Friday, January 12

PM -- *Board meetings at Holiday Inn University, Prices Fork Road*

4:00 Virginia Sheep Industry Board Meeting (Open to the public)

6:00 Virginia Sheep Producers Association Board Meeting (Open to the public)

Saturday, January 13

AM

8:00 Registration and Commercial Exhibits

9:00 "Making Effective Use of Livestock Guard Dogs"
Dr. An Pieschel, TN Cooperative Extension, Tennessee State University

10:00 Virginia Tech Research Update
"Strategies for Improving Flock Genetics"
Mr. Randy Borg, Dept of Animal & Poultry Sciences, Virginia Tech

"Parasite Resistance: Only for Hair Sheep?"
Ms. Kathryn MacKinnon, Dept of Animal & Poultry Sciences, Virginia Tech

10:45 Break and Commercial Exhibits

11:15 "Comparative Health Concerns for Sheep and Goats"
Dr. Kevin Pelzer, VA-MD Regional College of Veterinary Medicine

12:00 Lunch at the Alphin-Stuart Livestock Arena – Virginia Sheep Producers Association Annual Meeting and Awards
Updates from American Sheep Industry Association & American Lamb Board

PM

1:30 "National Animal Identification System: Current Status for Small Ruminants"
Ms. Linda Campbell, Luray, VA, Chair, NAIS Goat Species Working Group

2:00 "Making the Most of Your Feed Dollars"
Dr. Mark Wahlberg, Dept of Animal & Poultry Sciences, Virginia Tech

2:45 Break and Commercial Exhibits

3:00 "Practical Lessons Learned the Hard Way"
Producer Panel

4:00 7th ANNUAL VIRGINIA BRED COMMERCIAL EWE LAMB SALE *Selling Katahdin, Katahdin x Dorper, Suffolk, Suffolk x whiteface, & Cheviot x Finn crossbred ewe lambs*

If you are a person with a disability and require any auxiliary aids, services, or other accommodations for this symposium, please discuss your accommodation needs with Scott Greiner at (540) 231-9163 at your earliest convenience.

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THE LIVESTOCK GUARDIAN DOG

An Peischel, PhD
Goats Unlimited
Ashland City, Tennessee

I recently had an individual call and want to discuss the training of livestock guardian dogs. For a while I listened and at the same time, thinking to myself - train ?? - I don't "train", I facilitate success. Everything I do beginning with the selection of breeding stock, whelping, exposure to different classes of goats and topography, to a range of different predators, the situation is managed so each individual pup is given every chance to succeed. Every experience for a pup has to be positive, the pup needs to feel in control, and their intense natural instinct to guard needs to be self-expressed.......then, the big day comes when they are sent miles away to guard the goats by themselves; they're on their own. My dogs have never let me down, I sleep peacefully. Goats Unlimited has been fortunate to never have lost a goat to predation with the use of livestock guardian dogs.

Goats Unlimited is located in rolling hardwood hills situated in the northern middle section of Tennessee. Our major predators are coyotes and domestic pack dogs. We do land cleaning and enhancement, restoration of marginal lands and riparian areas and weed abatement with our Kiko meat goats. Our type of business puts the dogs in situations where they could be guarding in a neighborhood type setting with people around or in densely forested areas where they will rarely encounter a human. There are also weather, topographic and vegetation extremes that the livestock guardians learn to survive in.

Breeding Stock: The Pyrenean Mountain Dog and the Akbash

The dogs used for breeding purposes are selected from ranches/farms that are using dogs as livestock guardians. Both the dam and sire of the dogs selected have to be guarding and the physical conditions (terrain, predator type, weather) very similar to ours. The dogs must be physically sound, structurally correct and representative of the breed standard.

The breeds we have selected as livestock guardians are the Pyrenean Mountain Dog and the Akbash. Each breed was selected for specific breed characteristic traits that fit our management program. As you begin the journey of "success facilitation", never lose sight of the fact, and remember that these dogs are nocturnal - so are the predators.

The Pyrenean is mentioned in documents hundreds of years old owing its origin to the plateau of Tibet. It started as one of the Mastiff family and came into Europe overland with the Aryan hordes. Remaining isolated in the Pyrenees Mountains (between France and Spain) for centuries, they guarded the flocks on the high and isolated mountain slopes. They have a natural guarding instinct, protecting with their very lives those placed in their protection. Pyreneans are large and powerful, have great stamina and a coat providing protection from foe and climatic elements. Their air of quiet confidence and tolerance makes the Pyrenean an ideal fit for our management requirements.

The Pyrenean is well suited to the neighborhood land cleaning, restoration and weed abatement projects as project size can vary from 20 to 160 acres. They are more people tolerant, therefore, less aggressive toward humans. For our conditions, their coat protects them from the winter rain, hail and occasional snow. The dogs are expected to find their own shelter and protect themselves from the elements.

The Akbash originated in western Turkey centuries ago for the guarding of sheep. White in color, their shorter length double coat is shed annually. They have a fleet appearance built for speed and stamina (long legs, muscular, strong) with keen eye sight and hearing. They are ideal for forest/brush and rangeland operations. Akbash are more aggressive to predators, have a strong maternal and guarding instinct and a forceful independent nature in their guardian behavior.

The Akbash was chosen to cross with the Great Pyrenean in an effort to reduce the dense coat of the Pyrenean. The hair coat of the cross is much shorter and has proven advantageous in hot, humid climates. The cross is exceptionally athletic like the Akbash yet the personality and the bone structure of the Pyrenean has been maintained. The crossbred guardians have the same black pigmentation around the eyes, nose and mouth as do the originating breeds.

Whelping and Feeding

We do not breed our guardians until they have proven successful as livestock guardians in their own right, have OFA's (Orthopedic Foundation for Animals) confirming no evidence of hip dysplasia and are at least 2 years of age. Once the dogs are bred, they are maintained on a higher plane of nutrition (27% crude protein and 18% fat) with a vitamin/mineral (especially readily absorbable calcium and phosphorus) supplement given daily. The bred females are used for guarding on acreage close to homebase so they can be monitored daily as whelping day approaches. Approximately 8 days before whelping, they receive a parvovirus and 7-way vaccination. They are whelped out in the brush with the goats. It is up to the bitch to provide a "safe" area for her pups and to guard them. I check them from a distance with binoculars, leaving everything up to the dam. Pyrenean and Akbash pups are born in litters of 5 to 10 with an average birth weight between 1.5 and 2.5 pounds. After whelping, the female receives added nutrition; a cooked meal once daily (cooked meat, a gravy bullion base with suet, supplemental vitamins and minerals, goat milk, and rice). The dog consumes all she wants of this mixture and a high quality dry dog food is provided in a self-feeder free choice.

The pups will be twice their birth weight by day 5 - they grow exceptionally fast and need high levels of nutrients for the rapid long bone growth that occurs. Their eyes begin opening about 12-14 days of age and they are immediately started on warm goat milk. A liquid mineral/vitamin supplement is added to the milk of which the pups can drink all they want - offered 3 times in a 24 hour period. At three weeks of age, the pups start eating cooked food - mashed rice, puppy chow soaked in goat milk, vitamin/mineral supplement. By the time they are 5 weeks old they are chewing on dry dog food but still receiving a cooked meal a day with cooked meat. Once they are 6 weeks old, they are consuming dry food daily and an evening meal of dry food soaked in goat milk with cooked meat. Because this breed of dog experiences rapid bone growth, it is vitally important to provide a balance of calcium, phosphorus and vitamin D3 until about 18 months of age. Between three and six months of age they may grow from 30 to 100 pounds.

Preventative Health Care

At 2 days of age, both the front (single) and rear (double) dewclaws are removed from the Pyrenean pups. The pups receive a parvo virus vaccination at 5 weeks of age, a 7-way vaccination (canine distemper, adenovirus type 2, coronavirus, parainfluenza, parvovirus and leptospira bacterin) at 8, 12, 16 and at 20 weeks of age another parvo virus vaccination. At 12 and 16 weeks of age they receive lyme vaccine and at 16 weeks they are vaccinated against rabies. They begin a life long monthly heartworm prevention program at 3 months of age. Males are neutered at 4 to 5 months of age and females spayed before first heat, about 6 to 7 months of age. All of the dogs, upon reaching one year of age, are on an annual vaccination program for 7-way, lyme and rabies.

Guarding Management

The pups are born within the same time frame as kidding (March/April and October/November) so during any year several litters of guardian pups are born. When pups open their eyes there are many "kid" eyes staring back at them, checking them over. The kids are cautious around the pups and are tolerant when the pups start waddling around, interrupting the kids' nap time. Kidding takes place in solar powered electric fencing (5 to 6 strand polywire or electronetting) so the pups learn at a very early age where they are to stay. They have a great respect for the electric fence - it only takes one time of contact and their memory is imprinted forever.

The pups need to be COMPLETELY bonded with the goats for them to be successful guardians. I do not pet the pups nor do I let anyone else pet them. They are handled when receiving vaccinations or heartworm medication. The pups will come around and "check in" when someone goes into the pasture to check the goats. The pups' presence is acknowledged with a quick "pat" on the head and they are encouraged to "get back to the goats". Once they are completely bonded, then an extended head pat and neck rub, which is an acknowledgement to them, is given. They are usually about 6 to 8 months old when this begins to happen. However, each pup is an individual, maturing at a different rate than littermates, so take care that they are totally bonded before befriending. And remember, the guardians are for the goats.

Weaning the Pups

Once the pups are 6 weeks old, the extra supplemental meal fed to the bitch is eliminated and she eats dry food only. This initiates the "milk" drying off process. The pups are encouraged to eat more food fed in individual pans and the self-weaning has begun. By the time they are 8 weeks old, they have weaned themselves. We leave the bitch with the pups if self-weaning has been successful. This allows the pups to travel with their mother and start learning the ropes of becoming a successful guardian. Should self-weaning not succeed, the bitch is removed from the pasture, and an older, neutered male is placed with the pups as "teacher/mentor". The pups stay with the kids to weaning; weaning the kids at 3 months of age.

It is now time to introduce the herding dogs (Border Collie, New Zealand Heading dog and Huntaway). The guardian pups are still in the "apprehensive, curious" phase of development so they more readily accept the working dogs. As the goats are moved to different areas to clean brush and browse, the pups are mustered with the goats by the herding dogs. The pups learn to travel with the mob and to not challenge the herding dogs.

