

## WELCOME

We deeply appreciate your attendance at this 21<sup>th</sup> 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 "*Organic Goat Production.*" 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:

- **Organic Rules and Regulations**
- **Organic Meat Goat Production**
- **Organic Dairy Goat Production**

*Chad Goss  
Lisa Waltz  
Nancy Coonridge*

The afternoon workshops are:

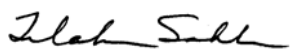
- **Natural Medicine for Organic Goat Production**
- **Regulations and More Regulations**
- **Organic Cheesemaking**
- **Basic Goat Husbandry**
- **Basic Herd Health**
- **Nutrition for Production**
- **Overview of Legal Issues Faced by Meat Goat Producers**

*Lisa Waltz  
Chad Goss  
Nancy Coonridge  
Jerry Hayes  
Lionel Dawson  
Steve Hart  
William Wheeler, Jr.  
and Sheri Mueller*

- **Livestock Guardian Dogs**
- **Goat Farm Budgeting**
- **Benefits of Government Programs**
- **Predator Management**
- **Introduction to AI**
- **Fitting and Showing for Youth and Adults**
- **Fun Tenth for Youth**

*Paula and Dan Lane  
Roger Sahs and Damona Doye  
Dwight Guy  
Ken Cearley  
Erick Loetz  
Kay Garrett  
Sheila Stevenson*

Please let us know your wishes for the 2007 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.



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**Tilahun Sahlu**

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

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# ORGANIC RULES AND REGULATIONS

Mr. Chad Goss

Oklahoma Department of Agriculture

This page is a pdf document downloaded from the Oklahoma Department of Agriculture (ODA) web site (<http://www.oda.state.ok.us/forms/food/cpb.pdf>) Other documentation on Organic certification in Oklahoma is available on the ODA web page (<http://www.oda.state.ok.us/forms-home.htm>) under the heading of Food Safety and subheading Organic Section.

## Oklahoma Organic Food Act



- Who must be certified and licensed as an organic producer?
- What are the basic requirements for initial certification of a farm, livestock, or processor?
- How is a license obtained?
- How is continuance of compliance done?
- How do I obtain a list of licensed certified organic growers?
- Who do I call for more information about the organic food act?

Answers in this brochure.



### CERTIFICATION INFORMATION

Each production or handling operation or specified portion of a production or handling operation that produces or handles crops, livestock, livestock products, or other agricultural products that are intended to be sold, labeled, or represented as "100 percent organic," must be certified to NOP standards by the Oklahoma Organic Food Section which is an certifying agent for USDA/NOP.

#### Certification Standards for Producers

1. Completion of a producer, livestock, or processor application form available from the Department that meets all NOP Standards
2. Submission of soil residue test results from the proposed production sites; Assays conducted by our department.
3. Verification by documentation or test results that application of prohibited substances during the previous three years were not made;
4. On-site inspection of the crop during the growing season.

#### PRODUCTION PRACTICES:

Producers who have met all requirements of the National Organic Program Standards will receive "Organic Certification."

Must have Organic Production and Handling System Plan. This includes:

- (1). Description of practices and procedures to be preformed and maintained, including the frequency with which they will be preformed



Food Safety Division  
Poultry, Eggs and Organic Foods  
405-522-5924 office  
405-522-1060 fax  
PO Box 528804  
Oklahoma City, OK  
73152-8804  
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www.oda.state.ok.usg

Oklahoma Department  
Of Agriculture, Food  
and Forestry

## Certified Organic Food



Food Safety Division  
Poultry, Eggs & Organic Section  
PO Box 528804



#### PLEASE SEND ME THE FOLLOWING:

- ☐ ORGANIC FOOD ACT
- ☐ CERTIFICATION APPLICATION
- ☐ LIST OF GROWERS CERTIFIED

COMPANY NAME

ATTENTION

ADDRESS

CITY

STATE

PHONE

(PLEASE TYPE OR PRINT)

SEND TO:  
STATE OF OKLAHOMA  
DEPARTMENT OF AGRICULTURE, FOOD & FORESTRY  
FOOD SAFETY DIVISION  
POULTRY, EGGS AND ORGANIC  
PO BOX 528804  
OKLAHOMA CITY OK 73152-8804

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*Goss, C. 2006. Organic Rules and Regulations. Page 1 in Proc. 21st Ann. Goat Field Day, Langston University, Langston, OK.*

# ORGANIC MEAT GOAT PRODUCTION

**Rev. Dr. Lisa Waltz**

*Waltz's Ark  
Delta, CO*

## ***Transitioning From “Traditional” to Organic Meat Goat Production***

I would like to preface this discussion by stating that I did not have to work at a transition for my goat herd. I started with organic meat production from the beginning. As a naturopathic doctor I understand the problems that arise in human and animal health when chemicals are relied upon in food and in health care. Also as a person who suffered from a form of Lupus, the need to stay far away from additives in my own food and the complications that can arise for me in handling chemicals, it was important to me to be able to provide food for myself and my family, and ultimately to the open market, without concern for killing myself in the process. That said, I have assisted many goat producers across the nation in transitioning their herds from traditional production methods to organic. All have thus far been successful and several have exclusive contracts with major organic food store chains.

I thought it most humorous when one producer who contacted me for assistance wanted assurances that the animals he saw in the photos on my web site were indeed naturally raised and not photos of other peoples' animals. This could be considered almost a rude statement on the surface, but, listening further brought in the humor for me. It seems his extension service agent informed him that the way to start raising goats organically was to dig a very big hole as it would be quickly filled with the bodies of his dying herd. His agent was absolutely convinced that there was no way on this earth that a goat could be raised to maturity and encouraged to reproduce without a great deal of chemical intervention.

It's a shame that such attitudes prevail, and I happily assist anyone with learning that changing methods can indeed be done successfully. When you consider the facts of goats it is obvious that they have survived thousands of years prior to the invention of vaccines, chemical dewormers, drugs, etc. Goats have been developed in some of the harshest environments known to man based only on what nature provides for them. Taking lessons from nature is the first step to moving any livestock or food production method to natural.

Nature herself culls the weak and provides nutritious plants that serve all the needs of the animals that reside on the planet. It's when we take those animals into a farm or ranch situation that we mess a bit with that natural plan. So the best place to start your transition is by learning about goats in a more natural setting. We know that goats are browsers, tending to nibble here and there on a wide variety of plants from grasses to leafy plants to brush and small trees. We know that goats like to wander around while they eat, unlike horses and cows that we see standing in one small area while they chew the grasses to the ground level. We know that some of these plants have constituents that are natural dewormers, natural mineral providers, natural pain relievers, natural antibiotics, etc. Knowing these basic facts, we can provide the same to our meat and dairy goats in a more natural setting that enables us to work with nature, not against it.

Why would you want to transition your goats to organic? There are as many different reasons as there are producers, but a few advantages include better herd health, better herd longevity and

production, a ready niche market for naturally raised meats, and undertaken properly it can actually reduce the expenses for your herd. Some of the disadvantages include needing to spend a little more time observing your livestock, field/browse area preparation, and taking the time to learn a new way of doing things. In my experience the advantages have far outweighed the disadvantages, not only in my own operation but also in those I have helped to make the transition.

With nature as the starting point, those of you with adequate pasture and browse areas can start transitioning your goat herd to natural production by merely observing your animals regularly. If you have delicate type stock that is used to being micromanaged it will take a while to fully transition. Goats that have been born to the world of chemicals may have some problems that will need to be tended to, such as trouble with parasite loads, easily picking up illnesses, learning to eat what is available, etc. Culling cannot be underemphasized – those goats that do very poorly through the transition period need to be removed from your herd. Keep only those that are adapting well. They will be the producers of your organic generations to come.

Animals easily adapt to their environments when we don't interfere too much. I think sometimes in our quest to produce all we can to improve the bottom line we forget that some of our modern inventions may actually be harming our bottom line in the long run. The goat that needs constant chemical worming is not a healthy goat, no matter what it looks like on the outside. The goat that consistently produces kids with problems is not a healthy goat regardless of what you are feeding it. The goat that does not thrive on what nature can provide is not a healthy goat. Many a producer has commented to me that after stopping chemical usage, many goats that they had marked for culling ended up improving greatly and remained in their herds. So the problem may not be that the goat is susceptible to worms or disease, it may well be that the chemicals and questionable or overly rich feed given to that animal for prevention are doing more harm than good.

This is not to say that you should not step in with modern chemicals if the need truly arises. I certainly do. However, any goat that required that sort of intervention is generally not going to stay in my herd, or she or her kids are not going to be sold as organically raised goats. You will most likely find, however, that once you get the hang of observing your goats for problems and nipping them in the backside before it gets to the need for drugs, you will be intervening far less than you have ever had to in the past.

The second thing you need to do to transition your goats to organic production is to learn to see what your goats need to be healthy. Mineral deficiencies can create problems for your herd. If you live in an area where the soil is poor, or lacking in important items such as selenium or copper, you will need to provide free choice mineral mixes formulated for your area. Lack of botanical variety in your pasture and browse areas, or in the type of hay you provide, can create nutritional deficiencies that result in poor reproductive rates, low birth rate kids, low survivability of kids, and susceptibility to illness. Learn what a healthy goat should look like, and measure your herd against that basic standard. Make adjustments to their diets accordingly.

If your botanical variety is lacking it would an important thing for you to augment that area for your goats. When modern farming methods came along we stopped doing some of the things that worked a while ago before we had these giant tractors and special crops. Remember in the days of your youth (or your parents' youth for those of you younger farmers!) when each field was surrounded by hedgerows and shelterbelts? Remember when productive fields were surrounded by areas that were

never plowed? Remember when all farmers and ranchers practiced field and pasture rotation? When preparing your land to transition your goats is the perfect time to return to some of those older methods – they worked then and they still work now.

Separate your pasture and grazing areas into smaller areas that you can shift your goats through regularly. Preferably have some areas that can be left alone for at least an entire year. In these areas, plant edible bushes, small trees, large trees, medicinal plants, edible wildflowers, grass varieties, etc. Give these time to establish before allowing goats to return and browse. Put in hedgerows and shelterbelts around your property lines and field separating fences, and occasionally allow the herd access to these areas. Hedgerows can be beautiful to look at as well as quite functional for feed and field protection, and you will find that the wildlife will appreciate your efforts, such as pheasant, quail, songbirds, beneficial insects, etc. and these areas may increase the value of your property. Remember the more variety you can provide, the less work you as the producer have to do to keep your herd healthy, happy, and productive.

If you are feeding in pens either seasonally or through the year, you need to pay close attention to what you are feeding them. The pellets in a sack contain things you may not want in your organic goats. And usually these foods are too rich, or they are not nearly as “complete” as they may be advertised to be. Buy the best hay you can afford during breeding times and kidding times, as the better nutrition will lessen the chances of ketosis and the odd problems such as fescue poisoning. Supplement with fresh stuff you have around – goats love treats of non-toxic fresh weeds (dandelion leaves are a special joy!), prunings from safe trees and bushes, and plants you pull out of your gardens. Just remember to not give them any plants from the nightshade family as they are toxic, and to not give food items that have been treated with any chemicals or may be growing near a busy road. If you prefer to grain at kidding time, make sure it is a natural mixture of grains with no additives. Your feed provider can usually hook you up with some organic sources of grains.

Supplemental minerals are important all the time, but most important if you are pen raising, if you are in a drought situation, or if your browse or hay is questionable in nutritional content. I feed my herd a natural mineral mix, combined with kelp and diatomaceous earth, offered free choice in PVC pipe feeders year round. I know the arguments regarding DE, and I won’t cover them here, but I will point out that DE is used by organic food producers to kill pest insects on plants, and I will point out that DE is also high in trace mineral content that often isn’t included in general goat mixes. It has kept my fly population down, and I have used it when I was an organic vegetable producer and still use it on my own organic food plots, which are shared with the goats.

Parasites are always a big topic of discussion with goat producers, and the number one area of concern for those who wish to go organic but have been told otherwise by those who believe only chemicals get rid of parasites. There is a tendency in goat production to over-deworm – reading any internet list will provide evidence of this. Most questions related to a goat with a problem are always replied to by several suggesting that the goat has not been sufficiently wormed. First, a healthy goat is going to be resistant to parasite load. Second, all afflictions of our goats are not caused by worms. Parasites are opportunistic, taking any opportunity afforded them to take hold within any host animal, including humans. Stress, lack of proper nutrition, severe weather, and environment are some prime opportunities for parasites to thrive within our goats. Our goal in natural goat production is to eliminate or manage carefully those triggers.

Breeding for resistance to parasites would be very important here. Starting with hardy stock that is adapted to your current property is a vital first step. Remember, goats are highly adaptable overall, so your goal should be to cull those that seem to be constantly parasite loaded, and to breed those who are already showing a resistance so that their kids will develop further resistance. Introducing them to natural dewormers is the second step. There are many anthelmintic plants in the botanical world – that word simply means that active constituents within the plant either kill worms and their larvae and/or helps create an inhospitable environment for the parasite to remain in.

The biggest mistake I see most producers making when they move to natural production is attempting to rely on only one type of natural dewormer for their herd. One dose does not fit all, and one plant does not fit every situation. As in healing and treating illness, deworming should be done with combinations of plants, and those combinations should match the situation. For example, I use one combination in early spring when parasites are just starting to get active again. I use a different combination when the weather has been especially wet, and a different combination as parasites increase activity in their life cycles. I use a different combination for those animals that have just been brought to the farm for replacement stock, and a different combination for those animals that have undergone a period of stress, such as kidding, fighting, predator problems, etc. I've learned to match my dewormers to the herd itself, and in so doing have eliminated the need for constant worming. These deworming formulas are offered to the goats free choice as well as in their drinking water when the need arises. If I've just had a large group of does kid, for example, I will put a mixture into their drinking water for a few days. I've never had any goat refuse water that had natural dewormers nor medicinal herbs included. There will be further discussion of natural dewormers in my afternoon session on medicinal herbs for goats.

Incidences of illness will be far less once you have transitioned your herd to organic. Again, a healthy goat is a hardy goat, and when they are getting the nutrients they need to remain healthy the opportunity for illness to take over is greatly reduced. Weather can have an impact on illness as can bringing in outside stock, no matter how healthy the herd. These would be times to be especially vigilant, and administer medicinal plants to the goats when the need arises. A watchful producer can tell when a doe or buck or kid seems a little “off” – instead of waiting to see what develops and reaching for a syringe full of the drug of the day, that would be the time to administer some helpful medicinal plants, not just to the goat looking “off” but to all goats in that area, pen, pasture, etc.

I can't emphasize enough the importance of isolating new stock from your herd! Introducing new stock is a major way to spread disease through your goats, and the easiest to control. All new stock should be quarantined for a period of time before introduction to your existing herd. Many recommend two weeks, though my personal preference is 60 to 90 days. Moving a goat from one farm to another can cause enough stress for any underlying problem to surface, and the further that distance, the more stressed that animal has been. That particular goat may be harboring something that it picked up that is just waiting for the right opportunity to attack the goat's vital systems. It is far better for the problem to surface in an isolation pen than it is in the midst of your herd. While in isolation the goat should be carefully observed for any signs of problems. The moment a sign appears, that goat should be treated accordingly. This is a good time to introduce the new stock to natural dewormers, new feed, new supplements, etc. so that they are well adjusted by the time they are turned in with the main herd.

Please note here that there is a very big difference between “homeopathic” treatments and “medicinal herb” treatments. Many people who have no training confuse the two. Homeopathy is the



principle of like treating like. For instance, if you have a particular ailment you may take a homeopathic treatment that is made from the essence of that ailment. “Homeopathic” is often mistaken by many people to mean “home remedy” because of the sound of the term. Homeopathic medicine is a field unto itself, and does not involve “home remedies”. Medicinal herbs are just that – plants that grow and are used for medicine. Most of the drugs on the market today are derived from medicinal plants! There will be more information on medicinal herb use in the afternoon session.

There are a few pitfalls to avoid when transitioning to organic production. One would be giving up too soon. I’ve seen folks try to make the transition without being fully prepared to guide the herd through the transition and give up as soon as a goat or two got the sniffles. The only way these animals are going to build an immunity to what is in their immediate environment is to allow their immune systems to deal with what is there. Give it time. Certainly if a goat is in trouble you should act accordingly! But don’t feel that if all the goats aren’t thriving without dewormer in a couple of weeks that your attempt has failed.

Another pitfall would be not culling your herd to match your ultimate goals, or buying hardy stock to help you reach those goals. If a goat does not thrive without a lot of chemical intervention, it should be culled. If a goat seems to always be sickly while all around it do quite well, that goat should be culled. If a goat seems to be continually wormy no matter how often she hits the natural dewormers, that goat needs to be culled. If you are out shopping for fresh stock to add to your gene pool, select not for what animal looks the meatiest after eating the latest “superfood”, select for health and vigor on average input. Some genetic lines in all goat breeds just don’t do well in any setting, and there is no sense in spending dollars in the way of medicines and special feeds just to try to make a “pretty goat” healthy enough to give you more mediocre stock.

The biggest pitfall is in not observing your stock. You don’t need to hang out with them all day every day, but you do need to spend enough time each day to learn personalities, eating habits, drinking habits, and how they look on an average day. That way you can jump right in with appropriate measures if a goat is not looking quite right, or looks fine but has gone off feed, or is hanging off by itself. We all know how well goats can hide the fact that they may not be feeling well, which is of course Nature’s way of not drawing predators to the herd. Observation of the daily habits of your herd will teach you more than any book, mentor, or course could ever teach.

In conclusion, it is quite possible and not terribly complicated to transition your herd from traditional cattle-type production methods to natural goat production. All it takes from you is a bit of education, a good eye, a steady bit of nerves, and a dose of patience. Let them be the goats that nature intended and you will be rewarded with vigorous animals that reproduce well and often.

*The proper citation for this article is:*

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# **CERTIFIED ORGANIC DAIRY GOAT MANAGEMENT**

**Ms. Nancy Coonridge**

*Coonridge Organic Goat Cheese  
Pie Town, NM*

I'm Nancy Coonridge and I have an Certified Organic Grade A Goat Dairy in New Mexico. I have spent the last 38 years living with goats, working on finding out how to give them a natural life. For the last 8 years my goats and dairy have been Certified Organic by New Mexico's certifying agency, NMOCC.

I want to find out who here is already Certified Organic, who would like to be, and who has their doubts about the whole thing!? I want all of you to ask any questions you have after I have given my talk, but let's especially hear from those of you who have your doubts about organics.

## **Why Do You Want to Be Organic?**

Let's start off considering why you want to be organic.

- Maybe you want to have safe wonderful products for yourself, your family and your consumers.
- Maybe you are tired of contributing to the New Jersey sized agriculture induced dead zone at the mouth of the Mississippi.
- Maybe that desire leads you to want to take land out of conventional production, both on your farm and on any farms you purchase feed from.
- Maybe you are ready to gain access to the Organic Market Place. This niche market is the fastest growing segment in the food industry today.

## **The Organic Market Is an Untapped and Wide Open Market for Goat Dairy Producers**

There isn't a month that goes by when I don't get a request for organic goat butter, organic raw goat milk, organic goat cottage cheese or some other organic product that I do not make! Recently I got a request from a Natural Foods Distributor who wanted 15,000 pounds of organic goat cheese on a regular basis. 15,000 lbs is probably all I produce in a year so I couldn't help them. Maybe you can!

Thinking about why you want to become organic now will help you know what you want to accomplish on your dairy farms. And it can remind us all, when the going gets rough, why it is worth while for us to be Certified Organic.

For me being Certified Organic is the culmination of of my life's journey with goats. I once hiked with a young goat up the drainage of part of the Sacramento River in California. After many adventures we got to the river at dusk. I stood in awe at the beauty of the wide Sacramento placidly reflecting the sunset. My young goat immediately walked up to the river's shore, spread her front legs and lowered her head to drink like a baby deer. That experience drove into my heart the wish to find

a way to live in harmony with the natural world. That somehow thru the goats I could become a part of the land around me.

### **How to Become Certified Organic**

There will be other speakers today giving the details of becoming certified. I would like to remind you that your animals must be under organic management for a year before they can be certified organic. You must feed 100% organic feed and use no prohibited substances for one year. Your pastures must be proven to not have had any prohibited substances on it for 3 years before it can be certified.

You need to provide your milking does access to pasture at all times. They need to be getting 120 days of feed or 30% of their nutrition from it.

If you are raising goats for meat they must be handled organically for the last trimester of their dams pregnancy and can never have a prohibited substance used on them. If you buy a doe who has had a round of antibiotics, after one year of organic management she can be milked with your organic herd but she can never be certified organic for meat production.

As I talk more about goat dairying organically, remember that no one else can tell you what will work at your dairy. After following faithfully all we need to do to be certified, each of us has a different vision for our dairy. Each of us has different living conditions for our animals. We milk different breeds that have been managed in different ways. Use what you want of what I or anyone else suggests and leave the rest, always keeping within your organic guide lines.

It doesn't hurt to be skeptical until you see the results in your own herd.

I once heard about an experiment with cats who were raised, some on raw and some on pasteurized milk. For results we were told that after 3 generations the cats raised on pasteurized milk had all died, which was to convince us to use raw milk.

I count it one of the blessings of my life that I have all the raw goat milk I want to drink, but I know many goats who have been raised for far more than 3 generations on pasteurized milk and they are healthy and reproducing.

### **What Is Certified Organic Management?**

Basically organic management is managing our animals so we use no prohibited substances. All our feed will be certified organic and we will throw away our antibiotics and commercial dewormers.

We need to educate ourselves and work closely with our certifiers. **MAKE IT YOUR JOB TO KNOW ALL YOU CAN ABOUT WHAT IS EXPECTED** by your certifier. **LEARN TO ARTICULATE** to your inspector **WHAT YOU ARE DOING** organically at your dairy. A great resource is the **ATTRA ORGANIC LIVESTOCK HANDBOOK**, which you can get at [www.attra.org](http://www.attra.org).

## **How Can We Manage an Organic Goat Herd Without the Non-organic Input We May Be Currently Using?**

The first and perhaps most important thing we can do is HAVE SUPERBLY HEALTHY ANIMALS. We need to breed and cull for animals who thrive in the environment we provide them. Put your energy in to animals who are not always coming down with a snuffle or going off feed.

After I had my epiphany about living naturally with goats I started raising them in Northern California. Did I work at becoming "Natural", whatever that is or Organic? No, I just did what my goat mentors did. I and the many other young and beginning goat breeders, used antibiotics when ever we felt like it, and dry treated all the does in our herds, whether they had a mastitis problem or not. We were helping to the creation of antibiotic resistant super bacteria.

We dewormed on a schedule, never testing for an individual animal's worm load. We killed all the dung beetles in our area and once again helped with the development of super resistant parasites.

We pooled all our colostrum so every kid would have the benefit of the entire herd's antibodies. We thought we were doing the best thing for our animals and in some ways we were but we were also paving the way for the rapid spread of CAEV when it came on the scene. Situations change and we have to change with them.

### **Become Commercial Dairy Person Operators!**

An important step in being commercial and organic is LEARNING TO CULL.

Don't keep an animal just because her mother was a permanent champion, or her grandmother was a beautiful color. We can't afford to keep an animal who isn't thrifty at our dairy.

When we have a health problem we are going to decide if we have a herd health problem or an individual animal's health problem

The doe who gets pneumonia may have been suffering from our poor management but if she is the only doe to get sick we also know she is not thriving under our management. Perhaps she needs to find a new home.

To have superbly healthy animals we have to LET IT BE OK THAT OUR ANIMALS WILL NEVER REACH THEIR FULL GENETIC POTENTIAL. We don't have to pour the grain into them to make top ten status over taxing their udder's and their metabolism. This has to do as much with the commercial production of milk as it does with Organic Production. We have to keep on top of the balance between feeding for a high test and feeding for thrifty production that makes us money!

### **To Be Certified Organic We Will Use Only Certified Organic Feed Including Our Pastures.**

All feed you purchase must come with an organic certificate from the producer. This includes the Organic Certificate and a separate Products list telling just what is being certified. Make sure you have both. Look at the label of your salt mixes. Salt is not an item you have certified but you will need to make sure your mixes do not include any flavorings or non organic grains. Work with your Certifier.

## **To Be Certified Organic We Are Going to Stop Using Prohibited Substances Medications and Dewormers**

This can be upsetting. I took years to convert to organic. When I came to New Mexico and built my dairy I came to pristine land and brought contaminated goats. I had a lot to learn.

If you are converting right now what will you do without antibiotics?

Remember your first priority is to have

1) healthy animals,

2) cull constant offenders. I went out of my way to bring a doe with chronic mastitis to New Mexico. I spent untold hours messing with that goat, using penicillin and sulfa, infusing and fasting her as natural goat raisers suggested. I only tormented the doe and introduced mastitis into other does. I needed to cull. When you have a problem with your goats the first thing to do is find out if you really need antibiotics? Many times animals are treated because it is simpler to give a shot than to

3) decide if there really is a problem. I once had to pull a kid because it's head was turned back on it's body blocking the birth canal and it could not be born. I trimmed my fingernails and scrubbed up my hand and arm, then I reached into the doe to draw the head into the proper birthing position. Just when I got the head facing forward, it slipped away and I had to go in again, putting my arm all the way into the straining doe's body. This time I was able to help the doe push out the kid which was alive. It was a huge doe kid that had grown for so long with her head turned back it took about a week before she held it in the normal position. The mother was meanwhile just about in shock. She didn't get up and she wouldn't eat. This was before I was certified organic but I knew if she didn't have a fever, antibiotics wouldn't do her any good. It was five days before the doe ate much or came into her milk but after that she did just fine, and breed normally the next year. Maybe I was just lucky but I had to wait to see if antibiotics were really necessary and in this case they were not. In this case the doe had only started her hard labor and was still full of her own natural lubricant.

4) Find out what are the alternatives to antibiotics and other medicines now routinely used on conventional farms? We may need to look at the alternative medicines being used on people today, as well as consider what did people do 60 years ago before antibiotics? We do need to remember that just because something was used before the advent of antibiotics or is being used now as an alternative, that doesn't mean it is organic. Mercury used to be used to treat syphilis. I had a friend who took massive amounts of Chinese herbs for fertility only to find the high amount of estrogen in the herbs was feeding her then undetected breast cancer. Check out your options old and new.

Once I forgot to remove my summer salt mix from my pregnant does. This salt mix had extra calcium in it. That fall and winter I was also feeding an excellent alfalfa hay. After my doe, Exquisite, kidded, she got milk fever. She could not withdraw from her bones the calcium she needed to meet her rapidly increasing milk needs because she was used to having all her calcium supplied in her feed.

She went down and I had nothing to treat her with. Once again I was not organic at the time, I just had never had a case of milk fever before and was not prepared. If you have supplemental calcium to give a doe in this situation make sure it is not laced with non organic substances. Exquisite rapidly

went into a coma, and was laid out on her side with her eyes glazed over. My herd manager came into the pen and suggested I shoot her so we could bleed her and at least eat the meat. There seemed no way she could live. I remembered that in a James Herriot book, this old English Vet said that a treatment milk fever was filling the animals udder with air using a bicycle pump.

I didn't have a pump or any idea how I could have used one but I did have a cannula to infuse a teat and a 6 cc syringe. I cleaned off the does teat and pushed in 6 cc's of air. Then I took out the syringe and refilled it with air and pushed it in again. I kept doing this until one side of her udder was tight, then I did the same on the other side. I felt sick as I left her still and unresponsive in her pen. When I came back in 20 minutes Equisite was standing and alert. It was like a miracle. She came into her milk normally and I didn't have to treat her again.

5) But what will you do if you must use a prohibited substance on a doe. Under organic certification you can not just skip treating an animal so you can keep her in organic production. Right now consider where you will send animals who are given probated substances to save their life. Remember you don't want a marginally healthy animal in your herd anyway, and not many of us can afford to keep very many animals around and not producing for the year it takes to become organic again. Your certified will also not let you treat animals and hold them for a year as a management tool.

### **What about Dewormers?**

How can a herd in a wet climate do without chemical dewormers? Currently parasite control is a world wide problem. Already you know you have to alternated dewormers or the worms will more rapidly build up an immunity to whatever you use.

I live where it is so dry , parasites in my goats are not a problem. One way to control parasites would be to move to dryer area. You can investigate rotating your pastures.

Actually you are going to be on the cutting edge of a new era of parasites control whether you become organic or not because new alternatives will have to be found. Dewormers are becoming less effective.

You are lucky to have two parasite researchers in your area working on Small Ruminant parasite control. Their research into natural substances that parasites will not become resistant to will help you in your organic herd. They are Dr. Joan Burk ([www.scsr.org](http://www.scsr.org)) and Dr. Helen Swartz.

### **Some Misc Management Problems**

If you are using milk replacer you will need to find a source that is organic If you can't find a source for organic milk replacer you will need to give it up. You can give you kids milk from your certified herd or from someone Else's certified organic herd. Commercially purchased organic cow milk is a cheaper alternative for me than my own goat milk. I dislike using it because my goats milk is rich in CLA since they eat no grain. CLA is has beneficial health properties for kid goats and people. I use a combination of mother raising and hand raising. The kids at my dairy nurse their mothers and I also give them a bottle once a day so they will be tame and love me too.

Mother raising is essential for me because my range land is so rough the kids need their moms to keep an eye on them when the herd is browsing. The kids don't go with the herd until they are 3 months old.

I use weaning bits to stop the kids from nursing when they are 2 to 3 months old. This way kids and dams can be together and the kids learn what to eat and are a part of the herd and learn more about living with guardian dogs.

To control flies at the dairy I start early before my last frost and use fly predators throughout the season until after my first fall frost. I have used some predators that did not work. Keep trying until you have enough of the correct predators to control your fly problems. Traps are good here too, but I rely on the fly predators and chickens to scratch up problem areas.

### **Organic Goat Cheese Making**

In your organic creamery you will want to use the best cheese making practices. To be organic you will need to only bring in certified organic products to use in your yogurt or cheese. I use herbs in my cheese so all those herbs are certified organic and I have Certification on the herb company I get them from.

Of special concern is veg enzyme rennet. You will need a letter stating the rennet is NOT genetically modified. I have been able to get GMO free rennet from Glengarry Cheesemaking and Dairy Supply (613-525-3133). Perhaps someone will be able to produce a Certified Organic animal rennet. Without certified organic rennet and cultures our cheeses will not be able to be called 100% Certified Organic but will be Certified Organic. (95% organic)

I hope I can be an encouragement to anyone who is interested in being Certified Organic. Let's give one another support. Maybe some of us can form an Organic Goat Co-op, to buy feed in bulk and apply for grants!!



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## **BASIC GOAT HUSBANDRY**

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### **Introduction**

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

### **Pre-Parturition**

The kid management program should actually begin prior to parturition, with attention to the nutritional needs of the gestating doe in late lactation and during the dry 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.

<b>Age</b>	<b>Amount of Fluid</b>	<b>Feeding Schedule</b>
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  $\frac{1}{4}$  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.

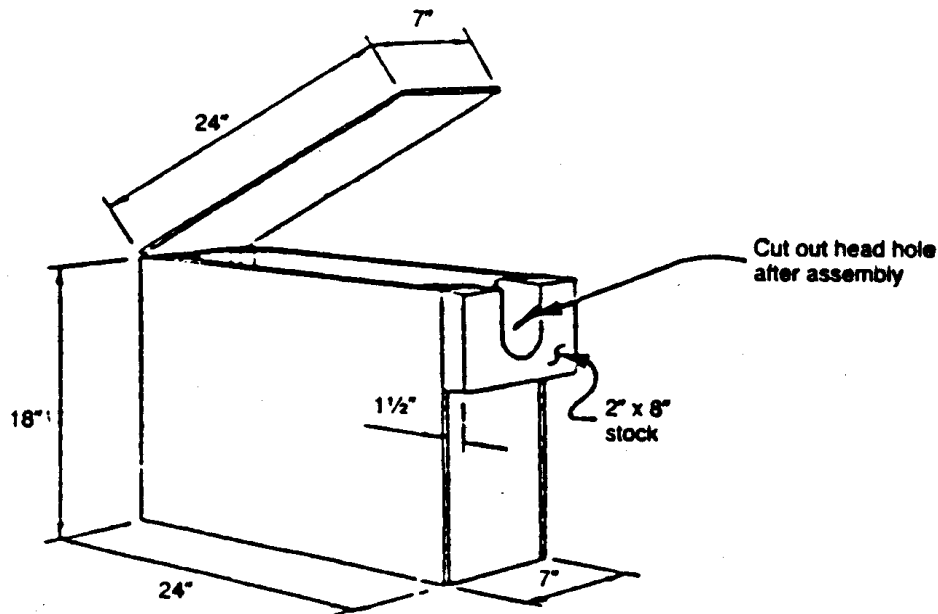
Kids should be consuming forages such as pasture grass or hay by two weeks of age and grain within four. Careful attention needs to be given to formulation of a concentrate supplement for the pre-weaning kid. Palatability is of primary concern. Molasses at the rate of 10% of the total dry matter, corn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

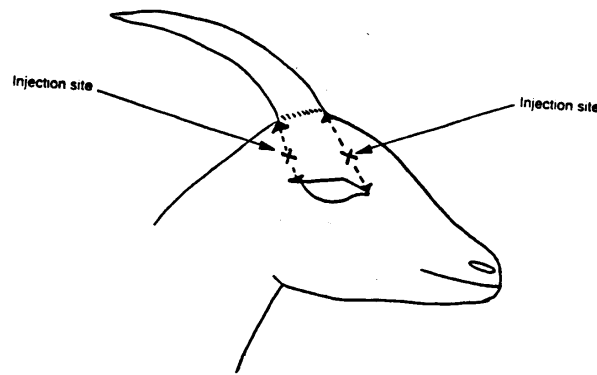
Several factors need to be considered when making the decision as to when to wean dairy goat kids. The most important consideration is whether or not the average daily consumption of concentrate and forage is adequate for growth and development to continue in the absence of milk. Fixed weaning ages are 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.

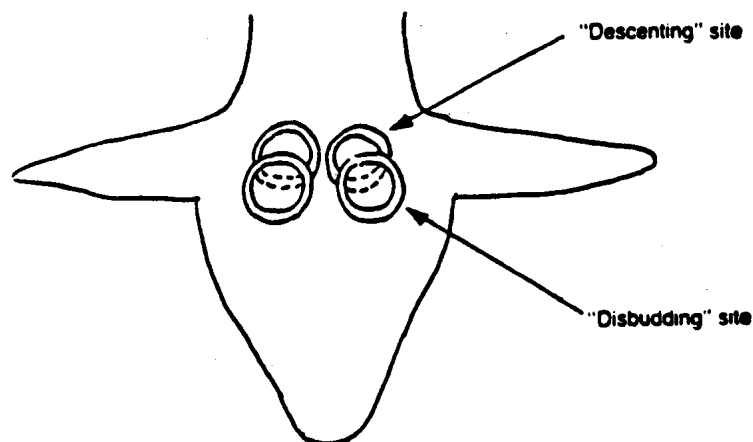


Although local anesthetic is commonly advocated, the actual technique is not easy and the baby goat will scream while being held in preparation for a ring block or a cornual nerve block.



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. Descending could be done at the same time if necessary. Inject the kids with 150 IU tetanus antigen. Although the risk of tetanus after disbudding is not great, it is a good practice to do it.



### **Dewatting**

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.

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# NUTRITION FOR PRODUCTION

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## **Introduction**

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

### ***The ruminant stomach***

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

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

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

Inadequate fiber consumption can then lead to several disease conditions. The most important disease condition is acidosis or an extremely low pH in the rumen, causing decreased feed consumption.

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

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

## **Nutrients**

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

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

## ***Water***

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

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

### ***Carbohydrates***

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

Cellulose is often referred to as fiber, although the term fiber also pertains to other substances such as hemicellulose and lignin. Fiber in young plants may be highly digestible and provide a high level of energy, but fiber in older, mature plants is often poorly digested and may only provide half the energy of other carbohydrates. Fiber in the diet may be characterized chemically in several ways, such as crude fiber (CF), acid detergent fiber (ADF), and neutral detergent fiber (NDF). These abbreviations are used in hay analysis and may appear on feed tags. In general, the lower the fiber level, the higher the level of digestible energy. However, a certain minimum fiber level is required for healthy rumen function.

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

### ***Fats***

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

### ***Protein***

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

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

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

## ***Vitamins***

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

The bacteria in the rumen of the goat can synthesize adequate amounts of the water soluble vitamins. Thiamine, or vitamin B1, may become deficient under some conditions (e.g., feeding a high concentrate diet, especially those with high sulfur which may come from a high level of molasses) and cause the disease polioencephalomalacia. Another situation that could lead to thiamine deficiency is improper feeding of the coccidiostat Albon. The coccidiostat ties up thiamine, making the coccidia unable to reproduce. Feeding Albon longer or at higher levels than recommended could lead to polioencephalomalacia. Polioencephalomalacia is a nervous disorder where the animal becomes blind, depressed, presses with his head, and the pupil slit in the eyes becomes up and down rather than the normal side to side profile. Treatment requires immediate injection of large quantities of thiamine.

Fat soluble vitamins must be supplied to the goat because the body cannot directly make them. The recommended levels of vitamins in formulated feed is 5,000 IU (international units, a measure of the potency of vitamins) of vitamin A per lb, 2,000 IU/lb of vitamin D, and 20 IU/lb of Vitamin E. The liver can store significant amounts of the fat soluble vitamins.

**Vitamin A** can be synthesized from carotene, the pigment that gives grass and hay their green color. As long as sufficient green feed is consumed, vitamin A intake will be adequate. Vitamin A is necessary for normal epithelium (skin) development and vision. A deficiency of vitamin A causes many symptoms, including tearing of the eyes, diarrhea, susceptibility to respiratory

infection, and reproduction problems. Vitamin A is often supplied to animals not consuming green forage such as in winter months. Many mineral and vitamin supplements contain vitamin A.

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

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

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

## ***Minerals***

The inorganic nutrients are called minerals. Minerals are further subdivided into macrominerals, those required at 0.1% or more in the diet (macro means large), and microminerals, those required at the part per million (ppm) level (micro means small). A ppm is the weight of a paperclip in a thousand pounds of feed. A hundred ppm is equal to 1.6 ounces in a thousand pounds of feed. Macrominerals include calcium, phosphorus, sodium, potassium, chloride, sulfur, and magnesium. Microminerals include iron, copper, cobalt, manganese, zinc, iodine, selenium, molybdenum, and others. Minerals function in many ways in the body. Some such as calcium and phosphorus are major structural components of bones and teeth, as well as having other functions. Other minerals facilitate nerve functioning or fulfill a role as electrolytes. The mineral requirements for goats are not as well known as they are for other livestock species and have often been extrapolated from sheep or cattle requirements due to a lack of studies in goats. As such, mineral recommendations for goats often have a wide range because of lack of accurate goat-specific information.

## ***Macrominerals***

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

*Calcium (Ca) 0.3 - 0.8%*

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

*Phosphorus (P) 0.25 - 0.4%*

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

*Sodium (Na) 0.2%*

*Potassium (K) 0.8 - 2.0%*

*Chloride (Cl) 0.2%*

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

*Sulfur (S) 0.2 - 0.32%*

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

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

#### *Magnesium (Mg) 0.18 - 0.4%*

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

#### *Micro or trace elements*

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

#### *Iron (Fe) 50 – 1000 ppm*

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

#### *Copper (Cu) 10 - 80 ppm*

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

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

*Cobalt (Co) 0.1 - 10 ppm*

The only well accepted biological function of cobalt is as a component of vitamin B<sub>12</sub>. Rumen microbes utilize cobalt for growth and produce vitamin B<sub>12</sub>. Cobalt deficiency symptoms include loss of appetite, anemia, decreased production, and weakness. Most natural feedstuffs contain adequate levels of cobalt.

*Zinc (Zn) 40 – 500 ppm*

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

*Manganese (Mn) 40 – 1000 ppm*

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

*Selenium (Se) 0.1 – 3 ppm*

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

*Molybdenum (Mo) 0.1 – 3 ppm*

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



*Iodine (I) 0.5 – 50 ppm*

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

### ***Mineral nutrition considerations***

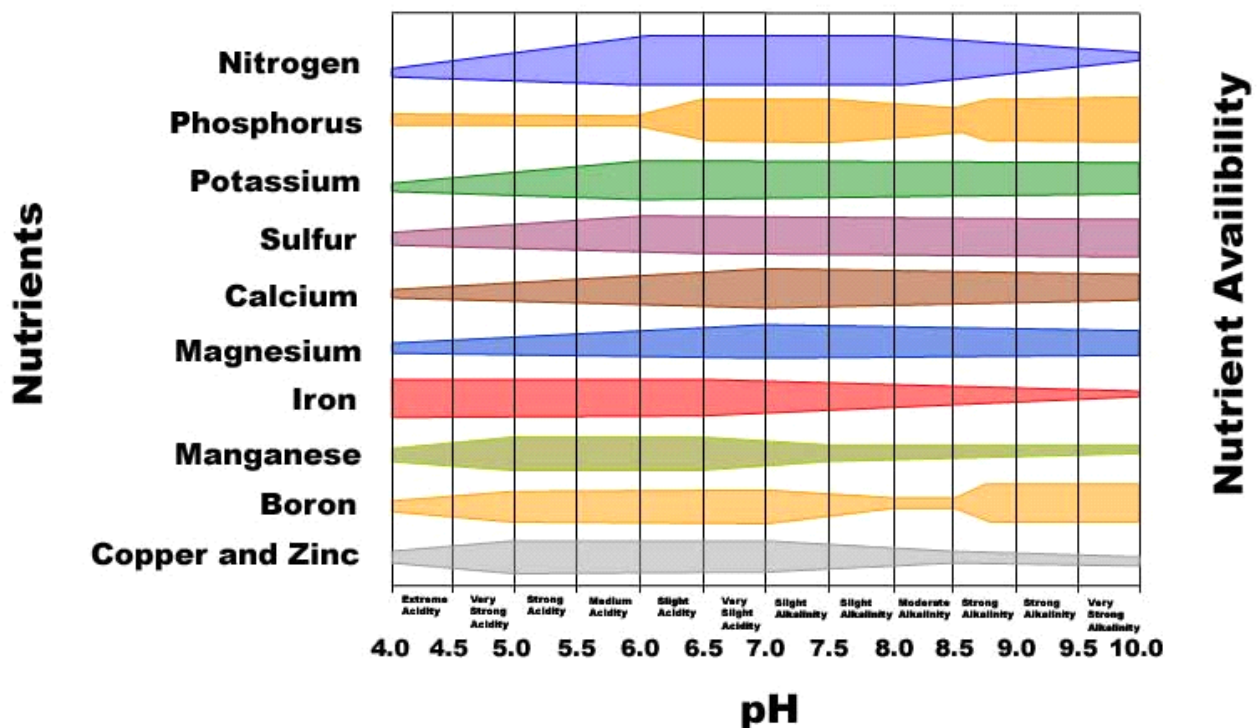
Plants are a major source of minerals for the goat, containing all minerals that goats require except iodine. However, plant requirements for minerals, such as cobalt and selenium, may be much lower than the level required for animals. Some soils are inherently deficient in some minerals such as iodine and selenium due to soil geology. Plants grown on soils deficient in a mineral are likely to be deficient in that mineral. However, some plants have an ability to concentrate the minerals available in the soil. Maps of mineral deficient areas of the U.S. are available. However, consulting local extension agents is a better method of determining soil mineral deficiencies or toxicities that could affect mineral levels in local forages. Soil maps showing deficient areas of selenium, copper, molybdenum, and cobalt are located at the end of this article.

