering your herd from new animals begins during purchase. Be sure to ask the seller for health and production records on animals you plan to buy. Ask about the disease or herd health program followed. Also, look at the whole herd, not just the few animals you plan to purchase. This will give an indication of the health program followed. Upon arrival at your farm, place new animals in quarantine for a minimum of 30 days. Consult a veterinarian for a quarantine vaccination protocol and any diagnostic tests that should be performed. Buckets, shovels, fencing, etc. used in the quarantine area should not be moved and used in the general herd. Feed and care for quarantined animals last and do not re-enter your herd before changing clothing and washing boots to prevent carrying diseases from new animals to your herd. As an example, if a quarantined animal has a caseous lymphadenitis abscess that bursts, a person may inadvertently step in the pus from that abscess and carry that on his or her boots. If that person then reenters the farm herd, he may contaminate the ground or other animals.

Consider quarantining animals that have returned from exhibitions or fairs and have had contact with other animals. If felt necessary, follow the same quarantine guidelines for these animals as with purchased animals. For show animals, the potential risk of diseases entering your herd must be weighed against the difficulties in establishing and maintaining quarantine. Do not haul animals other than your own to and from shows.

Biosecurity PPP #4 - Establish a protocol for visitors to your farm

Many visitors to your farm will likely be producers themselves. To ensure that diseases are kept from entering your farm area, establish a protocol for any visitors and their vehicles. Control traffic entering your farm and have a separate parking area or ensure that vehicles are clean of mud and manure. This includes livestock trailers, feed delivery trucks, and veterinary vehicles. Consider having disposable boots available for visitors who wish to tour your facilities and herd. Alternatively, have a footbath with disinfectant where visitors can clean their shoes before and after seeing your animals. Have a wash basin or facility for visitors to wash their hands before and after handling animals. Explain that your procedures protect not only your herd, but theirs as well.

Biosecurity PPP #5 - Do not allow persons who have had contact with livestock in foreign countries on your farm, or bring clothing or other items from them to your farm, for a period of 5 days after their arrival in the U.S.

Largely in response to outbreaks of Foot and Mouth Disease (FMD) in other countries, the USDA published guidelines for persons from, or who have traveled to, foreign countries where FMD is present. These persons are encouraged not to have contact with livestock for 5 days after entering the U.S. Some states or institutions, such as Langston University, recommend a 10-day waiting period. The virus causing FMD can be carried in hair and nasal passages, clothing, luggage, shoes, etc. Following this PPP helps safeguard the entire U.S. livestock industry. Outbreaks of FMD, while not a threat to humans, result in the necessary destruction of all infected and potentially infected animals with enormous industry and economic consequences. Preventing or minimizing contact between foreign travelers and your herd for the period after their arrival may also prevent the spread of other diseases as well.

Benefit of Using MGQA

Using MGQA procedures can assist livestock owners in making correct production decisions. The PPP may also bring new ideas or approaches to existing management activities. Utilizing HACCP-like principles in implementing the MGQA promotes a quality management style that anticipates and fixes problems before they occur. It also promotes the planning needed to know what to do when mistakes or problems do occur and how to prevent them in the future. The goal of MGQA is simple, assist goat owners in producing an animal in a wholesome environment that will yield safe, high quality products that consumers prefer and will continue to purchase.

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Livestock Guardian Dogs

Paula and Dan Lane

Bountiful Farm
Shady Point, OK

Making the Decision

Here's your situation-you have, or are planning to have, a herd of goats. An integral part of your business (or hobby) plan is keeping your goats safe, whole, and healthy. You need to consider housing, feed, medications, breeding, fencing, and … protection.

"Goats are tough, they have big horns and can protect themselves." "We've never had any problem." "Our house dogs will chase away anything that threatens our place or our animals." "We just don't have any predators here." "We have good fences, they'll keep anything out." "I'll take care of any predators."

These are a few of the lines we've heard from people considering the protection aspect of their business plan. Some are said in good faith; some are delivered in sublime ignorance; and others are excuses to do nothing.

The fact is that if you raise goats, sooner or later, you will have predators attack your herd. Since 1980, the population of the United States has increased to roughly 286 million people according to the 2000 census. These 286 million people own about 53 million dogs. If everyone restrained their dogs with fences or leashes they would pose no problems for stock owners. As it is, domestic dogs are the number one stock killer in the United States. The chances of meeting your neighbor's dog over the body of one of your goats just keeps growing, right along with the population. Along with the growth of the dog population, coyotes (the second most common predator in the United States) have been forced to adapt to the encroachment of humans and they've done a splendid job of it. The coyote population has not only grown, but become much wiser in the ways of humans. Coyotes also sometimes breed with domestic dogs to whelp a canine (called coydogs) that embodies the worst of both worlds, a wild predator that has no fear of humans.

Add to the dog/coyote mix, the fact that the Endangered Species Act, coupled with federal re-population programs involving cougar, wolves, and bear have not only increased the traditional large predator population and moved it into areas where they were formerly extinct, but makes dealing with these predators more a process of having a good lawyer rather than a good rifle. Throw in a few of the smaller wild predators like bobcats and foxes and you have a total combination that virtually guarantees that you, at some point, will be the recipient of some predator's attention.

The question really becomes not if you'll be visited by a predator, but "When will it happen and what will I do about it?" Your choices, as with so many things these days, are legion. You will find people using llamas, donkeys, non-Livestock Guardian Dogs (LGD) dogs of many different breeds, and LGDs of every breed and mix of breeds that you can imagine. The interesting thing is that almost everyone thinks their idea for protecting their herd is the "best".

You'll first need to decide if you want a dog or a llama or a donkey. Rest assured that llamas and donkeys can work effectively as guardians. You can find many people who use them and are well-satisfied. If you go this route, be sure to talk to people who have successfully used the species of animal you want to use and listen closely to what they have to say. We chose dogs for two reasons: 1) we belong to the group of people who have used these other animals unsuccessfully - through ignorance no doubt, and 2) we realized that carnivores not only would think llamas and donkeys are tasty but with pack size or brute strength and agility be able partake of that tasty meal.

Narrow Your Choices

Let's assume you've decided you actually need and want a dog to guard your livestock. How do you choose one? Where do you start? How much will it cost? How do you know it will work for you?

These are some of the initial questions most people have when faced with the myriad of potential decisions they'll soon have to make about getting a Livestock Guardian Dog. Notice I say "guardian", not "guard" dog. Not everyone agrees that this word choice is important, but we bring it up here because it is quite significant in the conceptualization of what this dog will do for your herd. A guard dog guards. To us, it brings to mind junk yard dogs, attack trained dogs, sentry dogs and others of the same ilk. Guard dogs generally guard, first and foremost, against human beings. Guardian dogs, on the other hand, guard primarily against other animal predators. Guard dogs are bred and trained to please their human masters.

Livestock Guardian Dogs are bred to be self-reliant about the question of whether to attack or not. In fact, LGDs make lousy attack dogs because they, not you, make the decision to attack; and they, not you, make the decision to stop attacking. In other words, they're often hard to call off. LGDs, in general, are affectionate toward their owners but make a point of not being dependent upon them.

This difference between a normal guard dog and a livestock guardian is not the only difference between them. A guardian also nurtures its animals, especially lambs or kids. A guardian will help a first time mother clean and dry her kids, even if the mother is so panicked by her new experience that she doesn't let her instincts guide her to care for the babies. She may even abandon them and, if she does, the LGD will be there to keep the newborns safe until help comes. In the rare instance when we have a new mother without her kid, we go for a walk in the woods and look for a big white blob among the trees. The blob soon turns into a Great Pyrenees dog, curled around the kid(s) keeping it safe and warm.

Do people use guard dogs with their stock? You bet. We've heard from folks who use Dobermans, Rotweilers, even wolf crosses and swear by them. Do we recommend the practice? Not on your life, or more properly, not on the lives of your animals. Anyone who uses dogs with high prey drive to guard their livestock is risking a bloodbath in the stockyard and for those who do it knowingly, that's their own business. Even people who use working dogs without a high prey drive such as Aussies are taking a chance. How many times a day would you like your herd run into the barn and back to the pasture? Most dogs will do what they were bred to do and, although there are always exceptions, we can only recommend a dog that has been bred to work as a LGD. No matter which of the many histories of the LGD that you may read, they all agree on one thing - these dogs have been bred for thousands, yes thousands, of years to do the job of protecting the animals that are important to you.

Now that you have decided that a LGD is what you want, what next? You may not want to hear this but your work has just begun. There are probably hundreds of breeds of dogs that are bred for livestock protection. We keep hearing about breeds new to us on a regular basis so we certainly don't have a definitive answer. If you want to browse breeds we can recommend Molosser World (http://www.moloss.com/) and Livestock Guardian Dogs (http://www.lgd.org/home.htm). Even these two extensive sites are not exhaustive but they give it a good try.

At this point we believe that Great Pyrenees, Anatolian Shepherd, Akbash, and Maremma are the most common working LGD in the U.S. We are NOT saying they are the best; we are NOT saying ignore all the others; we are simply saying that we think you can find a source for good working dogs of these breeds fairly easily. "OK," you say, "which one do I choose?" Without question, the only sane answer is "Do your homework". All of these breeds have an intensely loyal group of supporters and there is no way we would call their wrath down upon us by saying one of these is "better" than another. In fact, we don't believe that any breed is "better" than another. We do believe that one breed will fit your specific circumstances more precisely than the others and that your efforts in researching breeds will be repaid a hundred times more than what spend if you will examine your choices until "your" breed jumps out at you and says, "Here I am!"

Here are some factors that may influence your choice of an LGD breed:

- What are their characteristics when guarding? Do they aggressively go after predators or do they warn predators off? No matter how aggressive or non-aggressive they are, all LGDs will fight, kill, or die if necessary to protect their animals.

- Do they tend to be aggressive toward humans?

- Do you want long- or short-haired animals? What kind of maintenance grooming is required for a specific breed?

- What is the health history or tendency of a particular breed?

- How does the breed take to the climate where you live?

- Does the breed you like tend to guard territory or its herd, or both?

- What is your physical set up and location? How will that breed fit your situation?

- How big do dogs of this breed get?

- Finally, cost. An LGD is worth what you think it is; rare breeds will usually cost more than the more common ones. Registered dogs will usually cost more than unregistered dogs. Adult LGDs of any breed will cost considerably more than pups. The price range is extensive although it is usually somewhere between $50 and $1000, with pups from $50 to $600. That's still leaves quite a bit of room for personal budgets and ideas of quality.

There are some people who are convinced that mixing two or more LGD breeds provides them with the perfect dog for their situation. This possibility has both pros and cons for the stock owner and we recommend you learn all you can about the breeds of LGDs before you consider mixing.

You may be able to think of more factors that will influence your choice of a breed. Go ahead and try. The more you think about, at this point, the more certain you will be when you make your decision.

Once you have found your breed, or maybe just narrowed it down to two or three choices, we strongly recommend that you find some working dogs of this breed and go visit the farms or ranches where you can actually see them working. These don't have to be breeders, just people who are using these dogs to protect their stock. If you can't find a farm to visit in person, at least do a virtual visit on the net and then talk with the farmers about their operation and how their dogs fit into it.

After you have done that, you're ready to make your final decision and to start shopping for your new LGD

Buying your LGD

Now that you've completed all your homework and research, visited farms with working LGDs of the breed you have chosen and talked to the farmers there, you're ready to acquire a dog, right? Almost. You really should decide if you want (need) an adult, an adolescent, or a newly weaned puppy.

Just owning an LGD does not guarantee your stock won't be ravaged by predators. Owning a puppy certainly won't. You'll need to balance your need for immediate protection against the increased cost of an adult guardian. Adult guardians are somewhat more difficult to find just when you need one and many people opt for the puppy on that basis alone. At this point, let's assume you're starting with a pup.

To locate a breeder, we recommend asking people you know who use that breed to refer you to a breeder they trust. You can also locate breeders on the internet and through breed clubs. However you locate one, here is a list of questions we feel you would do well to ask:

1. "Do you guarantee your dog's working instincts?" Remember, you're buying your dog to work, no matter what else there is about the dog, if it won't work, it's worthless to you. Most buyers try to satisfy themselves by buying only from working farms. This is a good method but a respected show breeder with a long list of good working placements will also work. Either way, ask for references and see what other customers had to say about this breeder's dogs. References combined with the guarantee should keep you from being stuck with a non-working dog.

2. "Do you guarantee the dog's health?" If the dog is ill when you buy it, even if you don't know it, all you'll get will be problems. If you spend the money for a good LGD, you deserve to start with a healthy one. Most breeders will recommend you take your new pup to a vet and have it checked in the first couple weeks you own it to insure you're starting with a healthy dog.

3. "Do your breeding dogs have Orthopedic Foundation for Animals (OFA) certification?" Large and giant breed dogs are subject to joint problems, primarily hip dysplasia. Through x-rays and OFA certification of the sire and dam you can reduce the possibility of getting a pup that is genetically

inclined to these problems. OFA certification is definitely no guarantee but it does give an indication both of the joint health of the breeding dogs and the care the owners give their dogs.

4. "Do you guarantee your dogs against genetic defects until they reach maturity?" Many problems that are genetic do not show up until the dog reaches maturity. These breeds usually do not mature until around two years of age. A working dog that can't see due to entropian (a condition where the eyelid turns in toward the eye) or that can't move due to joint problems is of little use to a stock raiser. There is no sure way to avoid these problems but buying a pup from a breeder who knows the line is free from these defects and will guarantee it, can increase your probability of owning a healthy dog in the future.

5. "Are these guarantees in writing?" "How do you plan to satisfy the guarantee if it becomes necessary?" "Is this in writing too?" "What do I have to do to satisfy the requirements of your guarantee?" Don't be afraid to demand a written money-back guarantee. All the soothing guarantees in the world are meaningless if you can't show later that they were actually given.

6. "Do the puppies all have the appropriate shots for their age?" "Do the sire and dam have the appropriate shots?" If the breeder doesn't care enough to spend the time and money to keep the dogs and their pups healthy, go elsewhere.

7. "How do these pups differ from each other in behavior?" Not all pups in a litter have the same personalities. Some may be more aggressive than others, some may better problem solvers, and occasionally, some may not like either humans or stock animals. It is a good idea to pick a pup that is moderate in its behavior, neither aggressive nor docile. A bright-eyed pup that is outgoing but not overly so is what you're looking for.

8. "Will you be available to help me through problems if they arise during the time we own this pup?" "What is your experience with working LGDs?" These dogs are neither machines nor robots; they are all individuals and, especially as juveniles or adolescents, may act in unexpected or unsettling ways. Although their instincts may be solid, they may need to be taught what is unacceptable behavior. Rough play and dominance behavior with the stock are the most common adolescent behaviors which cause problems. This behavior can be upsetting and costly to you if you do not know how to treat the situation effectively.

9. "Do you expect specific actions from me in regard to this pup after I take it home?" What are they?" Most responsible breeders will expect you to care for the dog and keep it healthy. They'll be glad to talk to you about how to do that as well as asking for a promise to take care of the dog.

10. "How do I get the dog to my house?" Hopefully you can just drive over and pick it up on the day the breeder releases it. Maybe you did virtual visits on the web or even via telephone. Before you commit to a particular purchase price, find out what it includes. Is shipping included? Usually not. We sell our dogs FOB on our farm and shipping is the responsibility of the purchaser. We will work with the buyer and transport the dogs to the airport at no extra charge as will most reputable breeders.

If you think about it, you may be able to come up with more questions that you'll need or want answered. Do not be embarrassed or hesitant. Ask questions until you are comfortable that you know

all you need to know at that time. If the breeder resents the time and effort you're asking for, go elsewhere. Most breeders we know will talk all day long about their dogs and be happy to find someone who'll listen.

When you're comfortable with the breeder, you've agreed upon a purchase price, and all that's left for you to do is to wait until your pup is old enough to leave its dam, you're ready to move to the next step: preparing for your LGD to arrive.

Preparing For Your LGD

The first step in preparing for your LGD is your own mental preparation. You are not getting a pet puppy. Yes, LGDs are dogs, but they're not like any dog you've ever met. Decide now that the day you bring your puppy home it will go directly to the barn without making a stop at the house. It definitely shouldn't spend its first night in the house, no matter how cute, cuddly and forlorn it looks. Your pup most likely was born in a barn and has spent its whole short life in the company of livestock of some kind. You won't be doing it any favors by taking it into a strange place like your house where there is absolutely nothing familiar. By introducing it immediately into the environment where it will spend all its time, you'll be doing it a big favor.

The next mental step is to understand that, just because the pup is small, it doesn't need to go in with baby livestock just yet. Puppies need to grow into their situation. Without their dam to teach them, they very probably will make some missteps along the way. When a pup is in its litter, it learns to play with its littermates in a rough and tumble process that teaches it some elementary things about fighting, how to relate to other dogs, and helps develop its growing muscles. When a pup is moved from a litter to other babies, like kids or lambs, it will tend to interact with them just like it did with its littermates. The results can be disastrous for the kids and the pups. Playing with kids like that will probably kill them if it goes on very long at all. You'll lose the value of the stock and probably of the pup when you decide it's unfit to be an LGD and kill it or put it in rescue.

Normally, the dam will teach her pups how to act around the stock, but since you've just removed the pup from its dam's influence, you'll need to find a new teacher. Your best bet is to select a few of your older does. You'll need to select carefully; these does shouldn't be dog aggressive but should be assertive enough that they won't put up with any "garbage behavior from a stupid little puppy". These does will eventually teach your pup its manners around stock. They won't hurt the pup but will certainly let it know the results of inappropriate behavior. Remember, the pup's dam often looks and sounds like she's about to kill her pups when disciplining them, so a little light bashing from a gentle goat will just be par for the course as far as the pup is concerned.

If you don't own at least one goat or sheep that will teach the pup manners, buy one; it's worth it if you can find one. If you're not able to do that, guess who wins big in the motherly discipline department. The time to learn about disciplining a pup is before it arrives. Prepare yourself to spend some time with the pup and teach yourself about a puppy's concept of discipline. If you can manage to visit a newly whelped litter of about four weeks or older, watch what happens when a pup runs afoul of its mother. The pup screams and cries like death itself is about to visit. Momma growls, snarls, and puts her pup on its back and her mouth on its throat. It doesn't last long but it is a very effective method to teach pups not to do certain behaviors. You really don't need to act like you're going to rip the pup's throat out with your teeth but the growling and snarling is good. Putting the pup on its back affirms

that you're the boss and putting your hand lightly on its throat will serve that same purpose as teeth. Make sure this only lasts a few seconds, until the pup acknowledges the correction. Please understand we're talking about young pups only. Most pups will submit easily but any dog, even a young pup, has the potential to contest a claim of the alpha position. If you claim it with an older dog, you'd better be prepared to prove it in no uncertain terms or you may very well have an uncontrollable dog that will need to find an alpha human if it is to lead a productive life around humans.

Now here's the tricky part, you can only do this when you catch the pup in the act of "bad" behavior and interrupt it. This is where using the goat as a teacher has the big advantage because if you don't use her, then YOU have to be there when the behavior happens if you want to stop it. Learning this fact when the pup is already at your farm can be quite disheartening. If you work all day and no one is available to be a "mom" to your pup, don't despair, you can do it in your spare time. It will just take longer.

Another aspect of mental preparation is to decide now that your house-dogs and pets will remain just that. They will need to stay out of the goat yard and segregated from your LGD. Allowing your non-LGD dogs access to the goat yard will provide the potential for a variety of tragedies. The results of not segregating your other dogs can be that of teaching your LGD that dogs are allowed into the goat yard and, consequently, that whatever they do is allowed to happen in the goat yard. It can also teach your LGD that playing with others dogs is acceptable, as is either leaving with them to play or inviting others in to play. Either of these unacceptable behaviors may eventually litter your goat yard with bodies. Most problems with LGDs are problems that we have created by inadvertently training the LGD in ways we never intended.

We even had a situation where two of our dogs arrived at their new home at about the same time as a neighbor had a litter of Great Pyrenees/Chow cross pups. The fences were leaky and, consequently, the LGDs were around these puppies almost from birth until the pups were big enough to come over and play with the goats. When the goats started to not survive the pups' games, we received a call about the problem and that brings us to the greatest mental preparation of all: YOU are still responsible for the safety of your goats!

LGDs were developed over thousands of years. The shepherds also lived with the flocks during most of that time and helped fight the bears, wolves and brigands that preyed upon the flocks. These dogs were not bred to be automatons; they were bred to make their own decisions about when and where to fight and to do a great job of it. Mostly, the shepherds didn't have neighbors because they worked communally in large family units or villages. The dogs had no problems telling friend from foe. Today, in some areas, it gets a little complicated. Not recognizing the subtle shadings of relationships in the modern world, LGDs accept others as threat or non-threat. It is or it isn't; there's no middle ground. We still have the responsibility to insure that our dogs understand our point of view on predators. When you kill a goat, it's ok; when a dog the LGD has been allowed to accept kills a goat it isn't ok. When there is any confusion like this on the part of your LGD, sometimes a rifle is the best way to remove it. When your LGD sees you kill the killer-dog, it will learn and you will have solved that particular problem. While wild predators pose no problems for the LGDs, the intricacies of neighborly interaction and the unaccountable teachings of their owners sometimes can cause seemingly inexplicable behavior. Some farmers want dogs that will not hesitate to attack any intruder, no matter how many legs it has, while others prefer a somewhat less aggressive dog. One reason why there are so many gradations of aggressiveness in the different breeds of LGDs available today is that the

shepherds in the various isolated areas of the world where these dogs developed had slightly different problems. In some, brigands and bands of thieves were commonplace; in others, they were not. Just as it was then, so it is now in the sense that some of us want or need more aggressive LGDs than others.

Now let's take a look the physical preparations you'll need to make before the arrival of your LGD to insure that both you and the pup have the easiest transition possible.

First, and perhaps most importantly, your pup will need a "safe place". If this is your first LGD and the first one for your stock also, your pup is going to need a haven where it can get away if the stock gets too rough with it. Remember, your pup is eight to ten weeks old and is too small for you to count on it taking care of itself totally. If it came from a farm, the dog is used to staying out of the way but probably not used to stock being dog aggressive and actively trying to injure it. Even if you properly introduce the pup to your stock, there's no guarantee they'll take your word that the new dog is their friend; you may have to give them some time to adjust. In the meantime, your pup may need to escape in a hurry. We recommend something built along the lines of a creep feeder pen (meaning a pen with a small entry hole to allow the pup in and out while denying access to the larger goats) stout enough to withstand a determined goat's bashing but not overly large. The pen should be arranged so it is convenient for you to get to as it will be where you initially feed your pup. It should also be where the pup will be among the goats, even when it's in its safety zone.

When making the pen, it would be advisable to build it with a top and bottom also, as well as a way to close the entryway and latch it. This will make it dog-proof and enable you to use it for a "jail" later if necessary. The potential for "jail time" arises from the fact that adolescent dogs often have no more sense than do adolescents of any other species. After your dog has bonded to its goats, separation from them for short periods can be an effective punishment for rough play and can often cure undesirable behavior with only one application. This option is easy and quick; IF you have the jail available at the time you need it. You can trust that somewhere along the line you'll want a dog proof pen, even if it's just to keep the dog out of the way when you're working goats.

Your next item will be to check your fences. If you have goats, they're probably already in pretty good shape but LGDs can make it through fencing that will stop a goat. Some LGDs tend to roam, while others want to make sure their borders are safe beyond the perimeter of their enclosure. Fixing your fences before the dog finds out it can get out is well worth the effort. In some cases, you may feel that it doesn't really matter if the dog is in or out as long as it stays attentive to the goats. If you hold your goats with barbed wire, you might as well accept that it will leak dogs any time they want it to. The problems that may arise from leaky fences have more to do with protecting your investment in the dog than with keeping the dog with the goats. After bonding, the dog will not be too far away from them. LGDs, however, are not generally familiar with traffic and cars are a pretty common cause of death for LGDs. Other potential trouble for escaping LGDs can come from unfriendly landowners, law enforcement, or thieves. All in all, you'll probably sleep easier if you make sure your LGD will remain on your property.

You'll also need to check with the breeder to see what kind of food your pup is being fed. We recommend that you continue whatever it is and then make the transition to the food you've chosen on a gradual basis. We really have only one hard and fast rule about feeding: Watch your animal and if it shows indications (extreme weight gain or loss, bowel movement not healthy, personality and

temperament swings, condition of coat) that something may be wrong, consider diet a prime suspect after you've looked at and discarded the more obvious things. There are a tremendous number of theories about feeding LGDs and we'll try to cover some of them here.

1. You don't need to feed it anything; it can live off the land. This is actually true if you want your LGDs to eat your goats. They can't live off the land without feeding somewhere and your herd will be their only choice. It's either that or have them off hunting instead of guarding, and since they have an extremely low prey drive that concept would be a total failure. Historically, some LGDs were used to cull the herd and nourish themselves at the same time. If you don't feed your dogs intentionally, please don't shoot your dogs when they feed themselves on the only food available to them, your stock.

2. There is a position that since dogs are carnivores, they should be fed a RAW diet. The idea is to feed entire animals, not just meat so that the dogs get the entrails, organs, skin, and bones. This is supposed to give them a balanced diet and keep them healthy. We kind of like the idea but it is terribly expensive unless you have a cheap source of animals to feed. Even our wethers are worth too much to use for dog food.

3. Some people cook a mixture of meat and vegetables and, essentially make a "home designed" dog food they feel is healthier than commercial foods.

4. Commercial dry dog food, called kibble, is the most common form of dog food for LGDs. You can find many different theories about how much protein and fat is enough or too much to feed your dog. With large or giant breeds, overfeeding young pups may cause them to grow faster than their frame will develop and, consequently, they'll have joint problems. Since the dogs are extremely active, not feeding enough will cause slow growth, weight loss, or malnutrition. In cold weather, these dogs need a higher protein/fat intake to provide the energy to survive and work in cold temperatures. We currently feed our dogs free choice with a 26% protein and 14% fat dog food. It works for us but it may not work for everyone. Start with what your breeder says works for them and go from there.

Another concern about commercial dog food is the ingredients. Some foods use a filler that has no nutrition but provides soft stools for the dogs. Other use "animal by-products" which could mean the food is largely composed of ground up feathers. Still others are mainly corn and vegetable products. All we can tell you is to read the labels and do a little research. Beyond that we go back to our first rule, "Watch the dog and see how it's doing. If it's obviously in radiant good health, don't fix it. If it has problems, and you can't see an obvious cause, try changing the diet."

Once you've made all these arrangements, you're ready for your pup.

Introducing Your New LGD

As the "new kid" on the block, your LGD will need to be introduced to everything about its new home. A proper introduction will help ensure that your dog will become the guardian you want and need rather than a "problem child" demanding too much of your time and effort re-training and re-orienting it to do the work of guarding your stock.

There are many aspects of introducing your new LGD; let's look at them one at a time.

The Area

If your new LGD is a puppy, a natural tendency is to bring the cute little thing into the house so it won't be lonesome and afraid in its new surroundings. DON'T DO IT! Your puppy has lived in a barn around goats since birth. Your barn will not only provide a familiar environment for the pup but will start from the beginning teaching it that its home is where your stock is, not where its humans are.

If your new LGD is an older dog, provide a secure place such as an escape proof pen for its first night. Take it for a walk on a lead around the perimeter of your pen(s) or pasture so it will understand the limits of its new area. You may need to do this several times before the dog shows an understanding that this is its new area to protect. Your sensitivity to the animal will help you decide when the dog is ready to be released into its new area.

The Animals

Although there are headings for the different situations you may have, only the new elements to be considered are addressed in each category.

Other Dogs

There are several categories of "other dogs" that may be associated with introducing your new LGD.

1. LGDs. If your dog is a puppy, your adult LGDs should accept the pup almost immediately. You may have to witness a short explanation of "I'm the boss and you're the puppy," but there should be no serious problem.

2. Great Pyrenees are a special case in the LGD world at this point. Great Pyrenees are generally not same- gender aggressive if one or both of them is spayed or neutered. Introducing Great Pyrenees in this case should be easy and simple, needing little time but still requiring you to be alert for anything more than a short alpha demonstration.

3. Introducing intact same-gender Great Pyrenees or the same gender of another LGD breed regardless of reproductive status can be a risky and traumatic business. We recommend that you do not try it initially. You can try penning them in adjoining pens and see how they act. If you just have to put two adult LGDs of the same gender together, wait until they have had time to adapt to their new home, but be prepared to break up a "for real" dog fight. With younger dogs the fight is sometimes not too serious, other times, especially with fully adult dogs; it can be a fight to the death. If you plan on same-gender intact dogs working together, start with only one adult and let the puppy(ies) grow up with the adult. There will still be fights as the pups go through adolescence and become adults but the chances of lethal fights will be greatly decreased.

4. Pet dogs of any breed. Do not let them into your stock pens, introduce them to your new LGD, or encourage your new LGD to accept them. We strongly recommend total segregation of pets from LGDs. We understand that people often let their pet dogs associate with their LGDs to no ill effect. There is always the possibility, however, that either latent instincts of the pets will come to the fore

or that the LGDs will learn to accept other dogs as "OK". If you decide not to segregate your pets from you LGDs, you are opening yourself and your stock to the possibility of carnage and mayhem on a large scale. We feel it's just not worth the gamble.

Goats Familiar with Guardians

If you raise goats that have been around dogs before, you'll have very little to do in the way of introducing a farm raised or already working LGD to his or her charges. Simply put the dog on a lead and take it into the area where the goats are. Observe both the dog and the goats and when they are all comfortable, release the dog and observe some more to ensure everything goes well. The entire process may take as little time as five or ten minutes but do not take that estimate for granted; stay there, observe, and don't leave until you and the animals are at ease with the situation. If the dog is mature, or close to it, that may be all it takes. Some dogs, however, require some time to accept new stock, even if the stock is dog friendly. You'll never know for sure until you watch all of the initial behavior. You may need to pen your new dog in the area of the stock for a while until it understands that this is its new home. (A note here: it is also wise when introducing a new goat into your herd to insure your LGDs accept it. Some dogs require time and you may need to pen the goat in an adjacent pen while the dogs get accustomed to it.)

An immature dog or puppy may become excited or exuberant about all these new friends and want to sniff them all immediately. If this happens, and you're lucky, a mature goat will teach the pup some manners and decorum and that will be that. If that mature goat isn't available, you need to take its place. When you observe inappropriate behavior by a pup, immediately interrupt that behavior by shouting harshly and/or exhibiting some form of threatening behavior of your own. Make it short and to the point, stopping immediately when the pup changes its behavior. If you observe this behavior from a pup, you need to ensure that the pup knows it will not be tolerated. The closer you can copy its mother's behavior in correcting it, the more effective it will be.

In any discipline, immediacy is paramount. If you don't interrupt the behavior, there's a good chance that the pup will not know why you're being "mean" to it. If you believe that the undesirable behavior may continue, secure the pup in an escape proof pen in the immediate area of the goats, preferably in a holding pen close to the barn, and release the pup when you can observe it until you're satisfied that it will behave appropriately.

Goats Unfamiliar with Guardians

If you raise stock that have no experience with dogs, you must protect pups and younger dogs from them initially. An older dog will sense the fear and hostility in the goats and should treat them gently while avoiding any confrontations. A panicked or dog-fearing goat will attack a dog and can injure them badly. Many LGDs will not fight back and, if the dog doesn't understand it is endangered, it will not know about avoiding attacks until it learns by experience. Other LGDs do not tolerate that kind of behavior and will put a stop to it immediately. To say the least, this may lengthen the time you need to accomplish the introductions. Your presence and awareness are paramount during the introductions so that you can avoid this type of potential disaster. Some pups have never had to deal with this situation and will need to be protected. We recommend securing the pup in an escape proof pen in the center of the goats' area. The goats can make the adaptation to the presence of a dog and you can take the dog among them on a lead until you see that everyone has accepted the situation. Even then,

providing an area where the pup can escape an attack is prudent. The stock should adapt fairly quickly, within hours or a few days at the most. Again, you need to be sensitive to the attitudes of your animals and observe their relationships.

Guardians Unfamiliar with Your species of Stock

If possible, it is always easiest to buy your new guardian from a farm that raises the same type of animals that you do, otherwise there is a chance your new LGD will consider them as predators initially. Take your dog in among the animals on a close lead and explain that these are its new charges to guard. Make sure it understands that you expect it to take care of these strange new critters. In this case, the escape proof pen in the center of the herd is a virtual necessity. Your dog will live in close proximity to its new charges until everyone seems to accept the situation. If your stock has not been around dogs and shows aggression toward your LGD, once again, pen the dog in the center of the herd, taking it out into the herd on a short lead regularly until everyone is accepting of the situation.

Chickens And Other Fowl

We don't know how they decide but some LGDs want to chase chickens and others don't. If this is important to you, let your breeder know in advance and have him help you select a dog that shows little to no interest in chasing chickens. If you are getting a puppy, the odds are that you will need to pay particular attention to introducing your dog to your fowl if they will come into contact, or for that matter, if you plan for the dog to be guarding fowl. When the dog gets to your farm, have some chickens penned so they are available to you and set the dog in the pen with them. Explain that they are to be treated as animals to be guarded and stay with the dog to ensure it leaves the fowl alone. If you have free range chickens, after penning the dog with some chickens for a short time, arrange for chickens to be in the stock area where the dog will be living. Be alert to its reaction to the birds as well as your other stock and correct any tendency you see for chase behavior. With any undesirable conduct, early detection and fast, interruptive action are the most important factors in stopping this behavior before it becomes a major problem.

Planning For Future Stock But None Are Present

If you are starting a stock operation and want a Livestock Guardian to protect them when they arrive, make your arrangements to receive the stock and the dogs at about the same time. If you must acquire one before the other, get the stock first, then the dogs. LGDs need to be "with" their stock, not locked up alone and waiting for them or treated as a pet until the new animals arrive and then expected to turn into an LGD. Getting your LGD early is asking for problems.

General Characteristics of LGDs

Earlier we mentioned that your new LGD is not like any dog you've met. This is true enough that people with years of experience with dogs often, after acquiring their first LGD, find themselves facing situations they never imagined existed. We'd like to address some of these differences here. At this point we need to tell you that we raise Great Pyrenees and have never raised or owned any other breed of LGD. Rather than make the brash statement that all of the LGDs will conform to the behaviors we're going to talk about, we'll say right now that they won't all fit into one neat mold. We will say that it is our opinion that the more common breeds of LGDs will generally fit the behaviors we'll mention to

a greater or lesser degree but we offer these to you so you'll recognize what's happening when you come across one of these behaviors, not to say that it is a "one size fits all" description of LGDs.

Independence is, perhaps, the single most obvious and sometimes irritating characteristic people notice with their first LGD. We've even had people tell us that LGDs should all be obedience trained so that the owner should have control of the dog instead of letting the dog do what it wants when it wants to do it. This is an idea we applaud when it's aimed at pets and dogs that work in close concert with humans. With LGDs it is asking for total disaster.

Your LGD is the result of thousands of years of breeding to teach it to evaluate threat situations in an instant and to act in a way that best counters the perceived threat. Even if you, the dog's owner, wanted to live with your goats on a 7/24 basis, you could neither see nor hear the threats as effectively as your dogs could. You couldn't communicate directions to one dog fast enough to counter many of them, and you surely couldn't be with several dogs simultaneously to guide each one through various behaviors. These dogs are there so you don't have to live with your stock on a 7/24 basis.

Another result of this breeding is that LGDs just don't fall all over themselves to please you when you give them commands. You can teach them basic obedience if you choose, but it will never be like watching a Border Collie drop to the ground the second you tell it to. Opinions vary among stockowners about just what kind of obedience their dogs should learn. However it's phrased, usually the owners will have the dog come when they need it, be quiet long enough to administer medications like wormer when necessary, and not beat them through the gate every time it's opened. More than that is frosting on the cake.

Your LGD should be bonded to the stock and be glad to see you in the pasture, not the other way around. Some dogs will be more willing to be pets than others, but all should bond to the stock if given the correct environment. This means that you can pet them and give them treats if you want to, but do it in the goat yard, where the goats are. DO NOT do it outside of the goat yard or even by the gate if the goats are not there too. We cannot say often enough that most LGD failures are the result of inadvertent training for failure by the owners and teaching your LGD to expect human attention when they leave their stock is definitely failure-oriented training.

LGDs often have dominance issues with each other and sometimes with humans. You want to ensure that your LGDs understand that you are Alpha. If you raise them from pups it shouldn't be too hard, but we make a practice of regularly standing over our dogs (meaning we stand astride their back-a superior position) of either gender, holding them, and for short times physically controlling their movements. We do this so that if the time ever comes when we must exert a physical superiority over any one of them, they have already given their consent to be treated that way. When you need to work with an injured dog, or in some other emergency, you may not have the time to assert dominance over them.

Multi-Use LGDs

These dominance issues between dogs will often lead to fights, especially at feeding time, if you allow it. Pups and adolescents will fight and may even draw blood but it is seldom serious. On occasion (the occasion being they're able to get to each other) adult dogs (strangers or dogs that are always separated, not necessarily those who have grown up together) of the same gender will fight and

these altercations may be lethal. We would advise that you break these fights up if possible although your personal safety is critical here. The dogs will not be aware of you and, if you should place one of your body parts where teeth are being used, you could be injured. Here are some ways that have worked in the past to break up fights. If there are two people available, each of you grab a tail (preferably a different one for each of you) and hold the dogs apart until they calm down enough for you to assert physical control over them and take them to separate pens. We have heard of hitting the dogs over the head but don't recommend it. If you are alone and are lucky enough to have a hose handy, spraying as high a pressure water as possible in their faces will sometimes cause them to stop long enough to get them separated. As a last resort, hitting and pushing them apart with a 2x4 can work although it can be difficult to do and maintain your personal safety. If the fight is truly lethal, almost any means your imagination can come up with, other than placing yourself in the middle of it, is better than losing a dog.

LGDs will sometimes amaze you with the way they respond to the goats. During kidding season, they will often help clean and dry new kids if the mother goat will let them. Some individual dogs will be so protective of new kids that they will not allow the mother to approach it. This is not a breed trait that we know of but individual dogs of different breeds have been known to act this way. Obviously this is not to be allowed and the dogs seem to understand when you correct them.

It seems that many LGDs have an affinity for babies and often you'll find kids leaving the mother at night and curling up with the dogs. When a goat leaves her kids in the woods and then forgets where she put them, we'll often find a dog curled up with them, waiting for us or the mother to come back and claim them.

There are, perhaps, more differences between the guarding behaviors of the different LGDs than in any other single thing. Some dogs guard property as their personal territory while others don't care where they are as long as they're with their stock. Some have combinations of these two behaviors.

Here is a typical guarding behavior for a Great Pyrenees. First, they'll warn all predators of their presence through barking and "marking" their territory. In most cases, a wild animal will not attack stock when it's protected by dogs and the warnings are sufficient. Wild predators that have no other options will fight to get access to the stock, as will domestic and feral dogs on a killing binge. If the predator persists, the dog will threaten and see if the predator will leave. If not, the dog will stay between its stock and the predator to protect the stock and deny access to them by the predator. Great Pyrenees will fight when necessary to protect the stock but they are not as aggressive about this as some of the other LGDs who will choose to fight if the predator doesn't heed their early warnings. This is a case where a Great Pyrenees will definitely herd its animals while it holds them in a group and keeps them away from the threat. Great Pyrenees and other LGDs will usually work as a team when there are multiple dogs available, some doing guard duty with the stock while others advance to meet the threat. The way that they divide the duties appears as if they had held long meetings, deciding just who would do what and go where. While this is obviously not what happens, their coordination can be amazing when working as a pack.

While this is certainly not an exhaustive collection of LGD behavior, it can give you some idea of what to expect from your new LGD.

We often hear that people want their LGD to do double duty; on one hand they need a livestock guardian and, on the other, they'd like a yard/house dog to keep them company. Right up front, let's acknowledge that this can work, but we don't think it can work well. There are two distinct aspects to this idea that need to be examined before you make a decision that may be irrevocable and find that you have a situation you didn't quite expect.

First and foremost are the laws of physics. No dog can be in two places at the same time. Almost as important is the fact that no dog curled up in a nice, warm, closed-up house will be as alert or as able to detect and react to predators as a dog out in the pasture with the goats.

The simple fact is, when you have the dog with you, it's not with the livestock. This may seem obvious but we get the impression that not everyone actually considers this when thinking about dual-purpose dogs. Even if the dog does alert to predators while in the house, the reaction time to let the dog out of the house and move to the area where the stock are threatened may take longer than the predator needs to "grab a quick bite" and be on its way. This lengthened reaction time will hold true in varying degrees whether the dog is in the yard, in a house with a "doggie door", or shut in.

Most people want the company of a dog in the evening when they're home. This companionable interlude happens at the same time that the hunters begin their daily quest for dinner so at the exact time when your guardian is most important, it's in the house. By the very nature of the job description, a dual-purpose dog cannot perform both jobs constantly and effectively. The argument may be made that wild predators will sense the lingering presence of the dog and avoid the place. This overlooks the fact that dogs keep most wild predators away by their immediate presence and the threat of forcing a fight for the opportunity to chase prey. It also overlooks the fact that feral or domestic dogs don't give a fig if they smell your dog; unless it's there to confront intruders other dogs will ignore it. For those who say they have a dual-purpose dog and they are happy with the arrangement, we can only wish them luck and hope that nothing with big teeth or sharp claws falls through the holes in their defensive plan.

Part two of the consideration has to do with the individual dog and its ability to live two separate lives simultaneously. Some dogs can, some can't. Some LGDs are not suited to live in a household and some can do it. The fact is that your LGD was probably raised in a barn with stock. This is what it has been conditioned to and what it is used to. Your dog, if it is an adult, should be bonded to your stock, not to you. When you teach the dog to value your presence more than the stock's presence, it can be very difficult to keep the dog's focus on the stock during those times you want it with the goats. If your dog is a puppy, it should adapt to both you and the goats easily, but it will have a preference. Persuading the pup to accept living in the non-preferred style, while allowing it access to its preferred style on an intermittent basis, can be a Herculean task.

We have also found that LGDs are often quite uncomfortable when brought into a house. They aren't used to it and usually whatever purpose you had in mind is thwarted before you can even begin. If you adapt an LGD to the house, it will still gladly go into the pasture but getting them to stay there while you go to the house can be a problem. As we said earlier, some dogs can handle this schizophrenic lifestyle while other dogs can't. The problem is that your dog may be unable to make the sudden and repetitive adaptations between both kinds of existence. If this is the case, there is a good chance that by the time you discover this inability you'll have lost a good LGD.

LGD Grooming and Health Care

One of the things we hear fairly often is, "I don't want a dog with a long coat because I don't have the time to take care of it." Think about this: "Did the shepherds of long ago spend any time brushing their dogs?" The real answer is, "No one really knows." It is hard to imagine that they did though. A long coat on a pet or show dog is not the same as a long coat on a working dog. At least with a Great Pyrenees, the coat is pretty well self-cleaning and self-maintaining. Sure you can cut out matted hair every few months but the dogs will lose their coat at least on an annual basis and the mats will fall away. Since these dogs live outdoors and often have no manufactured shelter at all, their coats have natural oils that help protect them against the weather. One of the implications of this is that you certainly don't want to wash an LGD as it will reduce their ability to withstand the sometimes driving rain or other wet or cold conditions in which they may live. Although you do need to notice the condition of your animals and ensure they stay healthy on the outside as well as on the inside, all-in-all a long coated LGD doesn't need the excessive care that other long coated breeds demand.

Goats are often raised in parts of the country where the temperatures can get pretty high. We often hear that a long coated dog will get too hot. Although there is some accuracy in that statement, the coat doesn't play as major a role in heating and cooling as you might expect. Dogs don't sweat like people. They sweat through the pads of their feet. They also expel heat through their mouth, primarily using their tongue as a radiator and, consequently, they have some trouble throwing off heat during the hottest parts of the year because the tongue isn't a particularly large part of the body. A dog is pretty inefficient as a cooling machine so most dogs can use some help during hot weather if we expect them to stay active. Some folks actually shear their dogs for summer to help keep them cooler but we don't recommend it. The coat is a marvelous protection against the sun (a shorn dog can sunburn easily and white is actually a highly reflective color). It's also protection against teeth, claws (remember other dogs are predators too, not just the relatively shy wild predators), briars and sharp branches which are possible in much goat country. There are not too many parts of the country where sudden summer storms are unknown so, even during the hot season, they may need their coats intact to keep them dry and warm in a storm. A shorn coat can also open a dog up to attack by various insects that normally can't penetrate the thick hair. Timing can play a major role here too; if cold weather comes before the coat grows back in, then your dog will surely have trouble coping with the elements. A partial measure is to shear only the stomach so the dog can get closer to the coolness of the ground when they dig a new bed.

