

*Proceedings of the 21<sup>st</sup> Annual*

**DAIRY SHEEP ASSOCIATION OF  
NORTH AMERICA SYMPOSIUM**



**Madison, Wisconsin, USA  
November 5 – 7, 2015**



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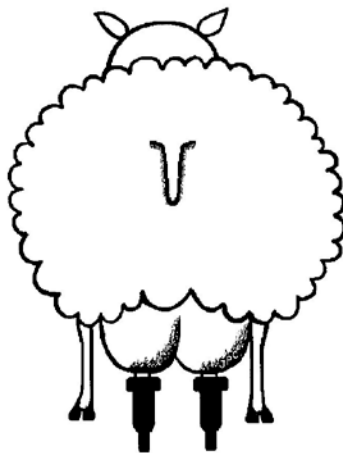
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University of Wisconsin-Madison  
Madison, Wisconsin, USA

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### **Proceedings Edited and Compiled by:**

David L. Thomas, Madison, Wisconsin, USA

### **Photographs on the Cover from Stops on the Saturday Tour: (clockwise from upper left)**

Processing sheep milk at Cedar Grove Cheese, Plain, Wisconsin

Banquo, a natural rind sheep milk cheese in the style of Ossau  
Iraty, from Cedar Grove Cheese

An East Friesian dairy ewe and Brenda Jensen, owner and  
cheesemaker, Hidden Springs Farm and Creamery, Westby,  
Wisconsin

Bad Axe, a semi-hard but creamy sheep milk cheese, from  
Hidden Springs Creamery

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## Program of Events

### Wednesday, November 4, 2015

7:30 a.m. – 2:00 p.m. **Pre-Symposium Cheese Making Workshop** (additional registration fee), Center for Dairy Research (CDR), University of Wisconsin-Madison, 210 Babcock Hall, 1605 Linden Dr., Madison, WI 53706-1565. Instructors: Bene Coude, Mark Johnson, and other CDR staff and Brenda Jensen, Hidden Springs Creamery, Westby, WI.

### Thursday, November 5, 2015

- 8:30 a.m.     **Registration** Opens, Pyle Center (Check for room assignment in the lobby)
- 9:30 a.m.     **Welcome**, Dr. Richard Straub, Associate Senior Dean, College of Agricultural and Life Sciences, University of Wisconsin-Madison
- 9:45 a.m.     ***A New Producer and Their New Cheesemaker – Challenges in Getting Started*** – Sam and Abe Enloe, Enloe Brothers Farms, LLC, Rewey, WI and Anna Landmark, Landmark Creamery, Albany, WI
- 10:30 a.m.    **Break** for Trade Show and Networking
- 11:00 a.m.    ***Perspectives on Surviving and Growing in Dairy Sheep Production*** – Bill Halligan, Bushnell, NE; Dean and Brenda Jensen, Westby, WI; and Dave Galton, Locke, NY
- 12:00 p.m.    **Lunch**, Pyle Center — Included in registration
- 1:15 p.m.     ***Milking Machine Basics and Special Considerations for Small Ruminants*** – Dr. Doug Reinemann, Extension Dairy Equipment Specialist, Department of Biological Systems Engineering, University of Wisconsin-Madison
- 2:00 p.m.     ***Udder Health for the Production of Quality Sheep Milk*** – Dr. Pam Ruegg, Extension Milk Quality Specialist, Department of Dairy Science, University of Wisconsin-Madison
- 2:45 p.m.     **Break** for Trade Show and Networking
- 3:15 p.m.     ***Markets and Marketing of Sheep Milk Cheeses*** – Jeanne Carpenter, Specialty Cheese Buyer, Metcalfe’s Markets, Madison, WI & Global Cheesemonger, The Artisan Cheese Exchange, Sheboygan, WI
- 4:00 p.m.     ***Impact of Non-GMO Labeling on Artisan Cheese Production*** – Cathy Strange, Global Cheese Buyer, Whole Foods Market, Austin, TX and Past President, American Cheese Society
- 5:30 p.m.     ***Reception - A Culinary Celebration of North American Artisanal Sheep Milk Cheeses***. Room 109, Lee Lounge, Pyle Center. Cheese tasting open to all Symposium attendees.

**Friday, November 6, 2015**

- 7:30 a.m.     **Registration** Opens, Pyle Center (Check for room assignment in the lobby)
- 8:15 a.m.     **Welcome** – Ben Brancel, Wisconsin Secretary of Agriculture, Trade and Consumer Protection
- 8:30 a.m.     **Experiences with Rearing Lambs that Do Not Nurse a Ewe** – Rusty Burgett, Director, National Sheep Improvement Program, Ames, IA
- 9:15 a.m.     **Best Practices for Raising Lambs on Milk Replacer** – Dr. Tom Earleywine, Director of Nutritional Services, Land O'Lakes Animal Milk Products Company, St. Paul, MN
- 10:00 a.m.    **General Discussion on Artificial Rearing of Lambs** – Symposium Participants. Facilitator: Michael Histon, Shepherds Manor Creamery, New Windsor, MD
- 10:45 a.m.    **Break** for Trade Show and Networking
- 11:15 p.m.    **Finding and Keeping Good Farm Labor – Management Practices and Labor Laws** - Jennifer Blazek, Dane County Dairy and Livestock Agent, University of Wisconsin-Extension, Madison, WI
- 12:00 p.m.    **Lunch and DSANA Annual Meeting**, Pyle Center - Lunch included in registration
- 1:30 p.m.     **Principals of Dairy Nutrition** – Michel Wattiaux, Professor of Nutrition and Management, Department of Dairy Science, University of Wisconsin-Madison
- 2:15 p.m.     **Break** for Trade Show and Networking
- 2:45 p.m.     **Adaptations for Feeding Dairy Sheep** - Rusty Burgett, Director, National Sheep Improvement Program, Ames, IA
- 3:30 p.m.     **Developing and Maintaining a Healthy Dairy Sheep Flock** - Dr. Mike Maroney, D.V.M., Research Animal Resource Center, University of Wisconsin-Madison
- 7:00 p.m.     **Banquet**, Lowell Hall Dining Room — Additional fee required



**Saturday, November 7, 2015**

7:45 a.m. Buses arrive at Lowell Hall, 610 Langdon St., Madison, WI 53703-1195

**Bus I Itinerary**

- 8:00 a.m. Depart Madison for Cedar Grove Cheese, E5904 Mill Road, Plain, WI 53577
- 9:05 a.m. Arrive Cedar Grove Cheese for tour & tasting
- 10:15 a.m. Depart Cedar Grove Cheese
- 11:30 a.m. Arrive at Rooted Spoon Restaurant, 219 S. Main St., Viroqua, WI 54665 for lunch
- 12:15 p.m. Depart Rooted Spoon Restaurant to Hidden Springs Creamery, S1597 Hanson Road, Westby, WI 54667
- 12:45 p.m. Arrive at Hidden Springs Creamery for tour of dairy sheep farm and creamery
- 3:00 p.m. Depart Hidden Springs Creamery to Madison
- 5:30 p.m. Arrive at Lowell Hall, 610 Langdon St., Madison, WI 53703-1195

**Bus II Itinerary**

- 8:00 a.m. Leave Madison for Hidden Springs Creamery, S1597 Hanson Road, Westby, WI 54667
- 10:30 a.m. Arrive at Hidden Springs Creamery for tour of dairy sheep farm and creamery
- 12:00 p.m. Depart Hidden Springs Creamery to Rooted Spoon Restaurant, 219 S. Main St., Viroqua, WI 54665 for lunch
- 12:30 p.m. Arrive at Rooted Spoon Restaurant
- 1:30 p.m. Depart Rooted Spoon Restaurant to Cedar Grove Cheese, E5904 Mill Road, Plain, WI 53577
- 3:00 p.m. Arrive Cedar Grove Cheese for tour & tasting
- 4:30 p.m. Depart Cedar Grove Cheese to Madison
- 5:30 p.m. Arrive at Lowell Hall, 610 Langdon St., Madison, WI 53703-1195

**Symposium Concludes – Enjoy an evening in downtown Madison!**

## Sponsors

### **Platinum:**

**Carr Valley Cheese Co.**, S3797 County Hwy G, La Valle, WI 53941, USA;  
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**Spooner Agricultural Research Station, University of Wisconsin-Madison**,  
W6646 Hwy 70, Spooner, WI 54801, USA;  
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**Biotic Industries, Inc.**, 147 Edd Joyce Rd., Bell Buckle, TN 37020, USA;  
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### **Silver:**

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**Coburn Company**, 834 E Milwaukee St., Whitewater, WI 53190, USA;  
<http://www.coburn.com/>

**D. Eckerman Tax Services, LLC and Eckerman Sheep Company, LLC**, N681  
S. Rollwood, Antigo, WI 54409, USA; <http://www.eckermantax.com/>

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**Chr. Hansen, Inc.**, 9015 W Maple St., Milwaukee, WI 53214, USA; <http://www.chr-hansen.com/>

**Hook's Cheese Company, Inc.**, 320 Commerce St., Mineral Point, WI 53565, USA; <http://www.hookscheese.com/>

**Sartori**, 107 N. Pleasant View Road, P.O. Box 258, Plymouth, WI 53073, USA; <http://www.sartoricheese.com/>

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Please support these sponsors as you purchase equipment, supplies, and services for your dairy sheep farm or sheep milk processing facility.

# **CHALLENGES GETTING STARTED: PRODUCER PERSPECTIVE**

**Abe and Sam Enloe  
Enloe Bros. Farms, LLC.  
Rewey, Wisconsin, USA**

## **Introduction**

Family farm  
Milk 200 dairy cows, finish 100 steers/year, raise all replacements  
Milk 180 sheep, finish wethers, raise all replacements

## **Finding a Market**

Catch 22: Not enough milk to be worth shipping, but too much risk to buy large number of sheep to start.  
It only takes one connection.