Various factors other than soil mineral level can interact to influence the mineral content of forages. Soil pH is one factor that affects mineral uptake by plants. Under acidic soil conditions, many trace minerals are less available for plant uptake. Environmental temperature at certain times of the year may also affect mineral uptake. Interactions among minerals after soil fertilization can also affect their availability for incorporation into plant material. Season of the year affects plant mineral concentrations, mainly due to a dilution effect, with decreasing mineral levels as plants grow. Different plant species will also have varying contents. Browse and forb plant species may have higher mineral concentrations than do some grasses. As goats eat a variety of plants, they are less likely to have mineral deficiencies than other species of animals that eat predominantly one plant species.

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

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

### Influence of pH on Availability of Plant Nutrients

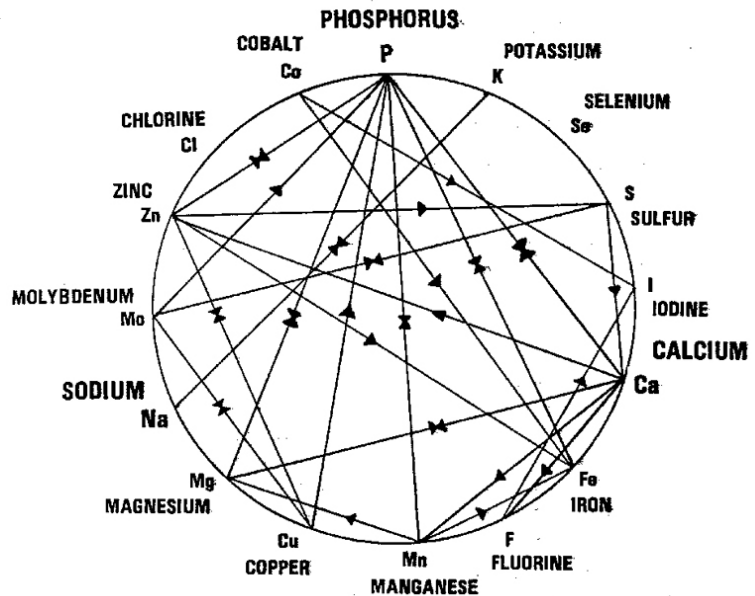


(S.S.S.A.P., 1946. 11:305.)

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

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

## MINERAL INTERRELATIONSHIPS



### *Choosing a mineral supplement*

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

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

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

Calcium	\$1.15
Phosphorus	4.50
Salt	0.40
Magnesium	1.11
Potassium	1.50

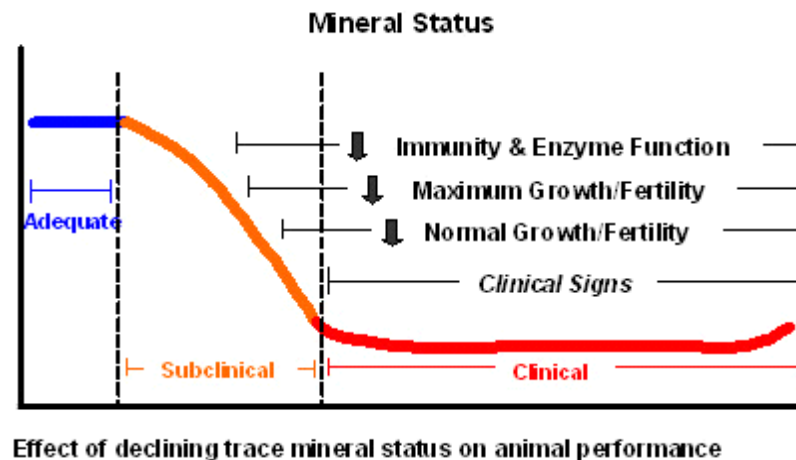
Trace minerals	0.45
Other minerals	0.65
Total	9.70

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

### ***Diagnosing mineral deficiencies or toxicities***

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

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



### ***Take home lessons on mineral nutrition***

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

## **Body condition scoring**

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

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

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

## **Using the Langston Interactive Nutrient Calculator**

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

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

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

### ***Getting started***

To teach you to use LINC, we will go through an example. Here is the assignment, calculate the nutrient requirements for a nonpregnant 3 year old mature ½ Boer-cross doe that had twins 6

weeks ago will be used. The doe has a 32 inch heartgirth and is under intensive grazing management. Her body condition score is 2.5.

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

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

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

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

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

**Question 4** asks the body weight of the goat. If the weight is known or a good estimate is available, it should be entered in the box. If the weight is unknown, the heartgirth (chest circumference) can be measured to predict body weight. Check the box to estimate weight via heartgirth and enter heartgirth in inches. A menu will appear with choices of genotype (breed) of goat (Alpine, Angora, Boer, ½ or less Boer, ¾ or 7/8 Boer, La Mancha, Nigerian dwarf, Oberhasli, Saanen, Toggenberg, and Spanish). Some breeds require input of body condition score. Body weight is then estimated. Input “32” inches for a “½ or less Boer” and the estimated weight of the doe is 105 lbs. This can be used for estimating bodyweight for medicine dosage or weights for management purposes.

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

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

**Question 7** asks the percentage TDN of the diet being fed and uses a default value of 60. If the TDN level in the feed is known, this value can be adjusted. For dairy goats, the default value is

65%. Use the default of 60%. If you know the value of the feed you plan to use put it in here. This value is important in prediction of intake.

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

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

### ***Providing needed nutrients***

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

There may be periods when nutrient requirements cannot be met, resulting in loss of body weight. This is acceptable at certain times in the production cycle if body condition is sufficient to draw upon body reserves and maintain the desired production level. An example would be weight loss during early lactation because sufficient nutrients cannot be consumed. However if the doe is in poor body condition, is a growing yearling, or has severe weight loss during this time, milk production will be depressed. During a drought, it may be acceptable for open or early pregnant animals that are not lactating to lose weight. During late pregnancy, inadequate nutrition can have adverse effects on pregnancy outcome and subsequent lactation. We can estimate what the projected bodyweight losses would be by reducing the bodyweight gains in question five and then calculating nutrient requirements until the energy and protein requirements match intake of those nutrients. Severe undernutrition can cause abortion, reduced livability of the kid(s), reduced milk production and adversely affect maternal behavior.

### **Feeding Different Classes of Goats**

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

#### ***Feeding bucks***

Mature bucks can obtain most of their nutrients from pasture. However, yearling and 2 year old bucks have greater nutrient requirements since they are still growing. Bucks need to be in good body condition (BCS greater than 3) before the breeding season because feed intake may be

relatively low during that time, with loss of body weight. Thus, body condition should be evaluated 3 months before the breeding season. Decisions can then be made on the supplemental nutrition needed for the buck to achieve the desired BCS.

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

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

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

The mineral supplement bag predicts intake of 0.5 to 1 lb/month/hundred lbs of body weight. At that rate, the 200 lb buck will consume 2 lbs/month or 0.067 lbs/day (2 lbs ÷ 30 days), roughly 1 ounce. Some supplements estimate an intake such as 1 to 1.5 oz/day, but this can vary with the size of the goat. Enter 0.07 lbs for the mineral. Therefore, in this example it can be assumed that forage dry matter intake is 3.55 lbs. The value of 3.55 is entered into the “Amount, as-fed” column for range forage. Clicking in the “Amount, lbs DM” column will calculate the amount of DM and nutrients provided (Running total) compared with the Requirements. The amount of *as-fed* native range grass provided should be increased until the forage dry matter provided equals the 3.55 lbs previously calculated. This is done by trial and error method until a correct answer is found. In this case, the correct amount is 3.95 lbs of as-fed native range, which will provide 3.55 lbs of dry



matter. Therefore, the estimated daily ration for this buck is 3.95 lbs of native range grass hay, or an equivalent amount of pasture, on a dry matter basis plus 0.07 lbs of mineral per day.

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

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

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

### ***Feeding replacement bucks and does***

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

Does will generally gain sufficient weight if an adequate amount of a moderate quality forage is available. If doelings are not gaining adequate weight (as measured by a scale or through the heartgirth conversion program), they could be supplemented with whole shelled corn at 0.5 to 1% of body weight per day (1/4 to 1/2 lb of corn per head per day for 50 lb doeling). Feeding excessive grain to does causes an overly fat condition. Fat may be deposited in the udder, leading to reduced formation of milk secretory tissue. The doe is also more likely to have pregnancy toxemia and

birthing problems. If sufficient good quality pasture is not available, growing doelings will need good quality hay and a supplement such as whole shelled corn, sweet feed, or range cubes or pellets at 0.5 to 1.0% of body weight.

Bucklings must gain more weight than doelings to reach puberty. While there are no available recommendations for weight of meat goat bucklings at first breeding, these animals need to reach an adequate size to achieve puberty. Like doelings, body condition should be monitored and supplemented at 0.5 to 1% of body weight per day (1/4 to 1/2 lb of corn per head per day for 50 lb buckling. Most bucks do not let a lack of body weight interfere with breeding, but some body reserves are necessary to maintain fertility and mating activity throughout the breeding season.

### ***Feeding does throughout their life cycle***

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

Use the LINC to calculate the nutrient requirements for a 130 lb nonpregnant, mature Boer doe without change in body weight and with intensive pasture grazing. The requirements are 1.50 lbs of TDN, 0.18 lbs of crude protein, 4.03 grams of calcium, and 2.82 grams of phosphorus, with an estimated dry matter intake of 2.31 lbs (based on the composition of fall bermudagrass; 50% TDN and 9% CP). Feeds used are fall bermudagrass and a mineral supplement. A 130 lb doe is expected to consume the mineral at 0.1% of body weight per month = 1.3 lbs/30 days = 0.04 lbs of mineral per day. The estimated 2.31 kg dry matter intake of fall bermudagrass (3.25 lbs as-fed) provides 1.14 lbs of TDN (76% of requirement) and 0.20 lbs of crude protein (111% of requirement). In this example, it appears questionable as to whether or not body weight of the doe could be maintained with this forage (i.e., 50% TDN). The goat's ability to select higher quality plant parts, as noted above, might enable them to maintain their body weight. In this regard, if they are able to select a diet with a TDN concentration of 60% rather than 50% then the amount of TDN supplied is  $(2.86 \times 0.60 = 1.37 \text{ lbs})$  which is 91% of the required amount, somewhat close to her requirements. Again, it is important to monitor body condition.

Calculate the nutrient requirements for a Boer doe weighing 70 lbs, gaining 5 lbs per month, and with intensive pasture grazing, using LINC. The requirements are: 1.3 lbs TDN, 0.25 lbs crude protein, 2.98 grams of calcium, and 2.08 grams of phosphorus with a dry matter intake estimate of 2.06 lbs. If we adjust estimated TDN and estimated protein for the forage (questions 7 and 8 in LINC) since the 50% TDN of fall Bermudagrass is different than the 60% assumed, and use 9% CP instead of the 12% assumed, predicted dry matter intake is 2.32 lbs. Using the same feeds, fall bermudagrass and mineral, with a mineral consumption of 0.02 lbs (1% of body weight /month, divided by 30) and using fall bermudagrass for the remainder of her intake (3.3 lbs as fed), both TDN (1.16 lbs intake, 89% of requirement) and crude protein (0.21 lbs intake, 84% of requirement) are inadequate. To achieve the desired growth rate, supplementation may be necessary. By trying sweet feed as a third feedstuff it is determined, through trial and error, that 0.75 lbs of sweet feed along with 2.0 lbs of fall pasture will provide most of the energy requirement but only 0.19 lbs of

crude protein (76% of requirement), which is inadequate. By deleting the sweet feed and changing to a 16% dairy ration to supply the needed crude protein, it is finally determined that 0.75 lbs of a 16% crude protein dairy ration, 2.0 lbs pasture, and 0.02 lbs of mineral will provide 1.3 lbs of TDN (100% of requirement) and 0.25 lbs of protein (100% of requirement). The weight gain to achieve adequate breeding size should continue to be monitored with possible feeding adjustments made. The lesson here is that this doe, because of the need for growth, has higher requirements than a mature doe and needs extra nutrition.

### ***Flushing meat goats***

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

### ***Winter feeding of does***

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

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

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

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

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

### ***Feeding does in late gestation***

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

A ration can be balanced using bermudagrass hay and 20% range cubes to meet the requirements by feeding 1.5 lbs of range cubes and 3.0 lbs of bermudagrass hay. This illustrates the high level of nutrition that is needed, especially in the last 3 weeks of pregnancy. High quality hay as well as supplementation is usually required. The range cubes contain a mineral supplement so on additional mineral mixture is needed.

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

### ***Feeding the lactating doe***

The lactating doe has very high nutrient requirements. Calculate the requirements for a 4 year old 110 lb Boer-cross doe nursing twins in week 4 of lactation. When lactating is selected under question #2 on LINC, a form drops down. Select litter size (twins), week of lactation (4), and age at kidding (4). The program then predicts production of 4.5 lbs of milk per day with 3.6% fat and 3.3% crude protein. Nutrient requirements are 2.8 lbs of TDN, 0.41 lbs of protein, 7.61 g of calcium, and 5.33 grams of phosphorus, with 4.14 lbs of dry matter intake predicted (based on default dietary TDN and CP concentrations). During lactation, the doe can consume nearly enough nutrients if an abundant supply of high quality pasture is available, such as in spring or early summer. However, does will likely lose some bodyweight due to the high demands of peak lactation (weeks 3 to 8 of lactation) and an inability to consume an adequate quantity of feed. Kidding should take place when there is an adequate supply of high quality pasture. If there is not adequate pasture, supplemental feed will be required. Inadequate nutrition will decrease body condition and reduce milk production and kid weaning weight.

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

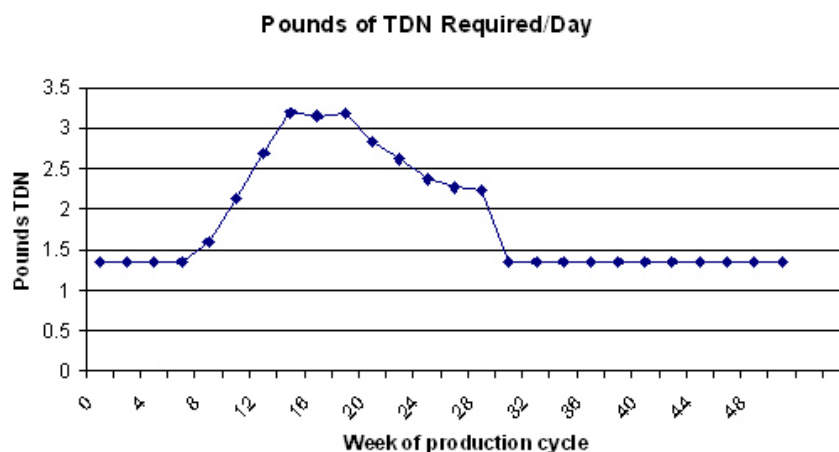
Kids are usually weaned at about 12 weeks of age. Milk production of the doe begins to decrease after the 6<sup>th</sup> week of lactation and is quite low by the 12th week. Nutrient requirements decline as stage of lactation advances, enabling the doe to maintain body condition or even increase it on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

## Creep feeding

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

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

### Effect of Kidding Season on Nutrient Requirements



Nutrient requirements of does change dramatically with stage of production. Requirements increase dramatically the last 6 weeks of gestation due to increasing fetal growth and remain high in early lactation (kidding occurred on week 20 in chart). During the month prior to kidding and for the following 3 months (assuming weaning at 12 weeks of age), the doe will consume nearly as much

nutrients as in the remaining 8 months of the production cycle. Thus, during that time it makes sense to supply nutrients from an inexpensive source, typically pasture. The cost of providing the same nutrients as hay is more than twice that of pasture, and supplying through purchased feeds may be four to five times greater than for pasture.

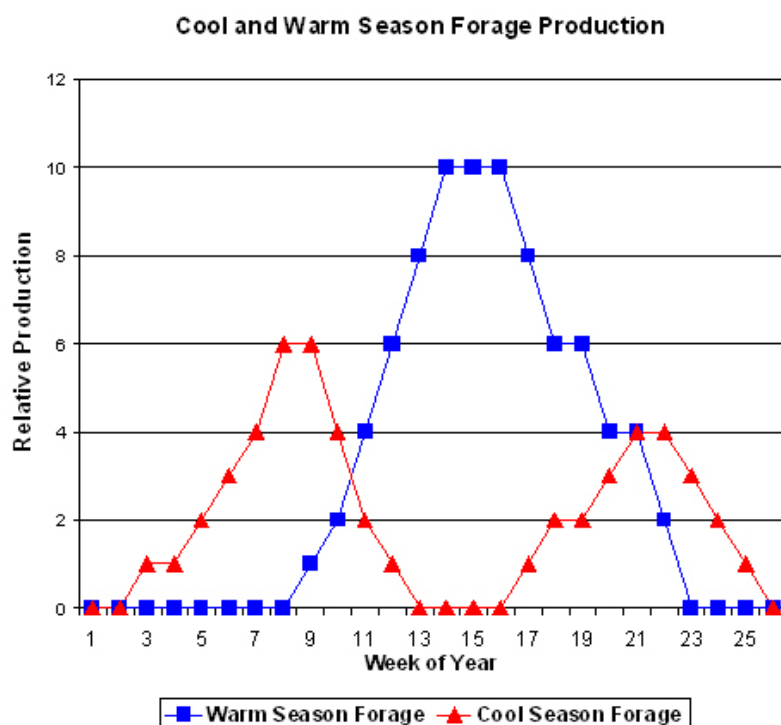
Kidding should be planned for a time when pasture is rapidly growing. This period corresponds to late spring for pastures comprised of warm season forages such as bermudagrass or native range, browse, and forbs, but could be either fall or early spring for cool season grasses such as ryegrass, wheat, orchardgrass, and fescue. Cool season grasses usually produce less forage per acre than warm season forages, but generally are higher in energy and protein. The accompanying figure shows the relative production of cool and warm season forages for central Oklahoma. Consult a local pasture extension specialist or livestock extension specialist for local forage growth patterns. Rapidly growing pasture is high in protein and energy. A major consideration in determining the date to kid is level of forage production at that time. However, there are other considerations in selecting kidding date, such as parasites and market opportunities. Some markets provide a substantial price premium from kidding at a specific time of the year, such as producing prospect show wethers or registered animals. However, it may take a considerable market premium to cover the cost of purchased feed, so general reliance on pastures and forages is best.

### Artificial Raising of Kids

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

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

Initially kids can be fed using a baby bottle or a nipple such as the Pritchard teat which fits on a plastic soda bottle. Kids can be bottle fed twice a day, although three times a day the first 4 to 6 weeks of life may



increase growth rate. Kids are very susceptible to bloating and other gastrointestinal problems from milk replacers that contain a high level of lactose due to use of dried whey in their formulation. Reduced lactose milk replacers will reduce bloating problems.

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

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

### **Considerations in Ration Formulation**

Rations should be balanced not only for protein and energy, but calcium and phosphorus contents should be calculated, macrominerals supplemented, and a trace mineralized salt used to provide microminerals. A vitamin premix should be used to provide at least vitamin A and E. If the diet is being fed at high levels to bucks or wethers, there is risk of urinary calculi. To prevent urinary calculi, the ration should be formulated with a minimum of phosphorus, over twice as much calcium as phosphorus, and a urine acidifier such as ammonium chloride at 0.5-1.0 % of the diet. Salt can also be included in the diet, such as at 1%, to reduce incidence of urinary calculi.

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

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

### **Feeding Systems**

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

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



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

### **Nutritional Disorders**

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

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

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

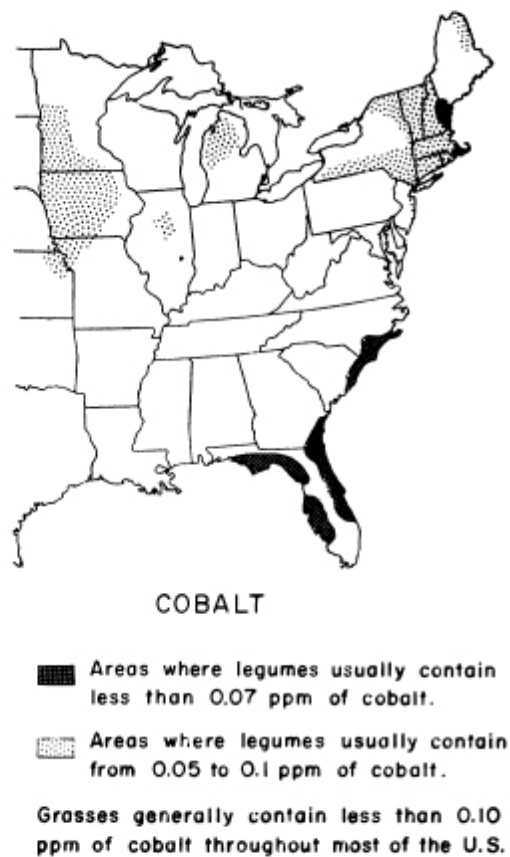
*Enterotoxemia* is caused by bacteria in the intestine that grow rapidly and produce an endotoxin in response to high levels of starch (grain) in the diet. Animals are in extreme pain from the effect of the endotoxin and often die quickly. Vaccination will help prevent this disease.

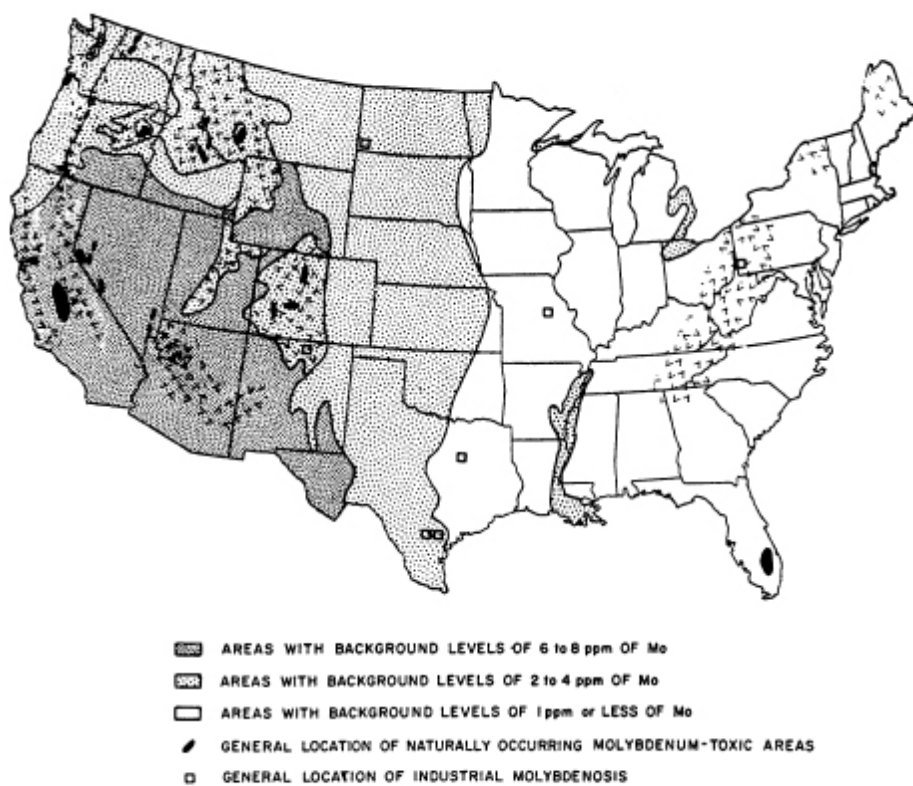
High levels of grain in the diet and stress are associated with *polioencephalomalacia*, which is a thiamine deficiency. High dietary levels of sulfur (such as from molasses in the diet) can increase incidence of the condition. The animals appear drunk, may not be able to stand, become blind, and slowly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

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

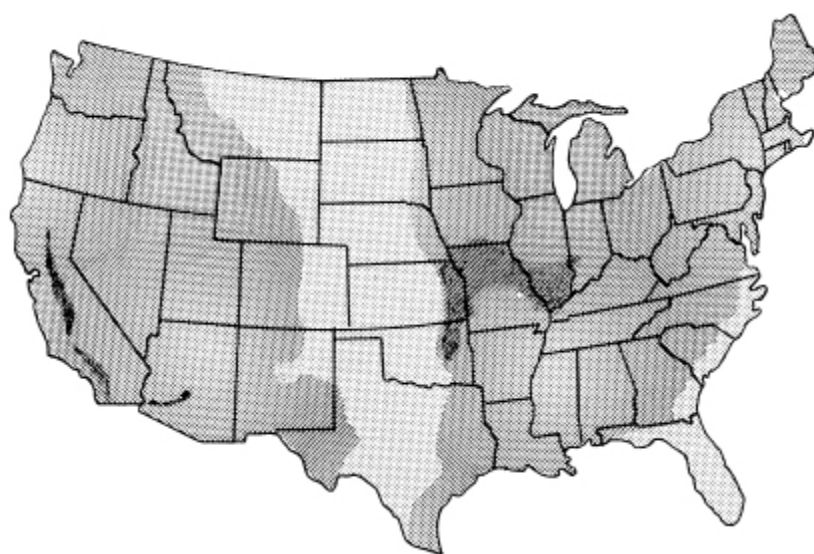
#### Soil-Related Nutritional Problem Areas for Grazing Animals

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





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



AREAS WHERE 50% OR MORE OF LEGUMES HAVE 10-12+ PPM OF COPPER

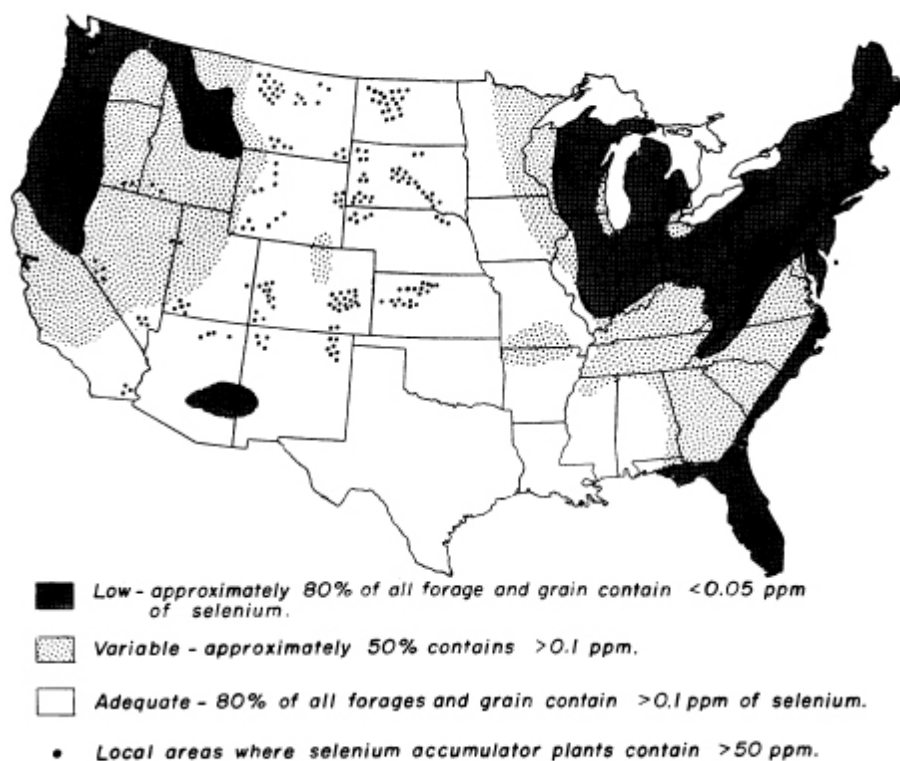


AREAS WHERE 40-70% OF LEGUMES HAVE 6-10 PPM OF COPPER



AREAS WHERE 35% OR MORE OF LEGUMES HAVE 6 PPM OR LESS OF COPPER

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



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

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

### Definitions useful for this article

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

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

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

**Carbohydrates** - The major energy source found in most feedstuffs. Carbohydrates contain twice as many hydrogen atoms as carbon and as many oxygen atoms as carbon, commonly designated as  $\text{CH}_2\text{O}$ . They include substances such as sugar, starch, fiber, cellulose, and hemicellulose.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Vitamins** - Specific organic substances required for various metabolic functions.

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# **AN OVERVIEW OF LEGAL ISSUES FACED BY MEAT GOAT PRODUCERS**

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## **INTRODUCTION**

From the initial dream of creating a commercially successful meat goat operation to the daily operation of that operation, not a day will go by that will not include dealing with a legal issue of one type or another. Legal issues dealt with by meat goat producers as part of the operation of their business include environmental regulations, labor issues, production contracts, leases, UCC Financing Statements and landowner liability, just to name a few. Legal issues that do not directly affect the farming operation but which are no less important to the continued existence of the meat goat operation include divorce law and pre-nuptial agreements, bankruptcy law and bogus check collection. The purpose of this module is to familiarize you with the basic legal issues you are likely to deal with in a meat goat production operation. Since most of the issues addressed are governed by state law which differs state to state, this module is not intended to give specific legal advice but instead give you an overview of the issues you potentially might face so that you can address the issue in an appropriate manner. The best advice is always to seek the professional legal services of an attorney in your area who is familiar with the laws of your state. This module is not intended to provide the reader with anything more than a brief overview of the complex legal issues with which you must become familiar in order to guide a successful operation.

## **Landowner Liability**

Land ownership in the United States has many benefits but it also has many potential liabilities. As urbanization spreads farther and farther into what have historically been agricultural lands, the issue of landowner liability has become increasingly important to farmers. Though landowners are liable under a wide variety of circumstances, the two most common and serious sources of liability are those that arise from the presence of people on your land and those that arise due to activities taking place on your land.

### ***Liability for persons on land***

Most states determine the duty of care required by a land owner based on the classification of the entrant upon his land. Under this legal theory, a person entering upon a landowner's land would be classified as either a trespasser, licensee or invitee. A trespasser is someone who is on the land without the owner's permission and from who's presence the landowner receives no benefit. Generally, a landowner owes no duty of care to a trespasser but may take no steps to intentionally harm the trespasser in any way. If the landowner is aware of frequent trespassers upon his land, then his duty of care may be somewhat higher and the trespassers must be warned of any dangers, especially those they are unlikely to discover themselves that could cause serious injury or death. It is also considered appropriate to alert the proper law enforcement authorities if there are frequent, unwelcomed and previously warned trespassers on the property. While nothing may happen after law enforcement authorities are alerted, that step may be an important one should activities involving trespassers result in harm or physical injury.

A landowner owes a greater duty of care to child trespassers in some instances due to the fact that children lack the ability to appreciate risks and apply mature judgment. The “attractive nuisance doctrine” requires that the level of care for child trespassers be adequate to protect young children from injury if any condition exists on the land that could lure children into danger. The Courts have discretion to determine liability of the landowner in relationship to the nature of the injury, the nature of the “attractive condition” and the age of the child, with younger children garnering more latitude from the Courts than older children with perceived greater knowledge of dangers.

Naturally existing dangers, such as ponds and other bodies of water, generally do not require any additional level of care. However, the landowner must check with the local jurisdiction in which he resides as there may be decisions from the Courts in his particular state that require landowners to take special precautions when bodies of water (either naturally occurring or manmade) exist on his property. Any improvements associated with the pond or body of water, such as boat docks, boats, or swings, may be considered as an attractive nuisance and require a greater duty of care. The greater duty of care may be anything from a sign warning entrants to the dangers posed by the water bodies, to a fence around the body of water, much as is required consistently of landowners who build swimming pools on their property. Consulting with local insurance agents and attorneys more familiar with a particular state’s laws and common practices is advisable.

A licensee is someone on the landowner’s property with the permission of the owner that does not provide a benefit to the landowner. Social guests are an example of a licensee. A landowner owes a higher duty of care to a licensee than he does to a trespasser. A landowner must notify a licensee of any hidden dangers on the property and not act in any way that could cause harm to the licensee. In some jurisdictions, a landowner may be required to repair any dangerous conditions for the benefit of licensees. Again, it is critical to check with local attorneys and insurance agents concerning the responsibilities of the landowner.

An invitee is someone who is on the land with the landowner’s permission and from whom the landowner receives some sort of benefit. An example of an invitee is a hunter or fisherman who pays a fee to use the property. An invitee is owed the highest duty of care by a landowner. A landowner is required to make the property reasonably safe for the invitee and is required to warn an invitee about any potential dangers on the property.

Some jurisdictions around the country have adopted a system of landowner liability based on a general duty of reasonable care for foreseeable risks, and many commentators are of the opinion that this entire area of the law is moving toward this general reasonable care standard. Under this system, a landowner owes a duty of reasonable care under all circumstances and to anyone on his property for any reason. Courts under this system determine liability by looking at such factors as foreseeability of the visitor’s presence, risk of injury, benefits of the harmful condition and burden imposed on landowner by correcting the condition.

In those situations where the landowner has created a situation that is extremely dangerous, the doctrine of “strict liability” is applied by the courts. The doctrine of strict liability holds that the creation of the dangerous situation alone results in liability for the landowner. An example of the creation of a dangerous situation would be the storage of chemicals or explosives on the property or

the keeping of animals that are deemed dangerous. The doctrine of strict liability will be applied both in jurisdictions that recognize a general duty of care by a landowner and those that recognize a duty of care based on an entrant's classification.

### ***Liability for Activities on Land***

A landowner may be liable for activities that take place on his/her property if those activities unreasonably interfere with the use and enjoyment of other people's property. Activities that unreasonably interfere with the use and enjoyment of another person's property generally fall into one of three categories, they include nuisance and trespass, which are common law violations, and the violation of environmental regulations

The first type of activity that unreasonably interferes with another person's use and enjoyment of his/her property is called a "nuisance". A nuisance may either be a "private nuisance" in which it affects a small amount of adjacent land or a relatively close neighbor or it may be a "public nuisance" in which a larger number of people, such as an entire neighborhood or community are affected. Excessive animal noise, dust, tractor noise, flies and noxious odors are examples of things which could constitute a nuisance. Nuisance claims are civil matters, not criminal, and therefore must be brought before the court by a complaining witness. In the case of a public nuisance, the action may be brought by an individual, association or municipality.

When determining whether one land owner's use of land is an "unreasonable" interference of another land owner's use of land, the court must weigh several factors. First, the court must determine whether the offending use is suitable for the area in which it is being conducted. Second, the court must determine if the extent and character of the harm, as well as the nature of the use being interfered with is appropriate for the area. Third, the court must determine what benefits, if any, are being provided by the offending use and whether the harm can be avoided if the activity were allowed to continue. The court will balance these factors as well as any other relevant evidence in order to resolve the issue.

If a nuisance is found to exist, the court has several options in deciding how to remedy the situation. These remedies include such options as money damages and/or an injunction. Money damages compensate a complaining landowner for the interference with the use and enjoyment of his property. An injunction is a court order ordering that the offending activity be stopped. If an activity is ordered stopped, the court may additionally award damages to the complaining party for the harm done before the activity was stopped. If the court allows the activity to continue, damages may be awarded to cover past and/or future injury. Most jurisdictions give courts wide latitude in determining whether an activity is a nuisance and what, if anything, should be done to remedy the situation. In some circumstances, farmers and ranchers have been required to move the offending activity away from the neighboring and offended party. Again, the Courts are given wide latitude in fashioning appropriate remedies.

The second type of activity that unreasonably interferes with another person's use and enjoyment of his/her property is called a "trespass". A trespass occurs when there is a physical invasion of the land of another without his/her permission. A common example of a trespass that arises from agricultural lands is the unauthorized invasion of wayward livestock onto another person's land. A landowner is liable under the theory of trespass for any damage done as a result of

the trespass. Most states have statutes that determine the amount of liability for straying livestock and the responsibilities of the livestock owner as well as the landowner upon whose property the livestock stray.

The third activity is the liability that arises from the violation of environmental regulations. Environmental regulations may be federal, state or local regulations. The Clean Water Act, the Clean Air Act, the Endangered Species Act, the Federal Insecticide, Fungicide, and Rodenticide Act and the Comprehensive Environmental Response, Compensation and Liability Act are but a few examples of environmental regulations from which a violation may result in landowner liability. Due to the complexities of environmental regulations, a full discussion of each environmental law relating to landowners will not be discussed in this module. Instead, the operation owner should consult with properly trained environmental advisors as well as the state and local environmental regulatory officials to determine the scope and manner in which the environmental regulations affect the landowner and goat operation owner in their jurisdiction.

### ***Landowner Liability Insurance***

One way to mitigate the exposure to liability that one has as a landowner is to purchase landowner liability insurance. Though insurance varies by state and by insurance carrier, the basic premise behind landowner liability insurance is to minimize the exposure a landowner has to claims arising from his ownership of real property. When searching for landowner liability insurance make sure to understand the scope of the insurance, who is protected by the insurance, as well as the payment limits of the insurance. Close readings of available policies are absolutely necessary and the individual producer may have to spend a considerable amount of time in finding the right liability coverage to address their particular operation.

## **Contracts**

Contracts have become an everyday part of life for farmers and livestock producers. From mortgages and promissory notes to pasture leases and bill of sales, legal documents have permeated the agricultural world. A general understanding of these legal documents has become important in order to both protect yourself and know what rights and interests you are giving up or assigning to others. This section focuses on Secured Transactions and the Uniform Commercial Code, Bill of Sales, Pasture and Farm Leases and Production Contracts.

### ***Secured Transactions and the Uniform Commercial Code***

Farmers and livestock producers have become increasingly dependent on creditors as a primary means of financing their land, machinery, crops and livestock. It is for this reason that it is very important to have a basic knowledge of how these transactions work and of the rules that govern them. When a creditor loans money to a farmer or livestock producer, he/she will frequently take a security interest in something that the farmer owns. This security interest may be in the land, home, farm equipment and implements, livestock, crops or any other property in which the farmer has an ownership interest. A secured transaction occurs when a creditor grants credit and in return is given a security agreement that grants a security interest in property of the obligated party. The creditor who receives the benefit of the security agreement is the secured party and the party giving the interest is the obligor. The property in which the security interest attaches is referred to as collateral. If the obligor defaults

on the loan and security agreement, the secured party may take possession of the collateral. If the obligor becomes bankrupt, the secured party may receive the collateral through the bankruptcy estate rather than receive only a portion of the estate after it is divided among all the obligor's creditors.

A secured transaction has two primary stages: attachment and perfection. Attachment occurs at the point in time when the security interest becomes enforceable against the obligor. This happens when value is given by the secured party to the obligor and the obligor has duly executed and authenticated a security agreement containing a detailed description of the collateral. Attachment can also occur if the secured party is given or takes physical possession of the collateral. Attachment does not require any additional steps such as the filing the security agreement. Attachment happens instantly at the point value is exchanged for the security agreement.

The second stage is the perfection of the security interest. Perfection occurs at the point in time in which the secured party is protected against any subsequent creditors claiming a security interest in the same collateral. To have a perfected security interest the secured party must generally file a UCC Financing Statement detailing the nature of the security interest and describing the collateral or the secured party must have physical possession of the collateral.

The basic rules concerning secured transactions are found in Article 9 of the Uniform Commercial Code. This section of the Uniform Commercial Code has been adopted by all fifty states and the District of Columbia. Though each state designates where the UCC financing statement should be filed, the basic form of the filing is uniform among the states. Each state has designated a central filing office so as not to have financing statements spread out across each of the counties or parishes of the state. Many states have designated that the Secretary of State shall be the office responsible for recording UCC Financing Statements. Other states have designated offices such as the Corporation Commission or the County Clerk in a central county as the office responsible for recording UCC Financing Statements.