First and foremost to protect your LGD in hot weather, we recommend water. There's nothing like a dip in a pond, tank, or even a large watering trough to cool off a dog that needs to get rid of some extra heat. The constant availability of water for both internal and external use is the single strongest tool you have to keep your dogs healthy throughout the summer.

On occasion, you'll find an inflamed area on a small patch of your dog's skin. Usually the dog will bite or scratch at it and remove enough hair in a roughly circular spot that you can see the red and possibly oozing skin. These are called "hot spots" and usually are caused by external parasites or allergies. Fast treatment is urgently needed as these are minor problems that will probably grow rapidly and/or develop infections. There are several remedies for hot spots. Commercially, Sufodene, available in the pet section of department stores, and Cut Heal, available in the horse section of farm stores, are quite effective. We've also used corn starch (simply pack the hot spot with it) and found it as effective as the commercial products. The hot spot will usually dry up in two or three days with a daily application and there is no lasting effect. As always, if you have questions about this condition

or if it doesn't go away quickly once you treat it, check with your vet. In fact, we recommend you check with your vet before you have this condition, or any of the others we'll talk about, so you'll be prepared with expert advice from your own vet.

Let us add here that everything we say about dog conditions, problems, and medication is either from our limited experience with our own dogs, anecdotal from other breeders, or from our vet for our specific situations. We are not veterinarians and the things we'll mention here are more for your awareness so you can have preventive consultations with your vet rather than to lead you through any veterinary procedures.

You'll need to be aware that there are other skin problems your dog may experience including any of several different types of mange. If you have questions regarding any abnormalities in your dog's appearance, the safest bet is to consult your veterinarian.

External parasites can also cause your dog severe problems, including death, if there are too many of them. Fleas and ticks are the most common and we use Frontline brand flea and tick treatment that we get from our vet. It can get expensive but nothing we've found seems to be as effective. Dipping your dog in various brands of poison made for dipping can kill the fleas and ticks if you can get it soaked through the coat (a difficult job at best with some breeds) but it wears off quickly, especially in wetter areas, and it is a real hassle to dip most LGDs. There are other types of treatments for dogs and off-label drugs that we've heard recommended but before you use them, once again, please consult your vet.

The most dangerous of the internal parasites of which we are aware are heartworms. These things can degrade the quality of your dog's life as well as shorten it. Our vet tells us to start heartworm treatment on pups at about four months; check with yours about it if your LGD is a puppy. If your LGD is an adult, ensure that you know whether it has been given heartworm treatment before you acquired it. If it didn't, and has heartworm, if you treat it, you'll kill the worms and they can create a blockage in the heart that can be fatal to your dog. Your vet can test for heartworm if you're not sure of your dog's history and it's the only sensible thing to do if you don't know and want to start treatment. As far as we are aware, there are two different types of treatments for heartworm. There are heartworm-specific medications called Heart Guard and Revolution and there is Ivermectin (we need to stress it's not Ivomec Plus). Ivermectin is significantly less expensive than the heartworm-specific medications but it is off-label usage and may be lethal to collie type dogs. (We have often been made aware that some folks give their collies this medication with no ill effects but that doesn't change the fact that it may be lethal to them). We give one cc per hundred pounds orally on a monthly basis but we checked with our vet before we started and suggest that you check with yours. Ivermectin also will generally keep your dogs free of intestinal parasites other than tapeworms. Once again, however, you must look at your dogs on a regular basis. If your dog’s hair coat looks poor; they seem to start losing weight for no reason; or their gums lose color, have your vet do a fecal exam if you don't have the equipment to do it yourself.

There are several vaccines which are generally recommended to keep your dogs healthy. We use a seven-way shot (there are some differences in brands but ours covers Distemper, Adenovirus Type 2, Coronavirus, Parainfluenza, Parvovirus (MLV & KV), and Leptospira Bacterin). We order from a supply house. It's much less expensive to give the shots yourself but your vet should be willing to guide you through it and tell you exactly what vaccines to purchase. At this time, multiple puppy shots

with annual boosters for adults are generally recommended although there is some talk about not needing to vaccinate adults that often. We still do the annual boosters and will continue to do so until our vet tells us that the new evidence is clear that we need to change.

Rabies vaccine is a virtual requirement for your dogs. Their job is to stand between your stock and predators, all of which may possibly be rabid. You can get the vaccine and give the shot yourself, but in Oklahoma as well as several other states, the law considers the dog as unvaccinated unless the shot is given by a veterinarian. As usual, dog owners and breeders will argue about which way is best but the answer is, of course, "Whichever way you feel fits your situation" and that is a question no one but you can answer.

Finally there's the question of spaying and neutering. It is a question as much of effectiveness for your LGDs as it is a social or health question. A "fixed" dog tends to keep its attention on the job much more consistently than does an intact dog as well as the fact that a bitch attending to her pups is not out guarding.

A second and quite major consideration is: "What effect will excessive testosterone have on your intact males?" We found to our dismay that one of our dogs who had been an excellent guardian as well as stud dog couldn't take the pressure when he reached the age of four years. He was in with a bitch in heat as well as a very rutty buck and several does that were in heat. The particular combination led him into aggressive dominance driven behavior towards the buck. As a result, we have one buck that was mauled and we felt after trying several different interventions that we needed to castrate our stud. We kept him away from all the other animals for a month while the heaviest testosterone levels subsided and have since placed him back as a guardian to insure his appropriate behavior before offering him for sale as an adult guardian.

There quite often is a big controversy about spay/neuter any time you gather dog owners and we won't get into the social aspect of it right now. The health part of spay/neuter you can discuss with your vet. Spaying is a surgical procedure and we have our vet do all the spays for our dogs. Castration can be done on the farm with the same elastrator and bands you use for goats. Again, check with your vet for the details and make sure you vaccinate the dog for tetanus if you do it yourself. Early spaying and neutering is a concept that is readily accepted among most vets at this time. One of the big advantages to the dog owner is that the vet often charges a fee for the procedure that is based upon the size of the dog. With LGDs, eight to twelve week old puppies are a lot smaller and, consequently, the procedure is a lot cheaper than with adult dogs.

We recommend that you take a close look at the question of spay/neuter for LGDs and for pets. It isn't going to go away and PETA is getting more heavily involved in trying to force legislation to mandate it. It's a complicated issue and when you add the "Animal Rights" agenda, the facts of the issue can get obscured pretty easily. We think that it's far more than a question of budget or attitude; it's a question of "What's the best action that we, as individuals, can take for ourselves, our dogs, our stock, our pocketbooks, and our personal freedom?" Often the answers to these questions seem to contradict each other and we believe that LGD owners have a responsibility to look deeply at the whole issue. If you do, you may very well end up with the same position that your first reaction led you to but at least you'll have the satisfaction of knowing that you reached a studied conclusion.

Dog Food Delivery Systems

Perhaps one of the most common issues that people with LGDs have questions about is feeding their dog. We've talked about your feed choices earlier so here we'll address the question of delivering the food to your dogs rather than your goats. Some LGDs will protect their food from all comers while others are real wimps and stand back while even young goats gorge on delicious high dollar food.

For those worried about the goats, our advice is, don't be. If the goats clean up the dog food, the only real victims will be you and your budget because dog food sure ain't hay and you'll keep replacing it until your dog actually gets to eat. If the dog protects its food, it may sound like your dog is going to kill something but, if you'll watch without panic, you'll see that there is a lot of threat noise and posturing but no grabbing or biting. (At least there had better not be or you have some heavy re-training in your future!)

Especially if you have multiple LGDs, the most efficient answer we've found to feeding working LGDs is to use self-feeders. This will keep you from being locked into a specific time to feed the dogs. It also means there is always free choice food available to the dogs so they're never stacked up at the gate waiting to be fed just as the goats decide to go back out to forage. We have never had to hold food back from any of our working dogs because they were eating too much and they seem to stay quite healthy choosing when and how much to eat without our interference. In addition, alpha and dominance issues in regards to food can be resolved according to the dogs' schedule, not yours. It seems to be somewhat less violent that way.

Self-feeders are easy to locate. Usually everyone from the local feed store to the local pet store will have some variation of the self-feeder for dogs. We find that the size that holds about 50 pounds works well for us, but if you have a single dog, you might want to try one a bit smaller. You'll need one with a capacity that will hold enough to feed your dog for as long as possible without molding in the feeder. The quantity your dog eats daily, the humidity, and the insect activity in your area are the major issues affecting the amount of food you can effectively store in the feeder and still provide quality food for your dog. If you can find someone who manufactures or assembles the actual feeders, you may save a good deal of money buying seconds. These feeders can be classed as seconds for a marred finish on the metal or other similar inconsequential irregularities. We bought ours several years ago for about half the price we would have paid in a retail store. If you have chickens, you'll need to raise the feeder by placing a milk crate or similar item under it to prevent the chickens from getting the leverage they need to open the door and eat if they manage to find the feeder.

Simply using a self-feeder is not, unfortunately the complete answer. If your goats like dog food, a little thing like a gravity activated swinging door won't stop them. They'll have it figured out as fast as your dogs do (if not a little faster, the dogs aren't as greedy about their feed as the goats are.) You'll have to allow your dogs access to the feeder while denying access to the goats. Although it sounds difficult to imagine such a thing, the method is quite simple: surround the feeder with a sturdy fence, cut hole in the fence too high and too small for a goat to jump through but placed just right for your dog and, presto!, you have a goat proof dog feeder.

We have placed hog panel, cattle panel and utility panel (but a wooden fence or any barrier too high for goats would work) around the feeder and cut a hole in the panel about 14 inches off the ground with the hole being 9 inches to 1 foot square. The dogs can get through the hole to get to the feeder and the goats can't. Make sure any sharp edges or points are smoothed off to protect the dogs when they go

through because it is a tight fit. Variations of this method include making a hole for the dogs to crawl under or teaching them to jump in over the top. We don't use these variations because we feel it teaches and encourages the dogs to use skills helpful in circumventing our fencing.

To teach the dogs to use the feeders, put them in the 'pen' show them the food, and lock them in. They can almost always figure out how to get out. You do need to check though; we've had to rescue some dogs that would have stayed in there forever if they weren't released. You may have to do this two or three times before they catch on.

On occasion, you'll find that a goat or two will figure out how to get in to a specific feeder. In that case, you'll have four choices:

1. Reconfigure the feeder fence with a different height from ground and a smaller hole.

2. Sell the goat or otherwise physically remove it from the pen where the feeder is located.

3. Feed the dogs individually.

4. Resign yourself to feed that goat dog food.

We have never found a way to un-train the goat from getting into the feeder without either making changes in the way it's built or making it just as unusable for dogs as it becomes for goats. (i.e., electric fence to keep animals away is just too inclusive!) The goat will learn easily that it is a "bad thing" to be in the feeder but that just means they run when they see you coming.

With a little patience, because the really determined goats will provide excellent quality control data, you'll have a goat proof dog food delivery system that will provide your LGDs with quality food on a continuing basis.

Closing

We have tried to share in this article most of the major points we've learned from our experience with our dogs, other LGD owners and breeders, and a variety of written materials. Below we'll list a few of the sources we have used and some we still refer to on a regular basis.

Livestock Protection Dogs by Orysia Dawydiak & David Sims, 2004, ISBN1-57779-062-6

Three Excellent Web Sites
http://www.lgd.org
http://www.canids.org/occasionalpapers/livestockguardingdog.pdf
http://www.nal.usda.gov/awic/companimals/guarddogs/guarddogs.htm

E Mail lists that you can join by going to http://yahoogroups.com
GoatandSheepRancher@yahoogroups.com
workingLGDs@yahoogroups.com

Dan and Paula Lane

Bountiful Farm
Shady Point, Oklahoma
Email: bountiful@direcway.com
URL: www.bountifulfarm.com

This information has been previously published in a different format on the US Goat Producers Cooperative website at www.usgpc.org and in the Meat Goat Monthly News

The proper citation for this article is:

Lane, P. and D. Lane. 2005. Livestock Guardian Dogs. Pages 43-63 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

Interactive Nutrient Calculator

Steve Hart

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

Introduction

The E (Kika) de la Garza American Institute for Goat Research of Langston University is currently leading a consortium of institutions and producer groups in forming a web-based meat goat production certification program. The program will allow persons to study modules developed on all aspects of goat production. Those wishing for certification can pay a fee and take tests on each module. However, the information contained in the modules is available free to anyone; only those wishing certification will have any expense. What follows is taken from the goat nutrition module being developed for the certification program.

Ration balancing background

An early decision necessary in the ration balancing process is the period of time to be addressed. For example, in a 3-month post-weaning period for growing meat goats, should one ration be developed or should the period be divided into smaller segments such as 1 month?. From an efficiency of diet utilization standpoint, the smaller the interval the better. Long feeding periods should result in less than expected performance early in the period and possibly higher levels later, but with the degree of compensation not assumed complete and dependent on numerous factors. But from a practical view, longer periods are simplest. However, changing cost and availability of feedstuffs could also influence the number of different rations balanced within a production phase.

The term ‘ration’ denotes a daily amount, whereas diet refers to food consumed regardless of time. Animals require absolute amounts of energy and nutrients rather than concentrations. Hence, to balance a ration it is necessary to have an estimate of daily feed intake and express requirements as concentrations thereof. This intake estimate can be based on prior experience or established methods of prediction, although this is an insignificant consideration if feeding a set, limited amount. Although much nutrition and feeding research has dealt with rations, it would seem that relatively most small ruminants in normal settings of the world consume basal forage diets sometimes along with limited amounts of nutrient or energy dense feedstuffs. For goats, use of rations has been mainly restricted to confinement dairy units and ‘show’ farms.

Ration balancing must consider factors in addition to energy and nitrogen, most notably minerals and vitamins. A deficiency in any of these constituents can make supplying appropriate amounts of energy and nitrogen irrelevant. Moreover, there are other considerations, such as the nitrogen to sulfur ratio and dietary means of averting present or future metabolic and health conditions. For the former, sheep and goats are subject to urinary calculi, resulting in the common practice of dietary inclusion of ammonium chloride and sometimes additional salt in moderate to high concentrate diets. For the latter consideration, ruminants with high milk production potential are often limited in calcium intake in late gestation to metabolically prepare for calcium mobilization in early lactation.

To balance a ration, it is necessary to know nutrient and energy concentrations in available feedstuffs. Laboratory analyses are preferable but relatively less important for concentrates vs forages. For common concentrate feedstuffs, 'book' composition values from the region of interest can in many instances suffice. Conversely, forages are quite variable in nutrient composition. If book values are used, the forage of interest should be matched as closely as possible with those listed in the literature source, and there may be extrapolation necessary such as between forages of different stages of maturity. Byproduct feedstuffs also can vary appreciable in nutrient composition.

In order to decide which feedstuffs should be included in diets, costs per unit of most pertinent nutrient or energy should be compared. For example, feedstuffs such as soybean, cottonseed, peanut, and fish meals are typically added as sources of crude protein (CP), rumen undegraded intake protein, and(or) rumen degraded intake protein, whereas cereal grains are added for energy. Some feedstuffs supply appreciable energy and CP and, thus, cost relative to both should be computed. However, factors in addition to cost influence diet or ration inclusion, such as minimum fiber levels, palatability, associative effects, matching of rates of ruminal degradation of energy and CP sources, avoidance of urinary calculi, ease of handling, 'rule of thumb' limits such as inclusion of nonprotein nitrogen sources like urea, etc.

Associative effects between feedstuffs are very important considerations when balancing rations. That is, some feedstuffs may impair or enhance utilization of others when fed together. Typically associative effects are viewed as having influence via change in feed intake and(or) digestion, although influences on efficiency of metabolism are possible as well. Magnitudes of change in intake vs digestion depend on whether or not intake is ad libitum or limited such as with low forage availability. A common associative effect is when cereal grains rise above 30% of the diet, with further increases decreasing forage intake and(or) digestion; magnitude of change in digestion and intake are inversely and directly related to forage quality or digestibility. Another example of an associative effect is when a forage low in CP is supplemented with a feedstuff high in CP. Rate of fiber digestion is increased, with an increased extent of digestion with restricted forage intake; with ad libitum intake, total and possibly forage intake are elevated though the decrease in ruminal digesta residence time may restrict change in extent of digestion. Another type of potential associative effect is matching of carbohydrate and CP sources similar in rates of ruminal digestion.

Even though a feedstuff may be low in cost and, thus, highly desirable to be placed in a ration, low palatability can limit utility of inclusion. With such feedstuffs, allowing a period of slow adaptation can be very important. Moreover, anecdotal evidence suggests that goats when well accustomed to a certain diet or supplement require more time to become accustomed to even small dietary changes than at least cattle, even if not entailing introduction of particularly unpalatable feedstuffs.

Another feedstuff with a cost to nutrient concentration ratio that cannot always be directly extrapolated to a dietary inclusion level is urea or other nonprotein nitrogen sources. There are common recommendations for upper levels of urea in diets to avoid urea toxicity and ensure efficiency nitrogen utilization, such as supplying no more than one-third of CP in the concentration portion of the diet with the required total level of CP.

How do we adequately provide for the nutritional needs of our animals?

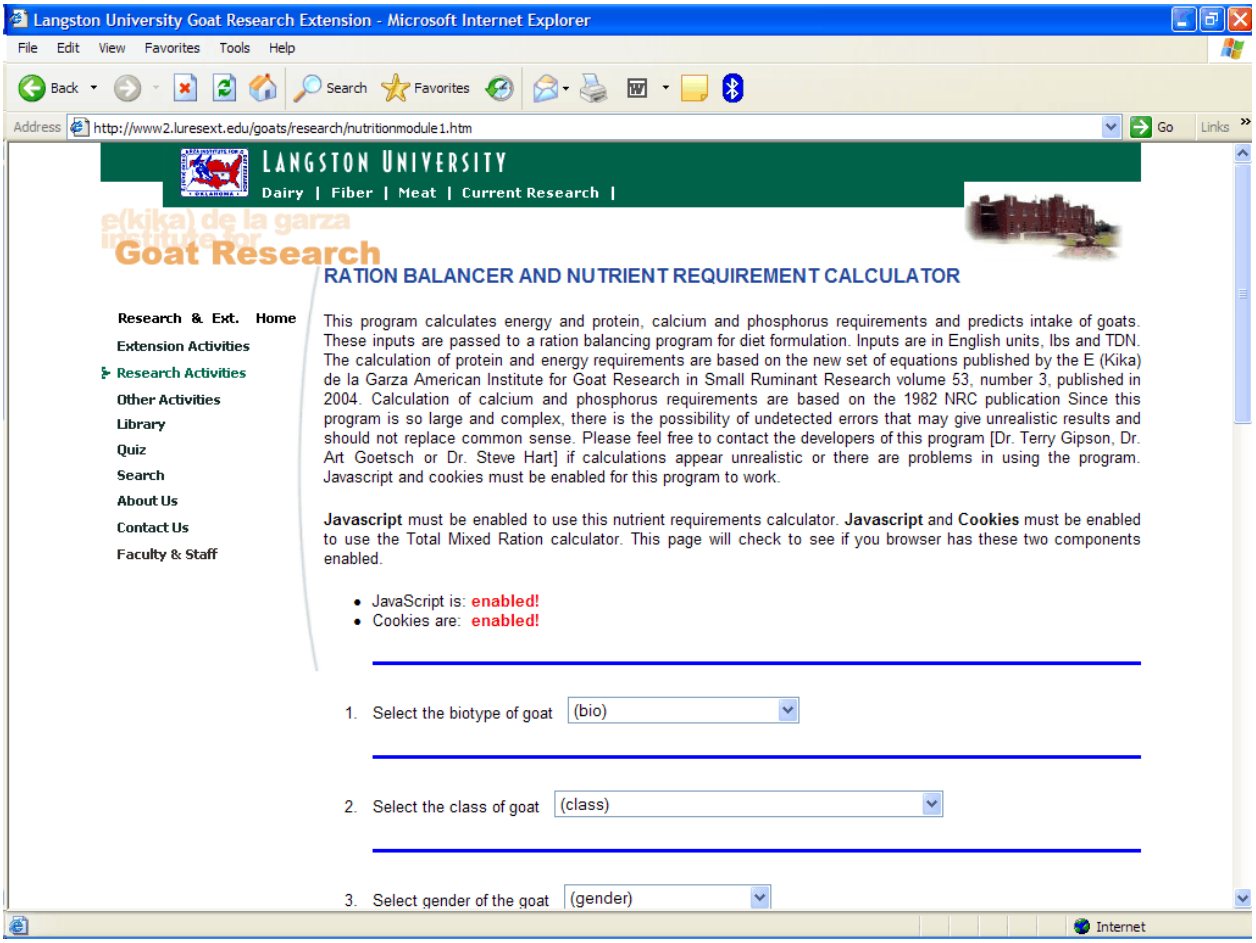
Firstly, we calculate the nutrient requirements. But how do we calculate nutrient requirements? In the past, calculating the nutrient requirements meant digging through technical manuals or scientific articles and looking up values in a table. Sometimes those values needed to be multiplied or divided by other value(s) or added to or subtracted from other value(s). Understanding the mathematics sometimes was complicated and difficult. The E (Kika) de al Garza American Institute for Goat Research has developed an Interactive Nutrient Calculator to facilitate the mathematical calculations necessary to determine nutrient requirements for various classes of goats. The Interactive Nutrient Calculator uses the equations derived from research conducted at the Institute to develop expressions of nutrient requirements of goats published in a special issue of Small Ruminant Research (2004, Volume 53, Number 3) published by Elsevier Science.

Secondly, we then utilize available feedstuffs, including pasture or hay, to fulfill those requirements. The Interactive Nutrient calculator also has a feed library and producers can select from various feedstuffs to create a ration that will meet nutrient requirements. The Interactive Nutrient Calculator also has capabilities for adding feedstuffs not found in the feed library.

To use the Langston Interactive Nutrient Calculator, you need to answer questions about your goats and your management practices. The Interactive Nutrient Calculator will then predict intake and requirements for energy, protein, calcium, and phosphorus. We will illustrate the use of the Interactive Nutrient Calculators using examples for a lactating dairy goat and another for a growing meat goat. It should be noted that the Interactive Nutrient Calculator is designed to cover all aspects of goat production and theses two examples are for illustration purposes only.

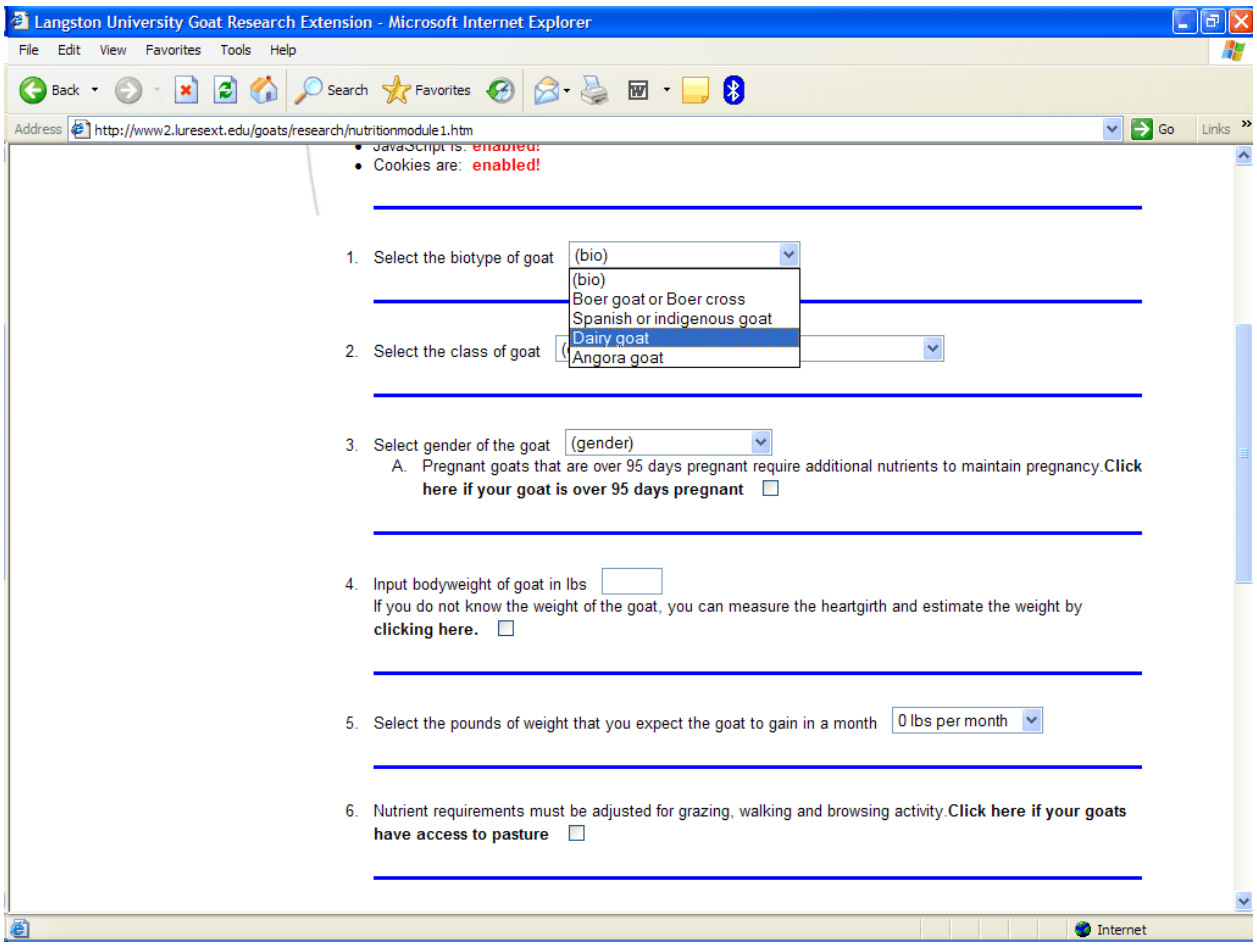
Lactating Dairy Goat Example

Step #1. Access the Interactive Nutrient Calculator by typing http://www.luresext.edu/goats/research/nutritionmodule1.htm in the address box of your web browser. The Interactive Nutrient Calculator is browser independent and will operate in Internet Explorer, Netscape, Firefox, Opera, or any browser of your choice.

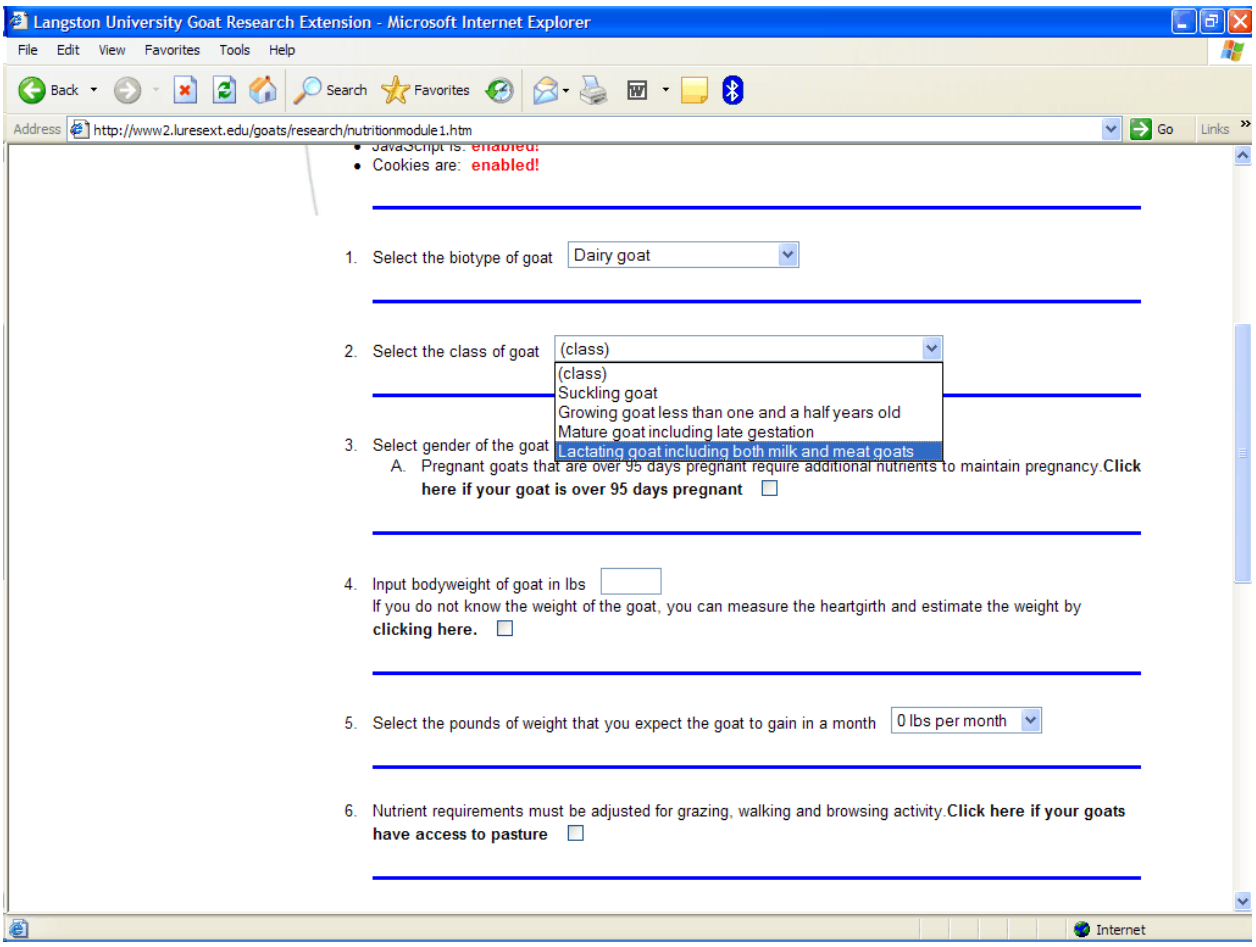


The Interactive Nutrient Calculator requires the functionality of Javascript and cookies. If these two browser components have been disabled, you will need to enable them before using the Interactive Nutrient Calculator. The Interactive Nutrient Calculator will automatically test for the functionality of these two components and will inform you of their functionality, as illustrated in Figure 1 above with the message that javascript and cookies are enabled with "enabled" appearing in bright red letters.

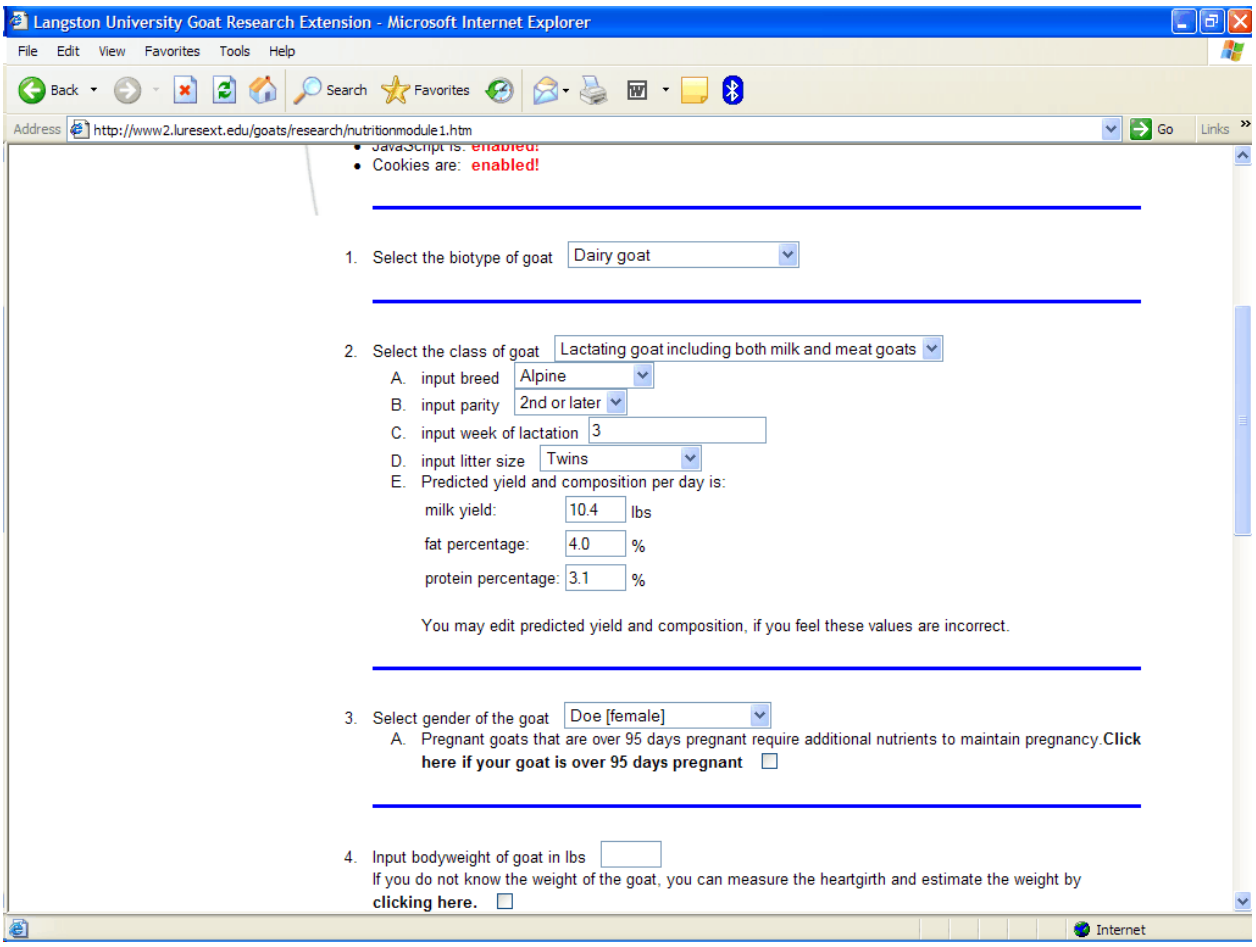
Step #2. Answer questions about your dairy goat and management.



Select the biotype of goat. You select "Dairy goat" from the drop down menu for biotype of goat. Other biotype options include Boer goat or Boer cross, Spanish or indigenous (native) goat, and Angora goat.

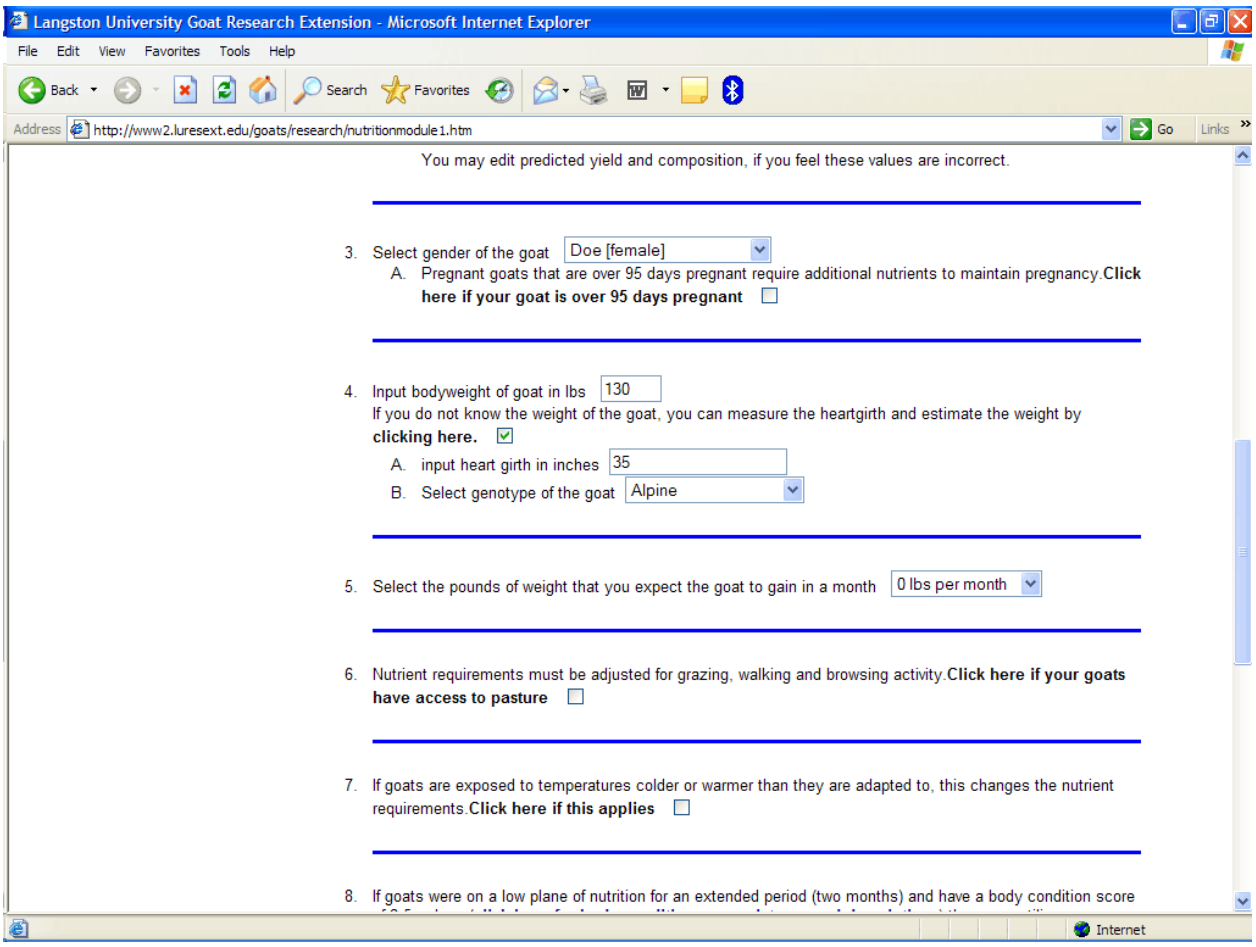


Select the class of goat. You select "Lactating goat including both milk and meat goats" from the drop down menu for class of goat. Other options include suckling, growing goat less than a year and a half old, or mature goat including late gestation.



Input Milk Production Data. Once you have selected "Lactating goat including both milk and meat goats" from the drop down menu for class of goat, a submenu appears and asks questions about factors affecting predicted milk production. These factors are breed, parity, week of lactation (weeks since kidding), and litter size (number of kids) for lactating dairy goats. For lactating meat and Angora goats, factors are litter size, week of lactation, and age of doe at kidding in years. For dairy does, the options for breed are Alpine, LaMancha, Nigerian Dwarf, Nubian, Oberhasli, Toggenberg, Saanen, or Experimental. For dairy does, parity options are 1st or 2nd or later. For dairy, meat, and fiber producing goats the options for litter size are single, twins, or triplets or greater. For non-dairy goats, the options for age of doe at kidding are 2 to 3 year old or younger, 4 year old, 5 year old, or 6 year old or older. Once these factors have been selected, the Interactive Nutrient Calculator will then predict the amount of milk produced and fat and protein percentages.

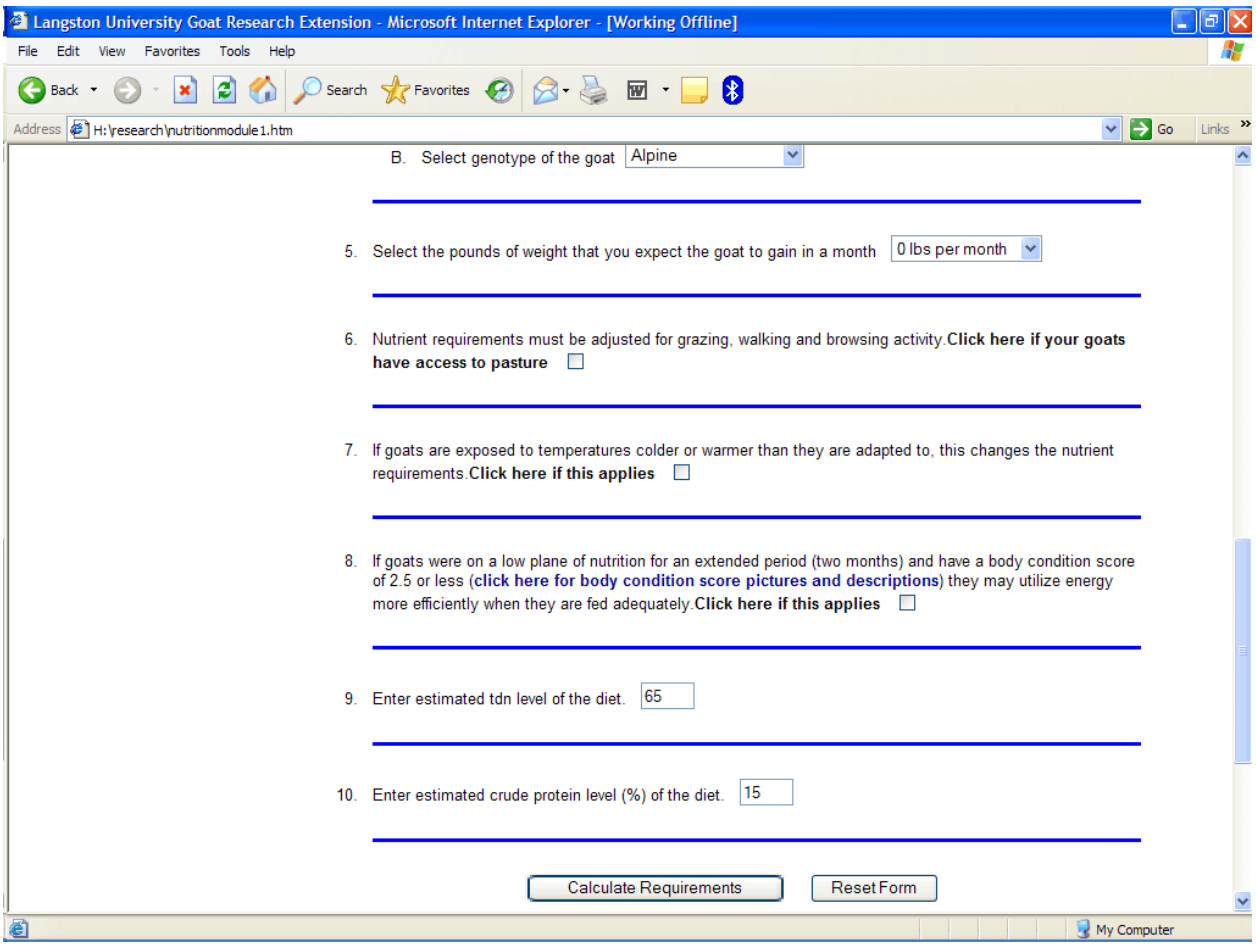
For our lactating dairy goat example, we will use an Alpine doe, 2nd or later parity, 3rd week of lactation, and delivered twins. Given our inputs, the Interactive Nutrient Calculator, predicted a milk yield of 10.4 lbs with 4.0% fat and 3.1% protein. These values can be edited, especially for producers who know the amount of milk and fat and protein of their milk.



Select gender of the goat. In our example, this menu item is automatically chosen as "Doe [female]" because we selected "Lactating goat including both milk and meat goats" from the drop down menu for class of goat. Other gender options include Buck [male] or Wether [castrated male]. For our example of a lactating dairy goat, doe is the obvious choice; however, under other scenarios, we would need to choose the gender.

Input body weight of goat in lbs. You can either input actual or estimated weight in the text box or you can have the Interactive Nutrient Calculator estimate the body weight for you using heart girth and breed information. Other options in the breed drop down menu include Angora, Boer, ½ or less Boer, 3/4 or 7/8 Boer, LaMancha, Nigerian dwarf, Oberhasli, Saanen, Toggenberg, or Spanish. This body weight estimation can also be useful for calculating body weight for medicines if a scale is not available.

For our lactating dairy goat example, we inputted 35 inches for heart girth and chose Alpine from the Breed drop down menu. The Interactive Nutrient Calculator estimated a body weight of 130 lbs for our Alpine doe.



Select the pounds of weight that you expect the goat to gain in a month. You select the amount of expected weight gain for your goats. Options for this drop down menu range from 0 to30 lbs per month. For our lactating dairy goat example, we will assume a mature doe that is not losing weight; therefore, we will accept the default value of 0 lbs per month.

Nutrient requirements must be adjusted for grazing, walking, and browsing activity. Nutrient requirements may need adjusting for the physical activity of the animals, such as for the energy expended during grazing. The drop down menu options include stable feeding, intensive management (will fit most Oklahoma goats), semi-arid grazing (goats on extensive ranges out West), and arid (desert) grazing.