The weanoffs are separated into two groups; the doelings (disbudded) and the wethers/bucklings (horned). At weaning, the pups and their "teacher" go with the doeling weanoffs. The pups will stay with the doelings until they are approximately as tall as the doelings. It is important to keep the pups with a group of goats that are just slightly larger than the pups are. This prevents the pups trying to "play" with the goats. When they try to become too aggressive or assertive, the goats are large enough to convince the pups they do not want to proceed with bad actions. Once the pups reach a point where they need to be removed from the doeling mob, they are taken to the wethers/buckling group along with their "teacher". It is also at this time when they learn to eat from self-feeders.

The wethers/buckling mob is physically larger and the bucklings less tolerant of "playful" pups; they straighten the pups out right away. It is at this point in "facilitation time" that the litter of pups is separated. Only 2 pups are kept together with an older (mentor) guardian. When the 2 pups are almost as tall as the goats, they are moved to either a doe mob, or in with a group of yearling bucks. These mobs are each being guarded by a minimum of three experienced dogs. They will stay with this size of goat until they are a year old. But, they will be exchanged every few weeks so that all the pups will be with other mature guardians and other pups. Do not keep the same two pups together. I prefer to only have one pup with other guardians but sometimes we have as many as 10 to 12 pups at a time and it makes logistics difficult. I like my dogs to be able to work together with any dog they may be placed with in the future. They have to be adaptive in acceptance to all livestock guardians and all classes of goats.

Evaluating the Maturing Dog

Up to this point, the maturing dogs have been in an area that has coyotes and domestic pack dogs as predators. They will be in this setting as yearlings. Between one and two years of age the guardians will participate in at least three kiddings. They are observed for their active guardianship of the young kids and does. Their personalities and temperaments are critically assessed. This is a major turning point in time when any guardian not "passing the test" will be culled. At about two years of age, they go into densely forested areas to guard and now in their guarding career will be faced with the possibility of encountering bear. Here they are guarding in higher elevation vegetation; lots of dense brush, blackberries, downed timber (or harvested area) and trees. Guarding in the mountains will round out their guarding experiences and I now consider them mature, experienced livestock guardians. The goats they are guarding under these vegetative conditions are mature wethers and mature does.

It takes time and a sincere effort to facilitate the success of a livestock guardian dog. They will save you many dollars and heartaches. A mature, experienced guardian is irreplaceable and commands respect. Goats Unlimited would not be successful without them. And it is to the "livestock guardian dog" that I am grateful.

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PREDATORS AND PREDATION MANAGEMENT

An Peischel
Small Ruminant Specialist (Goats)
Cooperative Extension Service
Tennessee State University
and
University of Tennessee
Phone: 615-963-5539

?? WHY ??

? WHY ?

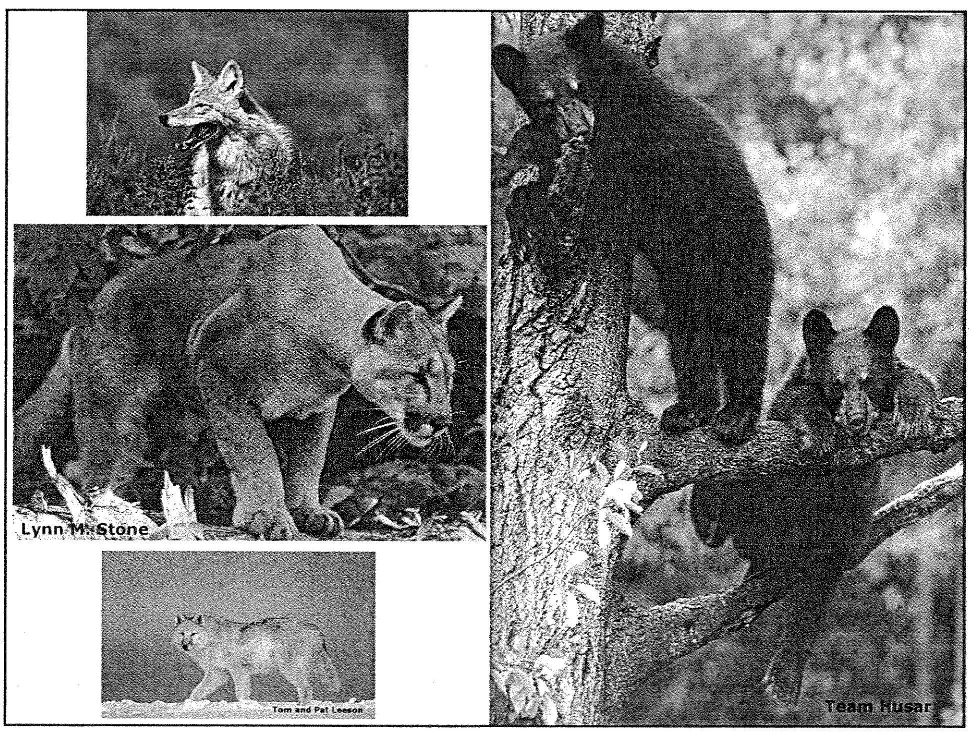
- Long term monetary effect
- Long term herd stress
- Consumption pattern changes
- Effect on guardians
- Human anxiety

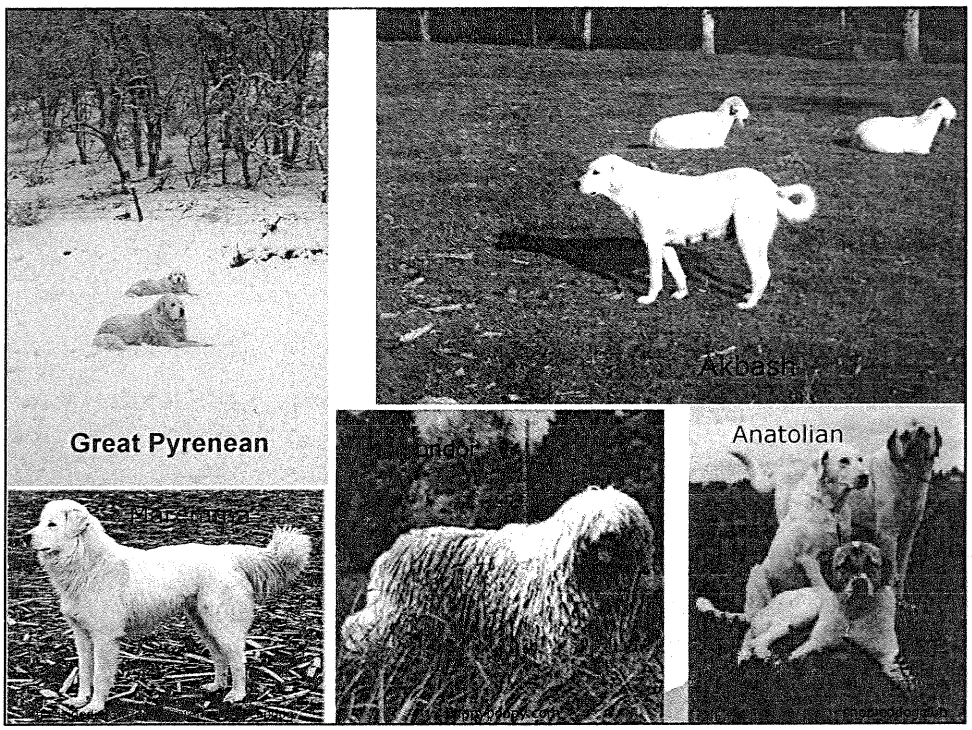
the CONCEPT

- respond aggressively to predators
- display instinctive protective behavior
- remain with and respect livestock specie
- posses confidence / power / stamina
- environmental versatility

the SELECTION

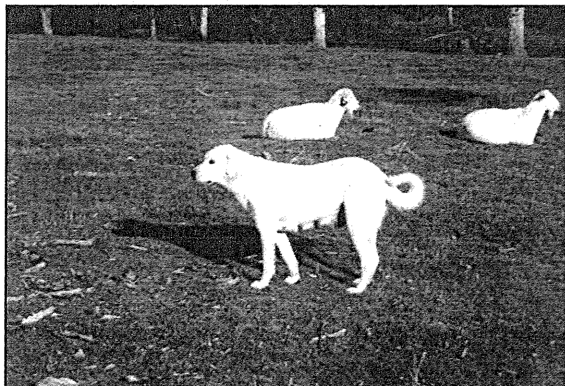
- ◆ identify type of predator
- ◆ climate / topography
- ◆ vegetation type
- ◆ genetic heritability





Great Pyrenean

- large and powerful
- great stamina
- dense coat
- quiet confidence
- more people tolerant



Akbash

- short length double coat
- built for speed and stamina
- keen eye sight and hearing
- more aggressive to predators
- forceful independent nature

Benefits and Problems of Livestock Guardian Dogs

	Stay with sheep			
	Number of dogs	Mostly	Usually	Rarely
Great Pyrenees	437	53	24	23
Komondor	138	50	23	27
Akbash	62	71	12	17
Anatolian	56	69	16	15
Maremma	20	79	16	5
Shar	11	30	20	50
Kuvasz	7	33	33	34
Hybrid	23	70	13	17
Other	9	33	17	50
Total	763	55	22	22

R.A.Woodruff

Benefits and Problems of Livestock Guardian Dogs

	Effectiveness			
	Number of dogs	Very	Somewhat	Not
Great Pyrenees	437	71	22	7
Komondor	138	69	1	12
Akbash	62	69	22	9
Anatolian	56	77	13	10
Maremma	20	70	20	10
Shar	11	40	30	30
Kuvasz	7	57	29	14
Hybrid	23	87	4	9
Other	9	43	29	28
Total	763	71	21	8

R.A.Woodruff

Benefits and Problems of Livestock Guardian Dogs

	Aggressive to...		
	Number of dogs	Predators	Dogs
Great Pyrenees	437	95	67
Komondor	138	94	77
Akbash	62	100	92
Anatolian	56	96	86
Maremma	20	94	94
Shar	11	88	89
Kuvasz	7	100	67
Hybrid	23	95	85
Other	9	83	100
Total	763	95	74

R.A.Woodruff

Benefits and Problems of Livestock Guardian Dogs

	Economics			
	Number of dogs	Asset	Breakeven	Liability
Great Pyrenees	437	83	11	6
Komondor	138	82	8	10
Akbash	62	71	12	12
Anatolian	56	82	8	10
Maremma	20	84	5	11
Shar	11	50	0	50
Kuvasz	7	80	0	20
Hybrid	23	84	5	11
Other	9	20	20	60
Total	763	82	9	9