Article 9 of the Uniform Commercial Code places the responsibility of determining the proper form of the filing and the proper place of filing of a security interest with the party filing the document. Article 9 states that a filing office may refuse to accept a record for filing only for certain specified reasons. The fact that a record is accepted for filing does not necessarily mean that the filing is effective for the purpose intended by the filer. If you have any questions regarding the filing of a UCC financing statement, you should seek legal advice to determine what should be filed and where it should be filed. Attachment "A" is a sample copy of a UCC Financing Statement and can be found on-line in both PDF and DOC formats by searching for "UCC1 Financing Statement".

### ***Bill of Sale***

A properly executed Bill of Sale is a legal document establishing the transfer of ownership of personal property, whether tangible or intangible, from one person or party to another. A Bill of Sale is a useful document because it evidences that value was given in exchange for the specific piece or pieces of personal property listed on the Bill of Sale better than a simple receipt. A Bill of Sale should include the legal names of both the buyer and the seller, the purchase price of goods sold and the effective date of the sale. A Bill of Sale should be signed by the seller and generally should be notarized by a Notary Public. Though there is no uniform Bill of Sale, it is recommended

that a Bill of Sale should include language verifying that the grantors are the lawful owners of the goods being sold and that the goods are free from all encumbrances.

A properly executed Bill of Sale will establish the effective date of the legal transfer of ownership of personal property listed in the document. This is important because it does not matter who has physical custody of the goods once the Bill of Sale is signed and executed. A Bill of Sale does not need to be filed of record to be valid. The signing and execution of a Bill of Sale is *prima facie* evidence, meaning valid on its face, that the money has been paid and that ownership of the property has been transferred.

A Bill of Sale protects both the buyer and the seller by setting out in detail the terms of the transaction. A Bill of Sale should be executed when purchasing or selling, especially to a private party, farm equipment, implements, crops, etc. Further, a Bill of Sale should always be used when buying or selling livestock. A Bill of Sale for livestock that is registered, or that potentially can be registered, with a specific registry should include the specific information or registration number for each animal being sold. Many registries will require a Bill of Sale in order to show a transfer of ownership in their records. When purchasing registered animals you should contact the registry and determine whether there is any specific form they require for a Bill of Sale. A sample Bill of Sale has been attached as attachment “B”.

### ***Goat Registration***

The subject of the registration of goats is a difficult subject to address because there is no industry wide standard for registration. Instead, registration of specific breeds is governed by various associations which generally deal with a specific goat breed. Goat registration is strictly done on a voluntary basis and is not required by state or federal law. Though not mandatory, goat registration is of importance to those involved in the goat industry as a means of keeping track of the bloodlines within the breed as well as keeping a central database of breeders and owners within the breed. In addition, registration gives an owner a means of identifying members of his herd in case they are lost or stolen. Each association has its own standards and procedures for registering animals with their association. Some associations recognize the registration of herds as well as individual goats. Most associations require information including registration number of the sire and dam as well as information about the person registering the animal. For information about registration of a specific breed, please contact the association regarding standards and procedures, as well as costs, of registering your animals.

### ***Pasture and Farm Leases***

Pasture and farm leases can be a very useful tool when beginning a farming or livestock operation. The leasing of farm and pasture land can also be a useful way for existing farming and livestock operations to increase their size and production without having to have the capital necessary to purchase new land outright. When leasing real property, first make sure that all terms of the lease are in writing. Though most states recognize that oral leases for land less than one year in length are legally enforceable, without the terms of the lease being in writing a court has no way of knowing the exact terms of the lease. The focus of this section will be on those clauses that are generally necessary for a fully detailed and legally enforceable lease. It is important to remember

that contract law varies from state to state and that the following is only an informational overview and should not be relied upon to be legally enforceable in your state.

The first issue when negotiating a farm or pasture lease is the duration of the lease. A farming operation that is relying on the continued use of the leased land needs to find land where a multi-year lease can be agreed upon. The lease agreement should state an exact period of time that the lease is valid. The lease should have an identifiable ending point so as to avoid any confusion as to when it expires. Further, you might want to negotiate extensions to the lease. An example of a lease extension is to state that the lessor shall have the option at the end of the lease period to renew the lease for a specified period. It is common when negotiating lease extensions to also negotiate the future price for each extension of the lease. The critical issue is not to become dependent on leased land only to lose the land because the lease signed did not adequately protect your needs. By negotiating these issues up front, you can avoid leasing land where you will only be able to negotiate a short term lease if your intent is to lease for a long term.

The second item when negotiating a lease is the issue of compensation to be paid to the landowner. A little research about land values and lease prices before entering into negotiations will help you settle on a price that is fair and reasonable to both parties. Lease prices can be affected based on land location, lease duration and availability of land in the area. In some circumstances the lease price can be tied to the production or crop yield of the leased land. This type of lease protects the person leasing the land by shielding them from loss in case of a bad production year. In addition to negotiating how much the compensation will be for the land you must also determine how that compensation will be paid. Pasture and farm leases can be paid annually, monthly or any other way that is mutually agreeable to both parties. Many farmers and livestock producers prefer to set up the lease payments on an annual basis since their income is based on a production season instead of a regular monthly income.

Another issue that should be dealt with in negotiation is the issue of termination. Both parties should agree as to when and how the lease should be terminated and the requirements for notice of termination. Further, issues such as any acts of the tenant that would constitute a breach of lease should be discussed as well as the tenant's rights if the property should be transferred or condemned during the lease period. It is important to remember that the more issues that can be settled prior to the preparation and signing of the lease will make for an easier working tenant/landlord relationship.

Once the negotiation of the lease terms is completed, either party can be charged with the responsibility of drawing up the lease. The lease must positively identify each party to the lease and include the legal description of the land subject to the lease. The lease must include all of the negotiated terms of the lease including duration, compensation and any other terms that are relevant to the lease such as who is responsible for insuring the property. A more thorough and detailed lease will lead to less misunderstanding and confusion and less likelihood of the disputed issue ending up in court. A sample Pasture Lease has been attached as attachment "C".

### ***Production Contracts***

Production contracts are a legally binding contract between a producer and processor by which a producer agrees to acquire, feed and care for livestock until such time that the livestock is

transported to the processor in exchange for a payment that has been set out in the production contract. Production contracts can be beneficial to both parties involved. A production contract is a way for a processor to insure a steady supply of goods or livestock of a consistent quality. It also allows a processor to be able to accurately budget the expense of the product or livestock being purchased and neutralize any negative consequences associated with the shifting market prices of the contracted product. Production contracts give a producer a guaranteed market for a specified amount of product or livestock. This allows a producer to more accurately budget the costs associated with the care and/or breeding of livestock in order to determine profitability and create an operating budget. One of the drawbacks to the producer is that he gives up a level of control in the operation of his business. The down side of production contracts for both parties is that you lose any advantage that you might receive from favorable market price trends.

Production contracts are subject to strict legal requirements due to the fact that, like any contract, it can be written to disproportionately favor one party over the other. Generally, the processor enters into the negotiation process with the upper hand because it is the larger and more financially secure party to the production contract. It is for this reason that the Farm Security and Rural Investment Act of 2002 prohibits or negates production contract confidentiality clauses in certain instances for livestock and poultry producers. The act allows producers to discuss the details and terms of a production contract with legal advisers, state and federal agencies, accountants, lenders or anybody else the producer chooses to discuss the terms of the production contract with despite the existence of a confidentiality clause.

Though production contracts can be a valuable asset for livestock producers, it is of vital importance to understand each and every term of the production contract. Despite the fact that the laws surrounding production contracts are geared to even the playing field it is still up to the individual producer to be familiar with the terms of the contract and not sign a contract that he is either not able to fulfill or that is written to favor the processor. The best way to determine if the contract is fair is to seek out legal advice before signing any production contracts.

### **Choosing a Business Entity**

Starting, owning and operating a business can be time consuming and very overwhelming. When deciding issues such as the nature and location of the business it is easy to overlook the issue of choosing a business entity. There are many different business entity types to choose from and benefits and drawbacks associated with each. Types of business entities include corporations, limited liability companies, partnerships and sole proprietorships. This section will discuss each of these business entities in greater detail. Each state has requirements in its statutes for setting up businesses and filing appropriate records to reflect those businesses. The producer should check with the proper state authorities, usually the Secretary of State, to determine the filing and recognition requirements for businesses in his or her state.

#### ***Sole Proprietorship***

The easiest type of business entity to start operating is a sole proprietorship. A sole proprietorship is a business entity owned and managed by one person. The sole proprietorship can be organized very informally and is not subject to very few federal or state regulations. A sole proprietorship is indistinguishable from the person owning and controlling the company. Because



the sole proprietorship is indistinguishable from the person owning the company, the owner is personally liable for all actions of the company. A sole proprietorship is taxed at the individual income tax rate of the owner. A sole proprietorship does not pay income taxes separately from the owner. The benefit to operating a sole proprietorship is that there is no expense in creating and registering the business entity. In addition, there are not requirements regarding the management and control of a sole proprietorship. One drawback with a sole proprietorship is that it offers no liability protection to the owner. For example, if an owner of a sole proprietorship was sued as the result of an action that occurred while doing business as the sole proprietorship he could have money from his personal savings account garnished as a result of the lawsuit. Another drawback is that there are very few tax advantages for operating a sole proprietorship. The owner is subject to the federal self-employment tax which is often a substantially higher tax rate than that which other business entities are subjected.

### ***Partnership***

A partnership is created if two or more individuals agree to enter into a business arrangement.

The agreement may either be in writing or may be oral. Though an oral partnership is legally enforceable it is always recommended that the partners define, in writing, the role that each individual performs and how the proceeds, assets and debts of the partnership are distributed. Partnerships, like sole proprietorships, are generally not required to be registered with the state but there are advantages in most states for registering partnerships. A limited partnership is a type of partnership that requires registration with the state that limits the liability of the individual partners for actions taken by the partnership. Benefits to creating a partnership include that it is relatively inexpensive to create and that individual partners can pool their resources and share control of the company. Drawbacks include personal liability, except in Limited Partnerships, and taxation at the individual income tax level.

### ***Limited Liability Company***

Limited Liability Companies, or LLC's, are business entities which share characteristics of both partnerships and corporations. LLC's limit the personal liability of members for obligations and/or actions of the company. LLC's are created by filing Articles of Organization with the state in which they are to be created. There are fees associated with the filing of the Articles of Organization. Generally, the Secretary of State is charged with the registration of business entities within a state. In addition to the Articles of Organization, most states require that an Operating Agreement be drawn up that establishes the members of the company as well as how the company is controlled and the duties of the members. LLC's are taxed in the same manner as Sole Proprietorships and Partnerships. Profits and/or losses pass through the LLC and are taxed at the individual income tax level of each member. Since LLC's have not been in existence as long as some of the other forms of business entities, the Courts have not fully explored the various protections afforded by these entities. Again, proper legal and accountant advise is necessary in determining the form of business entity.

## ***Corporation***

Corporations are the most complex type of business entity. A Corporation is created by filing Articles of Incorporation, or a similar document depending on the state, with the designated agency within the state. Corporations are governed by Bylaws that state the purpose and nature of the corporation, establish the rights of the shareholders and name the directors and officers of the corporation. Corporations are owned by shareholders who own stock in the corporation. Corporations may be wholly owned by one person or may be traded publically and owned by thousands of people. Many states have prohibitions against agricultural business being owned by corporations. Most states have exceptions to this rule where the corporation is owned by members of a family who are engaged in the operation of the farm. Corporations allow shareholders and officers to operate with limited liability for actions and/or obligations of the Corporation. Corporations are generally taxed at both the corporate level and at the individual income tax level of the shareholders. Small corporations can often elect to be classified as an 'S' Corporation. This means that taxes are not paid by the corporation and the tax liability passes through the corporation and on to the shareholders.

There are several of factors that must go into choosing a type of business entity. It is important to understand the consequences associated with each type of business entity. Consulting with both an attorney and a Certified Public Accountant will allow you to make an informed and knowledgeable decision. Often, the tax implications for the producer will be the guiding or determining factor in identifying and deciding upon a proper business entity.

## **Corporate Farming Laws**

Corporate farming laws, also referred to as anti-corporate farming laws, have become a common means by which state legislators have recognized the economic importance of the family farm and enacted legislation in order to preserve and protect the family farm from being driven out of business by large corporate farming operations. Nine states have enacted laws that prohibit or limit corporate farming. These states are South Dakota, North Dakota, Oklahoma, Iowa, Minnesota, Wisconsin, Nebraska, Missouri and Kansas.

Though corporate farming laws vary from state to state, the general purpose of these laws is to place restrictions on corporate farming activities. Most of the states that have enacted these laws have set out exemptions to the general prohibition of corporate farming to allow family farm corporations. Generally, a family farm corporation is a corporation owned by members of a family engaged in the operation of a family farm. Some states require that at least one member of the family farm corporation must physically reside on the farm. In addition, most of these states allow banks to take ownership and control of farmland if the acquisition is done for the purpose of collecting a debt or enforcing a legal security interest.

## **Farming Cooperatives**

One issue that all independent farmers face is the question of how to consistently and effectively control the price they pay for the products and services necessary to operate their business as well as the price they receive for the goods which they produce. One common and effective way of controlling these prices is the formation of Farming Cooperatives or "Co-ops".

Farming Cooperatives are legal business entities created under state law which are owned and operated for the purpose of benefitting those individuals who use its service. Farm Cooperatives can serve a variety of functions including, but not limited to, providing loans to farmers, purchasing and selling supplies with greater bargaining power than that of the individual farmer, bargaining on behalf of its members, providing transportation services and marketing agricultural products for its members.

Farm Cooperatives are formed by filing the legal documents required for incorporation in the home state of the Cooperative. Laws regarding incorporation are different in each state so it is important to become familiar with the rules regarding incorporating in the state in which you reside. In addition to filing the necessary paperwork for incorporation, the Cooperative must also adopt and ratify bylaws. Bylaws are the legally enforceable set of rules that establish the rights and obligations of the cooperative's members. Bylaws further govern the election and duties of the board of directors of the Cooperative. It is the board of directors that supervise and handle the business matters of the cooperative. Another important duty of the board of directors is to select the individual who will serve as the cooperative's manager or chief executive officer.

One of the most important steps in the formation and operation of a Farm Cooperative is the acquisition of the startup capital necessary to achieve the business goals of the Cooperative. There are many different ways to finance the establishment of a Cooperative. Two common ways of financing a new Farm Cooperative are charging a membership fee to those individuals using and benefitting from the Cooperative and by selling membership stock to those individuals using and benefitting from the Cooperative.

### **Labor Issues**

Most farm operations require assistance, at least from time to time, to complete the chores and tasks necessarily associated with the operation of the farm. This brings up the question of how to classify your "farm hands". State and Federal law require that anyone working on your farm either be classified as "contract laborer" or an "employee". Though each state can specifically define each of these relationships, the following is an overview of the nature and consequences of each of these classifications.

The first classification is that of contract laborer. A contract laborer is generally defined as:

- 1) someone over whom there is a limited level of direction or control;
- 2) someone who supplies his/her own equipment, material and supplies;
- 3) someone who can be discharged at any time or choose not to come to work without fear of losing employment;
- 4) someone who controls his/her own hours of employment;
- 5) someone who's employment period will be for a temporary or limited period of time; and
- 6) someone who is not an integral part of the business.

As an employer, there are several advantages to having “contract laborers” rather than employees. The most attractive advantage to an employer is that you do not have to withhold federal, state and Social Security (FICA) taxes, or pay unemployment or workers' compensation insurance for independent contractors. Contract laborers also do not receive benefits such as paid sick leave, vacation, health insurance and retirement benefits. It is very important when hiring contract laborers that you are aware of the state and federal rules defining these relationships. If you classify someone as a “contract laborer” and the State and Federal authorities disagree with your classification, you may be responsible for any state and federal taxes owed by that individual.

The second classification is that of employee. An employee is someone whose work is controlled by the employer and/or is an integral part of the business. As an employer, you will be responsible for withholding federal, state and Social Security (FICA) taxes, as well as responsible for carrying unemployment and workers' compensation insurance. Full time employees whose only source of income comes from their employment with you are generally going to be classified as employees and not contract laborers. If you have any questions regarding the classification of your farm hands, you should seek the advice of a Certified Public Accountant. A wrong classification can end up costing you a lot of time and money in the long run.

### **Bogus Check Collection**

Accepting personal checks is an important part of conducting business in the world we live in today. Businesses or producers refusing to accept personal checks place themselves at a distinct disadvantage and are turning away potential profits. Unfortunately, the price a business or producer pays for accepting personal checks can sometimes seem to outweigh the benefits. No business or producer is exempt from accepting payment for goods or services by means of bogus or counterfeit checks.

There are a few simple steps that can be taken while accepting the personal check that can help you collect your money in the unfortunate event that the check is returned unpaid. The most important rule to remember when dealing with personal checks is to not accept third-party checks, payroll checks or checks written for more than the amount of the purchase. These three types of checks are common schemes that counterfeiters and forgers use to try to pass bogus checks. Checks should only be accepted from a named party on the check. Always check identification to make sure that the person writing the check is a named party on the check and compare the signature on the check to the signature on the identification. You should also verify that the information printed on the check is accurate and collect additional information for your protection. It is recommended to ask for the writer's home and business phone numbers. If the check does not have an address printed on its face you should get an address. In addition to the writers name, address and telephone number, it is also advised to get the writer's drivers license number, expiration of license and date of birth. This information is helpful in the event that you must turn your check over to law enforcement to help collect payment.

Another item to be aware of is the number of the check. Many law enforcement agencies advise that accepting checks on newly opened accounts has more risk associated with it than accepting checks on established accounts. Many businesses refuse to accept checks with a check number lower than 500 or 1000. When accepting personal checks written on a new account it is advisable to ask to see two forms of identification and carefully review the identification to make sure that the

information on the provided identification matches the person writing the check. Forgers and counterfeiters often have checking accounts under different aliases and identification to match each alias. The bottom line when accepting a personal check is to use good judgment and due diligence to determine whether accepting the personal check is an acceptable risk. When in doubt as to the identity or character of the person presenting the personal check ask for an alternate means of payment.

No matter how careful you are in accepting personal checks, eventually you are going to receive a check back unpaid. The laws regarding the collection of returned checks are different from state to state and sometimes from county to county or city to city. Calling your local law enforcement agency is often a good way to find out what steps are legally acceptable in your community or state to collect a bogus check. Most jurisdictions will allow you to use the information that you collected at the time of accepting the check to contact the individual and ask them to take care of the bad check. If this is unsuccessful, you generally have three options available to try and collect on the bogus check. The first option is to hire a collection agency to try and collect on the bogus check. This is often the most effective means of collecting a debt but it is also generally the most expensive. Most collection agencies will take a fairly significant percentage of all monies that they collect on your behalf. The second option is to turn the check over to your local law enforcement agency. This is often a very slow way to try to collect a bogus check and can result in additional requirements on your part if you are required to testify in court regarding the check. The last option is to personally sue the writer of the check either in small claims court or in a general civil court. Filing a small claims case generally does not require an attorney but does require the payment of court filing fees and the payment of a process server. The down side to trying to collect a bogus check through a court case is that it is easier to get a judgment against an individual than it is actually collecting the money granted to you by that judgment.

## **Divorce**

Though the subject of divorces and family law may not seem to have a direct impact on the operation of a goat farm, the consequences of a divorce can be devastating to the family farm. The basic premise behind a divorce is to split all assets and debts of a marriage evenly between the husband and the wife. This is often easy to do if the only items to divide are the house, car, clothes, mortgage and credit card debt. What happens when there is a farm, livestock and the debt associated with that farm thrown into the mix? The equitable splitting of the land, legally known as real property, and personal possessions, legally known as personal property, becomes more complicated. In many situations, neither party will be able to retain the farm because there is no way to fairly and equitably divide the farm without selling it and dividing the proceeds.

The first issue to look at is how the farm land is owned and under what type of business arrangement the farm is being operated. If the actual land is owned jointly by both parties, bought during the marriage, or lived on as the marital homestead, the law in most states considers the land or real property as being jointly owned by the parties. In this situation, the land is generally not going to be considered an asset of the business. Where the land is jointly owned by the parties, the first order of business is determining how to equitably divide the assets, meaning both real and personal property.

Generally the parties begin the process of dividing the assets and debts by determining the equity, if any, that exists in the farm and its associated assets. In those situations where the debts and assets of the farm are equal to each other and there is no equity in the farm, then it is simply a matter of deciding who is going to get the farm and be responsible for those debts associated with the farm. The party not getting the farm and its associated debts will receive nothing in return because there is no actual value in the farm. In those situations where there is either equity and/or excessive debt built up in the farm, then it must be determined what the value, either negative or positive, of the equity is and how that value will be offset in favor of the parties. For example, if the farm has a positive equity of \$100,000, then the party not receiving the property would be entitled to half of that value. There are several ways that one-half of the equity can be paid to the other party. It can be paid as a cash settlement, either paid in full at the time the divorce is granted or paid out in payments over a specified period of time. If the party keeping the farm pays the other party at the time the divorce is granted it often requires them to take out a mortgage against the property. Another way that the value could be given to the other party is by dividing the other assets of the marriage in such a way that the party not receiving the farm would be awarded not only their share of the property, but also additional property equaling half of the value of the equity in the farm. This is common where there are enough assets to make it a feasible solution.

In those situations where the farm is owned by a corporation or other business entity, the issue to be determined is ownership of the company and how do you put a value on that ownership. If there is stock ownership in a company and that stock is determined to be an asset of the marriage, then the value of that stock should be equally divided between the parties. Because each state has their own laws regarding marriage and divorce, it is important to seek the advice of an experienced family law attorney when dealing with any issues arising from a divorce.

### **Pre-Nuptial Agreement**

One way to avoid problems caused by the division of property in a divorce is to sign a pre-nuptial agreement before getting married. A pre-nuptial agreement is a legally binding contract between a husband and wife that controls such things as assets brought into the marriage by either party, financial matters during the marriage and the splitting of property in the event that the marriage should be terminated for any reason. Though many people think that pre-nuptial agreements take all of the romance out of a marriage, it is very important to discuss and disclose all financial matters prior to entering into a marriage. In the situation where one party has acquired assets such as a goat farm, it is in the best interest of both parties to discuss their role in the operation of the farm and what expectations they would have regarding the farming operation if the marriage was to be terminated and the property divided. A pre-nuptial agreement is the best way to ensure that the farm, no matter how big or small, does not have to be sold as a result of a divorce.

### **Bankruptcy**

When a farmer is unable to continue to pay the bills both arising from the operation of the farm as well as personal obligations, he or she may face pressure and harassment from creditors. The farmer may even be subject to legal action taken on the part of the creditors against the farmer. One way that a farmer can respond to this pressure and harassment from creditors is to seek protection under the United States Bankruptcy code. The United States Bankruptcy law allows debtors suffering from financial hardship to settle their obligations by petitioning a federal court and

developing a plan to either reorganize their debt or divide their available non-exempt assets among their creditors. There are several different plans, known as Chapters, that allow debtors to receive this relief.

Chapter 7 of the U.S. Bankruptcy Code deals with the liquidation and distribution of the debtor's estate to his/her creditors. The bankruptcy code establishes a list of items which are exempt from being collected and liquidated as part of the bankruptcy. This list of exempted items varies from state to state but usually allows you to keep up to a certain amount of equity in your home, car, clothing and home furnishing as well as many other necessary items. All possessions which are not exempt under the bankruptcy code are collected by a Trustee appointed by the court and sold. The proceeds are then applied to the debts. Certain debts are not dischargeable in bankruptcy court. Debts that are not dischargeable include most taxes, school loans, child support and alimony.

Chapter 11 of the U.S. bankruptcy Code addresses the reorganization of the debts of a business. Under a Chapter 11 plan a business debtor enters into an agreement with its creditors under which all or part of its business is allowed to continue. The debts of the business are restructured in such a way as to hopefully allow the business to successfully service its debts.

Chapter 12 of the U.S. Bankruptcy Code deals specifically with the adjustment of debts of a family farmer with regular annual income. Chapter 12 requires that for the tax year before filing 50 percent of the debtor's gross income must come from farming, while total debts must not exceed \$3,237,000.00, and at least 50 percent of the debts must come from the farming operation. Closely-held entities, such as corporations or limited liability companies, are also eligible if one family owns more than 50 percent of the stock or equity, members of the family conduct the farming operation, more than 80 percent of its assets are related to the farming operation and its debts do not exceed \$3,237,000.00. In addition, at least 50 percent of that debt must have arisen from the farming operation.

Once the bankruptcy case is filed, a trustee is appointed to help administer the case. The debtor, however, is entitled to remain in possession of the farm assets, subject to specific duties and can only be removed for cause. A meeting of creditors is held where the debtor is questioned by creditors and the trustee. The Chapter 12 debtor has ninety days from filing to propose a three to five year plan of reorganization. This plan must meet specific statutory requirements. For example, secured creditors generally are entitled to receive at least the value of their collateral, and unsecured creditors must receive at least as much as they would receive under a Chapter 7 liquidation. All "disposable income" during the plan term is to be paid on unsecured debt. The plan must provide for full payment of priority debts. A bankruptcy judge will evaluate the debtor's plan at a confirmation hearing, and if the judge deems the plan feasible and in compliance with the Bankruptcy Code, it is confirmed. Upon completion of the plan the debtor is granted a discharge. In certain cases a hardship discharge may be granted if the plan was not completed due to circumstances for which justice demands that the debtor not be held accountable.

Chapter 13 of the U.S. bankruptcy Code deals with the reorganization of the debts of an individual. Under a Chapter 13 plan the individual debtor proposes a plan which establishes how the debtor's obligations are going to be paid. This plan usually lasts for a period of between three and five years. During the pendency of the plan, the debtor will be protected against wage and

property garnishments and may keep possession of all of his/her property. The proposed plan must be approved by the Bankruptcy judge and the creditors are allowed to file and be heard regarding objections to the plan. Certain debts are not dischargeable under a Chapter 13 plan. These include debts whose original term of payment is longer than the time of the proposed repayment plan, alimony and child support. Debts which were incurred after the filing of the bankruptcy petition and were not approved in advance by the bankruptcy trustee are also not dischargeable.

### **The Environment and the Clean Water Act**

The Clean Water Act, officially titled the Federal Water Pollution Control Act, 33 U.S. §§1251 - 1387, provides a comprehensive system for the regulation of pollutants in the waters of the United States with the objective of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. This act was originally adopted in 1948 and has been amended numerous times before arriving at its present form. The Environmental Protection Agency ("EPA") is the primary federal agency assigned with the enforcement of the Clean Water Act. The EPA works in conjunction with state environmental agencies and the U.S. Army Corps of Engineers in regulating under and enforcing the Clean Water Act. The Corps is involved more specifically in the wetlands portion of the CWA.. Though the scope of the Clean Water Act is very broad, the focus of this section is on that part of the Act which most directly relates to livestock farmers and producers. This is the issue of water quality standards.

The Clean Water Act gives the states the authority to establish water quality standards for their waters. The EPA must approve all water quality standards and may promulgate water quality standards where no agreement can be reached with a state. The monitoring of waterbodies to determine if the water quality standards are being met is left up to the state. Monitoring water quality is done by taking random samples and using these results to generate statistical reports about the water quality of a waterbody. The Clean Water Act requires that states send reports to the EPA detailing known information about bodies of water and a list of waters that do not meet their water quality standards.

The issue of whether or not livestock farms are directly subject to the Clean Water Act has been hotly debated over the past years with the outcome varying widely. Until recently, state law in California exempted farmers from the state's Clean Water Laws. Farmers and livestock producers were not required to apply for or receive permits even if their farm was directly connected to a body of water. Now, California farmers are having to cope with the added burden on complying with the Act and going through the process of applying for and receiving necessary permits. Additionally, the 2<sup>nd</sup> Circuit U.S. Court of Appeals in New York recently ruled that a cow farm that does not discharge into a waterway cannot be needlessly made to comply with regulations under the guise of the EPA's Clean Water Act. The Court noted that farmers go to great lengths to protect the environment and found that there are effective regulations in place in the states and in the EPA to protect the quality of water. The bottom line when dealing with the Clean Water Act is to be familiar with the environmental rules and regulations governing the state in which one plans to operate.



## **The Packers and Stockyard Act**

The Packers and Stockyards Act is designed to maintain competition and integrity in the meat, livestock and poultry industries. The Packers and Stockyards Act was originally passed in 1921 and has been updated and amended several times through the years. The last major amendment came in 1978. The act contains provisions banning unfair and deceptive business practices such as price discrimination, weight and grade manipulation of livestock or carcasses, commercial bribery and misrepresentation of source, condition, or quality of livestock. The act gives the Secretary of Agriculture the authority to regulate livestock marketing activities at public stockyards and the operations of meat packers and live poultry dealers. In addition, the act authorizes the U.S. Department of Agriculture to regulate the rates of stockyard operators and market agencies at the stockyards.

Enforcement of the Packers and Stockyards Act is charged to the Grain Inspection, Packers and Stockyards Administration. It is the mission of the administration to promote fair and competitive trading practices for the overall benefit of consumers and agricultural producers. Unfortunately, the Grain Inspection, Packers and Stockyards Administration is regularly understaffed and criticized for not investigating and taking formal actions regarding complaints made as per the act. Further, the enforcement of the act is often challenging because it is difficult to prove the existence of anti-competitive practices. Some states have enacted state legislation mirroring the federal act believing that it is easier to enforce these provisions at the state level rather than at the federal level.

One should be aware of who is and who is not subject to the act. For example, farmers and ranchers are not subject to the Act when marketing their own livestock or when buying livestock for their own stocking or feeding purposes.

Livestock producers benefit from the act so it is important to understand the benefits afforded by the Packers and Stockyards Act. Livestock producers may file claims for reparations against stockyard operators, commission firms, auction markets and dealers. If a consumer is harmed by a packer, the Packers and Stockyards Act provides for private civil actions by the harmed party against the offending party.

Another benefit that livestock producers receive from the Packers and Stockyards Act is the financial protection aspect of the act. Payment protection for the sellers of livestock is provided directly under the act by statutory requirement. Prompt payment for the purchase of livestock is an important element of the financial protection established by the act. Financial protection is further enforced by bonding requirements of a packer trust which provides protection to livestock producers who fail to receive payments from meat packers.

## **Urban Sprawl**

Every year in the United States thousands of acres of farmland and grazing pasture are lost due to urbanization and the growth of existing cities. This is often referred to as Urban Sprawl. The Merriam-Webster dictionary defines urban sprawl as “the spreading of urban developments (as houses or shopping centers) on undeveloped land near a city”. Urban sprawl is a source of concern for farmers and livestock producers, as well as legislators, for several reasons. A primary concern is the increase in tension between farmers and livestock producers and their new urban neighbors.

Farming and ranching operations are often seen as a nuisance when near urban areas because of the noise and odor pollution associated with these operations. In addition, stray animals from a livestock operation cause more concern when loose in a residential or commercial area than when loose in rural agricultural land. It is for reasons such as these that all states have enacted “right-to-farm” legislation protecting existing farming, ranching and livestock production operations.

Right-to-Farm legislation varies widely from state to state. Most states have given farmers and livestock producers legal protection from nuisance suits brought against them by individuals who choose to move into the area and then bring nuisance actions against the agricultural operation seeking to stop the operation. Many states have incorporated the common law defense of “coming to the nuisance” into the right-to-farm legislation and making it an automatic defense to a nuisance suit. Most states recognize that in order to receive this protection a farmer or livestock producer must have been in business at its current location for a period longer than a year and must be in compliance with all local, state and federal regulations governing its operation. Some states have enacted right-to-farm legislation that creates agricultural districts within the state. In these states, agricultural producers within the defined districts will receive the protection granted by the legislation. In this manner, legislators have been able to recognize a distinction between urban, commercial and agricultural lands.

Another legal mechanism by which states protect agricultural lands is zoning. Zoning, which can be done at the state and/or local level of government, is a means by which to control the use of a given piece of land. In some states the zoning regulations dictate minimum land parcel size, limit permissible uses and deter the sale of land for other purposes besides agricultural uses. These states generally allow uses such as farm labor housing, processing facilities and marketing facilities so long as they are associated with the agricultural uses set forth in the zoning. Some states and municipalities zoning laws create mixed areas that remain substantially rural in character but include non-commercial farms and large-lot residential areas.

In addition to the legal mechanisms which physically restrict the use of land such as right-to-farm and zoning laws, various states have also enacted more subtle ways to encourage agricultural growth and prosperity. Nearly every state has passed laws which provide agricultural land with differential tax status or tax incentives. Many states have enacted legislation which require local tax authorities to assess agricultural land based on the value of its present use rather than the value of its highest or best use. This is important because it prevents agricultural lands from being taxed in the same manner as residential or commercial property even if the property is in the same area. Some states provide agricultural producers with lower tax assessments if they agree to certain conditions such as agreeing not to develop their land for a specified period of time. These states are directly using tax incentives to preserve existing farmland and encourage new agricultural operations.

Some municipalities and cities have also begun combating the issue of urban sprawl. Besides the negative effect urbanization can have on agriculture there is also a negative effect on the municipality or city. The more spread out a city becomes the more extensive and expensive it is to provide services such as water and sewer lines as well as the additional burden on police and fire services. Some cities and municipalities have fought this by creating urban growth boundaries. These boundaries clearly mark the parameter of the city or municipality and require new growth to take place within the boundary. Urban growth boundaries protect both the city and the rural agricultural lands surrounding it.

## **Pro Bono Legal Services**

Farmers and livestock producers, like everybody else, are not exempt from finding themselves in times of financial hardship or in need of legal advice and representation. In these situations it is beneficial to know effective ways to seek out sources of free or pro bono legal services. Pro bono legal services are available covering most legal issues. The American Bar Association and all state bar associations strongly encourage practicing attorneys to donate their time and services back to their community by way of performing pro bono services. There are several effective ways to locate a pro bono attorney. The first method that will be discussed is the use of the internet as a research tool for locating pro bono legal services. Before mentioning any specific sites or giving any web addresses, it must be stated that we do not intend to imply that we sponsor or are associated with the persons or entities who created the aforementioned sites. These web sites are provided as a starting point for your research and do not reflect all sources available.

A good resource to utilize when beginning your search is FarmLaw's resource page (<http://www.farmlaw.com/resources.html>). This web site has a pro bono links section. Another agricultural law resource is the Farmers' Legal Action Group, Incorporated's web page (<http://www.flaginc.org>). Both of these web sites link to the American Bar Association's ("ABA") Center for Pro Bono and Public Services. The ABA's Center for Pro Bono and Public Services web site has links to pro bono services available for each state in the country (<http://www.abanet.org/legalservices/probono/directory.html>). In addition to these sites, using search engines such as Google (<http://www.google.com>), PogPile (<http://www.dogpile.com>) and Yahoo (<http://www.yahoo.com>) can be another useful way to seek out information regarding potential pro bono legal services. When using search engines, it is useful to make your search as detailed as possible in order to return useful information. One of the most useful websites is the National Center for Agricultural Law and research and Information website: [www.nationalaglawcenter.org](http://www.nationalaglawcenter.org). This website is divided into reading rooms on a variety of different subjects in which the producer can find links to various federal, state, local laws, statutes, regulations and court decisions on a wide variety of agricultural law topics.

Another way to search for pro bono legal services is to call your state bar association. The telephone numbers for your state bar association should be available by calling information. Most state bar associations are located in the capital city. State bar associations often have booklets or pamphlets containing useful information on available pro bono services as well as summaries and frequently asked questions about common areas of law. In addition, legal referral services available through the state bar association might be able to tell you what pro bono services are available in your state as well as any local bar chapters in your area. Make sure when you are discussing your matter with a prospective pro bono attorney that he fully understands your legal situation as well as your financial situation. This will be beneficial to both you and the attorney to determine whether he/she can help you with your legal issues.

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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 286million 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 keep 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-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 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, entry 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 Pyr, 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 Livestock Guardian Dog. 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 Livestock Guardian Dog 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 Dog, Akbash, and Maremma are the most common working livestock guardians 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 it will pay you for your efforts in researching a hundred times over what you 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 human aggressive?
- Do you want long or short-haired animals? What kind of maintenance grooming is required of 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 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 entropion (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 be 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 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 Pyr/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 they 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, today, 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 gone, 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, over feeding 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.

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.

### *The Area*

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. Pyrs 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 dewormer 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 Pyr will threaten and see if the predator will leave. If not, the Pyr 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 Pyr will definitely herd its animals while it holds them in a group and keeps them away from the threat. Pyrs 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 Pyr, 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 insure 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, insure 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 and, if their 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 ratty 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 spay and neuter 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 some rescue 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 Thoughts**

We have tried to share in this module 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.

### **Bountiful Farm**

[http://www.bountifulfarm.com/Introducing your Pyr.html](http://www.bountifulfarm.com/Introducing%20your%20Pyr.html)

[http://www.bountifulfarm.com/Dog Discipline.html](http://www.bountifulfarm.com/Dog%20Discipline.html)

Livestock Protection Dogs by Orysia Dawydiak & David Sims, 2004, ISBN 1-57779-062-6

### **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](mailto:GoatandSheepRancher@yahoogroups.com)

[workingLGDs@yahoogroups.com](mailto:workingLGDs@yahoogroups.com)

*The proper citation for this article is:*

*Lane, P. and D. Lane. 2006. Livestock Guardian Dogs. Pages 69-89 in Proc. 21st Ann. Goat Field Day, Langston University, Langston, OK.*

## **GOAT FARM BUDGETING**

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Investing in a farm is often an expensive undertaking and can be financially stressful. Land ownership in particular is costly. Historical rates of return to agricultural assets average 4 to 5% making it difficult to make principal and interest payments on land notes with farm income only. Hence, business planning is especially important in ranching operations even if the decision to produce goat meat is a lifestyle choice or hobby rather than strictly an economic one. An expensive hobby may create a serious financial drain on the producer's checking account.

The agricultural producer or farm manager is challenged when organizing and managing farm resources to maximize economic returns to owned or controlled resources. Resources include land (owned and rented) and associated improvements, capital (borrowed and owned), and labor (hired, farm operator, and additional family). The manager is responsible for combining available resources and knowledge to best achieve the desired goals and objectives of the farm business.

As a key component of a business plan, budgeting is a management tool that helps the beginning producer evaluate the feasibility of a proposed venture and helps established producers identify areas for improvement. Budgets identify financial resources needed for both farm investment and annual operating costs. With budgets, management can begin to answer such questions as:

- How may the available resources best be used?
- What enterprises (crops and/or livestock) can be produced and which will contribute most to returns to owned resources?
- How much of the controlled land should be devoted to each enterprise?
- What equipment and machinery will be needed to produce the potential enterprises?
- What production practices should be used to produce each of the enterprises?
- How much labor (both family and hired) will be needed on the farm?
- What are the capital requirements?

Budgets help ensure that investors make decisions based on realistic data, not just emotions. Knowledge of budgeting and the ability to use them will help make the right decision.

### **Types of Budgets**

There are three basic types of budgets that can be used in the farm business management process. Each type of budget provides different information to the manager for use in the decision-making process. The common thread in each type is that, if properly defined and used, the budget format

permits the manager to use economic logic to answer questions of what, how much, and when resources should be used to achieve the goals and objectives as established by the farm family.

The three types of budgets are:

- 1) Whole-farm budget
- 2) Enterprise budget
- 3) Partial budget

### ***Whole-Farm Budgets***

Since it is a plan for the future use of farm resources and establishes the future direction of the farm organization, the whole-farm budget must conform to the farm family goals and objectives to be successful. Farm management that is goal-directed integrates the goals and objectives of the farm with those of the family and reduces pressure on competitive uses of family controlled resources. Oklahoma State University (OSU) Extension fact sheet F-244, "Goal Setting for Farm and Ranch Families," can help develop a process for identifying farm and family goals, prioritizing them, and identifying management strategies that achieve identified goals.

The whole-farm budget should start with the inputs the operator has available for use in the farm business. Often the amount of land and operating capital available are limiting factors. Other factors such as buildings, the farmer's managerial skills, and available markets can also be relatively fixed. It is important to start with those fixed elements in planning a whole-farm budget. The results of the whole-farm budget should combine the resources, constraints, technical information, and price data into a realistic whole-farm budget for the farm being considered. The outcome should be a plan that can provide direction for the farmer and family to follow in maximizing the returns to owned resources.

To develop a whole-farm budget:

- 1) List the goals and objectives of the farm firm.
- 2) Inventory the resources available for use in production.
- 3) Determine physical production data that will be used in the input/output process.
- 4) Identify reliable input and output prices.
- 5) Calculate the expected variable and fixed costs and all returns.

### ***Enterprise Budgets***

Questions may arise as to whether goats will help supplement farm income or if a larger operation is even technically feasible. In an enterprise with seasonal and cyclical price changes, sensitivity to variable grain and hay prices, and a vulnerability to drought, appropriate management practices and an identification of key cost components are important. Circumstances over which the producer has no control can wreak havoc in the short run if a producer neglects strategic planning and risk management.

An enterprise budget estimates the full economic costs and returns projected to accrue to an activity - raising livestock or producing grain - for some period, generally one year. Enterprise budgets incorporate information about the specific resources, management practices, and technology used in the production process. Budgets help provide a decision framework for assessing both short- and long-range economic analyses of production agriculture. Budgeting allows producers to evaluate options before committing resources. Budgets can also be used to estimate potential income and the size of farm needed to earn a specified return or to compare the profitability of two or more systems of production. Budgets provide the documentation necessary to project cash flows and obtain/maintain credit-worthiness. Budgets can be used to estimate the amount of rent that can be paid for land or machinery.

A goat enterprise budget is a statement of what is generally expected from a set of particular production practices, listing the expected revenue and expenses incurred. It is designed to show profitability, not just cash flow. Profit is shown as residual earnings after resources utilized in the operation have been assigned a payment. The enterprise budget shown in Table 2.1 lists anticipated costs of operating inputs plus fixed costs (interest, depreciation, taxes, and insurance) on machinery, equipment, and livestock along with expected production per doe. Since the budget documents variable and fixed costs, it is useful in calculating profitability, break-even values, and the potential return on an investment.