For our lactating dairy goat example, we will leave this option unchecked.

If goats are exposed to temperatures colder or warmer than they are adapted to, this changes the nutrient requirements. This is an advanced feature modeled after other species where animals require more energy if they are exposed to a temperature much warmer or much colder than that to which they are accustomed or require less energy if the converse.

For our lactating dairy goat example, we will leave this option unchecked.

If goats were on a low plane of nutrition for an extended period (e.g., two months) and have a body condition score of 2.5 or less, they may utilize energy more efficiently when they are fed adequately. This question relates to the phenomena of compensatory growth that has been well described in cattle. If the box is checked, two questions will appear. Select how long it has been, in weeks, since the animal changed from a low to adequate plane of nutrition and the body condition score at the beginning of improved nutrition. Click to follow a link for body condition score pictures and descriptions.

For our lactating dairy goat example, we will leave this option unchecked.

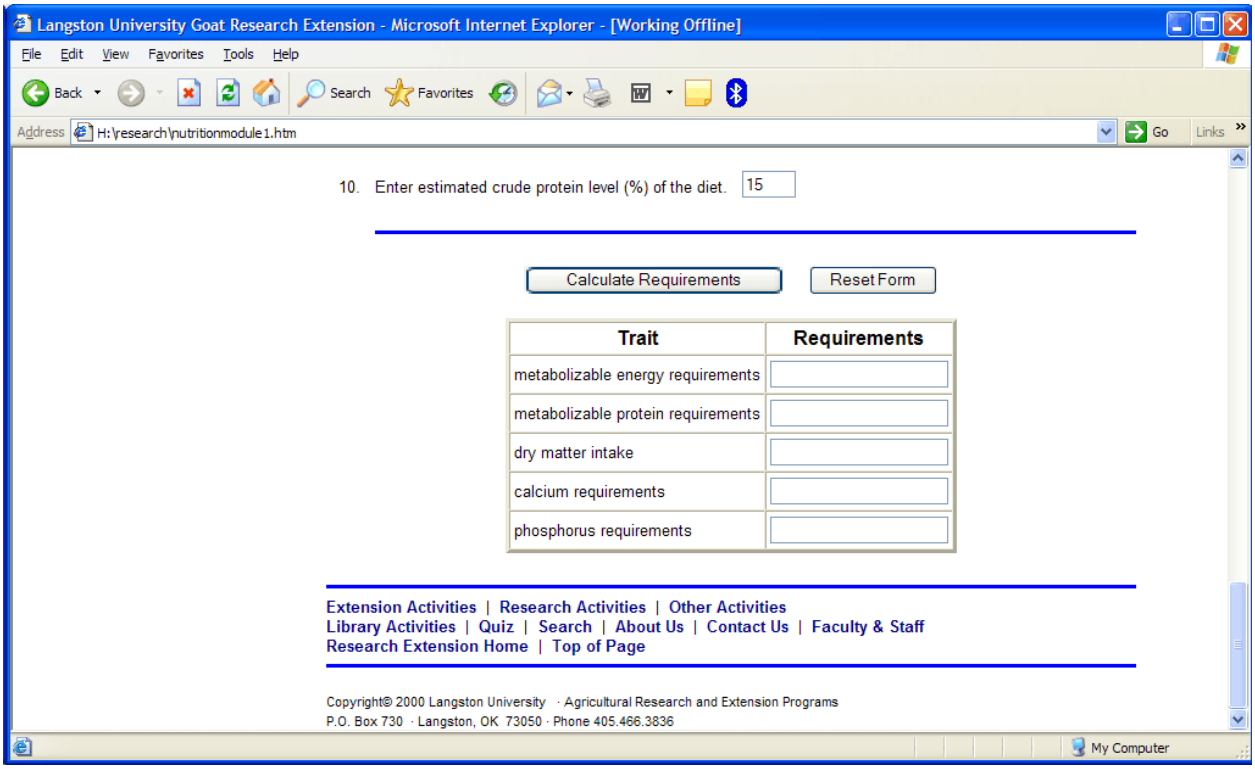
Enter estimated TDN level of the diet. A default TDN percentage of 60% is used for non-dairy goats. Adjust according to the planned level in the diet. For dairy goats, the default value is 65%.

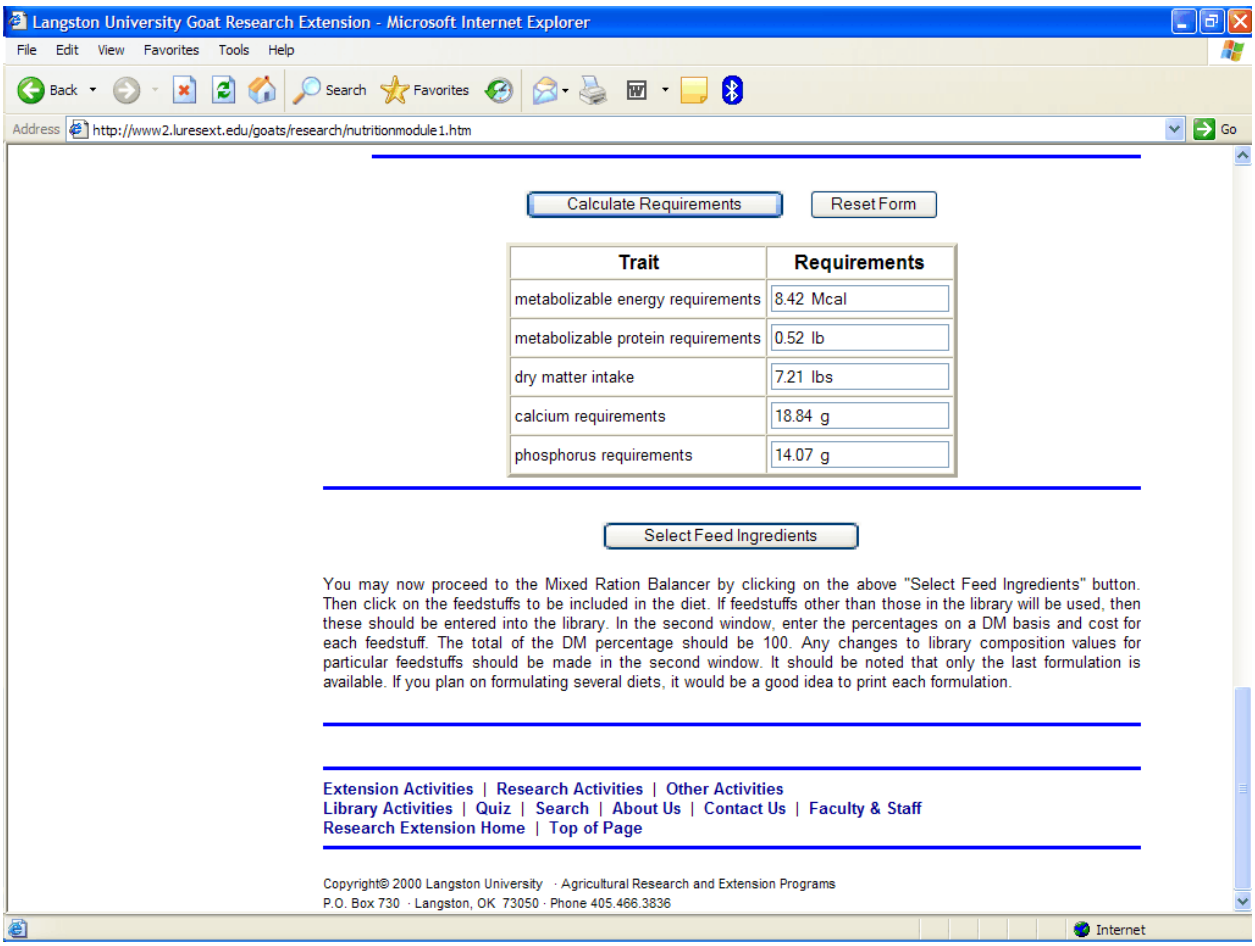
For our lactating dairy goat example, we will leave this TDN value unchanged.

Enter estimated crude protein level (%) of the diet. The default protein percentage is 10%. Again, adjust according to your planned diet. For dairy goats, the default changes to 15%.

For our lactating dairy goat example, we will leave this TDN value unchanged.

At the bottom of the Interactive Nutrient Calculator, you will see a table with the rows under **Trait** labeled metabolizable energy requirements, metabolizable protein requirements, dry matter intake, calcium requirements, and phosphorus requirements. The rows under **Requirements** are blank.

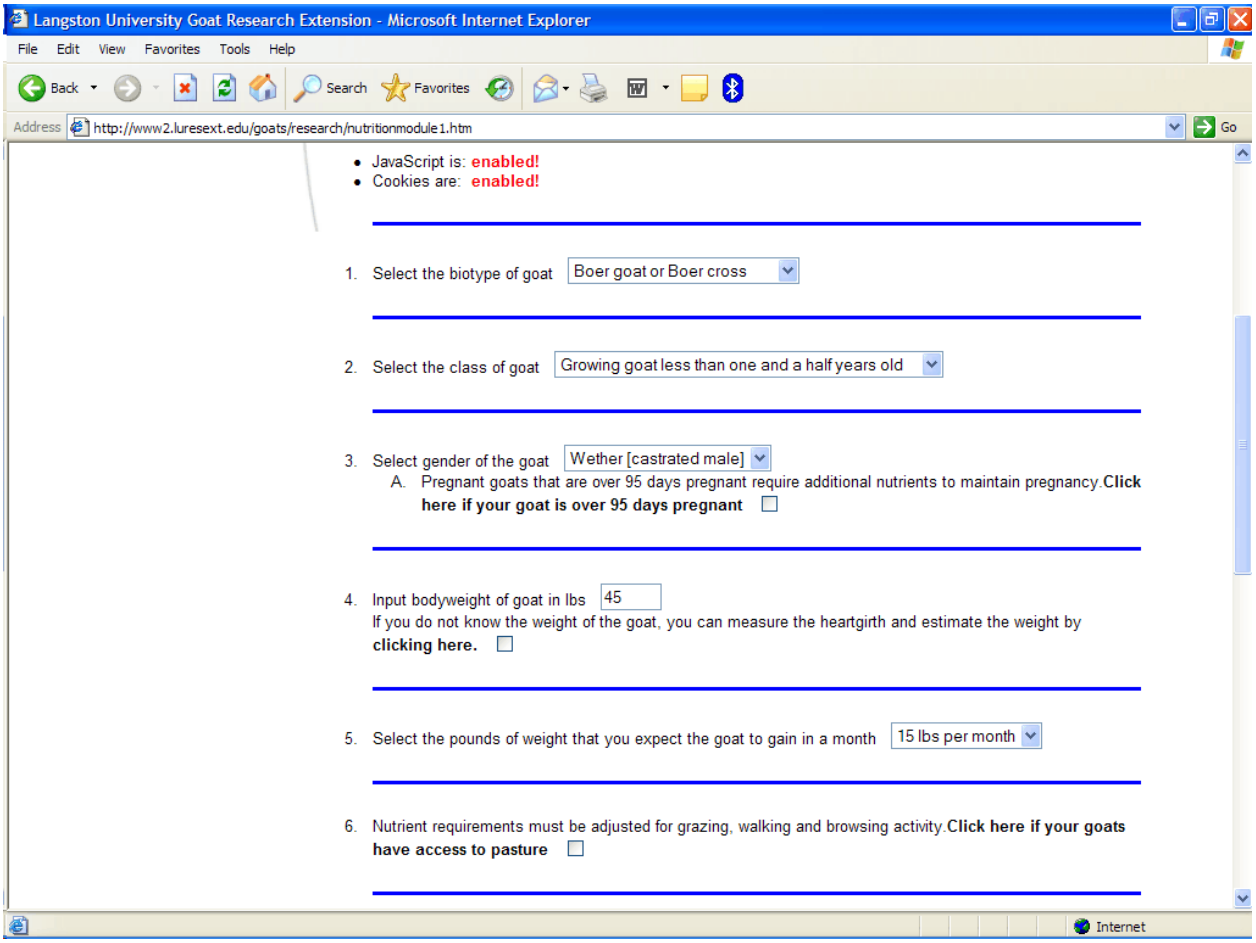




Click on the Calculate Requirements button. The nutrient requirements are now estimated. A value of 8.42 Mcal for metabolizable energy requirements, 0.52 lb for metabolizable protein requirements, 7.21 lbs for dry matter intake, 18.84 g for calcium requirements, and 14.07 g for phosphorus requirements were estimated using the inputs from our lactating dairy goat example. You will also notice that a section under the nutrient requirements table has appeared. It is the link to the feed library. You have successfully completed the first part mentioned in the Introduction above. You are ready to move to the second part of selecting available feedstuffs to formulate a ration that will meet the nutrient requirements that you just calculated.

Before continuing with this example, we will calculate the nutrient requirements for our growing meat goat example beginning with Step #2 as outlined above.

Growing Meat Goat Example



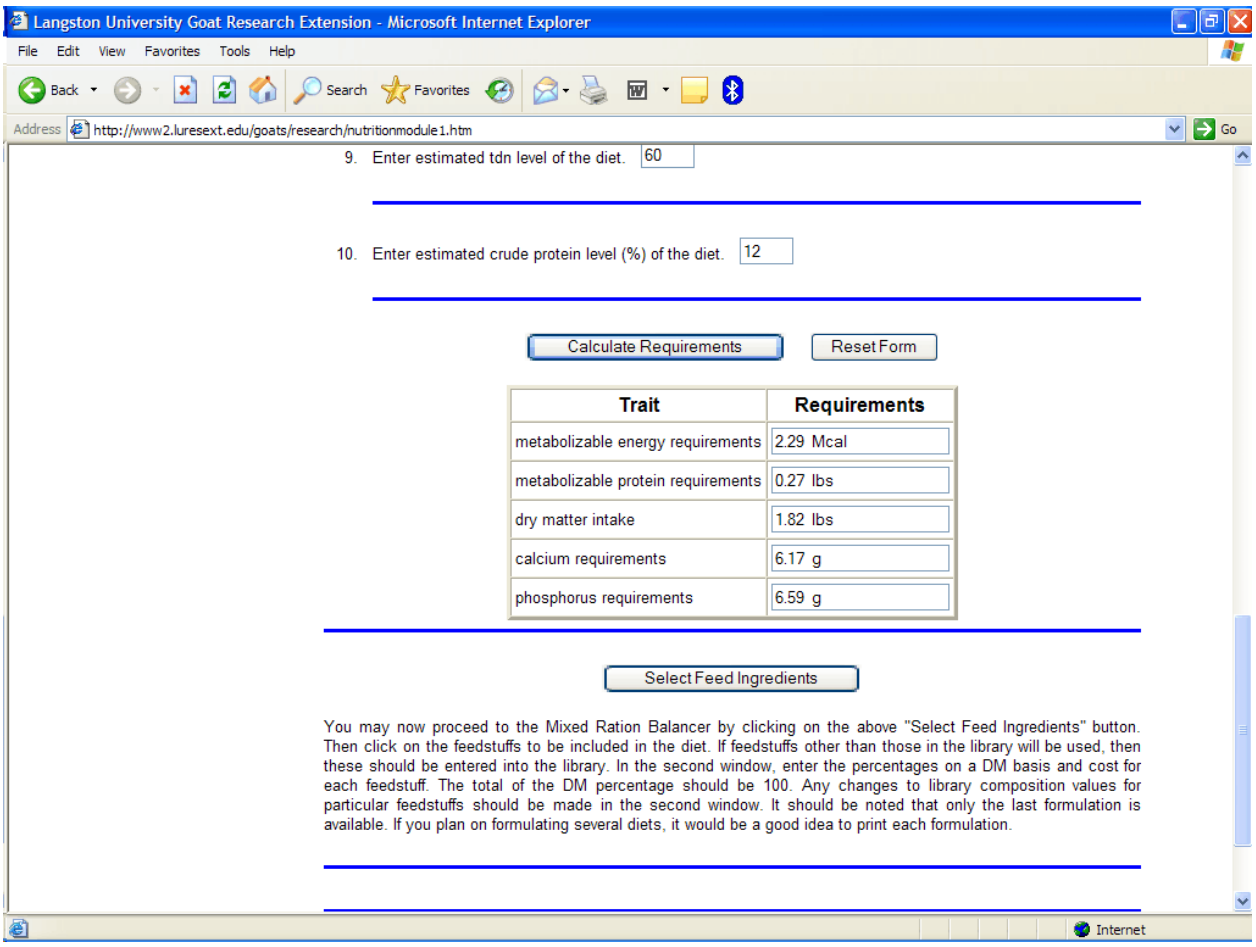
Select the biotype of goat. You select "Boer goat or Boer cross" from the drop down menu for biotype of goat.

Select the class of goat. You select "Growing goat less than a year and a half old" from the drop down menu for class of goat.

Select gender of the goat. You select "Wether [castrated male]" from the drop down menu for gender.

Input body weight of goat in lbs. For our growing meat goat example, we will assume a body weight of 45 lbs. Type this value into the text box.

Select the pounds of weight that you expect the goat to gain in a month. For our growing meat goat example we desire an average daily gain of 0.5 lb/day. Therefore, you select 15 lbs per month from the drop down menu for weight gain in a month.



As in the lactating dairy goat example, we will accept the default values for *Nutrient requirements must be adjusted for grazing, walking, and browsing activity*; *If goats are exposed to temperatures colder or warmer than they are adapted to, this changes the nutrient requirements*; *If goats were on a low plane of nutrition for an extended period (two months) and have a body condition score of 2.5 or less, they may utilize energy more efficiently when they are fed adequately*; *Enter estimated TDN level of the diet*; and *Enter estimated crude protein level (%) of the diet*. The default values for these last two options for growing meat goats are 60% and 12%, respectively.

Click on the Calculate Requirements button. The nutrient requirements are now estimated. A value of 2.29 Mcal for metabolizable energy requirements, 0.27 lb for metabolizable protein requirements, 1.82 lbs for dry matter intake, 6.17 g for calcium requirements, and 6.59 g for phosphorus requirements were estimated using the inputs from our growing meat goat example. As in the lactating dairy goat example, you will notice that the link to the feed library under the nutrient requirements table has appeared.

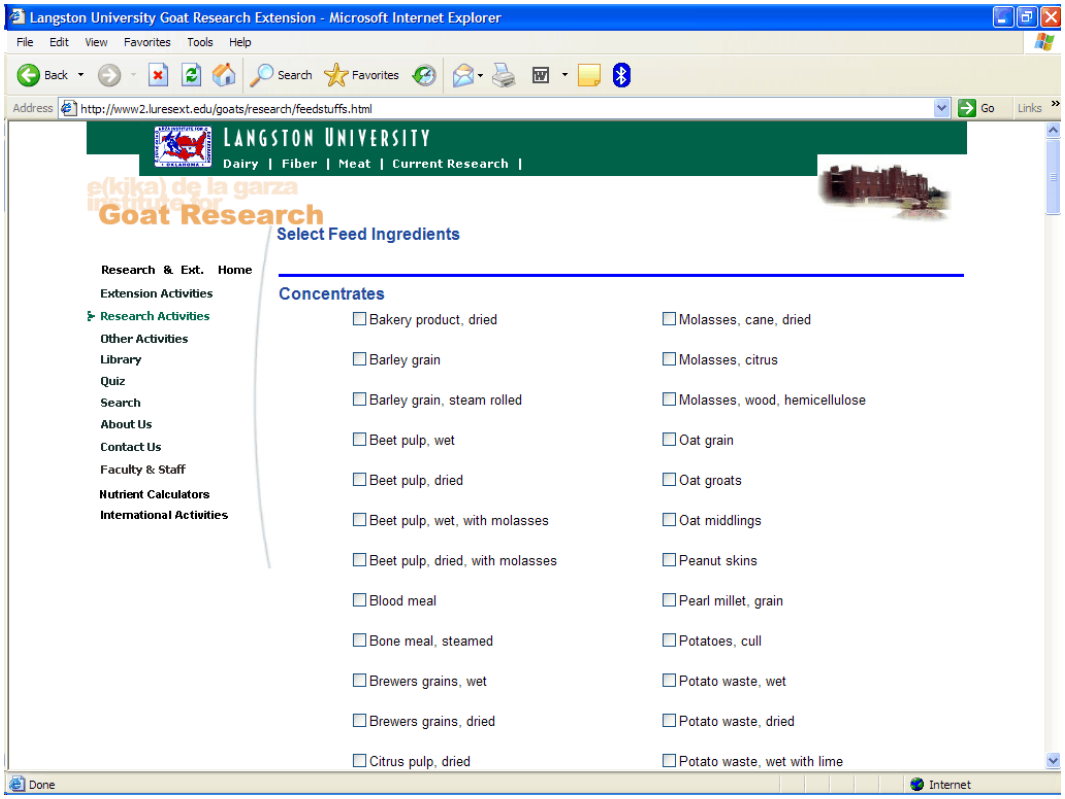
We will use the lactating dairy goat example to illustrate the feed library and subsequent ration formulation.

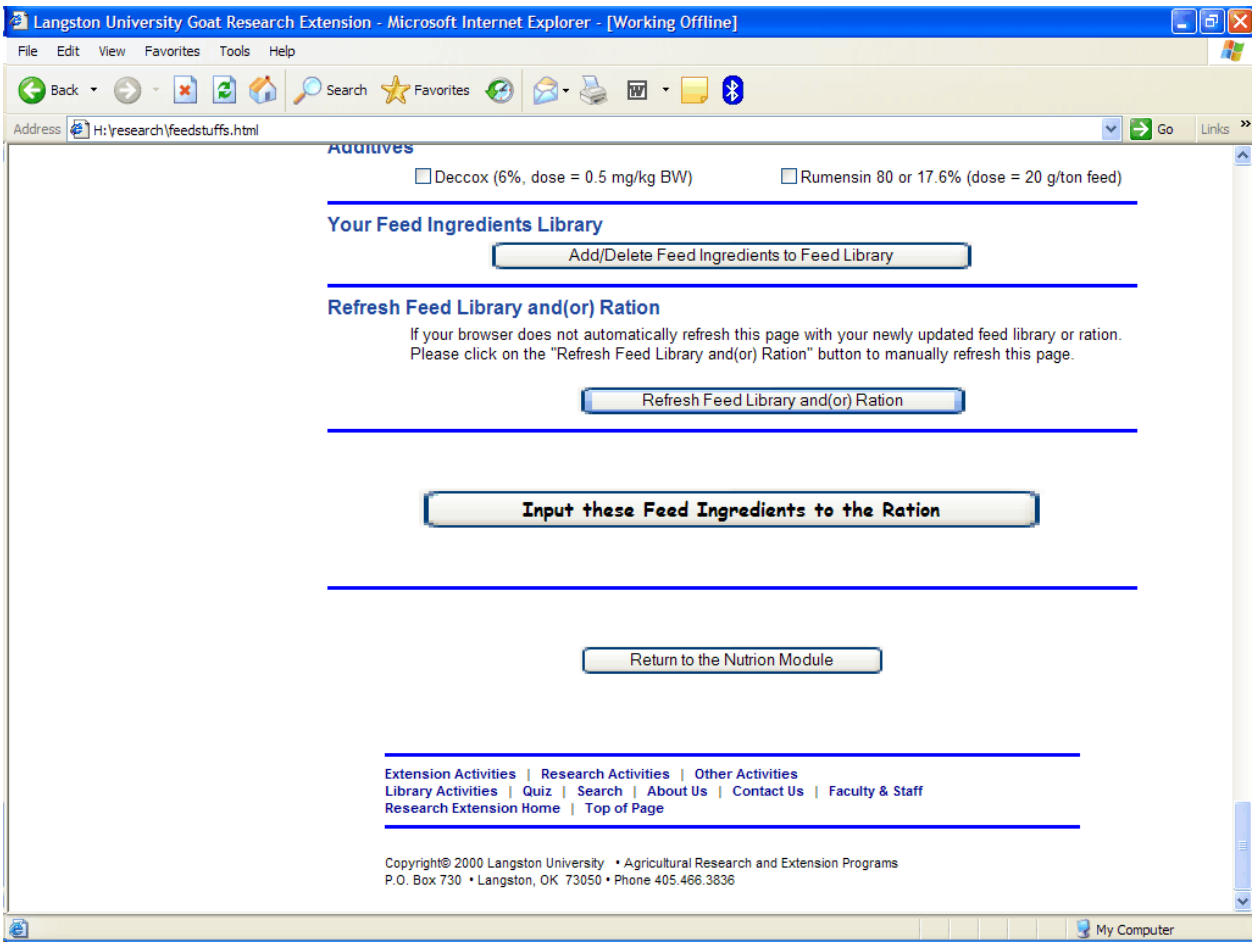
Feed Library and Ration Formulation

You can enter the feed library by clicking on the Select Feed Ingredients button. The feed library has 91 feed ingredients under the category of Concentrates, 94 feed ingredients under the category of Forages, 14 feed ingredients under the category of Minerals, 5 feed ingredients under the category of Vitamins, and 2 feed ingredients under the category of Additives. The feed library has the flexibility of adding feed ingredients if none of these 206 feed ingredients is exactly the feed ingredient that is available to you.

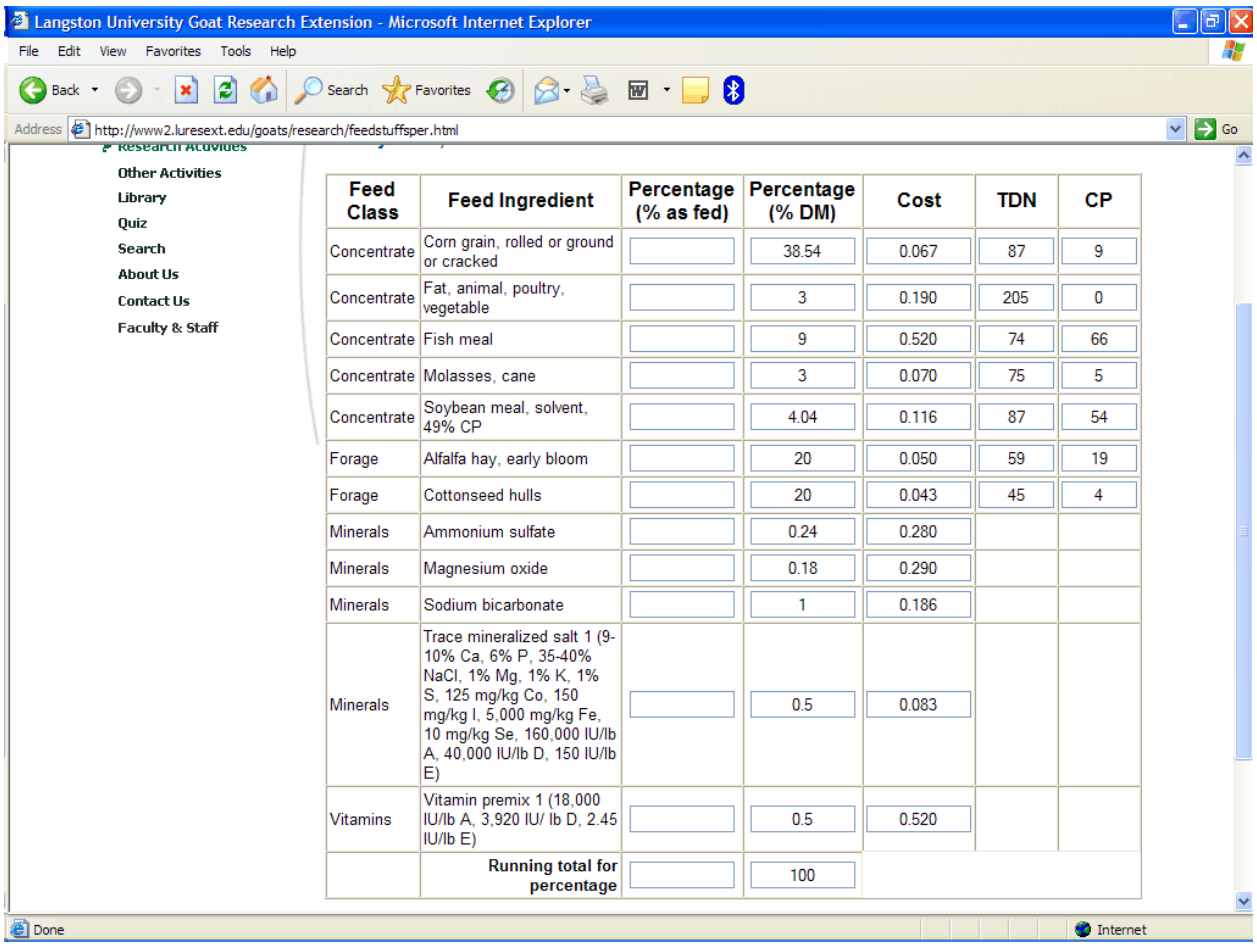
For our lactating dairy goat example, we will use a ration consisting primarily of cracked corn, cottonseed hulls, alfalfa hay, and fish meal and with lesser percentages of soybean meal, molasses, and fat. We will also add minerals and vitamins to the ration. We begin by clicking on the checkboxes associated with "Corn grain, rolled or ground or cracked", "Fish meal", "Fat, animal, poultry, vegetable", "Molasses, cane" and "Soybean meal, solvent, 49% CP" from the Concentrates category and "Alfalfa hay, early bloom" and "Cottonseed hulls"from the Forages category. Under the Minerals category, you can add the minerals by clicking on "Ammonium sulfate", "Calcium bicarbonate","Magnesium oxide", and "Trace mineralized salt 1 (9-10% Ca, 6% P, 35-40% NaCl, 1% Mg, 1% K, 1% S, 125 mg/kg Co, 150 mg/kg I, 5,000 mg/kg Fe, 10 mg/kg Se, 160,000 IU/lb A, 40,000 IU/lb D, 150 IU/lb E)". Also you can click on "Vitamin premix 1 (18,000 IU/lb A, 3,920 IU/ lb D, 2.45 IU/lb E)" under the Vitamins category.

We have now selected all the feed ingredients that we desire for our lactating dairy goat example.



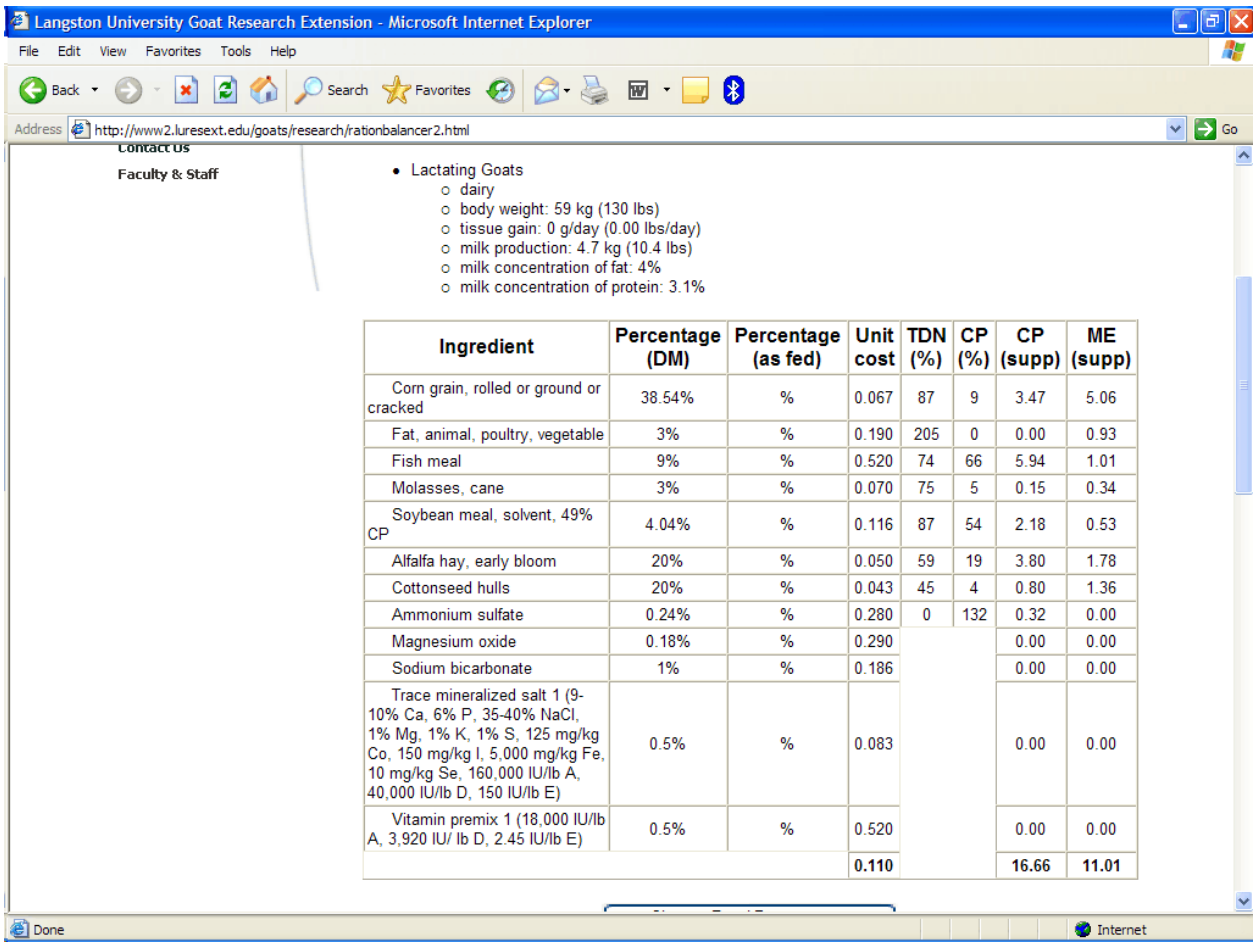


After you have selected the desired feed ingredients, you must scroll to the bottom of the feed library page and locate the “Input these Feed Ingredients to the Ration” button.



Feed Class	Feed Ingredient	Percentage (% as fed)	Percentage (% DM)	Cost	TDN	CP
Concentrate	Corn grain, rolled or ground or cracked		38.54	0.067	87	9
Concentrate	Fat, animal, poultry, vegetable		3	0.190	205	0
Concentrate	Fish meal		9	0.520	74	66
Concentrate	Molasses, cane		3	0.070	75	5
Concentrate	Soybean meal, solvent, 49% CP		4.04	0.116	87	54
Forage	Alfalfa hay, early bloom		20	0.050	59	19
Forage	Cottonseed hulls		20	0.043	45	4
Minerals	Ammonium sulfate		0.24	0.280		
Minerals	Magnesium oxide		0.18	0.290		
Minerals	Sodium bicarbonate		1	0.186		
Minerals	Trace mineralized salt 1 (9-10% Ca, 6% P, 35-40% NaCl, 1% Mg, 1% K, 1% S, 125 mg/kg Co, 150 mg/kg I, 5,000 mg/kg Fe, 10 mg/kg Se, 160,000 IU/lb A, 40,000 IU/lb D, 150 IU/lb E)		0.5	0.083		
Vitamins	Vitamin premix 1 (18,000 IU/lb A, 3,920 IU/ lb D, 2.45 IU/lb E)		0.5	0.520		
	Running total for percentage		100			

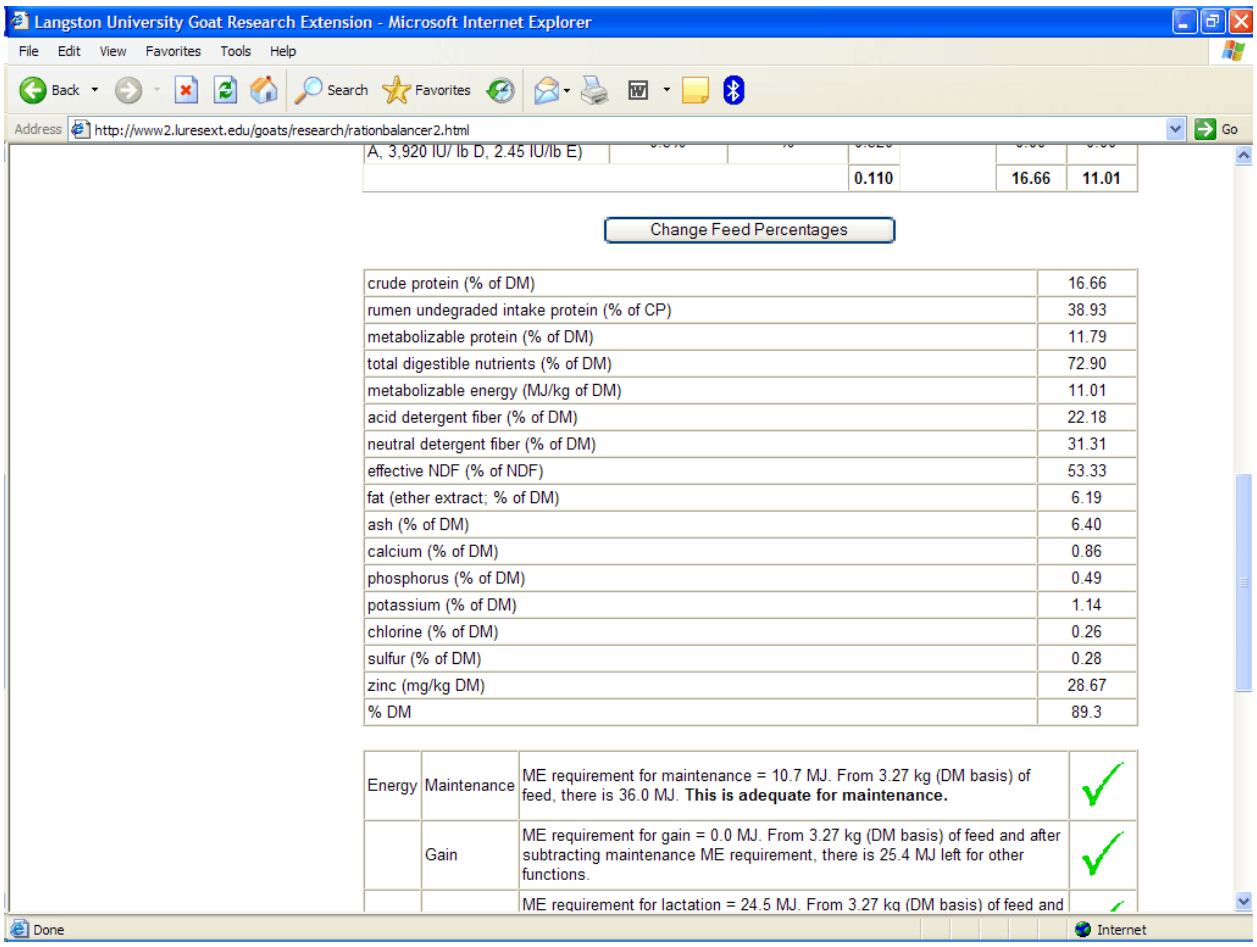
The next step is to input the percentage of each feed ingredient as it will appear in the ration in the table. This can be on an as fed basis or a dry matter basis. The ration balancer will use the dry matter basis in calculating the nutritional basis of the ration. If you enter the percentages on an as fed basis, the ration balancer will automatically calculate the dry matter basis for you. Both the as fed and dry matter bases should equal 100%. A running total for as fed and dry matter is located at the bottom of the table. You may add the feed cost in this table, which can either be in absolute or relative amounts. Feed costs should be on an as fed basis, and in the same units (e.g., dollars per as fed lb). This might require dividing $210 per ton of soybean meal by 2,000 lbs/ton to arrive at $0.105 per as fed lb, and $2.67 per bushel of corn by 56 lbs/bushel to obtain $0.048 per as fed lb. Some example costs have been added. You may change the total digestible nutrients (TDN) percentage and crude protein (CP) percentage of any feed ingredient listed in the table. At the bottom of the page is a "Continue" button. Click on this button to proceed to the analysis of the ration.



- Lactating Goats
  - dairy
  - body weight: 59 kg (130 lbs)
  - tissue gain: 0 g/day (0.00 lbs/day)
  - milk production: 4.7 kg (10.4 lbs)
  - milk concentration of fat: 4%
  - milk concentration of protein: 3.1%

Ingredient	Percentage (DM)	Percentage (as fed)	Unit cost	TDN (%)	CP (%)	CP (supp)	ME (supp)
Corn grain, rolled or ground or cracked	38.54%	%	0.067	87	9	3.47	5.06
Fat, animal, poultry, vegetable	3%	%	0.190	205	0	0.00	0.93
Fish meal	9%	%	0.520	74	66	5.94	1.01
Molasses, cane	3%	%	0.070	75	5	0.15	0.34
Soybean meal, solvent, 49% CP	4.04%	%	0.116	87	54	2.18	0.53
Alfalfa hay, early bloom	20%	%	0.050	59	19	3.80	1.78
Cottonseed hulls	20%	%	0.043	45	4	0.80	1.36
Ammonium sulfate	0.24%	%	0.280	0	132	0.32	0.00
Magnesium oxide	0.18%	%	0.290			0.00	0.00
Sodium bicarbonate	1%	%	0.186			0.00	0.00
Trace mineralized salt 1 (9-10% Ca, 6% P, 35-40% NaCl, 1% Mg, 1% K, 1% S, 125 mg/kg Co, 150 mg/kg I, 5,000 mg/kg Fe, 10 mg/kg Se, 160,000 IU/lb A, 40,000 IU/lb D, 150 IU/lb E)	0.5%	%	0.083			0.00	0.00
Vitamin premix 1 (18,000 IU/lb A, 3,920 IU/ lb D, 2.45 IU/lb E)	0.5%	%	0.520			0.00	0.00
			0.110			**16.66**	**11.01**

This next page is divided into three parts. The top part gives the class and production level of the goat, which is a lactating dairy goat in our example. This is followed by a table of the feed ingredients in the ration, the as fed and dry matter percentages, feed cost, if entered previously, TDN and crude protein percentages of the feed ingredient, and the amount of crude protein and metabolizable energy supplied by each feed ingredient at its given dry matter percentage. At the bottom of the table, total crude protein percentage and metabolizable energy in megajoules (MJ) for the ration is presented. The ration balancer has converted your metabolizable energy requirement from Mcal to MJ, and metabolizable protein requirement and predicted dry matter intake from pounds to grams (g) and kilograms (kg), respectively (1 Mcal = 4.1839 MJ; 1 lb = 454 g; 1000 g = 1 kg). This conversion is necessary for the functionality of the page, which is also used by a more complex version of the nutrient requirement calculator and that complex version requires values to be expressed in MJ, g, and kg. A button is below the table that will allow you to return to the previous page and change as fed and/or dry matter percentages, feed costs, crude protein percentage, or TDN percentage of individual feed ingredients.



The middle section provides the nutritional breakdown of the ration in tabular form. Values for crude protein and metabolizable energy are repeated. Metabolizable protein is a calculated and reported. This value will be used in the bottom section to ascertain if the ration is adequate in metabolizable protein or not. TDN, ADF, NDF, fat percentage, ash (total minerals) several individual minerals, and dry matter percentage is also calculated for the ration.

The bottom section checks the ration and determines if it will meet the nutrient requirements when consumed at the predicted rate. The upper half of this table checks the ration for adequacy in metabolizable energy. This half gives the metabolizable energy requirements for maintenance plus any appropriate stage of production such as gain, gestation, lactation, or fiber production. The total amount of metabolizable energy is calculated by multiplying the predicted dry matter intake by the metabolizable energy level in the ration, which can be found at the bottom of the table in the upper section or in the upper part of the table in the middle section. If an adequate amount of metabolizable energy is available for maintenance or appropriate stage of production then a green check mark will appear. If the ration is inadequate, then a red X will appear. The bottom half of the table gives the metabolizable protein requirements, and protein adequacy is calculated in an analogous fashion to energy. The metabolizable protein percentage can be found in the upper part of the table in the middle section, and this value along with predicted dry matter intake is used to calculate available metabolizable protein.

If the ration is inadequate in either metabolizable energy or protein, then you may use the "Change Feed Percentages" button located in the upper section to modify the percentages until you have formulated a ration that does meet the metabolizable energy and protein requirements. In some cases, it may be necessary to return to the feed library and choose new feed ingredients for a ration that will meet metabolizable energy and protein requirements. Or a producer can accept that the desired level of growth (gain) or milk production (lactation) may not be met with a desired ration.