## **Daily Flock Management**

Sheep husbandry  
Facilities  
Lamb rearing  
Raising slaughter and replacement lambs  
Dairy ewe management/nutrition

## **Cash Flow**

Seasonality creates periods of budget strains  
Facilities are expensive  
Feed is expensive  
Labor can be expensive

## **Our Approach**

Limit risk as much as possible.  
Share knowledge/costs/facilities between cow and sheep operations

# **CHALLENGES TO LAUNCHING A CHEESE BUSINESS - INSIGHTS FROM A SMALL BUSINESS TWO YEARS IN**

**Anna Landmark  
Landmark Creamery  
Albany, Wisconsin, USA**

My name is Anna Landmark. I'm the cheesemaker and co-founder of Landmark Creamery, which we launched in the fall of 2013. My co-founder, Anna Thomas Bates, heads up our sales and marketing, while I make the cheese and oversee the aging. We've now completed our second full season of making cheese. In 2013 we produced around 1000 lb. of cheese. In 2014 we produced 6,600 lb. of sheep milk cheese from 40,000 lb. of milk from Sam and Abe Enloe. This past year we made over 15,000 lb. from 93,000 lb. of milk, and next year our plan is to make 21,000 lb. of cheese and purchase 120-130,000 lb. of milk. Our business is growing by leaps and bounds, there's good buzz about our cheeses on several widely-read cheese blogs and retail shops, and we won two big awards, a blue ribbon at the US Cheese Championships and a third place at ACS. We're still in a fairly fragile place financially, however, and facing many of the same issues every new business experiences.

## **1.) Cash Flow**

To be blunt, the seasonal flow of our business makes cash flow hard to manage. Our biggest milk payments and wheel aging costs are April-June, but our biggest sales months are November-December. We have been hitting a pinch in August/September the past two years in our ability to pay our bills.

We initially had been planning to sell a lot more fresh cheese and at farmers markets than we ended up doing. Several factors lead to this change, with the primary being the perishability of our product and its high cost, which limits distribution and sales opportunities. 75% of our business is wholesale through distributors, less than 5% farmers market, and the rest direct sales to a dozen restaurants and retail stores in the Madison and Milwaukee markets. 76% of the sheep milk from Enloe's goes into production of our top selling cheese, Anabasque, a washed rind cheese that we age for 4-6 months.

We're also still getting caught up from our first year of production when we didn't have cheese to sell for the first five months. The first full year of production, our flagship cheese, Anabasque, needed a good 4-6 months to age, and a couple new cheeses that we were banking on being able to sell at 2-3 months, took much longer to develop flavor. My inexperience as a cheesemaker played a part here as well – a little more salt would have done the trick.

Two-thirds of the way through our first production year, we were able to secure a line of credit, which certainly helped us get caught up in 2014. That line, however, just didn't go far to help cover our growth in 2015, where we doubled our production over 2014. All of cash gets tied up in inventory. Banks, however, don't put much value on inventory, they want more concrete assets.

## **2.) High Overhead Costs & Hidden Costs**

The past two years we've been fortunate in that Bob Wills has welcomed us into his plants, Clock Shadow in Milwaukee and Cedar Grove in Plain, Wisconsin. Both of these facilities are 1.5-2 hours away from where we live, however, so transportation has been a huge hidden cost that has driven up our overhead.

In addition to the long commutes for both of us, we've had big transportation costs moving our wheels around. Cedar Grove and Clock Shadow are both busy factories and just don't have the space for us to age our cheese there. So we've been paying Bear Valley to age our cheese for us, and we have the transportation costs of moving wheels around, which was a 3-hour drive from Clock Shadow.

And then, once the cheese is aged and ready to sell, we transport many of our wheels to a couple different local factories who consolidate shipping pallets for different distributors.

And then there are the milk hauling costs, because we aren't making cheese right on a farmstead.

Having an affinage facility and having those other cheesemakers willing to consolidate pallets for distributors has actually been incredibly helpful to our business. Our cheese is well taken care of, and given our distance from it, frankly would be hard for us to do as good of a job right now. And without the ability to get our smaller orders of wheels onto the distributors' pallets, our wholesale sales would certainly not be as strong. But for each of these advantages, there have been costs that we initially weren't planning for and that eat into our profits.

The distance to the plant has also driven up our need for additional help, for packing our fresh cheese and also for helping with all the equipment washing and managing some of the long production hours. Both of us have small children, so 12-14 hours at the plant just isn't possible. And coming home for a few hours and then returning to finish draining the cheese or salting wheels, isn't an option when the drive is an hour and a half. So we've had to pay more for assistance than we would have ideally wanted to this past year. Next year, with the increase in our production we have planned, we will be hiring two 50-75% employees. But our increased production level will be better able to support employees than it has been this past year.

## **3.) Sales & Marketing**

What do you do with your mistakes? How do you launch new products? How do you get your distributors to sell more? When do you make the jump from small and medium distributors to one of the big guys?

These are all questions we're still working through and sometimes learning the hard way about. One big revelation was the ability to sell off-label those batches that while good, just weren't great and weren't going to help our brand at all. We had to take a hit on the price, but it was worth it getting those several batches of cheese out of inventory and off of the books.

It costs more money and takes more time to sell cheese than you think it will. Our budget for marketing, attending trade shows, making trips to travel around with the distributors' sales people has dramatically jumped this past year, and will again next year. It can be difficult to determine whether a trip is going to pay for itself in increased sales. Often the increases don't come immediately or they might have happened without the trip. The greatest value, however, comes from the stronger relationship that each trip builds with the distributors. You build goodwill, confidence in your products, and reinforce that you're a willing partner in building sales of your cheeses and selling the story of your brand.

Because we knew we wanted to grow quickly and produce enough cheese to be able to purchase enough milk from the Enloe's so that they could afford to start milking, we structured our business so that Anna focuses primarily on sales and marketing, along with managing the deliveries and much of the packaging. This allows me to focus on the production and aging. One of the biggest benefits is that Anna has had the time to make trips to New York, Chicago, St. Louis and Detroit to build relationships with our distributors and visit retail shops, which if I were on my own most likely wouldn't have happened.

#### **4.) Mitigating the Challenges**

Things that we're doing to mitigate these challenges and build a stronger financial base for our new business include the following:

- Applying for a larger line of credit with more flexibility, that takes into account growth over the next couple years, which may be a package of several types of loans;
- Moving to a new production facility in 2016 that's closer to our homes and that will also provide some savings in both make costs and hauling;
- And, we're weighing the pros and cons of building a small affinage facility with a cut and pack room, to both cut aging costs and time in the car hauling wheels around.

#### **5.) In a Good Place**

Despite these challenges, overall we're feeling very good about where we're standing after just two years. First of all, we have a steady supply of high quality milk, which allows us to have a steady supply of cheese that we can age out to sell year round. We've won a few awards this year, which has opened up opportunities with new distributors and garnered some media attention. We've been able to steadily increase our sales alongside our increased production, even with a high price point on our cheeses. And with two years of production now, under our belts, we're feeling more confident in our consistency of product and in our ability to now start finding greater efficiencies and reduce costs while keeping our production standards high and consistent. We're also very happy with our business model, with one of us focusing on production and the other on marketing and sales. We're feeling good about our positioning for many more years of growth.

# **PERSPECTIVES ON SURVIVING AND GROWING IN DAIRY SHEEP PRODUCTION**

**Bill Halligan  
Irish Cream Sheep Dairy  
Bushnell, Nebraska, USA**

## **What is Important**

The most important thing is the MARKET. Until you know where you are going to sell your milk you cannot plan for the production you need to make. The problem is that when you start you usually do not have a clear plan of what your market is going to be. The point is if you have the milk sold above your cost of production you will find a way to produce the milk.

A love of sheep and the outdoors life style that sheep dairying brings is a must. If this is not important to you and your family then why do it. It is not easy to start and run a dairy of any kind and with sheep dairying you do not have the support industry to help that cow dairies do.

The money to get the dairy started is a must. The amount of money available will determine if you start with 10 or 300 ewes. There is no one magic number of ewes that is best. The size of the dairy will depend on your variables. Your market, capital, farmstead, dairy knowledge, available labor and feed supply are some things to consider.

I have a great love of sheep. I have visited sheep producers from Montana to Texas to Michigan and it is amazing how sheep will adapt to the environment they live in. In Wyoming they run sheep where it is too cold for cattle to survive and so high in the mountain that cattle get sick. In Texas they have sheep where it is too dry and hot for cattle and yet sheep milk very well on the great grass that grows in Wisconsin. Sheep have one trait that none of the other dairy animals have, they like each other.

## **Market**

When we started our dairy we drew a line in the sand to milk 500 ewes and to sell milk to a creamery. We have completed the goal and it has had its ups and downs. The second year we were forced to freeze our milk to reach our market. Freezing milk works very well but it increases your cost over 30 cents per pound. Once the milk is frozen and you have 40,000 pounds you can cross the country for 15 cents per pound if you have a market that can use 40,000 pounds.

The marketing concept of converting the milk to an end product so that you can have many customers may be a better method. The sheep dairy industry is so thin that it is hard to find a new buyer for your milk mid-season. The money needed to make a small creamery to use your own milk may be cheaper than milking twice as many ewes. The downside is that you now have two enterprises to manage.



## **Ewes That Like To Milk**

The lack of a genetic database and a large selection of dairy proven rams is a problem for all of us in the dairy industry. We started with our original range ewes and up graded with dairy rams. Purchasing ewes from a milking dairy would have been a great help for us the first four years. If you purchase sheep make sure that they come from a milking dairy and not just a good sales pitch. The test to call any animal a dairy animal is that she will give her milk to the milker but she may not produce a profitable amount of milk.

We have a milk meter on each claw so we see what the ewe is milking. From this data we cull the poor ewes. We have ewes in the US that can make a profitable sheep dairy. It takes keeping a lot of replacement lambs then testing and culling the poor ewes and milking the rest. A plan needs to be in place to get new rams for your dairy at least every 2 years. It is going to take some travel to get the rams and the worst part is that dairy rams are not tough fighters, they only think they are.