An enterprise budget should contain several components. A detailed description should include a production goal, the production techniques to be employed, the land resource required, and even something about the capital and labor requirements. An enterprise budget should include all costs and all returns associated with the defined enterprise.

## Production

Historically, a lack of a developed nationwide marketing system in the United States caused seasonal price fluctuations and wide variations by location. Goat meat is favored by a number of ethnic groups who have immigrated to this country and many producers have traditionally supplied goat meat to these populations on an individual basis. However, with goat meat demand steadily increasing and domestic producers raising more goats to meet this growing appetite, market outlets such as livestock sales auctions are becoming more common.

A sample budget considering a herd size of 50 does and two bucks is shown in Table 2.1. The kids are marketed at four months of age. The total quantity of production is multiplied by the actual or expected price to determine value of production. Gross or total receipts are the sum of production values for individual items. For example, the expected returns in the budget are averaged for reporting on a per doe basis. A herd technically does not market 30.5 male kids for sale. This is a statistical result of the averaging process for the herd. The averaging process yields a realistic estimate of the budget unit (doe) returns to the entire herd given the assumed kid crop percentage, death loss, and cull doe replacement rates.

Table 2.1 - Meat Goat Budget, 50 Head Unit, 180% Kid Crop, 10% Kid Death Loss, 20% Doe Replacement Rate, Central Oklahoma Native Pasture, Per Doe Basis.

	Unit	Price/Head	Quantity	Total	\$/Head
<b>PRODUCTION</b>					
Male Kids	Head	\$67.32	40.50	\$2,726	\$54.53
Female Kids	Head	\$67.32	30.50	\$2,053	\$41.06
Cull Does	Head	\$58.23	7.00	\$408	\$8.15
Cull Replacement Doe Kids	Head	\$87.50	0.00	\$0	\$0
Cull Bucks	Head	\$104.99	0.00	\$0	\$0
<b>Total Receipts</b>				<b>\$5,187</b>	<b>\$103.75</b>
<b>OPERATING INPUTS</b>					
	Unit	Price	Quantity	Total	\$/Head
Pasture	Head	\$1.60	1	\$80	\$1.60
Hay	Head	\$7.56	1	\$378	\$7.56
Grain	Head	\$0.00	1	\$0	\$0.00
Protein Supplement	Head	\$22.23	1	\$1,112	\$22.23
Salt/Minerals	Head	\$1.80	1	\$90	\$1.80
Vet Services/Medicine	Head	\$1.77	1	\$88	\$1.77
Vet Supplies	Head	\$3.25	1	\$163	\$3.25
Marketing	Head	\$8.50	1	\$425	\$8.50
Mach/Equip Fuel, Lube, Repairs	Head	\$6.20	1	\$310	\$6.20
Machinery/Equipment Labor	Hours	\$7.75	0.90	\$349	\$6.98
Other Labor	Hours	\$7.75	2.00	\$775	\$15.50
Annual Operating Capital	Dollars	7.25%	39.03	\$142	\$2.83
<b>Total Operating Costs</b>				<b>\$3,911</b>	<b>\$78.22</b>
<b>Returns Above Total Operating Costs</b>				<b>\$1,276</b>	<b>\$25.53</b>
<b>FIXED COSTS</b>					
	Unit	Rate		Total	\$/Head
Machinery/Equipment					
Interest at	Dollars	8.25%		\$88	\$1.76
Taxes at	Dollars	1.00%		\$18	\$0.36
Insurance	Dollars	0.60%		\$7	\$0.13
Depreciation	Dollars			\$160	\$3.19
Livestock					
Interest at	Dollars	8.25%		\$431	\$8.62
Taxes at	Dollars	1.00%		\$73	\$1.45
Insurance	Dollars	0.60%		\$32	\$0.63
Depreciation	Dollars			\$160	\$3.20
Land		\$0			
Interest at	Dollars	0.00%		\$0	\$0
Taxes at	Dollars	0.00%		\$0	\$0
<b>Total Fixed Costs</b>				<b>\$967</b>	<b>\$19.34</b>
<b>Total Costs (Operating +Fixed)</b>				<b>\$4,878</b>	<b>\$97.56</b>
<b>Returns Above all Specified Costs</b>				<b>\$309</b>	<b>\$6.19</b>

Source: OSU Enterprise Budget Software.

### Production Costs

Three general types of costs comprise the total cost of producing any type of farm commodity. They are variable (operating), fixed, and overhead expenses. Overhead expenses (also known as indirect costs) are difficult to allocate among individual enterprises. Examples include telephone,

electricity and accounting services. Overhead expenses are included in whole-farm budgets, but are generally excluded in enterprise budgets.

### *Variable Costs*

Variable costs are those operating inputs that vary as the level of production changes. They are items that will be used during one operation year or one production period. Examples include feed, fuel, vet medicine and supplies. They would not be purchased if production were not undertaken.

Variable costs may also be classified as cash or non-cash in nature. For instance, labor expenses are included in the operating input section of Table 2.1. No differentiation between owner supplied or hired labor is assumed. If the farm operator or a family member supplies labor, a wage rate or salary that represents earnings if employed elsewhere would be shown. This illustrates one of the most important concepts in economics - opportunity costs. Every resource used in the production process has one true cost, its opportunity cost. The opportunity cost of labor is the return the resource can earn when put to its best alternative. If the operator decides not to assign a charge to the labor item, residual earnings (as defined by Returns Above Total Operating Costs) includes labor income. The producer can then determine whether the return is adequate compensation for his/her labor efforts.

### *Fixed Costs*

Fixed costs are not affected by short-term enterprise decisions and do not vary with the level of production. Generally, fixed costs are those ownership costs associated with buildings, machinery, and equipment that are pro-rated over a period of years. Fixed costs may also be cash or non-cash in nature. Real estate taxes, personal property taxes, and insurance on buildings are examples of cash fixed costs. Non-cash costs include depreciation and interest on capital investment.

The interest charge for capital assets such as machinery, equipment, and breeding livestock used in the goat operation is based on the average amount of capital invested over the ownership period, usage per year, and an interest rate. It is important to note that money invested in purchased capital assets has an opportunity cost as well - the return they can earn from their best alternative use. This interest on investment reflects a payment to a farmer's owned resources.

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

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

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

### *Returns Above Total Operating Costs*

The return to fixed costs, risk, and management (that is, the returns above total operating costs) is computed by subtracting total operating costs from total receipts. When returns above operating costs are positive, production is economically rational for an established enterprise. Positive returns above total operating costs indicate that the enterprise generates enough revenue to cover all variable costs and some portion of fixed costs. If returns above total operating costs are negative, the enterprise is not generating enough revenue to cover even variable costs. Unless the producer is willing to subsidize the operation (for instance, by contributing off-farm income), eliminating this enterprise will increase profits or decrease losses on the overall farm business. The return above total operating costs is also known as gross margin.

### *Returns Above All Specified Costs*

In determining overall enterprise profitability, fixed costs also have to be part of the profit equation. The return above all specified costs is calculated by subtracting total variable and fixed costs from operating revenues. This amount represents residual earnings for management, risk, and to land (because land costs can have a large variation within a region, land costs are excluded). Each individual must decide whether this return is a sufficient reward for management skills, risk exposure, and to land devoted to the enterprise. It should be noted that since non-cash items may be included in fixed costs, operating profits are not the same as net cash or operating receipts as shown in a cash flow statement.

In Table 2.1, the return above total operating costs is positive. Having a positive return above operating costs indicates the operation is able to contribute to fixed costs associated with owning capital assets. A positive return above all specified costs indicates that the operation is self-supporting and shows an amount available for reinvestment in the business or family living. In cases where operating costs are covered, but the return above all costs is negative, insufficient income is generated to cover all fixed costs. Any loss may be a short-run problem, however.

Building on budgets to determine break-even prices or yields and view sensitivity analysis is helpful in evaluating the financial risk associated with an enterprise. The break-even price is the price at which all costs will be covered given average production; the break-even yield is the level of production needed to cover all costs given average market prices. Break-evens above variable costs and above all costs both provide useful information. With sensitivity analysis, income variability due to price and production risk is demonstrated, typically with tables of numbers showing returns under different price and yield scenarios. This information helps the managers assess their willingness to assume the risk of these variations.

One of the most important keys to successful goat operations is to be as cost effective as possible. As mentioned previously, one needs to periodically evaluate the contributions of all resources used in the operation. Look at possibilities for improving cost control through new technologies or cultural practices. Identify key leverage points that can generate the "most bang for the buck". Are there ways to reduce the number of trips to the feed store while still meeting nutritional requirements? Can you do a better job of taking care of the herd instead of regular visits from the veterinarian? Benchmark what other producers are doing. Spending dollars wisely given the appropriate management practice can generate major dividends that impact the bottom line.



After all possibilities to improve the budget have been exhausted and long-run earnings still appear unsatisfactory, the best decision may be to exit the enterprise and employ resources in a different enterprise or investment.

OSU software is available to develop a customized budget for an individual operation (<http://www.agecon.okstate.edu/budgets>). The Microsoft Excel-based software provides users access to important agricultural references during an "interactive" budget building process. Through a series of links and pop-up menus, users may override defaults with their own values to customize the budget if their experience and farm records indicate different values and production practices. Where possible, web-links are built into the spreadsheets to provide users important economic and agricultural science information on the Internet. Link examples include OSU Extension publications, Oklahoma Agricultural Statistics Service data, and Langston University goat information.

The software is designed to be flexible and user-friendly. After specifying a base livestock budget setting via a start-up form, the budget (as shown in Table 2.1) may be further customized by clicking on any budget item which links to a corresponding supporting sheet within the workbook. For example, to access and change the default kidding percentage for the herd, one may click on any of the production items linking to the Production sheet. The Production sheet summarizes herd information, kid retention and sales, culling and replacement practices, and herd buck information. Default values for kidding percentages, kid death losses, and average sale weight are based on information from the E. (Kika) de la Garza Institute for Goat Research at Langston University. Kidding percentages can then be tailored to match a particular operation on the screen.

### ***Partial Budgets***

Partial budgeting is a procedure where receipts and expenses, which change with a change in organization or procedures, are listed in a systematic order. It is a process to allow a total farm budget to be fine-tuned. It allows the analysis of a defined change to see if the change would improve the total farm budget.

The steps in constructing a partial budget are to:

- 1) State the proposed alternative or change that will be analyzed.
- 2) Collect data on all aspects of the business that will be affected by the change.
- 3) Classify or group the types of impacts that will occur by including expenses increased or reduced and receipts increased or reduced.

The partial budget is based on the concept that a change in the organization of the business will have one or more of the following effects:

### Positive Economic Effects

- The change will eliminate or reduce some costs.
- The change will increase returns.

### Negative Economic Effects

- The change will cause some additional costs.
- The change will eliminate or reduce some returns.

The net change between positive and negative economic effects is an estimate of the net effect of making the proposed change in the total farm budget. A positive net change indicates a potential increase in income and a negative net change indicates a potential reduction in income due to the proposed change.

## **Other Aids to the Process**

### ***Education***

The producer needs to know what they are doing or raising goats will be a painful lesson in the pocketbook. You will need to have an eye for detail, be able to follow set procedures, and understand the risks involved. Use the best information available and include all decision makers in the business planning process. Talk to local growers and Extension personnel. Other sources of information are books/periodicals on meat goat production and industry, commodity organizations, and meat goat websites such as Langston University. The National Ag Risk Education Library provides risk management education on a variety of topics including goats. Focus on financial management as much as production performance. Realize that alternatives that appear profitable for one producer may not work for another. Everyone's experience levels, managerial abilities, and willingness to assume risk is different. Do your homework!

### ***Financial Records***

Records are the foundation for accurate budgets, financial statements, and tax reports. While tax reporting is the primary motivation for record keeping for many producers, research has shown positive returns to investments in record keeping and analysis in support of farm and ranch decisions. The sample budget previously discussed may be tailored to fit an individual producer's operation, but its reliability as a planning tool is only as good as the quality of the data.

Since budgets should be based on the best information possible, the producer's own records are a good place to start. A variety of tools are available to assist producers in keeping financial records. The record-keeping system that a farm manager should use depends on the cost - time, effort, and cash - in obtaining a system, maintaining it, and the value of the output as a decision tool. Farm record systems vary in the amount of information collected, the method of entering data, and the structure of final reports. Goat producers should choose the method appropriate to the size and complexity of their operation.

Computerized record-keeping systems are affordable and especially useful for manipulating data for different types of reports. Although a computerized system may not reduce the amount of time spent keeping records, computerized records make financial summaries simple, more efficient and effective for management needs. For instance, an annual or monthly cash flow statement based on actual income and expenses can be generated in a matter of seconds. Income and expenses can be sorted by enterprise so that farm managers know where "profit centers" are on the farm. Whole farm or enterprise budgets can be prepared and compared to actual transactions so that financial progress can be monitored at regular intervals. Graphs prepared with a few keystrokes can show where cash is coming from and where it is going and are invaluable in getting a quick feel for the farm's financial situation.

A number of user-friendly commercial software products are now available that can be adapted for farm use. One such software program that is appropriate for farms and ranches requiring only cash records is Quicken. Quicken is user-friendly, widely available, and inexpensive. More information on using Quicken for farm financial record keeping is available from the OSU Department of Agricultural Economics at <http://www.agecon.okstate.edu/quicken/>. Producers who need a payroll system plus the ability to invoice and maintain accounts payable and receivable may want to use QuickBooks, which is a small business double-entry accounting system, or a comparable package. Cash flow features and investment tracking are lacking in QuickBooks.

Hand record books are available through the Oklahoma Cooperative Extension Service and from many lenders. The OSU Agricultural Economics website offers a book from which individual pages are available to be printed as needed: <http://www.agecon.okstate.edu/farmbook/>.

Oklahoma farmers and ranchers can call on the Intensive Financial and Management Planning Support (IFMAPS) program to receive free, confidential assistance in farm business planning, including analyzing the potential for a new farm business. Trained financial specialists work with families one-on-one to develop financial statements and evaluate alternative plans. The plans typically include budgets for the farm enterprise(s), a cash flow plan, income statement, balance sheet, debt worksheet, and financial measures. Contact your local agricultural Oklahoma Cooperative Extension Educator or call the IFMAPS Center at 1-800-522-3755.

### ***Budget Limitations***

Although "best estimates" should be used to develop budgets for use in farm business analysis, it is important to remember that projections are influenced by production and price uncertainty. Such variability creates risk to the operator and puts pressure on the reliability of the estimates used in the enterprise budgets. Everything doesn't proceed just like you planned it. Even under careful use, errors can compound themselves to the point where budgets can have little or no value. This element of risk should be considered and evaluated by the manager when determining the solutions that best meet the goals and objectives of the farm family. Successful farm managers adjust their numbers throughout the year at regular intervals by comparing actual outcomes versus planned. This internal evaluation will help identify existing or potential problems and will result in fewer unpleasant surprises.

Budget preparation is time consuming, but it can pay major dividends. It requires pencil and calculator activity as well as searching data sources for information to be used in preparing the

budget. Software is also available to assist in budget calculations. Not only is it important to work hard, but also to work smart.

### **Conclusion**

Budgets (whole-farm, enterprise, and partial) are management tools to help evaluate the farm business. Like a puzzle, each budget brings to the table an important piece that will help address how available resources best fit together on the farm. Specific questions such as how and what to produce, production levels, and achieving goals can be answered once the puzzle is completed. Business management requires that producers focus on financial management as much as production performance. Successful managers discover that life is a whole lot easier saving money through budget planning. Goat producers interested in being profitable should expect to do no less.

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# **PREDATOR MANAGEMENT**

or

## **COPING WITH PREDATORS**

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### **INTRODUCTION**

Successfully raising goats is a challenging enough endeavor in the absence of problems caused by predators. When predators are added to the mix it can become overwhelming and costly. Predators such as coyotes, bobcats, mountain lions, red foxes, feral hogs, and domestic or feral dogs are among the suspects when mortalities occur. The National Agricultural Statistical Service reported that in Texas in 2003, 110,000 sheep and goats, with a value of \$10.9 million, were lost to predation. These estimates are conservative since: 1) they are derived only from reported losses made at initial counts of lambs and kids; 2) losses have been shown to be 2 to 3 times higher in the absence of control programs which are already in place, like USDA/APHIS Wildlife Services (see <http://www.aphis.usda.gov/ws/>); and 3) they only take into account direct losses to producers, not future value of animals and animal products, nor the multiplier effect on local economies.

This article will concentrate on instilling in the student the practice of objectively evaluating the physical evidence of predation in order to: 1) accurately assign responsibility; 2) chose the proper tool(s); and 3) proceed with an integrated pest management approach.

#### ***The Problem***

Predation on small livestock such as goats is a serious problem in many areas. As previously mentioned millions of dollars in losses are reported to USDA/APHIS Wildlife Services each year, a considerable portion being that experienced by goat producers. Some predators such as coyotes are becoming increasingly a matter of concern because of their remarkable ability to adapt to the presence of humans-even to the point of entering back yards to kill pet dogs and cats. Other predators are relatively unlikely in the minds of some. Dogs, both feral and domestic, are a major source of loss especially in goat producing areas which are on the edges of cities and suburbs. In fact, even in rural areas un-restrained dogs can be a major threat.

In years past goat production was centered in regions such as the Edwards Plateau of Texas in which ranchers shared the burden of predator management and were successful on a large scale, practically ridding the region of livestock killing predators. When predation occurred, the reaction on the part of ranchers was swift and effective. Though never fully removed, except for wolves, goat-threatening predator populations were maintained at a level which allowed survival of livestock operations in the face of the relatively few predators that remained.

The trend in the past few decades has been less large-scale goat production in these and other areas, and a corresponding lessening of effort to control predators has ensued. The producers that remain find themselves with basically no community-wide support in the battle against livestock losses to predators. The situation warrants increased awareness of all aspects of predator

management so that the struggle to maintain meat goat production enterprise viability can be successful.

Though challenging, predator management can be successful if adequate awareness, knowledge, and some essential skills are acquired. Of utmost importance is a thorough understanding of Integrated Pest Management which will be detailed later.

### ***The Approach***

The intent in this article is to utilize some of the same instructional material which Texas Cooperative Extension wildlife specialists have used in Predator Awareness Workshops throughout Texas since 1994. The meetings begin with the topic "Predator Appreciation", meaning- a) to be cautiously or sensitively aware of, b) to judge with heightened awareness, and c) to comprehend with knowledge. Getting a handle on each of these definitions is helpful in analyzing situations that may require corrective action, developing a strategy for predator management, and then implementing it wisely, economically, and humanely.

### ***Evolution of Expectation and Terminology***

In at least one way, the evolution of thought regarding how we approach the reduction of losses by predators to livestock, in this case goats, has mirrored the treatment of invasive brush on rangelands. As with efforts to address brush encroachment, there was a time when "predator eradication" was the terminology associated with dealing with livestock losses to predators. With the passage of time, it was realized that "eradication" might have been a rather overly ambitious objective. Individual predators were being removed, population levels were being reduced, but efforts were not successful in annihilating populations. Though much lessened at times, predation continued at some level even under the most motivated strategies.

Next, "predator control" became the order of the day. At least, it was thought, we can "control" predators. Again, a level of predation remained in many instances, even after concerted control efforts, which was unacceptable. And it seemed, unavoidable.

"Predator management" has become a more accurate portrayal of current efforts at reducing predation. In fact, the concept of "coping with" predators has emerged as an even more suitable moniker for the situation in which producers often find themselves today. Embodied in the idea is acknowledgement that a variety of practices might be implemented including lethal and non-lethal means to accomplish the objective of reducing predator-related losses. The ideal aim would be the selective removal of only the offending animal(s) when feasible. Texas Cooperative Extension has utilized the idea in the production of several educational products dealing with predation: Coping with Bobcats, Coping with Coyotes, and Coping with Feral Hogs (visit <http://tcebookstore.org> for details). Heretofore in this module the term predator management will be utilized with the intention that it includes the spirit of "coping".

### ***Development of Effectiveness and Acceptability of Tools and Strategies***

Much like the changes in the way we refer to livestock loss-causing predator removal activities the methods that have been used have changed through the relatively recent past. Early on,

toxicant-laced baits were utilized to effectively remove problem predators. However, collateral damage was extensive. Non-target wildlife was killed inadvertently. Public disfavor of the practice generated efforts to remove the practice, culminated in a ban on the use of the chemical in such practices by Executive Order of President Nixon in 1972. Today there are only two toxicants available for predator management, none for indiscriminate placement. The use of these will be discussed later.

Available to predator managers today is an array of tools and techniques, some non-lethal, some lethal, from which the proper one(s) for a given situation can be selected. Non-target mortalities have been greatly reduced, practically to the point of non-existence in some instances. One particular technique has the ability to remove only the offending individual animal.

## **APPROACH**

### **Integrated Pest Management**

In order for farmers to effectively wage war on insect threats Integrated Pest Management (IPM) was implemented some years ago. It utilizes five basic components which provide for a systematic approach to the formulation of strategies for addressing pest concerns of various kinds, including the predators confronted by meat goat producers.

1. Pests versus Beneficials
2. Scouting
3. Economic Thresholds
4. Management Alternatives
5. Environmental Concerns

### *Pests versus Beneficials*

Being able to recognize when a predator is detrimental (Pest) or beneficial in a particular situation, is an important skill for predator managers to possess. Obviously, when a predator is killing goats it has earned the name Pest. However, some animals which may be of little concern to you day-to-day, yet provide a food source (prey) for predators, can be performing a valuable service to your operation as they provide a buffer for the effect that would be realized in their absence. Predators are generally opportunistic in their feeding habits. A density of rabbits and/or rodents providing a ready food source for predators which would otherwise be homing in on your goats is a beneficial situation, lessening to some degree the amount of predation that would otherwise take place if rabbit numbers were low.

Likewise, situations can exist in which one potentially threatening predator population in effect can control or limit the population density of a known killing predator. If raccoons are the predator of concern (killing or maiming young kid goats, e.g.) coyotes can actually be beneficial to a degree because they are considered by many to limit raccoon numbers since raccoons are a food source for coyotes. Far-fetched, certainly, since coyotes themselves are usually a threat to goat production.



But, you get the point. Be sure that by lowering one population you do not inadvertently enhance another which could be just as damaging to your operation. The interrelationships of predator and prey species are fascinating. An understanding of them is crucial to the realization of the desired results from your predator management efforts.

### *Scouting*

First, the presence of predators must be ascertained. Roads and sandy draws can be monitored for droppings (scats) and tracks, largely identifiable by species. Look for scrapes where animals mark their territory. Net-wire fences provide the opportunity to check for hair left behind as animals cross over or under. Digs or slides under fences can be indicative of certain species. Scent stations made by clearing all of the vegetation off a piece of ground about 1 yard in diameter along a roadside, with some sort of track bearing surface like flour or slacked lime generously dusted over it and a scent source like bobcat urine (available from trapping suppliers) in the center, can provide a means of seeing which predators are present in an area. Monitor the stations daily for at least three consecutive days.

Next, the trend of the population density of potential predators is important. If population density information is gathered the same way every season or year, e.g. using the same roads, the same methods, i.e. objectively gathered, it will be useful for planning your predator management strategy. By keeping track (no pun intended) of the information gathered-number of scats and/or tracks on a given route which is monitored the same way every season or year, the number of sets of tracks, and scent station nights in which various species occur, and accumulating the information over several years and across areas-you can begin to see what trend might be apparent in various predator populations and adjust your predator management accordingly.

Trouble spots might become apparent as you monitor predator numbers. Whether by virtue of goat losses having occurred there or the presence of an unusually high density of predators you may choose to initially aim your management efforts there.

### *Economic Thresholds*

Economic feasibility understandably drives much of what is done in agricultural operations, just as it does in other business ventures. With regard to predator management feasibility can be determined by identifying the economic threshold, that point at which the level of damage incurred is sufficient to justify the cost of the control practice. Before undertaking any predator management activities, many of which can be rather expensive, be sure that the end justifies the means. It makes no sense to expend thousands of dollars to reduce losses amounting to hundreds. At least attempt to utilize economically appropriate measures. Balance the "control" expense with the value of the loss. A relatively minor loss (monetarily) to predation will warrant a different response than a more extensive loss. Let the degree of loss dictate the response.

### *Management Alternatives*

A key element of IPM is the development of an array of management alternatives-a toolbox, so to speak-from which to select the appropriate approach to a particular situation. Both non-lethal and

lethal techniques are available. Non-lethal means might be considered first, then lethal ones if necessary.

Often a predation problem can be effectively thwarted by non-lethal measures such as:

- 1) Shed kidding or night penning year-round
- 2) Guard animals such as donkeys (jennies, usually), llamas, or dogs can be effective.
- 3) Fencing type and configuration can limit predation, or at least provide for more effective application of some types of lethal techniques such as snares which can be placed in digs under net-wire fences. Electrified offset (~8 inches) wires can be placed on fences at about 8 inches off the ground and again at about 30 inches to deter fence climbing by cats. Overhanging top portions of fences can also deter fence climbing. A buried lateral apron of net wire can deter digging under fences.
- 4) Noise-making devices, especially around pens where animals are kept overnight can help ward off predators, though eventually the predators will likely grow accustomed to the noise and ignore it.
- 5) Aversive taste conditioning of predators has met with only limited success so far, but remains a possibility in the future.

If non-lethal practices are not feasible or effective, lethal measures might then be necessary. The toolbox most commonly includes:

- 1) Foothold or leghold traps- generally buried alongside travel-ways and baited with an attractant or visual lure like an over-hanging feather or tuft of hair, or blind-set in known paths; can be fairly selective depending on placement, bait, and overall operator skill.
- 2) Live traps or cage traps- fairly selective depending on size, bait, and trigger mechanism
- 3) Snares- suspended loops of cable with a one-way slide that tightens on the animal and restrains or kills it as it passes through a dig under a fence; selectivity depends on skillful placement in known passage-ways of offending animals and frequent monitoring.
- 4) M-44s (sodium cyanide delivery devices), and Livestock Protection Collars (LPCs) (containing sodium monoflouroacetate- or Compound 1080)- available in some states; selectivity is canine specific for M-44s and offending individual animal specific for LPCs; strict compliance with governmental regulations regarding their use and licensing for applicators is required. Contact your state wildlife officials and agriculture officials for more information. For licensing in Texas contact the Texas Department of Agriculture.
- 5) Aerial gunning- effective and selective; approval and/or permit(s) required. Check with your state wildlife officials for pertinent regulations and permits. For further assistance contact USDA/APHIS Wildlife Services office in your state.

### ***Environmental Effects***

An IPM approach always includes evaluation of potential environmental impacts. The manipulation of wildlife populations can involve numerous ramifications. Be aware of the effect

that reducing the population density of one species may have on population levels of others. If lowering the numbers of coyotes, for example, will likely enhance white-tailed deer survival and therefore their population density, be prepared to harvest added numbers of deer in order to keep the population from exceeding the level which can be supported by the existing habitat without degradation. If M-44s or LPCs are used make sure that all label requirements are followed in order to protect non-target animals from being affected and to safeguard against environmental contamination. When used properly these tools are safe and pose minimal threat to the environment.

## **INTERPRETING EVIDENCE**

### ***Tools Needed***

The basic skills needed to address suspected predation incidents are similar to those required for a crime scene investigator. Among these are: an inquiring mind, critical thinking skills, knowledge of the habits of potential culprits, objectivity, and of course a strong stomach. Often a kill site is discovered well after decomposition has begun.

Various "sign" can be sought out as evidence. The presence of tracks, scats, and hair left nearby (on fences, e.g.) are tell-tale signs of visitation by a particular animal. However, generally more conclusive evidence is required to rule out whether that animal was just passing through or was indeed the perpetrator.

The mode of attack can be indicative of certain predators. Also the damage suffered can point to one predator or another. For example puncture spacing (canine teeth, talons), number of bites, location of damage (throat area vs. back of head or back), presence or absence of sub-dermal hemorrhage, and the location of the carcass and its general condition. If the carcass of a kid goat is found bearing soft hooves which appear never to have been walked on, there is a chance that the animal was still-born or died of neglect and subsequent exposure. Look for milk in the stomach to see if it ever nursed, and signs of dehydration such as sunken eyes. Also look for bites by skinning the throat area and the back of the neck. If there is an absence of hemorrhage under the skin, even if bite punctures are present the animal was almost surely dead before being bitten. On the other hand if hemorrhage is present the animal was still alive when bitten, pointing toward predation.

## **SPECIES PROFILES**

Rather than presenting extensive information about the biology of various species habits, factors relevant to the objective scrutiny of goat losses or damage will be presented for several of the more common predators. More detailed information about the life history of each can be found in *The Mammals of Texas*, by Schmidly, and *Predator Control as a Tool in Wildlife Management*, by Rollins, et al. See the Reference Material section.

### ***Coyotes***

Typically, and there are some exceptions of course, a coyote will kill goats by attacking the throat region, biting and collapsing the trachea. Death occurs by suffocation after (sometimes) a rather prolonged struggle, leaving considerable sub-dermal hemorrhage. Sometimes a coyote will bite the side of the head or even the back of the head. A young, inexperienced coyote may bite

wherever it can catch the animal. Eventually, with maturity, the throat attack seems to be the mode most often adopted.

Coyote tracks are rather slender and elongated. Their travel is usually deliberate, resulting in a straight path with hind feet often falling in the track of the front feet. Particularly distinguishing characteristics include visible nail marks (often the middle two toes only) and bi-lobed heel pad.

Scats are usually cylindrical and cigar-shaped with minor strictures apparent and blunt or pointed ends. The texture varies according to the current diet, whether primarily vegetation (seeds from fruits) or animal (hair and bone).

An integrated approach using a variety of control measures is most effective. Non-lethal means include net-wire fencing and guard animals. Also consider trapping (No. 4 with chain and drag hook), snaring, hunting from the air and from the ground, M-44s, LPCs, or calling with prey-mimicking audio devices (calls).

### ***Bobcats***

Bobcats with few exceptions attack goats by biting the back of the neck at the base of the skull or on the side of the head, or by biting the back of the jaw and lower part of the skull while restraining them by embedding their claws in the goat's side or flank. Death is usually caused by crushing the spine and/or skull. After the kill the carcass may be fed upon immediately or it may be cached-dragged to another location and partially covered with debris-to be fed upon later. If the meat spoils before consumption it may be abandoned for another fresher kill. Often hair will be plucked from the carcass giving it a scruffy appearance.

Tracks are more rounded in appearance than those of a coyote, and are larger. Nail marks are usually not apparent since cats typically keep claws retracted until needed for defense or capture of prey. The heel pad is tri-lobed. On especially soft surfaces the track may appear to be "tented" or "peaked" between the toes owing to the shorter hair between them compared to coyotes.

Bobcat scats are cylindrical and are segmented with prominent strictures and usually have elongated pointed ends, often with protruding hair.

Non-lethal methods include electrified offset wires on fences, over-hang on top of fence, both to deter climbing. Previously mentioned lethal means are effective for bobcats also.

### ***Mountain Lions***

Though rare compared to other predators which threaten goat operations, mountain lions can cause extensive loss. Their diet is mostly deer in many areas, but includes livestock at times. They are known to kill a deer every 3-14 days, depending on how quickly the meat spoils and the number of deer available. Like bobcats they drag and then cache their dead prey, sometimes urinating and defecating on top of the debris that has been kicked upon it. Scrapes created by pushing and kicking debris up on to the carcass will sometimes point to the eventual direction of travel.

Lion tracks and scat are similar to those of a bobcat, only larger.

The most effective and selective means of lion capture is by trained dogs. Foothold traps (No. 4 ½ with chain and drag hook) and foothold snares can be effective, also. Considerable skill is required to minimize non-target captures.

### ***Red Foxes***

The red fox is an introduced species which is often confused with the smaller gray fox, and is responsible for goat losses in some locales. They can be distinguished by their white-tipped tail.

Tracks are coyote-like, though smaller, but in contrast all marks from all four claws on each foot are likely to be visible. Scats are generally non-segmented, bearing pointed ends with protruding hair.

Predation by red foxes is typically characterized by multiple bites on the back. Due to their size, relatively small animals such as kid goats are most at risk to red foxes.

For control consider trapping, snaring, and hunting. Red foxes can often be called up with the use of prey-mimicking audio devices (calls).

### ***Feral Hogs***

At least 30 states have reported the presence of feral hogs-hogs which are either domestic hogs gone wild or descendants of free-roaming hogs brought to North America by explorers in the 1600's. Livestock predation, including goats, is one of the many negative impacts that they have caused. Young animals are particularly vulnerable.

Often no evidence of predation is found when feral hogs are the culprit because the entire prey animal is consumed. A bloody patch of ground, a hoof or two, or an inverted skin with hooves and maybe the skull attached, is likely to be all that remains, if anything. Sometimes the only indication may be circumstantial-missing young, dams with distended udders, and the known presence of feral hogs in the area.

Signs of their presence include: rubs on trees and utility poles, wallows in mud, and rooted-up soil, rocks, and debris where they have searched for food items.

Being a cloven-footed animal their tracks are similar to deer and even goats, but with more blunt tips and obvious dew claw marks. Scats are large and resemble a pile more often than a cylindrical mass, especially when fruits and other plant items are being consumed.

Aerial hunting is the most efficient and effective control means for feral hogs. Also use portable cage traps or funnel traps built on-site with t-posts and welded wire hog panels. With either setup use a one-way gate and pre-bait the trap with the gate open for several days until hogs grow accustomed to entry, then set for capture.

### ***Domestic and Feral Dogs***

Though "wildlife predators" claim more of the immediate attention when predation of goats is known or suspected, free-roaming domestic dogs, some of which are more accurately described as wild or feral, are serious contenders for the top spot on the list of suspects. Since breeds vary extensively in size and conformation track evidence often resembles wild canines or cats. Typical characteristics of tracks include bi-lobed rear of heel pads and a more sloppily-placed print, i.e. less deliberate, straight-line travel.

Kills by dogs are often characterized by multiple bites on the hind quarters and flaps of skin pulled away from the animal due to the dog's attempts to restrain the fleeing. Several animals might be attacked at once by a single dog or a pack of dogs, sometimes with little if any feeding on the carcasses.

Non-lethal measures include guard animals and net wire fencing. Otherwise use foothold traps, cage traps, snares, aerial and ground hunting, and M-44s (only if dogs are known to be killing livestock- Check local laws and regulations)

## **RECOMMENDED REFERENCES**

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**INTRODUCTION TO ARTIFICIAL INSEMINATION**  
or  
**ESTABLISHING AN AI PROGRAM FOR GOATS REQUIRES MORE THAN AI**

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**Introduction**

Routinely artificial insemination (AI) is described as a tool-mediated transfer of semen to a female's reproductive tract -instead of using natural service (NS)- for the production of young. After you get more involved with AI you will come to accept that in reality AI is a first generation assisted reproduction technology (ART) which is used in combination and coordination of various procedures for the sole purpose of ensuring that one or more oocytes (eggs) are fertilized by sperm that were once –usually- frozen in suspended animation.

This presentation/document not only deals with the very small window of opportunity of a few hours when fertilization must take place but situates in proper perspective the need for mastering the AI technique as well as the requirements necessary for establishing a successful AI program, which definitively, entails more than becoming proficient at AI.

For reproduction to be successful (whether by natural or artificial means) several actions must take place at the correct time and in the correct order. Understanding these natural events is the key to successfully substitute the natural course of events with procedures aimed at getting similar outcomes by technological means. As the number of days in gestation advance, more and more, embryo survival, fetal development and birth of a healthy kid will be linked to management actions you may have or may have not taken prior to breeding as well as during pregnancy and parturition.

**Importance and Types of AI**

Perhaps the chief reason why AI is a commonplace routine used by most productive livestock industries stems from the fact that much of the fast paced genetic progress accomplished by the dairy cattle industry can be traced back to the incorporation of AI in their breeding management. AI provides an important and extremely flexible approach to attain many productive objectives; to date still underutilized by the national goat industry.

Goat AI procedures and equipment vary depending upon the location where sperm is placed in the female's reproductive tract, and this in turn depends on the technique and technology selected to accomplish it. AI can be used with fresh semen or thawed-frozen semen that was collected on previous years. AI can be used on naturally occurring or hormonally induced estruses. AI can incorporate several levels of management decision-making or one can use timed insemination. Most notably, AI allows goat producers to become independent from the reliance on a "breeding season" characteristic of seasonally polyestrous animals.

In summary, the purpose of this presentation/document is to combine the focused view on a technical aspect with the broader picture of AI management: Help you recognize what is needed to establish an AI program for your herd, -both in terms of technical demands as well as current associated costs-, to highlight what are the conditions most likely to improve your chances of success and to pinpoint realistic expectations of an AI program.

### **Reasons to Consider AI**

Experienced producers as well as scientists working in the area of assisted reproduction technology, have come to accept that any time a technical procedure is used in lieu of nature, the outcome is likely to be a less efficient one. That is, it is difficult to have the same number of does pregnant when using AI than when relying on Mr. Buck to naturally service a breeding group. Confronted with this paradoxical statement a newcomer's logical first-in-line question is, "If AI has sub par performance when compared to natural breeding, why is the technique advocated? This is because AI has a number of important contributions to make. These contributions may not be realistically achieved in a cost-effective manner when using natural breeding.

For example, consider the situation where, for whatever valid reason (e.g., costs of feeding, housing, health, fencing and labor come to mind) raising and caring for your own bucks is not desirable. Or perhaps you only have one valuable buck and you wish to use him on several dozen does in a short span of time. Or think of a herd manager faced with the undesirable option of having to breed genetically related animals (*i.e.*, inbreeding). Or what about the situation where a producer wants to accelerate the pace at which his herd productive performance is being attained? In all these circumstances AI is an attractive option.

Having the paternal contribution to your herd inside a tank can be more economical, convenient and less of an overall headache than having to tend after more than one buck when males are actually only needed during a few weeks out of a calendar year. In addition, to this, if you select the correct male, AI can contribute to accelerate the genetic progress towards economically important traits. Furthermore, your herd most likely can benefit from target breeding. This means selecting to inseminate high proven sires to your seasoned does and using genetically promising bucks to inseminate the young upcoming herd replacements.

AI has additional benefits, it can be used to synchronize kidding operations by manipulating the length of the breeding season. Not only this, but AI, along with estrus and ovulation synchronization by hormonal means can be used to produce kids and/or milk "out-of-season", at times of additional economic incentive, when, commonly, goats are reproductively quiescent.

From a health-related and animal welfare perspective, the ever present danger of transmitting an assortment of diseases or introducing antihelminthic (deworming chemical agents) resistant parasites can not be overly emphasized and is a valid concern when using natural breeding schemes, particularly if they include scenarios where bucks from other farms are introduced to the herd, even if this introduction is temporary.

Under certain conditions the tactic of pasture breeding will not allow for controlled parturition (much less for goats in range conditions) because actual mating dates often go unrecorded. Finally, I find myself in the community that advocates AI because, if anything, it promotes good record

keeping and a healthy review of historical herd facts. Along with dates of reproductive activity, breeding, pedigrees, etc., more often than not, there is valuable fresh documentation of body weights, conditioning score, type traits, medical treatments, and productive statistics. Certainly this additional appraisal, of information already available, can be used to make strides toward improvement of the flock as it will generate valid and robust arguments for deciding who goes and who stays in the herd. (*a.k.a.* selection).

### **AI technique or AI management?**

It will be beneficial for our discussion if you quickly separate in your mind two aspects associated with AI. Technique from management. The technique of AI is a manipulative skill that relies heavily on perceptual and tactile sensory capabilities. This you learn by doing, following a step-by-step recipe and adjusting as the need arises in response to what type of animal and situation you will be confronted with. Establishing an AI program that fits **YOUR** operations management can only be taught by **YOU**.

AI management is more complex and highly individualized because it comprises more than learning one skill and implies experience for a particular dynamic set of circumstances that can not be recreated and transmitted in a classroom setting. My aim, in this respect, is to make you aware of the most important elements required to successfully incorporate an AI program in to your breeding management and to help you get started towards that objective.

### **FAQ About AI**

The one basic question very difficult to answer is, “How do I decide if AI fits in my operation?”. It’s difficult to respond because, on the one hand, you have producers looking at the profit margin as the deciding factor and, on the other hand, you have goat enthusiasts who feel that not everything a person does needs to be governed by monetary profit. This presentation is geared to help those of you who are in the first group, and would like to come to a better understanding of the hows and whys of establishing an AI program (but I will let you do the math). Folks in the second group need little enticement; they will find the technology fun and gratifying to try.

Here are “**the**” 10 most frequently asked questions that a newcomer usually has concerning AI:

- Q1 What kind of success rate can I expect to have?
- Q2 Should I hire an AI technician or become proficient myself?
- Q3 How long will it take to learn to AI and where do I get this training?
- Q4 What is the basic equipment needed for AI and what are the associated costs?
- Q5 Where can I get the material and equipment needed for AI?
- Q6 How labor intensive is actually AI’ing?
- Q7 What other conditions do I need to provide to increase my chances of success?
- Q8 What is the “correct” AI procedure to use?
- Q9 If I adopt AI, can I say adios to Mr. Buckaroo?

- Q10 Are there any drawbacks when adopting AI?

Each one of above questions can not be answered without careful qualification. In other words, the answer depends on what, how much and how in depth the person responding to the questions knows about **YOUR** particular herd situation. The answer provided is only going to be relevant and useful as the context in which your question is made.