Conclusions

There are many different methods balancing rations. This can be done in a very simplistic fashion such as with a hand calculator. Spreadsheets are often used as well, which greatly increases the speed with which formations can be changed. Typically effectiveness of these methods are dependent on knowledge of the balancer. Alternatively, there are software packages and the Institute's Interactive Nutrient Calculator available that have incorporated requirements. Some such packages and programs have capabilities of determining least cost rations; however, factors such as feedstuff availability, ease of handling, minimum fiber levels, etc., still need consideration. Regardless of the method used, most appropriate requirement expressions and feedstuff composition values are usually deemed of relatively greater importance.

The Langston Interactive Nutrient Calculator is a powerful tool that will aid the goat producer in more efficiently managing his/her animals. Goat rations can be formulated to exactly meet the nutrient requirements of any class of goat in any stage of production. This will prevent underfeeding, which will decrease desired production levels, and will prevent overfeeding, which will decrease profitability due to feed losses.

The proper citation for this article is:

Hart, S. 2005. Interactive Nutrient Calculator. Pages 64-83 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

Quality Assurance from Milking to Processing

Steve Zeng

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

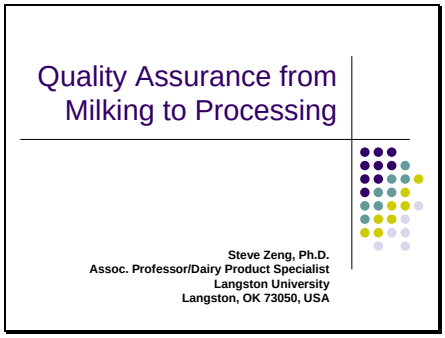
The most important requirement for a high quality dairy goat product is that the product must be safe, that is, free of pathogenic bacteria and antibiotics, be nutritious and have a good flavor. To obtain the highest quality of dairy goat products, it is critical to start with the highest quality of raw milk possible. The production of goat milk on the farm and the manufacturing of milk products, such as fluid milk, powdered milk, cheese, ice cream and yogurt, in the processing facilities are subject to the Pasteurized Milk Ordinance (PMO). In addition to the PMO, all goat milk (raw milk to finished products) undergoes inspection, sampling, laboratory testing, and conforming to quality standards to ensure it is pure and wholesome for human consumption.

On dairy goat farms, a Standard Operating Procedure (SOP) of goat management, personal hygiene, milking procedure, and milk storage must be in place. Lactating goats must be in good health. Staff that milk the goats must carry out good sanitation practices at all times. A routine procedure from pre-dipping to post-dipping teats must be performed at each milking. And milk should be cooled in a storage tank to 45°F or lower within two hours.

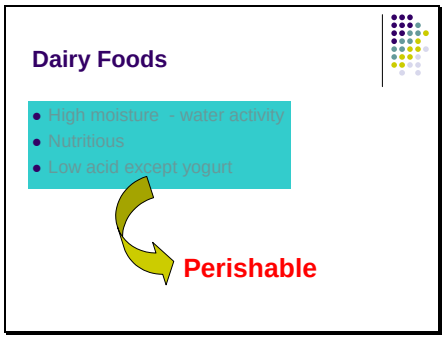
Prior to processing, all raw goat milk is subjected to testing for chemical composition, antibiotic residues, bacterial quality and somatic cell count. Almost all goat milk products undergo pasteurization by law, with the exception of aged cheeses. Controlled pasteurization destroys all pathogens and almost all bacteria present in raw milk, and helps ensure a safe, high quality and long shelf-life dairy product for consumers. To complete a sound quality assurance program, good post-pasteurization practices must be carried out from packaging, storage, product delivery and handling in the store.

Following are outlines of quality assurance from dairy farms to processing facilities.

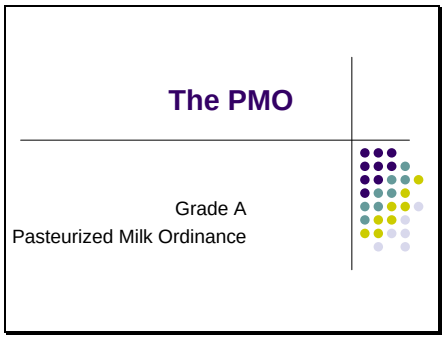
Slide 1



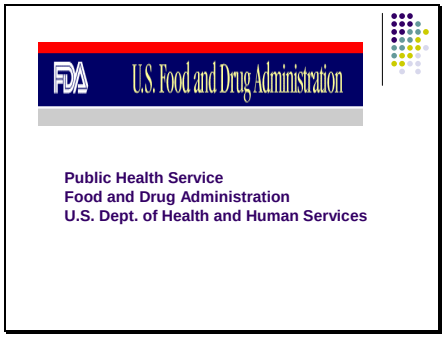
Slide 2



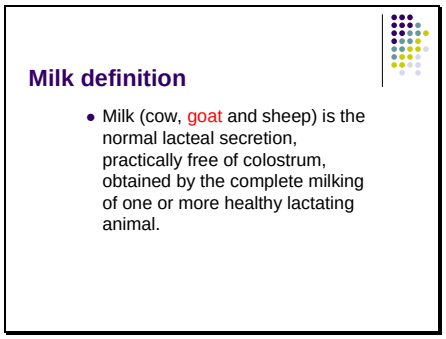
Slide 3



Slide 4



Slide 5



Slide 6

Slide 7

Raw Milk

- Temperature:< 45 ºC within 2 h after milking
- Bacterial limits: <100,000 cfu/ml for individual tank milk Somatic cell count: <1,000,000/ml for individual tank milk (750,000/ml for cow milk, to be lowered to 400,000/ml effective in 2007)
- Drug residues: No positive results

Slide 8

Pasteurized Milk and Milk Products

- **Temperature:** **< 45 ºC or less**
- **Bacterial limits:** **< 20,000 cfu/ml**
- **Coliform count:** **< 10 cfu/ml**
- **Phosphatase test:** **< 350 milliunits/L**
- **Drug residues:** **No positive results**

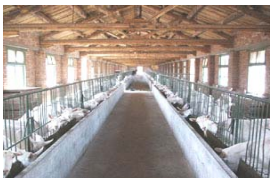
Slide 9

Dairy Goat Farm Inspection

Slide 10

What Does an Inspection at Dairy Barn Involve?

- Equipment
- Tank Room
- Milking Parlor
- Surroundings
- Waste Handling
- Drugs
- Water Supply



Slide 11

What Does an Inspection in Processing Plant Involve?

- Receiving Area
- Equipment Checks
- Record Reviews
- Processing Area
- Warehouse & Dry Goods
- Personal Hygiene

Slide 12

HTST Pasteurizer

Chart Recorder

Slide 13

Milk Plant Inspection

- Once every 3-6 months
- Without notice
- Access to all facility within reasonable time
- Defects marked
- Warning issued

Slide 14

Partial Example

Department of Health and Human Services Public Health Service Food and Drug Administration	MILK PLANT INSPECTION REPORT (Includes Receiving Stations, Transfer Stations, and Bulk Tank Cleaning Facilities)	INSPECTING AGENCY
NAME AND LOCATION OF PLANT	POUNDS SOLD DAILY	Milk Other Milk Products Total Permit No.

Inspection of your plant today showed violations existing in the items checked below. You are further notified that this inspection sheet serves as notification of the intent to suspend your permit if the violations noted are not in compliance at the time of the next inspection. (See sections 5 and 5 of the *Grade "A" Pasteurized Milk Ordinance*.)

1. FLOORS:
Smooth, impervious, no pools; good repair; trapped drains .... (a)___
2. WALLS AND CEILINGS:
Smooth, washable, light-colored; good repair ..... (a)___
3. DOORS AND WINDOWS:
All outer openings effectively protected against entry of flies and rodents ..... (a)___
Outer doors self-closing; screen doors open outward ..... (b)___
4. LIGHTING AND VENTILATION:
Adequate in all rooms ..... (a)___
Well ventilated to preclude odors and condensation; filtered air with pressure systems ..... (b)___
5. SEPARATE ROOMS:

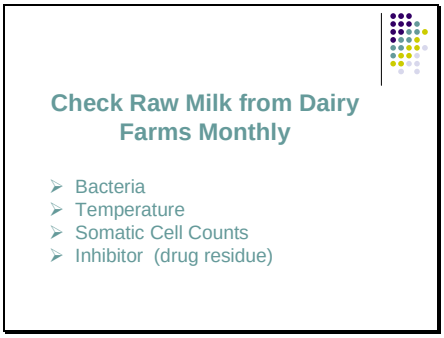
Aseptic system sterilized ..... (f)___
13. STORAGE OF CLEANED CONTAINERS AND EQUIPMENT:
Stored to assure drainage and protected from contamination ... (a) ___
14. STORAGE OF SINGLE-SERVICE ARTICLES:
Received, stored and handled in a sanitary manner; paperboard containers not reused except as permitted by the Ordinance ..... (a)___
15a. PROTECTION FROM CONTAMINATION:
Operations conducted and located so as to preclude contamination of milk, milk products, ingredients, containers, equipment, and utensils ..... (a)___
Air and steam used to process products in compliance with Ordinance ..... (b)___

(C) TIME AND TEMPERATURE CONTROLS:
Flow-diversion device complies with Ordinance requirements ..... (a)___
Recorder controller complies with Ordinance requirements ..... (b)___
Holding tube complies with Ordinance requirements ..... (c)___
Flow promoting devices comply with Ordinance requirements ..... (d)___
(D) ADULTERATION CONTROLS:
Satisfactory means to prevent adulteration with added water ..... (a)___
16d. REGENERATIVE HEATING:
Pasteurized or aseptic product in regenerator automati-

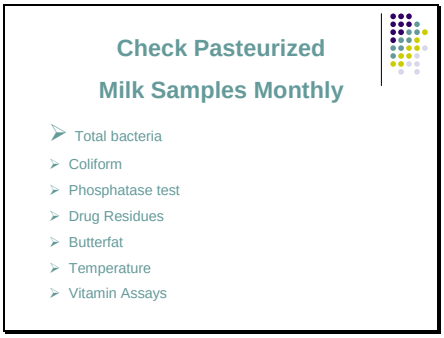
Slide 15

Laboratory Analyses

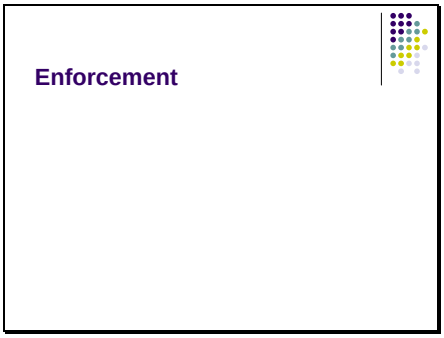
Slide 16



Slide 17



Slide 18



Slide 19

Antibiotic Residues

- A positive test automatically carries at least a one-day suspension of the permit and the milk must not be offered for sale or consumption until subsequent samples are proven to be free of antibiotics.

Slide 20

3 out of 5 Compliance

- SCC is usually performed using Fossomatic instruments. If SCC exceeds 1,000,000/ml or the total bacteria count exceeds 100,000 cfu/ml 3 out 5 times, the milk is down-graded.

Slide 21

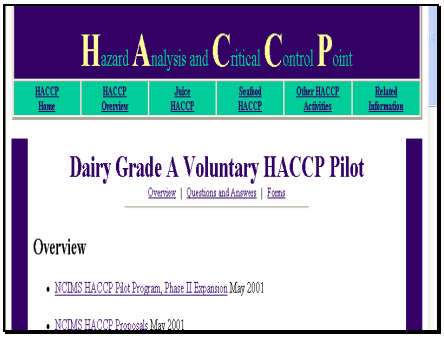
3 out of 5 Compliance

- the Grade A permit is suspended.

Slide 22

- **A suspended permit can be reinstated by the inspector if all the violations have been corrected accordingly.**

Slide 23



Slide 24

Pathogens posing a risk to safety of dairy foods

- *Salmonella*
- *Listeria monocytogenes*
- *E. coli*
- *Staphylococcus aureus* (low risk pathogen where starter cultures are utilized; outbreaks linked to semi-hard cheeses in France)

Slide 25

Salmonella

Salmonella Outbreak Affecting More People

What Can You Do to Prevent Salmonella Poisoning?

By Michael Smith, MD
WebMD Medical News

Reviewed By Brunilda Nazario, MD
on Monday, August 02, 2004

Aug. 2, 2004 -- Health officials are reporting that the number of people affected by a recent salmonella outbreak continues to climb. What can you do to prevent salmonella food poisoning?

WebMD Weight Loss

Key Nutrient
Aid Weight L

Slide 26

Sources of recontamination

a. Hands
b. Insects
c. Hair
d. Sneeze
e. Wounds
f. Bandages
g. Gloves
h. Moisture dripping into product
i. Unsatisfactory equipment covers or processes

Slide 27

High quality dairy products are difficult to come by!

A total quality assurance program from farm to processing plant makes it possible!

The proper citation for this article is:

Zeng, S. 2005. Quality Assurance from Milking to Processing. Pages 84-93 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

A Guide to Drug Usage in Goats

Lionel Dawson, D.V.M., M.S., Dip., ACT

Department of Veterinary Clinical Sciences
Oklahoma State University
Stillwater, OK
and
E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, OK

Extra-Label Drug Use

Live animals are considered unprocessed food if those animals are intended for slaughter or the milk from these animals is intended for human use. All persons involved in raising, handling, transporting, managing, and marketing food-producing animals are encouraged to establish systems and protocols to ensure that animal drugs are used properly to prevent illegal drug residues from contaminating human food.

There are few drugs for use in goats that have Food and Drug Administration (FDA) approval. The FDA approved drugs for use in goats are: Decoquinate (Deccox®), Fenbendazole (Panacur®/Safeguard Suspension), Monensin (Rumensin® premix), Neomycin (neomycin soluble powder and liquid), Thiabendazole, morantel tartrate, and Ceftiofur (Naxcel). Administering any drug not specifically labeled for use in goats or any product, either prescription or over the counter, that is not used as directed on the label is considered "Extra-label" or "off-label" drug use. Only veterinarians may prescribe or use products "off-label" or "Extra-label" provided they have a ***valid veterinarian - client - patient relationship*** (VCPR) with the producer.

Most goat producers are unaware that they do **NOT** have "extra-label" drug use privileges. Only veterinarians who have established a VCPR with a particular client may prescribe or use drugs in an extra-label manner on that client's animals if the animal's health is threatened and suffering or death may result from failure to treat. To establish a VCPR, the veterinarian should have visited the farm, and have a thorough knowledge of the management of these animals, or has recently seen the animal to be treated. Once a VCPR has been established, the veterinarian may use drugs in an extra-label manner provided that the **client has agreed to follow his or her recommendations.**

Three Conditions of Extra-label Drug Use

The veterinarian has examined the animal(s) in question recently and has made a diagnosis and a determination that products with proper labeling will not work in this instance.

The client has been instructed by the veterinarian in the proper use and administration of the product, a withdrawal period has been determined, and the client is willing to follow the instructions given by the veterinarian.

The veterinarian is available to respond to any adverse reaction or follow up examination and treatment that may occur to the animal due to the administration of the drug or failure of the drug to work.

FDA Criteria for Using Pharmaceuticals Extra-Label

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

The veterinarian must first examine the animal and assumes responsibility for making clinical decisions regarding the health and treatment of the animal within the guidelines of a VCPR. Often a goat owner will not have the animal examined by a veterinarian, but will telephone a veterinarian, who may never have visited the farm, with a list of symptoms and ask for a recommended treatment.

The second criterion requires that the veterinarian determine there is no marketed drug specifically labeled to treat the diagnosed condition, or that the recommended dosage on the label for that product is clinically ineffective. Since there are few drugs labeled for use in goats, it is not difficult to determine whether or not there is a legally licensed product available.

The third criterion requires that the individual animals to be treated are clearly identified, and that accurate records be maintained regarding the treatment of those specific individuals. Many registered goats are either tattooed, ear-tagged, or notched for identification. If there is no permanent identification, the owner must make some effort to identify the treated animals with a visible temporary mark by using temporary tags or paint. If possible, these animals should be isolated. Records on animals and treatment must be kept for future reference to avoid any drug residues in the meat or milk.

The fourth criterion requires that a significantly extended time period be assigned for drug withdrawal prior to marketing meat or milk from treated animals when pharmaceuticals are used in an extra-label manner. The owner must keep accurate records of the treatment, namely the person treating this animal, date, route of administration, product used and a proper withdrawal period. Proper withdrawal period can be obtained from your veterinarian.

Most goat owners casually treat their animals and do not keep proper records of animals treated, drugs used or proper withdrawal period for that product. If no information is available to establish a withdrawal time, then the treated animal or animal products such as milk and meat are permanently barred from the human food chain.

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

Prohibited Drugs

Following the guidelines established in the Animal Medicinal Drug Use and Clarification Act of 1994 (AMDUCA), the following drugs cannot be used in an extra-label manner in food producing animals**: Chloramphenicol, Gentamycin, Clenbuterol, Diethylstilbestrol, Dimetridazole**, **Ipronidazole, other Nitroimidazoles, DMSO, Nitrofurazones, Fluoroquinolones, Dipyrone, Phenylbutazone (Dairy), and Glycopeptides (such as Vancomycin**).

According AMDUCA, extra-label use of medications in or on animal feed is prohibited. However, according to the 2001 Compliance Policy Guide (CPG) Sec. 615.115 Extra-label Use of Medicated Feeds for Minor Species, the FDA has provided guidance on extra-label use of medicated feeds in minor species such as goats. A copy of the CPG is available at http://www.fda.gov/ora/compliance_ref/cpg/cpgvet/cpg615-115.html. This CPG does **NOT** make the practice legal, but the FDA would "not ordinarily consider regulatory action" if certain conditions were met. In brief, these guidelines strongly recommend that extra-label use of medicated feed is limited to treatment of minor species whose health is suffering or is threatened or whose death may result from failure to treat. The medicated feed must be manufactured and labeled in accordance with the approved conditions of use and if the medicated feed is to be used in a food producing minor species, the product must be approved for use in a food producing major species. Finally, the CPG discourages use of medicated feed in an extra-label manner for improving rates of weight gain, feed efficiency, or other production purposes.

Drug Administration

Once the decision has been made to use a specific product in a goat, the owner must be informed of the proper storage, use, and administration of that product. Commercial goat dairies must meet the specific requirements of the Pasteurized Milk Ordinance for storage of drugs used in animals producing milk for human consumption. Access to drugs should be restricted, and producers should be reminded that animal health products can be human health hazards. Owners should be instructed in the proper methods and location for administration of injectable drugs. Adequately sized syringes and sharp, sterile needles of appropriate size and length should be used. Label directions for oral medications and feed or water additives should be easy to read and understand, and any directions for dilution of drugs should be clearly indicated. Some products added to feed or water may be harmful to other species and this must be stated on the label. It is extremely important to determine an adequate withdrawal time to prevent illegal drug residues in products for human consumption. Although there are no drug residue test kits marketed specifically for goats, owners should be aware that drug residue testing is conducted on milk and meat produced for human consumption.

Ten Drug Use Tips

1. **Read the label** carefully – labeling directions change frequently.

2. **Use drugs only in animal species listed on the label** – drugs used in other species may cause adverse reactions, illegal residues, and possible animal deaths.

3. **Use the proper dose** for the species and size of animal to be treated – overdosing can cause illegal residues.

4. **Calculate pre-slaughter drug withdrawal times** accurately – determine pre-slaughter withdrawal and milk discard times from the latest drug administration.

5. **Use the correct route** of administration – giving drugs incorrectly can lead to drug ineffectiveness, adverse reactions, illegal residues, and possible animal deaths.

6. **Do not "double dose"** – use of the same drug in the feed and by injection can cause illegal residues.

7. **Select needle size and injection sites carefully**, if injections are necessary – misuse can lead to tissue damage, reduced effectiveness, and/or illegal residues.

8. **Allow proper withdrawal times for feed containing drugs** – during the withdrawal time ensure that storage bins and feed are completely free of medicated feed and feed only drug-free feed or illegal residues may result.

9. **Keep accurate records** of drugs used and animals dosed – poor records can be costly if drug residue violations occur.

10. **Seek the advice of your veterinarian** – your records will allow him/her to provide safer and more effective treatment and save you money by preventing illegal residues.

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

Veterinarians can play a vital role in educating goat producers about herd health quality assurance concepts through these three important avenues:

- Review of management practices with the client
- Establishment of a legal veterinary – client – patient – relationship
- Adherence to FDA guidelines for extra-label drug use.

Following the previously outlined practices will aid in the production of wholesome goat products free of drug residues.

Medications Commonly Used in Goats and Approximate Withdrawal Times

The following tables list medications commonly used in goats with their dosages and estimated withdrawal times (WDT)**.** These tables are adapted, with permission from the author Dr. Seyedmehdi Mobini of Fort Valley State University, Fort Valley, GA, from a paper that appeared in the proceedings of the Georgia Veterinary Medical Association Food Animal Conference in 2003. These recommendations were formulated by Dr. Mobini through a review of the literature in the United States and foreign countries, recommendations of the Food Animal Residue Avoidance Databank (FARAD), and personal experience. For many of the drugs mentioned, FARAD has calculated a Withdrawal Interval (WDI) to distinguish from the regulatory and approved WDT. The WDI is based on foreign drug approvals or extrapolations based on available tissue residue and/or related pharmacokinetic data on these drugs. In some cases, there is insufficient or no pharmacokinetic data from which FARAD can derive a WDI for goats. In those instances, FARAD has relied on sheep or cattle data and then added a scientifically-based time period to extend beyond the approved WDT to ensure safety as well as compliance with the Animal Medicinal Drug Use and Clarification Act of 1994 (AMDUCA). Finally, the reader should be aware that there are several drugs which may be approved for specific species at a specific dose and route of administration, but are **PROHIBITED from extra-label use** in any major or minor food animal species. These include **Sulfadimethoxine (Albon), Enrofloxacin (Baytril), Dipyrone, Clenbuterol, Nitrofurans (Furacin), Nitroimidazole (Metronidazole), Diethyl stilbesterol, Glycopeptides (Vancomycin)** and **Chloramphenicol.**

Medications Commonly Used in Goats and Approximate Withdrawal Times*

I. Antibiotics:	Brand Name	Approval	Dosage	Route	Frequency	Withdrawal Time	
						Meat	Milk
Procaine Pen. G	Crysticillin	extra-label	10,000-20,000 IU/lb	SC	Once a day	16-21 days	120 hours
Benzathine Pen G	Pen BP-48	extra-label	20,000 IU/lb	SC	Every 48 hours	30 days	NA
Amoxicillin	Amoxi-inject	extra-label	5 mg/lb	SC	Once a day	25 days	120 hrs.
Ampicillin	Polyflex	extra-label	5 mg/lb	SC	Once a day	10 days	72 hrs.
Oxytetracycline	LA-200	extra-label	9 mg/lb	SC	Every 48 hours	50 days	144 hrs
Sulfadimethoxine	Albon	***EXTRA - LABEL***	***USE IS PROHIBITED***				
Ceftiofur	Naxcel	**approved**	0.5-1 mg/lb	IM	Once a day	0 days	0 days
Erythromycin	Erythro-200	extra-label	1 mg/lb	SC	Once a day	5 days	96 hrs.
Tylosin	Tylan-200	extra-label	10 mg/lb	IM	Once a day	30 days	96 hrs.
Neomycin	Biosol	**approved**	5 mg/lb	PO	Twice a day	3 days	NA
Florfenicol	Nuflor	extra-label	9 mg/lb	IM	Every 48 hours	28 days	120 hours
Gentamicin	Gentocin	***DO NOT USE***					
Tilmicosin	Micotil	***DO NOT USE – TOXIC TO GOATS***					
Enrofloxacin	Baytril 100	***EXTRA-LABEL USE IS PROHIBITED***					

II. Anti-inflamatory Drugs:	Brand Name	Approval	Dosage	Route	Frequency	Withdrawal Time	
						Meat	Milk
Flunixin meglumine	Banamine	extra-label	1.1-2.2mg/kg	IV or IM	Once a day	10 days	72 hours
Phenylbutazone	Bute	extra-label	10-20 mg/kg	PO	Once a day	45 days	N/A
		DO NOT USE IN LACTATING ANIMALS					
Aspirin	Aspirin	extra-label	100 mg/kg	PO	Once a day	1 day	24 hours.
Dipyrone	Dipyrone	***EXTRA-LABEL USE IS PROHIBITED***					

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

IV. Anthelmintics:	Brand Name	Approval	Dosage	Route	Withdrawal Time	
					Meat	Milk
1. Avermectins:						
Ivermectin	Ivomec Drench	extra-label	0.3 mg/kg	PO	14 days	9 days
Ivermectin	Ivomec 1%	extra-label	0.3 mg/kg	SC	56 days	40 days
Doramectin	Dectomax	extra-label	0.3 mg/kg	SC	56 days	40 days
Eprinomectin	Eprinex	extra-label	0.5 mg/kg	PO	NA	NA
Moxidectin	Quest, Cydectin	extra-label	0.5 mg/kg	PO	23 days	56 days
2. Benzimidazoles:						
Albendazole	Valbazen	extra-label	10 mg/kg	PO	7 days	120 hours
Fenbendazole	Panacur/Safeguard	**approved**	10 mg/kg	PO	14 days	96 hours
Oxfendazole	Synanthic	extra-label	10 mg/kg	PO	14 days	120 hours
3. Cholinergic Agonists:						
Levamisole	Levasole	extra-label	8 mg/kg	PO	10 days	4 days
Morantel Tartrate	Rumatel	**approved**	10 mg/kg	PO	30 days	0 days

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

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

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

In the tables above PO = oral administration; SC = subcutaneous administration; IM = intramuscular administration; IV = intravenous administration; NA = insufficient kinetic data available to make withdrawal interval estimation.

NOTE: The drugs listed above are commonly used in goats. There are ony few drugs approved to be used in goats. The above withdrawal times for the various drugs are compiled from different sources. Extra-label use of these products is legal if prescribed by your veterinarian.

*Tables adapted from Mobini, S., 2003. Paper presented at the Georgia Veterinary Medical Association Food Animal Conference.

The proper citation for this article is:

Dawson, L. 2005. A Guide to Drug Usage in Goats. Pages 94-101 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

Administration of Injectable Drugs and Vaccines in Goats

Lionel Dawson, D.V.M., M.S., Dip., ACT

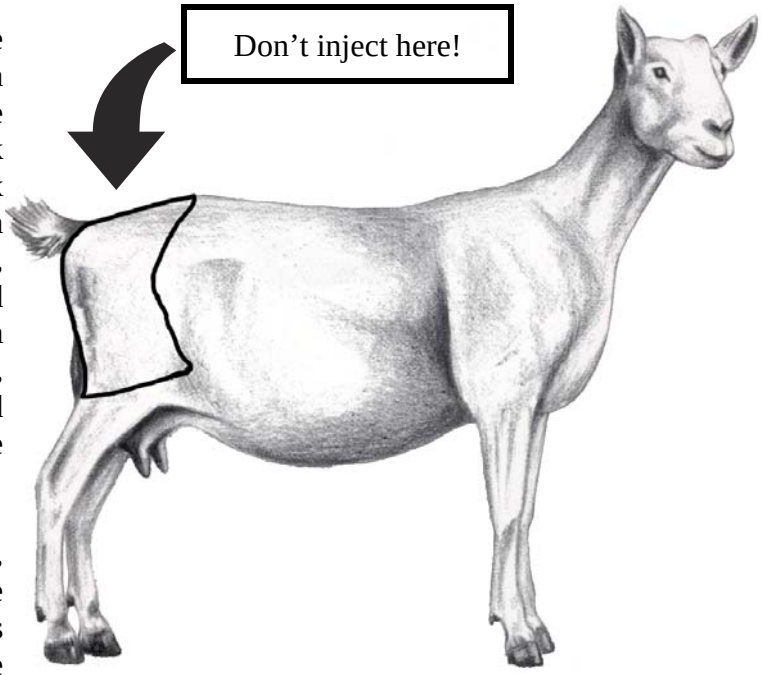
Department of Veterinary Clinical Sciences
Oklahoma State University
Stillwater, OK
and
E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, OK

Injection Site Defects

Live animals are considered unprocessed food, especially if those goats are intended for slaughter and entry into the food chain. Injection site lesions should be a major product quality concern for goat producers raising goats for meat. Persons involved with raising, handling, transporting, holding, and marketing meat and milk products are encouraged to establish systems to ensure that animal drugs are used properly and to prevent illegal drug residues.

Injection site defects are lesions or scars found in different cuts of meat. They result from tissue irritation caused by the administration of intramuscular (IM), and sometimes subcutaneous (SC), injections. Tenderness of the meat is also significantly reduced in the infected area that can extend out at least 2 inches in all directions from an injection site.

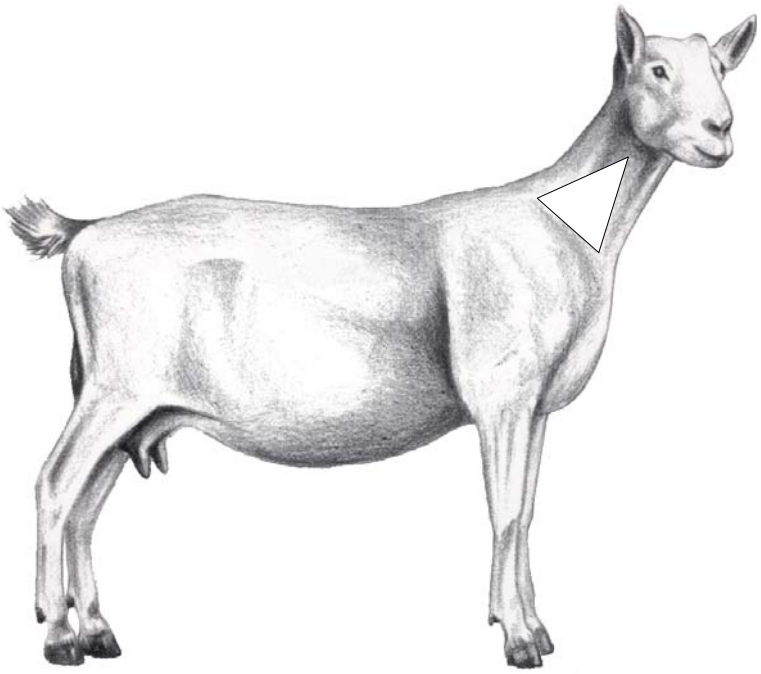
Commonly seen injection site defects in goat carcasses are found in the round. The round is the area on the rear leg, midway behind the hook bones (tuber coxae), to about six inches above the hocks. The muscles in this region are the middle gluteal, gluteobiceps, semimembranosus and semitendinosus muscles. Rounds from goats are economically important, because they are commonly processed and marketed as whole muscle products, not as ground meat.



When injection site defects occur, meat packers must trim and discard the damaged tissue. This greatly reduces the marketability and economic value of the meat.

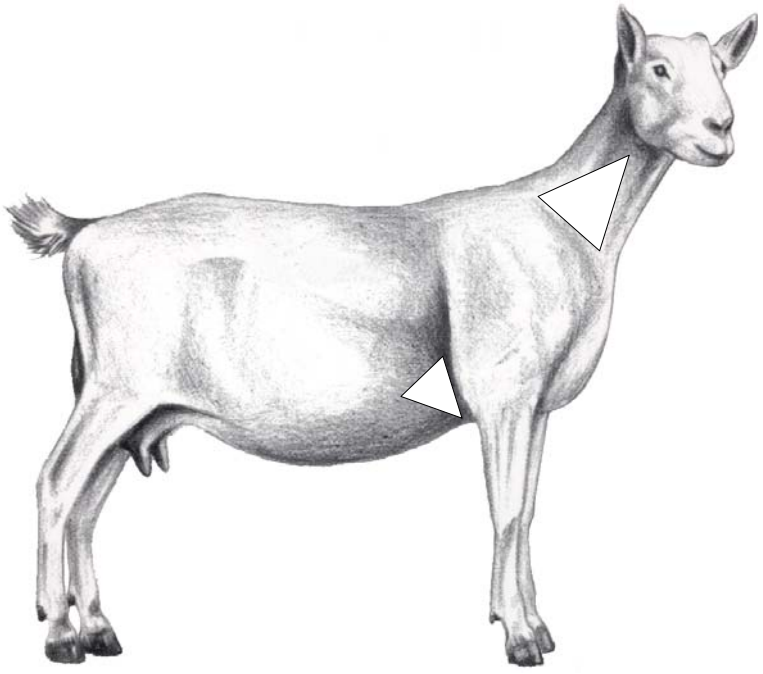
Intramuscular injection sites

Intramuscular injections are commonly given in the triangular area of the neck, bounded caudally by the shoulder, dorsally by the cervical vertebra, and ventrally by the nuchal ligament of the spinous process. Do not give intramuscular injections on the round for goats. Volume given in the muscle should not be more than 3 milliliters per site.



Subcutaneous injection sites

Subcutaneous injections are usually given in the axillary region, behind the elbow joint. They can also be given in the triangular area in front of the shoulders.



Recommended Needle Sizes and Lengths Used in Goats.

Age	*Gauge*	*Length*
<4 weeks old	20	1/2 inch
4 to 16 weeks old	20	5/8 to 3/4 inch
4 to 6 months	20	1 inch
>6 months	20 or 18	1 inch

Vaccination Schedule for Goats

Period	*Time to Vaccinate*	*Disease*	*Booster*
Kids (Dairy)	2, 4, and 8 weeks	CL perfringens C&D CL tetani-toxoid	Annual
Kids (Meat & Fiber)	4 and 8 weeks	CL perfringens C&D CL tetani - toxoid	Annual
Kids	4 to 6 weeks	Contagious ecythma (if a herd problem)	Annual or 2 months before the show season
Kids	8 and 12 weeks (optional)	Caseous lymphadenitis	Annual
Prebreeding			
Doe	30 days prior to breeding	Chlamydia (abortions) Leptospirosis (abortions) CL perfringens C&D CL tetani - toxoid	Annual (Optional) Annual (Optional) Annual
Bucks	30 days prior to breeding	Chlamydia (abortions) Leptospirosis (abortions) CL perfringens C&D CL tetani - toxoid	Annual (Optional) Annual (Optional) Annual
Gestation			
Doe	30 days prior to kidding	CL. perfringens C&D CL. tetani - toxoid	Annual

The proper citation for this article is:

Dawson, L. 2005. Administration of Injectable Drugs and Vaccines in Goats. Pages 102-104 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

Basic Goat Husbandry

Lionel Dawson, D.V.M., M.S., Dip., ACT

Department of Veterinary Clinical Sciences
Oklahoma State University
Stillwater, OK
and
E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, OK

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.

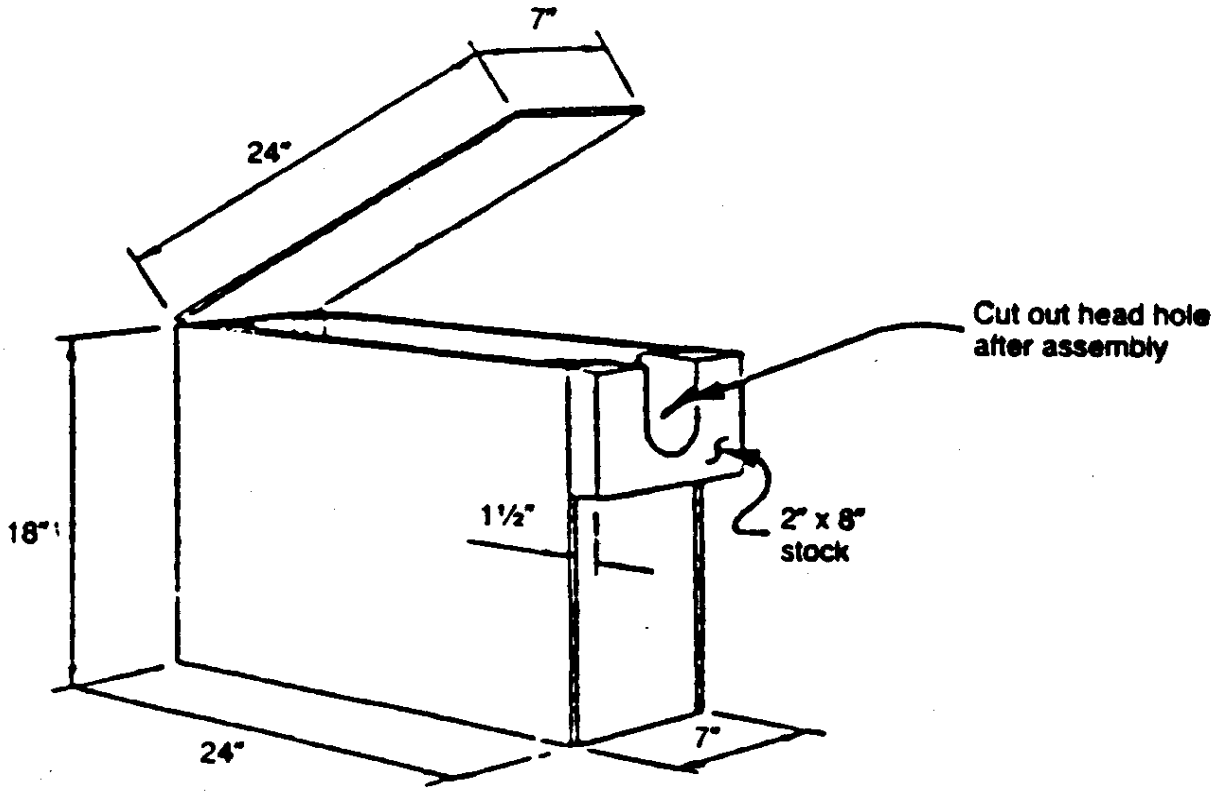
Kids should be consuming forages such as pasture grass or hay by two weeks of age and grain within four. Careful attention needs to be given to formulation of a concentrate supplement for the pre-weaning kid. Palatability is of primary concern. Molasses at the rate of 10% of the total dry matter, corn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

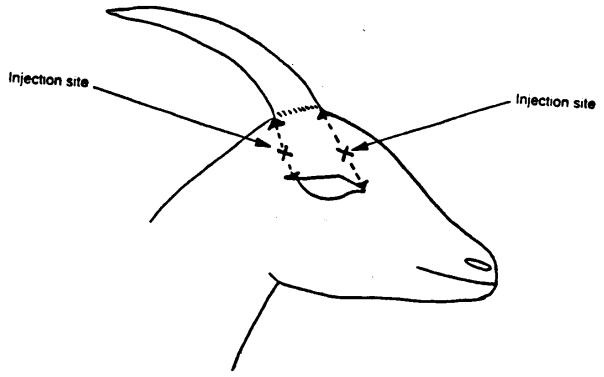
producers who have an erratic or marginal market for their milk delay weaning for longer periods than necessary. While milk feeding may promote more rapid growth than a concentrate-forage diet, maintaining kids on milk may delay the attainment of the dry feed intake level necessary for weaning and also 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.

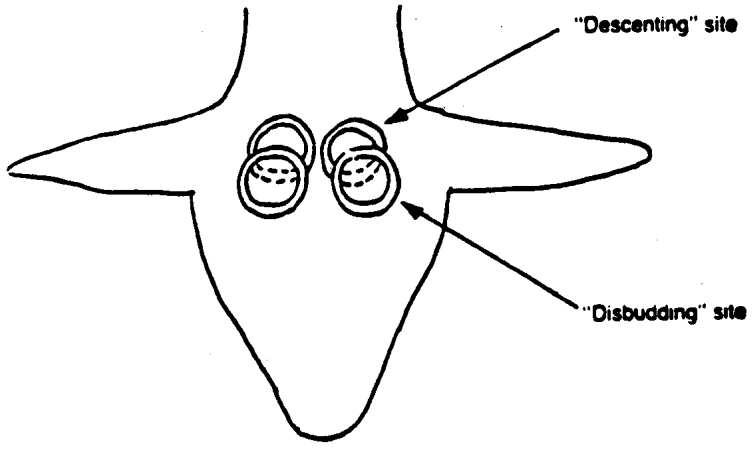


Although local anesthetic is commonly advocated, the actual technique is not easy and the baby goat will scream while being held in preparation for a ring block or a cornual nerve block.



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. Castration methods include use of a rubber ring, Burdizzo clamp, or surgical methods.

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.

The proper citation for this article is:

Dawson, L. 2005. Basic Goat Husbandry. Pages 105-110 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

Body Condition Scoring for Improved Management

**Mario Villaquiran, Terry Gipson, Roger Merkel,
Arthur Goetsch, and Tilahun Sahlu**

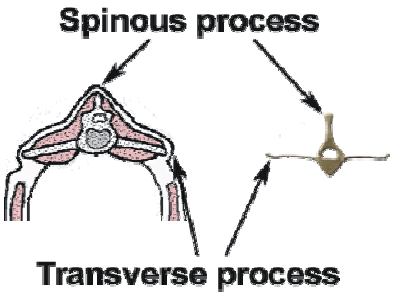
E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, Oklahoma 73050

Every goat producer has animals that are either too thin (under-conditioned) or too fat (over-conditioned). Failure to recognize these animals and take corrective actions will cost dearly in terms of decreased fertility, increased disease or internal parasite incidence, decreased milk production, and increased operating costs. Thus, goats need to be maintained with a moderate amount of body condition. When overall body condition starts to decrease in the herd, it is a sign that managerial intervention is needed such as supplemental feeding, deworming, pasture rotation, etc. Conversely, when overall body condition starts to increase in the herd, it is a sign that the producer should reduce supplemental feeding. Ignoring an animal's body condition and waiting to intervene until goats become either too thin or too fat may result in production and(or) animal losses or decreased profits from overfeeding. Therefore, producers need to develop skills in assessing body condition of their goats so that a desired moderate body condition can be maintained.

Body condition score (BCS) has been shown to be an important practical tool in assessing the body condition of cattle, sheep, and goats because BCS is the best simple indicator of available fat reserves which can be used by the animal in periods of high energy demand, stress, or suboptimal nutrition.

Scoring is performed in goats using a BCS ranging from 1.0 to 5.0, with 0.5 increments. In this publication, examples of BCS of 1.0, 2.0, 3.0, 4.0, and 5.0 are given using photographs and written descriptions. Assigning the 0.5 score increment is done when the animal being evaluated is intermediate to the BCS described in this publication. A BCS of 1.0 is an extremely thin goat with no fat reserves and a BCS of 5.0 is a very over-conditioned (obese) goat. In most cases, healthy goats should have a BCS of 2.5 to 4.0. BCS of 1.0 , 1.5, or 2.0 indicate a management or health problem. A BCS of 4.5 or 5 is almost never observed in goats under normal management conditions; however, these BCS can sometimes be observed in show goats.

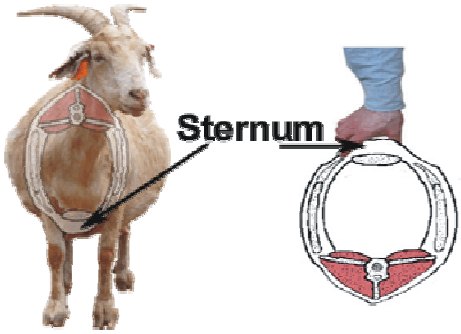
It is important to note that BCS cannot be assigned by simply looking at an animal. Instead, the animal must be touched and felt. The first body area to feel in determining BCS is the lumbar area, which is the area of the back behind the ribs containing the loin. Scoring in this area is based on determining the amount of fat over and around the vertebrae. Lumbar vertebrae have a vertical protrusion (spinous process) and two horizontal protrusions (transverse process). Both processes are used in determining BCS. You should run your hand over this area and try to grasp these processes with your fingertips and hand.



Grasp the spinous process to feel for fat and muscle.

Try to slide your fingers under the transverse process.

The second body area to feel is the fat covering on the sternum (breastbone). Scoring in this area is based upon the amount of fat that can be pinched.



A third area is the rib cage and fat cover on the ribs and intercostal (between ribs) spaces.

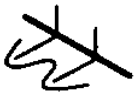
With practice, evaluating the BCS of an animal will only take about 10-15 seconds. By adding BCS as a regular part of your management program, you can more effectively monitor your feeding and herd health program for a healthy and productive herd.

BCS 1

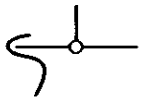
Visual aspect of the goat: Emaciated and weak animal, the backbone is highly visible and forms a continuous ridge. The flank is hollow. Ribs are clearly visible. There is no fat cover and fingers easily penetrate into intercostal spaces (between ribs).

The spinous processes of the lumbar vertebrae can be grasped easily between the thumb and forefinger; the spinous processes are rough, prominent, and distinct giving a saw-tooth appearance. Very little muscle and no fat can be felt between the skin and the spinous process. There is a deep depression in the transition from spinous to transverse processes.