## **Feed and Lamb Weaning**

We use a bunk line and a total mix ration with a feed wagon to feed our ewes. We wean the lambs a 12 hours and feed milk for 27 days and then wean on dry feed. We raise irrigated alfalfa, irrigated corn for silage and some pasture. We do not pasture any ewes while they are milking since we only get 14 inches of rain a year. This type of management gives us the ability to push the ewes for maximum production. The problem is that we are locked into a high cost production method and that may not be the same for a pasture fed method. The feeding method needs to fit well with the lamb raising plan. The cost of the equipment outside of the parlor is a very important expense. The more equipment the more ewes you need to milk to pay for the investment.

## **Labor**

When the supply of labor breaks down you no longer have a dairy. Over the last 11 years we have been to the breaking point, especially when I was milking one end of the day. We currently have a great group of people working for us and consider ourselves fortunate to have them. I would like to say we have a plan for the future but I know that we will always be at risk of not enough good people.

You have to blend many parts of the dairy to make the labor work; the following are things to consider.

- Do you leave the lambs on the ewes for 27 days or wean and feed the lambs?
- Do you graze on grass or mix feed for the ewes?
- Do you sell the milk out of the tank fresh or freeze?
- Do you process the milk into cheese and then have to sell the cheese?
- Do your own work on plumbing and electrical or hire outside support?
- Do you spend more money on a more labor efficient parlor?

Dairying is a 24 hour a day operation, you may be sleeping but the ewes are still making milk if you did everything right. The larger the dairy and the more people involved you will spend more time with people and less with sheep. Make sure you do not miss what you really enjoy with dairying.

### **Support Staff**

You must have a support staff. We use a dairy vet practice that does our testing of cultures and helps with unusual problems. We do all of the day to day vet work on the dairy ourselves. A dairy supply company supplies the chemicals for the parlor and they help when we have equipment problems. A sheep dairy nutritionist is very hard to find, we currently use a cow dairy nutritionist and are making more milk this year. The specialized sheep equipment we buy from the exhibitors that have been at the last 11 symposiums.

The most important support staff we have is DSANA. It is the research from the symposiums and the lectures that has provided the needed information. The visiting with people that are getting it done all over North America is a resource that is not available any place else.

A comforting soul to lean on comes in very handy, be it a friend, spouse or minister.

## **PERSPECTIVES ON SURVIVING AND GROWING IN THE SHEEP DAIRY INDUSTRY**

**Brenda & Dean Jensen  
Hidden Springs Farm & Creamery  
Westby, Wisconsin, USA**

Hidden Springs Farm and Creamery is located in Westby, WI. on 76 acres in the Driftless area. Dean is the owner and Director of Hidden Springs Mental Health Clinic. Brenda is fulltime between the farm and the creamery has a MBA and cheesemakers license. . The vision for Hidden Springs is to make high quality sheep milk cheeses while being sustainable sheep milk dairy.

Hidden Springs Farm started milking dairy sheep in 2001 with 40 cull ewes from the Spooner Research station. Putting in a double 12 stanchion milking system made by their local Amish, and a local dairy technician; This was a 2 person system with manual feeding, and 6 milking units. Dean milked in the morning with the Amish neighbor and Brenda in the evening. The milk was bagged, frozen, and sold to Wisconsin Sheep Dairy Coop. Soon at 150 sheep and very good milk. . Hidden Springs wanted to increase the value of their milk through cheese making to make Hidden Springs a more sustainable farm. The Dairy Business Innovation Center was contacted, and this began the journey to learn about cheese.

Hidden Springs started out renting space in local cheese plants and making cheese and working on their cheese markers license. Soon the already busy plants had no time available to make their cheese. A cheese plant was built converting an already existing basement on the farm. The goal was to milk 150 sheep and supplement the cheese making with buying milk from the Wisconsin Sheep Dairy Coop. Small amounts were purchased, but WSDC's milk was then mainly committed to another source. Hidden Springs tried offering more money for the purchase price with WSCDC with no positive results.

Labor at Hidden Springs was done with some hired help. Dean fed hay and did farm work with his team of Percheron draft horses. Brenda took the lambs off in 24 hours and took the females to the Amish farm to be raised and brought back. HS provided the pellets, milk replacer, and transportation and would pay for every live lamb to be returned after weaning. Brenda sold the male lambs off at 24 hours old and delivered them to her Amish neighbor.

Hidden Springs decided to increase their herd to have enough milk to make the cheese plant sustainable. In order to do this they put in a 2 sided 12 per side DeLaval milking parlor equipped with automatic feeding and automatic take offs. Increasing the herd to approximately 500, of with 250 to 300 milk 8 months out of the year, and 150 milking the remaining 4 months. During peak season Hidden Springs sells their weekend milk. This allows for cash flow and time off from cheese making during the weekend.

Hidden Springs decided to raise all its lambs at home , so employees could get 8 hour shifts by caring for the lambs. We put up new buildings and purchased new milk replacer machines. We hired a neighbor to come with his bobcat to do the feeding .

Constraints and barriers at Hidden Springs at this current time is manpower . Many large farms and cheese plants such as Organic Valley and Westby Creamery are always hiring. Hiring likeminded people with the skill sets to care for sheep and work in a food environment without receiving benefits has been a major growth inhibitor.

Current strengths at Hidden Springs is the award winning cheeses. This year at the American Cheese Society, Hidden Springs won more awards than any other cheese plant in North America. Hidden Springs has continually won numerous awards at the United States and World Cheese Championships. Current staff is energetic and passionate about sheep dairy farming and cheese making. We have a on staff mental health therapist! We have a knowledgeable staff. We have an excellent customer base and, are currently running out of cheese. HSC has a lot of opportunity to sell more cheese.

**Future plans:**

- Remodeled feeding/loafing facility, will feed ground hay
- Raised Wages to hire more competent staff
- Adding flow meters – greater production-lower SCC counts

**Thoughts:**

- Need to be big enough to hire more competent staff- higher wages to attract better employees
- Better consistent care of sheep; foot trimming, purchase bobcat; cleaning more often
- Brenda to better focus on cheese making

## **A PERSPECTIVE OF ACHIEVING A PROFITABLE DAIRY SHEEP BUSINESS**

**David Galton  
Shepherd's Way, LLC  
Genoa, New York, USA**

### **Introduction**

My wife, Sally and I started a dairy sheep operation in May, 2012 with a sheep milk supply contract with the Old Chatham Shepherding Company (OCSC). We leased the OCSC farm including the land and facilities while supplying the sheep milk to the OCSC creamery. At OCSC, the flock was expanded to 900 adult ewes along with the supporting young animals. In November, 2014, the flock was relocated to a new farm in central New York where we reside. In late 2014, we purchased the OCSC creamery business from Tom and Nancy Clark who we now lease the creamery facility from. At the present time, the sheep milk is transported back to the creamery in eastern New York. Within the next few years, a new creamery will be built near the farm.

### **Current Flock**

Currently, the adult flock is about 1,250 ewes. There are about 1,000 younger animals with 600 of these animals being yearlings that will lamb within the next few months. We are planning to have a flock of about 1,600 adult ewes which will be needed to meet the near-future milk demands for the OCSC business. Once the flock size is in balance with the creamery milk needs, a culling rate between 25 and 30% per year will be maintained for the adult flock. The goal is to manage the size and milk production of the flock in order to supply the quantity of fresh milk as needed by the creamery throughout the year. This goal will help to minimize the frozen milk need.

### **Reproduction**

The ewes lamb throughout the year which is achieved by using a reproductive synchronization program. Every week, the ewes between 65 and 72 days in milk are synchronized. They are exposed to dairy rams for a three week period, then they are housed with terminal rams until drying-off. With this reproductive program, the ewes have a lactation length of 180 to 200 days and a dry period of 40 to 60 days. Within a 12 month period, the ewes lactate for about 280 to 310 days. With this higher percent of the year in lactation, the adult flock averages between 950 and 1,050 pounds of milk per ewe per twelve months with the plan of achieving up to 1,200 pounds of milk with better management and genetics. The yearlings are exposed to dairy rams beginning at 100 pounds. The yearlings are weighed every two weeks to identify the animals to be moved to the breeding pen. Currently, the yearlings are lambing between 11 and 14 months of age.

## **Feeding**

The animals that are fed forages receive a total mixed ration. The rations are formulated for the given animal groups. Rations may consist of alfalfa baleage, grass baleage, corn silage, canola, distillers' grains, corn meal and minerals. Total mixed rations are fed once a day. Feed is pushed up to the feeding panels frequently throughout the day. Refusals from the adult flock are fed back to the older yearlings in order to reduce the amount of feed discarded. Lambs are kept on a total grain ration until they achieve 80 pounds. Once the lambs achieve 80 pounds of body weight, then they are fed a total mixed ration.

## **Milking Management**

Ewes are milked twice daily throughout the lactation in a double-30 stall parallel milking parlor (Greenoak North America, Inc.). Milking procedures consist of pre-dipping with subsequent cleaning of the teats with moist cloth towels that are washed during milking so the towels do not need to be dried. Once the teats are cleaned, the machines are attached. Machines are removed with automatic milk flow detachers. No "bumping" of udders occurs towards the end of milking. The milking system functions with a pulsation ratio of 50:50 and a pulsation rate per minute of 120 in the beginning of milking and as milk flow decreases, the rate changes to 220.

## **Housing**

The ewes are housed in a facility that has bedded pack areas for each management group. The facility has a drive-thru feed alley. Group sizes range from 100 to 250 animals per pen. The animal density is no less than 20 square feet of bedding area per animal. A scrape alley is between the bedded area and the feeding panels where the animals can eat and drink. The scrape alleys are cleaned daily and the bedded packs are tilled (composted) and bedded three times per week. The bedded packs are cleaned twice per year. The facility is tunnel ventilated during the warmer months of the year. With this ventilation system along with tilling the bedding, fly control in the facility is very good.

## **Lamb Management**

Newborns are housed in a climate controlled facility. The newborns are fed colostrum at least three times within the first 24 hours of life. Then the lambs are fed a milk replacer of 28% fat and 26% protein that is fed through automatic milk replacer feeders. Lambs are offered free-choice milk replacer and a grain starter until they are weaned at a minimum of 27 pounds of body weight. Once weaned, the lambs remain on a total grain grower diet until they reach 80 pounds and then are transitioned to a total mixed ration.