R.A.Woodruff

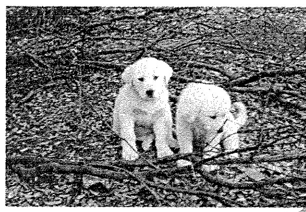
SELECTION of BREEDING STOCK

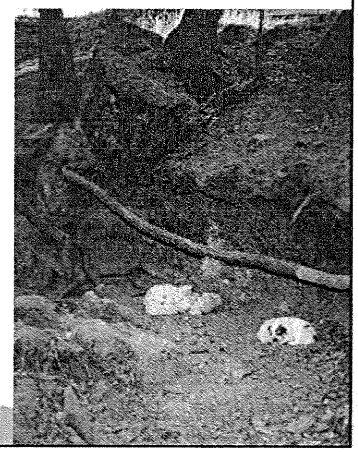
- Successful guardian in their own right
- Two years of age

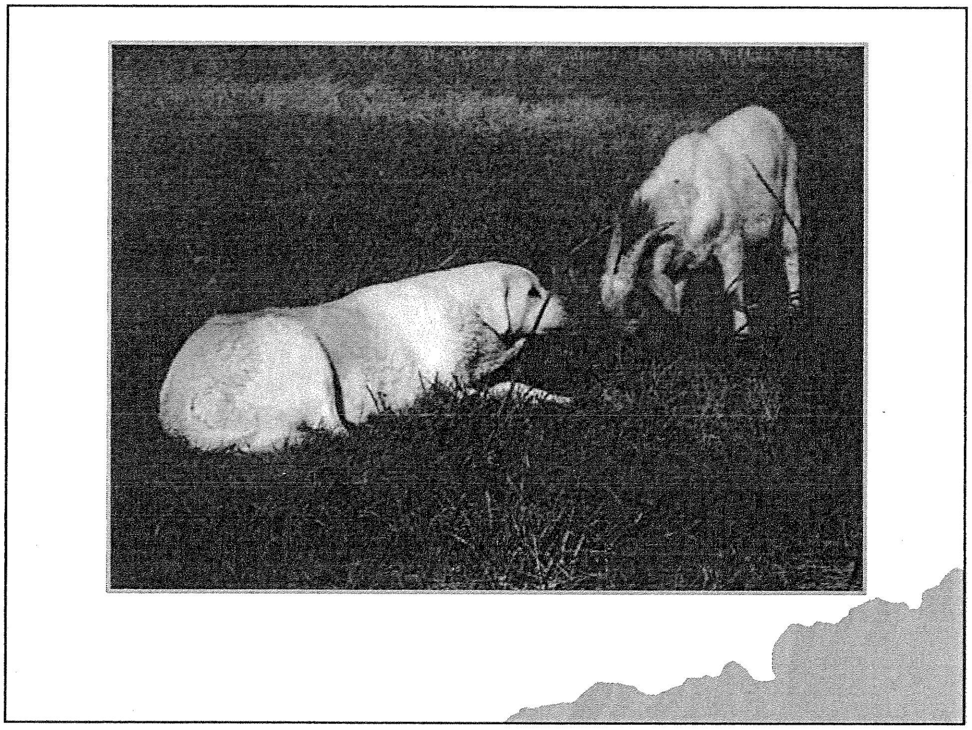
- OFA (Orthopedic Foundation for Animals)
- OCD (Osteochondrosis)

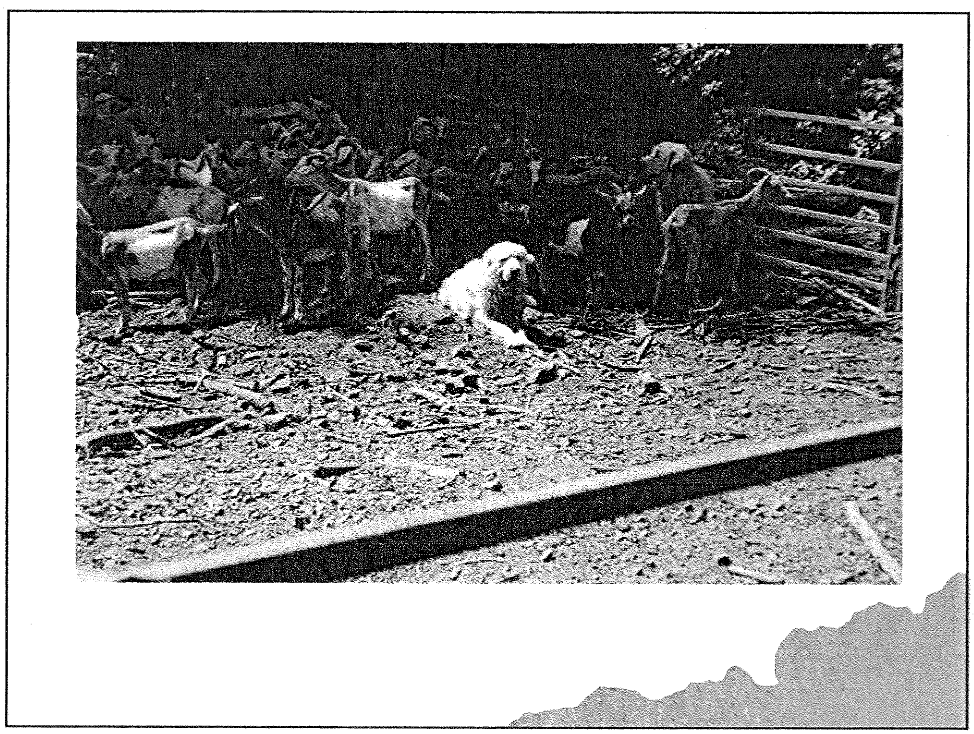
SELECTION of a GUARDIAN PUP

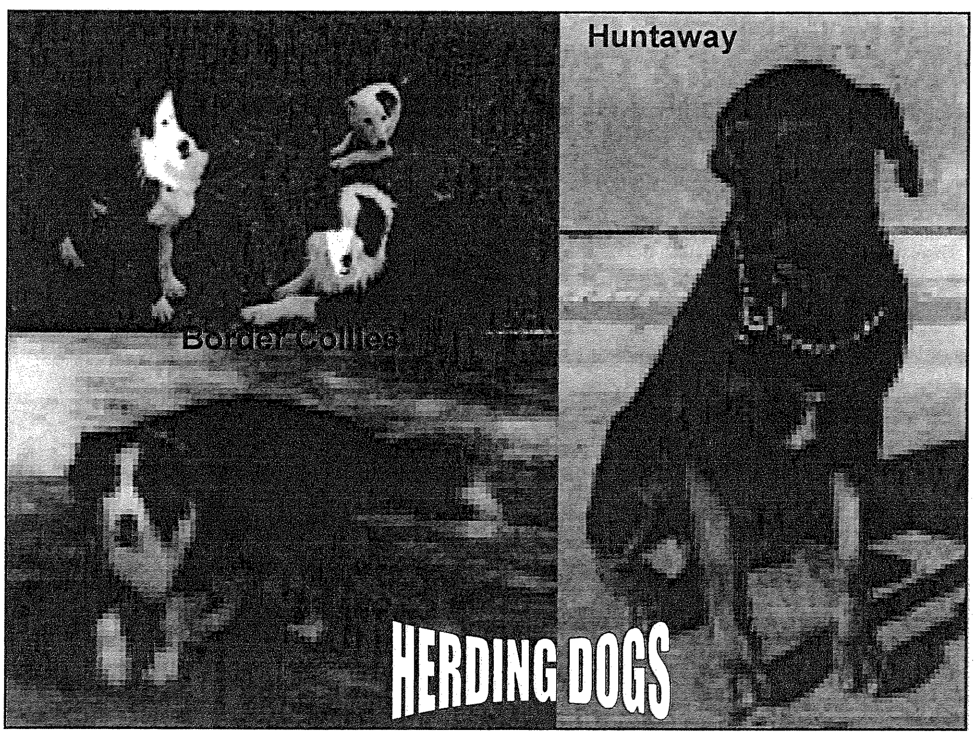
- Dam and sire are working guards
- Whelped with livestock
- Raised with livestock
- Facilitated to be successful
- Disposition