The hand can easily grasp the transverse processes of the lumbar vertebrae which are very prominent. Clearly half of the length of the transverse processes is discernible.



Diagrams adapted from Edmonson, et al., 1989. J. Dairy Science, 72:68-78. Used with permission from the American Dairy Science Association.



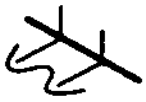
Sternal fat can be easily grasped between thumb and fingers and moved from side to side. The cartilage and joints joining ribs and sternum are easily felt.

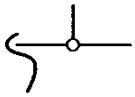
BCS 2

Visual aspect of the goat: Slightly raw-boned: the backbone is still visible with a continuous ridge. Some ribs can be seen and there is a small amount of fat cover. Ribs are still felt. Intercostal spaces are smooth but can still be penetrated.

The spinous processes of the lumbar vertebrae are evident and can still be grasped between the thumb and forefinger; however, a muscle mass can be felt between the skin and the spinous process. There is an obvious depression in the transition from spinous to transverse processes.

The hand can grasp the transverse processes but the outlines of the transverse processes are difficult to see. About one-third to one-half of the length of the transverse processes is discernible.



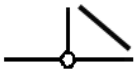


Sternal fat is wider and thicker but can still be grasped and lifted by the thumb and forefinger. The fat layer can still be moved slightly from side to side. Joints are less evident.

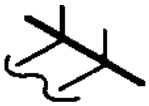
BCS 3

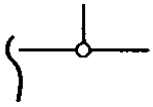
Visual aspect of the goat: The backbone is not prominent. Ribs are barely discernible; an even layer of fat covers them. Intercostal spaces are felt using pressure.

The spinous processes of the lumbar vertebrae cannot be easily grasped because the tissue layer covering the vertebrae is thick. When running a finger over the spinous processes, a slight hollow is felt. There is a smooth slope in the transition from spinous to transverse processes.



The outline of the transverse processes of the lumbar vertebrae is slightly discernible. Less than one-quarter of the length of the transverse processes is discernible.



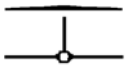


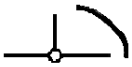
Sternal fat is wide and thick. It can still be grasped but has very little movement. Joints joining cartilage and ribs are barely felt.

BCS 4

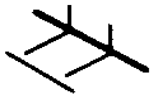
Visual aspect of the goat: The backbone cannot be seen. Ribs are not seen. The side of the animal is sleek in appearance.

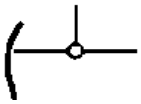
It is impossible to grasp the spinous processes of the lumbar vertebrae, which are wrapped in a thick layer of muscle and fat. The spinous processes form a continuous line. There is a rounded transition from spinous to transverse processes.





The outline of the transverse processes of the lumbar vertebrae is no longer discernible. The transverse process forms a smooth, rounded edge, with no individual processes discernible.



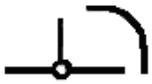


Sternal fat is difficult to grasp because of its width and depth. It cannot be moved from side to side.

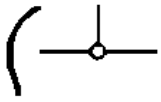
BCS 5

Visual aspect of the goat: The backbone is buried in fat. Ribs are not visible. The rib cage is covered with excessive fat.

The thickness of the muscle and fat is so great that reference marks on the spinous process are lost. The spinous process forms a depression along the backbone and there is a bulging transition from spinous to transverse process.



The thickness of the muscle and fat is so great that reference marks on the transverse process are also lost. It is impossible to grasp the transverse process.



The sternal fat now extends and covers the sternum, joining fat covering cartilage and ribs. It cannot be grasped.

The proper citation for this article is:

Villaquiran, M., T. Gipson, R. C. Merkel, A. Goetsch, and T. Sahlu. 2005. Body Condition Scoring for Improved Management. Page 111-117 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

Goat Milk Soap Making

Cindy Sterling

Swinging Gate Farm
(Dairy Goats & Handcrafted Soaps)
Norman, Oklahoma

Gone are the days of rendering soaps from kitchen drippings, making lye with fireplace ashes, and stirring suds over an open fire, often resulting in soaps that were so harsh they burned the skin. Today, soapmaking is a creative, safe and practical hobby--simple, rewarding and most of all, FUN!

Few people know what soap really is. Most of the cleansing bars that one buys at the store are detergents and not soap at all. Commercial soaps are made in huge vats by a process called the "continuous method". Ingredients are continuously added to one end and the soap removed from the other. During this process, the emollient glycerin that naturally exists in soap is removed and sold separately for its moisturizing qualities. Commercial soap is nearly always made from tallow (animal fat) and usually contains a variety of synthetic chemicals. Because of the lack of glycerin as well as the inclusion of poor quality ingredients and additives, commercial soap can often dry and irritate the skin or cause an allergic reaction. Although some people cannot use soap, most can use a soap that is free from questionable or synthetic additives.

Making soap is surprisingly easy, it's the result of combining a caustic agent (lye) using a liquid carrier (such as water, milk, tea) with fats and oils. You don't need to be a chemist to be a successful soapmaker. Once you understand the basics, you can create your own scents and recipes. You may like soaps made with cocoa butter or have a friend who loves oatmeal and honey goat milk soap. Maybe someone with allergies over reacts to scents and needs a fragrance-free soap. There are ways to make this craft expensive by indulging in high-priced essential oils and additives but most people are satisfied with the many reasonable priced and rewarding alternatives. Washing your face for the first time with a soap you've made yourself, is a wonderful feeling. Gentle, richly lathered, handmade soap cleanses without drying, leaving even sensitive skin feeling wonderfully moisturized, luxuriously soft, smooth, and beautifully fragrant.

Workshop participants will learn the basics of cold process goat milk soapmaking using ingredients available from the grocery store. Tips and recipes for handmade soaps will be provided along with a list of tools, equipment, materials, ingredients and safety procedures. Techniques and skills of handcraft soapmaking will be demonstrated in this hands-on workshop. Personal experiences in marketing handcrafted soaps will also be shared with the participants to make this workshop a fun and rewarding learning process.

The proper citation for this article is:

Sterling, C. 2005. Goat Milk Soap Making. Page 118 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

CURRENT PROGRAM SUMMARY

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

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

Extension Overview

Terry A. Gipson

Goat Extension Leader

The year 2004 was a busy year for the Langston University 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 activities include the annual Goat Field Day, Langston University Goat Dairy Herd Improvement (DHI) Program, grazing demonstrations, the eighth annual meat buck performance test, and various goat workshops on artificial insemination and on internal parasite control.

Goat Field Day

Our 19th annual Goat Field Day was held on Saturday, April 24, 2004 at the Langston University Goat Farm with over 300 participants in attendance. Last year's theme was Controlling Unwanted Vegetation Using Goats. Our featured speakers were Ms. Kathy Voth and our own Dr. Steve Hart. For the past six years, Kathy Voth has worked for the Bureau of Land Management and Utah State University on a demonstration research project to use goats for fire and weed control. Her interest in this sprang from her involvement in the 1994 Storm King fire, where 14 firefighters died, and from her desire to find a safer way to protect homes and lives. Her research project included managing a herd of 130 goats, measuring goat impacts on vegetation, and putting together solutions for fencing, watering, and managing animals so that livestock producers and land managers could easily and successfully use this tool. Kathy is adjunct faculty at Utah State University, teaching an internship program to prepare students to work for natural resource management agencies and organizations. She is now working with Utah State University to develop a network to provide training for those interested in teaching livestock to eat a wider variety of foods to control weeds and improve biodiversity. She is also coordinating a pilot project with the Grant-Kohrs Ranch National Historic Site to use cows to control Canada thistle, leafy spurge, and spotted knapweed. Kathy has developed several resource materials for vegetation management, including the website http://www.livestockforlandscapes.com. Livestock for Landscapes is a resource for information on management techniques, training opportunities, and suggestions for how communities and livestock producers can work together to create sustainable, economically viable communities and landscapes. In addition to the website, Kathy has developed a handbook entitled “Goats! for Firesafe Homes in Wildland Areas”.

Dr. Steve Hart has been at the forefront of an USDA Sustainable Agriculture Research and Education (SARE) grant that Langston University received in 2001. The primary objective of the project was to 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. To this end, we have been working with the Caddo Nation, Cherokee Nation, Choctaw Nation, Greater Seminole Nation, Osage Nation, and Sac and Fox Nation. Steve’s presentation focused on the results of that project.

Afternoon workshops included: Continued FireSafe session with Kathy Voth; Continued SARE session with Steve Hart; Basic Goat Husbandry I - hoof trimming, farm management calendar, disbudding, etc. with Jerry Hayes; Basic Goat Husbandry II - pregnancy diagnosis, injection sites, dewormers and other approved drugs with Dr. Lionel Dawson; Tanning Goat Hides - demonstration of basic goat hide tanning techniques with Roger Merkel; Oklahoma Milk Regulations - basic regulatory knowledge for dairy producers with Frank Harris of Oklahoma Department of Agriculture; Dairy Products Overview - discussion on goat dairy products with Steve Zeng; Nutrient Requirement Web Calculators - calculation of energy and protein and feed intake requirements using our new Internet-based calculation system with Art Goetsch; Simulation Goat Production Modeling - overview of computer simulation program for meat, dairy or fiber goat production with Mario Villaquiran; DHI Training - supervisor/tester training for dairy goat producers including scale certification with Langston staff; USDA Government Programs - overview of USDA Natural Resource Conservation Service's work with goats and its cost-sharing program with Dr. Mark Moseley and Mr. Dwight Guy Of USDA-NRCS; General Youth Activities - fun activities for younger youth with Sheila Stevenson; and Fitting and Showing for Youth and Adults - full day workshop with Kay Garrett.

Ms. Sheila Stevenson, Jeff Wilson, Ms. Candice Howell, the LU Collegiate 4-H Club, the LU Rodeo Team, Langston Fire and Police Departments, Guthrie Police Department, and other volunteers hosted a full day of activities for youth ages 5-12. This allowed the parents and older teens to enjoy the workshops knowing that their little ones were in a fun and safe environment. Some activities included goat education (i.e., goat petting area and goat bingo); Risk Watch Injury Prevention (i.e., water safety, fire/burn prevention); fishing derby; and many other activities. Other youth and interested adults were able to participate in a full-day clipping, fitting, and showing workshop conducted by Ms. Kay Garrett of the Oklahoma Meat Goat Association. Participants had the opportunity to have hands-on practice of clipping and fitting a goat and then show it before a judge in the show ring.

Goat DHI Laboratory

The Langston Goat Dairy Herd Improvement (DHI) Program, 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 for 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 1 and 2 show the growth of the Langston DHI lab in terms of number of herds and doe records processed and compared to 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 100 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.

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.

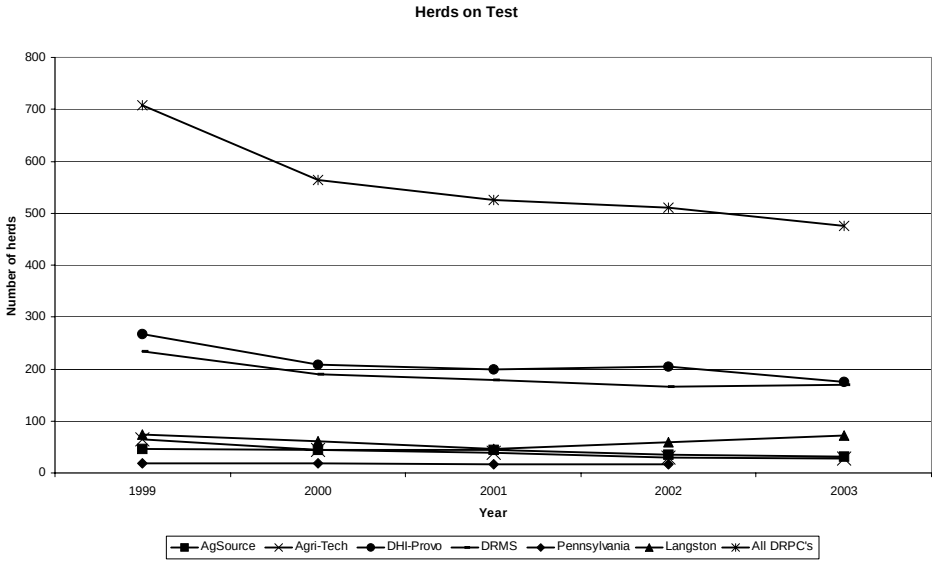


Figure 1. Number of goat herds on DHIA test by processing centers.

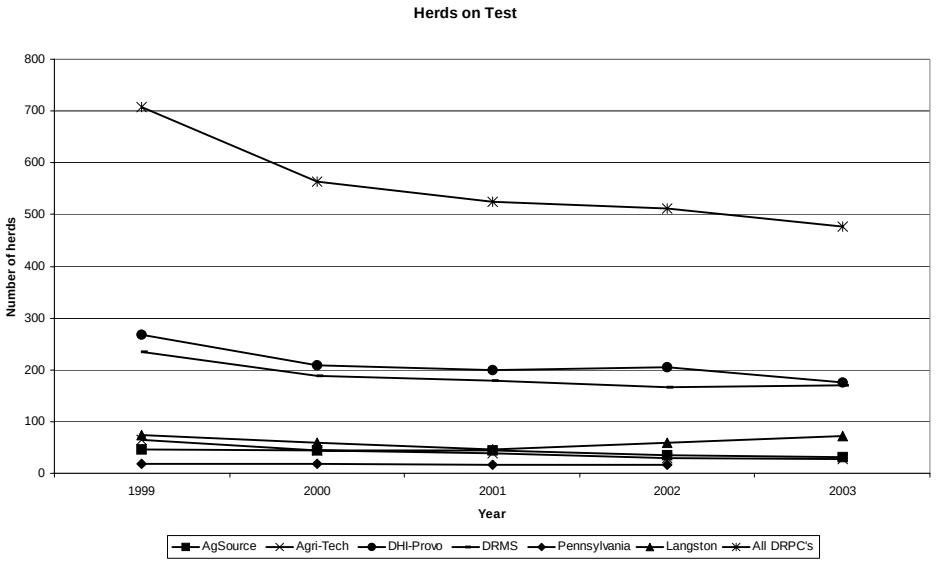


Figure 2. Number of does on DHIA test by processing center.

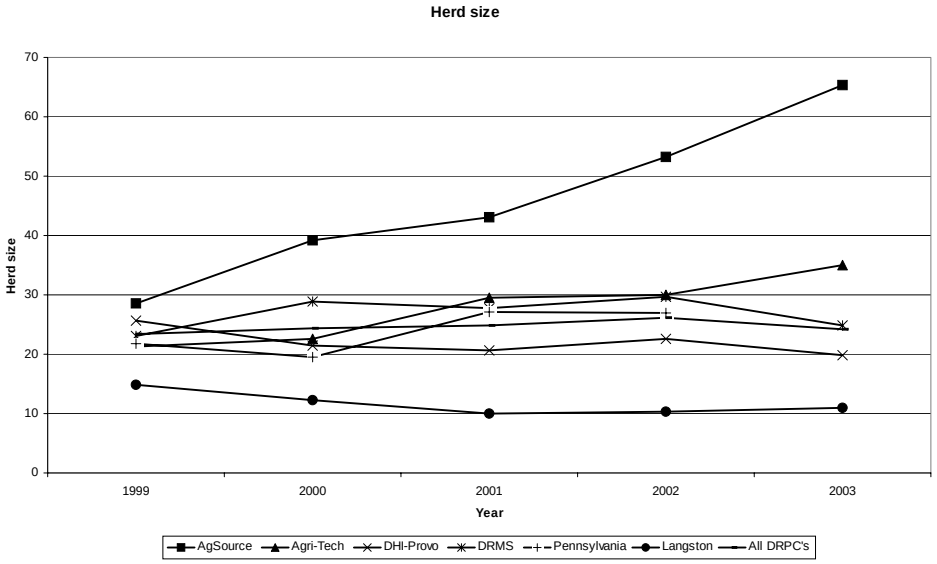


Figure 3. Average herd size by processing center.

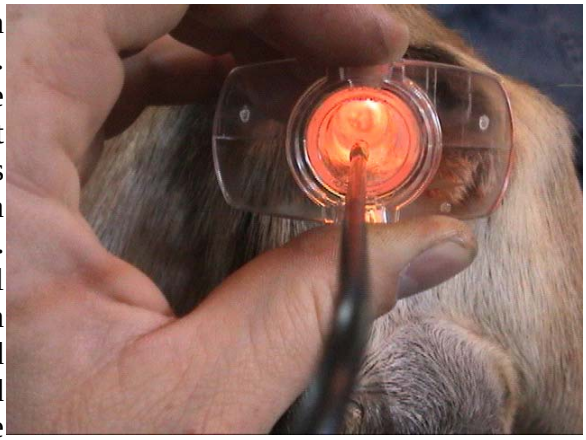
Goat Newsletter

The Goat Extension program published four issues of the 8-page Goat Newsletter in 2004. Interest in the newsletter has grown and we currently have over 3,400 subscribers to our free quarterly Goat Newsletter and the subscription list continues to increase every year. The Goat Newsletter is mailed to every state in the nation and to 10 countries overseas. Ninety-seven percent

of the mailings go to American households. At least one newsletter is mailed to a household in every state in the nation. Fifty percent of the newsletters are mailed to Oklahoma households. An additional thirty percent of the newsletters are mailed to households to state adjacent to Oklahoma.

Artificial Insemination Workshop

The use of superior sires is imperative in improving the genetic composition of breeding stock. Artificial insemination has long been used in the dairy cattle industry and is a simple technology that goat producers can acquire. However, opportunities for goat producers to acquire the necessary skills via formal and practical instruction are not widespread. Langston University has instituted a practical workshop for instruction in artificial insemination in goats. Producers are instructed in the anatomy and physiology of the female goat, estrus detection, and handling and storage of semen. Producers participate in a hands-on insemination exercise. An understanding of the anatomy and physiology enables the producer to devise seasonal breeding plans and to troubleshoot problem breeders. An understanding of estrus detection enables the producer to effective time inseminations for favorable conditions for conception and to effectively utilize semen. An understanding of semen handling and storage enables the producer to safeguard semen supplies, which can be scarce and costly. The experience of actually inseminating a female goat enables the producer to practice the knowledge that they have gained. The acquisition of these inseminating skill allows producers the use of genetically superior sires in their herds that they normally would not have access to. It also allows producers to save money by conducting the inseminating themselves instead of hiring and inseminator. In 2004, AI workshops were held in September at the Langston University campus and in October at the county fairgrounds in Tahlequah.



Hands-on practical experience is key to AI workshops

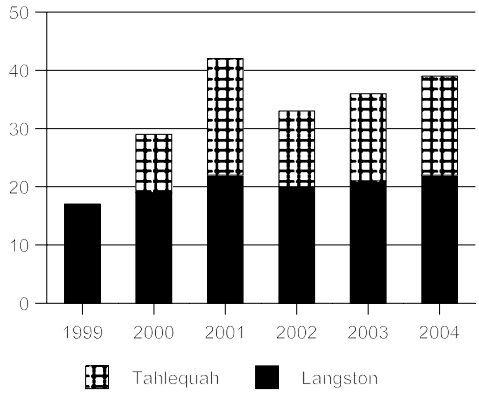


Figure 4. Number of participants enrolled in AI workshops.

Controlling Internal Parasites Workshop

In 2004, Langston University conducted several 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 about effective control programs among goat producers. 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 and how to collect fecal samples and how to conduct fecal egg counts. An understanding of life cycles enables the goat producer to devise seasonal control strategies. An understanding of anthelmintics enables the goat producer to rotate anthelmintics 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 bases. A decrease of just one deworming will save the goat producer $1.20 per goat, slow anthelmintic resistance and better ensure a wholesome product.

Nutrient Requirements of Goats

Under a research project which developed equations for energy and protein requirements for goats, as well as prediction of feed intake, an extension sub-project developed a website calculation system for "Nutrient Requirements of Goats" (http://www2.luresext.edu/goats/research/nutreqgoats.html). Nutrient requirement calculators represented on the website include:

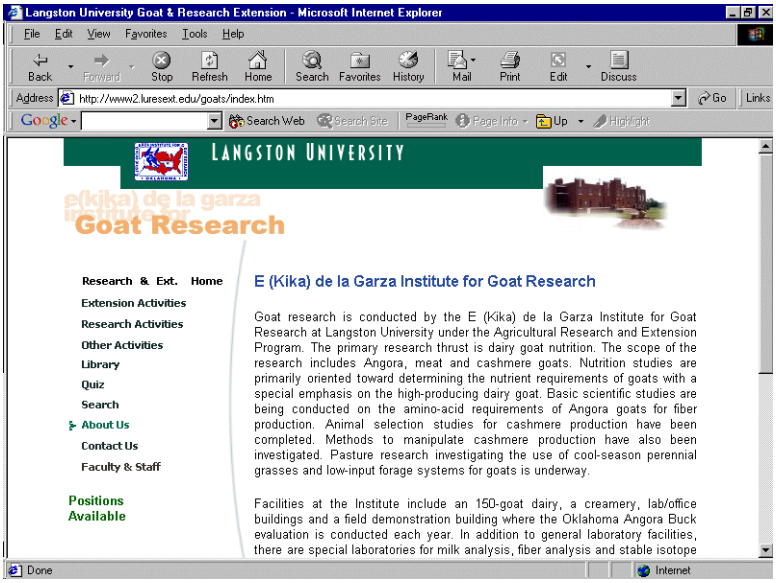
a. Energy requirement for:
    i. suckling goats.
    ii. growing goats.
    iii. mature goats.
    iv. lactating goats.
b. Protein:
    i. requirement for growing goats.
    ii. requirement for mature goats.
    iii. requirement for lactating goats.
    iv. requirement for rumen degraded CP.
    v. determination of metabolizable protein intake.
c. Energy and protein requirements for:
    i. Angora goats.
    ii. late gestation or pregnancy (day 95-150; 1, 2, or 3 kids per litter).
d. Feed intake (confinement) for:
    i. lactating goats.
    ii. Angora goats.
    iii. mature goats.
    iv. growing goats.
e. Energy requirement adjustments for:
    i. grazing.
    ii. acclimatization.
    iii. previous nutritional plane as assessed by body condition score (BCS).
f. Diet formulation
    i. estimating supplemental concentrate needs.
    ii. total mixed ration calculator.

Most calculators were based on studies of the project reported in a Special Issue of the journal Small Ruminant Research. For calculators with score inputs (i.e., grazing and body conditions), pictures are available to aid in determining most appropriate entries. Realistic examples are given,

as well as discussion of appropriate and inappropriate usage. However, for the experienced user there is an option to hide text and examples and to view only inputs and outputs. Also, calculators are equipped with printable version commands to obtain inputs and outputs in hard copy format. In summary, for nutrient requirement expressions to be of value, they must be readily accessible and reasonably simple. Therefore, a web-based goat nutrient requirement system was developed based on findings of a recent project. It is hoped that this system will enjoy widespread usage and enhance feeding practices for goats.

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 website include a document library with the complete proceedings of the annual Goat Field Day and the quarterly newsletter for the past several years. Both the proceedings and newsletters are also available in portable document format (pdf), which allows for the viewing and printing of documents across platform and printer without loss of formatting.



Information, recent abstracts and scientific articles of completed and current research activities in dairy, fiber, and meat production are available for online viewing and reading. Visitors can take a Virtual Tour of the research farm and laboratories, complete with digital photos and narrative. Visitors can browse a digital Photo Album on other Institute projects and activities. Visitors can also subscribe to our free quarterly newsletter online. Visitors can test their knowledge of goats with the interactive goat quiz which covers nearly all aspects of dairy, fiber and meat goat production. For those questions that are lacking in the interactive quiz database, visitors can submit a question to be included in the database. Visitors can read about research interests of faculty and contact faculty and staff via email.

Tulsa State Fair

At the 2004 Tulsa State Fair, Langston University participated in the Birthing Center program with twelve pregnant Spanish does. Dr. Carey Floyd of the Oklahoma Department of Agriculture coordinated the birthing center and said that the goats were the highlight of the center. The twelve 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 2005.

Fitting and Showing Clinic for 4-H/FFA Youth

In 2004, several clinics were held for Oklahoma youth interested in fitting and showing meat goats. These clinics were held in collaboration with the Oklahoma Meat Goat Association and were held in Idabel and Langston. Correct procedures for shampooing and blow-drying of the show goat and demonstrations of proper hoof trimming and clipping for both market and breeding animals were given. Show ring etiquette from an exhibitor's standpoint and from a judge's standpoint were discussed.

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 2004, collaborative work continued at the Oklahoma Black Historical Association site near Nobletown, OK with the conduct of workshops on basic goat management demonstrating vaccinations, castration, deworming, and hoof trimming.

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 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 eighth annual meat buck performance test started May 8, 2004 with 58 bucks enrolled from 17 different breeders. Fifty-six of the bucks were fullblood or high-percentage Boers and two were Kiko bucks. Forty-two bucks were from Texas, 13 from Oklahoma, 2 from Mississippi, and 1 from Kansas. The test was open to purebred and crossbred bucks born between December 1, 2003 and March 31, 2004. At check-in, bucks were given a physical examination by Dr. Lionel Dawson, dewormed with Cydectin (moxidectin), deloused with Atroban De-Lice, given a preemptive injection of Nuflor for upper respiratory infections, and those bucks that needed booster or initial vaccinations for enterotoxemia and caseous lymphandenitis were given them. Four weeks after check-in, all bucks were given a booster vaccination for enterotoxemia and caseous lymphandenitis. Entrance weight for the 58 bucks averaged 24.3 kg (58.6 lbs) with a range of 13.0 to 41.0 kg (28.6 to 90.3 lbs).

Adjustment Period

The performance-testing facility only has 53 Calan feeders but 58 bucks enrolled. To accommodate all animals, a new Feed Intake Recording Equipment (FIRE) system was used. The FIRE system is a completely automated electronic feeding system, which was developed for the swine industry, that Langston University has adapted for goats. The new FIRE system was installed last summer. Animals wear an electronic eartag, which is read by an antenna in the feeder. The FIRE system automatically records body weight and feed intake. After installation and a trial period

adjustment/training period was much shorter for the FIRE system than for the Calan feeders. However, the bucks on the Calan feeders mastered the Calan feeders and did quite well. With the combined FIRE system and Calan feeders, the Oklahoma Buck Performance Test Buck now has a capacity of 100 bucks.

All bucks underwent an adjustment period of two weeks immediately after check-in. During the adjustment period, bucks were acclimated to the test ration and to the Calan feeders or to the FIRE system. For the Calan feeders, each buck wears 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 previous day's feed remaining in the Calan feeder is weighed and removed. Fresh feed is weighed and placed into the Calan feeder. The difference in weights between the fresh feed placed 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 each Calan door and eating, it is possible to calculate the feed intake of the individual bucks. For the FIRE system, feed intake is automatically recorded every time a buck enters into the FIRE system to eat.

The area immediately around the Calan and FIRE 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 water provided by float-valve raised waterers.

In 2004, virulent soremouth worked through the bucks. On average, there are one to three mild cases of soremouth per year. However, there were eight cases of severe soremouth early in the performance test in 2004. Some animals were only mildly affected but others were severely affected. Dr. Lionel Dawson, veterinarian from Oklahoma State University, and the test supervisor monitored the bucks closely and aggressively treated the soremouth. However, Buck #1117 had an exceptional case of soremouth and, possibly combined with polioencephalomalacia, went off-feed and became very weak. He was taken to the Oklahoma State University, College of Veterinary Medicine for intravenous fluids. Unfortunately, the buck died the next day (5/20/04) while still at the College of Veterinary Medicine. The body was transported to Oklahoma State University's Diagnostic Laboratory. The post mortem report indicated that the animal had died of acidosis. In addition, Bucks #1111 and #1140 developed severe soremouth early in the performance test (during the adjustment period) and had to be isolated. After they recovered, several attempts were made to reintroduce the two bucks back into the performance test. However, on each occasion, both bucks became severely depressed, went off-feed, and developed cases of polioencephalomalacia. The decision was made to remove these two bucks from the performance test and manage them separately. On 7/13/04, Buck #1145 succumbed without any apparent symptoms. The body was transported to Oklahoma State University's Diagnostic Laboratory where the diagnosis was an acute case of pasturella pneumonia. On 7/25/04, Buck #1131 also succumbed without any apparent symptoms. The body was transported to Oklahoma State University's Diagnostic Laboratory where the diagnosis was urinary calculi. No other animal showed any sign of major illness and the overall health problems of the bucks on-test were minimal.

It is always difficult to find summer labor for the Buck Performance Test and in 2004, the buck performance test was fortunate to hire a second year veterinary student from Oklahoma State University. Unfortunately, after working for three weeks, she had an unexpected death in the family and decided to stay with her family to help them through the difficult time. A student worker, Ms. Nicole Singleton, filled in and assisted with the bucks. However, Ms. Singleton left for graduate school

at Oklahoma State University the first of August. After that, the test supervisor monitored and provided day-to-day activities of the performance test with the help of another part-time student. At the time of the mid-point report, the test supervisor was returning from the 8th International Conference in Pretoria, South Africa. He left Langston on June 15th for a three-week trip to Ethiopia. Langston University has collaborative research and training projects with two Ethiopian universities. On July 2, he left Ethiopia and traveled to the 8th International Conference on Goats, where he presented a poster. The International Conference on Goats is held every four years and is attended by some of the best goat researchers in the world. The poster that he presented at the 8th International Conference on Goats was on the effect of age at entry and weight at entry on final rankings on our buck performance test. In his absence, Dr. Mario Villaquiran and Ms. Nicole Singleton conducted the mid-point report.

Ration

Nutritionists at Langston University formulated the ration used in the performance test. In 1999, the amount of salt and ammonium chloride was doubled due to problems with urinary calculi the previous year. Except for the increase in salt and ammonium chloride, the ration is unchanged from that which was used in the first two meat buck performance tests. The ration 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 ration 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 0.21 ppm. In 2003, competitive bids were sought for the buck-test feed and Bluebonnet Feeds of Ardmore, OK was awarded the contract to supply feed for the buck performance test for 2003 and 2004.

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) pounds per day to be awarded any points.

International Boer Goat Association, Inc. Sanctioned Test

In 2003, the Oklahoma buck performance test was sanctioned by the International Boer Goat Association, Inc. The Oklahoma performance test continues to grow and to serve the meat goat industry.

Gain

The official performance test started on May 26 after the adjustment period was finished. Weights at the beginning of the test averaged 29.7 kg (65.4 lbs) with a range of 17.0 to 47.0 kg (37.4 to 103.5 lbs). Weights at mid-point averaged 42.5 kg (93.6 lbs) with a range of 28.0 to 60.0 kg (61.7 to 132.2 lbs). Weight at the end of the test averaged 54.2 kg (119.4 lbs) with a range of 32.5 to 72.5 kg (71.6 to 159.7 lbs). At mid-point, weight gain averaged 12.4 kg (27.3 lbs) with a range of 4.0 to 17.5 kg (8.8 to 38.5 lbs). Weight gain for the test averaged 24.1 kg (53.1 lbs) with a range of 12.5 to 31.0 kg (27.5 to 68.3 lbs). The type of feeder (Calan or FIRE) had no significant effect upon gain. Bucks on the Calan system averaged 23.5 kg (51.8 lbs) gain and bucks on the FIRE system averaged 24.8 kg (54.6 lbs) gain, which is a difference of 1.3 kg (2.9 lbs). Figure 5 shows the weekly body weight gains for both feeder types over the course of the performance test.

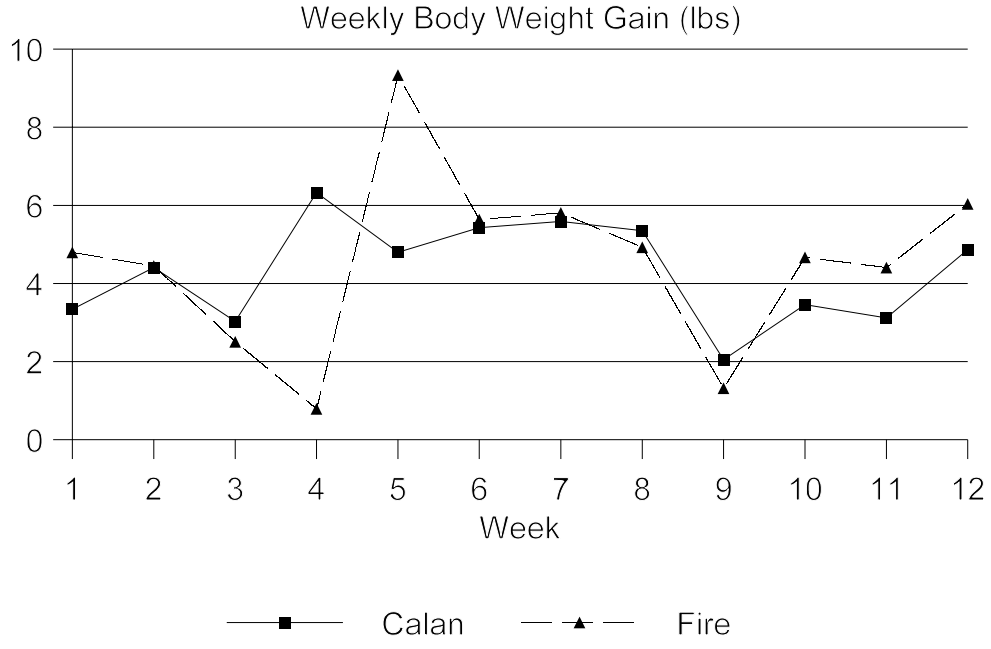


Figure 5. Calan vs FIRE - weekly body weight gains

Average Daily Gain (ADG)

At mid-point, the bucks had gained on average 295.9 grams/day (0.65 lbs/day) with a range of 95.2 to 416.7 grams/day (0.21 to 0.92 lbs/day). For the test, the bucks gained on averaged 287.3 grams/day (0.63 lbs/day) with a range of 148.8 to 369.0 grams/day (0.33 lbs/day to 0.81 lbs/day). The type of feeder (Calan or FIRE) had no significant effect upon average daily gain. Bucks on the Calan system averaged 279.8 grams/day (0.62 lbs/day) and bucks on the FIRE system averaged 295.7 grams/day (0.65 lbs/day) gain, which is a difference of 15.9 grams/day (0.04 lbs/day).

Feed Efficiency (Feed Conversion Ratio)

For the test, the bucks consumed an average of 163.2 kg (359.5 lbs) of feed with a range of 97.4 to 216.7 kg (214.5 to 477.3 lbs). The type of feeder (Calan or FIRE) had no significant effect upon intake. Bucks on the Calan system averaged 160.3 kg (353.1 lbs) intake and bucks on the FIRE system averaged 165.0 kg (363.4 lbs), which is a difference of 4.7 kg (10.4 lbs). Figure 6 shows the average daily intake for both feeder types over the course of the performance test. For the test, the bucks averaged a feed efficiency of 6.8 (feed efficiency is defined as the number of lbs. of feed needed for one lbs. of gain), with a range of 5.1 to 9.3.

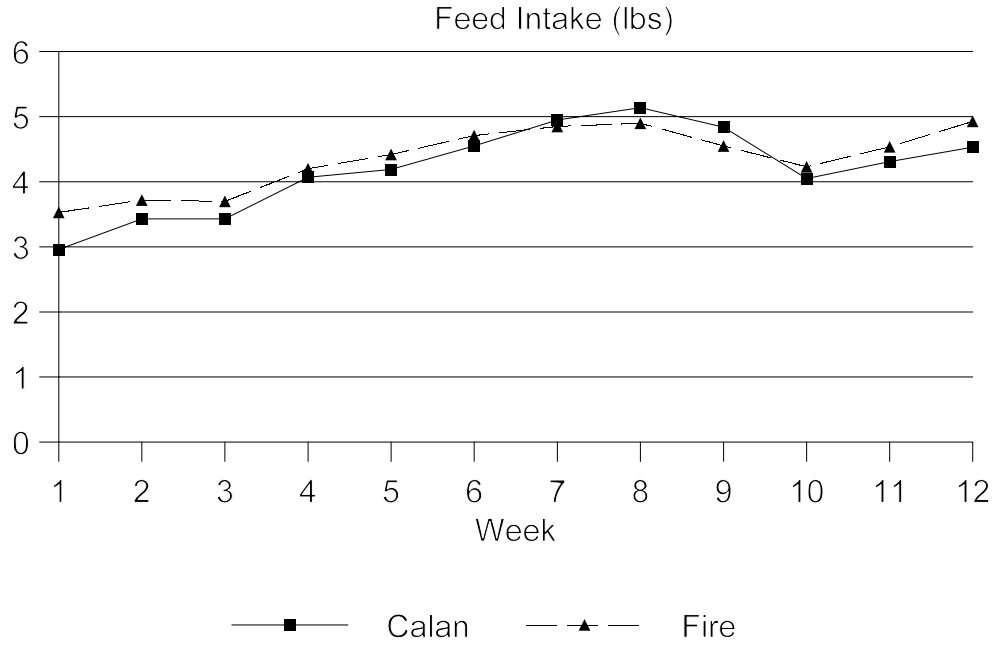
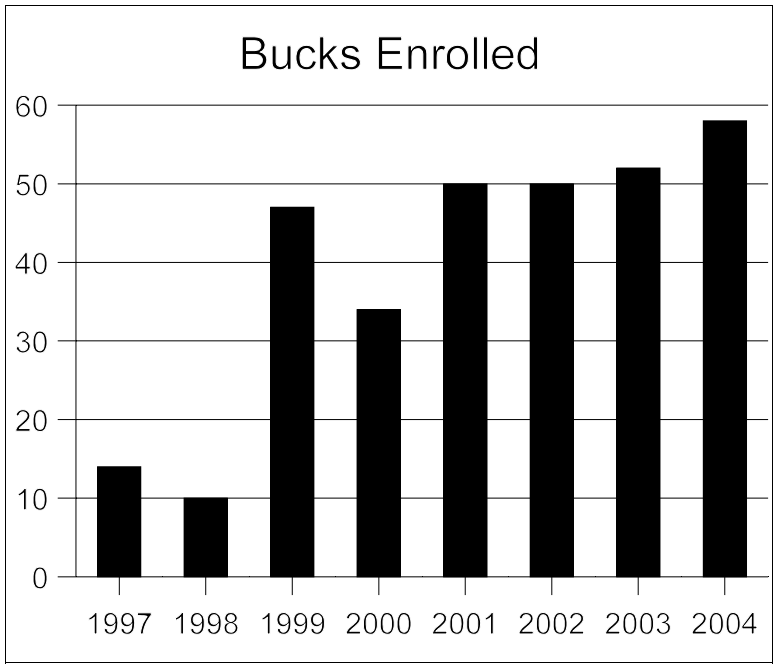
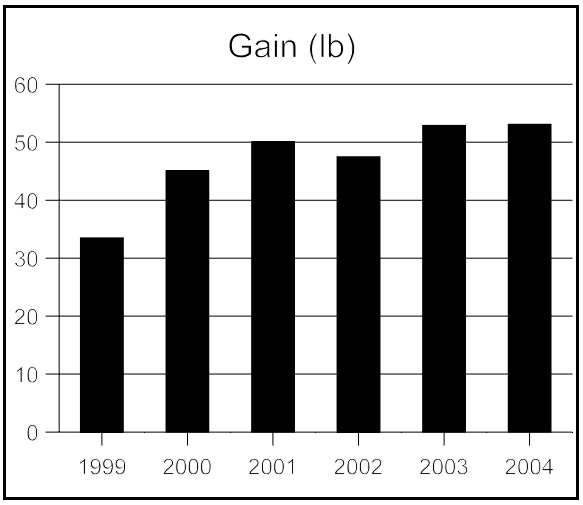


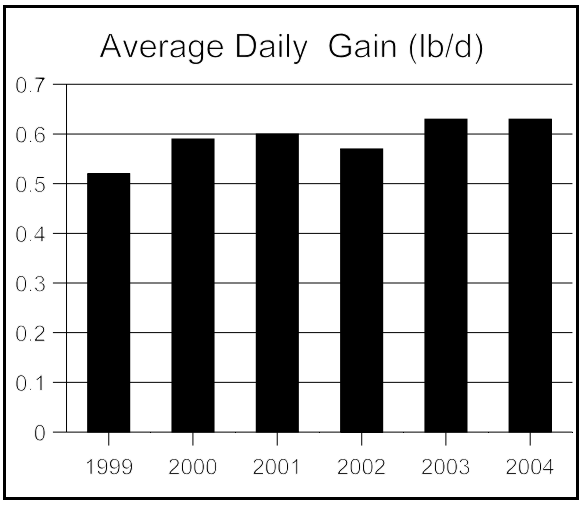
Figure 6. Calan vs. FIRE - daily feed intake.

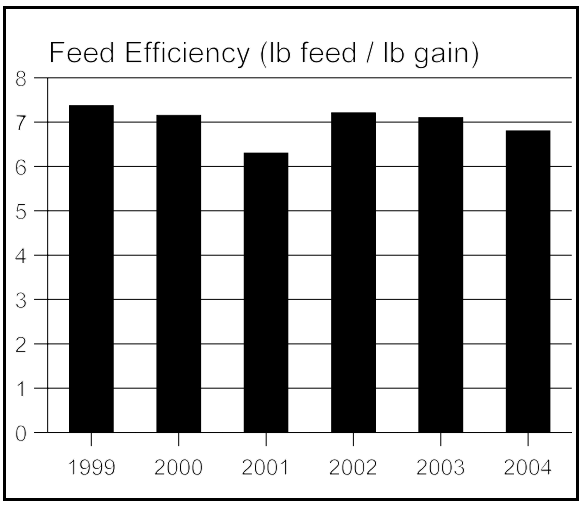
Muscling

The average loin eye area as determined by ultrasonography was 1.95 square inches with a range of 1.29 to 2.54 square inches. The average right rear leg circumference was 15.7 inches with a range of 11.0 to 19.5 inches.


Bucks Enrolled
60
50
40
30
20
10
0
1997 1998 1999 2000 2001 2002 2003 2004


Gain (lb)
60
50
40
30
20
10
0
1999 2000 2001 2002 2003 2004


Average Daily Gain (lb/d)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1999 2000 2001 2002 2003 2004


Feed Efficiency (lb feed / lb gain)
8
7
6
5
4
3
2
1
0
1999 2000 2001 2002 2003 2004

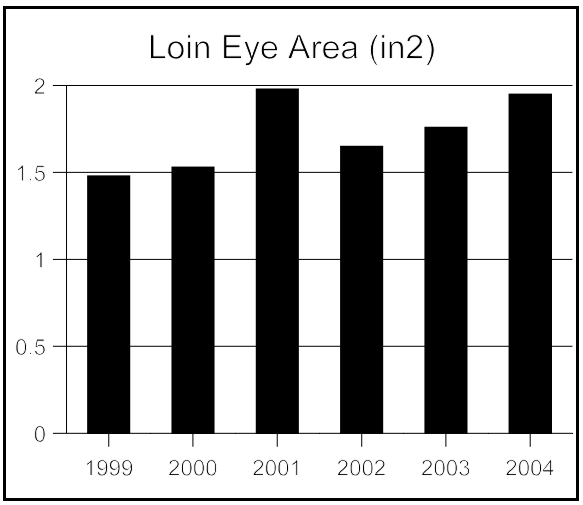

Loin Eye Area (in2)
2
1.5
1
0.5
0
1999 2000 2001 2002 2003 2004

Table 1. Bucks sorted by Index score.