## **Genetics**

Currently, dairy rams from different flocks that maintain milk production records are being used in attempt to minimize in-breeding. Genetic advancement and in-breeding are now a high

priority for the flock. We are interested in exploring with other dairy sheep breeders how to improve the genetics of the flocks through incorporating European and Canadian genetics.

### **Creamery**

The purchase of the OCSC creamery business allows for vertical integration of the total business which contributes to the stability of the sheep enterprise. Vertical integration offers the advantage of having a known year-round market for the sheep milk with the potential of future growth of sheep milk products.

### **Surviving and Growing**

Our business model achieves profitability through the following business aspects: 1) large flock size with the potential of flock growth; 2) achieving high milk production per year per ewe by using an aggressive reproductive program, feeding total mixed rations and uniform confinement housing year-round; 3) growth of healthy replacement animals; and 4) stabilizing the sheep enterprise with the ownership of a sheep milk product creamery. Genetics and inbreeding are the most limiting factors that need to be addressed to continue advancing the performance of the sheep and overall profitability of the business.

# MILKING MACHINE BASICS AND SPECIAL CONSIDERATIONS FOR SMALL RUMINANTS

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## **Introduction**

The physiological and mechanical principles from milking small ruminants are much the same as for milking cows. There are, of course some differences, and adjusting milking machine design and operation for the following differences will be discussed:

- Milk harvest requires cooperative effort between the Sheep/goat and the operator. Sheep appear to have higher stimulation requirements than cows or goats so that the success of sheep milking is more highly dependent on a good relationship between the operators and a consistent and effective pre-milking routine.
- Sheep and goats use specialized milking units that should conform to the anatomy of the animals milked.

All types of milking machines have the following basic components and functions:

- a. A system for vacuum production and control.
- b. A pulsation system.
- c. One or more milking units to withdraw milk from the udder.
- d. An arrangement for transporting milk from the milking unit to a storage facility.
- e. Milk cooling and storage equipment.
- f. Additional equipment for cleaning and sanitizing the milking machine after milking.

The flow paths for milk and air through a typical milking system are illustrated in Figure 1. Note: In this paper pipes or lines refer to rigid pipes permanently mounted in the milking facility, whereas tubes or hoses refer to flexible tubes that are not permanently fixed to any structure but connect different parts of the milking machine and are movable during the milking operation. Air is continuously removed from the system by the vacuum pump, creating a partial vacuum within the system and the force to withdraw milk from the udder. The air removed by the vacuum pump enters the system at various locations.

Milk enters the milking unit through the teatcups and flows through the short milk tubes to the claw. Air is admitted into the milking unit through an air bleed in the claw or through air vents near the bottom of each teatcup. “Unplanned” air admission occurs through the teatcups as they are attached or removed, or whenever they slip or fall off the cow. A mixture of milk and air moves from each claw, through the long milk tubes, through the milkline to the receiver. In the receiver milk and air are separated and the milk is pumped to the storage tank. Air moves from the receiver, through the sanitary trap and distribution tank toward the vacuum pump in the main airline.



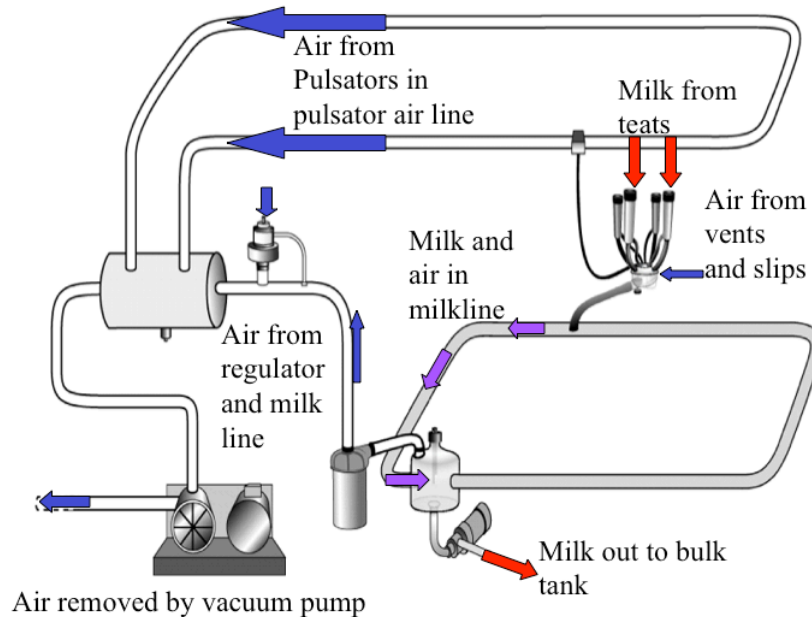


Figure 1. Air and Milk Flow in a Milking Machine.

Air enters each pulsator airline in short, regular bursts to create the opening and closing action of the liners. This pulsated air moves through the pulsator airlines to the distribution tank and on to the vacuum pump where it is discharged to the atmosphere. Other unplanned air admission enters as leaks in the pipelines, joints, and fittings. The regulator controls the vacuum level either by adjusting the amount of air admitted into the system (with a constant rate of air removal by the vacuum pump), or by adjusting the capacity of the vacuum pump to match the amount of air admitted into the system.

ISO standards specify the minimum requirements for milkline and vacuum pump sizing for small ruminant milking systems. Your local milking machine company representative can advise you on these specifications. As a very rough guideline; 1 cow = 2 sheep or goats so that a milking parlor setup designed for 16 cows will accommodate 32 sheep or goats. Sheep and goat milking parlors are common in single and double-sided parallel (milking units attached through back legs) and rotary configurations. Automatic milk metering and unit detachment is available in both configurations. I am not aware of any commercial robotic milking systems available today for small ruminants but I am sure that we will see them some day.

Milking units for sheep and goats have 2 teatcups and longer 'short milk tubes' (connecting the teatcups with the claw) than cow clusters. Small ruminant clusters are also more often fitted with shutoff valves to reduce air admission during unit attachment and removal and to remove milking vacuum from the teat ends before unit removal. One of the most important aspects of the cluster is how it is positioned on the udder. The weight of each teatcup should be evenly distributed on the two teats. This can be very challenging sheep and goats with udder conformation resulting in teats protruding from the side of the udder rather than pointing downward from the bottom of the udder. The wider variety of udder conformation in small ruminants is one reason that the short milk tubes are longer than in cow clusters. Breeding for more easily milkable udder conformation should be considered.

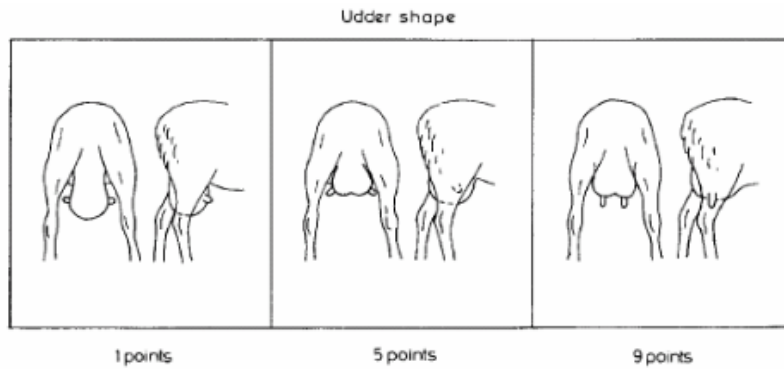


Figure 2. Linear Scale for udder shape evaluation where 9 is ideal.

The most important characteristic of the liner is that it fit the dimensions of the teats. This is much more challenging in small ruminants than in cows because: 1. Teat dimensions are more variable in small ruminants than in cows and 2. Liner selection is more limited for small ruminants than for cows.

A properly sized liner will allow the teat end to penetrate into the part of the liner that collapses during the d phase of pulsation. A simple estimation using a thumb or finger will identify the approximate distance from the top of the liner to the position where liner massage is effective. This can be compared to the pre-milking length of teats in the herd. If teats are too short for the liner both teat barrels and teat ends will appear congested after unit removal (red or blue color with signs of swelling).

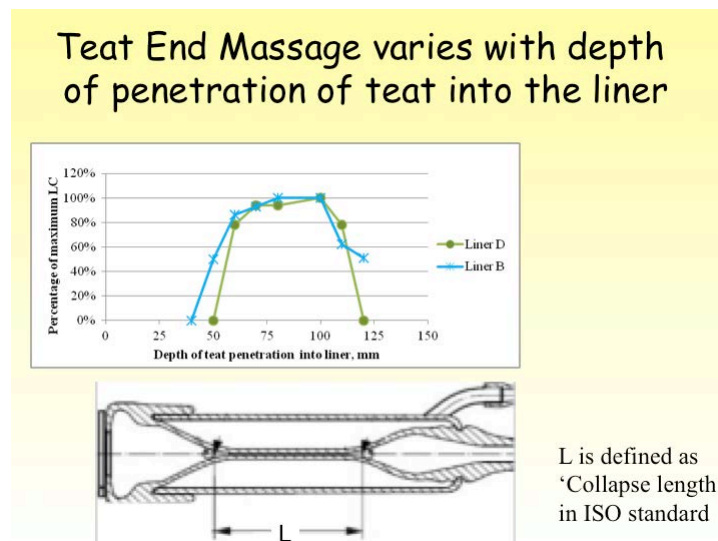


Figure 3. Identifying the part of the liner that provides massage to the teat end.

The liner barrel diameter should also be reasonable matched to the mid barrel diameter of teats. This dimension is somewhat forgiving because teats can expand somewhat to fill the cross section of the liner. If the liner barrel diameter is too large the teats will not be able to expand to form a seal in the liner barrel and signs of teat congestion, as described above, will occur.

If the mouthpiece opening of liner barrel diameter is too small teats will not fully penetrate the liner during milking. This may slow milking somewhat but does not promote teat tissue congestion and swelling and animal discomfort as long as the teat end is positioned in the zone of effective liner compression. It may not be possible to find a liner that fits all animals in a herd. If animal comfort and gentle milking are your goals, it is better to have liners that are too small for some animals rather than liners that are too big for some animals.