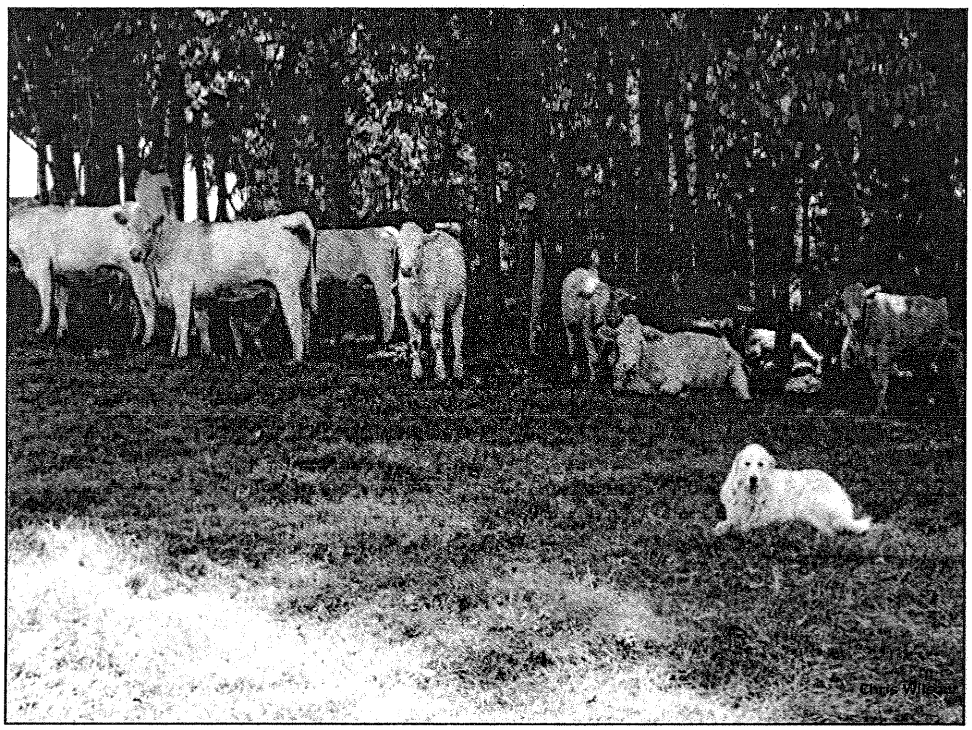


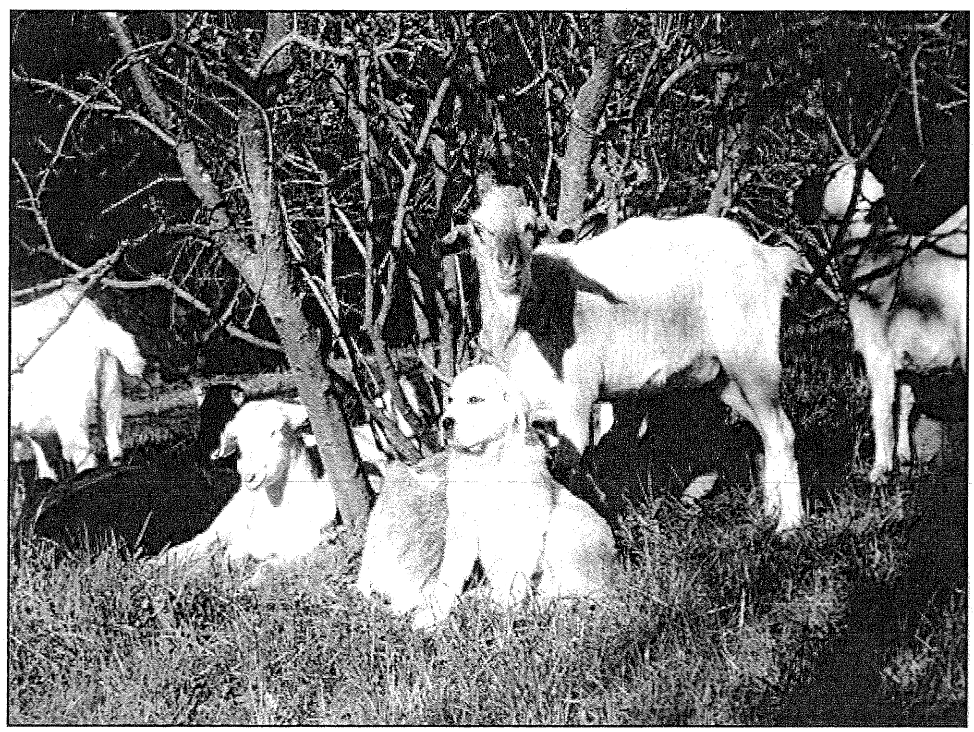







Huntaway
Border Collies
HERDING DOGS


Chris



Health Maintenance Program
(vaccinations)

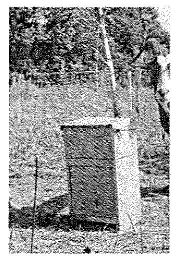
- Annual
  - Parvovirus
  - Rabies
  - Lyme Disease
  - 7 Way (canine distemper, parvovirus, canine coronavirus, parainfluenza, adenovirus Type 2 and leptospira bacterin)
- Monthly
  - Heartworm medication

Health Maintenance Program

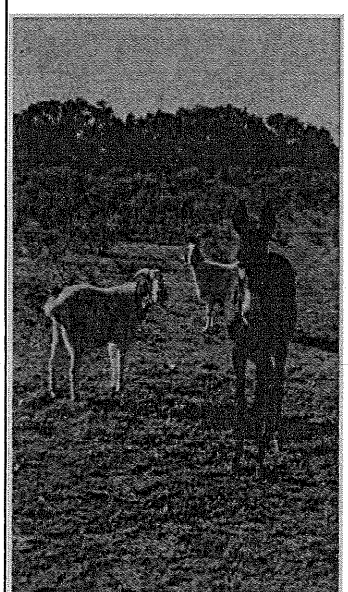
- Ticks
- Hotspots
- Burrs / Thorns (fibre / feet)
- Teeth
- Ears
- 3rd eyelid

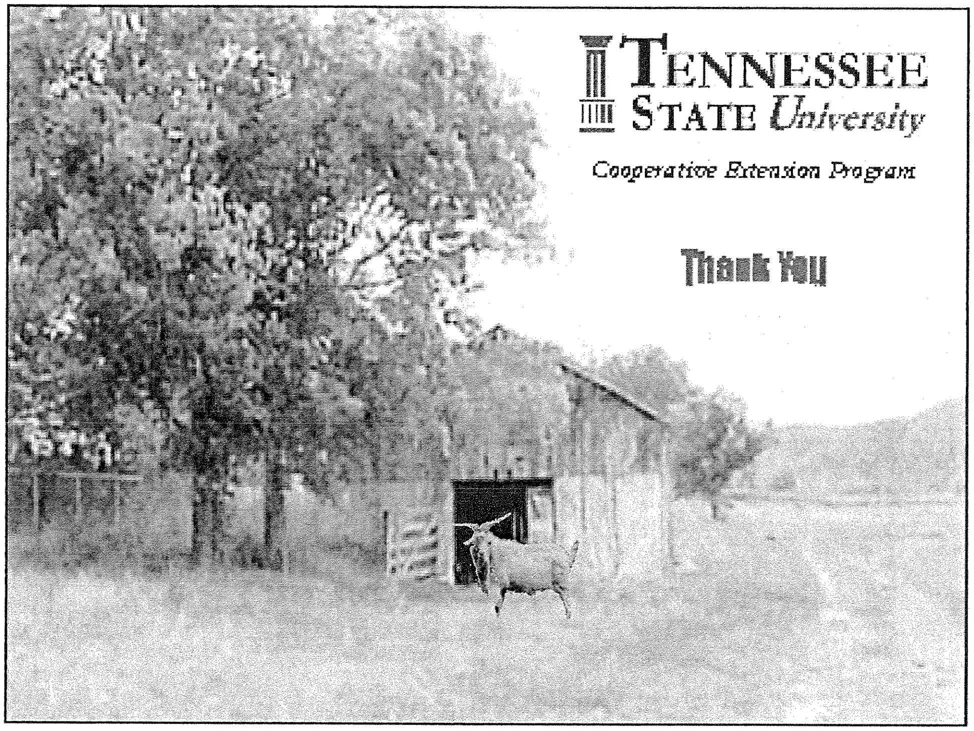
Nutrition

- Feed on behavioral patterns
- Balanced for energy and protein
- Mineral and vitamin supplements
- NO ruminant animal byproducts in diet



Guardian Options




TENNESSEE
STATE University
Cooperative Extension Program
Thank You

STRATEGIES FOR IMPROVING FLOCK GENETICS

Randy C.Borg[1], David R. Notter[1] and Rodney W. Kott[2]
[1]Virginia Polytechnic Institute and State University, Blacksburg, VA 24061
[2]Montana State University, Bozeman, MT 59717

Introduction

Most commercial sheep producers associate improvement in genetics with the use of top quality rams, and rightly so, since most genetic improvement in the flock can be attributed to ram selection. Ultimately, the quality of a ram's genetics is determined by the economic impact of his lamb crop on the operation's bottom line. After all, the lamb crop is generating most of the income, whether through market lamb sales, or retained use as breeding ewes within the flock. With improved genetics comes "better" performance from the sheep which influences expenses for things like feed, labor or capital investments (facilities, land, purchase of breeding stock, etc.). Studying the economic value of genetic improvement is important to provide commercial breeders with useful information to achieve meaningful genetic change. Our research has focused on using available tools such as expected progeny differences (EPD) to make economically efficient genetic improvement. To do this, the added value (or expense) associated with genetic change is evaluated. With this type of evaluation commercial breeders can assess the economic value of a ram based on his estimated genetic contribution to the future lamb crop.

The most important criteria for choosing breeding sheep is that they are reproductively sound (i.e. rams that can breed and ewes that maintain pregnancies and wean lambs). After assessing fertility, measures of genetic value for characteristics such as pre- and post-weaning lamb growth, number of lambs born and fleece traits are typically available either through comparisons within the flock (pedigrees, growth ratios, ADG, etc), or from EPD which are a more reliable measure of an animal's genetics. Appraising the value of such traits is relatively straightforward; obviously, increases in lamb growth, number of lambs born and wool quality or quantity all increase income for the system but at the same time each is also associated with added expenses to the production system.

Research

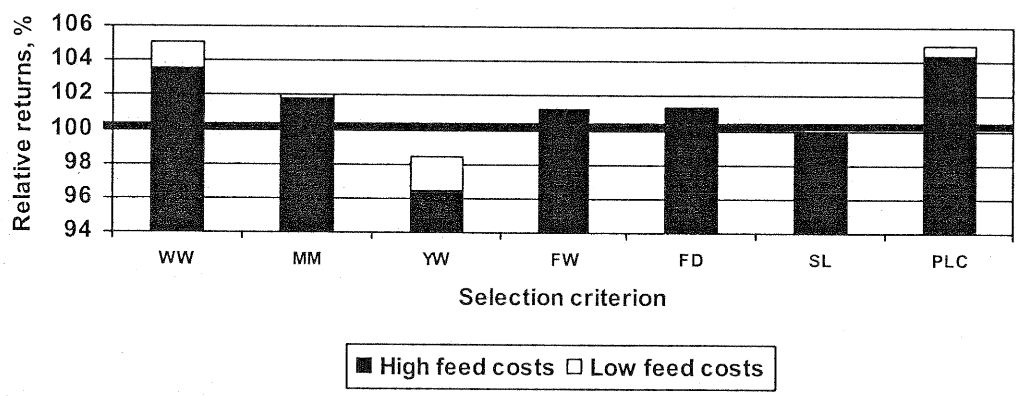
Methods: Data from Targhee sheep (a dual purpose meat and wool breed) participating in National Sheep Improvement Program's Across-flock National Genetic Evaluation were available for this study. EPD were obtained for production traits, including:

- WW = Weaning Weight (Weight at weaning, 120 days)
- MM = Maternal Milk (Genetic measure of milk production for lamb growth)
- YW = Yearling Weight (Weight at one year of age)
- FW = Fleece Weight (Weight of fleece at one year of age)
- FD = Fiber Diameter (Fiber diameter of yearling fleece)
- SL = Staple Length (Length of staple of yearling fleece)
- PLC = Percent Lamb Crop (number of lambs born per 100 ewes lambing)

The economic value of each trait was calculated based on the change in profit from a one-unit change in each trait, independent of all other traits. An example would be the profit or loss given by a one-pound increase in WW, with all other traits held constant. Profit was estimated by subtracting expenses from income. For example, the income from a one-pound increase in WW minus the cost of the additional feed required to support the added growth. Each trait was evaluated under different production scenarios that represented a range of feed costs and lamb markets that were common for producers. The resulting economic values for each trait represented the dollar value associated with genetic change in the trait.

Results: Figure 1 represents the relative value of each trait for a marketing system where market lambs are not discounted for heavy weights (i.e. heavy and light weight lambs have the same value per pound) and where differing feed costs were assumed for high feed costs (higher cost of purchased hay) and lower feed costs (lower cost of grazed forage). Values for each trait indicate the percentage change in profit from selection on the trait for high and low feed cost scenarios. A relative value greater than one hundred indicates positive change in income while a value less than one hundred represents a negative change in profit. For example in a grazing system the value of improving WW by one-unit is nearly a 5% increase in profit, compared to no change in the trait, as apposed to a one-unit increase in YW which yields a reduction in profit of nearly 2% due primarily to the added feed requirements of a larger breeding ewes.