### ***Q1. Evaluating results (success rate) of AI***

When making comparisons three simple rules apply: **1)** Don't compare apple with oranges; the results of such contrasts are likely to be meaningless, **2)** Use the same scale of measurement to avoid distorting (biasing) the results and, **3)** The more variables differ between what is being compared, the greater the inaccuracies that will creep into the assessment. That is, the more breeding systems or AI protocols and techniques diverge from each other, the more difficult it will be to attribute the reason for the differences to a single cause.

Evaluating AI results can be tricky since there are different ways to appraise results. One of the reproductive efficiency evaluation measures frequently used is pregnancy rate<sup>1</sup> (PR). However, recognize that even when we agree upon a statistic there are still... many forms of measuring PR<sup>2</sup>! If comparisons are going to be made using this guide then, it is only fitting to use the same scale of measurement. PR is defined as the number of females found to be pregnant (by some means of pregnancy detection at a standardized number of days post breeding) after a given number of breeding attempts (either by AI or NS) at an specific time in the breeding season.

If the gold standard for comparison is Mr. Buck's performance at his best<sup>3</sup>, under ideal conditions, then we can expect him to provide a pregnancy rate to 1st breeding of 85 to 90%. This means that if the buck is with a reasonable number of healthy and fertile females of breeding age, showing estrus and in good body condition he should be able to get 8 to 9 females pregnant out of a breeding group of 10 females over a period of about a week (assuming of course that the females will in fact come into heat during this time and not all on the same days).

Starting with this, perhaps to unrealistically perfect scenario, any time we intervene with some management practice, breeding performance is likely to drop. Keep in mind that even though pen breeding and hand mating also use natural service as the means for getting does pregnant, this type

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<sup>1</sup> There are various other ways to measure reproductive performance. For example, conception rate, fertility (kidding rate), prolificacy and fecundity.

<sup>2</sup> Pregnancy rate needs to be defined in terms of the method that is used to detect pregnancy. It is not valid to compare PR's generated using the popular non-return rate to estrus (21d-NRR? or 24dNRR?) and hormonal levels of blood or milk progesterone and/or the less common 45-d ultrasound scan.

<sup>3</sup> Implied in the use of "at its best" is the notion that the buck has undergone and passed a breeding soundness exam (BSE), has the necessary sexual power/desire (libido tests are rarely done) and there is proof (kids on the ground) of his reproductive prowess.

of breeding arrangement will in fact deliver decreased pregnancy rates because some of the responsibility is now, by design or necessity, being assumed or shifted to management.

There are 5 basic methods of artificially inseminating. These procedures are defined by the anatomical place where semen is deposited in the female's reproductive tract. Be aware nevertheless, that the 1st two "procedures" are really default actions rather than "types of insemination". It is what you do if you can not accomplish trans-cervical AI (TAI). In different words, if TAI fails you settle for leaving the semen within the cervix (*i.e.*, intracervically) counting the rings you were able to pass (3 rings, 2 rings, 1 ring in succession), if this is also unsuccessful you accept the worst case situation by leaving the semen as close to the cervix as possible. Each of these alternatives has an associated degree of success which presuppose a high proficiency has already been attained using each of the last 3 techniques in question:

**Table 1. Success Rate of Various AI procedures as measured by % Pregnancy Rate (PR).**

Method	PR (%)
Vaginal	< 15-25
Cervical (CAI)	<40-45
Transcervical (TAI)	55-65
Deep cornual (DCAI)	70
Intrauterine (LAI)	80-90

Evaluating also has to be understood as that moment of truth when we analyze how good are our results. Compare your own progress in time and then compare your achievements to those obtained by other people attempting the same thing. Keep in mind differences in animals, time, technique and environment, but absolutely, set the bar high by judging your accomplishments under the light of what the experts attain. This translated means, "published material that has received peer review in one of the many scientific journals" not your next door neighbor, or some entertaining magazine plagued with anecdotic accounts and other tales you will be unable to repeat, or some commercial party that has vested interest in inflating their results. "If it sounds too good to be true, it probably ain't true". It's your time and money. Ask to see the data.

After evaluation time, along the way (if your PR's are not speaking loud enough) at some point in time, you need to understand how and why you are getting the PR results your getting. Comparisons without adjustments will not fix the problem(s). With greater emphasis if your PR's are under the values given in table 1. You will accomplish this evaluation and fine tuning more effectively if you bring into the picture somebody who is not "emotionally attached" to your AI program who can serve as a fair evaluator and advisor. Maybe your local extension agent or somebody he or she may suggest that has the necessary expertise.

## ***Q2. Hiring or learning***

The first emotional response is always “yes I want to learn a new procedure”, that’s fine, we all want to take part in the adventure of learning. Do remember, nonetheless, the fun can quickly wear off and good managers avoid reaching decisions on emotions but rather rely on reason.

To determine need you must first agree upon a clearly defined objective. So let’s put the actual desires in perspective to what the objectives really are. A perfectly valid objective is to become a artificial inseminator technician and a totally different one to design, incorporate and manage a successful AI program. Can you do both? Yes. Do you need different skills for both? Yes again.

Be realistic about the time you can devote to the technical portion of an AI program. If you are a busy farm manager and/or goats are only part of your livelihood effort, then consider delegating the actual AI’ing to a member of your working crew and, instead concentrate on the various other aspects necessary to ensure a successful AI program. Does this comment imply that you actually need less time to develop an AI program? No, not at all, to the contrary. But consider that AI has a very narrow span of time when ***you have to be present*** or else you will not get those nannies pregnant.

Let’s take the easy question first. You want to develop the skills necessary for producing pregnancies by AI. AI results will reflect mercilessly on the amount of practice you devote to the task but overall it will require proper technique and attention to detail. This means, unequivocally, actual number of does inseminated. I personally would recommend that you give the option of learning a fair opportunity. After all, the cost of a 2 day session (including a wet lab)<sup>4</sup> will be approximately \$600 – \$800 for a group rate (or ±\$60 to \$80 per person), whether you end up actually doing the inseminations or supervising technicians it will always be to your benefit having theoretical and practical grounds to influence decisions.

In terms of specific time and numbers involved. Probably the first insemination, from the time you bring in the doe, to the time you place her back on the pasture or pen, the AI procedure will take about an hour to an hour and a half. Don’t take this remark to mean that its OK to be poking around inside a does’ reproductive tract for an hour, **certainly not!** If the actual “passing of the cervix” is taking more than 10 to 15 minutes you need to change the goat.

As you progress in dexterity you can probably plan to AI a typical goat in about 10 to 15 minutes. How many goats will it take for you to get there? Well, that is a very subjective appraisal, but for the sake of discussion, I would not be to convinced if you have not at least produced 20 pregnancies with the methodology of your choice (which actually means that you probably attempted close to 50 goats).

Now let’s tackle the more difficult aspect of the question. Your plan is in fact to design, develop

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<sup>4</sup> Langston University/American Institute for Goat Research, through its agricultural extension service, will offer demonstration clinics for AI in goats at Langston (Sept-9), Tahlequah (Oct-7) and a site to be determined in Eastern Oklahoma (Oct-28). Please confirm tentative dates with Dr. Terry Gipson.

and incorporate an AI program to your existing enterprise. How to go about getting this accomplished?

Well, for this type of project you need a broader set of capabilities. Some which you probably already have, some that you will need to develop and keep polishing and some that are yet to come through the unforeseeable road of actual experience. Let me point to the most significant areas that an AI program developer must feel in command:

1. Understand the doe's reproductive organs (anatomy) and their functions (physiology).
2. Know how semen is stored and handled.
3. Learn the appropriate manner of using the equipment required for inseminating goats considering animal welfare, sanitation, manual ability, and yes, actual accomplishments.
4. Develop the ability to accurately detect heat at an early stage.
5. Cultivate the ability to gather accurate records and use information of goat statistics.
6. Learn what are the environmental conditions that will influence your breeding results.

Each of the above areas of knowledge, deserves careful attention and can not be adequately evaluated in the limited scope of this presentation. Attempting to provide a “crash course” on each of these topics may accomplish just that... “crash management”.

### ***Q3. Learning curve***

How long it will take to learn depends strictly on how much you want to know and whether we are talking about AI technique or AI management. The shape of a learning curve, in either case, is totally dependant on the abilities of teacher and student as well as the resources at hand to accomplish the teaching and learning.

#### ***[AI technique]***

Learning to AI will require: **a)** somebody with the expertise willing to teach you (more than likely being paid to teach you), **b)** your willingness to be taught, **c)** your ability to develop new skills and, **d)** your discipline to gain competency by repetition, which is the fancy way of saying “practice, practice, practice”. However, the “practice, practice, practice” part of the equation has no meaning, if all it accomplishes is but providing the opportunity to make the same mistake over and over.

Learning the theoretical basics of AI can probably take a minimum of 1 to 3 hr and the actual practical portion about 3-5 h. Don't expect too much of a course in which you have invested this bare-minimum time. A lot of the effort comes once you have left the classroom.

It will be to your advantage to actually participate in more than one AI course, this will provide you with the opportunity to learn from different sources, reinforcing the good procedures and perhaps questioning some other previous lessons. Approach your new teachers with an open mindedness, nobody has all the answers, and there is always something to be learned from the experience of other people. Be willing to try new approaches.

AI is a dynamic field and new procedures are always being tested, there are great strides yet to be made in small ruminant AI. The only way to keep up with new developments is to read current material, participate in workshops and conferences, talk to other producers, get your local extension agent involved and update your information by taking refresher courses as often as time and money can permit.

*[AI Management]*

There is no school, that I know of, set up to provide the teaching of how to establish a successful AI program and its management. The only classroom I have been exposed to is the working arena of real life in the work I do. Any class and lesson set up to teach management is artificial and will not re-create the actual challenges you will be faced with. The best a classroom setting can provide you with is looking and discussing particularly “handpicked” case scenarios, the learning of which, may take a few hours, improving what you learned: a lifetime. I don’t want to sound discouraging on the subject, I do believe, that if a person is motivated to learn something, a bad teacher or a deficient teaching methodology can, at best, only slow you down.

Your best approach to gain the necessary expertise in AI management is to participate for a day or two (longer if you can afford the time) of an on-the-job training arrangement where you can see and try what other people are doing and actually using. Follow this by adopting what fits into your operation and by adapting what you feel is needed but different because of your particular situation.

***Q4. Equipment and material co\$t***

Here is a list with up to date costs. You will have to do the math.

<b>Item Description</b>	<b>Use</b>	<b>Must have</b>	<b>Co\$t (2006)</b>
Liquid nitrogen tank	Semen storage	✓	400-1200
Yearly refills	N <sub>2</sub> tank level maintenance	✓	150-200
Semen/doe	Fertilizing power	✓	25-35-55
Speculum assortment (25 × 175 mm for doelings and 25 × 200 for does).	Aids in entrance to vaginal vestibule	✓	5-6-8
Light source	Illuminates cervix entrance	✓	15-30-37
Non-spermicidal lubricant	Facilitates speculum entry	✓	3.5-4
Thaw container	Semen thawing		15-30-35
Inseminating gun	Semen delivery	✓	14-25-50-70
Paper towels	General clean-up	✓	1-1.5
Breeding stand	Restrains goat		150-350



<b>Item Description</b>	<b>Use</b>	<b>Must have</b>	<b>Co\$t (2006)</b>
Microscope (900 × Magnific.)	Check semen		250-600
Record keeping system	Organizes data management	✓	3-2500
Straw cutter	Opens end of straw		2.5-6
Plastic straw tweezers	To pull straw from goblet	✓	2.5-5
Bucket	For disinfection solution		3
Thermometer	Monitor water temperature	✓	5-20
French plastic tips	Facilitates cervical entry		12-18
Sanitizing solution	For used speculums	✓	3-5
Speculum brush	Speculum clean-up		3-4
Inseminating gun sheaths	Holds semen in place	✓	4.25-6
Sheath carrier	Maintains sheath integrity		10-15
Microscope slides & cover slips	Semen placement for microscope observation		24/100 units
Carrying case	To keep all your AI utensils		15-35
Sanitary sheath protectors	Maintains straw clean & prevents transmitting infection on the AI gun between goats		10-15
AI kits (wide selection)	Avoids separate purchasing		100-150-200

### ***Q5. Source of equipment and materials***

Your best bet on this matter is to consult with your local extension agent, herd veterinarian or fellow goat producers. It is risky to provide company names as they tend to imply an unwanted endorsement of a particular company or product. It also generates an opportunity for the crowd that is left out to argue and complain of unwarranted favoritism and unfair handling of the issue. For this reason I will not put in print their names in this document but I will happily provide you with names of companies I have personally dealt with off-the-record.

If you have access to computers with internet connection you already know that a search using key words on any of the freely available search engines can provide you with literally thousands of “hits” (sites that match your queried item). Printed commercial catalogs are another venue.

If you don't have the benefit of computers yet, you can visit your local library /college or make an appointment with your extension agent who can help you, in a matter of 30 minutes or so, to place a computerized search that will generate tons of sources from all over the world of where to get equipment or materials for goat AI, procedures, workshops, etc. There are also plenty of testimonials from fellow producers that can help you steer in the right direction.

The source of semen can be from fresh sources (your buck or the neighbor's) or from semen that has been frozen and thawed prior to its use. There are many companies that will ship frozen semen in dry ice containers. Semen sales and swaps also take place at many of the goat meetings.

### ***Q6. How labor intensive is actually AI'ing***

The number of people required depends on what kind of set up you have and what type of AI procedure you use. The values provided below apply to all inseminating techniques **except** laparoscopic procedures which will require more trained personnel as well as, the participation of a state, board certified licensed veterinarian<sup>5</sup>. Laparoscopy is classified as a minor surgical procedure (but "surgical" nevertheless) requiring the use of prescription drugs to sedate the animal.

Breaking down labor requirements involved in AI to more elemental components will make it easier to associate man-power needs with each part of the job at hand:

- ✓ Body condition score (BCS) in preparation to have good breeding groups (2 evaluators).
- ✓ Visual estrus detection (1 person). If you are using a teaser to mark does in standing heat (highly recommended) then you probably need to add another person to help change marking crayons and adjust the breeding/marking harness as need arises.
- ✓ Actual AI'ing (2 people; one of them the AI tech.).
- ✓ Record keeping (1 person).

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<sup>5</sup> The attempt to laparoscopically inseminate (LAI) not in adherence to appropriate procedures (which includes animal sedation) is not supported by this author, the American Institute of Goat Research (AIGR) or Langston University. In addition, keep in mind that animal welfare and necessary humane treatment of animals is compromised when unsuitable methods are used or condoned. To avoid liability under state or federal regulations check with your local licensed veterinarian.

***Q7. What are other conditions I need to provide to increase my chances of success?***

*[AI Technique]*

1. Practice.
2. Practice.
3. Be consistent and disciplined to follow the routine for the AI procedure you have selected. Whimsical changing of AI protocols will not be traceable. Consistent predetermined alterations can be evaluated over time<sup>6</sup>.
4. Make an effort not only to learn the step-by-step procedure but to understand why is it you are doing the things your doing.
5. Know when to inseminate in the estrus cycle.
6. Learn what is the criteria for goats that should not be inseminated.
7. Be open to criticism an incorporate amends to bad technique habits.
8. Even if you can not detect outward changes, recognize you are working with an animal that will respond to your actions.
9. Look and evaluate objectively your historical PR results.
10. Finally see 1 and 2.

*[Establishing an AI program]*

1. Be knowledgeable about goat reproductive biology.
2. The breeding herd needs your attention long before they are inseminated<sup>7</sup>.
3. Have a selection program for younger goats (age, development and genetics) and an appraisal/culling program for adult does which, jointly, will allow you to include premium doelings and exclude poor candidates from your AI program.
4. Make an effort to personally know your semen provider and his freezing procedures.
5. Know how to select appropriate semen.
6. Know how to handle semen shipments, transfer and handling of semen.

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<sup>6</sup> Don't draw conclusions on what you see happening in three goats, improvements are usually not as dramatic as one would hope for. More than likely changes will be small and difficult to detect without the aid of some statistical analysis procedure. These mathematical evaluation methods are insensitive to the actions of men and women. They will crunch numbers period. And, will take for granted that changes have been applied consistently over time. Therefore, if you don't have at least 30 goats per steady procedure modification or adaptation, it is rather unlikely that small changes (on a set up that is loaded with actions and events that can not be controlled) will impact results in such magnitude as to be clearly different.

<sup>7</sup> This includes: nutrition, genetics, health (deworming and checking for infectious diseases, proper ID, body condition and linear appraisal for type traits).

7. Learn the basics of semen quality evaluation.<sup>8</sup>
8. Have a working estrus detection program.
9. Use appropriate AI equipment and materials.
10. Plan sire-dam matches ahead of time. Avoid improvising.
11. Gain the appropriate skills for the actual AI procedure.
12. Provide an environment conducive to low animal (and people) stress.
13. Know how to use the information already collected on your goats.
14. Recognize differences in animal behavior and animal categories.
15. Be able to detect pregnancy as early as possible.
16. Be consistent with procedures that work.
17. Write it down. Keep logs, journals and records for different areas of work.
18. Keep records that can be used.
  - a. Simple.
  - b. Accessible.
  - c. Format that allows calculation of basic statistics<sup>9</sup>.
  - d. Format that encourages use-ability and user-friendliness.
  - e. Flexible. What works today may not work tomorrow.
19. Learn the technical jargon used in connection with different new AI-related areas of knowledge (*e.g.*, reproduction, genetics, statistics, equipment, etc). It will help you communicate with others more effectively.

***Q8. What is the “correct” AI procedure to use?***

Forget about the “ideal” procedure, it hasn’t been published yet for the basic reason that no two goats are alike. Nonetheless, it is true that many procedures have been time-tested and placed under scrutiny in an effort to improve results. In my opinion most inseminating protocols (within one of the types of AI) vary in the detail but essentially accomplish the same objective.

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<sup>8</sup> You never know when you have to challenge or question the quality of the product you paid for. Even the most reputable commercial outfits can make a mistake. What if there is question as to whether or not there has been damage to semen by inappropriate semen tank N2 level maintenance?

<sup>9</sup> Data are only numbers, statistics allows you to organize and summarize these data. Organized data becomes information. Information collected may or may not be relevant. Information that is not used has no chance of becoming knowledge. Selective use of knowledge will open the door to wisdom.

Procedures need to contain and discuss the following topics<sup>10</sup>:

- ✓ Time of insemination:
  - In the breeding season.
  - In the estrous cycle.
  - In the estrus period.
- ✓ Animal handling and restraining during AI.
- ✓ AI helper's contribution.
- ✓ Semen thawing, handling, loading and delivery.
- ✓ Actual entry and exit from reproductive tract.
- ✓ Number of inseminations per estrus period.
- ✓ Number of inseminations per breeding season.

The material that follows considers and responds to each of the above issues in the context of **transcervical insemination** (TAI) as used in the AIGR farm AI program.

***Time of insemination in the breeding season.*** Most of the year goats that are geographically located away from the equator show different degrees of anestrus depending on breed. That is, there is no sexual activity in either gender. Hence, no sexual receptivity. The breeding season has three phases that are clearly defined but can not be clearly differentiated in terms of outward behavior or physiology.

Breeders talk about a ***transitional phase*** at the beginning and end of the breeding season. The actual breeding phase or ***non-transitional phase*** is also referred as the ***cyclic phase*** in reference to the presence of the recurrent  $\pm 21$  day estrous cycles. There is some indication that the early transitional phase is characterized by asynchrony between ovulation and “in heat” behavior as well as the presence of “short cycles”. Some people claim that breeding at this time results in reduced pregnancy rates. A three year study, conducted by this author and colleagues, comparing NS and AI of young and adult goats (unpublished results) shows that the allegation of reduced fertility could not be substantiated under the particular conditions the research was conducted.

The transitional phase at the end of the breeding season is more associated with irregular cycles (of matching heat behavior and ovulation) with the presence or absence of heats and/or variable length of estrous cycles. The effects on heat length (at this stage of the breeding season) has not been documented.

***Time of insemination in the estrous cycle.*** The estrous cycle is divided in four characteristic phases: Estrus (high estrogen), metestrus (luteal phase begins), diestrus (high progesterone) and proestrus (follicular phase and CL regression). In nature goats are only sexually receptive when in estrus when levels of FSH are high and an eventual LH surge will trigger ovulation close to the end of estrus. AI is performed during estrus. Although a goat may be in estrus it will not necessarily

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<sup>10</sup> For a short version of this TAI procedure used at AIGR farm see the photocopy made available.

accept to be mounted by the male. The female will accept copulation only when in “standing estrus”. How long a goat stays in estrus is variable but on the average is between 18 and 36 h. Averages are just that, an insensitive numerical representation of the “typical” value, so don’t be surprised if some goats come in heat for a few hours or stay in heat for several days.

***Time of insemination in the estrus (heat) period.*** Not much controversy should exist regarding the time of insemination. It should take place approximately 18 to 24 hrs before the end of estrus because it is believed that does ovulate very near (6 h before), or soon after (12 h), the end of standing heat. Since the eggs viability is at its best at approximately 12 to 24 h after ovulation the sperm must be already on its way to the fertilizing region (upper 1/3 of the oviduct) when the doe is no longer sexually receptive.

Recognize that the time of insemination is given in reference to the end of estrus. This time can not be known but it can be anticipated if you have kept previous records of the female’s behavior, including the length of estrus. Female goats vary in the time they remain in heat, but this time for each animal tends to be somewhat repeatable, therefore, predictable. In my opinion it is always better to err on breeding “too early” than “too late” side because spermatozoa have viable fertilizing power for about 24 to 48 hours, whereas oocytes go down hill after 24 hours.

When you take the above facts in to consideration some useful rules of thumb can be developed **if you know the expected length of estrus:**

- Breed 18 to 12 h less than the projected length of estrus, (*e.g.*, if a goat is anticipated to have a heat period length of 24 h or less, breed her as soon as she comes in heat. If a doe usually stays in heat for 36 h, breed her 18 to 24 h after she shows the first signs of being in heat. If a doe usually stays in heat for 48 h, breed her 30 to 36 h after she shows heat signs, and so on...).
- Don’t breed after a doe has gone out of heat. It’s too late.
- If you don’t keep track of details such as the length of estrus then breeding either 12 or 24 h after the first signs of standing estrus should not give great differences between times, although, true, the overall PR will be lower than if you knew the actual length of the heat period and breeding were taking place using that information.

***Animal handling and restraining.*** A great effort should be placed in providing a low stress environment. Comfort will put the goat at ease and make the job simpler to accomplish. The animal handler should avoid getting goats excited by rough-handling.

The use of a breeding stand (milk stand) can facilitate animal restraining in an upstanding manner. There are a variety of stands with various improvements to facilitate raising up the platform where the goat stands.

***Helper’s contribution.*** Ensure you have appropriate help (brains and muscles). If your helper is not knowledgeable in what you are about to accomplish he/she may actually hinder your progress.

With some communication you can settle on some AI procedure choreography that is safe and efficient to follow. For example, a helper can be in charge of bringing the animal to the inseminating area, cleaning the vulva, inserting the lubricated speculum<sup>11</sup>, keeping the goat at ease and, when the time comes, raising the goat over one of his/her bent knees which is also positioned over the breeding stand. This arrangement of “goat over flexed leg” can help situate the goat in the best possible way to improve the actual “passing through the cervix”. The goat should bear her weight on the front legs while the rear legs are slightly off the ground. The body needs to be slightly stretched so that the internal organs of the reproductive tract are stretched in a length-wise manner.

*Semen thawing, handling, loading and delivery.*

1. Use the semen inventory sheet to determine what semen will be used and the location of semen straw inside the liquid N<sub>2</sub> tank. Using plastic tweezers<sup>12</sup> withdraw the appropriate semen straw from the liquid N<sub>2</sub> tank in the minimum time possible. The semen canister manipulation should not take more than 5-8 seconds. If the time is longer than 8 seconds re-introduce the semen straw to the goblet, place the goblet in the canister and reintroduce the storage device into the liquid N<sub>2</sub>. Re-attempt the procedure  $\pm 2$  m later.
2. As soon as the semen straw has been pulled out from the liquid N<sub>2</sub> tank place the styrofoam cap back on the semen tank neck opening and place the semen straw selected immersed in the water bath (34.5°C - 94 °F) for 1 minute.
3. Retrieve straw from water bath (water level should cover straw) and dry thoroughly with paper towel as water is spermicidal.
4. If ambient temperature is cold, warm the inseminating gun by friction accomplished by rubbing the metal rod with both hands prior to inserting the semen straw in the barrel of the inseminating gun. Alternatively you may want to use a commercial warming pad.
5. Cut the waxed end of the semen straw (usually colored) and place the cotton plug end (white) first into the barrel of the inseminating gun. Place (slide) the plastic French tip on the cut end of the French straw using hand pressure. Fit a French jacket sleeve over the metal rod and anchor in place by twisting clockwise or counter-clockwise while using hand pressure pushing down against the base of the metal rod<sup>13</sup>. Wrap the inseminating gun with a paper towel and place under armpit until ready to insert in reproductive tract.

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<sup>11</sup> Prepare speculum with the beveled front end lubricated with anti-spermicidal and anti-bacterial lubricating jelly (tip ring to about 2 inches from the tip). Use a dry paper towel to clean surrounding external debris from the vulva. Introduce the speculum in vaginal vestibule by angling the device upwards approximately 30° and then straighten flat and slide through vagina until you reach the cervix wall. Use appropriate speculum bore and length size that matches body development of the goat to be artificially inseminated. For Alpines this is 25 × 175 mm for doelings and 25 × 200 for does.

<sup>12</sup> Using your fingers (at 37 °C – 98.6 °F body temperature) will accomplish unwanted thawing of straws. If a portion of the straw thaws and is placed back in the tank the sperm involved will be destroyed.

<sup>13</sup> The use of a flexible sheath protector is debatable, may be warranted to protect the plastic French tip that has the semen if the gun is laid down on a table or other place where there can be contamination.

*Actual entry into the reproductive tract and exit.* This portion of the procedure is divided into seven parts:

1. A lubricated speculum of the correct diameter and length should be already in place inside the goat's vagina (see footnote on previous page). I'm all in favor of using the humanely designed (what a misnomer) speculums.
2. Introduce the lighting device and visually locate the cervix. Look at the slides from the presentation to understand what you actually should be seeing. If you encounter lots of secretion (which is normal in some goats) you may have to lower the goats rear legs so the fluids come out by gravity flow. Alternatively use a new, clean vaginal swab to extract excessive fluid but do not dry out.
3. Thread the French tip in to the os cervix.
4. With gentle circular motion, using slight forward pressure, complete getting through the cervix. Passing the French tip through the cervix will frequently require extensive manipulation of the inseminating gun. On the way to the uterine body expect to encounter approximately 3 to 4 cervical annular tissue folds. This normal anatomical obstruction (nature designed to interlock and only open at estrus and at parturition), are commonly called "rings" which is misleading and helps to create false expectations in the mind of the inseminator of what he/she will encounter in the way to the uterine body lumen. The presence of this overlapping tissue is what makes the actual AI procedure challenging as they will interfere with the otherwise smooth nature of the cervical canal. I have found that with difficult cervixes delivering a tiny bit of semen helps lubricate the tissue and aids in sliding the French tip. However, don't be surprised if on some goats the inseminating barrel just "slides right in" and no rings are felt. Unfortunately it does not happen too often.
5. You should stop as soon as there is no pressure felt against the inseminating gun tip. You have arrived home. Slightly touch the wall of the uterus and back off a little bit so you are not right against the uterine wall when semen is delivered.
6. Deposit semen slowly by depressing the inseminating gun plunger. Press with the thumb and not with the fingers (index and middle) so that the inseminating gun stays in place rather than coming out from the required semen-delivery spot.
7. Withdraw the inseminating gun slowly to avoid a siphoning action that can pull your semen back. Withdraw the speculum slowly. Place all inseminating equipment where it belongs and clean and sanitize thoroughly all reusable equipment used.

*Number of inseminations per estrus period.* This is a question often pondered by inseminators as well as people who give recommendations. There are two(?) schools of thought on this issue, one



group advocates two inseminations (12 h apart<sup>14</sup>) because it better guarantees that the small window of fertilizing opportunity is well covered at both ends. The other group supports a one time insemination under the claim that vaginal distention during estrus leads to oxytocin release which may cause cervical and vaginal contractions that affect adversely semen transport. Because I did not find satisfactory conclusive evidence on the matter I put the number of inseminations issue to the test. As you can see from the slides in the graphics of the presentation (data not published) no significant difference could be found that breeding once or twice per estrus period made any difference as far as pregnancy rates were concerned.

*Number of inseminations per breeding season.* The decision is largely determined by economics than by biology. It depends on how valuable is the breeding stock to you, semen costs need to be considered, overhead, variable and fixed costs (as technology investments tend to be) and their impact on keeping open goats in the herd (if a “cleanup” buck is not used) should enter the accounting, Consider also potential pregnancy rates at second or third breeding.

***Q9. If I adopt AI, can I say adios to Mr. Buckaroo?***

If your operation is such (as most productive operations are) dependent upon the number of replacements generated “in-house” then the answer is, “not really”, a clean-up buck is still a necessity, for those goats that are hard to settle. Even, further, don’t forget that a buck has no match when it comes to heat detection, with him on your team (either on a leash or fitted with a breeding prevention apron) I venture to say that no heat will go undetected. If you have many does in the breeding group one buck will be insufficient unless you use some kind of “buck rotation” approach. A practical alternative strategy is to have some males vasectomized or epididymectomized by your herd veterinarian to be heat detectors and not goat impregnators.

If you are capable of getting by with the pregnancy rates that AI can deliver at your hands or at the hands of whomever you hire to do the inseminating for you, and you are able to afford selling or keeping non-pregnant does, then by all means the answer to the question is yes, and literally, “Can that Buckaroo!” Send him to the LN<sub>2</sub> tank.

***Q10. Are there any drawbacks when adopting AI?***

Like anything else in life “nothing is completely perfect”. The main shortcoming is that the actual AI technical procedure only delivers acceptable pregnancy rates on skilled hands. I think of all other needs (such as time to learn, capital to purchase required equipment, etc.) as investments that will allow you to compete in today’s technologically oriented competitive livestock production environment.

On the larger objective, that of incorporating a cost-effective AI program, the project will benefit from the experience you already have accumulated on your particular operation, but will

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<sup>14</sup> Some other sources go as far as recommending to keep breeding -12 h apart- until the female is out of heat. Beware that if you use more than one insemination, -apart of the detrimental influence on your economy-, you must use the same source of semen (buck) or be prepared to have to run DNA testing to determine who in fact was the sire of your litter.

demand additional skills and the flexibility to incorporate new management approaches. An AI program will financially require you to decide if the proposal makes sense from an economic stance.

In summary, there is a significant effort that has to be placed on acquiring many specific techniques, much greater effort will be required on AI management areas discussed at some length in this document, but remember one management axiom: Nothing works... unless you do.

*The proper citation for this article is:*

*Loetz, E. 2006. Introduction to Artificial Insemination. Pages 110-127 in Proc. 21st  
Ann. Goat Field Day, Langston University, Langston, OK.*

## FITTING AND GROOMING FOR YOUTH MARKET DOE SHOWS IN OKLAHOMA

**Ms. Kay Garrett and Mr. Jim and Mrs. Mary Daniel**

*Blue Ribbon Boers*  
*www.blueribbonboers.com*

- ✓ **Remember - ALWAYS SAFETY FIRST** - Never use anything that does not appear safe. If you don't think something is right, stop and ask someone before you do it. Better to be safe than sorry.
- ✓ Never leave an animal tied up alone or on the stand alone. Learn how to tie a quick release knot. We suggest the slip knot.
- ✓ Never wash an animal in cold weather without the ability to dry them and warm them up quickly. Always wash and completely dry your animal before you start clipping to preserve the life of your clipper blades and a smoother clipping job.
- ✓ Until you feel confident in your ability to trim, never start out on your show animal, practice on an older animal or an animal that won't go to the show ring.
  - Equipment: Foot trimmers, clippers and shampoo. The rest of what we use is nice to have.
    - Halter
    - Grooming Stand
    - Clippers with #10 blade and 5/8" blade (Andis or Oster blades. I think Wahl's are coming out with a line comparable to the Andis and Oster)
    - Brushes and shedding comb
    - Coat finisher
- ✓ Start about 6 weeks out before your first show to get your animal into condition.
  - We condition our animals by worming, vaccinating, treating with a parasite control and good feed and hay. We suggest worming with Cydectin (1 cc per 10 pounds), vaccinating (CDT - Covexin 8, follow label), parasite control (Cylence 1 cc per 25 pounds along the back). We recommend and use Honor Show Feeds and high quality alfalfa hay.
- ✓ About a week before the show, wash your animal and trim it's feet. This will give the animal time to adjust to it's new "shoes" (feet). A couple of days before the show, rewash and finish trimming.
- ✓ A rule of thumb, if you cut long at first, then you can trim out faults. If you start short, you have no way to correct mistakes.

- ✓ We start with a # 10 and trim the wild hairs on the following places:
  - Ears
  - Chest floor
  - Front legs, dew claw, pasterns and hoof band
  - Belly
  - Tail
  - Hip
  - Hock
- ✓ We will change blades and use the 5/8 blade on the belly and hip depending on the hair length, type and quality. We will also use the shedding blade along the neck, topline and hip to smooth it out.
- ✓ Some suppliers that we use and are reputable dealers.
  - Outback Laboratories - [www.outbacklabs.com](http://www.outbacklabs.com) - 405-527-6355
  - Hoegger Caprine Supply - 1800-221-4628 - [www.thegoatstore.com](http://www.thegoatstore.com)
  - Jeffers - 1800-533-3377 - [www.jefferslivestock.com](http://www.jefferslivestock.com)
  - Mid-State - 1800-835-9665 - [www.midstatewoolgrowers.com](http://www.midstatewoolgrowers.com)

*The proper citation for this article is:*

*Garrett, K., J. Daniel, and M. Daniel. 2006. Fitting and Grooming for Youth Market Doe Shows in Oklahoma. Page 128-129 in Proc. 21st Ann. Goat Field Day, Langston University, Langston, OK.*

## FITTING AND GROOMING FOR YOUTH MARKET WETHER SHOWS IN OKLAHOMA

Ms. Kay Garrett and Mr. Jim and Mrs. Mary Daniel

*Blue Ribbon Boers*  
*www.blueribbonboers.com*

- ✓ **Remember - ALWAYS SAFETY FIRST** - Never use anything that does not appear safe. If you don't think something is right, stop and ask someone before you do it. Better to be safe than sorry.
- ✓ Never leave an animal tied up alone or on the stand alone. Learn how to tie a quick release knot. We suggest the slip knot.
- ✓ Never wash an animal in cold weather without the ability to dry them and warm them up quickly. Always wash and completely dry your animal before you start clipping to preserve the life of your clipper blades and a smoother clipping job.
  - Equipment: Foot trimmers, Lister Stablenate clippers and shampoo. Some other equipment that we like to use:
    - Halter
    - Grooming Stand
    - Slick sweater
    - Body blanket
    - Small clippers with #10 blade for small areas
      - Head
      - Feet
      - Trim legs
      - Horn base
      - Tail
- ✓ The wethers are completely slick shorn above the hocks. It is not wise to leave hair on the wethers. Leaving lots of hair on wethers make the wethers to appear fat and overly conditioned and finished when the judge handles them and analyzes them at a show.
- ✓ To trim below the hocks and tail, be very careful. You do not want to slick shear the legs. You only need to trim up the wild hair. You want to leave as much hair on as possible. You do not want the animal to appear "deer like". You will want to trim the hoof band and slick up the tail. The head needs to be slick sheared paying special attention under the chin and around the horns. Leave no hair on in the head area. I suggest using a small clipper such as the doe clippers around the head, leg and tail area with a number 10 blade. The tail should be trimmed up close but not completely sheared.
- ✓ Keep the blades oiled every 10 minutes or every time you switch sides on an animal.

- ✓ If the weather is cold, be sure to cover up your animal with blankets and slickies and use a heat lamp if necessary.
- ✓ Never, Never, Never, Never, Never, Never, Never, Never, Never, Never trim a doe in this fashion unless you plan on showing her with wethers for her show career. She will not compete in a regular doe show if she is slick sheared.
- ✓ Some suppliers that we use and are reputable dealers.
  - Outback Laboratories - [www.outbacklabs.com](http://www.outbacklabs.com) - 405-527-6355
  - Hoegger Caprine Supply - 1800-221-4628 - [www.thegoatstore.com](http://www.thegoatstore.com)
  - Jeffers - 1800-533-3377 - [www.jefferslivestock.com](http://www.jefferslivestock.com)
  - Mid-State - 1800-835-9665 - [www.midstatewoolgrowers.com](http://www.midstatewoolgrowers.com)



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*Garrett, K., J. Daniel, and M. Daniel. 2006. Fitting and Grooming for Youth Market Wether Shows in Oklahoma. Page 130-131 in Proc. 21st Ann. Goat Field Day, Langston University, Langston, OK.*

## **Extension Overview**

**Terry A. Gipson**

*Goat Extension Leader*

The year 2005 was a busy year for the Langston Goat Extension program. The goat extension specialists have answered innumerable producer requests for goat production and product information via the telephone, letters and e-mail, have given numerous presentations at several state, regional, national and international goat conferences for potential, novice and veteran goat producers, and have produced a quarterly newsletter. They have also been busy with several major extension activities. These activities include the annual Goat Field Day, Langston 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 20th annual Goat Field Day was held on Saturday, April 30, 2005 at the Langston University Goat Farm with over 400 participants in attendance. Last year's theme was Quality Assurance: Delivering a Wholesome Product to Market. Our featured speakers were Dr. Ann Wells and our own Drs. Steve Hart and Roger Merkel.

Dr. Wells is a veterinarian with more than 20 years experience in livestock production. She spoke on the topic of Herd Health and Quality Assurance in the morning session and on How to Help Your Vet Help You and on Sustainable Parasite Management for Goats in the afternoon sessions. Dr. Roger Merkel spoke on the topic of Why Have A Quality Assurance Program for the Goat Industry? and Dr. Steve Hart spoke on the topic of Quality Assurance for Goat Nutrition in the morning session.

In the afternoon, Dr. Merkel spoke on A Meat Goat Quality Assurance Program and Dr. Hart on our Interactive Nutrient Calculator. The Goat Field Day had several other practical afternoon sessions as well. In addition to these presentations, there were two youth programs in the morning and two in the afternoon. For the younger youth, there was a craft project and games played during the morning and afternoon. Older youth and interested adults were able to participate in a full-day clipping, fitting, and showing workshop conducted by Kay Garrett and Mary and Jim Daniel. Of the more than 400 Goat Field Day participants, 75% came from Oklahoma. Other states represented were Arkansas, Arizona, California, Colorado, Iowa, Kansas, Missouri, Nebraska, and Texas. Approximately 25% of the participants were youth with about half attending the Fun Tent and the other half attending the Fitting and Showing workshop.

### **Goat DHI Laboratory**

The Langston Goat Dairy Herd Improvement (DHI) Program is housed at the dairy farm, west of campus, operates under the umbrella of the Texas DHIA. In February 1998, the Langston DHI program became the first DHI program to introduce forms and reports in goat terminology to dairy goat producers in the United States. A national Dairy Herd Improvement Association (DHIA) has been in existence for a number of years. However, until 1996 DHIA catered only to cow dairies. The Langston DHI program has been very popular with dairy goat producers and has grown significantly since its establishment in 1996. Goat producers are now able to get records for their animals that reflect accurate information with the correct language. Currently we are serving a 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. Langston University continues to serve the very small-scale dairy goat producer. The average herds size on test with Langston University is 10 animals. This is significantly smaller than the herd size average for the five other processing centers.

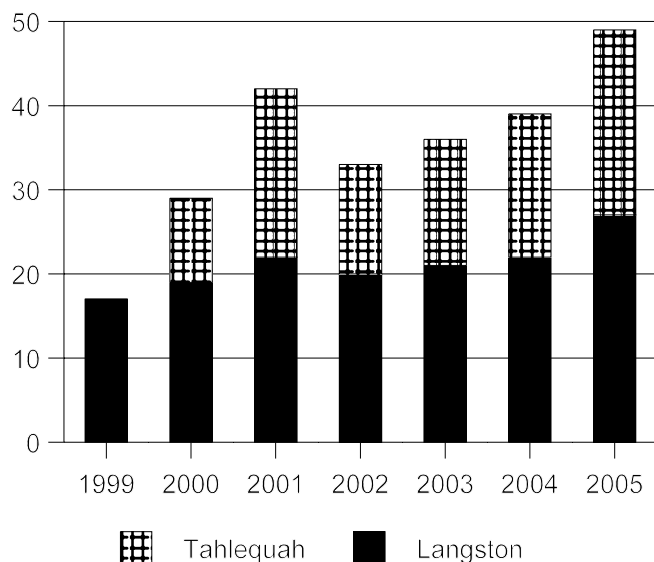
For those interested in becoming a Langston goat DHI tester, training is available either in a formal classroom setting or through a 35-minute video tape. Every tester is required to attend the DHI training session or view the tape and take a test. Upon completion of the DHI training, the milk tester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

### Goat Newsletter

The Goat Extension program published four issues of the 8-page Goat Newsletter in 2005. Interest in the newsletter has grown and we currently have over 3400 subscribers to our free quarterly Goat Newsletter and the subscription list continues to increase every year. The Goat Newsletter is mailed to every state in the nation and to 10 countries overseas. Ninety-seven percent of the mailings go to American households. At least one newsletter is mailed to a household in every state in the nation. Fifty percent of the newsletters are mailed to Oklahoma households. An additional thirty percent of the newsletters are mailed to households to state adjacent to Oklahoma.