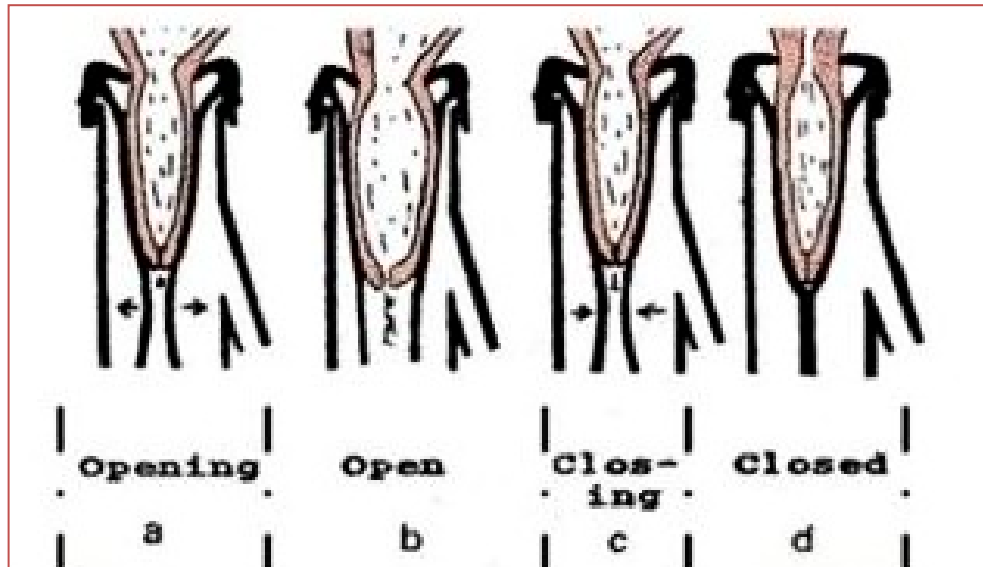


Figure 4. Liner fit: 1. The teat barrel should fill the line barrel when the liner is open (during the b phase of pulsation). 2. The teat end should be located in the part of the liner than provides massage (during the d phase of pulsation).

Dairy cows store about 20% of accumulated milk in the udder cistern with the remaining 80% in alveolar tissues. For dairy sheep the cisternal storage is about 50% and for Dairy Goats can be as high as 70%. Cisternal milk can be removed without the presence of a milk ejection response from the animal. The removal of cisternal milk before a milk ejection response has occurred results in a 'bimodal' milk harvest pattern (a first flush of milk from the cistern and a second flush of milk from the alveoli). The occurrence of bimodal milking depends on the relationship between the amount of milk in the gland cistern, the rate of milk removal, and the timing of the let-down response. If animals are well stimulated before unit attachment then milk letdown has occurred before unit attachment and bimodality will not occur. Because of the higher stimulation requirement in many sheep breeds bimodality is common. It is less common in goats due to the high percentage of cisternal milk. Bimodality does not increase mastitis risk. In extreme cases it can, however, reduce the efficiency of the milking routine because of unduly long cups-on time, and promote discomfort and kicking at milking units.

# UDDER HEALTH FOR PRODUCTION OF QUALITY SHEEP MILK

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## Introduction

Mastitis is a significant disease of virtually all mammals that are used for milk production. Most mastitis is caused by bacterial infections and in contrast to infections occurring in other organs, mastitis is unique because the udder itself is infected and the consequences of the infection include reduced milk production and reduced milk quality. Most dairy producers will have ewes that experience mastitis but in North America very little sheep specific research has occurred. The purpose of this paper is to review the occurrence and control of mastitis in dairy sheep.

## How is mastitis detected and defined?

Mastitis is defined as inflammation occurring in the mammary gland (udder) of lactating mammals and in most instances it is caused by bacterial infections. The infections occur when bacterial exposure at the teat orifice exceeds the ability of the teat to resist infection and bacteria are able to penetrate into the udder. After the infection occurs, the immune defenses of the ewe respond by sending inflammatory cells to the udder in an attempt to kill the pathogen. The magnitude of that inflammatory response determines the symptoms that are observed. Depending on the type of bacteria and the immune response of the ewe, mastitis may present in several different forms. The most obvious presentation is called *clinical mastitis*. Clinical mastitis occurs when the ewe experiences obvious symptoms. Those symptoms may occur in the milk or in the ewe and include abnormal appearance of milk (presence of clots or serum), swelling, redness or necrosis of one or more half udders, or severe symptoms such as anorexia (off feed), fever or agalactia (greatly reduced or no milk production). While several different types of bacteria can cause these symptoms, in sheep, *Mannheimia haemolytica* (previously called *Pasturella haemolytica*), *Pseudomonas aeruginosa* or some highly virulent forms of *Staphylococcus aureus* are often the causative agents. There have been no national studies to determine the incidence of clinical mastitis in dairy sheep, but clinical mastitis is estimated to occur in about 3-5% of ewes per year (Bergonier et al., 2003).

While clinical mastitis is very obvious, the most common type of mastitis cannot be detected without testing of the milk. *Subclinical mastitis* is defined as inflammation of the udder that is characterized based on measuring the number of inflammatory cells in the milk. In this presentation, the milk looks completely normal but contains an excessive number of white blood cells (called somatic cells when they are found in milk). This form of mastitis is not visually detectable and requires testing of the milk to identify affected sheep. Subclinical mastitis occurs when less virulent (more host-adapted) bacteria cause the infection. This is typically the most costly type of mastitis because these bacteria can cause long-term damage to milk secretory cells and result in decreased milk production. The most common types of bacteria causing subclinical mastitis in ewes are *Staphylococci* spp., including *Staph aureus* and the group of organisms

called “coagulase-negative” *Staphylococci* (CNS). There are no formal studies that have defined the prevalence of subclinical mastitis in dairy sheep flocks in the US, but researchers believe that up to 30% of ewes in some flocks may be affected with subclinical mastitis. Subclinical mastitis can be a significant cause of reduced production.

### **How does mastitis affect milk quality?**

Clinical mastitis causes obvious changes in milk and results in milk that is not suitable for human consumption. While milk from ewes with subclinical mastitis appears visually normal, this form of the disease has a potentially bigger impact on milk composition. The long-term infections caused by subclinical mastitis pathogens results in damage to the milk secretory cells and that cause changes in milk composition. According to Israeli researchers (Leitner et al., 2004), subclinical mastitis caused by coagulase-negative *Staphylococci* (CNS) resulted in a 46% decrease in milk production, 16x increase in somatic cell count (SCC) and significant changes in the processing characteristics of milk. In this study, the researchers compared milk from ewes with one healthy half udder and one subclinically infected half udder. The subclinical infections caused an 8% increase in the whey fraction, 12% reduction in casein (milk protein), 5% reduction in milk fat and caused the clotting time to increase from 413 seconds to 919 seconds. These significant impacts emphasize the importance of preventing and responding to subclinical mastitis in dairy sheep flocks.

### **What are the most common causes of mastitis?**

While there are rare instances of non-bacterial causes of mastitis, in most commercial dairy sheep flocks, mastitis is caused by a bacterial infection. Throughout the world, researchers have reported that CNS and *Staph aureus* are the most common causes of mastitis in dairy sheep (Gelasakis et al., 2015). Both of these pathogens are more commonly associated with subclinical mastitis as compared to the clinical presentation. In dairy cows, CNS are considered to be minor pathogens that often result in spontaneous cures. Interestingly, in ewes, CNS behave as major pathogens and often result in chronic subclinical infections with increased SCC and long-term reductions in milk yield and processing quality of milk. Other pathogens that can be a cause of subclinical mastitis in ewes include *Corynebacterium* spp., Yeast, *Streptococcus* spp., and *Enterobacteria* spp.

Unlike dairy cattle, a lentivirus has been associated with mastitis in sheep (Deng et al., 1986), however this organism has primarily been associated with mastitis in range flocks. Ovine progressive Pneumonia (OPP) can cause mammary gland symptoms and has been associated with lesions in secretory alveoli that produce milk. While it is known that the OPP virus has an affinity for mammary glands, the disease is a slowly progressive disease that results in weight loss, greatly reduced milk production and other symptoms that make it unlikely to become widespread in flocks that are used for dairy production.

## **How can the cause of mastitis be determined?**

The symptoms of mastitis are non-specific and indicate inflammation in the mammary gland but do not indicate the cause of the symptoms. The only way to determine the type of bacteria is to submit an aseptically obtained milk sample to a laboratory for culture. The following equipment is needed to ensure that a useful sample is collected: sterile, single use disposable plastic vials with tight fitting caps and at least 15 ml capacity; nitrile or latex gloves to reduce contamination of samples with bacteria present on the samplers' hands; and alcohol soaked cotton, gauze or baby wipes for adequate teat sanitation.

Before obtaining the sample, the udders should be clean and dry and a strip cup should be used to collect 2-3 streams of foremilk from each half udder. Teats should be sanitized using an approved teat disinfectant (such as 0.5% iodine) that remains on the teats for *20 to 30 seconds* prior to removal. The procedure for collecting the sample is as follows: *Thoroughly dry the teat* with a single use cloth or paper towel. Scrubbing of the teat end should be vigorous to fully sanitize the teat using 70% ethyl or isopropyl alcohol. If both teats are sampled a separate swab must be used for each sample. Sanitation is not complete until the surface of the swab remains clean after it is used and the sanitized teat should not be allowed to contact the legs of the ewe. The cap should be removed from the sample vial without touching the inside and it should be held so that the inner surface faces down. Milk from the teat to be sampled can be directed at an angle into the sampling vial. A sample size of 3-5 ml is usually adequate. The cap should be immediately replaced after the sample is obtained. Milk samples need to be cooled immediately and should not be placed on warm surfaces (such as the top of milk lines) for any significant amount of time. If samples are to be submitted to a diagnostic laboratory, they should be submitted within 24 hours of collection. If samples cannot be processed within 24 hours, they should be frozen until transported to the lab.