Figure 1. Returns over feed costs as a percentage of average performance



Lamb growth was of major economic importance, reflecting the added value of larger market lambs. Similarly, the economic importance of PLC was also high. More lambs born per ewe had an obvious advantage for increasing profit by producing more lambs for market. Although increasing PLC reduces the number of single born lambs and increases the number of multiple litters, it also influences lamb survival and ADG of these lambs, because twin and triplet born lambs typically have lower survival and ADG than single born lambs.

Selection for MM also increases lamb weight, however, the lamb gain associated with milk production is less efficient that gain from a lamb's direct feed intake and therefore the economic value is about one half the value of WW. Ewes that produce more milk have higher energy requirements and thus consume more feed (supplement or hay) than those producing less milk which results in somewhat higher feed costs from selection for MM.

Although rams contribute the most genetic improvement to the flock and the lamb crop generates the most income, it is the breeding ewe that accrues the most expense within the flock. Selection for increased YW with no change in WW results in increased post-weaning gain and a larger mature body size of the breeding ewe. Heavier ewes have a higher feed requirement and therefore a higher feed cost, with little change in income. Therefore, selection for added ewe weight has a negative relative influence on the profitability of the system.

The preceding research has resulted in the development of an economic breeding objective for the Targhee breed. Economic values for each trait have been implemented in multiple trait selection indexes to provide breeders with a single dollar value used to rank rams on their cumulative economic value based on predicted genetic values for each trait. Furthermore, this research helps put into perspective the relative economic importance of different traits and demonstrates the value of reproduction over growth and wool traits for sheep.

Ongoing research: Currently our research is focusing on characterizing the relationships between genetic improvements of reproduction and lamb growth with survival of the lambs and breeding ewes. Knowledge of the genetic influence on lamb and ewe survival can help make optimal changes in genetic improvements for the flock by increasing the length of time a ewe is reproductively functional, thereby reducing the number of lambs retained for breeding each year and allowing more lambs to be marketed.

Preliminary results indicate heritability associated with the length of time a ewe stays productive in the flock is low, ranging from 0.01 to 0.14. This indicates only a small genetic influence on the length of time a ewe remains productive. Although the genetic component of ewe survival is small, it is important because it provides a means of improving flock productivity through selection. Yet to be addressed is the genetic relationship between a ewe's length of productive life and other production traits, such as reproduction and lamb growth.

PARASITE RESISTANCE: ONLY FOR HAIR SHEEP?

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Introduction

Sheep and goat producers worldwide sustain extensive economic losses due to internal parasitism. The greatest areas of impact are in hot humid climates, such as the southeastern US and gulf coast regions, where the most devastating losses result from infection with the barber pole worm, *Haemonchus contortus*. Rapid development, tremendous egg laying capacity, and requirement of both larvae and adults to feed on blood make this abomasal parasite the number one threat to most sheep production units. Animals with a small worm burden may not show clinical signs of haemonchosis, but could have significantly decreased wool and muscle growth. Sheep with more substantial worm burdens are greatly affected and can lose over 50 mL of blood per day, resulting in severe anemia, anorexia, depression, loss of condition, reduced growth rate and even death.

Control of gastrointestinal parasites is complicated by the increased prevalence of worms that are resistant to chemical anthelminthics, creating a greater need for alternative methods of parasite control. Management-based control strategies, such as decreased frequency of anthelminthic use, providing proper dosages of dewormers, pasture rotation, etc., can only delay the accumulation of resistant nematodes. Selection of current wool sheep breeds for resistance to internal parasites is possible, but long periods of intensive selection would be required to permit meaningful reductions in parasite burden.

Caribbean hair sheep are known to be resistant to gastrointestinal nematodes, but the mechanism that enables them to fight off infection by these internal parasites has yet to be determined. Multiple studies have shown differences related to the immune response (antibodies, etc.) between hair and wool sheep and also between infected and uninfected animals. These studies have indicated that resistance is potentially mediated by genes that control the immune system. The goal of this study was to determine the mechanisms and genes involved in the development of resistance to gastrointestinal nematodes in Caribbean hair sheep.

Procedures

Twenty-four hair lambs of St. Croix and Barbados Blackbelly lineage and 24 wool lambs of 50% Dorset, 25% Rambouillet and 25% Finnsheep breeding were used in the study and maintained at the Virginia Tech Sheep Center in Blacksburg, VA. January, 2005-born lambs were raised under field conditions with no effort to preclude parasitic infection. In May, 2005, lambs were infected once a week for 4 weeks with 3,000 *H. contortus* larvae to ensure that all lambs had been exposed to the parasite. One week after the last infection, lambs were dewormed and moved to raised pens to prevent reinfection. Lambs were dewormed again three days later, at which point all fecal egg counts were found to be zero. Light coccidia infections were found, but symptoms of coccidiosis were not observed.

Approximately one week after the last deworming, 24 lambs were orally infected with 10,000 *H. contortus* larvae and the remaining 24 lambs were left as uninfected controls. *Haemonchus contortus* larvae were obtained from sheep located in Blacksburg, VA. At both 3 and 27 days post-infection, 12 lambs were killed, followed by exsanguination. Day 3 and 27 were chosen to represent responses to *H. contortus* larvae and adult worms, respectively. Control animals were slaughtered at 3 (6 lambs), 13 (12 lambs) and 24 (6 lambs) days after the start of sample collection (Fig. 1). The gastrointestinal tract was removed immediately after slaughter and processed for collection of parasites and abomasal and lymph node tissues.

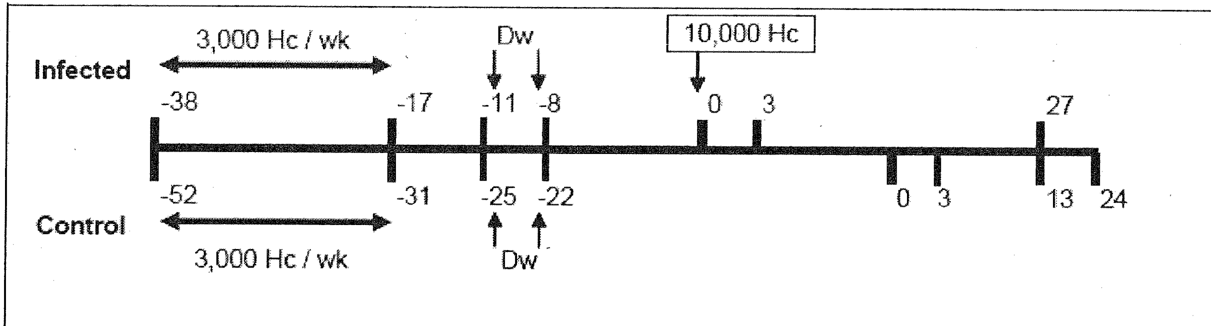


Fig. 1. Days relative to infection with *Haemonchus contortus* (Hc) L_3 (infected) and/or start of sample collection (uninfected control).

Dw - Dewormed with Fenbendizole and Levamisole

IgE Analysis

The antibody immunoglobulin E (IgE) is typically associated with hypersensitivity reactions and allergy, but also activates certain cells that have been shown to damage parasites. To measure circulating IgE antibodies, blood was collected at day 0, 3, 5, 16, 21, and 24 or 27 from available animals. To measure a local gut response, abomasal lymph nodes were collected.

RNA extraction, Florescence Labeling and Microarray Hybridization

Total RNA was extracted from abomasal tissues, concentration and purity were determined and only high quality samples were used. RNA was reverse transcribed and the resulting cDNA were labeled with a florescent dye and incubated with a bovine cDNA microarray. Images of the microarrays were scanned and total intensity values (brightness of the dye) were obtained to determine levels of gene expression.

Experimental Design and Statistical Analysis

In order to better assess the differences between infected and uninfected animals and minimize cost, cDNA of each resistant hair lamb was paired with cDNA from a random susceptible wool lamb for each infection status and day sampling, resulting in 24 microarrays. Paired samples were hybridized to the Michigan State University bovine cDNA microarray, containing over 18,000 unique gene transcripts.

Scanned images were processed and flagged for abnormalities. A two step mixed model analysis was performed, where the first step adjusted for array-specific variation. Residuals were carried over to the second step, which tested for gene-specific effects of the sheep breeds. Breed differences were then determined for each of the experimental groups. Genes with significant ($P < 0.01$) differential expression were grouped by their function using GO! Ontology classifications to determine highly represented groups of genes.

Results

Microarray Analysis

Sixty or more genes were determined to be differentially expressed ($P < 0.01$) in each of the experimental groups of hair versus wool lambs (Fig. 2 and 3). Significant differences in infected animals at three days post-infection were of particular interest because of the potential for the sheep to respond quickly to invading larvae. This experimental group had 29 genes with greater expression in wool lambs and 31 genes with increased expression in hair lambs. One of the highly represented functional groups included genes involved in **immune response**. Four of five genes in this group had **greater expression in hair sheep**, and the remaining immune gene with increased expression in wool lambs is associated with both positive and negative regulation of immune response. One of the most notable findings within the immune related genes was increased expression in hair lambs of **interleukin-4 receptor α** (a receptor for signaling molecules involved in a systemic response and relating to antibody production) and **interleukin-12 receptor β1** (receptor for signaling molecules involved in a cellular, more localized, response) without significant differences ($P < 0.01$) in parasite-free animals. Results found in control animals at day 13 (Fig. 3) were typical of those found in the other control groups and are the only ones presented here.