ID	Breed	Birth date	Weights (lbs) Entry	Start	End	Gain (lbs)	ADG (lb/d)	Intake (lb)	FE*	LEA (in^2)	RLC (in)	Index
1114	15/16 Boer	01/21/04	48.5	57.3	117.8	60.6	0.72	341.8	5.64	2.12	17.00	100.99
1108	Boer	02/29/04	58.4	59.5	117.8	58.4	0.69	295.5	5.06	1.92	15.50	100.92
1149	Boer	02/16/04	47.4	58.4	122.2	63.9	0.76	396.3	6.20	2.23	17.00	100.91
1156	Boer	01/26/04	47.4	60.6	118.9	58.4	0.69	369.3	6.33	2.45	19.00	100.90
1155	Boer	01/19/04	45.2	57.3	121.1	63.9	0.76	353.8	5.54	1.77	14.00	100.77
1142	Boer	01/24/04	28.6	45.2	110.1	65.0	0.77	361.9	5.57	1.53	13.00	100.75
1138	31/32 Boer	01/24/04	43.0	43.0	96.9	54.0	0.64	277.8	5.15	1.66	14.00	100.73
1121	63/64 Boer	02/13/04	37.4	49.6	113.4	63.9	0.76	363.5	5.69	1.57	13.00	100.63
1128	Boer	02/11/04	47.4	63.9	122.2	58.4	0.69	370.2	6.34	2.20	17.50	100.63
1144	Boer	01/18/04	34.1	37.4	90.3	52.9	0.63	279.4	5.29	1.61	13.00	100.63
1132	Boer	03/03/04	47.4	65.0	125.6	60.6	0.72	404.8	6.68	2.23	17.50	100.57
1143	Boer	02/07/04	61.7	80.4	139.9	59.5	0.71	403.7	6.79	2.54	19.50	100.56
1130	Boer	02/07/04	59.5	72.7	132.2	59.5	0.71	392.2	6.59	2.36	18.00	100.55
1136	Boer	02/13/04	51.8	45.2	92.5	47.4	0.56	249.9	5.28	1.75	14.00	100.50
1120	Boer	01/25/04	49.6	63.9	126.7	62.8	0.75	388.6	6.19	1.81	15.00	100.49
1139	Boer	02/25/04	48.5	52.9	106.8	54.0	0.64	321.7	5.96	1.84	15.00	100.44
1137	Boer	02/12/04	56.2	69.4	127.8	58.4	0.69	428.5	7.34	2.53	19.50	100.44
1116	63/64 Boer	01/25/04	43.0	59.5	120.0	60.6	0.72	371.6	6.13	1.71	14.50	100.41
1101	Boer	01/10/04	66.1	85.9	147.6	61.7	0.73	435.7	7.07	2.39	18.50	100.34
1104	Boer	01/24/04	48.5	67.2	135.5	68.3	0.81	456.3	6.68	1.64	14.00	100.33
1102	Boer	01/18/04	40.7	55.1	110.1	55.1	0.66	355.2	6.45	1.86	15.00	100.26
1151	Kiko	02/08/04	37.4	48.5	102.4	54.0	0.64	310.0	5.74	1.49	13.00	100.25
1158	Boer	01/01/04	61.7	66.1	114.5	48.5	0.58	282.5	5.83	1.92	16.00	100.24
1119	Boer	02/15/04	48.5	68.3	125.6	57.3	0.68	389.1	6.80	2.08	16.50	100.23
1141	Boer	01/12/04	60.6	77.1	134.4	57.3	0.68	375.3	6.55	2.08	16.50	100.23
1146	Boer	03/02/04	44.1	51.8	96.9	45.2	0.54	274.8	6.09	1.89	15.00	100.17
1127	Boer	02/08/04	44.1	54.0	114.5	60.6	0.72	403.9	6.67	1.52	13.00	100.06
1115	31/32 Boer	01/25/04	39.6	56.2	109.0	52.9	0.63	346.9	6.56	1.72	14.50	100.02
1122	Boer	12/13/03	71.6	84.8	146.5	61.7	0.73	463.6	7.52	2.15	17.00	99.99
1113	31/32 Boer	01/26/04	52.9	63.9	116.7	52.9	0.63	384.4	7.27	2.09	16.50	99.97
1129	31/32 Boer	01/24/04	57.3	68.3	125.6	57.3	0.68	380.7	6.65	1.67	14.00	99.94
1112	Boer	02/05/04	50.7	54.0	98.0	44.1	0.52	275.3	6.25	1.78	14.50	99.93
1154	Boer	01/25/04	61.7	73.8	128.9	55.1	0.66	429.2	7.79	2.39	18.00	99.93
1148	31/32 Boer	01/25/04	46.3	56.2	101.3	45.2	0.54	273.0	6.05	1.63	13.50	99.85
1123	Boer	12/12/03	62.8	72.7	126.7	54.0	0.64	403.4	7.48	2.11	16.50	99.82
1124	Boer	02/14/04	45.2	62.8	117.8	55.1	0.66	384.9	6.99	1.71	14.00	99.81
1150	Boer	02/05/04	68.3	79.3	126.7	47.4	0.56	312.6	6.60	1.97	16.00	99.76
1109	Boer	01/02/04	90.3	103.5	159.7	56.2	0.67	447.6	7.97	2.54	19.50	99.73
1125	Boer	01/24/04	73.8	96.9	156.4	59.5	0.71	477.4	8.03	2.29	17.50	99.68
1105	Boer	01/24/04	50.7	66.1	121.1	55.1	0.66	430.0	7.81	1.91	15.50	99.64
1107	Boer	02/06/04	71.6	82.6	136.6	54.0	0.64	430.2	7.97	2.28	17.50	99.64
1134	Boer	02/15/04	45.2	63.9	107.9	44.1	0.52	316.9	7.19	1.75	14.50	99.40
1147	Boer	01/19/04	68.3	82.6	126.7	44.1	0.52	367.3	8.34	2.42	18.50	99.29
1135	Boer	02/24/04	45.2	52.9	89.2	36.3	0.43	214.6	5.91	1.29	11.00	99.28
1106	Boer	12/08/03	59.5	72.7	120.0	47.4	0.56	364.6	7.70	1.83	15.00	99.27
1103	Boer	01/13/04	76.0	95.8	147.6	51.8	0.62	435.6	8.42	2.06	16.50	99.11
1152	Boer	02/26/04	55.1	67.2	111.2	44.1	0.52	341.0	7.74	1.66	14.00	99.06
1126	Boer	02/02/04	65.0	81.5	125.6	44.1	0.52	352.1	7.99	1.94	15.50	99.03
1118	Boer	01/04/04	73.8	92.5	139.9	47.4	0.56	436.5	9.22	2.48	19.00	98.99
1153	Boer	12/22/03	78.2	84.8	125.6	40.7	0.49	322.6	7.92	2.02	16.00	98.97
1157	Boer	01/01/04	46.3	51.8	84.8	33.0	0.39	241.1	7.30	1.47	12.50	98.90
1133	Kiko	02/08/04	38.5	44.1	71.6	27.5	0.33	221.6	8.05	1.46	12.00	98.56
1110	Boer	01/05/04	73.8	82.6	120.0	37.4	0.45	348.6	9.31	2.14	17.00	98.47

* lbs of feed for one lb. of gain.

Table 2. Bucks sorted by Gain (ADG).

ID	Breed	Birth date	Weights (lbs) Entry	Start	End	Gain (lbs)	ADG (lb/d)	Intake (lb)	FE*	LEA (in^2)	RLC (in)	Index
1104	Boer	01/24/04	48.5	67.2	135.5	68.3	0.81	456.3	6.68	1.64	14.00	100.33
1142	Boer	01/24/04	28.6	45.2	110.1	65.0	0.77	361.9	5.57	1.53	13.00	100.75
1149	Boer	02/16/04	47.4	58.4	122.2	63.9	0.76	396.3	6.20	2.23	17.00	100.91
1155	Boer	01/19/04	45.2	57.3	121.1	63.9	0.76	353.8	5.54	1.77	14.00	100.77
1121	63/64 Boer	02/13/04	37.4	49.6	113.4	63.9	0.76	363.5	5.69	1.57	13.00	100.63
1120	Boer	01/25/04	49.6	63.9	126.7	62.8	0.75	388.6	6.19	1.81	15.00	100.49
1122	Boer	12/13/03	71.6	84.8	146.5	61.7	0.73	463.6	7.52	2.15	17.00	99.99
1101	Boer	01/10/04	66.1	85.9	147.6	61.7	0.73	435.7	7.07	2.39	18.50	100.34
1114	15/16 Boer	01/21/04	48.5	57.3	117.8	60.6	0.72	341.8	5.64	2.12	17.00	100.99
1132	Boer	03/03/04	47.4	65.0	125.6	60.6	0.72	404.8	6.68	2.23	17.50	100.57
1116	63/64 Boer	01/25/04	43.0	59.5	120.0	60.6	0.72	371.6	6.13	1.71	14.50	100.41
1127	Boer	02/08/04	44.1	54.0	114.5	60.6	0.72	403.9	6.67	1.52	13.00	100.06
1143	Boer	02/07/04	61.7	80.4	139.9	59.5	0.71	403.7	6.79	2.54	19.50	100.56
1130	Boer	02/07/04	59.5	72.7	132.2	59.5	0.71	392.2	6.59	2.36	18.00	100.55
1125	Boer	01/24/04	73.8	96.9	156.4	59.5	0.71	477.4	8.03	2.29	17.50	99.68
1156	Boer	01/26/04	47.4	60.6	118.9	58.4	0.69	369.3	6.33	2.45	19.00	100.90
1137	Boer	02/12/04	56.2	69.4	127.8	58.4	0.69	428.5	7.34	2.53	19.50	100.44
1108	Boer	02/29/04	58.4	59.5	117.8	58.4	0.69	295.5	5.06	1.92	15.50	100.92
1128	Boer	02/11/04	47.4	63.9	122.2	58.4	0.69	370.2	6.34	2.20	17.50	100.63
1119	Boer	02/15/04	48.5	68.3	125.6	57.3	0.68	389.1	6.80	2.08	16.50	100.23
1141	Boer	01/12/04	60.6	77.1	134.4	57.3	0.68	375.3	6.55	2.08	16.50	100.23
1129	31/32 Boer	01/24/04	57.3	68.3	125.6	57.3	0.68	380.7	6.65	1.67	14.00	99.94
1109	Boer	01/02/04	90.3	103.5	159.7	56.2	0.67	447.6	7.97	2.54	19.50	99.73
1102	Boer	01/18/04	40.7	55.1	110.1	55.1	0.66	355.2	6.45	1.86	15.00	100.26
1154	Boer	01/25/04	61.7	73.8	128.9	55.1	0.66	429.2	7.79	2.39	18.00	99.93
1124	Boer	02/14/04	45.2	62.8	117.8	55.1	0.66	384.9	6.99	1.71	14.00	99.81
1105	Boer	01/24/04	50.7	66.1	121.1	55.1	0.66	430.0	7.81	1.91	15.50	99.64
1138	31/32 Boer	01/24/04	43.0	43.0	96.9	54.0	0.64	277.8	5.15	1.66	14.00	100.73
1123	Boer	12/12/03	62.8	72.7	126.7	54.0	0.64	403.4	7.48	2.11	16.50	99.82
1107	Boer	02/06/04	71.6	82.6	136.6	54.0	0.64	430.2	7.97	2.28	17.50	99.64
1139	Boer	02/25/04	48.5	52.9	106.8	54.0	0.64	321.7	5.96	1.84	15.00	100.44
1151	Kiko	02/08/04	37.4	48.5	102.4	54.0	0.64	310.0	5.74	1.49	13.00	100.25
1144	Boer	01/18/04	34.1	37.4	90.3	52.9	0.63	279.4	5.29	1.61	13.00	100.63
1115	31/32 Boer	01/25/04	39.6	56.2	109.0	52.9	0.63	346.9	6.56	1.72	14.50	100.02
1113	31/32 Boer	01/26/04	52.9	63.9	116.7	52.9	0.63	384.4	7.27	2.09	16.50	99.97
1103	Boer	01/13/04	76.0	95.8	147.6	51.8	0.62	435.6	8.42	2.06	16.50	99.11
1158	Boer	01/01/04	61.7	66.1	114.5	48.5	0.58	282.5	5.83	1.92	16.00	100.24
1118	Boer	01/04/04	73.8	92.5	139.9	47.4	0.56	436.5	9.22	2.48	19.00	98.99
1136	Boer	02/13/04	51.8	45.2	92.5	47.4	0.56	249.9	5.28	1.75	14.00	100.50
1150	Boer	02/05/04	68.3	79.3	126.7	47.4	0.56	312.6	6.60	1.97	16.00	99.76
1106	Boer	12/08/03	59.5	72.7	120.0	47.4	0.56	364.6	7.70	1.83	15.00	99.27
1146	Boer	03/02/04	44.1	51.8	96.9	45.2	0.54	274.8	6.09	1.89	15.00	100.17
1148	31/32 Boer	01/25/04	46.3	56.2	101.3	45.2	0.54	273.0	6.05	1.63	13.50	99.85
1134	Boer	02/15/04	45.2	63.9	107.9	44.1	0.52	316.9	7.19	1.75	14.50	99.40
1112	Boer	02/05/04	50.7	54.0	98.0	44.1	0.52	275.3	6.25	1.78	14.50	99.93
1147	Boer	01/19/04	68.3	82.6	126.7	44.1	0.52	367.3	8.34	2.42	18.50	99.29
1152	Boer	02/26/04	55.1	67.2	111.2	44.1	0.52	341.0	7.74	1.66	14.00	99.06
1126	Boer	02/02/04	65.0	81.5	125.6	44.1	0.52	352.1	7.99	1.94	15.50	99.03
1153	Boer	12/22/03	78.2	84.8	125.6	40.7	0.49	322.6	7.92	2.02	16.00	98.97
1110	Boer	01/05/04	73.8	82.6	120.0	37.4	0.45	348.6	9.31	2.14	17.00	98.47
1135	Boer	02/24/04	45.2	52.9	89.2	36.3	0.43	214.6	5.91	1.29	11.00	99.28
1157	Boer	01/01/04	46.3	51.8	84.8	33.0	0.39	241.1	7.30	1.47	12.50	98.90
1133	Kiko	02/08/04	38.5	44.1	71.6	27.5	0.33	221.6	8.05	1.46	12.00	98.56

* lbs of feed for one lb. of gain.

Table 3. Bucks sorted by Feed Efficiency.

ID	Breed	Birth date	Weights (lbs) Entry	Start	End	Gain (lbs)	ADG (lb/d)	Intake (lb)	FE*	LEA (in^2)	RLC (in)	Index
1108	Boer	02/29/04	58.4	59.5	117.8	58.4	0.69	295.5	5.06	1.92	15.50	100.92
1138	31/32 Boer	01/24/04	43.0	43.0	96.9	54.0	0.64	277.8	5.15	1.66	14.00	100.73
1136	Boer	02/13/04	51.8	45.2	92.5	47.4	0.56	249.9	5.28	1.75	14.00	100.50
1144	Boer	01/18/04	34.1	37.4	90.3	52.9	0.63	279.4	5.29	1.61	13.00	100.63
1155	Boer	01/19/04	45.2	57.3	121.1	63.9	0.76	353.8	5.54	1.77	14.00	100.77
1142	Boer	01/24/04	28.6	45.2	110.1	65.0	0.77	361.9	5.57	1.53	13.00	100.75
1114	15/16 Boer	01/21/04	48.5	57.3	117.8	60.6	0.72	341.8	5.64	2.12	17.00	100.99
1121	63/64 Boer	02/13/04	37.4	49.6	113.4	63.9	0.76	363.5	5.69	1.57	13.00	100.63
1151	Kiko	02/08/04	37.4	48.5	102.4	54.0	0.64	310.0	5.74	1.49	13.00	100.25
1158	Boer	01/01/04	61.7	66.1	114.5	48.5	0.58	282.5	5.83	1.92	16.00	100.24
1135	Boer	02/24/04	45.2	52.9	89.2	36.3	0.43	214.6	5.91	1.29	11.00	99.28
1139	Boer	02/25/04	48.5	52.9	106.8	54.0	0.64	321.7	5.96	1.84	15.00	100.44
1148	31/32 Boer	01/25/04	46.3	56.2	101.3	45.2	0.54	273.0	6.05	1.63	13.50	99.85
1146	Boer	03/02/04	44.1	51.8	96.9	45.2	0.54	274.8	6.09	1.89	15.00	100.17
1116	63/64 Boer	01/25/04	43.0	59.5	120.0	60.6	0.72	371.6	6.13	1.71	14.50	100.41
1120	Boer	01/25/04	49.6	63.9	126.7	62.8	0.75	388.6	6.19	1.81	15.00	100.49
1149	Boer	02/16/04	47.4	58.4	122.2	63.9	0.76	396.3	6.20	2.23	17.00	100.91
1112	Boer	02/05/04	50.7	54.0	98.0	44.1	0.52	275.3	6.25	1.78	14.50	99.93
1156	Boer	01/26/04	47.4	60.6	118.9	58.4	0.69	369.3	6.33	2.45	19.00	100.90
1128	Boer	02/11/04	47.4	63.9	122.2	58.4	0.69	370.2	6.34	2.20	17.50	100.63
1102	Boer	01/18/04	40.7	55.1	110.1	55.1	0.66	355.2	6.45	1.86	15.00	100.26
1141	Boer	01/12/04	60.6	77.1	134.4	57.3	0.68	375.3	6.55	2.08	16.50	100.23
1115	31/32 Boer	01/25/04	39.6	56.2	109.0	52.9	0.63	346.9	6.56	1.72	14.50	100.02
1130	Boer	02/07/04	59.5	72.7	132.2	59.5	0.71	392.2	6.59	2.36	18.00	100.55
1150	Boer	02/05/04	68.3	79.3	126.7	47.4	0.56	312.6	6.60	1.97	16.00	99.76
1129	31/32 Boer	01/24/04	57.3	68.3	125.6	57.3	0.68	380.7	6.65	1.67	14.00	99.94
1127	Boer	02/08/04	44.1	54.0	114.5	60.6	0.72	403.9	6.67	1.52	13.00	100.06
1104	Boer	01/24/04	48.5	67.2	135.5	68.3	0.81	456.3	6.68	1.64	14.00	100.33
1132	Boer	03/03/04	47.4	65.0	125.6	60.6	0.72	404.8	6.68	2.23	17.50	100.57
1143	Boer	02/07/04	61.7	80.4	139.9	59.5	0.71	403.7	6.79	2.54	19.50	100.56
1119	Boer	02/15/04	48.5	68.3	125.6	57.3	0.68	389.1	6.80	2.08	16.50	100.23
1124	Boer	02/14/04	45.2	62.8	117.8	55.1	0.66	384.9	6.99	1.71	14.00	99.81
1101	Boer	01/10/04	66.1	85.9	147.6	61.7	0.73	435.7	7.07	2.39	18.50	100.34
1134	Boer	02/15/04	45.2	63.9	107.9	44.1	0.52	316.9	7.19	1.75	14.50	99.40
1113	31/32 Boer	01/26/04	52.9	63.9	116.7	52.9	0.63	384.4	7.27	2.09	16.50	99.97
1157	Boer	01/01/04	46.3	51.8	84.8	33.0	0.39	241.1	7.30	1.47	12.50	98.90
1137	Boer	02/12/04	56.2	69.4	127.8	58.4	0.69	428.5	7.34	2.53	19.50	100.44
1123	Boer	12/12/03	62.8	72.7	126.7	54.0	0.64	403.4	7.48	2.11	16.50	99.82
1122	Boer	12/13/03	71.6	84.8	146.5	61.7	0.73	463.6	7.52	2.15	17.00	99.99
1106	Boer	12/08/03	59.5	72.7	120.0	47.4	0.56	364.6	7.70	1.83	15.00	99.27
1152	Boer	02/26/04	55.1	67.2	111.2	44.1	0.52	341.0	7.74	1.66	14.00	99.06
1154	Boer	01/25/04	61.7	73.8	128.9	55.1	0.66	429.2	7.79	2.39	18.00	99.93
1105	Boer	01/24/04	50.7	66.1	121.1	55.1	0.66	430.0	7.81	1.91	15.50	99.64
1153	Boer	12/22/03	78.2	84.8	125.6	40.7	0.49	322.6	7.92	2.02	16.00	98.97
1109	Boer	01/02/04	90.3	103.5	159.7	56.2	0.67	447.6	7.97	2.54	19.50	99.73
1107	Boer	02/06/04	71.6	82.6	136.6	54.0	0.64	430.2	7.97	2.28	17.50	99.64
1126	Boer	02/02/04	65.0	81.5	125.6	44.1	0.52	352.1	7.99	1.94	15.50	99.03
1125	Boer	01/24/04	73.8	96.9	156.4	59.5	0.71	477.4	8.03	2.29	17.50	99.68
1133	Kiko	02/08/04	38.5	44.1	71.6	27.5	0.33	221.6	8.05	1.46	12.00	98.56
1147	Boer	01/19/04	68.3	82.6	126.7	44.1	0.52	367.3	8.34	2.42	18.50	99.29
1103	Boer	01/13/04	76.0	95.8	147.6	51.8	0.62	435.6	8.42	2.06	16.50	99.11
1118	Boer	01/04/04	73.8	92.5	139.9	47.4	0.56	436.5	9.22	2.48	19.00	98.99
1110	Boer	01/05/04	73.8	82.6	120.0	37.4	0.45	348.6	9.31	2.14	17.00	98.47

* lbs of feed for one lb. of gain.

Table 4. Mid-point results.

ID	Breed	Birth date	Weights (lbs) Entry	Start	Midpoint	Gain (lbs)	ADG (lb/d)	Intake (lb)	FE*
1101	Boer	01/10/04	66.1	85.9	123.3	37.4	0.89	212.1	5.66
1102	Boer	01/18/04	40.7	55.1	82.6	27.5	0.66	152.6	5.54
1103	Boer	01/13/04	76.0	95.8	115.6	19.8	0.47	184.9	9.33
1104	Boer	01/24/04	48.5	67.2	101.3	34.1	0.81	221.5	6.49
1105	Boer	01/24/04	50.7	66.1	99.1	33.0	0.79	221.1	6.69
1106	Boer	12/08/03	59.5	72.7	101.3	28.6	0.68	185.8	6.49
1107	Boer	02/06/04	71.6	82.6	114.5	31.9	0.76	200.2	6.27
1108	Boer	02/29/04	58.4	59.5	92.5	33.0	0.79	121.6	3.68
1109	Boer	01/02/04	90.3	103.5	132.2	28.6	0.68	214.2	7.48
1110	Boer	01/05/04	73.8	82.6	100.2	17.6	0.42	167.5	9.50
1112	Boer	02/05/04	50.7	54.0	73.8	19.8	0.47	97.8	4.94
1113	31/32 Boer	01/26/04	52.9	63.9	95.8	31.9	0.76	185.8	5.82
1114	15/16 Boer	01/21/04	48.5	57.3	85.9	28.6	0.68	143.0	5.00
1115	31/32 Boer	01/25/04	39.6	56.2	85.9	29.7	0.71	170.3	5.73
1116	63/64 Boer	01/25/04	43.0	59.5	89.2	29.7	0.71	187.2	6.30
1118	Boer	01/04/04	73.8	92.5	123.3	30.8	0.73	221.6	7.19
1119	Boer	02/15/04	48.5	68.3	98.0	29.7	0.71	183.9	6.19
1120	Boer	01/25/04	49.6	63.9	96.9	33.0	0.79	186.8	5.65
1121	63/64 Boer	02/13/04	37.4	49.6	88.1	38.5	0.92	165.9	4.30
1122	Boer	12/13/03	71.6	84.8	114.5	29.7	0.71	196.8	6.62
1123	Boer	12/12/03	62.8	72.7	101.3	28.6	0.68	197.4	6.89
1124	Boer	02/14/04	45.2	62.8	89.2	26.4	0.63	169.9	6.43
1125	Boer	01/24/04	73.8	96.9	127.8	30.8	0.73	221.0	7.17
1126	Boer	02/02/04	65.0	81.5	96.9	15.4	0.37	127.4	8.26
1127	Boer	02/08/04	44.1	54.0	83.7	29.7	0.71	166.3	5.59
1128	Boer	02/11/04	47.4	63.9	96.9	33.0	0.79	194.5	5.89
1129	31/32 Boer	01/24/04	57.3	68.3	102.4	34.1	0.81	182.8	5.35
1130	Boer	02/07/04	59.5	72.7	103.5	30.8	0.73	181.4	5.88
1132	Boer	03/03/04	47.4	65.0	96.9	31.9	0.76	192.8	6.04
1133	Kiko	02/08/04	38.5	44.1	61.7	17.6	0.42	106.2	6.03
1134	Boer	02/15/04	45.2	63.9	88.1	24.2	0.58	156.4	6.46
1135	Boer	02/24/04	45.2	52.9	61.7	8.8	0.21	71.8	8.15
1136	Boer	02/13/04	51.8	45.2	63.9	18.7	0.45	73.1	3.91
1137	Boer	02/12/04	56.2	69.4	103.5	34.1	0.81	188.5	5.52
1138	31/32 Boer	01/24/04	43.0	43.0	68.3	25.3	0.60	94.1	3.72
1139	Boer	02/25/04	48.5	52.9	77.1	24.2	0.58	128.7	5.31
1141	Boer	01/12/04	60.6	77.1	106.8	29.7	0.71	175.5	5.90
1142	Boer	01/24/04	28.6	45.2	78.2	33.0	0.79	172.1	5.21
1143	Boer	02/07/04	61.7	80.4	114.5	34.1	0.81	204.2	5.98
1144	Boer	01/18/04	34.1	37.4	61.7	24.2	0.58	118.7	4.90
1146	Boer	03/02/04	44.1	51.8	77.1	25.3	0.60	142.7	5.63
1147	Boer	01/19/04	68.3	82.6	111.2	28.6	0.68	185.9	6.49
1148	31/32 Boer	01/25/04	46.3	56.2	76.0	19.8	0.47	78.3	3.95
1149	Boer	02/16/04	47.4	58.4	90.3	31.9	0.76	166.0	5.20
1150	Boer	02/05/04	68.3	79.3	99.1	19.8	0.47	133.4	6.73
1151	Kiko	02/08/04	37.4	48.5	74.9	26.4	0.63	140.8	5.33
1152	Boer	02/26/04	55.1	67.2	89.2	22.0	0.52	170.3	7.73
1153	Boer	12/22/03	78.2	84.8	109.0	24.2	0.58	162.9	6.72
1154	Boer	01/25/04	61.7	73.8	109.0	35.2	0.84	222.5	6.31
1155	Boer	01/19/04	45.2	57.3	90.3	33.0	0.79	156.7	4.74
1156	Boer	01/26/04	47.4	60.6	89.2	28.6	0.68	164.5	5.75
1157	Boer	01/01/04	46.3	51.8	65.0	13.2	0.31	92.4	6.99
1158	Boer	01/01/04	61.7	66.1	82.6	16.5	0.39	113.1	6.84

* lbs of feed for one lb. of gain.

The proper citation for this article is:

Gipson, T. 2005. Extension Overview. Pages 140-156 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

International Overview

Roger Merkel

International Program Leader

The American Institute for Goat Research of Langston University has been very active in international activities during the past year. Brief synopses of the major international grant activities are given below. Institute staff also have written or collaborated on several grant proposals that have been submitted to expand the Institute's international program. Additionally, during the past year Langston University hosted and trained personnel from the Democratic People's Republic of Korea on dairy goat production and dairy goat milk products and safety.

Institutional Partnerships with Ethiopian Universities

Langston University is continuing its partnerships with two universities in Ethiopia, Debub University in Awassa located in southern Ethiopia and Alemaya University near Dire Dawa in eastern Ethiopia. Activities during the past year centered around visits by Langston University personnel to Ethiopia and an artificial insemination program begun at both universities. In June 2004, Drs. Terry Gipson and Lionel Dawson traveled to Ethiopia to present seminars and training at both universities. Dr. Gipson spoke on computer simulation models, statistical analysis, and gave an overview of the goat nutrient calculators available on our website. Dr. Dawson presented seminars on goat health and disease, the veterinary program at Oklahoma State University, and also taught Ethiopian personnel how to perform an epididymectomy, or the making of a teaser buck. Drs. Gipson and Dawson also visited some of the women's groups for goat production established as part of project activities.

A goal of the current partnerships with these Ethiopian universities was to collect and ship Boer goat semen to Ethiopia for use in a crossbreeding program, with crossbred goats given to women cooperating in the village goat groups. Over 2,500 straws of Boer goat semen were collected from Langston University bucks and shipped to Ethiopia in May 2004. Dr. Roger Merkel then traveled to Ethiopia where he was met by Teresa and Don Wade, owners of Bio-Genics Ltd., a firm that specializes in collecting and freezing goat semen, goat artificial insemination, and conducting artificial insemination workshops. Teresa and Don Wade donated their time to travel to Ethiopia and teach staff and students at each university how to preform artificial inseminations. Roughly 45 animals at each university were inseminated. Over a dozen crossbred kids were born at Debub University while very few were born at Alemaya. The does inseminated at Alemaya were purchased from local markets for the insemination. Unfortunately, many of them were pregnant when purchased and aborted during the estrus synchronization protocol used to prepare the animals. However, several people at both universities became proficient in insemination and will be able to continue using the remaining semen.

In addition to teaching artificial insemination at both universities, the Wade's also taught the basics of goat semen freezing to personnel at the National Artificial Insemination Center of Ethiopia. The training received by the center was timely in the fact that the center had recently been given the mandate of beginning an artificial insemination program for goats. Center personnel were very appreciative of the training they received and the Institute hopes to have further collaborative activities with the National Artificial Insemination Center..

A final aspect of these institutional partnerships completed in the past year was the training of a scientist from Alemaya University, Dr. Asefa Asmare. Dr. Asefa arrived at Langston University in April 2004 and returned to Ethiopia last October. During his time here, Dr. Asefa conducted several research projects and assisted several other scientists in their research trials. Dr. Asefa participated in the annual meeting of the American Society of Animal Science. He, along with Dr. Merkel, and gave a progress report on partnership activities at the annual conference of the Association Liaison Office for University Cooperation in Development in Washington DC. Dr. Asefa also gave seminars and lectures to Langston University students and staff.

Al-Sharaka Program for Higher Education in Iraq

Langston University's involvement in the University of Oklahoma-led partnership of Al-Sharaka Program for Higher Education in Iraq consists of providing training in small ruminant production to Iraqi scientists and establishing a ruminant nutrition laboratory at Salahaddin University in Arbil, Iraq. Analytical equipment, chemical reagents, and laboratory supplies have been procured and will be shipped to Iraq in the coming months. To provide training in small ruminant production, Langston University conducted a 3-week training program for seven Iraqi scientists in Egypt.

Updating and Enhancing the Skills of Iraqi Scientists in Small Ruminant Production

This training was held from September 7 through 29, 2004 at the Desert Research Center and Animal Production Research Institute of Egypt. Langston University is currently collaborating with the Desert Research Center and Animal Production Research Institute of Egypt on a Middle East Regional Cooperation (MERC) Grant funded by the United States Agency for International Development. Also participating in the MERC grant are Al-Quds University in East Jerusalem for activities in the Palestinian Authority, Jordan University of Science and Technology of Jordan, and the Volcani Center of Israel.

Seven Iraqi scientists representing four universities, Salahaddin University, Arbil; Basrah University, Basrah; University of Babylon, Hilla; and Al Anbar University, Al Ramadi; attended the training. The main objectives of the training program were to:

Impart technical knowledge to the Iraqi scientists;

1. Provide an opportunity for the Iraqi scientists to meet and establish contacts with Egyptian scientists and scientists from other Middle Eastern institutions who attended a concurrent MERC training program;
2. Demonstrate to the Iraqi scientists the extension component of the MERC program and;
3. Foster future relationships among all participating institutions.

During the first week of training, the Egyptian partners trained Jordanian, Palestinian, and Iraqi scientists on a small ruminant record software package developed in the MERC program. Following that software training, an additional two weeks of training was given to the Iraqi scientists by Drs. Roger Merkel, Terry Gipson, and Arthur Goetsch of Langston University and Dr. Lionel Dawson of Oklahoma State University. Topics discussed included computer applications, data handling and statistical analysis, herd health, reproductive management, and nutrition. Also during this time, the Iraqi scientists had the opportunity to visit Egyptian agricultural research institutes, Cairo University, and a research station located in Alexandria, Egypt. At the end of the training, Dr. Goetsch

accompanied the Iraqi and Egyptian scientists to the north Sinai for a two-day visit to farmers participating in the extension component of the MERC grant.

Potential for Development of Goat and Cow Cheeses in China

Drs. Tilahun Sahlu and Steve Zeng were invited to China to complete a USDA-FAS funded project entitled "Potential for Development of Goat Cheeses in China" in September 2004. The Chinese collaborators for this cheese promotion and research project were Northwest Sci-Tech University of Agriculture & Forestry, Jiangxi Agricultural University, Zhejiang University, and China Agricultural University. The objectives were to help create dairy curricula for cheese manufacturing at Chinese universities; promote cheese production and consumption in China; and seek future long-term joint research projects between Langston University and Chinese universities. During this trip, seminars on cheese manufacturing and on HACCP programs for dairy farms and processing plants were given to under-graduate and graduate students. In addition, cheese making workshops were conducted at Jiangxi Agricultural University and China Agricultural University.

International Collaboration in Goat Research and Production Web-Based Decision Support Aids

This recently awarded grant that will begin in July of 2005. Through collaboration with institutions in Jordan, China, France, and Mexico, two web-based goat production and research decision-support tools developed at Langston University (goat nutrient requirements and feed intake; goat production system simulation model) will be translated into Arabic, Chinese, French, and Spanish. Adaptations in the tools will be made for widespread application. An international internet working group of professionals focusing on goats will be formed, and there will be an increased internationalization of Langston University through visits to other countries as well as participation of the foreign collaborators in programs at Langston University. This project will enhance the capability of the American Institute for Goat Research of Langston University to conduct collaborative research with many other countries on issues relevant to U.S. agricultural competitiveness, increase the sharing of research findings, elevate testing and adoption of new technologies developed in foreign countries, and improve the capability to provide leadership in increasing goat production efficiency in the U.S.

Training Representatives from the Democratic People's Republic of Korea

From November 1 through 8, 2004 the American Institute of Goat Research hosted 5 persons from the Democratic People's Republic of Korea (DPRK) and 4 representatives of Global Resources Services, Inc. Global Resources Services, Inc (GRS) is a private international humanitarian aid and development organization and was the sponsoring organization for the training. GRS has been assisting the DPRK government in establishing a goat dairy to produce milk and goat milk products to increase the supply of these valuable foods in the DPRK.

The goal of the training was to introduce the DPRK and GRS personnel to the important concepts of dairy goat production with a concentration on reproduction and dairy products. Upon their arrival, the visitors were welcomed by Drs. Marvin Burns, Dean of the School of Agriculture and Applied Sciences and Tilahun Sahlu, Director of the American Institute for Goat Research. Drs. Roger Merkel, Arthur Goetsch, and Terry Gipson then provided overviews of the Institute's international, research, and extension activities, respectively.

The rest of the training period was spent discussing and holding training sessions on aspects of dairy goat production and making of goat milk products. Drs. Roger Merkel and Lionel Dawson began the training by presenting reproductive tract anatomy and basic reproduction in small ruminants. Dr. Tera Auchtung of the Institute presented information on photoperiod and its effects on reproduction and use for out-of-season breeding. These discussions were followed by a half-day hands-on training on artificial insemination of goats conducted by Mr. Les Hutchens of Reproduction Enterprises, Inc. The following day was spent at the Reproduction Enterprises, Inc. facility in Stillwater, OK where Mr. Hutchens and his staff introduced the procedures of semen collection, evaluation, and freezing as well as the conduct of a breeding soundness exam on bucks.

Dairy goat nutrition and a discussion on management practices to control internal parasites was led by Dr. Steve Hart. Dr. Lionel Dawson returned to the training venue at the Institute farm to discuss herd health issues with the scientists. Mr. Erick Loetz, farm manager, along with Mr. Jay Stevens provided training on goat milking, mastitis detection, and milk handling safety from the udder to creamery. Mr. Loetz also discussed farm management. Mr. Jerry Hayes, assistant farm manager, provided general management information and demonstrations on hoof trimming, horn tipping, body condition scoring, dehorning, and castration using an elastrator. Finally, Dr. Steve Zeng provided two days of training on milk safety and production of goat cheese.

The delegation stated that they were very impressed by the breadth and depth of the training as well as the quality of the training personnel. They left Langston University with updated knowledge on goat production that will be of great use as they implement their dairy goat plans in the DPRK.

Goat Production in the Middle East (MERC Project)

Numerous activities were conducted in the last year on the Middle East project, with the following collaborators: Al-Quds University in East Jerusalem, Volcani Center of Israel, Jordan University of Science and Technology, and Desert Research Center and Animal Production Research Institute of Egypt. Earlier, a training session on a small ruminant record-keeping system held in Egypt was discussed. In July of 2004, project participants from Egypt (Dr. Hassan El Shaer), Jordan (Dr. Khalil Ereifej), and Israel (Drs. Uzi Merin, Nissim Silanikove, and Gabriel Leitner), as well as the Institute, attended the 8th International Conference on Goats. In addition to short papers about specific activities on the MERC project, there was a special session on international research projects. In this session, chaired by Dr. Roger Merkel, Drs. Ereifej, El Shaer, and Silanikove overviewed activities at their respective locations. There was also an informal meeting held among the MERC project participants discussing upcoming activities.

One of the activities underway at each Mid-East location is the characterization of chemical and bacteriological status of goat milk. Israelis are focusing on effects of subclinical intramammary infection on milk production and quality. Goat production practices have been evaluated through use of a questionnaire in the West Bank, Jordan, and Egypt, including the identification of major constraints to high levels and efficiencies of production. Technology transfer is a major part of the project, particularly in Egypt, Jordan, and the West Bank. Training areas include use of byproduct feedstuffs such as with supplemental feed blocks, ammoniation of crop residues, goat health care including mastitis detection and treatment, manufacture of traditional and alternative cheeses, milk product hygiene, and use of improved genotypes.

8th International Conference on Goats

The 8th International Conference on Goats (ICG) was held in Pretoria, South Africa from July 4 through July 9, 2004. This conference provided the opportunity for goat specialists and enthusiasts to interact and exchange knowledge about modern goat production. Langston University was well represented with Drs. Terry Gipson, Arthur Goetsch, Roger Merkel, Ryszard Puchala, Tilahun Sahlu, and Steve Zeng attending and presenting research findings of the university. The five-day scientific program was stimulating and encompassed all facets of research, education and production. On day one of the scientific program, Dr. Tilahun Sahlu delivered the keynote speech for the conference. In his presentation entitled "Foresight on Goat Research", Dr. Sahlu touched upon several important issues facing the scientific community. Dr. Sahlu noted that research is always evolving and ever-changing and that research is affected by economics and funding levels but also by political decisions and current events. Dr. Sahlu also stated that livestock production and distribution of products are going through both horizontal and vertical integration as well as increased globalization. In summary, Dr. Sahlu stated that "Therefore, as goat researchers our priority or goal should be to have a positive impact on the quality of life that includes the social, economic, and biological well-being of the world population that we serve".

Current and Recently Completed International Projects

The following is a list of on-going or recently completed international projects of the American Institute for Goat Research of Langston University.

Title: **International Collaboration in Goat Research and Production Web-Based Decision Support Aids**

Support: USDA International Science and Education Competitive Grants Program

Period: 2005-2008

Institutions: Langston University
Jordan University of Science and Technology in Jordan
Northwest Science-Technology University in China
Département des Sciences Animales of Institut National Agronomique in France
University of Chapingo in Mexico

Objective: The goal of the project is to facilitate future collaborative research between the American Institute for Goat Research of Langston University and institutions in Arabic-, Chinese-, French-, and Spanish-speaking countries, as well as to gain knowledge of goat research and production practices in other areas of the world. Objectives are to translate and adapt two web-based goat production and research decision-support tools developed at the American Institute for Goat Research (goat nutrient requirements and feed intake; goat production system simulation model) for use and future collaborative research in the Middle East, China, France and other French-speaking countries, and Central and South America.

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

Support: USAID Middle East Regional Cooperation Program

Period: 2000-2005

Institutions:

Egypt	Desert Research Center and Animal Production Research Institute, Cairo
Israel	Volcani Center, Bet Dagan
Palestinian National Authority	Al-Quds University, East Jerusalem
Jordan	Jordan University of Science and Technology, Irbid

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: **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

Period: 2002-2005

Institutions: Fort Valley State University, Fort Valley, GA (lead institution)
Awassa College of Agriculture of Debub University, Awassa, 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

Period: 2002-2005

Institutions: Oklahoma State University, Stillwater, OK
Alemaya University, Dire Dawa, 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

Title: **Al-Sharaka Program for Higher Education in Iraq**

Support: United States Agency for International Development

Period: 2003-2005

Institutions: U.S. University of Oklahoma, Norman, OK (lead institution)
Oklahoma State University, Stillwater, OK
Cameron University, Lawton, OK

Iraq Al Anbar University, Ramadi City
Babylon University, Hilla City
Basrah University, Basrah
Salahaddin University, Arbil
University of Technology, Baghdad

Purpose: Assist in modernizing and revitalizing Iraqi institutions of higher education

Langston University-Specific Activities:

Provide training to Iraqi university scientists to enhance and upgrade knowledge and techniques of small ruminant research and production

Provide equipment and expertise to establish a ruminant nutrition feedstuff analytical laboratory

Title: Potential for Development of Goat and Cow Cheeses in China

Support: USDA FAS

Period: 2002-2004

Institutions: Langston University

China	Northwest Sci-Tech University of Agriculture & Forestry
	Jiangxi Agricultural University
	Zhejiang University
	China Agricultural University

Objectives: Help create dairy curricula for cheese manufacturing at Chinese universities; promote cheese production and consumption in China; and seek future long-term joint research projects between Langston University and Chinese Universities.

The proper citation for this article is:

Merkel, R. 2005. International Overview. Pages 157-164 in Proc. 20th Ann. Goat Field Day, Langston University, Langston, OK.

Research Overview

Arthur Goetsch

Goat Research Leader

There has been and is a wide array of research areas addressed by our program. All major types of goats produced in the US are considered, i.e., ones raised for meat, milk, and(or) fiber, both cashmere and mohair. The increasing demand for goat meat and decline in the mohair industry in recent years have resulted in an expansion of research topics with meat goats, but because the future is unknown, all goat industries will continue to receive attention. The Institute has and will in the future conduct research to increase levels and efficiencies of goat production, enhance utilization of goat products, and improve use of goats for specific purposes such as vegetation management. There is intent to increase economic returns to those raising goats or processing their products, as well as providing other benefits such as enhanced sustainability of livestock production systems.

A large proportion of the Institute's research program is made possible by grants, many of which are through USDA programs. Although dissemination of information generated from all of these projects occurs, some entail strong extension components. Likewise, there are projects listed in our international section that entail significant research components.

To provide an idea about our research program since the last Field Day, listed below are research projects and experiments we have been involved with in 2004, abstracts for 2005, and summaries of scientific articles that were published in 2004 or currently are "in press" to appear in 2005 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
µ = micro

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: *Decreased Methane Emission by Ruminants Consuming Condensed Tannins*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2004-38814-02606
Period: 2004-2007
Investigators: R. Puchala[1], A. L. Goetsch[1], C. R. Krehbiel[2], and V. H. Varel[3]
Institutions: [1]Langston University, [2]Oklahoma State University, and [3]USDA ARS Meat Animal Research Center
Objectives:

- Determine effects of consuming different condensed tannin sources on the ruminal microflora and methane emission, digestibility, nitrogen and energy balance, and energy expenditure by goats.
- Determine effects of consuming diets with different levels of a forage containing condensed tannins on the ruminal microflora and methane emission, digestibility, nitrogen and energy balance, and energy expenditure by goats.
- Determine effects of different frequencies of consumption of a forage containing condensed tannins on the ruminal microflora and methane emission, digestibility, nitrogen and energy balance, and energy expenditure by goats.

Title: *Evaluation and Modeling Extended Lactations in Dairy Goats*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2004-38814-02579
Period: 2004-2007
Investigators: T. A. Gipson[1], A. Capuco[2], T. Sahlu[1], L. J. Dawson[3], and S. Ellis[4]
Institutions: [1]Langston University, [2]USDA ARS Gene Evaluation and Mapping Laboratory, [3]Oklahoma State University, and [4]Clemson University Research Center
Objectives:

- Compare extended versus standard lactations with reference to milk, fat, and protein yield, reproduction and health issues . nitrogen and energy balance, and energy expenditure by goats.

- Mathematically model the lactation curve for extended lactations in dairy goats, with particular emphasis on the effect of extended lactations has upon the shape and scale of the lactation curve.
- Examine the physiological changes in the mammary gland over the course of an extended lactation.

Title: *Quality, Safety, and Shelf-Life of Dairy Goat Products in the U.S. Market*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2004-38814-02587
Period: 2004-2007
Investigators: S. S. Zeng[1], M. Perdue[2], and S. E. Gilliland[3]
Institutions: [1]Langston University, [2]USDA ARS Environmental Microbial Safety Laboratory, and [3]Oklahoma State University
Objectives:

- Establish a comprehensive database of dairy goat product safety, quality and shelf-life on the store shelves.
- Identify the unique values such as CLA of dairy goat products.
- Develop and implement biological, biochemical and/or physical interventions to control undesirable microbes.
- Enhance the marketability and profitability of goat milk and dairy products by improving product microbiological and sensory quality, and by prolonging shelf-life of finished products.
- Assist store managers and personnel handling goat milk and dairy products by providing information and techniques to maximize product quality and shelf-life.