The symptoms of mastitis are a result of the immune system of the ewe detecting and responding to the infection and in a significant proportion of cases, the milk sample obtained from the affected half-udder may not contain sufficient numbers of bacteria to be identified in the lab. The failure to recover bacteria from a milk sample does not necessarily mean that bacteria are not present in the gland. Approximately 35% of milk samples obtained from dairy cows with symptoms of mastitis will be culture negative and it is likely that similar proportion of milk samples obtained from dairy ewes will also be negative. In some instances, culture negative cases indicate that the ewe's immune system has successfully eliminated the pathogen. If this is the case, we would expect the milk to rapidly return to normal appearance (2-4 days) and the SCC to return to normal levels within a few weeks. However, in some instances, the milk sample will be culture negative but the udder is still infected (false-negative). In this case, the ewe will likely maintain a chronically increased SCC and the best strategy is to assume that the udder remains infected and that milk from that ewe could potentially infect other ewes. These false negatives are especially common for infections caused by CNS and *Staph aureus*.

## **What are the role of Somatic Cells?**

The SCC refers to the number of white blood cells that have migrated from the blood stream into an udder half in order to combat an infection. Somatic cell counts measure the number of

WBC and udder epithelial cells that are present in milk and are an indication of a healthy immune response to infection. While the SCC of goats is not always a specific indicator of mastitis, the SCC of sheep behaves more similarly to that of cows and in ewes a significant increase in somatic cells occurs almost exclusively in response to bacterial infection of the mammary gland (Paape et al., 2007). In an uninfected half-udder, the SCC count is generally lower than 200,000 to 400,000 cells/ml (Bergonier, et al., 2003). Higher counts are almost always associated with bacterial infections and indicate the presence of subclinical mastitis. Many healthy half-udders have SCC values that are less than 100,000 cells/ml (Pengov, 2001). In a comparison of SCC and bacteriological status of half-udder milk samples collected from the UW Spooner Research Flock, microbiologically negative samples had SCC <60,000 cells/mL, samples from half-udders that had been infected but were healing (culture negative) were about 330,000 cells/mL and milk samples from half-udders that were infected (contained bacteria) had SCC that exceeded 1,000,000 cells/ml. The SCC response is specific to the infected half-udder and ewes infected in a single half-udder will typically have a high SCC in that half udder and low SCC in the healthy half udder. For example, in 39 ewes with intramammary infections in a single half udder, the SCC of the healthy half udders was 195,000 cells/ml as compared to 1,329,820 cells/ml in the infected halves (unpublished data).

The SCC of individual udder-halves can be determined using a CMT paddle or other SCC tests (such as the PortaSCC or the Direct Cell Counter (DCC, DE Laval)). When using individual ewe or half-udder SCC values, a threshold of 200,000-400,000 cells/ml should be used to identify ewes that have subclinical mastitis. The CMT test is normally scored using a 5 point scale (negative, trace, 1,2,3). Milk containing 200,000-400,000 cells/ml would result in CMT scores of “trace” and scores above that threshold (any thickening) indicate the presence of subclinical mastitis. Ewes with SCC >400,000 cells/mL can be considered to have subclinical mastitis and an attempt should be made to identify the causative organism.

It is also important to monitor the bulk tank SCC. Milk regulations in the US require the bulk tank SCC to be <750,000 cells/mL for both cow and sheep milk but it should be possible for dairy sheep producers to produce milk with bulk tank SCC <300,000 cells/ml. If the bulk tank exceeds this level, the SCC of each ewe should be determined and a mastitis investigation should be initiated. The SCC data can be used to select ewes for culturing and to identify chronically infected ewes for interventions such as treatment or culling, target specific ewes for intramammary dry off therapy or identify risk factors for mastitis such as stage of lactation, housing or milking management.

### **How does mastitis spread?**

Some mastitis pathogens are transmitted in a contagious manner when healthy teats come in contact with infected milk that came from a ewe with subclinical mastitis. This form of transmission often occurs during milking and the consistent application of post-milking teat dip is an important strategy that is effective in reducing transmission via this route. Other types of pathogens are considered as opportunistic pathogens that normally reside in the housing environment of the sheep; ewes are exposed when they come in contact with wet or contaminated housing environments. Additionally, CNS are the most common mastitis pathogen in many flocks and the likely source of CNS is skin on the teats or inner legs of ewes (this skin

often contacts teats). However, many CNS infections become chronic subclinical infections, and contagious transmission of CNS is possible. It is also important to recognize that the yeast infections are often associated with non-hygienic administration of intramammary treatments and great care must be taken when these treatments are used (Spanu et al., 2011).

### **How can mastitis be prevented?**

While there is very little research specifically about risk factors for mastitis in milking sheep in N. America, research in other countries has indicated that hygiene and milking practices vary significantly among flocks and influence the risk of mastitis (Gonzalo et al., 2005, Gelasakis et al., 2015). Management practices that improve udder hygiene and reduce teat exposure to bacteria are likely to result in less mastitis. Poor udder conformation has been linked to increased risk of mastitis (Gelasakis et al., 2012) and ewes with deep and pendulous udders should be considered for culling. The most common mastitis pathogens in milking sheep are commonly found on skin and improving hygiene of teats, inner legs and tails is a commonsense recommendation for prevention of mastitis. Pastures and other housing areas should be kept clean and provide a dry place for ewes to rest. Milking equipment should be clean, well maintained and provide stable teat end vacuum. Pulsators should be properly serviced and designed specifically to provide the proper pulsation rate for sheep. Teat cup liners should be observed for wear and replaced in accordance with the manufacturers recommendations. The milking routine should be standardized to include use of pre-milking teat sanitation, and minimize the possibility of transmission during milking. Milking technicians should wear disposable nitrile or latex gloves, remove milking units promptly and apply post-milking teat dip to all teats. Contact with milk that comes from udders of chronically infected ewes is a known risk factor for spread of contagious mastitis so those ewes should be either culled or milked last. It may also be important to review nutritional management. Some research has indicated that deficiency of vitamin A or selenium may contribute to increased risk of clinical mastitis in ewes (Giadinis et al., 2011). Both of these nutrients have a role in ensuring effective immune function.

### **How can mastitis be treated?**

Ewes that develop clinical mastitis are often seriously ill and should be treated immediately according to protocols that have been developed in consultation with the flock veterinarian. Most treatments for severe clinical mastitis are administered systemically, and the ewe may require supportive therapy. There are no antibiotic compounds approved for treatment or prevention of mastitis in milking sheep. Drugs used for these purposes are considered by the FDA to be administered in an “extra-label” manner, and this usage must be prescribed and supervised by a licensed veterinarian. The prescribing veterinarian must have an established veterinary client patient relationship (VCPR). Not all drugs can be administered to food producing animals, even by veterinarians and no drugs should be administered to milking sheep without prior consultation with a veterinarian to ensure that the guidelines for extra label usage are followed. FDA regulations also prohibit all administration of compounded drugs (homemade combinations of drugs). Administration of a drug that is approved for treatment of another sheep disease (such as the use of ceftiofur for treatment of pneumonia), to treat mastitis is also considered as extra-label usage. It is important to recognize that systemic administration of



ceftiofur will not achieve effective inhibitory levels in the mammary glands of cows, sheep, or goats.

Subclinical mastitis is the most common form of the disease and the efficacy or economics of treatment of subclinical mastitis during the lactation period is completely unknown. Most subclinical mastitis can be treated at the end of lactation through the use of intramammary dry off treatment. The use of intramammary dry off treatment has been shown to positively influence milk yield and SCC in the subsequent lactation and is recommended (Gonzalo et al., 2004, Spanu et al., 2011). Extreme care should when intramammary treatments are given because the use of intramammary treatments increases risk of mastitis caused by yeast bacteria. If selective dry off treatment is desired, ewes eligible for treatment can be selected by review of monthly SCC records. Research has shown that milk samples obtained from ewes with 3 or more monthly somatic cell counts  $\geq 400,000$  cells/mL in the previous lactation were 6 to 8 times more likely to be positive for mastitis pathogens in the next lactation as compared to milk samples obtained from ewes with SCC below that threshold and that threshold may be appropriate to identify ewes that should receive dry off treatment (Spanu, 2009).

Drugs administered to lactating sheep are very likely to result in residues in the milk. Residues can occur for both antibiotic compounds and compounds such as antiparasitic drugs. Veterinarians who prescribe extra label treatments must include a label with a clearly defined withholding time for both meat and milk. The purpose of the withholding time is to ensure that the milk does not contain drug residues. The sale of milk containing residues is illegal and detection of drug residues in milk that has entered the food chain will result in considerable fines. This issue is quite important for dairy sheep producers because milk withholding periods for sheep that receive antibiotics (or other drugs) are not well defined. At least one study has indicated that withholding periods for some antibiotics given to sheep should be longer than periods recommended for the same drugs administered to dairy cows (Pengov and Kirbis, 2009). Very long durations (>1 month) of milk residues have been reported for both doramectin (i.e. Dectomax) and ivermectin compounds (Imperiale et al., 2003, Imperiale et al., 2004) and these products should not be administered to lactating sheep. Flocks that use dry off treatment should routinely check the comingled milk in the early lactation period to ensure that residues are not present. The best way to prevent residues is to ensure that all the requirements for extra label drug usage are met, ewes that receive treatments should be marked and segregated from the milking flock and a permanent record of all treatments given to ewes should be maintained.

## **Conclusions**

Mastitis is an important disease of dairy sheep and the prevalence of mastitis varies among flocks depending on flock management. While clinical mastitis can occur, most symptoms of mastitis are not apparent and the subclinical form of the disease can result in significant reductions in productivity and milk quality. In most flocks, CNS are the most important cause of mastitis in dairy sheep. Prevention of infection is the key to control of mastitis and good hygienic housing and milking practices are a necessity to minimize the impact of this disease in dairy sheep flocks.