### Artificial Insemination Workshop

The use of superior sires is imperative in improving the genetic composition of breeding stock. Artificial insemination has long been used in the dairy cattle industry and is a simple technology that goat producers can acquire. However, opportunities for goat producers to the necessary skills via formal and practical instruction are not widespread. Langston University has instituted a practical workshop for instruction in artificial insemination in goats. Producers are instructed in the anatomy and physiology of the female goat, estrus detection and handling and storage of semen. Producers participate in a hands-on insemination exercise. An understanding of the anatomy and physiology enable the producer to devise seasonal breeding plans and to troubleshoot problem breeders. An understanding of estrus detection enables the producer to effective time inseminations for favorable



conditions for conception and to effectively utilize semen. An understanding of semen handling and storage enables the producer to safeguard semen supplies, which can be scarce and costly. The experience of actually inseminating a female goat enables the producer to practice the knowledge that they have gained. The acquisition of these inseminating skill will allow producers the use of genetically superior sires in their herds that they normally would not have access to. It also allows producers to save money by conducting the inseminating themselves instead of hiring and inseminator. In 2005, AI workshops were held in September at the Langston University campus and in October at the county fairgrounds in Tahlequah.

Number of participants enrolled in AI workshops.

## **Controlling Internal Parasites Workshop**

In 2005, 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>). Most calculators were based on studies of the project reported in a Special Issue of the journal Small Ruminant Research. For calculators with score inputs (i.e., grazing and body conditions), pictures are available to aid in determining most appropriate entries. Realistic examples are given, as well as discussion of appropriate and inappropriate usage. However, for the experienced user there is an option to hide text and examples and to view only inputs and outputs.

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

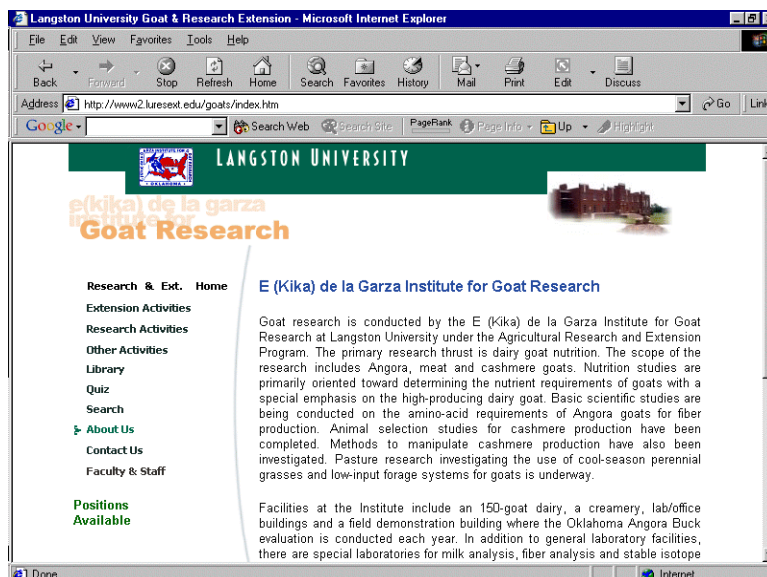
In summary, for nutrient requirement expressions to be of value, they must be readily accessible and reasonably simple. Therefore, a web-based goat nutrient requirement system was developed based on findings of a recent project. It is hoped that this system will enjoy widespread usage and enhance feeding 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 web site include a document library with the complete proceedings of the annual Goat Field Day for the past three years and the quarterly newsletter for the past several years. Both the proceedings and newsletters are also available in portable document format (pdf), which allows for the viewing and printing of documents across platform and printer without loss of formatting.



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

## Web-based Training for Meat Goat Producers

Meat goat production is one of the fastest growing sectors of the livestock industry in the United States. New producers, as well as some established ones, have an expressed need for current, correct information on how to raise goats and produce safe, wholesome products in demand by the public. As the meat goat industry grows and evolves, a quality assurance program is essential. Such a QA program ensures the production of a wholesome product that satisfies consumers and increases profit for the meat goat industry.

Langston University was awarded funding by the Food Safety and Inspection Service of USDA to develop training and certification for meat goat producers. Langston University organized and led a consortium of 1890 universities and producer associations in this project. The consortium identified the subject topics most pertinent and pressing for the instructional modules. The consortium then identified experts on the selected subject topics and pursued these experts as module authors. These authors represent the most qualified persons in their field in academia as well as in the industry. Langston University translated the sixteen instructional modules into web pages with

accompanying images, and pre- and post tests for those producers wishing to pursue certification. All modules are also available in pdf for easy printing and the introductory module is available as a podchapter for downloading and listening on your favorite mp3 player. The web-site (<http://www2.luresext.edu/goats/training/qa.html>) was unveiled in late 2005.

Even though this web-site (<http://www2.luresext.edu/goats/training/qa.html>) was only recently unveiled, 32 producers have enrolled for certification, have registered a 15% increase in scores from pre- to post test, and have successfully completed an average of six of the sixteen modules. These instructional materials will best serve meat goat producers in assisting them to produce a safe, wholesome, healthy product for the American consumer. Funding source for this project was USDA/FSIS/OPHS project #FSIS-C-10-2004 entitled "Development of a Web-based Training and Certification Program for Meat Goat Producers."

### **Body Condition Score Pamphlets**

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 increases excessively 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.

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. Langston University has developed two educational tools for assisting goat producers with body condition scoring in goats. The first is a BCS pamphlet and the second is a web site (<http://www2.luresext.edu/goats/research/bcs.html>).

These educational resources for assessing BCS should enable the goat producer to evaluate management direction and to correct deficiencies or excesses in management; thus, improving productivity and profitability of the enterprise. More than 4,000 BCS pamphlets have been distributed.

### **Tulsa State Fair**

At the 2005 Tulsa State Fair, Langston University participated in the Birthing Center program with twelve pregnant Spanish does. Dr. Hellwig of the Oklahoma Department of Agriculture coordinated the birthing center and said that the goats were the highlight of the center. This was a huge success and plans are underway to provide pregnant does for 2006.

### **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 ninth annual meat buck performance test started May 7, 2005 with 62 bucks enrolled from 19 different breeders. Breed and geographical distribution are given in the table below.

State	Boer	Kiko	Savanna	Grand Total
KS	2			2
MO	4			4
NE	4			4
OK	5	6	3	14
TX	36	2		38
Grand Total	51	8	3	62

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 lymphadenitis were given vaccinations. Four weeks after check-in, all bucks were given a booster vaccination for enterotoxemia and caseous lymphadenitis.

Half of the bucks were randomly assigned within breeder to either Calan feeders or Feed Intake Recording Equipment (FIRE) system.

Average age in days and entry weight are detailed in the table below.

Feeder Type	Trait	Average
Calan	Average of Age (d)	97.9
	Average of Entry Weight (lbs)	51.8
Fire	Average of Age (d)	102.0
	Average of Entry Weight (lbs)	51.3

Entrance weight for the 62 bucks averaged 51.5 lbs with a range of 30.8 to 78.2 lbs. Age at entry averaged 100.0 days with a range of 86 to 157 days.

### *Adjustment Period*

The performance-testing facility only has 53 Calan feeders but 62 bucks enrolled. To accommodate all animals, the new Feed Intake Recording Equipment (FIRE) system was used. The FIRE system is a completely automated electronic feeding system, which was developed for swine but we have adapted it to goats. Animals wear an electronic eartag, which is read by an antenna in the feeder. The FIRE system automatically records body weight and feed intake. This year, half of the bucks are in the FIRE system and half are in the Calan feeders. For producers, who enrolled more than one buck in the Buck Performance Test, the test supervisor randomly assigned half of their bucks to the FIRE system and half to the Calan feeders. The 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.

Because the FIRE system has not previously been used with goats, Langston University determined the appropriate stocking density per FIRE feeder. As many as 10 young goats can share a FIRE feeder without adverse effects. Langston University also compared the FIRE system with the Calan feeders. We found no differences in average daily gain or feed intake of growing goats on the FIRE system and the well-established Calan feeders.

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, yesterday’s feed that remains in the Calan feeder is weighed and removed from the Calan feeder. Fresh feed is weighted and placed into the Calan feeder. The difference in weights between the fresh feed place in the Calan feeder one morning and the remaining feed the next morning is the amount consumed. Because only one goat is capable of opening the Calan door and eating, it is possible to calculate the feed intake of the individual bucks. 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. Whenever the weather was permitting, the bucks had access to the outside pens as well as the inside pens.

In 2005, we were fortunate to hire a second year veterinary student from Oklahoma State University, Ms. Jennifer Howard. Jennifer did a wonderful job with the bucks.

On July 13, buck #3242 was having problems with his back legs. He was breaking over on his pasterns and slightly dragging both hind hooves as he walked. Dr. Lionel Dawson was contacted and examined him. There was some swelling and pain along the spinal cord but his temperature was normal and he was eating, defecating, and urinating normally. Possibly another buck in his pen injured him. He was isolated and treated with analgesics and steroids. He improved slightly; however, he still tended to knuckle under as he walked. He then gradually started to deteriorate in movement, eventually went down, and was unable to stand. Dr. Dawson continued evaluation and it was decided that the best option for the buck was euthanasia. The owner was contacted and granted permission to euthanize the buck. On August 3, the buck was euthanized and the body transported to OSU College of Veterinary Medicine for necropsy. Results from the necropsy showed that the buck suffered from a congenital constriction of the cervical vertebrae and there were no signs of trauma.

### *Ration*

Nutritionists at Langston University formulated the following ration. 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 was 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.



<b>Ingredient</b>	<b>Percentage (as fed)</b>
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%
<b>TOTAL</b>	<b>100.00%</b>

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 .74%, .37% and 1.07%, respectively. Zinc concentration is 33.04 ppm, copper is 17.15 ppm and selenium is .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 (.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 25 after the adjustment period was finished. Weights at the beginning of the test averaged 63 lbs with a range of 36.3 to 96.9 lbs. Weights at the end of the test averaged 115.3 lbs with a range of 71.6 to 157.5 lbs. Weight gain for the test averaged 52.4 lbs with a range of 29.7 to 80.4 lbs.

The type of feeder (Calan or FIRE) had no significant effect upon gain. Bucks on the Calan system averaged 52.6 lbs gain and bucks on the FIRE system averaged 52.1 lbs gain, which is a difference of 0.5 lbs

#### *Average Daily Gain (ADG)*

At mid-point, the bucks gained on averaged 0.62 lbs/day with a range from 0.31 lbs/day to 0.92 lbs/day. For the test, the bucks gained on averaged 0.62 lbs/day with a range of 0.35 lbs/day to 0.96 lbs/day.

The type of feeder (Calan or FIRE) had no significant effect upon average daily gain. Bucks on the Calan system averaged 0.63 lbs/day and bucks on the FIRE system averaged 0.62 lbs/day gain, which is a difference of 0.01 lbs/day.

#### *Feed Efficiency (Feed Conversion Ratio)*

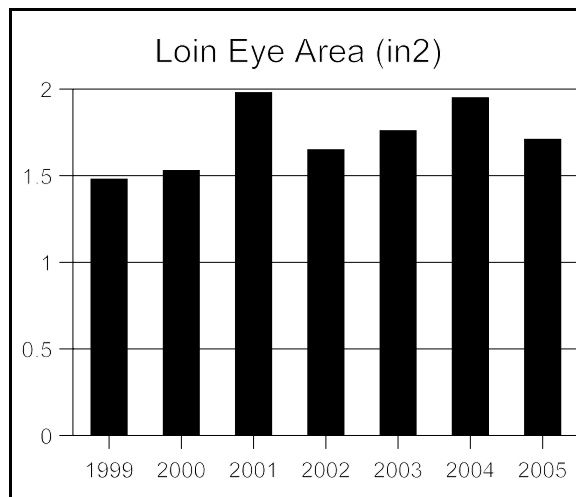
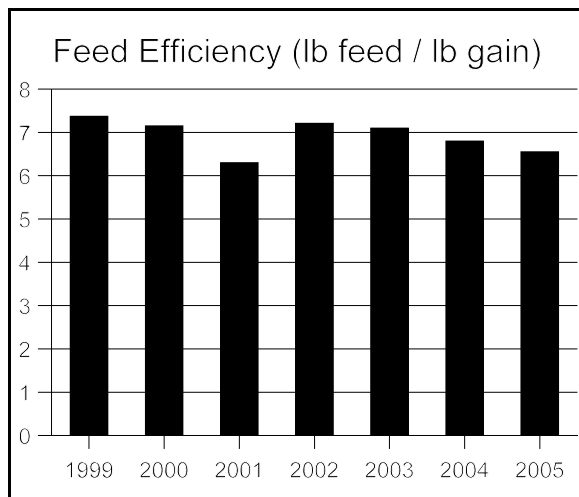
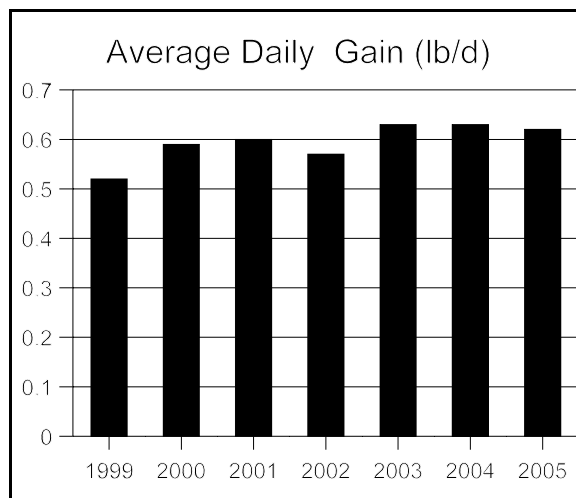
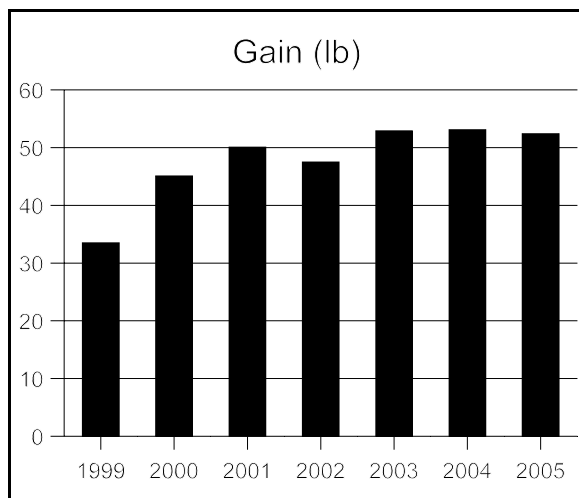
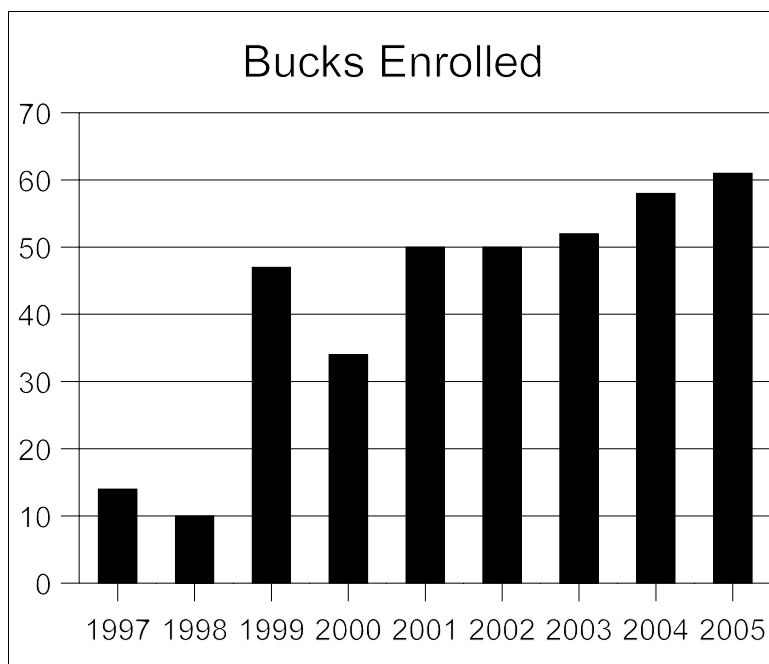
For the test, the bucks consumed an average of 335.5 lbs of feed with a range of 193.3 to 482.9 lbs.

The type of feeder (Calan or FIRE) had no significant effect upon intake. Bucks on the Calan system averaged 328.9 lbs intake and bucks on the FIRE system averaged 338.1 lbs, which is a difference of 9.2 lbs. Figure 2 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 6.55 (feed efficiency is defined as the number of lbs. of feed needed for one lbs. of gain), with a range of 4.53 to 11.34.

#### *Muscling*

The average loin eye area as determined by ultrasonography was 1.71 square inches with a range of 0.95 to 2.36 square inches and the average left rear leg circumference was 18.5 inches with a range of 14.5 to 22.0 inches.



*The proper citation for this article is:*

*Gipson, T. 2006. Extension Overview. Pages 133-142 in Proc. 21st Ann. Goat Field Day, Langston University, Langston, OK.*

## **International Overview**

**Roger Merkel**

*International Program Leader*

### **Objectives**

Of the 767 million goats in the world, less than 0.2% reside in the United States, while over 90% can be found in countries of Asia and Africa. Goats and goat products are part of the livelihood of a majority of the world's population and are an important resource for poor farmers in many countries of the world. Part of the mission of the American Institute for Goat Research is to effect positive change in goat production throughout the world. To fulfill this aspect, the Institute has developed and maintains many strong ties with research and academic institutions around the world. Collaborative research projects, along with academic and research training, have been the traditional modes of collaboration. However, recently the Institute has increased its activities in the area of agricultural development with the goal of enhancing food security and income generation for many of the world's poor.

In addition to collaborative work with foreign institutions, the Institute has hosted visiting scientists from over 20 foreign countries for conduct of research. Training for foreign livestock workers and scientists as well as for U.S.-based persons who will travel and work overseas are other ways in which the Institute is active in the international arena.

International research and training, hosting foreign scientists, and teaching those who will teach others are internationally-focused activities that give the Institute unique opportunities to not only increase knowledge of foreign production systems and constraints, but also to positively impact agricultural development in foreign countries and help alleviate poverty and hunger. General objectives of the Institute's international program are to: 1) increase our knowledge of goat production systems worldwide and current constraints to increased production; 2) build human capacity through training foreign scientists and agricultural workers in goat production thereby allowing them to more effectively carry out their missions of teaching, research, and extension; 3) increase Langston University and the Institute's involvement in agricultural development and impact on human welfare; and 4) enhance the Institute's knowledge of development and development issues.

### **International Research**

During the last five years, the American Institute for Goat Research has expanded its international research activities to include countries in the Middle East, Africa, and Asia. While most international projects conducted by the Institute have aspects of research, training, and extension, some are more research oriented. Many of these types of grants are typified by a number of recent projects begun with countries in the Middle East.

### ***Middle East Activities***

The grant “Multinational Approaches to Enhance Goat Production in the Middle East” promotes collaborative research, training, and extension activities among Langston University, the Desert Research Center of Egypt, the Volcani Center in Israel, Al-Quds University in East Jerusalem working in the West Bank, and the Jordan University of Science and Technology. The objective of this grant is to revitalize and develop the Middle East goat industry via research and technology transfer to increase income and improve the standard of living. Specific goals of the grant include the characterization of current goat production systems, distribution of improved goat genotypes, development of new technologies for production of milk products, and the transfer of appropriate technologies to Middle Eastern households.

One of the activities underway at each Middle Eastern location is the characterization of chemical and bacteriological status of goat milk. Israeli scientists 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 and crop residues, goat herd health, manufacture of traditional and alternative cheeses, milk product hygiene, and use of improved genotypes.

Within the past year, three additional grants have been awarded to the American Institute for Goat Research for research collaboration in the Middle East. The first of these establishes collaboration with the Newe Ya’ar Research Center of the Agricultural Research Organization in Israel on a grant entitled “Energy Expenditure for Activity in Free-Ranging Ruminants: A Nutritional Frontier.” The second grant continues the collaborative research relationship between the Institute and the Desert Research Center of Egypt through researching “Effects of Acclimatization on Energy Requirements of Goats.” Both of these research grants deal with important aspects of energy expenditure by goats.

A third grant involving a Middle Eastern institute also includes institutions in three other regions of the world. The grant “International Collaboration in Goat Research and Production Web-based Support Aids” partners the American Institute for Goat Research with Jordan University of Science and Technology, Northwest Science-Technology University in China, Département des Sciences Animales of Institut National Agronomique in France, and University of Chapingo in Mexico. This grant expands usage of the interactive, web-based nutrient calculator for goats and the goat production simulation program developed by Institute scientists through translation into Arabic, Chinese, French, and Spanish. Having the web-based nutrient calculator in these languages will increase the number of producers and scientists who will be able to utilize the unique features of the calculator and enhance its usefulness.

### **Training and Program Support**

Recently, the American Institute for Goat Research collaborated in a University of Oklahoma-led project with Oklahoma State University and Cameron University, all located in Oklahoma, and Salahaddin University, Basrah University, Al-Anbar University, University of Technology, and Babylon University in Iraq. This grant “Al-Sharaka Program for Higher Education in Iraq”

supported the United States Agency for International Development activities to upgrade and revitalize the higher education system in Iraq. The role of the Institute and Langston University was to provide training in small ruminant production to Iraqi scientists and to establish a ruminant nutrition laboratory at Salahaddin University.

To accomplish the former goal, a three-week training was held in Cairo, Egypt in September 2004. This training, “Updating and Enhancing the Skills of Iraqi Scientists in Small Ruminant Production,” provided information on computer technology, herd health and reproduction, statistical analysis, nutrition, and manuscript preparation to seven Iraqi scientists. The first week of the training led the attendees through an Arabic language small ruminant record-keeping software program. This portion of the training was conducted by Egyptian scientists as part of the grant “Multinational Approaches to Enhance Goat Production in the Middle East.” Also attending this week of the training were scientists from Jordan and the Palestinian Authority. During this time, the Iraqi scientists had the opportunity to make contacts and interact with other scientists in the region. The remaining two weeks of the training session consisted of sessions led by Institute personnel. During the final three days of the training, the Iraqi scientists traveled to the north Sinai to visit goat farms and speak with producers.

To accomplish the establishment of a ruminant nutrition laboratory, analytical equipment and associated chemicals and supplies were purchased for Salahaddin University. Textbooks on various topics in animal science as well as laboratory procedure manuals were purchased. The equipment, supplies, and books were sent to Salahaddin University in the summer of 2005.

### ***Democratic People’s Republic of Korea***

In addition to providing program support to government-funded programs, the American Institute for Goat Research has also conducted training and support activities for projects funded by non-government organizations. In November 2004, the Institute conducted an eight-day training program for five persons from the Democratic People’s Republic of Korea (DPRK). This training was supported by Global Resources Services, Inc., an organization that has a history of working in the DPRK and that has established a goat dairy in the southern region of the country. The Korean personnel received training in animal management, artificial insemination, semen collection and freezing, nutrition, herd health, milking procedures and mastitis prevention, and cheese making.

As an extension of this work, Dr. Roger Merkel of the Institute traveled to the DPRK in June 2005 with representatives of Global Resources Services, Inc. to provide training and technical assistance to the dairy in the areas of nutrition, forages, and internal parasite control.

### **Agricultural Development**

The Institute is proud of its activities in the area of agricultural development. Partnerships with foreign institutions have led to the opportunity to impact the lives of poor farmers. While many of Institute’s international grants have aspects of direct development, the succession of grants with Ethiopian institutions have had the most direct development activities.

### *Ethiopian Connection*

Langston University and the Institute have had a long and fruitful relationship with universities in Ethiopia. This relationship began with research grants awarded in the 1990's and expanded to include more aspects of training, research, and development through university partnerships and other grants that have been awarded in the last five to seven years. In 1998, a three-year grant was awarded to Langston University to for an institutional partnership with Awassa College of Agriculture of the newly-formed Debub University in Awassa, Ethiopia entitled "Enhance Food Security and Income Generating Potential of Families in Southern Ethiopia Through Improved Goat Production and Extension." The following year a three-year grant was awarded for a partnership with Alemaya University, called "Enhancing Institutional Research and Extension Capabilities for Increased Food Security Through Improved Goat Production." Both grants were designed to enhance the research, teaching, and extension capabilities of all institutions involved through a program of collaborative research, training of Ethiopian scientists at LU, and the establishment of village development projects designed to enhance household food security, income generating potential, and family health status through increased goat productivity. Increased goat production was accomplished via the provision of goats and appropriate technology to women's groups for goat production in villages near both universities.

In 2000, Langston University was awarded a sustainability grant entitled "Enhanced Education and Computer Capabilities: The Foundation for Sustained Collaboration" for further activities with Debub University and a new institution, Oklahoma State University was added to the partnership. Further, Langston University was awarded a companion Technology Enhancement grant to establish a student computer laboratory on the Debub University campus, an activity that was completed in November, 2001.

Two additional grants were awarded in 2002 for continued work with these two Ethiopian universities. A new partner, Fort Valley State University, became the lead institution in a grant furthering activities with Debub University while the Institute and Oklahoma State University continued activities with Alemaya University. These grants had a similar focus to the original projects with the addition of training and research in reproduction, artificial insemination, and herd health.

Most recently, in late 2005 the American Institute for Goat Research of Langston University and Prairie View A&M University, Prairie View, TX were awarded a \$7 million grant from the USAID Mission in Ethiopia for a project entitled "Ethiopia Sheep and Goat Productivity Improvement Program." This 5-year program entails collaboration with the Ministry of Agriculture and Rural Development of the Government of Ethiopia. The overall goal of the program is to conduct research and extension activities in the areas of production and marketing that will result in a sustainable increase in small ruminant productivity in Ethiopia to improve food and economic securities. The project will work in five regions of Ethiopia (Tigray, Amhara, Oromia, Southern States, and Somali), and address a number of factors including human and institutional capacity building, research and technology transfer, introduction of improved animal genetics, and determining appropriate utilization of indigenous breeds.



*Some of the successes of American Institute for Goat Research's Ethiopian projects include:*

- 11 scientists from Debub and Alemaya Universities received training in the U.S. in topics such as ruminant nutrition, goat reproduction, statistical analysis, adult education, internal parasites, and extension methodologies. Additionally, Ethiopian personnel learned new laboratory and research techniques and presented information on Ethiopia to U.S. university staff and students.
- A conference on small ruminant production was held at Debub University in 2000. Over 50 participants from Ethiopia and several foreign countries attended the conference, the first of its kind in Ethiopia. The proceedings of the conference can be found at the Institute's website at <http://www2.luresext.edu/international/Titlepages.htm>.
- A networked computer laboratory was established on the Debub University campus for use by staff and students.
- Langston University received a special award to purchase laboratory equipment and supplies for Alemaya University to upgrade their ruminant nutrition laboratory.
- A workshop on curriculum development was held at Debub University.
- Numerous seminars on small ruminant nutrition, herd health, internal parasites, and statistical analysis have been presented to Ethiopian students.
- Special training on web page design, use of computer programs, detection of internal parasites, and evaluation of animal health have been conducted by U.S. scientists on trips to Ethiopia.
- Surgical procedures to insert ruminal cannula and perform an epidymectomy were taught at both universities.
- Books and other laboratory supplies have been purchased and sent to the universities
- Over 2,500 straws of Boer goat semen were shipped to Ethiopia for use by the universities. This was the first importation of Boer goat semen into Ethiopia.
- Two professionals in goat artificial insemination and semen freezing traveled to Ethiopia and conducted workshops on artificial insemination at both universities and taught goat semen freezing procedures to staff at the National Artificial Insemination Center of the Ethiopian Ministry of Agriculture.
- Crossbred Boer x local goat kids have been born at both Debub and Alemaya Universities. These crossbred animals are the first of this genotype to be born in Ethiopia. The superior meat production and faster growth rate of the Boer goat has potential to greatly impact the expanding goat meat industry in Ethiopia. This impact goes beyond enhancing the local goat meat supply to increasing the ability of Ethiopia to export quality goat carcasses to Middle East clientele, thereby bringing important external revenue into the country, creating jobs, and improving local and regional economies.
- Development projects were established in areas surrounding Debub and Alemaya Universities where women's groups for goat production were formed and goats and production training provided. There are currently over 450 women participating in the projects. These projects benefit the rural population by enhancing food security and income generation potential. Proceeds from the sale of goats have been used to improve housing, purchase livestock, pay school fees, begin a small business, and improve family nutrition. The animals provided have also served as a buffer and resource for use in drought conditions, lessening the need for food aid for participating families. The universities have benefitted through increased interaction with rural producers and staff having more contact with farmers, thereby learning of, and assisting in solving, production constraints.

- Project activities have been mentioned on Ethiopian television, in U.S. newspapers, the Goat Institute's Goat Newsletter, and Ethiopian and U.S. radio. Langston University's activities in Ethiopia have also appeared in the scrollbar on CNN International.

### **The End Result**

The American Institute for Goat Research is proud of its international activities and the impact they have on strengthening human and institutional capacity of foreign institutions, providing important and relevant research results on local issues of importance, and in the assistance provided to small farmers, and particularly women, in enhancing family nutrition and income generation. These are unique activities that support the mission of the Institute and the goals of its personnel.

Through these activities, Institute personnel learn about goat production throughout the world and are exposed to foreign cultures and customs. The knowledge gained through these activities is put to use by personnel in their research, extension, and teaching duties.

The foreign scientists who come to conduct research at the Institute also bring with them a wealth of information that is imparted to Institute scientists. The results of the research conducted by those scientists can be used to improve goat production both here and abroad. Foreign institutes with whom the Institute collaborates gain from the training functions and research trials conducted and become better equipped to perform their missions of teaching, research, and extension.

Most importantly, though, is the satisfaction that through its efforts, the American Institute for Goat Research is having a positive impact on goat production throughout the world and assisting village parents in lesser developed countries of the world to better provide for their families.

### **Recent International Grants**

Years	2005-2010
Title	Ethiopia Sheep and Goat Productivity Improvement Program
Collaborators	Langston University; Prairie View A & M University, Ministry of Agriculture and Rural Development of the Government of Ethiopia
Funding source	USAID Ethiopia
Funding amount	\$6,999,998

Years	2005-2008
Title	International Collaboration in Goat Research and Production Web-Based Decision Support Aids

Collaborators	Langston University; Jordan University of Science and Technology; Northwest Science-Technology University, China; Département des Sciences Animales of Institut National Agronomique, France; University of Chapingo in Mexico
Funding source	USDA International Science and Education Competitive Grants Program
Funding amount	\$99,959
Years	2005-2008
Title	Energy Expenditure for Activity in Free-Ranging Ruminants: A Nutritional Frontier
Collaborators	Langston University; Newe Ya'ar Research Center of the Agricultural Research Organization, Israel
Funding source	United States – Israel Binational Agricultural Research and Development Fund
Funding amount	\$310,000
Years	2005–2007
Title	Effects of Acclimitization on Energy Requirements of Goats.
Collaborators	Langston University; Desert Research Center, Egypt
Funding source	U.S. – Egypt Joint Science and Technology Fund
Funding amount	\$58,500
Years	2003 - 2006
Title	Al-Sharaka, The Partnership. Revitalizing the Higher Education System in Iraq
Collaborators	Langston University, University of Oklahoma; Oklahoma State University; Cameron University, Lawton, OK; Al Anbar University, Ramadi City, Iraq; Babylon University, Hilla City, Iraq; Basrah University, Basrah, Iraq; Salahaddin University, Erbil, Iraq; University of Technology, Baghdad, Iraq
Funding source	USAID
Funding amount	\$4,988,569

Years	2003 -2004
Title	Combating Micronutrient Malnutrition: Assessment of Constraints to Including Animal Source Foods in Children's Diets in Rural Ethiopia and Kenya
Collaborators	Langston University; Oklahoma State University; UCLA; Debu University, Ethiopia; University of Nairobi, Nairobi, Kenya.
Funding source	Global Livestock Collaborative Research Support Program
Funding amount	\$50,000
Years	2000 - 2008
Title	Multinational Approaches to Enhance Goat Production in the Middle East
Collaborators	Langston University; Desert Research Center, Cairo, Egypt; Volcani Center, Bet Dagan, Israel; Al-Quds University in East Jerusalem working in the West Bank; Jordan University of Science and Technology, Irbid, Jordan
Funding source	USAID/Middle East Regional Cooperation Program
Funding amount	\$1,199,725

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## **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 2005, abstracts for 2006, and summaries of scientific articles that were published in 2005 or currently are "in press" to appear in 2006 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:** *Characterization of the Energy Requirement for Activity by Grazing Ruminants*  
**Type:** USDA 1890 Institution Research Capacity Building  
**Project Number:** 2005-38814-16352  
**Period:** 2005-2008  
**Investigators:** T. Sahlu<sup>1</sup>, R. Puchala<sup>1</sup>, A. L. Goetsch<sup>1</sup>, T. A. Gipson<sup>1</sup>, K. E. Turner<sup>2</sup>, and B. Kouakou<sup>3</sup>  
**Institutions:** <sup>1</sup>Langston University, <sup>2</sup>Appalachian Farming Systems Research Center, and <sup>3</sup>Fort Valley State University  
**Objectives:** Develop and evaluate a system to predict the grazing activity energy cost for ruminants by determining effects of animal and dietary conditions on energy expenditure, metabolizable energy intake, the grazing activity energy cost, grazing and walking times, and horizontal and vertical distances traveled.

**Title:** *The Ability of Goats to Withstand Harsh Nutritional Environments*  
**Type:** USDA 1890 Institution Research Capacity Building  
**Project Number:** 2005-38814-16353  
**Period:** 2005-2008  
**Investigators:** A. L. Goetsch<sup>1</sup>, R. Puchala<sup>1</sup>, T. Sahlu<sup>1</sup>, and H. C. Freetly<sup>2</sup>  
**Institutions:** <sup>1</sup>Langston University and <sup>2</sup>Meat Animal Research Center  
**Objectives:** Determine if there are differences between goats and sheep and between meat goat species of the US in the ability to utilize diets with limited supplies of nitrogen and energy and to characterize the physiological bases of any such differences.



- Title:** *International Collaboration in Goat Research and Production Web-Based Decision Support Aids*
- Type:** USDA International Science and Education Competitive Grants Program
- Project Number:** 2005-51160-02281
- Period:** 2005-2008
- Investigators:** A. L. Goetsch and T. A. Gipson
- Institution:** Langston University
- Goal:** Facilitate future collaborative research between the American Institute for Goat Research (AIGR) 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:** Translate and adapt two web-based goat production and research decision-support tools developed at the AIGR (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:** *Energy Expenditure for Activity in Free-Ranging Ruminants: A Nutritional Frontier*
- Type:** United States - Israel Binational Agricultural Research and Development Fund
- Project Number:** US-3694-05 R
- Period:** 2005-2008
- Investigators:** A. L. Goetsch<sup>1</sup>, Y. Aharoni<sup>2</sup>, A. Brosh<sup>2</sup>, R. Puchala<sup>1</sup>, T. A. Gipson<sup>1</sup>, Z. Henkin<sup>3</sup>, and E. Ungar<sup>4</sup>
- Institutions:** <sup>1</sup>Langston University, <sup>2</sup>Newe Ya'ar Research Center, Agricultural Research Organization, <sup>3</sup>MIGAL-Galilee Technology Center, and <sup>4</sup>Agronomy and Natural Resources, Agricultural Research Organization
- Objectives:** Develop and evaluate a system(s) to predict the grazing activity energy cost of ruminants by determining effects of stocking rate (influencing available forage mass and forage quality) and animal production state and season (affecting energy demand) on energy expenditure, metabolizable energy intake, energy expended in grazing activity, grazing and walking times, horizontal and vertical distances traveled, and diet quality with grazing females of two breeds of cattle and goats.
- 
- Title:** *Effects of Acclimatization on Energy Requirements of Goats*
- Type:** United States - Egypt Joint Science and Technology Fund Program
- Project Number:** BIO9-017
- Period:** 2005-2007
- Investigators:** A. L. Goetsch<sup>1</sup> and H. El Shaer<sup>2</sup>
- Institutions:** <sup>1</sup>Langston University and <sup>2</sup>Desert Research Center
- Objective:** Develop a means of adjusting the maintenance energy requirement of goats for acclimatization.

**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<sup>1</sup>, A. L. Goetsch<sup>1</sup>, C. R. Krehbiel<sup>2</sup>, and V. H. Varel<sup>3</sup>  
**Institutions:** <sup>1</sup>Langston University, <sup>2</sup>Oklahoma State University, and <sup>3</sup>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<sup>1</sup>, A. Capuco<sup>2</sup>, T. Sahlu<sup>1</sup>, L. J. Dawson<sup>3</sup>, and S. Ellis<sup>4</sup>  
**Institutions:** <sup>1</sup>Langston University, <sup>2</sup>USDA ARS Gene Evaluation and Mapping Laboratory, <sup>3</sup>Oklahoma State University, and <sup>4</sup>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<sup>1</sup>, M. Perdue<sup>2</sup>, and S. E. Gilliland<sup>3</sup>  
**Institutions:** <sup>1</sup>Langston University, <sup>2</sup>USDA ARS Environmental Microbial Safety Laboratory, and <sup>3</sup>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<sup>1</sup>, A. L. Goetsch<sup>1</sup>, C. L. Ferrell<sup>2</sup>, and C. R. Krehbiel<sup>3</sup>

**Institutions:** <sup>1</sup>Langston University, <sup>2</sup>USDA ARS Meat Animal Research Center, and <sup>3</sup>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<sup>1</sup>, T. Sahlu<sup>1</sup>, and C. R. Krehbiel<sup>2</sup>

**Institutions:** <sup>1</sup>Langston University and <sup>2</sup>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<sup>1</sup>, A. L. Goetsch<sup>1</sup>, S. P. Hart<sup>1</sup>, L. J. Dawson<sup>2</sup>, Harvey Blackburn<sup>3</sup>,  
Stephan Wildeus<sup>4</sup>, Joseph Tritschler<sup>4</sup>, Jean-Marie Luginbuhl<sup>5</sup>, Matt Poore<sup>5</sup>,  
Marcos Fernandez<sup>6</sup>, Will Getz<sup>7</sup>, Tom Terrill<sup>7</sup>, Mack C. Nelson<sup>8</sup>, and Ken  
Turner<sup>8</sup>  
**Institutions:** <sup>1</sup>Langston University, <sup>2</sup>Oklahoma State University, <sup>3</sup>National Seed Storage  
Lab Animal Germplasm, <sup>4</sup>Virginia State University, <sup>5</sup>North Carolina State  
University, <sup>6</sup>Louisiana State University, <sup>7</sup>Fort Valley State University, and  
<sup>8</sup>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.

## Experiments in 2005

- Title:** *Quality, Safety, and Shelf-Life of Goat Milk (Liquid, Powdered, and Condensed) on the Market*
- Experiment Number:** SZ-05-01
- Project Number:** 2004-02587
- Investigators:** S. Zeng, S. Gilliland, S. Chen, B. Bah, and K. Tesfai
- Objectives:**
- 1) Establish a comprehensive database of goat milk safety, quality, and shelf-life on the store shelves
  - 2) Identify the unique values such as CLA of dairy products
  - 3) Develop and implement biological, biochemical, and(or) physical interventions to control undesirable microbes
  - 4) Enhance the marketability and profitability of goat milk by improving product microbiological and sensory quality, and by prolonging shelf-life of finished products
  - 5) Assist store managers and personnel handling goat milk and dairy products by providing information and techniques to maximize milk quality and shelf-life
- Title:** *Effects of Extended Lactation (Year-Round) on Quality of Goat Milk and Quality and Texture Characteristics of Cheese*
- Experiment Number:** SZ-05-02
- Project Number:** 2004-02587
- Investigators:** S. Zeng, S. Gilliland, S. Chen, B. Bah, and K. Tesfai
- Objectives:**
- 1) Determine the effect of year-round lactation on milk composition, microbiological quality, and SCC and, subsequently, on the quality and yield of goat cheese (semi-hard)
  - 2) Investigate the influence of extended lactation on cheese in terms of composition, rheological properties, protein profiles, and sensory characteristics
- Title:** *Effects of Tethering on Forage Intake and Grazing Behavior With High Forage Mass and Nutritive Value*
- Experiment Number:** AP-05-03
- 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 forage mass and nutritive value

- Title:** *Composition of Tissue Gain and Loss By Lactating Alpine Goats*  
**Experiment Number:** TN-05-04  
**Proposal Number:** 2003-03779  
**Investigators:** A.T. Ngwa, A.T. Goetsch, T. Sahlu, Puchala, I. Tovar-Luna, L. J. Dawson, G. Detweiler  
**Objective:** 1) Evaluate the effect of dietary forage level on the composition of tissue being gained or mobilized in lactating dairy Alpine does during the first 8 months of lactation  
. 2) Develop equations that will enable the prediction of body composition of dairy goats from shrunk body weight and urea space determinations
- Title:** *Methane Emission by Goats Consuming Different Sources of Condensed Tannins*  
**Experiment Number:** GA-05-05  
**Proposal Number:** 2004-02606  
**Investigators:** G. Animut, R. Puchala, A.L. Goetsch, T. Sahlu, V. H. Varel, and J. Wells  
**Objective:** 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
- Title:** *Effects of Fertilization, Supplementation, and Mimosa Presence on Performance of Meat Goat Does and Suckling Kids Grazing Grass/Forb Pastures*  
**Experiment Number:** RM-05-06  
**Proposal Number:** OKLX-SAHLU  
**Investigators:** R. C. Merkel, G. Detweiler, A. L. Goetsch, G. E. Aiken, E. Loetz, and T. Sahlu  
**Objective:** Determine effects of supplementation, fertilization, and mimosa tree presence on performance of meat goat does and suckling twin kids grazing grass/forb pastures
- Title:** *Effects of Grazing, Confinement, Stocking Rate, Diet Nutritive Value, and Level of Feed Intake on Compensatory Growth of Boer Kids*  
**Experiment Number:** AG-05-07  
**Proposal Number:** OKLX-SAHLU  
**Investigators:** A. L. Goetsch, G. Detweiler, and T. Sahlu  
**Objective:** 1) Determine differences between grazing and confinement in compensatory growth  
2) Determine effects of stocking rate on compensatory growth  
3) Determine effects of level of forage intake in confinement on compensatory growth  
4) Compare limited intake of a concentrate-based diet with forage ingestion on compensatory growth

- Title:** *Effects of Management Practices During Suckling That Influence Grazing Performance on Subsequent Kid Growth and Feeding Behavior in Confinement*
- Experiment Number:** TG-05-08
- Proposal Number:** OKLX-SAHLU
- Investigators:** T. A. Gipson, A. L. Goetsch, G. Detweiler, and T. Sahl
- Objective:** Determine effects of suckling growth while grazing of fertilization, supplementation, and mimosa presence on subsequent growth performance and feeding behavior when consuming a diet high in nutritive value with an automated feeding system
- 
- Title:** *Enhanced Goat Production Systems for the Southern United States - Phase 4*
- Experiment Number:** MV-05-09
- 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:** *Use of Goats for Sustainable Vegetation Management in Grazing Lands - Fourth Grazing Season*
- Experiment Number:** SH-05-10
- Project Number:** OKLX-SAHLU
- Investigators:** S. P. Hart, A. L. Goetsch, and T. Sahl
- 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:** *Effect of CLA Supplementation on milk and cheese yield and composition in dairy goats*
- Experiment Number:** MR-05-12
- Project Number:** 2004-02579
- Investigators:** M. Rovai, T. A. Gipson, S. Zeng, A. L. Goetsch, D. Bauman, and A. Lock
- Objective:** Determine the effect of rumen-protected trans-10, cis-12 CLA supplementation upon milk yield and composition in dairy goats and subsequently on cheese yield and quality.