Title: *Nutrient Requirements of Goats: Composition of Tissue Gain and Loss*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2003-38814-13923
Period: 2003-2006
Investigators: T. Sahlu[1], A. L. Goetsch[1], C. L. Ferrell[2], and C. R. Krehbiel[3]
Institutions: [1]Langston University, [2]USDA ARS Meat Animal Research Center, and [3]Oklahoma State University
Objective:

- Determine the composition of tissue gain by growing Boer crossbred and Spanish meat goats consuming different quality diets from weaning to 1 year of age.
- Determine the composition of tissue loss and gain by mature meat goats.
- Determine the composition of tissue loss and gain by lactating dairy goats.
- Develop equations to predict body composition of growing and mature meat goats and lactating dairy goats based on shrunk body weight and urea space.

Title: *Tethering for Detailed Study of Grazing Ruminants*
Type: USDA-CSREES-NRI 03-03289
Project Number: OKLX-GOETSCH

Period: 2003-2005
Investigators: A. L. Goetsch, R. Puchala[1], T. Sahlu[1], and C. R. Krehbiel[2]
Institutions: [1]Langston University and [2]Oklahoma State University
Objective:
- Validate use of tethering to study responses of meat goats to grazing conditions by investigating effects of grazing unrestrained versus tethered on grazing behavior, energy expenditure, forage intake, and composition of forage selected by meat goats on pastures with low and high forage quality and available mass.

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: *Energy for the Productive Caprine*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLX-38814-9500
Period: 2000-2004
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: 2000-2004
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.

Experiments in 2004

Title: *Relationships Between Body Condition Score and Body Weight in Goats*
Experiment Number: MV-04-01
Project Number: 2011-52101-11430
Investigators: M. Villaquiran, T. A. Gipson, R. C. Merkel, and A. L. Goetsch
Objective: Develop relationships between body condition score and body weight for different types of goats throughout the year with different planes of nutrition and stages of production

Title: *Effects of Forage Level and Physical Form of the Diet and Method of Feeding on Performance and Feeding Behavior by Growing Crossbred Boer Wethers*
Experiment Number: AG-04-02
Project Number: OKLX-SAHLU
Investigators: A. L. Goetsch, G. Detweiler, T. A. Gipson, R. C. Merkel, and T. Sahlu
Objectives: Determine effects of dietary forage level (100 vs 50%), physical nature of the diet (pelleted vs loose), method of feeding (Calan gates vs automated feed intake recording system), and their interactions on feeding feed intake, average daily gain, and gain efficiency of growing crossbred Boer wethers.

Title: *Enhanced Goat Production Systems for the Southern United States - Phase 3*
Experiment Number: MV-04-03
Project Number: 2011-52101-11430
Investigators: M. Villaquiran and T. A. Gipson
Objectives: Determine user-friendly means of deriving inputs for use of a web-based simulation program to appraise use of available resources and production conditions in different goat production systems

Title: *Composition of Tissue Loss and Gain by Mature Meat Goats*
Experiment Number: TN-04-04
Project Number: 2003-03779
Investigators: T. Ngwa, A. L. Goetsch, T. Sahlu, R. C. Merkel, G. Detweiler, T. A. Gipson, and R. Puchala
Objectives: 1) Determine the composition of tissue loss by mature meat goats in high body condition when placed on a low nutritional plane
2) Determine the composition of tissue gain by mature meat goats in low body condition when placed on a high nutritional plane
3) Develop relationships between body condition score and body composition for mature meat goats

4) Develop equations to predict body composition of mature meat goats based on shrunk body weight and urea space

Title: *Effects of Tethering on Forage Intake and Grazing Behavior With Low Quality Forage*
Experiment Number: TN-04-05
Project Number: USDA-CSREES-NRI 03-03289
Investigators: T. Ngwa, R. Puchala, A. L. Goetsch, T. Sahlu, and G. Detweiler
Objectives: Investigate effects of grazing unrestrained versus tethered on grazing behavior, energy expenditure, forage intake, and composition of forage selected by meat goats on pastures with low quality forage

Title: *Effects of Creep Grazing by Meat Goats of Pastures With the Tree Legume Mimosa*
Experiment Number: MY-04-06
Project Number: OKLX-SAHLU
Investigators: Maria Yiakoulaki, A. L. Goetsch, R. C. Merkel, R. Puchala, and T. Sahlu
Objectives: Investigate performance effects of creep grazing by meat goat kids of pastures with the tree legume mimosa compared with different stocking rates on mixed grass/forb pastures

Title: *Composition of Tissue Gain by Growing Meat Goats*
Experiment Number: TN-04-07
Proposal Number: 2003-03779
Investigators: T. Ngwa, A. L. Goetsch, T. Sahlu, R. C. Merkel, G. Detweiler, T. A. Gipson, and R. Puchala
Objective: 1) Determine the composition of tissue gain by growing Boer × Spanish and Spanish meat goats at different ages and on different planes of nutrition
2) Develop relationships between body condition score and body composition for growing meat goats
3) Develop equations to predict body composition of growing meat goats based on shrunk body weight and urea space

Title: *Preliminary Research on An Alternative Method of Inactivating CAEV in Colostrum*
Experiment Number: KW-04-08
Project Number: OKLX-SAHLU
Investigators: K. E. Washburn, Asefa, R. N. Streeter, L. J. Dawson, J. T. Saliki, T. Lehenbauer, and A. L. Goetsch
Objectives: Investigate treatment of colostrum with phenothiazine dye and light to deactivate CAEV

Title: *Effects of Tethering on Forage Intake and Grazing Behavior With High Quality Forage*
Experiment Number: AP-04-09
Project Number: USDA-CSREES-NRI 03-03289
Investigators: A. Patra, R. Puchala, A. L. Goetsch, T. Sahlu, and G. Detweiler
Objectives: Investigate effects of grazing unrestrained versus tethered on grazing behavior, energy expenditure, forage intake, and composition of forage selected by meat goats on pastures with high quality forage

Title: *Effects of Extended Storage and Season on Microbiological Quality and Composition of Goat Milk*
Experiment Number: SZ-04-10
Project Number: OKLX-SAHLU
Investigators: S. Zeng, and B. Bah
Objectives: Determine effects of lactation season and extended storage time on farm on composition and microbiological and sensory qualities of goat milk and to monitor the changes of pH, bacteria counts and processing characteristics of goat milk.

Title: *Effects of Vacuum-Packaging and Storage Temperature on Quality and Shelf-Life of Goat Milk Soft Cheese*
Experiment Number: SZ-04-10
Project Number: OKLX-SAHLU
Investigators: S. Zeng, B. Bah, R. Puchala, and K. Tesfai
Objectives: Determine effects of vacuum-packaging and storage on quality and shelf-life of goat milk soft cheese and to monitor the changes of pH, bacteria counts, and sensory properties of cheese during storage

Title: *Effects of Level of Feed Intake on Partitioning of Nutrients to Tissue and Mohair Fiber Growth in Growing Angora Goats*
Experiment Number: RP-04-12
Project Number: OKLX-SAHLU
Investigators: R. Puchala, A. L. Goetsch, and T. Sahlu

Objectives: Determine effects of different levels of feed intake on nutrient partitioning to tissue and mohair fiber gain by growing Angora goats, as well as effects on subsequent partitioning with a high nutritional plane.

Title: *Use of Goats for Sustainable Vegetation Management in Grazing Lands - Third Grazing Season*
Experiment Number: SH-04-13
Project Number: OKLX-SAHLU
Investigators: S. P. Hart, and A. L. Goetsch
Objectives: Determine effects of different goat grazing treatments on vegetation conditions and animal performance at three Oklahoma sites, in cooperation with the Cherokee, Greater Seminole, and Osage Nations.

Title: *Blood Constituents as Potential Indicators of Meat Goat Buck Test Performance*
Experiment Number: AA-04-14
Project Number: OKLX-SAHLU
Investigators: A. Asmare, T. A. Gipson, C. F. Rosenkrans, A. L. Goetsch, R. C. Merkel, and D. Kiesler
Objectives: Determine relationships between blood constituents (LDH isozymes, G6PDH isozymes, serum proteins, leptin, T_3, T_4, cortisol, IGF-1, and testosterone) determined before the meat goat buck performance test and performance during the test, in order to assess if one or a combination of such measures have potential to predict test performance.

Title: *Effects of Nutritional Plane on Energy Expenditure by Meat Goats*
Experiment Number: AA-04-15
Project Number: OKLX-SAHLU
Investigators: A. Asmare, R. Puchala, A. L. Goetsch, R. C. Merkel, and T. Sahlu
Objectives: Determine to what degree can meat goats decrease EE to maintain body energy status, how does initial body condition of meat goats affect the ability to decrease EE and maintain body energy status, how rapidly does EE change after a decrease in ME intake to achieve constant body energy status, and how rapidly does EE increase after an increase in ME intake.

Title: *Effects of Protein Deficiency on Gastrointestinal Mucosal Tissue and Responses to Nematode Infection in Goats*
Experiment Number: ZW-04-17
Project Number: OKLX-SAHLU
Investigators: Z. Wang, S. Hart, L. J. Dawson, A. L. Goetsch, and T. Sahlu
Objectives: To determine effects of varied protein intake by goats on:

1) apoptosis and proliferation of mucosal (columnar epithelial, goblet, and microfold) cells in the gastrointestinal tract;
2) infection of *Haemonchus contortus* in the gastrointestinal tract (worm burden and FEC);
3) immune responses, measured by ratios of mast, macrophage, eosinophil, and dendritic cells in gastrointestinal tissue, and production of antibodies against parasitic antigens.

Title: *Effects of Different Stocking Rates and Creep Grazing of Mimosa on Subsequent Performance of Growing Crossbred Boer Kids*

Experiment Number: AA-04-18

Project Number: OKLX-SAHLU

Investigators: A. Asmare, G. Detweiler, R. Puchala, A. L. Goetsch, T. A. Gipson, R. C. Merkel, and T. Sahlu

Objectives: Determine effects of preweaning stocking rate and creep grazing of mimosa on subsequent postweaning performance of meat goat kids.

Title: *Evaluation of Infusate Urea Concentration and Plasma Sampling Time to Predict Body Composition in Growing and Mature Goats*

Experiment Number: AA-04-19

Project Number: OKLX-SAHLU

Investigators: A. Asmare, R. Puchala, A. L. Goetsch, T. A. Gipson, L. J. Dawson, R. C. Merkel, T. Sahlu, and G. Detweiler

Objectives: Determine:
1) Most appropriate urea solution concentration for determining body composition of growing and mature goats
2) Appropriate time of plasma sampling
3) Effect of goat age on urea dilution
4) Importance of holding off feed and water

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Abstracts and Short Papers

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Performance by goats and sheep consuming a 65% concentrate diet subsequent to co- grazing of grass/forb pastures at different stocking rates

G. Animut[1,2], A. L. Goetsch[1], G. E. Aiken[3], R. Puchala[1], G. Detweiler[1], C. R. Krehbiel[2], R. C. Merkel[1], T. Sahlu[1] L. J. Dawson[4], and Z. B. Johnson[5]

[1]E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK. [2]Animal Science Department, Oklahoma State University, Stillwater, OK
[3]USDA ARS Dale Bumpers Small Farms Research Center, Booneville, AR
[4]College of Veterinary Medicine, Oklahoma State University, Stillwater, OK. [5]Department of Animal Science, University of Arkansas, Fayetteville, AR

A study was conducted to determine effects of previous co-grazing of mixed grass/forb pastures at three stocking rates (SR) on subsequent performance of goats and sheep consuming a 65% concentrate diet. Experimental periods, in 2002 and 2003, were 15 wk in length, following 16 wk of grazing. Sheep (Khatadin) and goats (≥ 75% Boer) were 4 to 5 mo of age when grazing began. Stocking rates were four (4), six (6), and eight (8) animals per 0.4-ha pasture, with equal numbers of sheep and goats and three pastures per SR. Two sheep and two goats from each pasture were used in this subsequent confinement phase of the study, with initial BW of 23 ± 2.7 and 25 ± 3.6 kg, respectively. ADG by all animals during grazing tended ($P < 0.10$) to decrease with increasing SR (53, 44, and 41 g for 4, 6, and 8, respectively). In the period after grazing, DMI was affected ($P < 0.05$) by year x SR (yr 1: 958, 955, and 1,011g/d; yr 2: 1,109, 904, and 931 g/d for 4, 6, and 8, respectively (SE = 49.6)) and species x year ($P< 0.06$) interactions (yr 1: 1,105 and 844; yr 2: 1,164 and 799 g/d for sheep and goats, respectively (SE = 40.5)). ADG was unaffected by SR ($P > 0.10$; 183, 153, and 159 g for 4, 6, and 8, respectively (SE = 8.3)) but was greater ($P < 0.05$) for sheep vs goats (193 vs 137 g; SE = 8.1). Gain efficiency (ADG:DMI) was not influenced by treatments. Energy expenditure (EE) measured twice via heart rate tended to increase linearly ($P < 0.07$) with increasing SR (562, 592, and 628 kJ/kg $BW^{0.75}$ for 4, 6, and 8, respectively; SE = 15.9). Body composition at the beginning and end of the experiment, measured from shrunk BW and urea space, was not impacted by SR. In conclusion, ADG by neither sheep nor goats consuming a 65% concentrate diet compensated for the effect of SR in a previous grazing period, which may involve effect of prior SR on subsequent EE.

The relationship between heart rate and energy expenditure in growing crossbred Boer and Spanish wethers

R. Puchala, I. Tovar-Luna, A. L. Goetsch, and T. Sahlu

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

Eight Boer (75%) x Spanish (BS) and eight Spanish (S) wether goats (155 ± 8 d of age and 19.2 ± 2.3 kg BW, initial) were used in a replicated crossover design experiment with a 2 x 2 factorial arrangement of treatments to determine effects of genotype, diet quality, and time of the day on energy expenditure (EE), heart rate (HR), and the EE:HR ratio with ad libitum, near maintenance, and fasting levels of feed intake. Diets were 65% concentrate (CON; 13.8% CP, DM basis) and coarsely ground alfalfa hay (FOR; 18.5% CP). EE was determined by respiration calorimetry with head-boxes, expressed relative to average BW within the 2-d measurement periods, and HR was measured using

Polar S610 heart rate monitors. EE ranked ($P < 0.05$) ad libitum > maintenance > fasting (499, 392, and 270 kJ/kg $BW^{0.75}$), and differences ($P < 0.05$) in HR were similar (95.8, 71.5, and 54.2 beats/min, respectively). However, EE:HR was highest among levels of intake ($P < 0.05$) for maintenance (5.09, 5.61, and 5.31 kJ/kg $BW^{0.75}$ per heart beat for ad libitum, maintenance, and fasting, respectively). HR with ad libitum intake tended to be higher ($P < 0.07$) for S vs BS goats (99.2 vs 91.9 beats/min), but genotype had no effect with maintenance intake or fasting. EE:HR with ad libitum intake was higher ($P < 0.05$) for BS vs S (5.57 vs. 5.07 kJ/kg $BW^{0.75}$ per heart beat). Hour of the day affected EE, HR, and EE:HR at all levels of intake ($P < 0.05$). With ad libitum and maintenance intake, EE was highest during and after meals at 0800 and 1600. Conversely, EE during fasting was only higher during daytime hours (0800 to 2000) than at night. For ad libitum, maintenance, and fasting intake, the highest EE:HR ratio was at 1600 (5.60, 6.00, and 5.58 kJ/kg $BW^{0.75}$ per heart beat, respectively). The lowest EE:HR ratio for ad libitum and maintenance intake was at 0700 (4.93 and 5.25 kJ/kg $BW^{0.75}$ per heart beat, respectively), whereas during fasting the lowest value (4.69 kJ/kg $BW^{0.75}$ per heart beat) was at 1000. In conclusion, for use of HR to predict EE, it appears desirable to determine the ratio of EE:HR over an extended period of time with a level of intake similar to that during prediction.

Energy utilization by lactating Alpine goats: dietary concentrate level and stage of lactation

I. Tovar-Luna[1], A. L. Goetsch[1], R. Puchala[1], T. Sahlu[1], S. P. Hart[1], and Z. B. Johnson[2]

[1]E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK
[2]Department of Animal Science, University of Arkansas, Fayetteville, AR

Twenty-four lactating and 13 nonlactating Alpine does were used to determine effects of stage of lactation and dietary concentrate level on energy utilization. Sixty and 20% concentrate diets (HE and LE, respectively) were consumed ad libitum by lactating does and at a level of intake near maintenance by nonlactating animals. Fecal and urine collections and respiration calorimetry were used to determine ME intake and energy expenditure. ME intake by lactating does was affected ($P < 0.05$) by an interaction between stage of lactation and diet (HE: 17.1, 20.0, and 17.9 MJ/d; LE: 17.9, 16.2, and 14.1 MJ/d for early, mid-, and late lactation, respectively (SE = 1.20)). Total milk energy yield decreased ($P < 0.05$) with advancing stage of lactation (7.04, 6.26, and 4.39 MJ/d for early, mid-, and late lactation, respectively; SE = 0.417) and was greater for HE vs LE (6.86 vs 4.94 MJ/d; SE = 0.509). Milk energy from the diet was similar between diets in early lactation but numerically greater in mid- and late lactation for HE than for LE (HE: 4.68, 6.31, and 5.02 MJ/d; LE: 4.88, 3.63, and 2.35 MJ/d for early, mid-, and late lactation, respectively (SE = 0.801)). The efficiency of ME utilization for maintenance based on data from nonlactating does was similar between diets and ranked ($P < 0.05$) mid- > early > late lactation (0.67, 0.71, and 0.61 for early, mid-, and late lactation, respectively; SE = 0.017). The efficiency of use of dietary ME for lactation ($k_{l\text{-}d}$) was not influenced by stage of lactation and was greater ($P < 0.05$) for HE than for LE (0.63 vs 0.55; SE = 0.034). In conclusion, $k_{l\text{-}d}$ by lactating goats appears influenced by metabolizability of the diet similarly regardless of stage of lactation.

Factors influencing urea space estimates in goats

A. Asmare[1,2], L. J. Dawson[3], R. Puchala[1], T. A. Gipson[1], M. Villaquiran[1], I. Tovar-Luna[1], G. Animut[1,4], T. Ngwa[1], R. C. Merkel[1], and A. L. Goetsch[1]

[1]E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK
[2]Animal Science Department, Alemaya University, Dire Dawa, Ethiopia
[3]College of Veterinary Medicine, Oklahoma State University, Stillwater, OK
[4]Animal Science Department, Oklahoma State University, Stillwater, OK

Female Alpine goats, 18 approximately 17 mo of age (yearling) and 18 5-mo-old (growing), were used to determine effects of animal age, urea dose (100, 130, and 160 mg/kg BW), and time without feed and water (shrink; 0, 16, and 24 h) on urea space estimates. A 20% (wt/vol) urea solution was infused into a jugular vein, with blood sampled before infusion and every 3 min to 21. BW was 49.8, 47.4, and 47.0 kg for yearlings and 26.1, 24.6, and 23.9 kg for growing animals after 0, 16, and 24 h shrinks, respectively (SE = 0.80). Time of urea equilibration with body water, determined by a grafted polynomial quadratic-linear model, was affected by a dose x age x shrink interaction ($P < 0.05$); yearling means did not differ (ranging from 7.3 to 10.8 min), although those for growing animals were greater ($P < 0.05$) for 0 h-130 mg (13.0 min) and 24 h-130 mg (13.2 min) compared with 24 h-100 mg (7.6 min) and 16 h-130 mg (7.1 min). Based on these times, 12-min samples were used to determine urea space. Urea space was influenced by an age x shrink interaction ($P < 0.05$), being similar among shrinks for yearlings (17.8, 18.8, and 18.9 kg) and greater ($P < 0.05$) for growing animals after 0 than 24 h shrink (12.9, 11.3, and 10.0 kg for 0, 16, and 24 h, respectively). Hemoglobin concentration in plasma, as an index of hemolysis, was greater ($P < 0.05$) for growing than for yearling animals (1.16 vs 1.86%), lowest among doses ($P < 0.05$) for 100 mg (1.05, 1.74, and 1.75% for 100, 130, and 160 mg, respectively), and highest among shrinks ($P < 0.05$) for 24 h (1.46, 1.42, and 1.61% for 0, 16, and 24 h, respectively). In conclusion, 13 min after infusion appears a reasonable sampling time for determining urea space in goats. Shrink time may have greater effect on urea space with growing vs older goats, and 24 h of shrink or at least 16 seem desirable before estimating urea space. Urea space estimates were similar with urea doses of 130 and 160 mg, and a lower dose such as 100 mg, though lessening hemolysis, can allow relatively greater effect of shrink time on urea space.

Change in energy expenditure by meat goats with varying levels of feed intake

A. Asmare[1,2], R. Puchala[1], A. K. Patra[1], R. C. Merkel[1], T. Sahlu[1], and A. L. Goetsch[1]

[1]E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK
[2]Animal Science Department, Alemaya University, Dire Dawa, Ethiopia

Twelve yearling meat goat wethers (7/8 Boer) were used in a 16-wk experiment to determine effects of different levels of nutrient restriction and a maintenance level of intake after restriction on energy expenditure (EE). Dehydrated alfalfa pellets were fed throughout the experiment. During the first 4 wk for adaptation, wethers were fed near maintenance. In wk 5 to 10, six wethers were fed at 60% of the maintenance level and in wk 11 to 16 were again fed near maintenance (60/100). The other six wethers were fed at 80 and 60% of maintenance in wk 5 to10 and 11 to 16, respectively (80/60). BW and EE were measured on the last day of most weeks, with EE determined from heart rate and the

previously determined ratio of EE to heart rate for each wether. BW did not differ between treatments (40.7, 38.9, 38.6, 37.1, 36.5, 37.1, 37.3, 37.4, 37.9, and 39.4 kg for 60/100, and 39.2, 38.2, 38.3, 37.5, 35.9, 37.5, 36.9, 36.3, 36.7, and 37.9 kg for 80/60 in wk 5, 6, 7, 9, 10, 11, 12, 13, 15, and 16, respectively). EE, expressed relative to BW at the end of the adaptation period, was not different between treatments in wk 4 (362 and 342), 5 (361 and 385), 6 (320 and 308), or 7 (280 and 302), but was numerically lower for 60/100 than for 80/60 in wk 9 (261 and 283; $P < 0.08$) and 10 (259 and 276 kJ/kg $BW^{0.75}$ for 60/100 and 80/60, respectively; $P < 0.13$). After the change in plane of nutrition, EE was less ($P < 0.05$) for 60/100 than for 80/60 in wk 11 (258 and 289) and greater ($P < 0.05$) for 60/100 in wk 12 (328 and 266), 13 (328 and 256), and 15 (332 and 257 kJ/kg $BW^{0.75}$ for 60/100 and 80/60, respectively). In summary, there appears a 1- to 2-wk delay or lag in change in EE by goats in response to a marked decrease in feed intake or increase after a severe restriction. Change in EE upon nutrient restriction may be complete within 4 wk, but that with increased intake up to maintenance after a severe restriction can occur more quickly.

Grazing behavior and energy expenditure by sheep and goats co-grazing grass/forb pastures at three stocking rates

G. Animut[1,2], A. L. Goetsch[1], G. E. Aiken[3], R. Puchala[1], G. Detweiler[1], C. R. Krehbiel[2], R. C. Merkel[1], T. Sahlu[1], L. J. Dawson[4], Z. B. Johnson[5]

[1]E (Kika) de la Garza American Institute for Goat Research, P. O. Box 730, Langston University, Langston, OK
[2]Animal Science Department, Oklahoma State University, Stillwater, OK
[3]USDA ARS Dale Bumpers Small Farms Research Center, Booneville, AR
[4]College of Veterinary Medicine, Oklahoma State University, Stillwater, OK
[5]Department of Animal Science, University of Arkansas, Fayetteville, AR

A study was conducted to assess effects of stocking rate (SR) on grazing behavior and energy expenditure (EE) by growing sheep and goat wethers co-grazing grass/forb pastures. Grazing was for 16-wk periods in 2002 and 2003. Pastures consisted of various grasses, primarily bermudagrass (*Cynodon dactylon*) and johnsongrass (*Sorghum halepense*), and forbs (e.g., ragweed; *Ambrosia spp.*). Sheep (Khatadin) and goats (³ 75% Boer) averaged 21 ± 0.7 and 21 ± 0.5 kg initial BW, respectively, and were 4 to 5 mo of age when grazing began. Stocking rates were four (SR4), six, (SR6), and eight (SR8) animals per 0.4-ha pasture, with equal numbers of sheep and goats. The nine pastures (three/treatment) were divided into four paddocks that were rotationally grazed in 2-wk periods. In wk 3, 8, and 13 of both years, EE was determined for one goat and one sheep in each pasture via heart rate. Grazing behavior using IGER Grazing Behavior monitoring system units was measured over 24-h periods on the same animals. The number of steps increased linearly ($P < 0.05$) with increasing SR (2,279, 2,707, and 2,788 for SR4, SR6, and SR8, respectively (SE = 96.4)), but was similar for the two species (2,633 and 2,550 for sheep and goats, respectively (SE = 69.9)). As SR increased time spent eating increased (7.4, 8.4, and 9.6 h) and time spent lying (11.0, 10.2, and 8.9 h), ruminating (7.9, 7.7, and 6.8 h), and idle (8.6, 8.0, and 7.6 h for SR4, SR6, and SR8, respectively) decreased ($P < 0.05$). Goats spent less time eating (1.1-h difference) and more time idle (0.7 h-difference) than did sheep ($P < 0.05$). SR, species, and year interacted ($P < 0.05$) in EE of wethers (year 1, sheep: 510, 569, and 572 kJ/kg $BW^{0.75}$; year 2, sheep: 572, 597, and 648 kJ/kg $BW^{0.75}$; year 1, goat: 524, 524, and 640 kJ/kg $BW^{0.75}$; year 2, goat: 499, 496, and 551 kJ/kg $BW^{0.75}$ for SR4, SR6, and SR8, respectively (SE = 17.0)).

In summary, influences of SR on grazing time and EE can vary with grazing season. With forage conditions of this study, SR had similar effects on grazing behavior of sheep and goats when co-grazing. Effects of SR on EE may contribute to impact on ADG by small ruminants.

Effect of initial body condition of Boer x Spanish yearling wethers and level of nutrient intake on change in mass of internal organs and tissues

A. T. Ngwa[1], L. J. Dawson[2], R. Puchala[1], G. Detweiler[1], R. C. Merkel[1], I. Tovar-Luna[1], T. Sahlu[1], and A. L.Goetsch[1]

[1]E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK
[2]College of Veterinary Medicine, Oklahoma State University, Stillwater, OK

Yearling Boer x Spanish wethers (54) were used to assess effects of initial body condition and level of feed intake on change in mass of internal organs and tissues. Before the experiment, 27 wethers were fed to achieve high body condition score (BCS; 1 to 5) and BW (IF) and 27 were fed for low BCS and BW (IT). During the experiment, IF wethers were fed low amounts of a pelletized diet and IT wethers received high amounts, with periodic changes in accordance with target BW change of -83 and 83 g/d, respectively. Harvest measures were determined before the experiment and after 12 and 24 wk. As expected, there were numerous treatment x time interactions ($P < 0.05$). BCS was 3.8, 3.2, 2.6, 1.9, 2.8, and 3.5 (SE = 0.11) and live BW was 53.3, 46.2, 42.4, 36.6, 40.1, and 48.2 kg (SE = 2.03) for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively. Carcass mass was 24.7, 21.6, 20.2, 14.7, 17.7, and 22.3 kg (SE = 1.02), and mass of noncarcass components was 24.7, 21.6, 20.2, 14.7, 17.7, and 22.3 kg (SE = 0.73) for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively. There were substantial declines in mass of many internal organs with advancing time for IF compared with relatively small change for IT. Examples include the reticulo-rumen (1,030, 589, 516, 865, 778, and 729 g; SE = 41.2), abomasum (229, 161, 128, 196, 187, and 191 g; SE = 10.0), small intestine (594, 269, 227, 546, 325, and 364 g; SE = 20.5), large intestine (397, 240, 240, 325, 325, and 264 g; SE = 17.2), liver (864, 454, 419, 556, 604, and 669 g; SE = 30.7), heart (252, 162, 165, 185, 156, and 169 g; SE = 8.9), and kidneys (138, 90, 89, 101, 105, and 103 g for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively; SE = 5.1). Conversely, change in visceral fat was much greater for IT vs IF (5.7, 3.9, 2.8, 0.6, 2.5, and 5.1 kg for IF-0 wk, IF-12 wk, IF-24 wk, IT-0 wk, IT-12 wk, and IT-24 wk, respectively; SE = 0.33). In conclusion, these results suggest that initial body condition can impact change in mass of energetically expensive internal organs with different planes of nutrition as well as of energy storage depots such as visceral fat, which may influence nutrient requirements and efficiency of energy use.

Postweaning performance by crossbred Boer kids consuming pelletized alfalfa subsequent to grazing at different stocking rates

A. Asmare[1,2], A. K. Patra[1], R. Puchala[1], G. Detweiler[1], T. A. Gipson[1], T. Sahlu[1], and A. L. Goetsch[1]

[1]E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK
[2]Animal Science Department, Alemaya University, Dire Dawa, Ethiopia

Thirty-two crossbred Boer kids were used to determine effects of different preweaning grazing treatments, influencing ADG, on subsequent postweaning performance while consuming dehydrated alfalfa pellets. Pastures used in the 76-d grazing period (0.4 ha) consisted of grasses such as bermudagrass and johnsongrass and various forbs, particularly ragweed. Stocking rates were 4, 6, and 8 does, each with two kids, per pasture (L, M, and H, respectively). In addition, a fourth treatment (C) entailed 8 does per pasture but with kid access to another 0.4-ha pasture containing mimosa trees. One-half of the does were Boer x Spanish and others were Spanish, with all having kids from Boer bucks. There were two groups per treatment, and four paddocks within each pasture were sequentially grazed in 7- to 14-d periods. Kids were weaned after grazing, with the 84-d subsequent growth phase (four 21-d periods) starting 3 wk later. Four kids from each pasture were used (one from each of four does), distributed into four pens each equipped with an automated feeding system. Initial BW was 17 kg (SE = 3.0) and preweaning ADG while grazing was 76, 61, 37, and 81 g for L, M, H, and C, respectively (SE = 6.7). Postweaning ADG was similar among treatments (56, 42, 49, and 69 g for L, M, H, and C, respectively; SE = 13.8), greater ($P < 0.05$) for wethers than for doelings (71 vs 37 g), not affected by genotype, and not correlated with preweaning ADG ($r = 0.09$; $P < 0.63$). Energy expenditure (EE), estimated each period from heart rate and the ratio of EE to heart rate determined for each animal, was similar among treatments (520, 554, 545, and 551 kJ/kg $BW^{0.75}$ for L, M, H, and C, respectively; SE = 20.7) and correlated with ADG ($r = 0.40$; $P < 0.0001$). In conclusion, differences among preweaning grazing treatments in ADG were not compensated for in a postweaning confinement phase with a pelleted alfalfa diet.

A comparison of herbicide, goats, and mowing for control of woody vegetation species

S. P. Hart, J. Joseph, A. L. Goetsch, and J. Brokaw

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

The objective of this study was to compare herbicide, goats, and mowing for control of woody vegetation species and their impact on herbaceous species. The study site was a native tallgrass prairie that had been invaded by woody species, predominantly blackberry, buckbrush, winged elm, and sumac. Two replicate 2.0-ha pastures were fenced with electric fence for containment of goats. Replicate 0.4-ha plots were used for control, mowing, and herbicide treatments. The mowing treatment consisted of mowing to a 15-cm height in the middle of the growing season each year. The herbicide treatment consisted of 1.2 L of Grazon P+D and 1.2 L of Remedy in 200 L of water/ha applied during the growing season each year. Goats were stocked for two summers, starting in early June, and were removed from the plots in the fall. The stocking rate was 15 and 10 hd/ha in the first and second year, respectively. Woody vegetation cover was measured by the line intercept method on five 30-m permanent transects per pasture and herbaceous species composition was measured by identification of plant species at 0.3-m intervals of the transect. Herbicide treatment reduced ground cover of blackberry (17.7 vs 1.9%; $P < 0.10$), flame leaf sumac (16.2 vs 0%; $P < 0.10$), smooth sumac (1.2 vs 0%; $P > 0.10$), rose (5.7 vs 2.0%; $P > 0.10$), and sassafras (1.1 vs 0%; $P > 0.10$), but winged elm, buckbrush, and greenbriar were not controlled by herbicide. Goats reduced percent ground cover of blackberry, (18.5 vs 13.7%; $P < 0.10$), sumac (21.1 vs 17.0%; $P > 0.10$), rose (3.7 vs 2.2%; $P > 0.10$), poison ivy (1.5 vs 0.7%; $P > 0.10$), and dogwood (9.1 vs 4.2%; $P > 0.10$), but buckbrush (25.1 vs 33.3%; $P > 0.10$) and persimmon cover (2.9 vs 5.7%; $P > 0.10$) increased despite being defoliated by goats. Only ground cover of buckbrush and flameleaf sumac were decreased by mowing (1.4 vs 0 and

10.2 vs 4.2%, respectively; P > 0.10). Grazing by goats reduced cheat, broomsedge, bluestem, hogwort, and sericia lespedeza as a percent of species present; however, Scribners panic, velvet panic, and black medic were increased. Mowing reduced percentages of common yarrow and inland rush, but increased sedge, bermudagrass, Scribners panic, velvet panic, and beaked panic grass. Herbicide reduced percentages of common yarrow, hogwort, and yellow oxalis, but increased cheat, Scribners panic, beaked panic, and tall fescue. In this two year study, herbicide was very effective at reducing woody species and goats were more effective than mowing, although the effectiveness of goats was limited by the short duration of the study.

Prediction of meat goat body weight from heartgirth, body condition score, and sex

M. Villaquiran, S. Hart, T. A. Gipson, G. Detweiler, R. M. Merkel, A. Patra, and T. Ngwa

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

Body weight is needed for accurate dosing of medicine and for marketing and management decisions. However, producers do not always have access to scales; therefore, other means of prediction are needed. Prediction equations using heartgirth exist for dairy goats, but no such equations are available for meat goats. Breeds of meat goats vary greatly in conformation and may require different prediction equations. It is not known if body condition score or sex affects these equations. The objective of this study was to develop equations to predict body weight of meat goats from heartgirth (HG, cm) measurements. Body weight (BW), body condition score (BCS), and heartgirth (cm) were measured for meat goats of Langston University four times in a year (n = 3,375). Genotypes represented included Spanish (S), Boer (B), Boer x Spanish (BX), Fainting, goats (F), and Angora (A). Prediction equations were developed using the GLM procedure of SAS. Heterogeneity of slopes analysis indicated that four equations were adequate for prediction with the seven genotypes. Linear regression fit the data set slightly better than curvilinear regression (R^2 = 0.849 vs 0.852). One equation was adequate to predict BW of S and F goats (BW = 0.629 + (0.460 x HG); (R^2 = 0.849, n = 790). BCS affected the equations for 1/2 BX and A. For BCS < 2.5, BW = 2.02 + (0.435 x HG) (R^2 = 0.817, n = 665); for BCS = 2.5, BW = -1.22 + (0.507 x HG) (R^2 = 0.764, n = 705). Sex affected the equations for B. For female, BW = -1.31 + (0.537 x HG) (R^2 = 0.921, n = 134); for males, BW = -5.02 + (0.623 x HG) (R^2 = 0.937, n = 136). Sex and BCS affected equations for 3/4 and 7/8 BX. For females with BCS < 2.5, BW = -3.75 + (0.562 x HG) (R^2 = 0.944, n = 144); BCS = 2.5, BW = -1.50 + (0.520 x HG) (R^2 = 0.882, n = 343), and BCS > 2.5, BW = 3.12 + (0.478 x HG) (R^2 = 0.792, n= 138). For males with BCS < 2.5, BW = 2.46 + (0.375 x HG) (R^2 = 0.870, n = 98), BCS = 2.5, BW = 2.56 + (0.419 x HG) (R^2 = 0.922, n = 142), and BCS > 2.5, BW = 6.46 + (0.441 x HG) (R^2 = 0.792, n = 0.80). BW of meat goats could be predicted with acceptable accuracy based on HG, but it was necessary to use separate equations for sex and BCS for some genotypes.

Effect of feeding system on performance test traits of young meat bucks in a central performance test

T. A. Gipson, L. Dawson, and T. Sahlu

E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK.

Central performance testing of meat goats is increasing in popularity in the US as indicated by increasing number of bucks on-test and increasing number of test stations. Various feeding systems are available which enable measurement of individual performance traits such as intake, gain, etc. The objective of this research was to compare the effect of two different feeding systems on performance test traits. In 2004, 56 young meat bucks (entry age 101 ± 20.0 d and weight 24.3 ± 5.8 kg), predominately Boer, were enrolled in the buck performance test at Langston University. Half of the bucks were randomly assigned to Calan (C) gate feeders and the other half to automated Feed Intake Recording Equipment (F) feeders. The F system is a completely automated electronic feeding system, which records body weight and feed intake of each individual animal's visit. For the C feeders, each buck wears a collar with an electronic key, which allows access to an individual feeder, feed is weighed and intake is calculated manually. For both C and F feeders, all bucks were weighed weekly for the 12 weeks of the performance test. Beginning weight, end weight, gain, average daily gain (ADG), feed intake (FI), feed conversion ratio (FCR), and residual feed intake (RFI) were analyzed using general linear models procedure of SAS. After a 2-wk adjustment period, bucks averaged 29.4 kg for C and 30.7 for F (P = 0.49). At the end of the performance test, bucks averaged 52.9 kg for C and 55.6 for F (P = 0.24). Gain was 23.5 kg for C and 24.9 for F (P = 0.22), which resulted in an ADG of 290.2 g/d for C and 297.3 for F (P = 0.56). FI averaged 160.5 kg for C and 166.1 for F (P = 0.49), which resulted in a FCR of 0.149 for C and 0.150 for F (P = 0.83). RFI averaged -0.003 for C and -0.008 for F (P = 0.89). The type of feeding delivery system had no effect upon any of the performance test traits. Therefore, the feeding delivery system should have no effect upon a buck's final ranking on a central performance test.

Summaries of Recent Journal Articles

(2004 and In Press)

Effects of ammoniation of wheat straw and supplementation with soybean meal or broiler litter on feed intake and digestion in yearling Spanish wether goats

G. Abebe, R. C. Merkel, G. Animut, T. Sahlu, and A. L. Goetsch

Small Ruminant Research 51:37-46. 2004.

The quantity and quality of available feedstuffs are major factors influencing productivity of ruminants in many parts of the world, especially regions with high animal numbers. Ruminants in such areas depend largely on crop residues at least during the long dry periods of the year for maintenance as well as production of meat, milk, skin and fiber. However, animal performance with such feedstuffs can be poor due to low voluntary intake and digestibility, which result from low protein concentrations and high levels of indigestible or slowly degradable fiber. Various physical, chemical and biological treatments have been used to improve utilization of low quality forages such as crop residues. In parts of the world where small farms predominate, treatment with a urea solution followed by a period of storage under air-tight conditions may be more practical. Treatment of crop residues with urea has three primary interrelated benefits, namely increased nitrogen concentration, digestibility and feed intake. An alternative to treatment of crop residues to enhance utilization is supplementation, although quality, availability and cost of potential supplements can limit application. Broiler litter is a low-cost agricultural byproduct available in many areas of the world that has been used as a supplementary feedstuff for low and moderate quality forages. Therefore, objectives of this experiment were to determine effects on feed intake and digestion in yearling Spanish wethers of supplementation of wheat straw treated with urea for ammoniation or untreated with soybean meal or broiler litter. Eight yearling Spanish wethers were used, consuming basal diets of wheat straw treated (ammoniated) with urea (T) or untreated (U) supplemented with soybean meal or broiler litter. Supplements were C (ground corn-based and fed at 0.64% body weight, dry matter basis, S (C plus 0.25% body weight of soybean meal) and LL and HL (C plus 0.5 or 1.0% body weight of broiler litter, respectively). Addition of soybean meal or different levels of broiler litter a moderate level of a grain-based supplement increased digestible organic matter intake by yearling Spanish goat wethers consuming a basal wheat straw diet, with magnitudes of change not significantly affected by ammoniation of wheat straw and being greater for the high level of broiler litter compared with the lower level and with soybean meal. Presumably because of extensive nitrogen recycling, including nitrogen from mobilized tissue, which prevented impact on extent of wheat straw digestion,change in digestible organic matter intake appeared primarily because of additional digestible organic matter provided by soybean meal and broiler litter without substitution for wheat straw intake. However, with prolonged feeding of untreated crop residues, limited tissue nitrogen available for recycling might be conducive to impact of supplemental nitrogen on intake and ruminal digestion. Ammoniated crop residues and concentrate supplements high in ruminally degraded nitrogen can be employed together when high nutritional planes are desired, although supplements with a lower concentration of nitrogen might be more economical. A relatively high level of broiler litter to supplement untreated wheat straw, in addition to a moderate level of supplemental concentrate, may be necessary to achieve digestible organic matter intake comparable to that with ammoniated wheat straw and a moderate level of concentrate supplement.

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

G. Animut, A. L. Goetsch, R. E. Estell, R. C. Merkel, L. J. Dawson, T. Sahlu, and R. Puchala

Small Ruminant Research 54:197-212. 2004.

Twenty-four Boer crossbred yearling wethers (23.5 ± 2.31 kg initial BW) were used to determine effects of stepwise increases in dietary level of Eastern red cedar (*Juniperus virginiana*) foliage (CF), compared with a constant relatively high level and subsequent availability of low-quality forage, on present and later consumption of CF. Animals were penned individually in Phases 1 (8 wk) and 3 (2 wk), and during Phase 2 (6 wk) wethers were kept in a pasture not containing cedar trees and were fed wheat hay. In Phase 1 a concentrate-based diet (CBD, 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 level of substitution of CF for CBD (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). In Phase 3 (2 wk), all wethers were offered the diet of 75% CBD and 25% CF as previously, without or with separate free-choice access to low-quality grass hay. CF was harvested weekly, refrigerated and hand-mixed with CBD prior to feeding. In Phase 1, 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: 90 and 71; wk 6: 96 and 81; wk 7: 93 and 63; wk 8: 96 and 84), although CF intake as g/day was greater ($P < 0.05$) for Set vs. Step in all but wk 7 and 8. In Phase 3, CBD intake was similar among treatments, and hay intake when offered averaged 149, 134 and 124 g/day for Step, Set and Control, respectively. For wethers not receiving hay, CF intake as g/day for Step was greatest among treatments ($P < 0.05$) but was not different from treatments with offered hay (67, 37, 30, 55, 53 and 56 g/day for Step, Set and Control without and with hay, respectively; SE = 7.1). Similarly, CF intake as a percentage of that offered 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 and Control without and with hay, respectively; SE = 7.6). Concentrations of various blood constituents at the end of Phases 1 and 3 did not indicate adverse health effects of CF consumption. In conclusion, gradual increases in dietary level of CF deserve further research as a potential means to elevate present and future CF consumption, with attention also directed to effects of type and level of other feedstuffs offered.

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

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

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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.