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## **MARKETS AND MARKETING OF SHEEP MILK CHEESES**

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### **Background**

Historically, sheep's milk cheeses have been popular throughout the world, because sheep can be raised and milked in mountainous regions where herding dairy cattle is impractical or impossible. Some of the most famous cheeses in the world are made from sheep's milk: Roquefort in France, Manchego in Spain, Pecorino Romano in Italy, and Feta in Greece. These four cheeses are well known in America and carried by most specialty cheese shops and upscale grocery stores.

In the United States, just as what's happened with specialty and artisan cow's milk cheeses, the market is witnessing more cheesemakers making original sheep milk cheeses. These cheeses are often labeled with original names, sometimes based on the region in which it is made, a play on the cheesemaker's name, or a whimsical title. Examples include:

- Driftless (fresh sheep's milk cheese named for region) – Hidden Springs Creamery, WI
- Baa Baa Blue (blue sheep's milk cheese) – Carr Valley, WI
- Dante (aged sheep's milk cheese) – Wisconsin Sheep Dairy Cooperative, WI
- Petit Nuage (fresh sheep's milk cheese, translates to little cloud in French) – Landmark Creamery, WI
- Woolly Rind (sheep's milk camembert) – Green Dirt Farm, MO
- Trade Lake Cedar (aged sheep milk's cheese named for region and aging techniques of using cedar boughs) – Lovetree Farmstead Cheese, WI
- Basseri (means farmhouse in Basque) – Barinaga Ranch, CA
- Morcella (sheep's milk cheese with morels) – Shepherd's Way Farms, MN

### **Market Growth of Specialty Cheeses in the United States**

Sheep's milk cheeses are ideal for an American palate because most are notable for a slightly sweet flavor, complex or salty finish, and rich texture. These qualities make for the ideal American cheese, because whether we realize it or not – Americans seek out flavors which are sweet, salty and rich.

More consumers today are identifying sheep's milk cheeses as a welcome alternative to traditional cheese from cow's milk, with more asking: "What cheeses do you have that are made from sheep's milk?" At Metcalfe's Markets in Wisconsin, this happens at least twice a day. A year ago, consumers were asking for goat's milk cheeses. Now, consumers are asking for goat and sheep's milk cheeses. This is because American sheep's milk cheesemakers are making high quality products to rival imported sheep's milk cheeses, and successfully marketing their cheeses to an American marketplace.

In the United States, specialty cheese represents \$2 billion in annual sales, or 12 percent of deli sales. Specialty cheese is one of the top 10 fastest growing deli categories, and sales in this category impact sales in perimeter categories, accounting for almost a quarter of total store sales. This is why more large retail chains are building specialty cheese departments as showcase destination points for customers.

One key reason for growth in American specialty cheeses can be summed up in one word: Millennials. This age group is comprised of 18-34 year-olds and is one of the primary sectors driving the growth in specialty cheese sales. Millennials want food that comes from a local source. They readily identify with “Farm to Table.” To them, this means supporting local farms and learning the story of the cheesemaker.

Millennials have grown up expecting transparency and authenticity in their food. They expect in-store chefs and cheesemongers to provide personal interaction and engagement, and seek out contact with farmers and cheesemakers through demos and tours. Millennials are looking for “inspiration” that comes from the Food Network, Facebook, Pinterest and food blogs, but they want that inspiration to be convenient at a fair price.

## **Market Opportunities**

Significant gaps in American-made sheep’s milk styles exist today, opening up opportunities for cheesemakers. These opportunities include:

A. Manchego – this is one of the world’s best-selling cheeses. It is incredibly popular in America, because 1) people have heard of it, so they can order it or ask where it is without looking foolish or feeling intimidated, and 2) it tastes good. It meets the needs of the American palate – it’s sweet, rich, and salty. While American sheep’s milk cheesemakers cannot legally call their cheese Manchego, as it has Protected Designation of Origin (PDO) status in the European Union, there is opportunity for more styles of this cheese to be made. For example, Hook’s Cheese in Wisconsin makes a “Spanchego” and Hidden Springs Creamery makes a Manchego-Style, which will likely be renamed to avoid PDO conflict. But there is much more room in this category for American sheep’s milk cheesemakers.

B. More mixed milk sheep and cow cheeses. This is important to help bring down the price of sheep’s milk cheese at retail. Cheesemongers know why sheep’s milk cheese is expensive, but the average American does not. And retailers can only educate people so fast. So if American cheesemakers can make a cheese that is a blend that wholesales in the magical \$10 range, retailers can sell it for \$20 a pound and move significant amounts of cheese.

C. More fresh and bloomy rind sheep milk cheeses. Currently, most cheeses made in America in this category are small batch and limited in distribution. We need more small-batch cheesemakers around the country in this category to fill the need. In Wisconsin, consumers constantly ask for a local Brie, as well as French-style fresh cheeses such as crottins or thimble cheeses. This is a huge category not currently being filled – and this is a great category for sheep’s milk cheeses, as most people buying a good brie don’t care nearly as much what it costs.

## **Summary**

More American cheese eaters – not just Millennials – want more artisan and specialty cheeses. Why? They want to expand their palate, indulge with new tastes, and eat what they see being made on the Food Network and at their favorite restaurants by local chefs. This means flavor options will continue to be more robust and include more gourmet varieties, providing great opportunity for the growth of American sheep's milk cheeses.

# NON-GMO LABELING AND ARTISAN CHEESE PRODUCTION

**Cathy Strange**  
**Global Cheese Buyer, Whole Foods Market**  
**Austin, Texas, USA**

## Whole Foods Market

431 stores

US 412, Canada 10, and UK 9

We have stores in all but 8 states: Alaska, Delaware, Montana, North Dakota, South Dakota, Vermont, West Virginia and Wyoming.

The next few stores we'll be opening include Huntsville, AL; Newport News, VA; L.A., CA; Longmont, CO; and Altamonte Springs, FL

Wauwatosa, WI in February 2016!

Mission driven company

Core values as the foundation

Publically traded: WFMI

12 autonomous regions

48 stores will be added by end of 2016

101 on the books through 2018

365 Store concept - 6 stores in 2016

## Ingredient Standards

Meat Step rating system; Seafood sustainable ranking; Produce responsibly farmed; Cleaning products ranking; Whole body standards

NEXT - *Non-GMO initiative*

## Meat



### THE 5 STEPS

Global Animal Partnership's 5-Step Animal Welfare Rating program outlines specific husbandry and management practices that promote farm-animal welfare. Step 1 is the first level in the program and a clear departure from conventional animal agriculture practices.

*At Step 1 farmers and ranchers must focus intently on the welfare of their animals and meet approximately 100 species-specific standards. For example, most physical alterations widely used in animal production are prohibited at Step 1.*

Beyond Step 1, each successive Step requires more animal-centered practices. The progressive nature of the 5-Step Animal Welfare Rating program encourages producers to improve their welfare practices and to attain higher Step ratings.

## Seafood



### Responsibly Farmed Seafood

Farming seafood (aquaculture) can provide a consistent, high-quality, year-round supply of healthy and delicious protein. When it's done right, aquaculture can be environmentally friendly and can be a crucial way to supplement wild-caught fish supplies. On the other hand, poor farming practices like the overuse of chemicals and antibiotics and those that cause water pollution and other negative impacts on the environment are bad news. Our strict Quality Standards and third-party verification process ensures that we only source farmed seafood from the world's leaders in environmentally responsible aquaculture.

Look for these colored labels to indicate the Seafood Watch® rating of each of our wild-caught products:



Abundant, well managed and caught in environmentally friendly ways.



Some concerns with how caught or with health of habitat due to other human impacts.



Presently caught in ways that harm other marine life or the environment.



Not yet rated.



## Produce

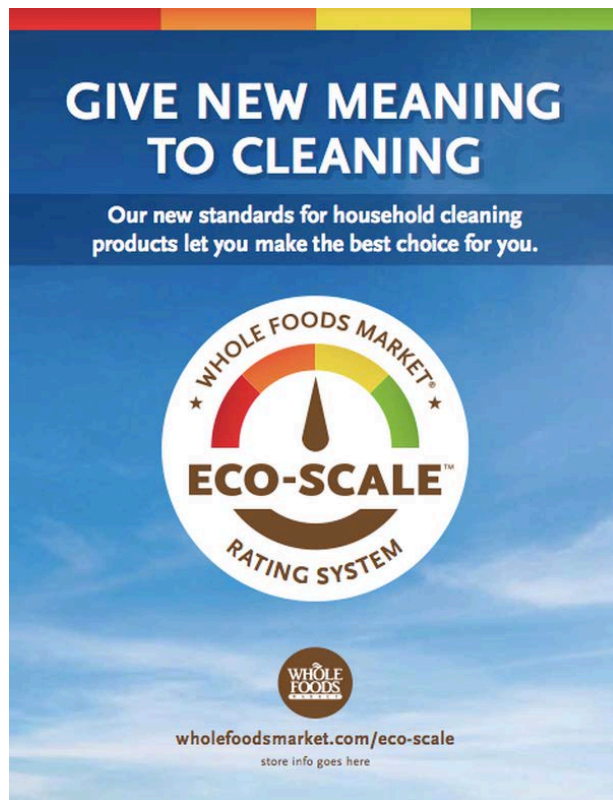


Get to know our **RESPONSIBLY GROWN RATING SYSTEM**

These ratings are based on standards you won't find anywhere else. In order to earn a Good rating, a farm must take major steps to protect human health and the environment. A Better rating indicates advanced performance, and a Best rating indicates exceptional, industry-leading performance.