Ontology Clustering

Excluding genes of unknown function, proportions of the top five ontology groupings (Fig. 2 and 3) were 1.5 to 8 times greater than proportions of the same functional groups over the entire array. Of all the genes present on the array, the most represented group, transcription

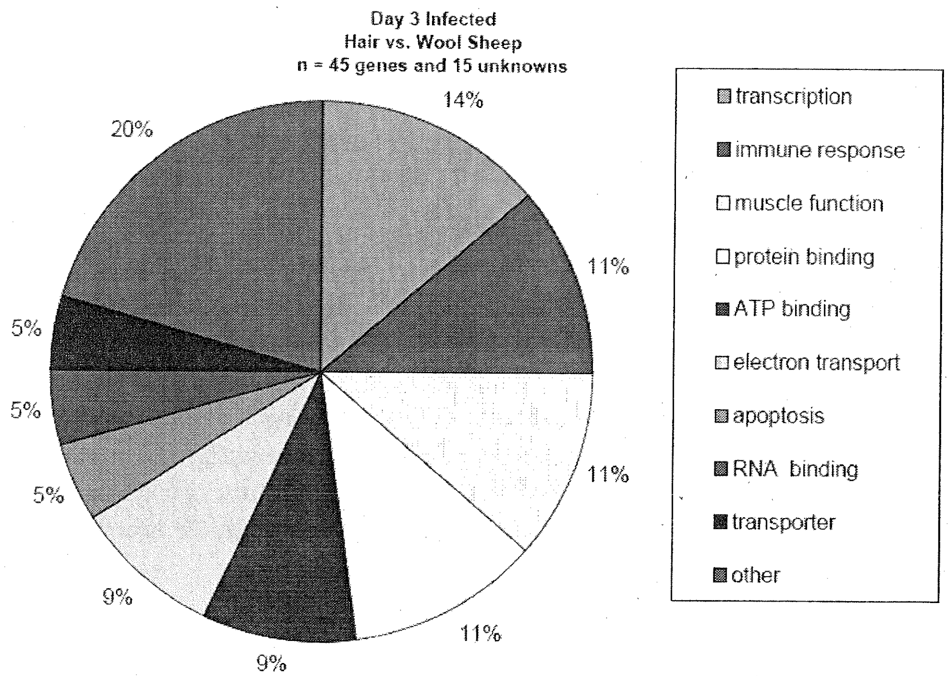


Fig. 2. GO! Ontology clustering of genes found to be significant ($P < 0.01$) from comparisons of abomasal tissue samples in infected hair versus infected wool lambs at three days post-infection, grouped by molecular function.

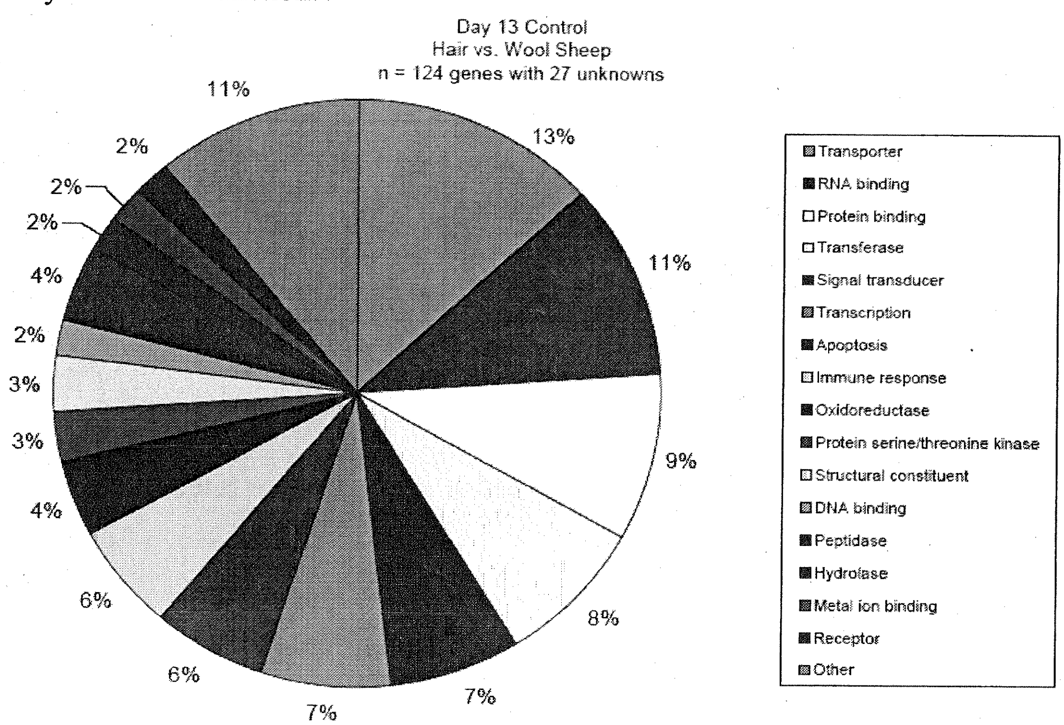
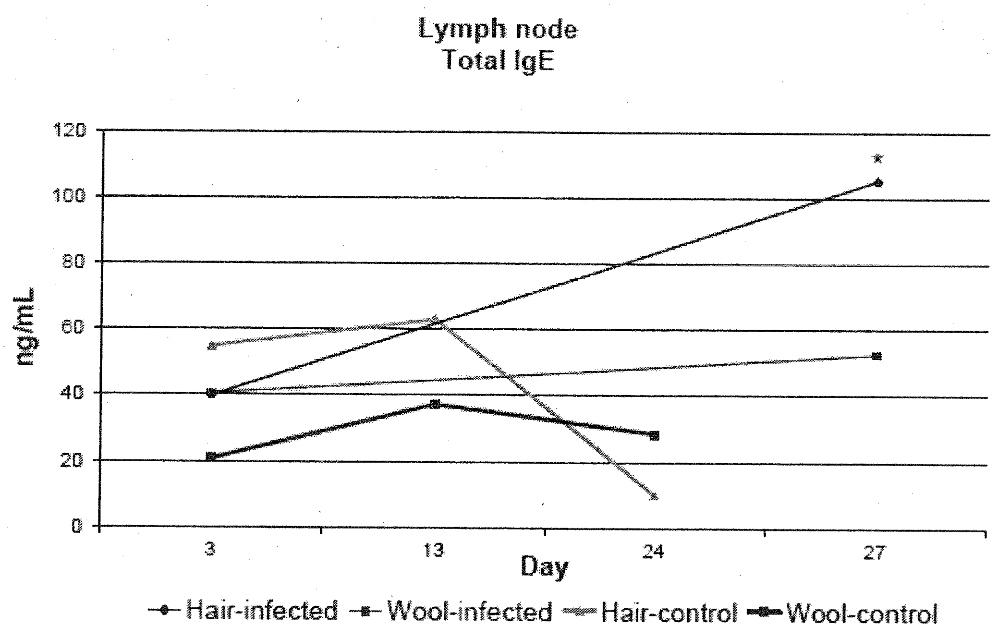


Fig. 3. GO! Ontology clustering of genes found to be significant ($P < 0.01$) from comparisons of abomasal tissue samples in uninfected control hair versus uninfected wool lambs at 13 days post-initiation of sample collection, grouped by molecular function.

factors, compromised 5.3 % of the 2799 genes of known function. All experimental groups had a **considerable number of immune related genes**, indicating these hair and wool sheep not only respond to parasitism in different ways immunologically, but potentially have different immune mechanisms present without parasite challenge.

Immunoglobulin E

Total IgE in serum is a measure of a systemic immune response, but did not differ between breeds in infected or uninfected animals at any time. However, lymph node samples from infected hair lambs showed significantly ($P < 0.01$) **elevated levels of total IgE by day 27** compared to wool lambs within the same group (Fig. 4). No differences were found between infected animals at day three or control animals at any time point. Although these differences do not necessarily show that the increase in IgE is due to infection with *H. contortus*, the lack of a breed differences in control animals suggest that parasitic infection caused an increase in levels of IgE in the lymph nodes. Further validation through measurement of IgE specific to *H. contortus* will be used to verify these results.



* $P < 0.01$

Fig. 4. Total IgE (ng/mL) in the abomasal lymph nodes of *H. contortus* infected or parasite-free hair and wool lambs.

Implications

Acquired Immunity

Although many researchers have tried to find genes associated with resistance to internal parasitism and most have not fully succeeded, the comparison of these two different breeds of sheep is proving to be very promising. Analysis of the data showed **major changes of the abomasum** in response to *H. contortus* even at **three days post-infection**. Although responses to adult worms were present, the early stages of response to these **immature worms may be of more importance**. Since the L_4 larvae are the only stage remaining in close contact with host tissue, a rapid response may be the most effective way to damage the invading parasite. The main differences in gene expression involved transcription, immune response, muscle function, and protein binding in genetically resistant Caribbean hair sheep versus susceptible wool sheep at three days post-infection. High representation of these particular groups may be indicating that the response of hair sheep to internal parasitism is more **immunologically mediated** with potentially **increased muscle function**, peristalsis, and flushing of the abomasal contents. Genes of interest will be further validated using quantitative RT-PCR. Additional immune mechanisms to be analyzed involve enumeration of white blood cells infiltrating abomasal tissues, measurement of IgE specific to *H. contortus*, and measurement of both total and parasite-specific Immunoglobulin A. These responses may be the key to determining the mechanisms involved in internal parasite resistance.

Sheep Industry

Determination of genes associated with resistance would be of tremendous value to the sheep industry. Once effects are verified, genes found to have an impact on decreasing worm burden could be used as **genetic markers for parasite resistance**. If alleles found to confer resistance are not present in current wool breeds, then crossbreeding to hair breeds with these alleles would allow for **introgression of parasite resistance into susceptible wool breeds** worldwide. Sheep breeds with hair and wool ancestry, such as the Dorper and Katahdin, would also benefit by **retention of favorable growth and carcass characteristics** while maintaining greater parasitic resistance. Additionally, producer **dependency on anthelminics for parasite control would diminish**, as would the rate of parasite resistance to anthelminics. Overall, the benefit to the sheep industry would be substantial, with decreased reliance on chemical dewormers and increased production of meat and wool products.

Acknowledgments

We would like to thank:

- Virginia Agricultural Council for providing funding for this project (No. 474).
- Everyone at the MSU Center for Animal Functional Genomics for enabling the microarray work, especially Dr. Jeanne Burton, Ms. Sue Sipkovsky, Dr. Rob Templeman and Dr. Paul Coussens.
- Dr. Frans Kooyman of Utrecht University, Netherlands, for his collaboration and measurement of IgE.

COMPARATIVE HEALTH CONCERNS FOR SHEEP AND GOATS

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There are many disease agents and management protocols that are similar for sheep and goats. Likewise, there are several differences between the species when it comes to clinical signs, treatment and management of these health issues. I frequently receive calls related to the following health issues shared among sheep and goats.

Copper

Copper is an essential mineral for both sheep and goats. Copper deficiency may result in anemia, decreased milk production, reduced fertility, increased incidence of disease and decreased natural resistance to parasites. Decreased growth rates and joint problems are observed in growing animals. The most commonly known condition resulting from copper deficiency is swayback or enzootic ataxia in lambs and kids which produces an ascending paralysis.

There is an interaction between dietary copper and molybdenum. It is recommended that the dietary copper to molybdenum ratios be 5:1 to 10:1.

Sheep are sensitive to copper toxicity. As a result, sheep should only be fed mineral formulated for sheep. Likewise, sheep should only be fed products designed for sheep, e.g. milk replacer. Sheep consuming goat or cattle mineral may develop copper toxicity.