- Title:** *Methane Emission by Goats Consuming Sorghum-Sudangrass and Kobe Lespedeza*
- Experiment Number:** GA-05-13
- Proposal Number:** 2004-02606
- Investigators:** G. Animut, R. Puchala, A.L. Goestch, T. Sahlu, V. H. Varel, and J. Wells
- Objective:** Determine effects of dietary grass (Sorghum-sudangrass) and legume (Kobe lespedeza) levels on the ruminal microflora and methane emission, digestibility, nitrogen and energy balance, and energy expenditure by goats.
- 
- Title:** *The Effect of Dietary Protein on Tissue GSH Concentration and Cytokine Expression in Goats*
- Experiment Number:** ZW-05-14
- Project Number:** OKLX-SAHLU
- Investigators:** Z. Wang, N. Wu, S. Hart, R. Merkel, L. Dawson, K. Matand, A. Goetsch, and T. Sahlu
- Objectives:** To determine the effect of fish meal supplementation in goats on:
- 1) GSH contents in spleen, mesenteric lymph nodes, liver, blood, abomasum and intestines
  - 2) Gene expression of cytokines (IL-2, -4, -5, -10, -13, and IFN-  $\gamma$ ), glutathione S-transferase, and growth factors (TGF- $\beta$  and IGF-I) in lymph nodes and spleen
- 
- Title:** *Effects of Acclimatization on Energy Requirements of Goats*
- Experiment Number:** AP-05-15
- Project Number:** BIO9-017
- Investigators:** A. K. Patra, R. Puchala, A. L. Goetsch, T. Sahlu, T. A. Gipson, G. Animut, G. Detweiler, J. Hayes, and L. J. Dawson
- Objectives:** Develop a means of adjusting the maintenance energy requirement of goats for acclimatization.



*The proper citation for this article is:*

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Proc. 21st Ann. Goat Field Day, Langston University, Langston, OK.*

# Abstracts

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### **Tethering meat goats grazing forage of high nutritive value and low to moderate mass**

A. K. Patra<sup>1</sup>, R. Puchala<sup>1</sup>, G. Detweiler<sup>1</sup>, L. J. Dawson<sup>2</sup>, G. Animut<sup>1</sup>, T. Sahlu<sup>1</sup>, and A. L. Goetsch<sup>1</sup>

<sup>1</sup>E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK

<sup>2</sup>College of Veterinary Medicine, Oklahoma State University, Stillwater, OK

Twenty-four yearling Boer x Spanish goats were used to determine effects of tethering on forage selection, intake, and digestibility, grazing behavior, and energy expenditure (EE) with forage of high nutritive value and low to moderate mass. Four 0.72-ha pastures of wheat (*Triticum aestivum*) and berseem clover (*Trifolium alexandrinum*) were grazed in December and January. Each pasture hosted six animals, three with free movement and three attached to a 4.11 m tether for access to a circular area of 53.1 m<sup>2</sup>. One animal of each treatment and pasture was used to determine forage selection, fecal output, or grazing behavior and EE. Measures were in the second week of 2-wk periods. Mass of forage DM before grazing in Tethered areas averaged 1,280 and 1,130 kg/ha in periods 1 and 2, respectively. The CP concentration in ingesta was greater ( $P < 0.05$ ) 23.9 and 20.9%; SE = 0.80) and the NDF level was lower ( $P < 0.05$ ) for Free vs Tethered animals (50.3 and 53.8%; SE = 1.20); in vitro true DM digestion was similar between treatments (80.8 and 80.7% for Free and Tethered, respectively; SE = 0.96). Intakes of DM (1,013 and 968 g/day; SE = 78.6), NDF (511 and 521 g/d; SE = 39.9), and ME (10.9 and 10.7 MJ/d; SE = 0.90) were similar between treatments, but CP intake was greater ( $P < 0.05$ ) for Free vs Tethered animals (241 and 203 g/d; SE = 17.2). There were small treatment differences in in vivo apparent digestibility of OM ( $P < 0.05$ ); 78.0 and 81.4%; SE = 0.49), CP ( $P < 0.05$ ); 80.0 and 81.7%; SE = 0.67), and NDF ( $P < 0.08$ ) 77.7 and 76.0% for Free and Tethered, respectively; SE = 0.78). There were no treatment effects on time spent ruminating, idle, or eating (346 and 347 min/d for Free and Tethered, respectively; SE = 42.5). Energy expenditure was considerably greater ( $P < 0.05$ ) for Free vs Tethered animals (571 and 489 kJ/kg BW<sup>0.75</sup> for Free and Tethered, respectively; SE = 8.9). Based on estimates of ME intake and recovered energy and an assumed efficiency of use of ME for energy accretion, this difference equated to an energy cost for free movement of 111 kJ/kg BW<sup>0.75</sup>. A greater distance traveled for Free than for Tethered goats presumably accounted for some but doubtfully all of this difference, suggesting that free movement influenced other physiological conditions impacting EE. In conclusion, tethering would seem to offer a production advantage over free grazing of less energy used for activity and may not be a perfect model of ones with free movement for all areas.

### **Tethering meat goats grazing forage of high nutritive value and moderate to high mass**

A. K. Patra<sup>1</sup>, R. Puchala<sup>1</sup>, G. Detweiler<sup>1</sup>, L. J. Dawson<sup>2</sup>, G. Animut<sup>1</sup>, T. Sahlu<sup>1</sup>, and A. L. Goetsch<sup>1</sup>

<sup>1</sup>E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK

<sup>2</sup>College of Veterinary Medicine, Oklahoma State University, Stillwater, OK

Yearling Boer x Spanish goats (24) were used in a crossover design to determine effects of tethering on forage selection, intake, and digestibility, grazing behavior, and energy expenditure (EE) with forage of high nutritive value and moderate to high mass. Four 0.72-ha pastures of wheat (*Triticum aestivum*) and berseem clover (*Trifolium alexandrinum*) were grazed in April to May. Each pasture hosted six animals, three with free movement and three attached to a 3 m tether for access to a

circular area of 28.3 m<sup>2</sup>. One animal of each treatment and pasture was used to determine forage selection, fecal output, or grazing behavior and EE. Measures were in the second week of 2-wk periods. Mass of forage DM before grazing in Tethered areas averaged 2,649 and 2,981 kg/ha in periods 1 and 2, respectively. The CP concentration in ingesta was greater ( $P < 0.05$ ) 23.1 and 20.3%; SE = 0.82) for Free vs Tethered animals. The level of NDF (54.0 and 55.9%; SE = 1.66) and in vitro true DM digestion (75.7 and 76.5%; SE = 1.20) were similar between treatments. Metabolizable energy intake was greater ( $P < 0.05$ ) for Free vs Tethered animals (12.7 and 10.4 MJ/d; SE = 0.89). There were small treatment differences ( $P < 0.05$ ) in in vivo apparent digestibility of OM (71.7 and 72.3.4%; SE = 0.24) and NDF (63.3 and 65.2% for Free and Tethered, respectively; SE = 0.92). There were no treatment effects on time spent ruminating, idle, or eating (405 and 366 min/d for Free and Tethered, respectively; SE = 42.5). Energy expenditure was considerably greater ( $P < 0.05$ ) for Free vs Tethered animals (633 and 512 kJ/kg BW<sup>0.75</sup>, respectively; SE = 27.4). In conclusion, differences in EE between goats freely grazing and tethered may not be solely attributable to ME intake, distance traveled, and(or) grazing time. Tethering as a model for free movement may offer a reasonable means of studying some aspects of grazing such as ingesta composition but appears inappropriate for others, including EE and efficiency of energy metabolism.

### **Urea space and body condition score to predict body composition of meat goats**

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Yearling Boer x Spanish wethers (40) were used to develop and compare body composition prediction equations for mature meat goats based on urea space (US) and body condition score (BCS). Before the experiment, one-half of the animals were managed to have high BW and BCS (1-5, with 1 being extremely thin and 5 very fat) and the others were managed to have low BW and BCS. During the 24-wk experiment, initially fat wethers were fed to lose BW and BCS and initially thin wethers were fed to increase BW and BCS. BCS, US, and whole body chemical composition were determined after 0, 12, and 24 wk. Mean, minimum, and maximum values were 42.1 (SE = 1.12), 24.5, and 59.0 kg for shrunk BW; 3.0 (SE = 0.11), 1.5, and 4.0 for BCS; 61.3 (SE = 1.01), 53.7, and 76.5% for water; 20.2 (SE = 1.11), 4.7, and 29.7% for fat; 15.6 (SE = 0.19), 13.3, and 18.1% for protein; and 2.9 (SE = 0.062), 2.2, and 3.7% for ash, respectively. For water, fat, and ash concentrations and mass, simplest equations explaining greatest variability (with independent variables of US, BCS, and(or) shrunk BW) based on BCS accounted for more variation than ones based on US, although in some cases differences were not large (i.e., water and ash concentrations and mass). Neither US nor BCS explained variability in protein concentration. Equations to predict protein mass based on shrunk BW and US or BCS were nearly identical in R<sup>2</sup> and the root mean square error. A 1-unit change in BCS corresponded to change in full BW of 8.9 kg (full BW, kg = 17.902 + (8.9087 × BCS); R<sup>2</sup> = 0.653), fat concentration of 7.54% (% fat = -5.076 + (7.5361 × BCS); R<sup>2</sup> = 0.612), and energy concentration of 3.01 MJ/kg (energy, MJ/kg = 0.971 + (3.0059 ×

BCS);  $R^2 = 0.615$ ). In summary, BCS may be used as or more effectively to predict body composition of meat goats than US. The primary determinant of BCS, within the range of BCS observed in this experiment, was body fat content.

### **Methane emission by goats consuming diets with different levels of condensed tannin-containing lespedeza and sorghum-sudangrass**

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Twenty-four yearling Boer × Spanish wethers (7/8 Boer; initial BW of  $34.1 \pm 1.02$ ) were used to determine effects of dietary levels of a condensed tannin (CT)-containing forage Kobe lespedeza (*Lespedeza striata*; K) and sorghum-sudangrass (*Sorghum bicolor*; G) on methane emission. Treatments were dietary K levels (DM basis) of 100, 67, 33, and 0% (100K, 67K, 33K, and 0K, respectively). Forages harvested daily were fed at 1.3 times the maintenance energy requirement. The experiment lasted 21 d, with measures on the last 8 d. N was 1.7 and 2.2%, in vitro true DM digestibility was 85.5 and 68.0%, and CT was 0 and 15.1% for G and K, respectively. DMI was similar among treatments (677, 664, 633, and 626 g/d; SE = 30.8) and gross energy (GE) digestibility increased linearly ( $P < 0.05$ ) with decreasing K (47.1, 51.4, 58.9, and 65.6% for 100K, 67K, 33K, and 0K, respectively). ME intake increased linearly ( $P < 0.05$ ; 398, 431, 485, and 513 kJ/kg BW<sup>0.75</sup>) and energy expenditure (356, 350, 399, and 504 kJ/kg BW<sup>0.75</sup>) and methane emission changed linearly and quadratically ( $P < 0.05$ ) with decreasing K (10.9, 13.8, 17.6, and 26.2 l/d; 3.3, 4.0, 5.4, and 8.2% GE; 7.0, 7.7, 8.8, and 11.9% DE for 100K, 67K, 33K, and 0K, respectively). In vitro methane production by incubation of ruminal fluid for 3 wk with a medium for methanogenic bacteria and other conditions promoting activity by methanogens also was affected linearly and quadratically ( $P < 0.05$ ) by K (7.0, 8.1, 9.2, and 16.1 ml for 100K, 67K, 33K, and 0K, respectively). The total bacterial count was similar among K levels, but the number of total protozoa increased linearly ( $P < 0.05$ ) and changed quadratically ( $P < 0.07$ ) as K declined (8.3, 11.8, 15.6, and  $27.1 \times 10^5$ /ml for 100K, 67K, 33K, and 0K, respectively). In conclusion, the CT-containing forage K decreased methane emission by goats regardless of nonzero level without deleterious effects on digestibility. The impact of K CT on methane emission appears attributable to changes in methanogenic bacterial activity, although alterations of protozoal actions might be involved as well.

## Effect of initial body condition of Boer x Spanish yearling wethers and level of nutrient intake on body composition

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Yearling Boer x Spanish wethers were used to assess effects of initial body condition and subsequent level of feed intake on body composition. Before the experiment, 27 wethers were fed to achieve high body condition score (BCS; 1 to 5, with 1 = extremely thin and 5 = extremely fat) and BW (I-F) and 27 were fed for low BCS and BW (I-T). During the experiments, I-F wethers were fed low amounts of a pelletized diet and I-T wethers received high amounts. In Exp. 1, harvest measures were determined before the experiment (wk 0) and after 12 and 24 wk, with seven animals per initial body condition and time. In Experiment 2, the other 12 animals (six per initial body condition) were used to determine energy expenditure (EE) at three times (wk 1-3, 11-13, and 22-24 for Early, Middle, and Late, respectively). As expected, there were numerous treatment x time interactions. BCS in Exp. 1 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 I-F:wk 0, I-F:wk 12, I-F:wk 24, I-T:wk 0, I-T:wk 1, and I-T:wk 2, respectively. Changes in carcass mass of protein (-5.9, -5.3, 7.0, and 5.8 g/d; SE = 0.89) and fat (-1.9, 0.2, 21.4, and 26.6 g/d; SE = 2.35) were greater ( $P < 0.05$ ) for I-T vs I-F, as was also true for non-carcass protein (6.1, 0.0, 14.5, and 6.3 g/d; SE = 0.91) and fat (-16.3, -10.4, 13.6, and 26.3 g/d for I-F:wk 1-12, I-F:wk 1-24, I-T:wk 1-12, and I-T:wk 1-24, respectively; SE = 2.49). Based on energy concentrations in empty body tissue lost or gained in wk 1-12 and 1-24 (14.8, 12.1, 19.9, and 26.4 MJ/kg for I-F:wk 1-12, I-F:wk 1-24, I-T:wk 1-12, and I-T:wk 1-24, respectively; SE = 2.13), the energy concentration in wk 13-24 was 9.4 and 32.9 MJ/kg for I-F and I-T, respectively. In Exp. 2, fasting (5.05, 4.37, 3.16, 4.44, 4.28, and 4.54 MJ/d; SE = 0.34) and fed EE (6.48, 5.97, 4.45, 7.39, 8.44, and 8.47 MJ/d for I-F:Early, I-F:Middle, I-F:Late, I-T:Early, I-T:Middle, and I-T:Late, respectively; SE = 0.58) were influenced by initial body condition x time interactions ( $P < 0.05$ ). Efficiency of ME utilization (I-F: use of dietary and mobilized tissue energy for maintenance; I-T: use of dietary ME for maintenance and gain) decreased as the experiment advanced (70.5, 60.3, 40.4, 66.7, 64.6, and 60.0% for I-F:Early, I-F:Middle, I-F:Late, I-T:Early, I-T:Middle, and I-T:Late, respectively; SE = 4.85). In conclusion, the energy concentration in tissue mobilized or accreted by yearling meat goats within certain body condition ranges may not necessarily be the same and appears influenced by initial animal characteristics and subsequent feeding conditions.

## **Effects of feeding method, diet nutritive value and physical form and genotype on feed intake, feeding behavior, and growth performance by meat goats**

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Thirty-two F<sub>1</sub> Boer x Spanish (28.7 kg, SE = 0.49 kg) and 40 3/4 Boer-1/4 Spanish (31.9 kg, SE = 0.47 kg) wethers, approximately 5 mo of age, were used to compare feeding systems with different dietary treatments. Feeding systems were Calan gates and automated feeding units allowing one animal to consume feed at a time. Two diets included concentrate (C) and two were dehydrated alfalfa (A), fed pelletized (P) or loose (L). The main effect of feeding method was not significant for any variable. There was an interaction in DMI involving feeding method, diet, and genotype, which indicated that with a concentrate diet, regardless of physical form, DMI was not influenced by feeding method. Main effect dietary treatment means (1.78, 1.67, 2.04, and 1.70 kg for C-P, C-L, A-P, and A-L, respectively; SE = 0.030) indicated that pelletizing had a slightly greater effect on DMI with A vs C. ADG was lowest among treatments for A-L (212, 205, 190, and 157 g for C-P, C-L, A-P, and A-L, respectively; SE = 8.9), and ADG:DMI was greater for C vs A (127, 120, 94, and 94 g/kg for C-P, C-L, A-P, and A-L, respectively; SE = 7.8). Both ADG and ADG:DMI were similar between genotypes. For wethers subjected to automated feeding units, the number of feeder visits was lowest among diets ( $P < 0.05$ ) for C-P (23.1, 31.2, 35.7, and 35.7 per day; SE = 2.00); total feeder occupancy time per animal ranked ( $P < 0.05$ ) C-P < A-P < C-L and A-L (74, 130, 105, and 122 min/d; SE = 6.8), and rate of DMI was greater for P than for L diets (24.6, 12.9, 22.0, and 13.7 g/min for C-P, C-L, A-P, and A-L, respectively; SE = 3.89). In summary, meat goats can markedly vary feeding behaviors in response to different diet types and forms; however, there appear limits to such changes, as exemplified by lowest ADG for A-L. Calan gates and automated feeding systems appear similar in the ability to compare growth performance with treatments such as the concentrate-containing diets and genotypes of this experiment. Pelletizing does not seem to affect growth performance with diets consisting of appreciable concentrate. Effects of pelletizing on growth performance of meat goats consuming forage diets may be attributable to change in level of feed intake, without impact on efficiency of feed utilization.

## ***Trans*-10, *cis*-12 conjugated linoleic acid reduces milk fat synthesis in lactating goats**

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The efficacy of *trans*-10, *cis*-12 conjugated linoleic acid (CLA) in reducing milk fat synthesis in dairy cows and sheep has been well documented. However, recent examinations of the effects of *trans*-10, *cis*-12 CLA on milk fat synthesis in lactating goats have proved inconclusive. The current study was therefore designed to determine if a lipid-encapsulated *trans*-10, *cis*-12 CLA supplement (LE-CLA; BASF AG, Ludwigshafen, Germany) would inhibit milk fat synthesis in lactating goats. Thirty multiparous Alpine dairy goats (50 ± 7.4 kg) in late lactation were randomly assigned in a 3 x 3 Latin square experiment. Goats fed a 60% concentrate diet (20% bermuda grass hay and 20%

alfalfa pellets) received either A) unsupplemented (Control), B) supplemented with 30 g/d LE-CLA (low-dose; LLE), or C) supplemented with 60 g/d LE-CLA (high-dose; HLE). The LE-CLA supplement supplied 3 and 6 g/d of *trans*-10, *cis*-12 CLA for the LLE and HLE treatments, respectively. Treatment periods were 14 d in length with a 14 d washout interval. Milk yield, DMI, and milk protein content and yield were unaffected by treatment ( $P > 0.05$ ). Compared with Control, milk fat yield was reduced 8.1% by the LLE treatment and 21.2% by the HLE treatment ( $P < 0.001$ ), with milk fat content reduced 4.4 and 16.0% by the LLE and HLE treatments, respectively ( $P < 0.001$ ). In conclusion, the results of the present study demonstrate that *trans*-10, *cis*-12 CLA reduces milk fat synthesis in lactating goats in a manner similar to that observed in lactating dairy sheep and cows. However, dose-response comparisons suggest that the degree of reduction in milk fat synthesis is less in goats compared with other lactating ruminant species studied. Further studies are required to verify and extend these results and to elucidate the mechanism of action for the effects observed with *trans*-10, *cis*-12 CLA supplementation.

### Effects of CLA supplementation on texture profile of semi-hard goat cheese

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Thirty Alpine does (BW  $50 \pm 7.4$  kg) were randomly assigned to three groups to study effects of *t*-10, *c*-12 conjugated linoleic acid (CLA) dietary supplementation on the texture profiles of semi-hard goat cheese. The trial consisted of three periods (2 wk in length with a 14-d interval) with CLA supplemented at 0, 3, and 6 g/d per doe for treatments 1, 2, and 3, respectively, using a 3 x 3 Latin Square design. In the early (first 3 d) and late (last 3 d) stages of each period, milk was collected for cheese manufacture. Samples were taken from one cheese block on d 1 and 60 after manufacture and cheese texture profile (hardness, springiness, cohesiveness, gumminess, and adhesiveness) was determined using an Instron textural analyzer. Cheeses made from milk collected early in periods had similar texture profiles ( $P > 0.05$ ) on d 1 after manufacture. However, after 60 d of aging at 8°C, both treatments 2 and 3 had lower cohesiveness ( $P < 0.05$ ) than treatment 1 while treatment 3 showed higher springiness (8.02 mm,  $P < 0.05$ ) than treatments 1 (6.78 mm) and 2 (6.85 mm). For cheeses made from milk collected late in periods, hardness, cohesiveness, and gumminess differed ( $P < 0.01$ ) among treatments on d 1 after manufacture. After 60 d of aging, hardness, springiness, gumminess, and cohesiveness increased while adhesiveness decreased ( $P < 0.01$ ) as CLA supplementation increased. In conclusion, supplementation of dairy goat diets with CLA as well as experiment stage and cheese age can impact texture profiles of semi-hard goat cheese.



## **Efficiency of energy use for pregnancy by crossbred Boer x Spanish does with different litter size**

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Twenty-four Boer x Spanish does (3 yr of age, having kidded once previously and with an initial BW of  $42.7 \pm 1.2$  kg) were used to determine the efficiency of ME utilization for pregnancy ( $k_{\text{preg}}$ ). Six does were nonpregnant and, based on ultrasound determination on day 45 of gestation, six had a litter size (LS) of 1, 2, and 3. However, only 10 of the pregnant does delivered the expected number of kids (three, four, and three with LS of 1, 2, and 3, respectively). Does were fed a diet of approximately 50% concentrate in accordance with assumed maintenance plus pregnancy energy requirements based on estimated nonpregnancy tissue BW and LS. Recovered energy (RE) was determined by subtraction of energy expenditure (EE; respiration calorimetry) near day 80, 100, 120, and 140 of gestation from ME intake (MEI). RE was assumed attributable to pregnancy tissues (fetus, fetal fluids and membranes, uterus, and mammary gland), and ME used for pregnancy ( $\text{ME}_{\text{preg}}$ ) was estimated by subtracting  $\text{ME}_m$  determined with nonpregnant goats from MEI by those pregnant. For does with actual LS equal to that expected, the no-intercept equation for the regression of RE against  $\text{ME}_{\text{preg}}$  was:  $\text{RE} = \text{ME}_{\text{preg}} \times 0.252$  ( $\text{SE} = 0.030$ ;  $R^2 = 0.64$ ), indicating a  $k_{\text{preg}}$  of 25%. Although, a regression including LS (1 vs. 2 or 3) suggested greater  $k_{\text{preg}}$  for LS of 1 ( $40.2\% \pm 5.6$ ) vs. 2 or 3 ( $20.5\% \pm 3.2$ ). Regressions for goats with LS different from expected suggested positive effects of use of energy mobilized from nonpregnancy tissues on  $k_{\text{preg}}$  and of use of dietary ME for energy accretion in nonpregnancy tissues on the efficiency of whole body ME utilization. In conclusion, the average efficiency of ME use for pregnancy regardless of LS in goats was near 25%, which when considering the expected proportion of all pregnancy tissues attributable to fetal or conceptus tissues implies an energy requirement for pregnancy of goats similar to common recommendations for sheep and cattle.

## **Relationship between energy expenditure and heart rate in pregnant Boer x Spanish does with different litter size**

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Twenty-four Boer x Spanish does (3 yr of age, having kidded once previously and initial BW of  $42.7 \pm 1.19$  kg) were used to determine effects of litter size (LS) and stage of gestation (near day 80, 100, 120 and 140) on the relationship between energy expenditure (EE) and heart rate (HR). Six does were nonpregnant (0) and, based on ultrasound determination on day 45 of gestation, six had LS of 1, 2 and 3. However, only 10 of the pregnant does had the expected number of kids (three, four, and three with LS of 1, 2 and 3, respectively). Does were fed a diet of approximately 50% concentrate in

accordance with assumed maintenance plus pregnancy energy requirements based on LS. EE determined by respiration calorimetry on d 80, 100, 120 and 140 of gestation with head-boxes was expressed relative to average BW within the 2-d measurement periods and HR was determined at the same time using Polar S610 HR monitors. There was an effect of animal within LS ( $P < 0.05$ ), CV of 10.2, 11.2, 3.8, and 8.6% and maximum differences of 41.7, 16.6, 5.2, and 12.0 of means for LS 0, 1, 2, and 3, respectively). Time of the day affected ( $P < 0.05$ ) EE, HR, and EE:HR; highest values 0900 and 1600 and lowest values between 0200 and 0700). CV for hourly values were 3.9, 2.1, and 2.4%, and maximum differences relative to means were 9.0, 4.1, and 4.8% for EE, HR and EE:HR, respectively. There was an interaction in EE:HR between LS and stage of gestation ( $P < 0.05$ ). EE:HR decreased as gestation progressed (LS 1: 7.29, 6.79, 6.14, and 5.53; LS 2: 6.73, 6.42, 6.07, and 5.02; LS 3: 6.53, 6.07, 5.71, and 5.07 (kJ/kg BW<sup>0.75</sup>)/(beats/min) on d 80, 100, 120, and 140, respectively, whereas nonpregnant goats had stable EE:HR (8.04, 7.78, 7.78, and 7.74 (kJ/kg BW<sup>0.75</sup>)/(beats/min)). In conclusion, changing EE:HR in pregnant animals may preclude use of HR to predict EE. Magnitudes of difference in EE:HR among animals and time of the day suggest benefit from determinations for individual animals and over extended periods of time.

## **Summaries of Recent Journal Articles** (2005 and In Press)

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

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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 =  $41.5 \pm 2.7$  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 BW<sup>0.75</sup>), 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**

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Small Ruminant Research 57:193-202. 2005.

Six Boer x Spanish goat wethers ( $43 \pm 5.1$  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.

### **Changes in goat milk composition during lactation and their effect on yield and quality of hard and semi-hard cheeses**

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Small Ruminant Research 59:55-63. 2005.

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 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.

## Performance and forage selectivity of sheep and goats co-grazing grass/forb pastures at three stocking rates

G. Animut, A. L. Goetsch, G. E. Aiken, R. Puchala, G. Detweiler, C. R. Krehbiel, R. C. Merkel, T. Sahl, L. J. Dawson, Z. B. Johnson, and T. A. Gipson

Small Ruminant Research 59:203-215. 2005

Differences among ruminant species in forage selectivity offer potential for efficient utilization of pastures with diverse arrays of plant species. One common management strategy that may influence forage selectivity is stocking rate (SR). Therefore, this experiment was conducted to determine effects of SR on performance and forage selectivity of growing sheep and goat wethers co-grazing grass/forb pastures. Grazing was for 16 weeks 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 (? 75% Boer) averaged  $21 \pm 0.7$  and  $21 \pm 0.5$  kg initial BW, respectively, and were 4 to 5 months 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 for rotational grazing in 2-week periods. Forage mass (pre- and post-grazed) and composition of grass vs. forbs were determined by quadrat samples and transect analysis, respectively. BW was measured every 4 weeks and preference values for grass, forbs, and ragweed (10 = highest possible preference; 0 = consumption in proportion to availability; -10 = no consumption) were determined from fecal micrhistology and transect measures. There was a year x SR interaction ( $P < 0.05$ ) in herbage DM mass before grazing (year 1: 2937, 3298, and 3351 kg/ha; year 2: 3033, 2928, and 2752 kg/ha for SR4, SR6, and SR8, respectively (SE = 174.4)). Post-grazed forage mass decreased linearly ( $P < 0.05$ ) as SR increased (2279, 1693, and 1288 kg/ha for SR4, SR6, and SR8, respectively (SE = 109.7)). In vitro true DM digestibility of pre-grazed forage samples was similar among SR, but SR x year interacted ( $P < 0.05$ ) for post-grazed samples (year 1: 57.0, 54.4, and 53.5; year 2: 56.8, 49.0, and 48.3 for SR4, SR6, and SR8, respectively (SE = 2.16)). Year and SR interacted ( $P < 0.05$ ) in the percentage of grass in pastures post-grazing determined by transect (year 1: 64, 69, and 74%; year 2: 50, 66, and 73% for SR4, SR6, and SR8, respectively (SE = 8.4)). The preference for grasses was higher and that for total forbs and lower for sheep than for goats ( $P < 0.05$ ). The preference value for ragweed, measured in year 2, was lower ( $P < 0.05$ ) for sheep than for goats (-1.6 vs. 0.2) and increased linearly with increasing SR. Average daily gain tended ( $P < 0.10$ ) to decrease linearly as SR increased (61, 51, and 47 g/day), and total BW gain per hectare increased linearly ( $P < 0.05$ ; 610, 759, and 933 g/day for SR4, SR6, and SR8, respectively). In conclusion, post-grazing herbage mass greater than 1000 kg/ha at most measurement times suggests that decreasing forage availability with increasing SR may not have been primarily or solely responsible for the effect on ADG by limiting DM intake. Rather, the effect of SR on available forage mass could have limited the ability of both sheep and goats to compensate for the effect of SR on forage nutritive value.

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

G. Animut, A. L. Goetsch, G. E. Aiken, R. Puchala, G. Detweiler, C. R. Krehbiel, R. C. Merkel, T. Sahlu, L. J. Dawson, Z. B. Johnson, and T. A. Gipson

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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-week 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 ( $\geq 75\%$  Boer) averaged  $21 \pm 0.7$  and  $21 \pm 0.5$  kg initial BW, respectively, and were 4 to 5 months 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-week periods. In weeks 3, 8, and 13 of both years, EE was determined on one goat and one sheep in each pasture via heart rate. In the same weeks, behavioral observations (position and activity) were made every 30 min of 13.5 h of daylight on two goats and two sheep in each pasture. Grazing behavior using IGER Grazing Behavior monitoring system units was also measured over 24-h periods on animals used for EE measurement. Based on visual observations, grazing (52.7, 57.1, and 61.4%) and standing time (61.1, 66.3, and 69.8%) increased and idle time in daylight (24.2, 21.1, and 15.9% for SR4, SR6, and SR8, respectively) decreased linearly ( $P < 0.05$ ) as SR increased. Species interacted ( $P < 0.05$ ) with year in daylight time spent standing and ruminating. Grazing time during daylight was similar between species (56.1 and 58.0% for sheep and goats, respectively), although idle time was greater ( $P < 0.05$ ) for goats (23.6 vs. 17.2%;  $SE = 1.36$ ). Time spent ruminating in daylight was similar among SR but was greater for sheep in year 2 but not year 1 (year 1: 22.3 vs 19.0%; year 2: 27.8 vs 15.1% for sheep and goats, respectively;  $SE = 1.44$ ). Based on the IGER units, the number of steps increased linearly ( $P < 0.05$ ) with increasing SR (2279, 2707, and 2788 for SR4, SR6, and SR8, respectively ( $SE = 96.4$ )), but was similar for the two species. 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) and more time idle (0.7 h) 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<sup>0.75</sup>; year 2, sheep: 572, 597, and 648 kJ/kg BW<sup>0.75</sup>; year 1, goat: 524, 524, and 640 kJ/kg BW<sup>0.75</sup>; year 2, goat: 499, 496, and 551 kJ/kg BW<sup>0.75</sup> 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.

## Effects of length of pasture access on energy use by growing meat goats

*T. Berhan, R. Puchala, T. Sahlu, R.C. Merkel, and A.L. Goetsch*

Journal of Applied Animal Research 28:1-7. 2005.

Six Boer x Spanish wethers ( $21 \pm 1.0$  kg initial BW and 7 to 8 months of age) were used in two simultaneous 3 x 3 Latin squares to determine effects of different lengths of access to pasture with moderate to high mass of forage of high nutritive value on energy expenditure (EE), recovered energy (RE), metabolizable energy (ME) intake and grazing activities. Wethers grazed a 0.7 ha pasture of a mixture of cool season forages in the fall/winter period for 4 (12.00 to 16.00 h), 8 (08.00 to 16.00 h) or 24 h; 4 and 8 h wethers were confined as a group in an enclosed facility at other times. Periods were at least 18 d in length, with 4 d for total feces collection in bags, 2 d to measure heart rate (HR) and grazing behavior and 1 d without feed or water for assessing body composition from urea space and shrunk BW. EE was based on HR and the predetermined ratio of EE:HR for each wether, and ME intake was the sum of EE and RE. Forage DM mass was 1985, 2016, 1634 and 1000 kg/ha at the beginning of period 1 and end of periods 1, 2 and 3, respectively. Hand-plucked forage samples averaged 22% crude protein and 39% neutral detergent fiber (dry matter basis). EE was greatest ( $P < 0.05$ ) for 24 h of pasture access (4.96, 5.13 and 6.19 MJ/d; SE = 0.253), although RE was similar among treatments (0.88, 2.16 and 1.57 MJ/d for 4, 8 and 12 h, respectively; SE = 0.361). Intake of ME was greater for 8 and 24 h vs 4 h (5.84, 7.30 and 7.76 MJ/d for 4, 8 and 24 h, respectively; SE = 0.530). As length of pasture access increased, number of steps ( $2.51, 4.57$  and  $6.41 \times 1000$ ), time spent ruminating (4.42, 6.33 and 7.28 h) and time eating (3.77, 6.35 and 7.24 h) increased ( $P < 0.05$ ) and idle time (15.81, 11.32 and 9.48 h) decreased ( $P < 0.05$ ), whereas time lying was greater ( $P < 0.05$ ) for 4 and 8 vs 24 h (8.39, 8.25 and 6.66 h for 4, 8 and 24 h, respectively; SE = 0.161). In conclusion, with moderate to high mass of forage of high nutritive value, limited pasture access of a minimal length could yield performance by growing meat goats at least comparable to that with continuous access.

## A foresight on goat research

*T. Sahlu and A.L. Goetsch*

Small Ruminant Research 60:7-12. 2005

Goats have been important to food and economic securities of developing regions for countless years, and their contributions to economic returns in developed countries has been rising as well. Though the number of goats is greater in developing than developed regions, a considerable amount of caprine research has been conducted in countries of the latter. Even with differences in experimental conditions among locations conducting goat research, in most instances some value can also be realized at other sites. There is a large number of topics that will necessitate research attention in the upcoming years in order for goats to maintain their key places in some farming systems as well as to perhaps assume greater roles in others. One of the foremost areas is the refining of nutritional requirements and nutrient utilization, inclusive of components such as impacts of grazing conditions and prior nutritional plane. Likewise, study of means to prevent unacceptable levels of internal parasitism as well as effects of infestation on nutrient needs is called for.



Moreover, changes such as increasing concerns for animal welfare, land deterioration, and food safety will impact the direction of goat research programs in the foreseeable future. Finally, the International Goat Association has a key role to play in focusing attention to areas in greatest need of scrutiny and ensuring that sound science is the basis for future developments of the goat industry.

### **Book review: Biostatistics for animal science**

*Gipson, T.A.*

Small Ruminant Research 57:287-288. 2005.

The book *Biostatistics for Animal Science* by Kaps and Lamberson is an excellent textbook or reference book on biometrics for graduate students or researchers in animal science. The book is easy to read and well formatted throughout with numerous easy to follow examples from various disciplines in animal science. Generally, textbooks on biometrics are deficient in animal science examples and rely heavily upon agronomic examples; however, this book is replete with real-life animal science examples with detailed explanations. Especially helpful is the utilization of SAS<sup>®</sup> programs and outputs to elucidate and augment the principles and computations involved in each of the examples. SAS<sup>®</sup> is a powerful statistical computing package that is oft used, and sometimes misused, in data analysis. This text with its philosophy of presenting the principles and theory first and foremost and then using SAS<sup>®</sup> to illustrate the application of those principles and theories is commendable. Most often, one finds texts on statistical principles and theory or texts that detail SAS statements and procedures, but rarely does one find a text that merges the two as well as *Biostatistics for Animal Science* has done. The initial chapters lay the groundwork of the basic principles and theories of statistics and distribution theory that are the underpinnings of the correct interpretation of hypothesis testing and data analysis. The description of these principles and theories are straightforward without becoming mired in statistical jargon that can easily confuse those who are not statisticians. The chapters dedicated to regression analysis and correlation progress in an appealing and natural manner, starting with simple linear regression and ending with nonlinear regression models. The section of Problems with Regression is very informative for graduate students and researchers alike when troubleshooting experimental or field data. For graduate students and researchers with limited experience in data validation or testing for outliers, the subsection on Extreme Observations is particularly useful. Another aspect of regression analysis not often discussed thoroughly, but that this text explains well is that of curvilinear relationships between the dependent and independent variables. This text does an outstanding job of differentiating between a curvilinear (or nonlinear) response surface and a nonlinear model, which is sometimes hard to understand for those not with a statistical background. The chapters detailing analysis of variance are comprehensive and complete. As with regression analysis, the progression for analysis of variance is logical and straightforward. The text begins with one-way analysis of variance with all of its nuances, including a random effects model, and terminates with repeated measures. In between the text systematically discusses and illustrates blocking, change-over designs, which includes a detailed discussion of Latin squares, factorials, nested designs, double blocking, split-plots, and analysis of covariance, which includes a test for heterogeneity with example. As an added bonus, the text in its final chapters covers discrete dependent variables using logit and probit models for binary and binomial variables. In summary, *Biostatistics for Animal Science* is an excellent text and should be on every animal scientist's bookshelf.

## **The effect of diets on milk production and composition, and on lactation curves in pastured dairy goats**

*Min, B.R., S.P. Hart, T. Sahlu, and L.D. Satter*

Journal of Dairy Science 88:2604-2615. 2005.

A 2-yr study investigated effects of different levels of concentrate supplementation on milk production, composition, and lactation curves in pastured dairy goats. For both years, 44 Alpine goats (*Capra hircus*;  $55 \pm 11$  kg body weight) were randomly allocated to 4 groups. Animals were supplemented with 0.66 (treatments A and B), 0.33 (treatment C), or 0 kg of concentrate (treatment D) per kg of milk over 1.5 kg/d. Mixed vegetative forages were rotationally grazed by the goats (treatments B, C, and D), except that treatment A was confined and fed alfalfa hay. Individual milk production was recorded daily, and milk samples were collected once every 2 wk for the 7-mo period (March to September) and analyzed for fat, protein, lactose, urea-N, nonesterified fatty acids, and allantoin (second year only). Milk yield and composition varied among dietary treatments, with some measures affected by year. Average daily milk yield was lowest for treatment D. The increased level of concentrate supplementation in treatment A led to 22% greater milk yield compared with treatment D. Milk production increased by 1.7 and 0.9 kg for each additional kilogram of concentrate fed per day during the first and second years, respectively. Average peak yield, time of peak yield, and persistency were lower for treatment D than for other treatments. The percentage of milk fat was lower for treatment D than for other treatments. Concentration of milk protein was greater for treatments A and B during the first year, and was higher for treatment C than for other treatments during the second year. Average milk lactose concentration was higher for treatments B and C than for other treatments. However, milk urea-N concentration in treatment A was higher than other treatments. Milk allantoin, used to estimate microbial proteins synthesis, was 20 to 25% greater for treatment A than for other treatments. Averaged across year, plasma urea-N and nonesterified fatty acids concentration were lowest for treatment B. Average organic matter intake was similar among treatments during both years. Ratios of acetate and propionate concentrations for treatment A were lowest among treatments. In conclusion, milk production and composition were affected by the feeding treatment and year. Increased level of nutrition lead to an increase in daily milk yield, peak yield, time of peak yield, and persistency compared with treatment D. Alpine dairy goats grazing on fresh forages without concentrate supplementation can produce milk inexpensively, and response to concentrate supplementation is greater for low quality pasture.