Growth of yearling meat goat doelings with changing plane of nutrition

R. Joemat, A. L. Goetsch, G. W. Horn, T. Sahlu, R. Puchala, B. R. Min, and J. Luo

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Periods of low rainfall are common in Oklahoma and other western States, as well as in regions of many other countries. An obvious practice to avert decreased productivity in dry periods is supplementary feeding. Hence, livestock producers must compare cost of supplementation with projected effects of not supplementing on current and future productivity. In addition, the maximum length of time with low nutrient intake that can be allowed without impairing future production potential is a consideration. In general, ruminants can partially or completely compensate for an earlier period of slow or no growth or body weight (BW) loss with a low nutritional plane through increased feed intake and(or) more efficient feed utilization. The magnitude and nature of compensatory growth is influenced by numerous factors, among which might be genotype or breed. Therefore, objectives of this experiment were to determine effects on growth performance by yearling Boer × Spanish and Spanish doelings of different lengths of nutrient restriction and levels of supplementation during realimentation. 25 Boer × Spanish (BS) and 25 Spanish (S) yearling doelings (27 and 21 kg initial BW, respectively), were used in a 16-week experiment (four 28-day periods) to determine effects on growth of length of nutrient restriction and level of concentrate supplementation during a subsequent period with a higher nutritional plane (realimentation). Doelings consumed prairie hay (6.2% crude protein) free-choice and received daily supplementation with 0.75% BW of concentrate (30% crude protein; C treatment), sequential 28-day periods of no supplementation and daily supplementation with 1.50 or 0.75% BW 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% BW of concentrate (H-56 and L-56, respectively). Average daily gain (ADG) was similar among dietary treatments and between genotypes in period 1. In period 2, ADG was generally lowest among treatments for 56-day restriction treatments, with the difference being greater for BS vs S (24, 34, 41, -63, and -96 g/day for BS, and 6, 13, -5, -40, and -36 g/day for S, with C, H-28, L-28, H-56, and L-56, respectively). In period 3, ADG was similar among dietary treatments for S but was lower with 28- vs 56-day restriction treatments for BS (85, -9, 0, 123, and 112 g/day for BS, and 26, 32, 34, 64, and 68 g/day for S, with C, H-28, L-28, H-56, and L-56, respectively). In period 4, ADG was lower for C vs H-56 and L-56 (39, 53, 71, 87, and 85 g/day

with C, H-28, L-28, H-56, and L-56, respectively). Overall ADG in periods 1-4 was similar among dietary treatments for S but was greater for C than for H-28, L-28 and L-56 (57, 28, 26, 46, and 22 g/day for BS, and 18, 24, 29, 35, and 29 g/day for S, with C, H-28, L-28, H-56, and L-56, respectively. In conclusion, growth and development of yearling S doelings appear slightly less susceptible to periods of low nutrient intake compared with BS doelings, indicating a greater importance of a continual adequate plane of nutrition for BS doelings. Realimentation periods of 28 or 56 days with concentrate given at 0.75% BW did not allow ADG by BS doelings to fully compensate for low ADG during feed restriction compared with C, and the same was true for concentrate supplemented at 1.50% BW with 28-day restriction periods. This suggests a longer period for realimentation than restriction necessary to achieve overall ADG similar to doelings continuously on a moderate nutritional plane.

Prediction of endogenous urinary nitrogen of goats

J. Luo, A. L. Goetsch, J. E. Moore, Z. B. Johnson, T. Sahlu, C. L. Ferrell, M. L. Galyean, and F. N. Owens

Small Ruminant Research 53:293-308. 2004.

Three databases were constructed to estimate endogenous urinary N (EUN) in nonlactating and lactating goats. The first database consisted of 22 observations in which urinary N (UN) was measured with nonlactating goats fed diets very low in N concentration (0.032-0.33% of DM). A log-log weighted linear regression of EUN (g) on BW (kg) indicated that 0.75 was an appropriate power of BW for which UN, the estimate of EUN, could be expressed. The intercept, which represented an estimate of EUN, was 0.122 g/kg $BW^{0.75}$. The second database for nonlactating goats, with means from 186 treatment-experiment combinations, was split into two groups, one for equation development (n = 121) and a second for evaluation of the equations (n = 65). With the development set, UN (g/kg $BW^{0.75}$) was regressed on total N intake (TNI; g/kg $BW^{0.75}$) or apparently digested N intake (DNI; g/kg $BW^{0.75}$). After removing observations with relatively high residual SD from the development set, equations were: $UN = 0.092 + (0.288 \times TNI)$ [n = 79; $R^2 = 0.59$] and $UN = 0.165 + (0.340 \times DNI)$ [n = 79; $R^2 = 0.59$]. The intercepts, 0.092 and 0.165 g/kg $BW^{0.75}$, are estimates of EUN when TNI and DNI are zero, respectively. At zero DNI, truly digested N intake should equal metabolic fecal N; thus, the DNI estimate of EUN may be applicable to nonlactating goats in zero or positive N balance with feed intake above maintenance and appropriate to use in summation equations to predict N requirements without need for further adjustment factors. Prediction equations for lactating goats with feed intake above maintenance were: $UN = 0.182 + (0.235 \times TNI)$ [n = 33; $R^2 = 0.65$] and $UN = 0.160 + (0.354 \times DNI)$ [n = 33; $R^2 = 0.72$]. In summary, based on databases from publications on goat feeding and nutrition, EUN of nonlactating goats with feed intake above maintenance was estimated at 0.165 g/kg $BW^{0.75}$ by regressing UN against DNI; EUN of lactating goats based on DNI seemed similar to that for nonlactating goats.

Maintenance energy needs of goats: predictions based on observations of heat and recovered energy

J. Luo, A. L. Goetsch, I. V. Nsahlai, Z. B. Johnson, T. Sahlu, J. E. Moore, C. L. Ferrell, M. L. Galyean, and F. N. Owens

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A database including 80 treatment means based on energy balance publications was constructed and analyzed to estimate fasting heat production (FHP) and ME required for maintenance (ME_m) of goats. Experiments entailed comparative slaughter, respiration calorimetry or CO_2 entry rate techniques. Goats were of eight breeds and five physiological states (preweaning; growing; mature and nonlactating; early and mid-pregnancy and lactating). Assuming that heat increment was 40% of total heat energy, unweighted and weighted (number of observations per treatment mean) log-log regressions (n = 74 following removal of outliers) of FHP against BW resulted in FHP (kJ) = 299 × $BW^{0.762}$ (R^2 = 0.82) and 244 × $BW^{0.826}$ (R^2 = 0.75), respectively. The 0.762 and 0.826 BW scaling factors did not differ ($P \geq 0.17$) from 0.75. The slope and intercept of a regression of recovered energy (RE) against ME intake (MEI) for preweaning goats differed ($P < 0.01$) from those for other physiological states. A linear regression analysis of RE on MEI (both kJ/kg $BW^{0.75}$) was conducted for the remaining 71 observations, after removing two observations with greater than 2.5 residual SD. The resultant equation was: RE = -298.0 (SE = 22.38) + (0.691 (SE = 0.028) × MEI) [n = 69; R^2 = 0.90]. These estimates of FHP and efficiency of ME use yielded an estimate of ME_m of 431 kJ/kg $BW^{0.75}$. In summary, FHP and ME_m of 298 and 431 kJ/kg $BW^{0.75}$, respectively, appear appropriate as general descriptors of the maintenance energy requirement of goats consuming diets at, near or above maintenance.

Metabolizable protein requirements for maintenance and gain of growing goats

J. Luo, A. L. Goetsch, I. V. Nsahlai, J. E. Moore, M. L. Galyean, C. L. Ferrell, Z. B. Johnson, T. Sahlu, and F. N. Owens

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A database of 349 treatment mean observations, representing 3404 goats from 73 publications between 1973 and 2003, was used to determine metabolizable protein (MP) requirements for maintenance (MP_m) and growth (MP_g) of goats. Published CP degradation properties of feedstuffs and proportions of dietary ingredients were used to estimate MP intake (MPI, g/day), which was regressed against ADG, with both variables scaled by $BW^{0.75}$. Goats were classified as meat (≥ 50% Boer; 60 observations), dairy (selected for milk production; 129 observations) and indigenous (160 observations) biotypes. Because of differences ($P < 0.01$) among biotypes in slopes, separate regressions were initially performed: meat: MPI = 2.55 (SE = 0.360) + (0.441 (SE = 0.0276) × ADG) (n = 58; R^2 = 0.82); dairy: MPI = 2.83 (SE = 0.344) + (0.299 (SE = 0.0238) × ADG) (n = 123; R^2 = 0.57); and indigenous: MPI = 3.23 (SE = 0.212) + (0.281 (SE = 0.0304) × ADG) (n = 152; R^2 = 0.36). Intercepts did not differ among biotypes ($P = 0.37$), but the slope for meat goats differed ($P < 0.01$) from those for dairy and indigenous goats; therefore, data sets for dairy and indigenous goats were pooled and split into development (n = 150) and evaluation (n = 125) subsets. Using the equation derived from the

development data subset for dairy and indigenous goats (i.e., MPI = 3.14 (SE = 0.189) + (0.285 (SE = 0.0168) × ADG) [n = 144; R^2 = 0.67)], MPI for the evaluation subset was predicted; regressing observed against predicted MPI of the evaluation data subset resulted in an intercept and slope not different from 0 and 1, respectively ($P > 0.05$). The equation from the development subset for dairy and indigenous goats was compared with the equation from the meat goat data set; there was a difference ($P < 0.01$) in slopes but not in intercepts ($P = 0.25$). Therefore, a dummy variable (D = 1 for meat goats and 0 otherwise) was used to develop a common intercept equation: MPI = 3.07 (SE = 0.165) + (0.290 (SE = 0.0150) × ADG) + (0.114 (SE = 0.0162) × D × ADG) (n = 202; R^2 = 0.75). In conclusion, based on regression of MPI against ADG, MP_m was 3.07 g/kg $BW^{0.75}$ for all biotypes of growing goats, and MP_g was 0.404 and 0.290 g/g ADG for meat and other (dairy and indigenous) goats, respectively.

Prediction of voluntary feed intake by lactating, Angora, growing and mature goats

J. Luo, A. L. Goetsch, I. V. Nsahlai, J. E. Moore, M. L. Galyean, Z. B. Johnson, T. Sahlu, C. L. Ferrell, C. L., and F. N. Owens

Small Ruminant Research 53:357-378. 2004.

Databases amassed from the literature were used to predict feed intake by lactating, Angora, growing and mature goats, using 221, 54, 282 and 99 treatment means, respectively. One prediction approach was based on a calculated constant overall efficiency of ME utilization (k) considering biotype (meat, ≥ 50% Boer; dairy; indigenous; Angora), BW (kg; all goats), 4% fat-corrected milk (FCM, kg; lactating), BW change or ADG (kg; lactating, growing and mature), dietary ME concentration (MEC, MJ/kg DM; all goats), tissue gain (TG, kg; Angora) and clean mohair fiber gain (FG, kg; Angora). For lactating goats, assumptions included efficiency of ME utilization for maintenance and activity: 0.503 + (0.019 × MEC); efficiency of ME use for gain (k_g): 0.75; efficiency of use of mobilized ME for lactation: 0.84; efficiency of use of dietary ME for lactation: 0.589; tissue energy concentration (TEC): 23.9 MJ/kg; ME requirement for maintenance and stall or pen activity (ME_mREQ): 0.5013 and 0.4227 MJ/kg $BW^{0.75}$ for dairy and other goats, respectively; and all mobilized tissue energy used for lactation. After removing observations with residuals greater than 1.5 × root mean square error (RMSE), k was 0.653 (SE = 0.0014). Predicted DM intake (DMI_P) including an adjustment (DMI_{AP}) for the ratio of ADG:FCM (ADGFCM) was: DMI = 0.0964 (SE = 0.0704) + (0.9334 (SE = 0.9314) × DMI_P) - (0.1237 (SE = 0.05923) × ADGFCM) [R^2 = 0.84; RMSE = 0.2187; n = 191]. Mean k, estimated from a random development data set, resulted in unbiased prediction of intake for an evaluation data set without observations removed. Assumptions for Angora goats that differed from lactating goats were efficiency of ME use for tissue gain (TG; kg/day): 0.006 + (0.0423 × MEC); efficiency of use of ME (dietary and mobilized tissue) for clean fiber gain (FG): 0.151; TEC = 4.972 + (0.3274 × kg BW); ME_m: 0.473 MJ/kg $BW^{0.75}$; ME used for FG: FG × 157 MJ/kg; and all mobilized tissue energy used for FG. Mean k for Angora goats was 0.525 (SE = 0.0112), and prediction accuracy was improved by adjusting for dietary CP concentration (PTCP, % DM): DMI = -0.1607 (SE = 0.11430) + (0.8227 (SE = 0.10851) × DMI_P) + (0.0199 (SE = 0.00697) × PTCP) [R^2 = 0.65; RMSE = 0.1239; n = 54]. Assumptions for growing goats included: k_g: 0.006 + (0.0423 × MEC); efficiency of use of mobilized tissue energy for maintenance: k_m; and ME_mREQ: 0.489, 0.580 and 0.489 MJ/kg $BW^{0.75}$ for meat, dairy and indigenous goats, respectively. After removing observations with residuals greater than 2 × RMSE, k was 0.634 (SE = 0.0020). Prediction accuracy was improved by adjusting

for ratios of ADG to BW (ADGBW), $BW^{0.75}$ (ADGMBW) and $ADGMBW^2$: DMI = -0.0047 (SE = 0.1854) + (0.9637 (SE = 0.04928) × DMI_p) - (70.27 (SE = 23.534) × ADGBW) + (38.71 (SE = 12.224) × ADGMBW) - (243.4 (SE = 121.73) × $ADGMBW^2$) [R^2 = 0.88; RMSE = 0.1030; n = 266]. Mean k estimated from a random development data set resulted in unbiased prediction of intake for an evaluation data set without observations removed. Assumptions for mature goats were the same as those for growing goats except for a ME_mREQ of 0.462 MJ/kg $BW^{0.75}$. k was 0.632 (SE = 0.00448), and prediction accuracy was improved by adjusting for PTCP, ADGBW and ADGMBW: DMI = -0.1241 (SE = 0.07374) + (0.7915 (SE = 0.06911) × DMI_p) + (0.0214 (SE = 0.00381) × PTCP) - (535.2 (SE = 66.35) × ADGBW) + (247.3 (SE = 29.53) × ADGMBW) [R^2 = 0.85; RMSE = 0.1537; n = 99]. Because of the relatively large number of observations in this study, these methods should be useful for predicting voluntary intake of different diets by a variety of goats in or near thermoneutral conditions fed in pens or stalls.

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

J. Luo, A. L. Goetsch, I. V. Nsahlai, T. Sahlu, C. L. Ferrell, F. N. Owens, M. L. Galyean, J. E. Moore, and Z. B. Johnson

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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, scaled by kg $BW^{0.75}$, were mean BW (kg), ME intake (MEI, kJ/d), ADG (g), ADG adjusted for grease fleece weight (adjADG, g), and clean fleece growth rate (CFGR, g/d); all variables in the regression analysis were Because of differences between growing and mature goats in intercepts and 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 11 observations with residuals greater than 1.5 times the residual standard deviation, the final equation was MEI = 496 (SE = 16.6) + 46.8 (SE = 4.06) × ADG [n = 68; R^2 = 0.66]. 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) × adjADG + 159 (SE = 55.1) × CFGR [n = 49; R^2 = 0.45]. In conclusion, estimated ME requirements for maintenance of mature Angora goats were 469 and 496 kJ/kg $BW^{0.75}$ and ME requirements for unadjusted and adjusted ADG and clean mohair growth were 46.8, 33.6, and 159 kJ/g, respectively.

Prediction of metabolizable energy requirements for maintenance and gain of preweaning, growing, and mature goats

J. Luo, A. L. Goetsch, T. Sahlu, I. V. Nsahlai, Z. B. Johnson, J. E. Moore, M. L. Galyean, F. N. Owens, and C. L. Ferrell

Small Ruminant Research 53:309-328. 2004.

Databases were constructed to determine ME requirements for maintenance (ME_m) and BW gain (ME_g) of preweaning, growing and mature goats by regressing ME intake (MEI) against ADG. Goats were categorized as dairy, meat (≥ 50% Boer) or indigenous biotypes. The preweaning database included 98 treatment means representing 1016 goats and the growing goat database consisted of 333 treatment means. Because of differences among biotypes of growing goats in intercepts and slopes ($P < 0.05$), separate regressions were performed. The meat subset included 60 observations from 11 publications, representing 548 goats; the dairy subset had 116 observations from 25 publications with 1851 goats; and the indigenous subset consisted of 157 observations from 34 publications and 1024 goats. Dairy and indigenous subsets were randomly split into independent sets for equation development and evaluation. The mature goat database included 69 treatment means from 23 publications and represented 495 goats. Small numbers of observations removed after initial regressions to improve fit did not markedly alter intercepts or slopes. Equations were as follows: preweaning: MEI = 484.6 (SE = 61.46) + (13.37 [SE = 1.95] × ADG) (n = 61; $R^2 = 0.44$); meat: MEI = 457.0 (SE = 22.30) + (25.23 [SE = 1.74] × ADG) (n = 57; $R^2 = 0.79$); dairy: MEI = 573.7 (SE = 46.20) + (23.56 [SE = 3.10] × ADG) (n = 56; $R^2 = 0.52$); indigenous: MEI = 500.0 (SE = 11.94) + (18.59 [SE = 1.64] × ADG) (n = 76; $R^2 = 0.63$); and mature: MEI = 462.2 (SE = 24.95) + (28.52 (SE = 5.05) × ADG) [n = 69; $R^2 = 0.32$]. Intercepts and slopes from regressions of observed against predicted MEI with evaluation data sets, based on equations for preweaning and growing dairy and indigenous goats, were not different from 0 and 1, respectively. When final equations for the different growing goat biotypes were tested, the intercept for dairy goats differed ($P < 0.05$) from that of meat and indigenous goats, and the slope for indigenous goats tended ($P = 0.16$) to differ from that of meat and dairy goats. Therefore, the following dummy variable equation was obtained (I1 = 1 for dairy and 0 for others; I2 = 1 for indigenous and 0 for others): MEI = 488.5 (SE = 14.4) + (91.5 (SE = 18.69) × I1) + (23.09 (SE = 1.24) × ADG) - (3.28 (SE = 1.98) × ADG × I2) [n = 189; $R^2 = 0.74$]. In summary, based on treatment mean observations from available publications and regression of MEI against ADG, ME_m was 485, 489, 580, 489 and 462 kJ/kg $BW^{0.75}$, and ME_g was 13.4, 23.1, 23.1, 19.8 and 28.5 kJ/g ADG for preweaning, growing meat, growing dairy, growing indigenous and mature goats, respectively.

Effects of method of offering broiler litter and level of prairie hay intake on growth of Boer x Spanish wethers

Y. Mekasha, R. C. Merkel, A. L. Goetsch, T. Sahlu, and K. Tesfai

Small Ruminant Research 55:123-134. 2004.

Thirty-four Boer × Spanish wethers (18 ± 0.3 kg initial BW; 5 months of age) were used in a 12-wk experiment (2 × 2 + 1 factorial arrangement of treatments) to determine effects of ad libitum consumption of broiler litter (B) alone or mixed with corn (60% B; BC) and of ad libitum vs. restricted ®) prairie hay intake on feed intake and growth performance. Treatments were: Control = ad libitum

intake of hay plus an average of 26 g/day of a mineral-based supplement; AH-B = ad libitum intake of hay and B offered separately; AH-BC = ad libitum intake of hay and BC; RH-B = restricted intake of hay (approximately 1% BW; DM basis) and ad libitum intake of B; RH-BC = restricted intake of hay and ad libitum intake of BC. Average corn DM intake (DMI) was 179 and 170 g/day for AH-BC and RH-BC, respectively, and B DMI was similar among supplement treatments ($P > 0.05$; 258, 271, 299 and 258 g/day for AH-B, AH-BC, RH-B and RH-BC, respectively). Hay DMI averaged 494, 442, 336, 175 and 160 g/day (SE = 16.7), and total DMI was 516, 700, 782, 474 and 585 g/d (SE = 26.2) for Control, AH-B, AH-BC, RH-B, and RH-BC, respectively. Overall ADG ranked ($P < 0.05$) AH-BC > AH-B and RH-BC > Control and RH-B (-6, 34, 79, 3 and 50 g), and the ratio of ADG:DMI ranked ($P < 0.05$) AH-BC and RH-BC > AH-B > Control and RH-B (-13, 49, 97, 5 and 85 g/kg) for Control, AH-B, AH-BC, RH-B and RH-BC, respectively. Total tract OM digestibility in period 2 ranked ($P < 0.05$) Control < AH-B, AH-BC and RH-B < RH-BC (34.0, 46.6, 49.8, 50.0 and 63.7% for Control, AH-B, AH-BC, RH-B and RH-BC, respectively). Ruminal fluid ammonia N concentration was lowest among treatments ($P < 0.05$) at 2 and 6 h after supplementation for Control (e.g., 6 h: 4.0, 19.5, 17.2, 38.2 and 25.8 mg/dl for Control, AH-B, AH-BC, RH-B and RH-BC, respectively; SE = 2.69). The ratio of acetate:propionate was greatest among treatments ($P < 0.05$) at 0, 2 and 6 h for Control (e.g., 6 h: 5.27, 4.04, 3.28, 3.64 and 3.10 for Control, AH-B, AH-BC, RH-B and RH-BC, respectively; SE = 0.218). In conclusion, depending on production goals and availability of high-quality feedstuffs such as cereal grains, free-choice consumption of B may be a simple and useful method of supplementing low-quality forage.

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

B. R. Min, B. R., W. E. Pomroy, S. P. Hart, and T. Sahlu

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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 that contains tannin, on internal parasites in goats. Wether goats with fecal egg counts greater than 1,200 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 were 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 potential to help control internal parasites of goats.

Prediction of fecal crude protein excretion of goats

J. E. Moore, A. L. Goetsch, J. Luo, F. N. Owens, M. L. Galyean, Z. B. Johnson, T. Sahlu, and C. L. Ferrell

Small Ruminant Research 53:275-292. 2004.

A database of 622 treatment mean observations of the dietary concentration of CP and apparently digestible CP (DCP) from 146 publications was used to estimate true digestibility of CP and metabolic fecal CP (MFCP) in goats. A regression of DCP against CP with the entire database yielded the equation: DCP = 0.8566 * CP (% DM) - 2.697 (r^2 = 0.851, root mean square error = 1.58). There were some observations with lower than predicted DCP, some of which were with diets containing browse. Therefore, observations with residuals < 1.58 were deleted, resulting in the equation: DCP = 0.8831 * CP (% DM) - 2.67 (r^2 = 0.952, root mean square error = 0.86; n = 562); estimates of MFCP and true CP digestibility were considered the Y intercept and slope, respectively. To address variables of the entire database with less than expected DCP, the database was split into a subset to develop equations (60% of observations), with inclusion of additional variables such as DM intake and dietary concentrations of forage and browse, and one to evaluate. However, multiple regression equations did not greatly improve prediction, with lower than predicted DCP appearing a consequence of depressed true CP digestibility rather than increased MFCP. In conclusion, for goats consuming diets without browse, 0.88 and 2.67% DM appear appropriate estimates of true CP digestibility and MFCP, respectively, similar to values for other ruminant species.

Energy requirements for lactation of goats

I. V. Nsahlai, A. L. Goetsch, J. Luo, J. E. Moore, Z. B. Johnson, T. Sahlu, C. L. Ferrell, M. L. Galyean, and F. N. Owens

Small Ruminant Research 53:253-274. 2004.

Data from 44 studies with 243 treatment mean observations, representing 2476 goats in various stages of lactation, were used to estimate the requirement for and efficiency of use of ME for milk production. Development and evaluation data subsets comprised, respectively, 68 and 32% of observations. Intake of ME was adjusted for level of feed intake, as 1 - [0.018 × (L - 1)], with L = multiple of the ME requirement for maintenance. ME intake was also adjusted for energy lost in excretion of excess nitrogenous compounds in urine (ExUN), as 33.01 kJ/g of N intake above endogenous urinary N (0.165 g/kg $BW^{0.75}$). Adjusted ME intake was partitioned into that used for maintenance plus activity [1.1 × 315 kJ/(kg $BW^{0.75}$ k_m), with k_m or efficiency of ME use for maintenance = 0.503 + (0.019 × ME, MJ/kg DM)], ME secreted in milk and ME gained as BW. When BW increased, ME intake was adjusted for tissue accretion (efficiency = 0.75) to derive dietary ME used in milk secretion. Milk yield was corrected to 4% fat [4%FCM; MJ/kg = 1.4694 + (0.4025 × % milk fat)]. For does decreasing in BW, FCM and milk energy from the diet were obtained by adjusting for use of mobilized tissue energy (23.9 kJ/kg; efficiency = 0.84). Based on no-intercept regressions, the dietary ME requirement for lactation was 5017 (SE = 105.3) and 5195 (SE = 94.4) kJ/kg FCM and efficiency of dietary ME utilization for lactation (ME regressed against milk energy) was 0.61 and 0.59 with and without correction for ExUN, respectively. Scatter plots of residuals with the development data subset, and

intercepts and slopes that were not different from 0 and 1, respectively, from regressions with the evaluation data subset of observed against predicted FCM and milk energy from the diet, indicated acceptable accuracy and no obvious bias. Therefore, these estimates and this factorial approach seem useful to predict energy requirements of lactating goats, with potential for future enhancements based on research concerning assumptions used in deriving these values.

Metabolizable protein requirements of lactating goats

I. V. Nsahlai, I. V., A. L. Goetsch, J. Luo, J. E. Moore, Z. B. Johnson, T. Sahlu, C. L. Ferrell, M. L. Galyean, and F. N. Owens

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Data from 31 studies with 174 treatment mean observations from goats in different stages of lactation were used to determine the metabolizable protein (MP) requirement for lactation (MP_l). Milk protein yield (MkP) was calculated from milk yield and protein concentration. MP was estimated from ingredient composition and a database of CP degradability properties and ruminal fermentable energy concentration derived from literature values when not provided in the original publication. MP_l was estimated from MP by subtracting MP used for maintenance functions (scurf, endogenous urinary and metabolic fecal) and adjusting for BW change. MP_l was regressed against MkP, and after removing observations with residuals greater than 1.5 SE, the equation was: MP_l = 10.2 (SE = 8.13) + 1.18 (SE = 0.095) × MkP (n = 149, adjusted R^2 = 0.51); the intercept was not different from zero (P>0.05). Based on a no-intercept equation, 1.30 (SE = 0.034) g MP_l was required for 1 g MkP, corresponding to milk protein efficiency of 0.78. A regression of observed values against ones predicted from the no-intercept equation had an intercept and slope not different from zero and one, respectively (P>0.05). In conclusion, even with an appreciable number of assumptions from literature other than original publications to estimate MP_l, there appears potential to reasonably well predict MP_l requirements of lactating goats. These results suggest an MP_l requirement of 1.30 g/g MkP. Although this approach and estimate of the MP_l requirement should have utility in expressing protein needs of or predicting milk production by lactating goats, improvements in accuracy with future research to refine assumptions are desirable and expected.

Energy and protein requirements of goats: developed equations, other considerations, and future research to improve them

T. Sahlu, A. L. Goetsch, J. Luo, I. V. Nsahlai, J. E. Moore, M. L. Galyean, F. N. Owens, C. L. Ferrell, and Z. B. Johnson

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A database of treatment mean observations from goat feeding/nutrition studies was constructed and used to develop expressions to describe nutrient requirements of goats. The ME requirement for maintenance (ME_m) was 485, 489, 580, 489 and 462 kJ/kg $BW^{0.75}$, and the ME requirement for gain (ME_g) was 13.4, 23.1, 23.1, 19.8 and 28.5 kJ/g ADG for preweaning, growing meat, growing dairy, growing indigenous and mature goats (indigenous and dairy), respectively. The ME_m of mature Angora

goats from multiple regression analysis (at 0 tissue gain and clean fiber growth) was 473 kJ/kg $BW^{0.75}$; ME requirements for tissue gain and clean fiber growth were 37.2 and 157 kJ/g, respectively. A factorial approach with linear regression was used to determine the dietary ME requirement for lactation of 5224 kJ/kg 4% fat-corrected milk, corresponding to an efficiency of ME use for lactation of 0.59. Metabolizable protein (MP) required for maintenance (MP_m) by mature meat, dairy and indigenous goats was determined as the sum of metabolic fecal (0.0267 g/g DM intake for diets not containing appreciable browse), endogenous urinary (1.031 g/kg $BW^{0.75}$) and scurf CP losses (0.2 g/kg $BW^{0.6}$), with an assumed efficiency of MP use for maintenance protein of 1.0. Based on linear regression of MP intake against ADG, for growing goats MP_m was 3.07 g/kg $BW^{0.75}$; MP required for ADG (MP_g) was 0.290 g/g ADG for dairy and indigenous goats and 0.404 g/g ADG for meat goats. The MP requirement for lactation was 1.45 g/g milk protein, equivalent to a milk protein efficiency of 0.69. The MP_m of growing and mature Angora goats from multiple regression analysis (at 0 tissue gain and clean fiber growth) was 3.35 g/kg $BW^{0.75}$, and MP requirements for tissue gain and clean fiber growth were 0.281 and 1.65 g/g, respectively. Identified areas of research that would yield knowledge allowing development of more accurate estimates of nutrient requirements include composition of accreted and mobilized tissue, effects of stage of maturity and nutritional plane on maintenance energy requirements, energy expenditure due to grazing activity, conditions influencing ruminally undegraded protein and efficiencies of MP utilization.

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

K. A. Soryal, K. A., S. S. Zeng , B. R. Min, and S. P. Hart

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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/day of concentrate mixture per 1.5 kg of milk (conventional confinement system). 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 the diet, milk, and cheese to establish the sensory quality of goat cheese.

Effect of feeding systems on composition of goat milk and yield of Domiati cheese

K. A. Soryal, S. S. Zeng, B. R. Min, S. P. Hart, F. A. Beyene*

Small Ruminant Research 54 121-129. 2004.

Twenty lactating Alpine goats were randomly allocated to four treatment groups to investigate the effect of pasture feeding with different levels of concentrates on composition of Alpine goat milk and quality of Domiati cheese during lactation. Goats in Group A were confined and fed alfalfa hay with 0.66 kg/d of concentrate mixture per 1.5 kg of milk. Groups B, C and D were rotationally grazed and received 0.66, 0.33, and 0 kg/d of concentrate supplementation, respectively. Milk from each group was processed into Domiati soft cheese twice monthly for a 6-month lactation period. Fresh cheese samples were evaluated for sensory quality. The results obtained from this experiment indicated that goats fed a high concentrate level with pasture grazing (Group B) produced milk with significantly higher contents of fat, protein and total solids and thus had a higher cheese yield than goats kept on pasture alone (Group D) or under a confined feeding system with concentrate and hays (Group A). The change of Domiati cheese yield over lactation followed the same trends of fat, protein and total solids in goat milk. The chemical composition of Alpine goat milk and the yield of Domiati cheese varied significantly during lactation, with high values in the early and the late lactations. Contents of milk fat, protein and total solids were highly positively correlated with Domiati cheese yield. The milk fat content had an adverse effect on the cheese flavor score while the level of total fatty acids in milk was positively correlated with the flavor score. Further research is needed to investigate the economical efficiency of milk production using concentrate supplementation to lactating goats and the processing functionalities of goat milk for cheese manufacturing.

Effects of supplemental protein source and level on growth performance of Boer crossbred wethers

S. Soto-Navarro, A. L. Goetsch, T. Sahlu, and M. R. Cameron

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The quantity and quality of protein reaching the small intestine are influenced by microbial protein synthesized in the rumen and by ruminally undegraded intake protein. When amino acid requirements are high, ruminally produced microbial protein may not meet tissue amino acid needs. In addition to the importance of the quantity of protein reaching the small intestine, the array of specific amino acids can have impact as well. Different sources of protein are available that vary in both susceptibility to ruminal degradation and in amino acid composition. Therefore objectives of this experiment were to determine effects of dietary crude protein (CP) level (13 or 19%) and source of supplemental protein on growth performance of weaned Boer × Spanish wether goats. Diets were 70% concentrate, had a ratio of ruminally degraded intake protein (DIP) to total digestible nutrients (TDN) of at least 0.09 and were formulated to maximize ruminally undegradaed protein from supplemental protein sources. Results of the experiment suggest that the dietary CP requirement of growing Boer crossbred wethers consuming a high concentrate diet is no greater than 13% and that a DIP:TDN ratio of 0.09 is adequate. Supplemental protein sources differing in amino acid profile may not impact DM intake or ADG with high concentrate diets at least 13% in CP.

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

M. Urge, R. C. Merkel, T. Sahlu, G. Animut, and A. L. Goetsch

Small Ruminant Research 55:149-158. 2004.

Forty-five weaned wether goats (12 Alpine, 12 Angora, 10 Boer [87.5%] and 11 Spanish) were used to determine effects on growth performance of consumption of a 75% concentrate diet (DM basis) 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, and age was 4 months when the experiment began. There were no interactions between genotype and dietary treatment in DM intake, ADG or gain efficiency in wk 1-12 or 13-24. DM intake in wk 1-12 ranked Alpine and Boer > Spanish > Angora (703, 689, 567 and 436 g/day; $P < 0.05$) and in wk 13-24 was significantly greater for Alpine and Boer vs. Angora and Spanish (712, 702, 515 and 456 g/day; $P < 0.05$). DM intake was similar between dietary treatments. In wk 8, OM digestibility was 79.3 and 71.3% (SE = 1.57) and NDF digestibility was 54.2 and 52.1% (SE = 3.46) for 75C and 50C, respectively. Total VFA concentration was similar between diets; the acetate:propionate ratio was greater ($P < 0.05$) for 50C vs. 75C (4.12 vs. 2.56). ADG in wk 1-12 was greatest ($P < 0.05$) for Boer (59, 59, 90 and 49 g/day for Alpine, Angora, Boer and Spanish, respectively); in wk 13-24 ADG was lowest ($P < 0.05$) for Spanish (25 g/day) and tended to be greater ($P < 0.10$) for Boer vs. Alpine (82 vs. 58 and 63 g/day). Gain efficiency (ADG:DM intake) was greater ($P < 0.05$) for Angora and Boer than for Alpine and Spanish in wk 1-12 (132 and 127 vs. 85 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). ADG and gain efficiency were greater ($P < 0.05$) for 75 vs. 50% dietary concentrate in wk 1-12 (ADG: 73 and 55 g/day; 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/day; gain efficiency: 77 and 101 g/kg for 75C and 50C, respectively). In conclusion, differences in growth performance among Alpine, Angora, Boer and Spanish wether goats were similar with 50 and 75% concentrate diets, and the genotypes responded similarly to the change in dietary concentrate level from 50 to 75%.

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

R. Puchala, B. R. Min, A. L. Goetsch, and T. Sahlu

Journal of Animal Science 83:182-186. 2005.

The objective of this study was to compare methane emission by goats consuming the condensed tannin-containing forage sericea lespedeza (Lespedeza cuneata) or a mixture of crabgrass (Digitaria ischaemum) and Kentucky 31 tall fescue (Festuca arundinacea). Two groups of 12 Angora does (initial average BW = 41.5 ± 2.7 kg) that previously grazed a pasture of sericea lespedeza or crabgrass/tall fescue for approximately 4 mo were used. After 1 wk of adaptation to
metabolism cages, gas exchange was measured for 24 h in an open-circuit respiration calorimetry system with four head boxes. Forage harvested daily from the previously grazed pastures was consumed ad libitum. Crude protein concentration was 10.3 and 13.0%, IVDMD was 64.5 and 75.3%,

and the level of condensed tannins was 17.7 and 0.5% for sericea lespedeza and crabgrass/tall fescue, respectively. Dry matter intake (1.11 vs. 0.67 kg/d) and digestible DMI (estimated from IVDMD; 0.71 vs. 0.51 kg/d) were greater ($P < 0.01$) for sericea lespedeza than for crabgrass/tall fescue. Ruminal ammonia N (3.7 and 9.9 mg/dL; $P < 0.001$) and plasma urea-N concentrations (16.7 and 20.9 mg/dL; $P = 0.07$) were lower for sericea lespedeza than for crabgrass/tall fescue. Concentrations of individual and total VFA and the acetate-to-propionate ratio in ruminal fluid did not differ between treatments ($P > 0.19$). Despite higher DMI by goats fed sericea lespedeza, daily energy expenditure (409 vs. 431 kJ/kg BW0.75), heart rate (70 vs. 73 beats/min), and the ratio of energy expenditure to heart rate (5.82 vs. 5.94) did not differ between sericea lespedeza and crabgrass/tall fescue, respectively ($P > 0.13$). Methane emission expressed as both quantity per day or relative to DMI was lower ($P < 0.001$) for sericea lespedeza than for crabgrass/tall fescue (7.4 vs. 10.6 g/d and 6.9 vs. 16.2 g/kg DMI). Substantial differences between the forages in condensed tannins concentration and methane emission by Angora goats suggest that condensed tannins decreased methane emission.

Effects of ruminally protected betaine and choline on net flux of nutrients across the portal-drained viscera and liver of meat goat wethers consuming diets differing in protein concentration

V. Banskalieva, R. Puchala., A.L. Goetsch, J. Luo, T. Sahlu

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Six Boer x Spanish goat wethers (43±5.1 kg BW) were used in an experiment with a 2 x 3 factorial arrangement of treatments to investigate effects of dietary CP level (9% and 15% DM) and supplementation with ruminally protected betaine or choline (0.9% DM) on plasma concentrations and net fluxes of oxygen, ammonia N, non-esterified fatty acids (NEFA), triacylglycerols (TG) and cholesterol across the portal-drained viscera (PDV) and liver. Neither betaine nor choline affected blood flow, packed cell volume, hemoglobin concentration or oxygen consumption. Blood flow and oxygen consumption were greater ($P < 0.05$) for 15% versus 9% dietary CP. Arterial plasma ammonia N concentration was greater ($P < 0.05$) for 9% versus 15% CP. Compared with Control, choline supplementation decreased ($P < 0.05$) PDV release and hepatic uptake of ammonia N with the 15% CP diet, whereas betaine decreased ($P < 0.05$) PDV release and hepatic uptake of ammonia N with 9% dietary CP.With 9% dietary CP, the concentration of NEFA in arterial, hepatic venous and portal venous plasma ranked ($P < 0.05$) choline < Control < betaine; with 15% CP, NEFA concentration also was greater ($P < 0.05$) for betaine versus Control, although the magnitude of difference was smaller than with 9% CP. The only treatment effect on NEFA, net fluxes had greater ($P < 0.05$) hepatic uptake with 9% CP than with 15%. Plasma TG concentrations also were increased ($P < 0.05$) by betaine with 9% dietary CP, whereas choline did not have any influence with either dietary CP level. Concentrations and net fluxes of cholesterol were similar among treatments. In conclusion, these data indicate that potential effects of ruminally protected betaine on performance of ruminants might involve changes in lipid metabolism, with the magnitude of alteration varying with dietary CP level.

Effects of walking speed and forage consumption on energy expenditure and heart rate by Alpine does

T. Berhan, R. Puchala, A. L. Goetsch, and R. C. Merkel

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Eight nonlactating Alpine does (2.5 to 6.5 yr of age; 46 ± 2.9 kg BW) were used to determine effects of standing vs. walking at different speeds and interactions between walking speed and forage ingestion on energy expenditure (EE), heart rate (HR) and their ratio. Coarsely ground alfalfa hay was fed at a maintenance level of intake, and measures were performed in a head-box respiration calorimetry system. In experiment 1, measures occurred at least 3 h after feeding for 20 min after the plateau in EE sequentially, while standing (0 m/s) on a treadmill and thereafter walking at 0.14, 0.28 and 0.42 m/s at a +5% slope. HR and EE ranked ($P < 0.05$) 0 < 0.14 < 0.28 < 0.42 m/s (HR: 79, 95, 108, and 125 beats/min; EE: 20.6, 25.8, 29.6, and 34.1 kJ/(kg $BW^{0.75}$ × h)). The ratio of EE:HR was lowest among treatments ($P < 0.05$) for 0 m/s (6.26, 6.54, 6.58, and 6.56 (kJ/(kg $BW^{0.75}$ × day)/(beats/min) for 0, 0.14, 0.28, and 0.42 m/s, respectively). In experiment 2, EE and HR were first determined while standing, followed by measures when walking at 0.07, 0.14 or 0.21 m/s at a +5% slope; measurements also occurred while consuming 50% of the daily allocation of forage when standing or walking at the different speeds immediately after measures without forage ingestion. Differences between values for forage consumption plus walking or standing and walking or standing without forage were calculated to determine the origin of, or factor responsible for, change in EE (i.e., walking (W) vs. forage consumption (F)), with the previous standing estimate without forage used as a covariate. There was an interaction ($P < 0.05$) between walking speed and origin of EE. EE due to W ranked ($P < 0.05$) 0 < 0.07 < 0.14 and 0.21 m/s (-0.3, 3.4, 4.8 and 5.9 kJ/(kg $BW^{0.75}$ × h)). Conversely, EE attributable to F was lower ($P < 0.05$) for 0 than for 0.07 and 0.21 m/s (9.0, 10.7, 10.3, and 10.7 kJ/(kg $BW^{0.75}$ × h) for 0, 0.07, 0.14, and 0.21 m/s, respectively). Differences in HR were generally similar in magnitude to those in EE (-1, 9, 17 and 20 beats/min for W, and 35, 51, 40 and 42 beats/min for F, at 0, 0.07, 0.14, and 0.21 m/s, respectively (SE = 2.1)). In summary, these results suggest potential use of HR to predict EE while grazing. Forage consumption increased EE to a greater extent than walking and may lessen effects of walking and walking speed on the grazing activity energy cost.

Changes in goat milk composition during lactation and their effect on yield and quality of hard and semi-hard cheeses

B. Fekadu, K. Soryal, S. Zeng, D. Van Hekken, B. Bah, and M. Villaquiran

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Bulk tank goat milk from the Langston University Alpine herd was used to investigate changes in composition of goat milk during lactation and their effects on the sensory quality and yield of hard and semi-hard cheeses. Milk was analyzed for fat, protein, casein, total solids and somatic cell count (SCC) and cheese was assayed for of fat, protein and moisture. Sensory evaluation of the cheeses was performed to establish the relationship between yield, quality and sensory score. The chemical composition of goat milk changed significantly over lactation, resulting in variation in yield and

sensory quality of hard and semi-hard cheeses. While casein content of goat milk did not change significantly as lactation advanced, SCC increased from early to late lactation. There were no significant differences in flavor, body and texture, and total sensory scores of either cheese type among aging times of 8, 16 and/or 24 wk, which indicates that the cheeses can be consumed after 8 wk for similar sensory quality as with longer aging. In hard cheese, yield was highly correlated with milk fat, protein or total solids, whereas only milk total solids content was highly correlated with semi-hard cheese yield. These findings indicate need to adjust cheese making procedures over the duration of lactation to increase milk nutrient recoveries and thus increase cheese yield. However, a year-round breeding system should minimize variation in chemical composition in bulk tank goat milk during lactation and help maintain consistent quality and yield of cheeses throughout the year.

Visiting Scholars, Graduate Students, and Interns (2004/2005)

Mr. Getachew Animut
Native of Ethiopia
2004-Ph.D. Student, 2005-Visiting Scholar
Research Projects: 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 (OKLX-0003832 - 00-38814-9502), and Decreased Methane Emission by Ruminants Consuming Condensed Tannins 2004-38814-02606)
Experiments: GA-02-01, GA-02-05, GA-03-04)

Dr. Thomas Ngwa
Native of Cameroon
Research Project: Composition of Tissue Loss and Gain by Goats (2003-03779)
Experiments: TN-04-04, TN-04-07

Dr. Berhan Tamir
Native of Ethiopia
Research Project: Energy Requirements of Goats (OKLX0003833 - 00-38814-9500)
Experiments: BT-03-09, BT-03-13

Dr. Ignacio Tovar-Luna
Native of Mexico
Research Project: Energy Requirements of Goats (OKLX0003833 - 00-38814-9500)
Experiments: CTZ-02-02, CTZ-02-08, CTZ-02-09, ITL-02-16, ITL-03-01, ITL-03-06, ITL-03-10

Dr. Aberra Melesse
Native of Ethiopia
Research Project: Flushing of Meat Goats (OKLX-SAHLU)
Experiments: RM-02-04, RM-03-11

Dr. Mario Villaquiran
Native of Columbia, Resident of Brazil
Research/Extension Project: Enhanced Goat Production Systems for the Southern United States (2011-52101-11430)
Experiments: MV-02-20, MV-03-14, MV-04-01, MV-04-03

Dr. Asefa Asmare
Native of Ethiopia
Research Project: Goat Nutrient Requirements, Management Practices, and Production Systems Milk Production by Meat Goats (OKLX-SAHLU)
Experiments: KW-04-08, AA-04-14, AA-04-15, AA-04-18, AA-04-19

Dr. Amlan Patra
Native of India
Research Project: Tethering for Detailed Study of Grazing Ruminants (USDA-CSREES-NRI 03-03289)
Experiments: AP-04-09, AA-04-18

Dr. Maria Yiakoulaki
Native of Greece
Research Project: Goat Nutrient Requirements, Management Practices, and Production Systems (OKLX-SAHLU)
Experiments: MY-04-06, SH-04-13

Mr. Sean Chen
Native of China
Research Project: Quality, Safety, and Shelf-Life of Dairy Goat Products in the U.S. Market

Dr. Maristela Rovai
Native of Brazil
Research Project: Evaluation and Modeling Extended Lactations in Dairy Goats (2004-38814-02579)