Goats fed sheep mineral are likely to be deficient in copper depending on the other feedstuffs in the diet. Goats should be fed goat mineral.

Caseous Lymphadenitis, CL, Boils

Is a bacterial infection of both sheep and goats. The organism involved is *Corynebacterium pseudotuberculosis*. The organism produces abscesses throughout the body. The bacteria are transmitted through the rupture of abscesses, releasing the organism and the organism then enters breaks in the skin. The organism can cause abscesses within the lungs resulting in aerosolization of the organism and inhalation by susceptible animals. The organism is credited for being one of the major causes of chronic weight loss in both sheep and goats.

Diagnosis is made by culturing the contents of the abscesses. There is a blood test, Hemolysin Inhibition Test, which tests for the toxin produced by the bacteria. The advantage of the test is that it can test animals that are infected but not showing observable abscesses.

California Animal Health and Food Safety Laboratory System
West Health Sciences Drive - UCD
Davis, CA 95616
- requires 0.5 ml of serum (red cells spun down and removed before shipping)
- costs $4.50/sample if the animal resides in California, $7.50/sample for submissions from other than California
- submission forms and billing information can be obtained at (530) 752-7577

http://cahfs.ucdavis.edu/

Sheep: the majority of abscesses occur in the lymph nodes of the head but also in the internal organs like the liver, kidney and lungs. The pus in the abscess ranges from being very dry to thick pudding. The color is white to pale green.
Vaccination, CaseBac®, is approved for sheep and has been effective in controlling the disease in some flocks.

Goats: the majority of abscesses occur in the lymph nodes under the skin but may also occur in internal organs. Most common places are under the jaw, in front of the shoulder and stifle. The pus may be fluid like, almost clear, with flecks of white pus to thick white sour cream texture.
Vaccination: there is no approved vaccine for goats. There have been reports of anaphylactic type reactions when CaseBac® has been used in goats.

Parasites

Internal parasites – both sheep and goats are infected with the same worm parasites, *Haemonchus* or the barber pole worm causing the majority of problems. The FAMACHA system works well for both sheep and goats.

Dewormers Approved for :

Sheep	**Goats**
Albendazole (Valbazen)	Fenbendazole (Safeguard)
Levamisole (Prohibit, Tramisol)	Morantel tartrate (Rumatel)
Ivomec drench	
Cydectin Drench	

As a general rule, goats need 2 times the amount of dewormer as sheep. Consult your veterinarian when the dosage and withdraw times are not listed for the species you are treating.

Coccidia: The coccidia that cause problems in sheep are different than the coccidia in goats. However, both types of coccidia are transmitted and survive in similar environments. Treatment for coccidia is the same for sheep and goats; sulfa drugs or Amprolium, Corid®.
For control of coccidia, decoquinate, Deccox®, is used in both species.
Ionophores can be added to feed to increase feed efficiency as well as a preventative for coccidian. Monensin, Rumensin®, is approved for goats and Lasalocid,Bovatec®, is approved for sheep.

Lice: The species of lice are different for goats and sheep so they don't share lice. The symptoms of lice infestation is the same for both species; intense itching, anemia, weight lose and hair or wool lose. Treatment involves topical application of either a permethrin or organophosphate.

Scrapie

Both sheep and goats are susceptible to scrapie. The estimated prevalence of scrapie in the eastern US is 0.52 or 52 sheep per 10,000 animals. The national average is estimated to be 20 sheep per 10,000 animals. An estimate for the prevalence of scrapie in goats is not available but is presumed to be very low. The problem with having sheep graze with goats is that if a case of scrapie is found in either species, the entire flock is considered exposed. In the case of sheep, the clean up process entails blood testing to identify animals that are susceptible based on genetics and then a follow up third eyelid test. Susceptible and positive animals are then slaughtered. The clean up with goats however requires that all females be slaughtered as there is no pre-mortem test. The goat's brain is then tested after slaughter.

Listeria

Both sheep and goats are susceptible to developing listeriosis. The organism, *Listeria monocytogenes,* is most often acquired through the environment. The organism lives in decaying forage, such as improperly ensiled silage, wasted hay around feeders, low areas that collect water or are boggy. The organism is thought to enter through breaks in the oral mucosa, lining of the mouth, and migrates up the nerve endings to the brain. Goats may be more susceptible to infections because of their nature to browse material that may damage the mouth. Animals close to one year of age are at increased risk due to lose of teeth. Sheep tend to respond to treatment better than goats and the earlier treatment begins the better the outcome.

Foot Rot

The organisms that cause foot rot, *Fusobacterium necrophorum* and *Dicheliobacter nodosus* live in goat and sheep feet. This is important in that new animals entering a herd or flock can bring the organisms with them infecting the resident animals. Animals with over grown hooves and housed in muddy environments are at increased risk of acquiring and maintaining the infection. The damage to the feet, separation of the hoof wall from the foot, is the same for both species. Goats are less likely to show signs of lameness compared to sheep. As a result foot rot may "hide out" in goats. Treatment, trimming hooves, antibiotics, and foot bath soaks are the same for both species. Prevention is to quarantine new animals for 30 days trimming feet when animals arrive and prior to entering the flock. Keeping feet trimmed will help reduce foot rot as well as other foot problems. The vaccine is approved for sheep. I have used the vaccine in goats without any problems except for the usual abscesses at the injection site.

Foot Scald

A condition that affects the tissues between the toes, often causing swelling above the toes. Goats often walk as if they have broken their leg, sheep are not as lame. Treatment for both is the same, antibiotics and foot soaks.

MAKING THE MOST OF YOUR FEED DOLLARS

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Feed represents the largest single input cost category of a sheep operation. There are many ways in which a producer can spend less money on the feeding program. However, producers should not reduce cost by underfeeding. In this paper the key stages of production will be outlined with a view towards the nutrition inputs needed to fulfill those requirements. Also, the feeds that may be used as a source of nutrition will be highlighted, especially the byproduct feeds. The importance of forages as a source of nutrition will also be emphasized. Finally, methods of purchasing feeds that result in reduced cost will be mentioned.

Stages of Production and Nutrient Requirements.

The phase of reproduction of a ewe basically defines her nutrient requirements. From the lowest stage in the production cycle to the highest it is almost a 3 X range in daily nutrition that is needed. In table 1 these values are depicted using a mature ewe with an average body weight of 154 pounds. You will note that energy (TDN) and crude protein (CP) are the 2 nutrients mentioned. The minerals and vitamins are also needed in proportion to energy and protein.

Table 1. Stage of Production and Required Nutrition of Mature Ewes (Based on 154 Lb Animal)

Stage of Production	Pounds of TDN	Pounds of CP	Voluntary Dry Matter Intake	Percent TDN*	Percent CP*
Maintenance	1.5	0.25	2.6	55	9.4
Early Pregnancy	1.7	0.29	3.1	55	9.3
Last 4 Wks Pregnancy, 130 - 150% Lamb Crop	2.3	0.42	4.0	59	10.7
Last 4 Wks Pregnancy, 200% Lamb Crop	2.8	0.47	4.2	65	11.3
Early Lactation, Single	3.6	0.73	5.5	65	13.4
Early Lactation, Twins	4.0	0.92	6.2	65	15.0

* Percentage of the Dry Matter

It is relatively easy to fulfill the requirements of ewes that are dry and nonlactating or are in early gestation. Average quality forages (meaning decent quality pasture or hay) will do this quite easily. Grain supplementation is not required at this time as long as forage quality is good enough.

Note the values as the ewe progresses through late gestation and into lactation. Required energy goes up substantially. Required protein goes up even more. But her ability to consume feed also increases. The ewe's metabolism is running faster, and one of the consequences is the noted increase in voluntary feed intake after lambing. Also, her body capacity is restricted before lambing because the fetuses which occupy the uterine area displace her capacity to consume feed. This restriction is no longer present after lambing, and voluntary feed intake increases substantially. So, one of the ways a ewe meets her greatly increased need for energy and protein during early lactation is simply to eat more feed. But, the feed has to be of higher quality, as seen in the columns headed as "Percent TDN" and "Percent CP".

Feeds and Rations for the Ewe Flock

Corn is the traditional energy supplement for sheep. However, the corn market dynamics are changing quickly. The next 2 paragraphs are direct quotes from an article by Jeff Wilson posted on the Bloomberg website on January 2.

"U.S. demand for corn used to make ethanol, a gasoline additive, will rise 34 percent to a record 2.15 billion bushels in the marketing year that began Sept. 1, the U.S. Department of Agriculture said Dec. 11. Corn is the nation's biggest crop and is also used to make livestock feed and sweeteners."

"The 110 factories now producing ethanol in the U.S. have boosted their annual capacity by 12 percent in the past six months, to 5.3 billion gallons, according to the Renewable Fuels Association in Washington. An additional 6 billion gallons of capacity will be added in the next two years as 79 new plants or expansions are completed, the association said."

The US corn crop in 2006 was 10.7 billion bushels. With ethanol use for corn increasing annually, and the export market continuing to be strong, there is a great deal of price pressure on the crop. March, 2007 futures prices are approaching \$4.00 per bushel, at least a full \$1.00 more than last year. The use of corn as a feed ingredient is still substantial, since chickens and hogs must be fed corn and not one of the byproducts from processing of corn.

Table 2. Nutrient Value of Selected Byproduct Feeds and Grains
(Values in this table are expressed on a Dry Matter Basis)

Feed	**Dry Matter Percent**	**TDN Percent (DM)**	**Starch & Sugar Percent (DM)**	**Crude Protein Percent (DM)**
Whole Soybeans	90	85	22	38
Soybean Meal	90	87	32	54
Soy Hulls	91	75	14	12
Ground Wheat	89	86	70	14
Wheat Midds	89	80	38	18
Wheat Bran	89	70		17
Ground Barley	88	80	60	12
Brewers Grains	21 or 92	66	14	26
Cracked Corn	88	87	75	10
Distillers Grains	91	86	14	23
Corn Gluten Feed	30 or 90	82	30	20
Hominy	90	92	52	12
Whole Cottonseed	90	96	55	23
Cottonseed Meal	92	77	15	44
Beet Pulp	91	74	40	10

However, byproduct feed availability is greater than ever. Distillers grains with solubles (DDGS), which is a byproduct of ethanol production, and corn gluten feed (CGF) a byproduct of making high fructose corn syrup, are very useful byproduct feeds for cattle and sheep. Soy Hulls, a byproduct of removing the oil from whole soybeans and further processing of the resulting soybean meal, is another byproduct that is fairly abundant. In table 2 are shown typical feed values for various whole grains, and several of the byproducts which are obtained from those grains. This table appears in VCE Publication 400-230, "Alternative Feeds for Cattle".