## **The effect of grazing forage containing condensed tannins on gastro-intestinal parasite infection and milk composition in Angora does**

*Min, B.R., S.P. Hart, D. Miller, G.M. Tomita, E. Loetz, and T. Sahl*

Veterinary Parasitology 130:105-113. 2005

The objective of this study was to evaluate effects of the condensed tannin (CT)-containing forage sericea lespedeza (sericea lespedeza (SL); Lespedeza cuneata; 15.2% CT), on fecal egg count (FEC), larval development (larvae/10 g of feces), worm burden and immune response compared with a crabgrass (Digitaria ischaemum)/Kentucky 31 tall fescue (Festuca arundinacea; control forage (CTF)) forage low in CT (0.32% CT) in grazing Angora does and their kids. Fifty worm-free mixed-age does were randomly allocated to three treatments. One treatment (10 does; initial liveweight (LW) =  $45 \pm 1.5$  kg) entailed grazing of SL forage from April 25 to July 15, 2002 with a second treatment of CTF (20 does; initial LW =  $43 \pm 1.4$  kg) grazing during the same period. Does of the third treatment (20 does; initial LW =  $44 \pm 1.4$  kg) grazed a sward of SL for 2 weeks and then one of CTF for 2 weeks followed by alternating between the two pastures every 2-week rotational grazing (ROT). To gauge levels of infective larvae on pasture, three worm-free Angora kids (initial LW =  $3.6 \pm 0.2$  kg) were randomly selected as tracers. Tracers grazed for final 60 days and were euthanized for determination of worm burden. The immune response of does was measured by skin thickness reaction after the intradermal injection of 250  $\mu$ g phytohemagglutinin (PHA). Mean FEC for SL and ROT were substantially lower ( $P < 0.01$ ) than for CTF does (145, 329 and 894 eggs/g, respectively). The FEC for kids was lower ( $P < 0.05$ ) for SL than for ROT and CTF (550, 2757 and 3600 eggs/g, respectively). Total fecal egg output ( $3.3$ ,  $6.0$  and  $26.9 \times 10^5$  eggs/day, respectively) and larval development (242, 263 and 792 larvae/10 g, respectively) were lower ( $P < 0.05$ ) for SL and ROT than for CTF. Tracers grazing on SL had lower total worm burdens than ROT and CTF ( $P < 0.01$ ). The immune response was higher ( $P < 0.01$ ) for SL (4.9 mm) and ROT (6.0 mm) than for CTF (3.0 mm) at 12 h after injection of PHA. The packed cell volume (PCV) in does was higher ( $P < 0.01$ ) for SL and ROT than for CTF (27, 26 and 23%, respectively). Does that grazed CT-containing forage had considerably lower milk somatic cell counts (SCC) than does grazing non-CT-containing forage. In summary, grazing CT forages reduced FEC, larval development and worm burden, and also appeared to enhance immune response. The CT-containing forage SL reduced gastro-intestinal parasite infections of Angora does and kids.

## **Effect of goat breed and milk composition on yield, sensory quality, and fatty acid concentration of soft cheese during lactation**

*Soryal, K., F.A. Beyene, S. Zeng, B. Bah, and K. Tesfai*

Small Ruminant Research 58:275-281

In the United States, Nubian and Alpine goats are two major dairy breeds and most dairy goat herds are in seasonal lactation. In this study, the effects of goat milk obtained from two dairy farms with either Alpine or Nubian breed of goats at various stages of lactation on yield, composition, sensory scores and fatty acids of soft cheese (Chevré) were evaluated. Results obtained from this study indicated that dairy goat breed did not affect cheese composition, sensory scores, and fatty acid

concentrations ( $P > 0.05$ ) except oleic acid. However, milk from Nubian goats resulted in a much higher cheese yield, a lower oleic acid concentration and a lower unsaturated fatty acid concentration than that from Alpine goats ( $P < 0.05$ ). Soft cheese made from late lactation milk had higher fat, protein, total solids and yield than mid lactation milk ( $P < 0.05$ ). While the sensory scores of cheese from Alpine milk varied throughout lactation, those of cheese from Nubian milk were virtually same regardless of the stage of lactation. If a dairy goat herd is raised to supply milk for cheesemaking, Nubian goats or a mixed herd with at least some Nubian goats will be of great interest to the cheese makers and in return the milk producers should get a higher premium for their higher cheese-yield milk. In addition, a year-round breeding program could help minimize variations in cheese composition, yield and fatty acid concentration, resulting in a more consistent quality of cheese throughout lactation.

### **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*

Small Ruminant Research. 2006. In Press.

Eight nonlactating Alpine does (2.5 to 6.5 yr of age;  $46 \pm 2.9$  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<sup>0.75</sup> × 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<sup>0.75</sup> × 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<sup>0.75</sup> × 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<sup>0.75</sup> × 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.

## **Predictive formulae for goat cheese yield based on milk composition**

*S.S. Zeng, K. Soryal, B. Fekadu, B. Bah, and T. Popham*

Small Ruminant Research. 2006. In Press.

Prediction of the yield and quality of different types of cheeses that could be produced from a given type and/or amount of goat milk is of great economic benefit to goat milk producers and goat cheese manufacturers. Bulk tank goat milk was used for manufacturing hard, semi-hard and soft cheeses (N = 25, 25 and 24, respectively) to develop predictive formulae of cheese yield based on milk composition. Fat, total solids, total protein and casein contents in milk and moisture-adjusted cheese yield were determined to establish relationships between milk composition and cheese yield. Soft, semi-hard and hard cheeses in this study had moisture contents of 66, 46 and 38%, respectively, which could be used as reference standards. In soft cheese, individual components of goat milk or a combination of two or three components predicted cheese yield with a reasonably high correlation coefficient ( $R^2 = 0.73-0.81$ ). However, correlation coefficients of predictions were lower for both semi-hard and hard cheeses. Overall, total solids of goat milk was the strongest indicator of yield in all three types of cheeses, followed by fat and total protein, while casein was not a good predictor for both semi-hard and hard cheeses. When compared with moisture-adjusted cheese yield, there was no difference ( $P > 0.05$ ) in predicting yield of semi-hard and hard goat milk cheeses between the developed yield formulae in this study and a standard formula (the Van Slyke formula) commonly used for cow cheese. Future research will include further validation of the yield predictive formulae for hard and semi-hard cheeses of goat milk using larger data sets over several lactations, because of variation in relationships between milk components due to breed, stage of lactation, season, feeding regime, somatic cell count and differences in casein variants.

## **Performance by goats and sheep consuming a concentrate-based diet subsequent to grazing of grass/forb pastures at different stocking rates**

*G. Animut, A. L. Goetsch, G. E. Aiken, R. Puchala, G. Detweiler, C. R. Krehbiel, R. C. Merkel, T. Sahlu L. J. Dawson, Z. B. Johnson, and D. H. Kiesler*

Small Ruminant Research. 2006. In Press.

A study was conducted to determine effects of grazing of mixed grass/forb pastures at three stocking rates (SR) on subsequent performance of goats and sheep fed a concentrate-based diet. Experimental periods, in 2002 and 2003, were 15 weeks in length, following 16 weeks of grazing (May to September) of pastures with warm season grasses and various forbs. Sheep (Katahdin) and goat ( $\geq 75\%$  Boer blood) wethers were 4 to 5 months 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 and three pastures per SR. Two sheep and two goats from each pasture were used in the subsequent confinement period, with initial BW of  $25 \pm 0.6$  and  $23 \pm 0.5$  kg, respectively. Average daily gain by all animals during grazing tended to decrease linearly ( $P < 0.10$ ) with increasing SR (61, 51, and 47 g/day for SR4, SR6, and SR8, respectively). In the period after grazing, DM intake tended ( $P < 0.10$ ) to be affected by an interaction between SR and year (year 1: 958, 966, and 1011 g/day; year 2: 1109, 904, and 930 g/day for SR4, SR6, and SR8, respectively (SE = 56.8)). There

was a tendency ( $P < 0.07$ ) for an interaction between SR and year in overall ADG (year 1: 172, 160, and 177 g; year 2: 193, 135, and 141 g for SR4, SR6, and SR8, respectively ( $SE = 12.6$ )). Sheep had higher overall ADG than goats (193 vs 133 g;  $SE = 7.9$ ). Gain efficiency (ADG:DMI) was not influenced by SR ( $P > 0.10$ ). Energy expenditure (EE) measured in weeks 3 and 9 via heart rate increased linearly ( $P < 0.05$ ) with increasing SR (562, 589, and 628 kJ/kg BW<sup>0.75</sup> for SR4, SR6, and SR8, respectively;  $SE = 16.4$ ). In conclusion, SR had no impact on ADG of sheep and goat wethers consuming a concentrate-based diet subsequent to the grazing period, which may involve effect of prior SR on subsequent EE.

### **Effects of the number of yearling Boer crossbred wethers per automated feeding system unit on feed intake, feeding behavior, and growth performance**

*T. A. Gipson, A. L. Goetsch, G. Detweiler, R. C. Merkel, and T. Sahlu*

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Thirty-six growing Boer x Spanish wethers (initial BW of  $30 \pm 0.7$  kg) were used in an 82-day experiment to determine effects of the number of animals per automated feeding system (NPF; 6, 8, 10 and 12), allowing consumption by only one animal at a given time, on intake of a 50% concentrate pelletized diet (9.2 MJ/kg ME, DM basis), feeding behavior and growth performance. During the entire experiment DM intake (1454, 1513, 1596 and 1374 g/day) and BW gain (156, 167, 181 and 136 g/day for 6, 8, 10 and 12 NPF, respectively) were affected by NPF quadratically ( $P < 0.05$ ), although gain efficiency (ADG:DM intake) was similar among NPF. The number of feeder visits (17.5, 17.1, 17.9 and 18.7) and meals (8.9, 9.0, 9.3 and 8.9) were similar among NPF, although feeder occupancy per day (97.8, 73.2, 83.0 and 71.7 min), visit (5.8, 4.4, 5.0 and 3.8 min) and meal (11.2, 8.2, 9.2 and 8.1 min for 6, 8, 10 and 12 NPF, respectively) decreased linearly with increasing NPF ( $P < 0.05$ ). The rate of DM consumption relative to feeder occupancy time plateaued as NPF increased to 8 (linear and quadratic changes,  $P < 0.05$ ; 14.6, 24.9, 21.5 and 23.1 g/min for 6, 8, 10 and 12 NPF, respectively). In conclusion, with these diet and animal characteristics, 8 or 10 wethers per automated feeder appear appropriate for achieving unrestricted growth performance.

### **Performance of Spanish and Boer x Spanish doelings consuming diets with different levels of broiler litter**

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Sixty Spanish (S) and 40 Boer x Spanish (BS) doelings ( $14.9 \pm 3.8$  and  $21.9 \pm 3.8$  kg initial BW, respectively, and approximately 6 months of age) were used in an experiment with four 3-week periods to determine effects of dietary broiler litter (L) level on growth performance. There were two groups per treatment with six S and four BS doelings in each. Dietary treatments were 20% coarsely ground millet hay and 80% concentrate, which consisted of 0 (0L), 20 (20L), 40 (40L), or 60% L (60L; total dietary level). An additional treatment was 80% hay and 20% concentrate (80F). Concentrate (primarily corn and L when included) DM intake (DMI) was 700, 593, 652, 387, and 165 g/d ( $SE = 20.3$ ) and total DMI was 883, 755, 825, 490, and 696 g/d ( $SE = 35.5$ ) for 0L, 20L,

40L, 60L, and 80F, respectively. There was a dietary treatment x period interaction in ADG (period 1: 104, 29, 36, -44, and 47 g; period 2: 124, 102, 53, -74, and 12 g; period 3: 175, 126, 126, 87, and 80 g; period 4: 161, 151, 136, 66, and 51 g for 0L, 20L, 40L, 60L, and 80F, respectively (SE = 12.2)). Treatment and genotype also interacted in ADG (S: 107, 85, 72, 8, and 36 g; BS: 174, 118, 103, 10, and 60 g for 0L, 20L, 40L, 60L, and 80F, respectively (SE = 9.2)). ADG:DMI ranked ( $P < 0.06$ )  $0L > 20L > 40L > 80F > 60L$  (152, 130, 102, 18, and 65 g/kg for 0L, 20L, 40L, 60L, and 80F, respectively; SE = 6.12). The acetate:propionate ratio in ruminal fluid was greater ( $P < 0.05$ ) for 60L and 80F than for other treatments (1.60, 1.73, 2.18, 3.80, and 3.67 for 0L, 20L, 40L, 60L, and 80F, respectively; SE = 0.27). Liver Cu concentration at the end of the experiment was influenced by dietary treatment (88, 275, 478, 286, and 47 ppm for 0L, 20L, 40L, 60L, and 80F, respectively; SE = 53.2). In conclusion, L can be effectively used in diets for growing meat goats, but high levels, such as above 40% of dietary DM, may restrict performance primarily via limited feed intake. However, the level of L below this threshold impacts efficiency of feed utilization.

### **Effects of level and source of supplemental protein in a concentrate-based diet on sites of digestion and small intestinal amino acid disappearance in Boer × Spanish wether goats**

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12 yearling Boer × Spanish wether goats fitted with ruminal, duodenal and ileal cannulae ( $34.5 \pm 1.39$  kg average BW) were used in an experiment with two simultaneous  $6 \times 6$  Latin squares to determine effects of different supplemental protein sources on sites of digestion and small intestinal amino acid disappearance with concentrate-based diets moderate or high in CP concentration. Diets were formulated to be 13 or 19% CP (DM basis), with supplemental protein provided by blood (BLM), corn gluten (CGM), cottonseed (CSM), feather (FTM), fish (FIM) or soybean meal (SBM). Small intestinal disappearance of the sum of essential amino acids measured (i.e., histidine, threonine, arginine, valine, methionine, isoleucine, leucine, lysine and phenylalanine) was greater for BLM vs. SBM (39.0, 33.4, 28.7, 33.1, 33.3 and 20.5 g/day for BLM, CGM, CSM, FTM, FIM and SBM, respectively). Small intestinal disappearance of some essential amino acids was similar among CP sources with 13% CP but different with 19% CP. With 19% CP, small intestinal disappearance of histidine and valine was greatest ( $P < 0.05$ ) among sources for BLM (histidine: 6.1, 1.8, 2.1, 1.9, 1.5 and 1.1 g/day; valine: 7.1, 3.6, 3.0, 4.3, 4.7 and 2.1 g/day), for leucine was greater ( $P < 0.05$ ) for BLM and CGM than for CSM, FTM and SBM (13.2, 13.1, 5.8, 8.5, 9.3 and 4.4 g/day), of lysine was greater ( $P < 0.05$ ) for BLM vs. CGM, CSM, FIM and SBM (8.2, 3.2, 3.9, 5.5, 4.1 and 2.9 g/day) and of phenylalanine was lowest among sources for SBM (6.6, 5.2, 3.8, 3.9, 3.7 and 2.2 g/day for BLM, CGM, CSM, FTM, FIM and SBM, respectively). Essential amino acids with small intestinal disappearance not influenced by protein source within CP level were threonine, methionine and isoleucine. However, small intestinal disappearance of threonine (2.5 and 3.8 g/day) and methionine (1.1 and 1.9 g/day for 13 and 19% CP, respectively) was greater ( $P < 0.05$ ) for 19 vs. 13% CP diets. In conclusion, use of different feedstuffs high in protein not extensively degraded in the rumen and with unique amino acid concentrations in diets of goats may have little influence on small intestinal absorption of select amino acids with dietary CP levels such as 13%, although effects may occur with much higher levels of CP (e.g., 19%).

## **Effects of dietary ratios of fish and blood meals on sites of digestion, small intestinal amino acid disappearance and growth performance of meat goat wethers**

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Six yearling Boer x Spanish wether goats ( $37 \pm 1.6$  kg initial live weight; LW) and 24 growing Boer x Spanish and 24 Spanish wethers ( $21 \pm 3.1$  and  $20 \pm 2.6$  kg initial BW, respectively) were used to determine the effects of total CP and two supplemental protein sources (fish meal, FIM; blood meal, BLM) in a 70% concentrate diet on sites of digestion, small intestinal amino acid disappearance and growth performance. Diets were formulated to be 12% or 15% CP (DM basis), with predicted ruminally undegraded intake protein (UIP) from FIM and BLM of 1.2 and 3.0% DM, respectively, achieved from FIM supplying 100, 67 and 33% and BLM 0, 33 and 67%, respectively (100F, 67F and 33F, respectively). True ruminal OM and N digestibilities were greater ( $P < 0.05$ ) for 12% vs. 15% CP and decreased linearly ( $P < 0.05$ ) as level of FIM decreased. Duodenal flows of both microbial and nonmicrobial, nonammonia (feed plus endogenous) N were greater ( $P < 0.05$ ) for 15% than for 12% CP and increased linearly with decreasing FIM level in the diet. Correspondingly, small intestinal disappearance of essential amino acids was greater ( $P < 0.05$ ) for 15% vs. 12% CP and increased ( $P < 0.05$ ) with decreasing FIM. In an 18 week growth experiment, DM intake (935 vs. 783 g/day), average daily gain (ADG; 145 vs 108 g) and ADG:DM intake (155 vs. 138 g/kg) were greater ( $P < 0.05$ ) for Boer x Spanish compared with Spanish wethers. Regardless of genotype, neither level of total CP nor of FIM influenced growth performance. In conclusion, with diets relatively high in concentrate and a CP level of 12%, amino acid requirements of common genotypes of growing meat goats in the US may be satisfied by basal dietary ingredients, with little or no potential to enhance performance by addition of feedstuffs high in UIP regardless of amino acid profile.

## **Efficiency of energy use for maintenance and gain by growing crossbred Boer and Spanish goats consuming diets differing in forage level**

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Eight Boer (75%) x Spanish (BS) and eight Spanish (S) wether goats ( $155 \pm 8$  days of age and  $19.2 \pm 2.3$  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 and diet quality on heat production with ad libitum, near maintenance and fasting levels of feed intake. Diets were 65% concentrate (CON; 15% CP, DM basis) and coarsely ground alfalfa hay (FOR; 23% CP). There were no significant interactions between genotype and diet. ME intake was similar between genotypes and greater ( $P < 0.05$ ) for CON vs. FOR both when intake was ad libitum (7.60 vs. 5.43 MJ/day) and near maintenance (4.31 vs. 4.09 MJ/day). DE concentration was greater ( $P < 0.05$ ) for CON than for FOR with ad libitum (74.4 vs. 55.5%) and restricted intake (77.0 vs. 59.6%). Energy expenditure (EE), determined by respiration calorimetry, at all levels of intake was similar between genotypes. EE was greater ( $P < 0.05$ ) for CON than for FOR at each of the three levels of intake, ad libitum



(573 and 521 kJ/kg BW<sup>0.75</sup> while fasting), near maintenance (426 and 400 kJ/kg BW<sup>0.75</sup>) and fasting (280 and 255 kJ/kg BW<sup>0.75</sup>). Efficiencies of ME utilization for maintenance ( $k_m$ ) and gain ( $k_g$ ) and the ME requirement for maintenance ( $ME_m$ ) were similar between genotypes.  $k_m$  was similar between diets (0.705 and 0.690 for CON and FOR, respectively), although  $k_g$  was greater ( $P < 0.05$ ) for CON than for FOR (0.603 vs. 0.387).  $ME_m$  was numerically greater ( $P < 0.17$ ) for CON than for FOR (407 vs. 379 kJ/kg BW<sup>0.75</sup>), which may have involved higher ME intake with CON. In conclusion, under the conditions of this experiment energy requirements and efficiency of utilization were not different between growing Boer crossbred and Spanish goats regardless of diet quality.

### **Evaluation of melatonin and bromocryptine administration in Spanish goats. III. Effects on hair follicle activity, density and relationships between follicle characteristics**

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Melatonin treatment for out of season breeding in goats may also affect skin hair follicle activity, thereby influencing the spring growth phase and yield of cashmere. Female Spanish goats (15 does and 65 kids) were allotted to 5 treatments: control (C), melatonin implant (MI; 18 mg, 42-day release); melatonin and bromocryptine implants (225 mg, 60-day release period; MIB); oral administration of melatonin (MO; 3 mg/day); and oral administration of melatonin and bromocryptine implant (MOB). Treatments began March 1 (spring), and hair follicle characteristics were monitored monthly from February to May. Mean initial and final body weights were  $27.9 \pm 1.2$  and  $35.3 \text{ kg} \pm 1.2$ , respectively. Total follicle number was greater ( $P < 0.05$ ) for the MOB group compared to the C group in April, while in May the total follicle number was greater ( $P < 0.05$ ) for the MIB group compared to the C and MO groups, whereas secondary follicle numbers were greater ( $P < 0.05$ ) for MIB than for C and MO and for MOB ( $P < 0.05$ ) vs. C, MI and MO groups. The primary active follicle percentage was correlated ( $P < 0.001$ ) with the secondary active follicle percentage ( $r = 0.32$ ), and the correlation ( $P < 0.01$ ) between secondary active follicle percentage and mean cashmere fiber diameter was  $r = 0.31$ . Primary active follicle ratio did not differ between treatments, but the secondary active follicle ratio was greater ( $P < 0.01$ ) for treatments with melatonin administration, compared to the control in March, April and May. Primary follicle number, secondary follicle number, total follicle number, secondary to primary follicle ratio, primary follicle diameter, secondary follicle and primary to secondary follicle diameter ratio averaged  $3.9/\text{mm}^2$  (SE = 0.15),  $26.8/\text{mm}^2$  (SE = 1.22),  $30.8/\text{mm}^2$  (SE = 1.31), 7.0:1 (SE = 0.23),  $74.0 \mu\text{m}$  (SE = 2.87),  $15.6 \mu\text{m}$  (SE = 0.19) and 4.7:1 (SE = 0.18), respectively. There were positive correlations ( $P < 0.001$ ) for follicular characteristics, such as secondary follicle number with total follicle number ( $r = 0.99$ ), secondary to primary ratio ( $r = 0.68$ ), group follicle number ( $r = 0.63$ ) and group secondary to primary follicle ratio ( $r = 0.63$ ), and primary follicle diameter with primary secondary diameter ratio ( $r = 0.96$ ). There were also negative correlations ( $P < 0.01$ ), such as primary follicle number with primary follicle diameter ( $r = -0.42$ ), secondary follicle diameter ( $r = -0.33$ ) and secondary and primary follicle ratio ( $r = -0.48$ ), and primary follicle number with primary and secondary diameter ratio ( $r = -0.33$ ). 90% of follicular groupings were of the trio primary follicle type, whereas the remaining 10% were of solo, duo and quartet primary follicular group formations. All primary follicles possessed medullae and some secondary marginal follicles (intermediate type) were medullated, but few follicles of the pure cashmere follicle type had medullae. Hair follicles

varied from low, moderate to high density in Spanish goats. Fiber growth rate, fiber diameter and extended follicular activity rate during the spring months suggest that an accelerated breeding program for Spanish goats by melatonin treatment for breeding in the spring could be also profitable by extending the spring cashmere growth phase into a commercially harvestable cashmere length.

**The relationship between heart rate and energy expenditure in Alpine, Angora, Boer and Spanish goat wethers goats consuming different quality diets at level of intake near maintenance or fasting**

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Six Alpine (AL;  $38.4 \pm 3.0$  kg), Angora (AN;  $23.1 \pm 2.7$  kg), Boer (BO;  $40.8 \pm 4.5$  kg) and Spanish (SP;  $33.6 \pm 2.2$  kg) wethers (1.5 yr of age) were used to determine effects of time of the day and potential interactions between time, genotype and diet quality on energy expenditure (EE), heart rate (HR) and EE:HR when fed near maintenance and fasting. The experiment consisted of four simultaneous crossovers, with 21 d for adaptation before measures. Diets were 60% concentrate (CON: 15% CP) and ground alfalfa hay (FOR: 23% CP), offered in two meals at 8:00 and 16:00 h. Energy expenditure was determined from  $O_2$  consumption and production of  $CO_2$  and  $CH_4$  over 2-day periods in fed and fasting states (total 4-day fasting period). Fasting EE was higher during the day than night, with values generally highest at 1600-1700 h. Animal within breed affected EE, HR and EE:HR ( $P < 0.05$ ). The diurnal pattern in EE varied with diet ( $P < 0.05$ ), although total daily EE was not different between diets. Before the morning meal, there were a number of hours during which EE was greater for CON than for FOR. However, at both meals the rise in EE was considerably greater for FOR vs CON, lasting for 3-4 h. The same general pattern in HR was observed, although the period of time when there was a dietary difference after the afternoon meal was shorter. For both fed and fasted goats, EE:HR differed among hours of the day ( $P < 0.05$ ). EE:HR tended ( $P < 0.09$ ) to differ between diets (5.99 and 6.21 for CON and FOR, respectively) and to be affected ( $P < 0.09$ ) by an interaction between breed and diet (AL: 5.84 and 6.38; AN: 5.91 and 5.73; BO: 6.05 and 6.58; and SP: 6.17 and 6.15  $\text{kJ}/(\text{kg BW}^{0.75} \times \text{day})$ :heart beats/min) for CON and FOR, respectively. In conclusion, for use of HR to predict EE by goats, it appears desirable to determine the ratio of EE:HR with a diet similar to that consumed during prediction and over an extended period of time.

## Effects of pasture inclusion of mimosa on growth by sheep and goats co-grazing grass/forb pastures

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Effects of mimosa alley-cropped in grass/forb pastures on growth performance of co-grazing sheep and goat wethers were determined. Eighteen sheep (Katahdin) and eighteen goats ( $\geq 75\%$  Boer blood), with BW of  $22 \pm 0.3$  and  $21 \pm 0.2$  kg, respectively, and age of 4 to 5 mo were used. Wethers grazed 0.4-ha pastures consisting of grasses, such as bermudagrass (*Cynodon dactylon*) and johnsongrass (*Sorghum halepense*), and forbs (primarily ragweed, *Ambrosia artemisiifolia*), for 16 weeks. Three pastures with alley-cropped mimosa (W, 3 m between rows and 0.5 m within rows) and three without (WO) were divided into four paddocks for 2-week rotational grazing. Daily mimosa leaf mass removal averaged 47.4 g per animal, although mimosa leaf harvest was complete long before the end of 2-week grazing periods. Mimosa leaf samples averaged 2.81, 37.8, 24.6, and 85.9% N, NDF, ADF, and in vitro true DM digestibility (IVDMD), respectively. Forage mass (grass and forbs) was similar ( $P > 0.05$ ) between treatments before (2928 and 2695 kg/ha; SE = 173.4) and after grazing (1507 and 1452 kg/ha for WO and W, respectively; SE = 140.4). Percentage of grass in forage determined by transect pre- (57 and 70%; SE = 8.3) and post-grazing (66 and 79% for WO and W, respectively; SE = 8.1) was not affected by treatment ( $P > 0.05$ ). Pre-grazed forage concentrations of N (1.25 and 1.24%; SE = 0.031), NDF (64.5 and 63.8%; SE = 1.95), and IVDMD (52.9 and 56.2% for WO and W, respectively; SE = 1.44) were similar ( $P > 0.05$ ) between treatments, as was also true post-grazing (N: 1.05 and 0.96%, SE = 0.054; NDF: 66.3 and 69.4%, SE = 2.68; and IVDMD: 49.0 and 48.0%, SE = 1.64, for WO and W, respectively). Overall ADG was numerically greater ( $P > 0.05$ ) for W vs. WO (68 vs. 51 g/d; SE = 8.6). Species and period interacted in ADG ( $P < 0.05$ ); ADG was greater for sheep than for goats in the first 4-week period but was similar in the other periods (first: 88 and 156 g/d; second: 89 and 105 g/d; third: 20 and 40 g/d; fourth: -6 and -16 g/d for goats and sheep, respectively (SE = 13.1)). In summary, alley-cropped mimosa increased quality of herbage available for grazing. Growth performance of co-grazing sheep and goats was only numerically enhanced, perhaps because of decreasing mimosa leaf availability as 2-week grazing periods advanced or overall relatively low intake of mimosa leaf. However, these findings do not suggest need for concern about potential anti-nutritional factors in mimosa and, thus, continuous inclusion of mimosa in low-quality diets at higher levels than in the present experiment should favorably impact performance of both sheep and goats.

## Effects of feed restriction on energy expenditure by 2 year old crossbred Boer goats

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Fourteen Boer (75%) x Spanish wether goats ( $51 \pm 1.8$  kg BW and 23 months of age) were used to determine effects of a moderate degree of nutrient restriction on heat production or energy expenditure (EE). The experiment consisted of a 26-day period (P1) followed by one of 50 days

(P2). Wethers were fasted on the final 4 days of each period, with gas exchange measured on the last 2 days. Fasting was preceded by collection of feces and urine for 7 days, with the final 2 days for gas exchange. All wethers were fed a 60% concentrate diet at a level of intake near maintenance in P1 (P1-100 and P1-80 treatments). In P2, six wethers continued on this level of intake (P2-100 treatment); eight wethers also were fed at this level for 15 days but then had ME intake sequentially reduced by approximately 10 and 20% for 10 and 21 days, respectively (P2-80 treatment). Intake of ME was lowest ( $P < 0.05$ ) for P2-80 (529, 535, 552 and 474 kJ/kg BW<sup>0.75</sup> (fasted) for P1-100, P1-80, P2-100, and P2-80, respectively). Fed EE was lowest ( $P < 0.05$ ) for P2-80 (495, 505, 467, and 406 kJ/kg BW<sup>0.75</sup>), whereas that while fasting was similar among treatments (287, 279, 273, and 253 kJ/kg BW<sup>0.75</sup> for P1-100, P1-80, P2-100, and P2-80, respectively). The ME requirement for maintenance (ME<sub>m</sub>) was greater ( $P < 0.05$ ) in P1 than P2 (477, 487, 421, and 376 kJ/kg BW<sup>0.75</sup> for P1-100, P1-80, P2-100 and P2-80, respectively), and when analyzed for P2 separately ME<sub>m</sub> was lower ( $P < 0.10$ ; 374 vs 425 kJ/kg BW<sup>0.75</sup>) and the efficiency of ME use for maintenance was greater ( $P < 0.08$ ) for P2-80 than for P2-100 (0.689 vs 0.625). In conclusion, moderate feed intake restriction impacted EE and ME<sub>m</sub> by mature meat goats largely via decreasing EE associated with or responsive to nutrient intake or workload rather than physiological processes responsible for fasting EE.

## Effects of diet quality on energy expenditure by 20-month old Alpine, Angora, Boer and Spanish wethers

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Small Ruminant Research. 2006. In Press.

Six Alpine ( $47.7 \pm 1.36$  kg initial BW), Angora ( $28.8 \pm 1.11$  kg), Boer (87.5% Boer and 12.5% Spanish;  $49.3 \pm 2.17$  kg), and Spanish ( $38.7 \pm 0.51$  kg) wethers (initial age of 19 months) were used to determine effects of genotype and diet quality on energy expenditure (EE) when fed near maintenance and fasted. The experiment consisted of four simultaneous crossovers, with 21 d for adaptation before measures. Diets were 65% concentrate (CON) or coarsely ground alfalfa hay (FOR). EE was determined from O<sub>2</sub> consumption and production of CO<sub>2</sub> and CH<sub>4</sub> with a head-box respiration calorimetry system, along with urinary N excretion, over 2-day periods in fed and fasted states (4-day fast). EE was expressed on the basis of average BW during the fasted measurement period. There were only significant interactions between genotype and diet in DM and gross energy intakes, which were due to differences in magnitude. Intake of ME was similar among genotypes and slightly greater ( $P < 0.05$ ) for CON than for FOR (450 vs. 424 kJ/kg BW<sup>0.75</sup>). Neither diet (373 and 371 kJ/kg BW<sup>0.75</sup> for CON and FOR, respectively; SE = 5.9) nor genotype (377, 377, 361, and 373 kJ/kg BW<sup>0.75</sup> by Alpine, Angora, Boer, and Spanish, respectively; SE = 9.3) influenced fed EE ( $P > 0.10$ ). Fasted EE was similar between diets but was greatest among genotypes ( $P < 0.05$ ) for Alpine (251, 224, 217, and 225 kJ/kg BW<sup>0.75</sup> by Alpine, Angora, Boer, and Spanish, respectively; SE = 7.2), which may have been due to a greater level of activity exhibited by Alpine than other genotypes when fasted. Efficiency of utilization of ME for maintenance was similar ( $P > 0.10$ ) between diets (0.685 and 0.657 for CON and FOR, respectively; SE = 0.0134). The ME requirement for maintenance was similar ( $P > 0.10$ ) between diets (342 and 352 kJ/kg BW<sup>0.75</sup> for CON and FOR, respectively; SE = 7.9) and among genotypes (353, 349, 326, and 362 kJ/kg BW<sup>0.75</sup> for Alpine,

Angora, Boer and Spanish, respectively; SE = 11.1). In summary, with a level of intake near maintenance, the maintenance energy requirement appears similar for Alpine, Angora, Boer and Spanish goats near 2 yr of age regardless of diet quality.

### **Efficiency of energy use for pregnancy by crossbred Boer x Spanish does with different litter size**

*I. Tovar-Luna, A. L. Goetsch, R. Puchala, T. Sahlu, G. E. Carstens, H. C. Freetly, and Z.B. Johnson*

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Twenty-four Boer x Spanish does (3 yr of age, having kidded once previously and with an initial BW of  $42.7 \pm 1.2$  kg) were used to determine the efficiency of ME utilization for pregnancy ( $k_{\text{preg}}$ ). Six does were nonpregnant and, based on ultrasound determination on day 45 of gestation, six had a litter size (LS) of 1, 2, and 3. However, only 10 of the pregnant does delivered the expected number of kids (three, four, and three with LS of 1, 2, and 3, respectively). Does were fed a diet of approximately 50% concentrate in accordance with assumed maintenance plus pregnancy energy requirements based on estimated nonpregnancy tissue BW and LS. Recovered energy (RE) was determined by subtraction of energy expenditure (EE; respiration calorimetry) near day 80, 100, 120, and 140 of gestation from ME intake (MEI). RE was assumed attributable to pregnancy tissues (fetus, fetal fluids and membranes, uterus, and mammary gland), and ME used for pregnancy ( $\text{ME}_{\text{preg}}$ ) was estimated by subtracting  $\text{ME}_m$  determined with nonpregnant goats from MEI by those pregnant. For does with actual LS equal to that expected, the no-intercept equation for the regression of RE against  $\text{ME}_{\text{preg}}$  was:  $\text{RE} = \text{ME}_{\text{preg}} \times 0.252$  (SE = 0.030;  $R^2 = 0.64$ ), indicating a  $k_{\text{preg}}$  of 25%. Although, a regression including LS (1 vs. 2 or 3) suggested greater  $k_{\text{preg}}$  for LS of 1 ( $40.2\% \pm 5.6$ ) vs. 2 or 3 ( $20.5\% \pm 3.2$ ). Regressions for goats with LS different from expected suggested positive effects of use of energy mobilized from nonpregnancy tissues on  $k_{\text{preg}}$  and of use of dietary ME for energy accretion in nonpregnancy tissues on the efficiency of whole body ME utilization. In conclusion, the average efficiency of ME use for pregnancy regardless of LS in goats was near 25%, which when considering the expected proportion of all pregnancy tissues attributable to fetal or conceptus tissues implies an energy requirement for pregnancy of goats similar to common recommendations for sheep and cattle.

### **Change in energy expenditure by meat goats with varying levels of feed intake near maintenance and below**

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Eleven yearling meat goat wethers (7/8 Boer and 1/8 Spanish) were used in a 16-week experiment to determine effects of different levels of nutrient restriction and a maintenance level of intake after a severe restriction on energy expenditure (EE). Dehydrated alfalfa pellets were fed throughout the experiment. During the first 4 weeks for adaptation, wethers were fed near maintenance. In weeks 5 to 10, six wethers were fed at approximately 60% of the maintenance level and in weeks 11 to 16

were again fed near maintenance (L-H). The other five wethers were fed at approximately 80 and 60% of maintenance in weeks 5 to 10 and 11 to 16, respectively (M-L). Body weight 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. Body weight differed among weeks but not between treatments (41.0, 41.5, 39.7, 39.5, 38.0, 37.2, 38.0, 37.5, 37.8, 38.8 and 30.3 kg for L-H (SE=1.29), and 38.6, 38.2, 37.2, 37.2, 36.6, 35.0, 36.6, 36.7, 35.9, 35.7 and 36.9 kg (SE=1.41) for M-L in wk 4, 5, 6, 7, 9, 10, 11, 12, 13, 15 and 16, respectively). Energy expenditure, expressed relative to BW at the end of the adaptation period, was 362, 366, 322, 280, 262, 260, 259, 331, 331 and 335 kJ/kg BW<sup>0.75</sup> (SE=11.4) for L-H, and 342, 378, 306, 301, 282, 276, 288, 263, 253 and 254 kJ/kg BW<sup>0.75</sup> (SE=14.8) for M-L in weeks 4, 5, 6, 7, 9, 10, 11, 12, 13 and 15, respectively. Retained or recovered energy was different ( $P < 0.05$ ) from 0 for L-H in weeks 4, 5, 6, 11, 12, 13 and 15 (65, -101, -56, -14, 4, 6, 192, 120, 121 and 117 kJ/kg week 4 BW<sup>0.75</sup>; SE=15.7) and for M-H in weeks 4, 5, 9 and 10 (92, -47, 25, 29, 49, 55, -14, 11, 21 and 20 kJ/kg week 4 BW<sup>0.75</sup> in weeks 4, 5, 6, 7, 9, 10, 11, 12, 13 and 15, respectively; SE=17.3). In conclusion, meat goats can markedly reduce EE in response to limited feed intake, with nonlinear change as time advances.

### **Effects of feeding method, diet nutritive value and physical form and genotype on feed intake, feeding behavior, and growth performance by meat goats**

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Thirty-two F1 Boer x Spanish ( $28.7 \pm 0.49$  kg) and 40 3/4 Boer-1/4 Spanish ( $31.9 \pm 0.47$  kg) wethers, approximately 5 months of age, were used to compare feeding systems with different dietary treatments. Feeding systems were Calan gates and automated feeding units allowing one animal to consume feed at a time. Two diets included concentrate (C) and two were dehydrated alfalfa (A), fed pelletized (P) or loose (L). The main effect of feeding method was not significant for any variable. There was an interaction in DM intake (DMI) involving feeding method, diet, and genotype, which indicated that with a concentrate diet, regardless of physical form, DMI was not influenced by feeding method. Main effect dietary treatment means (1.78, 1.67, 2.04, and 1.70 kg for C-P, C-L, A-P, and A-L, respectively; SE = 0.030) indicated that pelletizing had a slightly greater effect on DMI with A vs. C. ADG was lowest among treatments for A-L (212, 205, 190, and 157 g for C-P, C-L, A-P, and A-L, respectively; SE = 8.9), and ADG:DMI was greater for C vs. A (127, 120, 94, and 94 g/kg for C-P, C-L, A-P, and A-L, respectively; SE = 7.8). For wethers subjected to automated feeding units, the number of feeder visits was lowest among diets ( $P < 0.05$ ) for C-P (23.1, 31.2, 35.7, and 35.7 per day; SE = 2.00); total feeder occupancy time per animal ranked ( $P < 0.05$ ) C-P < A-P < C-L and A-L (74, 130, 105, and 122 min/day; SE = 6.8), and rate of DMI was greater for P than for L diets (24.6, 12.9, 22.0, and 13.7 g/min for C-P, C-L, A-P, and A-L, respectively; SE = 3.89). In summary, meat goats can markedly vary feeding behaviors in response to different diet types and forms; however, there appear limits to such changes, as exemplified by lowest ADG for A-L. Calan gates and automated feeding systems appear similar in the ability to compare growth performance with treatments such as the concentrate-containing diets and genotypes of this experiment. Most performance benefit in growing progeny from Boer crossbreeding may be achieved in F<sub>1</sub> animals, with little further improvement realized from the first backcross of F<sub>1</sub> females. Pelletizing does not seem to affect on growth performance with diets consisting of

appreciable concentrate. Effects of pelletizing on growth performance of meat goats consuming forage diets may be attributable to change in level of feed intake, without impact on efficiency of feed utilization.

### Visiting Scholars (2005/2006)

*Mr. Getachew Animut*

Native of Ethiopia

Research Project: Decreased Methane Emission by Ruminants Consuming Condensed Tannins 2004-38814-02606)

Experiments: GA-05-05, GA-05-13

*Dr. Thomas Ngwa*

Native of Cameroon

Research Project: Composition of Tissue Loss and Gain by Goats (2003-38814-03779)

Experiments: TN-04-04, TN-04-07, TN-05-04

*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, MV-05-09

*Dr. Asefa Asmare*

Native of Ethiopia

Research Project: The Ability of Goats to Withstand Harsh Nutritional Environments (2005-38814-16353)

*Dr. Amlan Patra*

Native of India

Research Projects: Tethering for Detailed Study of Grazing Ruminants (USDA-CSREES-NRI 03-03289) and Effects of Acclimatization on Energy Requirements of Goats (BI09-017)

Experiments: AP-04-09, AA-04-18, AA-05-15

*Mr. Sean Chen*

Native of China

Research Project: Quality, Safety, and Shelf-Life of Dairy Goat Products in the U.S. Market (2005-38814-02587)

Experiments: SC-05-01, SC-05-02

*Dr. Maristela Rovai*

Native of Brazil

Research Project: Evaluation and Modeling Extended Lactations in Dairy Goats (2004-38814-02579)

*Dr. Adnan Beker*

Native of Ethiopia

Research Project: Energy Expenditure for Activity in Free-Ranging Ruminants: A Nutritional Frontier (US-3694-05 R)

*Dr. Ahmed Askar*

Native of Egypt

Research Project: Characterization of the Energy Requirement for Activity by Grazing Ruminants (2005-38814-16352)