Notice that the primary byproduct feeds which are available in Virginia have 2 characteristics when compared to the whole grains from which they originate. They have slightly less energy due to the removal of either starch or oil from the whole grain. However, by removing this component the protein becomes more concentrated, thus these feeds have noticeably higher levels of this important nutrient.

As a result of these nutrient profiles, a greater amount of these byproduct feeds is needed to replace the amount of energy contained in corn. However, because of the higher protein content, when these byproduct feeds are used the amount of protein supplement required can be reduced, or even eliminated.

Example rations to provide the same level of nutrition are shown in tables 3a, 3b, and 3c (the difference is the hay quality used). These rations are designed to meet the needs of a 165-pound mature ewe in early lactation that is nursing twin lambs.

Table 3a. Rations Based on Alfalfa Hay and Byproduct Feeds and Nutrients Provided. Amounts shown are pounds per head per day

Feed	Ration 1	Ration 2	Ration 3	
Alfalfa Hay*	4	4	4	
Corn	2.5	--	--	
Soy 49	0.5	0.35	--	
Soy Hulls	--	2.5	3.5	
Nutrient	Amount of Nutrition Provided from the Ration			Daily Requirements or Max
TDN, lb	4.4	4.1	4.5	4
CP, lb	0.91	0.95	0.9	.92
DMI, lb	5.8	5.8	6.4	6.2 - 6.9
Ca, g	19	25	28	11
P, g	8	7	7	8

*Alfalfa Hay contains 65% TDN and 16% CP. 10% waste is included in calculations.

Table 3b. Rations Based on Grass-Legume Mixed Hay and Byproduct Feeds and Nutrients Provided. Amounts shown are pounds per head per day

Feed	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
Gr-Leg Mixed Hay*	4	4	4	4	4
Corn	2.5	1.5	--	--	1
Soy 49	.65	--	--	--	--
Corn Gluten Feed	--	2	3	--	--
Dry Distillers w/Sols	--	--	--	3	2
Nutrient	Amount of Nutrition Provided in the Ration				
TDN, lb	4.3	4.5	4.1	4.2	4.2
CP, lb	.91	.90	.98	1.0	.92
DMI, lb	5.9	6.2	5.8	5.9	5.8
Ca, g	18	20	22	19	18
P, g	9	13	14	9	9

*Mixed Hay contains 59% TDN and 14% CP. 10% waste is included in the calculations.

Table 3c. Rations Based on Early-Cut Grass Hay and Byproduct Feeds and Nutrients Provided. Amounts shown are pounds per head per day

Feed	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
Early-Cut Grass Hay*	4	4	4	4	4
Corn	2	--	--	--	1
Soy 49	1	--	--	--	--
Soy Hulls	--	--	--	1.25	--
Corn Gluten Feed	--	3.2	--	2.25	--
Dry Distillers w/Sols	--	--	3	--	2.25
Nutrient	Amount of Nutrition Provided in the Ration				
TDN, lb	4.1	4.1	4.1	4.3	4.3
CP, lb	.95	.92	.97	.89	.88
DMI, lb	5.8	6	5.9	6.3	6.1
Ca, g	8	11	8	13	8
P, g	10	16	10	14	10

*Grass Hay contains 57% TDN and 11% CP. 10% waste is included in the calculations.

By comparing tables 3a, 3b, and 3c the nutritive value of higher quality forage can be seen. This is especially true of the protein supplementation side. Table 3a shows that only 1/2 pound of soybean meal is needed in addition to high quality alfalfa hay and corn to meet the needs. In table 3c, with good quality grass hay, a full 1 pound of soybean meal is needed in addition to the hay and corn.

Due to the higher protein content in the byproduct feeds, especially corn gluten feed and distillers grains, when these feeds are used to meet the energy needs of the animal, the protein requirement is automatically met. However, it takes a greater amount of these feeds to fulfill the energy requirement than when corn-soy is used, due to the lower TDN content of the byproducts.

Relative Value of Feeds

Determining the relative value of the various feeds is not precise. The value of a feed in a particular ration varies, depending on whether the feed provides just one needed nutrient, or more than one. In other words, if the ration only needs additional energy, the extra protein that may be provided does not enhance the value of the feed in that ration, since that protein is actually not needed. It also depends on if the feed is used as a supplement to forage (such as when feeding ewes) or when it is the primary ingredient (such as finishing lambs).

There are many different models available which calculate relative value. Most of these use corn and soybean meal prices as a basis for the comparison, and the alternative feeds are derived on a cost of nutrition basis. These various models do not provide the same answer, but in general, they agree on the rank of the feeds.

In all of these determinations, the ranking was in order of energy content. In other words, most valuable was Whole Cottonseed, with Distillers close behind. Their value is considerably higher than the price of shelled corn. Next comes Corn Gluten Feed, with a value equaling or slightly exceeding that of corn. Wheat Midds, followed by Soy Hulls, have a value less than corn, due to their lower energy and modest protein level. The various values derived and model used to calculate the value are shown in table 4.

Table 4. Relative Feed Value ($/Ton) of Selected Byproduct Feeds Derived from Corn and Soybean Meal. Based On Corn at $3.83/bu ($136/T) and Soy Meal at $190/T

Feed	Missouri	VT ByConVal	NC Energy Only	NC Energy + Protein
Corn Gluten Feed	124	158	132	160
DDGS	143	165	Not Included in Model	
Soy Hulls	104	131	127	136
Wheat Midds	103	124	126	146
Wh Cottonseed	146	178	139	164

Considerations of Byproducts

The byproduct feeds focused on here have several advantages vs. corn and soybean meal, but also a few shortcomings. The following bulleted lists will highlight each of these factors.

ADVANTAGES

- Feed is already processed, and often pelleted, so no grinding is necessary
- Higher protein content for many of these feeds means that a single feed is all that is needed to adequately supplement livestock

DISADVANTAGES

- Feed is much more variable in nutrient content than are the basic grains due to differences in manufacturing and processing methods from plant-to-plant
- Feeds generally are severely deficient in Calcium and have an excess of Phosphorous. This imbalance, which is especially apparent when feeding grass hay vs. legume or mixed hay, must be fixed in the mineral supplementation phase of the feeding program
- The byproducts vary in palatability and voluntary intake. Corn gluten feed appears to be less desired by livestock, and maximum intake is less with CGF than with others of the byproducts
- Feeds are often available only in bulk purchases as opposed to bags, although many vendors now offer feeds in bags (for a higher price)

Feeding Growing-Finishing Lambs

The grow-finish lamb topic can be sub-divided into pre- and post-weaning. The pre-weaning phase is creep feeding, and post-weaning consists of various diets progressing to the time of marketing.

The rationale behind creep feeding is to enhance lamb growth by providing a grain mix that is supplementary to milk. Intake is going to be limited, since lambs consume all the milk that is available first. Consequently, the quality of the creep diet is paramount to success. Highly concentrated diets must be formulated.

Because by-product feeds are lower in energy than corn, any use of these will reduce energy content. As a result, performance will also be reduced. In addition, certain by-products have characteristics which limit their usefulness in creep diets. For example, whole cottonseed should not be used in creep feeds due to the gossypol included in cottonseed, which can be toxic to pre-ruminants. Corn gluten feed has a palatability problem.

Just don't use byproducts in creep feeds. Yes, you can reduce the cost of feed by using byproducts. But that reduction comes at a cost of reduced performance, and perhaps also increased health problems. Stick with corn and soy-based creep diets for lambs.

Once the lamb is weaned the byproduct feeds may have a place in the diet. However, performance is lower when the entire grain mix consists of byproducts. Again, this is due to reduced intake, and also to a lower energy content of these feeds. However, soyhulls may be the exception to this rule of intake and energy problems, as seen below, where voluntary intake was actually greater with a soyhull-based feed than with a corn-based feeding program.

One study from South Dakota compared corn and pelleted soy hulls as the primary ingredient in high grain lamb finishing diets. Dry distillers with solubles provided the protein supplement. Lambs averaged 92 days of age and were fed for 70 days. Final carcass weights were 69 pounds. Diet composition is shown in table 5. Results of gain are in table 6.

Based on cattle work (other sheep data is scarce), it appears that the byproduct feeds other than soy hulls should be limited to a maximum of 1/2 of the total diet of a lamb finishing diet. The factors which limit these feeds include energy content, imbalanced mineral profile, reduced palatability, and handling characteristics (such as pellet integrity).

Table 5. Composition of Diets Used in Finishing Lamb Study

Ingredient[a]	Corn Diet	Soybean Hull Diet
DDGS	17	17
Cracked Corn	76	--
Pelleted soybean hulls	--	76
Limestone	2	2
Liquid molasses	2	2
White salt	1	1
Commercial micro mineral and vitamin mix[b]	0.25	0.25
Deccox	0.1	0.1
Ammonium chloride	0.5	0.5

[a]%, DM basis

[b]Calcium 18%, iron 2%, manganese 1.6%, zinc 1.32%, iodine 0.032%, colbalt 0.008%, selenium 0.012%, vitamin A 400,000 IU/lb, vitamin D-3 80,000 IU/lb, vitamin E 24,000 IU/lb

Table 6. Animal Performance in Finishing Lamb Study

	Corn diet	Soybean hull diet	*P*-value
ADG (lb per day)	0.77 ± 0.02	0.79 ± 0.02	0.3316
Daily intake (lb)	4.1 ± 0.2	4.9 ± 0.3	0.0276
Feed to gain (lb)	5.1 ± 0.2	6.7 ± 0.6	0.0039
Residual[b] (lb per pen)	29.1 ± 1.4	13.9 ± 2.1	0.0056

[a]Values are means ± std error

[b]After observing the soybean hull diet self-feeders did not require frequent cleaning, feed refusal was recorded weekly for a 21 day period.

Conclusions

Corn has increased in price dramatically. Various byproduct feeds are less expensive than corn. Often these feeds can be purchased for less than their relative value. These feeds work very well as energy/protein supplements to hay-based diets for ewes. However, they are more limited in usefulness for the high grain diet fed to grow-finish lambs.

Corn and soybean meal continue to be viable options for grains to supplement sheep diets. While the various byproduct feeds may be less expensive per ton, it is possible to purchase corn at lower prices by buying in bulk and by shopping.

Regardless of whether a producer uses corn, byproducts, or a blend of the two, the grain portion of the feeding program will be more expensive this year. This is likely to be the case next year as well. Consequently, producers should continue to place emphasis on the forage portion of the diet and manage pasture and hay for high quality.

References

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