UNRATED	GOOD	BETTER	BEST
Not yet rated in key areas of sustainability	<ul style="list-style-type: none"> <li>18 farming practices to protect soil, water and human health</li> <li>No Whole Foods Market prohibited pesticides</li> <li>CMO transparency</li> <li>No irradiation</li> <li>No GMOs</li> </ul>	<ul style="list-style-type: none"> <li>Water and energy conservation</li> <li>Advanced soil health</li> <li>Protecting rivers, lakes and streams</li> <li>Farmer/worker health and safety</li> </ul>	<ul style="list-style-type: none"> <li>Protecting bees and butterflies</li> <li>Industry leadership on pest management and environmental protection</li> <li>Water and energy conservation</li> <li>Advanced soil health</li> <li>Protecting rivers, lakes and streams</li> <li>Farmer/worker health and safety</li> </ul>
	<ul style="list-style-type: none"> <li>18 farming practices to protect soil, water and human health</li> <li>No Whole Foods Market prohibited pesticides</li> <li>CMO transparency</li> <li>No irradiation</li> <li>No GMOs</li> </ul>	<ul style="list-style-type: none"> <li>Water and energy conservation</li> <li>Advanced soil health</li> <li>Protecting rivers, lakes and streams</li> <li>Farmer/worker health and safety</li> </ul>	<ul style="list-style-type: none"> <li>Protecting bees and butterflies</li> <li>Industry leadership on pest management and environmental protection</li> <li>Water and energy conservation</li> <li>Advanced soil health</li> <li>Protecting rivers, lakes and streams</li> <li>Farmer/worker health and safety</li> </ul>

## Cleaning Products



## Cheese



- rBST free
- Traditional production
- Family farms

### Next for cheese:

Quality Standard on Grass Fed labeling  
Non-GMO initiative



# March 08 2013

## Walter Robb, Co-CEO announces

"We are putting a stake in the ground on GMO labeling to support the consumer's right to know," said Walter Robb, co-CEO of Whole Foods Market. "The prevalence of GMOs in the U.S. paired with nonexistent mandatory labeling makes it very difficult for retailers to source non-GMO options and for consumers to choose non-GMO products. Accordingly, we are stepping up our support of certified organic agriculture, where GMOs are not allowed, and we are working together with our supplier partners to grow our non-GMO supply chain to ensure we can continue to provide these choices in the future."

### Whole Foods Market's Stance on GMO Labeling?

*At Whole Foods Market, we believe that people have a right to know what's in their food.*

That's why we have set a deadline that, by 2018, all products in our U.S. and Canadian stores must be labeled to indicate whether they contain genetically modified organisms (GMOs).

Whole Foods Market is the first national grocery chain to set a deadline for full GMO transparency. Clearly labeled products help shoppers who want to avoid foods made with GMOs to do so.

### What Products Will be Included in Your Labeling Standard?

Our non-GMO transparency initiative includes *all* food products we sell, going far beyond what any of the state initiatives and legislation has proposed so far. Products based on or containing ingredients created from government approved GMO crops will need to provide full transparency. Not only that, but our dairy and egg producers will also need to verify whether or not animals were fed GMO corn, soy or alfalfa.

### Why Have You Just Recently Announced You Will be Requiring Label Transparency?

This is not the first step we've taken toward GMO transparency. Whole Foods Market has been collaborating with many of its supplier partners for years to source products without GMO ingredients, and, we offer more choices for shoppers who are looking to avoid GMOs than any other retailer.

In 2009, Whole Foods Market began putting our 365 Everyday Value™ line through Non-GMO Project™ verification and encouraged our grocery supplier partners to do the same. Now,

only 5 years later, we sell more than 8,500 Non-GMO Project verified products -- more than any other retailer in North America.

In addition to looking to our non-GMO verified choices, shoppers who are looking to avoid GMOs can also choose from the more than 25,000 certified organic choices we offer companywide (organic certification prohibits the intentional use of GMOs).

Our 2018 commitment to full label transparency is the next step on the journey. *Our initiative will require full GMO transparency on products that are based on or contain GMO risk ingredients.*

Our customers are becoming increasingly hungry for information about GMOs and how to avoid products that contain GMOs, and have looked to us to help provide the transparency they're looking for.

## How do you determine if products are really non-GMO?

At Whole Foods Market, we believe non-GMO verification needs to be robust, science-based, credible, and based on standards created by multiple stakeholders. Accordingly, we have designated two methods of Non-GMO Verification that we will permit as substantiation that a product can be considered Non-GMO within Whole Foods Market:



Certified organic – which prohibits the intentional use of GMOs



The Non-GMO Project Verified program



NSF True North



# EXPERIENCE WITH REARING LAMBS THAT DO NOT NURSE A EWE

**Russell L. Burgett**  
**National Sheep Improvement Program**  
**Ames, Iowa, USA**

## **Background**

The weaning system utilized by a sheep dairy operation is an important economic decision. Systems range from allowing ewes to raise lambs for a period of time and machine milking after weaning to removing lambs immediately from ewes. A system should be chosen that maximizes production efficiency and assures animal welfare. Ewes milked for commercial production starting at 24 h post-partum produced 51.5% more milk than ewes allowed to raise their lambs until 30 d post-partum and milked from that point forward (McKusick et al., 1998). Additionally, total fat yield is reduced when lambs are allowed to nurse ewes due to a decrease in oxytocin released during machine milking.

The welfare of lambs is also an important consideration when choosing a lamb rearing system. The poor viability of East Friesian sheep due to respiratory disease has been reported in Europe (Katsaounis and Zygoiannis 1986, Ricordeau and Flamant 1969) and the U.S (Thomas et al., 1999) with death loss records exceeding 30% in some cases. At the University of Wisconsin-Madison, Spooner Agricultural Research Station (SARS), maintaining ewes with lambs in a confined lambing facility was thought to be contributing to poor air quality and thus predisposing lambs to respiratory upset/disease. Therefore, in 2013, a new lamb rearing system was developed in which lambs are artificially reared immediately after parturition.

## **Description of the Lamb Rearing System**

In 2013 at the Spooner Agricultural Research Station, the decision was made to remove lambs from their ewes immediately following parturition. This was performed to minimize the amount of ammonia gas in the environment in the lambing facility and improve animal wellbeing. Lambs are born in “drop pens” with approximately 20 ewes per pen. The pen is in a naturally ventilated barn with no heat and with free access to outside lots. Immediately following parturition, the ewes are allowed to clean their lambs but lambs are removed prior to suckling. Lambs are moved to the lamb rearing facility which is heated to approximately 1.67°C (35° F) and all lambs born to one ewe are placed into a 4’ long, 2’ wide and 2’ tall pen. The pens are straw bedded on a crushed limestone base on top of concrete. Lambs are dried if needed and placed under heat lamps if hypothermia is suspected.

Following parturition, ewes are moved to a “fresh ewe” pen and are the first ewes to enter the milking parlor at the subsequent milking period. Colostrum is collected by machine milking into a *Quarter Milker* (Coburn Manufacturing, Whitewater, WI) for the first 2 milkings after parturition. All of the first-milking colostrum from a milking period is tested for quality using a *Colostrometer* (Biogenics, Mapleton, OR). All colostrum that is adequate in quality is pooled and chilled in a refrigerator to be fed to the lambs. Any colostrum of poor quality is discarded.

Lambs are fed four feedings of colostrum at four-hour intervals with each lamb receiving 10% of its bodyweight in colostrum within the first two feedings (eight hours). All lambs are fed via esophageal tube. Prior to feeding, the tested, pooled and chilled colostrum is warmed to 41.67°C (107°F) in a water bath. The warmed colostrum cools to body temperature by the time it is removed from the water bath and delivered to the lambs. After the fourth feeding, all lambs are weighed, identified with ear tags, tails docked and castrated (if needed) via elastrator bands then moved to training pens where they are trained onto automatic milk replacer machines (*LacTek-Biotic Industries Inc. Bell Buckle, TN*). All lambs are offered a pelleted creep feed after approximately 7 days post-partum and are weaned onto the same feed at 30 days of age.

## **Benefits**

The largest benefit to the zero-nursing system is assuring adequate intake of high quality colostrum. This is the best way to improve lamb health and survival. When lambs are nursing ewes, it is impossible to determine the exact quantity and quality of colostrum intake. In this system, the producer tests each milking of colostrum and feeds a known amount to each lamb.

Additionally, air quality in the lambing facility is drastically improved because the main source of ammonia is no longer present (urine and feces from ewes). This system also allows for better observation of individual lambs as each lamb is visually seen and handled four times within the first 16 hours then an additional four times in the next 12 hours during the training phase. This better allows for individual care of lambs if needed and eliminates problems that may have been overlooked with ewes hiding their lambs. Also, the risk of lambs being stepped on or suffocating under a ewe are eliminated. With this system, lamb death loss was reduced to approximately 11% at the SARS.

It can be perceived that this system requires additional time and labor during lambing. This system requires good management but requires no additional time. If the ewes nurse lambs for a period of time, each lamb must be observed over that time to estimate colostrum intake and often, lambs require aid in nursing or fed manually. Ewes do not need to be worked with in the close quarters of a lambing pen, which reduces the physical stress on employees.

## **Cautions**

Adequate quantities of high quality colostrum are imperative in any lamb rearing system. This system simply allows producers to identify shortcomings in either quantity or quality (which is not feasible in other lamb rearing systems). Often times, ewe lambs or ewes lambing for the first time do not have sufficient colostrum to support their lambs and an alternative source is needed. Excess colostrum from mature ewes can be frozen and later thawed when needed. Also, artificial colostrum products have also been used successfully.

If certain transmissible diseases are present in the flock such as OPP, pooling colostrum should be avoided or pasteurization should be considered. Certain infectious agents can be vertically transmitted via colostrum and milk and should be considered before implementing this system.

## Conclusions

Any small ruminant dairy can implement the system of rearing of lambs that never nurse ewes. The increased animal health and survival has the potential to increase the returns to producers. Decreasing death loss from 30% to 10% provides 20% more lambs to market or provides a larger pool of replacement breeding animals to be used in selection decisions. Additionally, the benefits realized by this system can be realized in other rearing systems such as feeding each lamb adequate levels of high quality colostrum even if ewes raise lambs for a period of time. This system should be carefully considered to be integrated into small ruminant dairy operations.

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# BEST PRACTICES FOR RAISING LAMBS ON MILK REPLACER

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## Abstract

Lambing season can drive a shepherd's long-term success. The health, growth and early performance of a lamb crop directly impacts a flock's future performance in the parlor.

Nutrition is essential in giving lambs a solid start – and milk replacer can be a solution in this early success, with studies showing better growth performance and long-term performance potential than those fed cow's milk or non-sheep milk replacers.<sup>1</sup> However, success is not guaranteed on milk replacer alone. To secure the long-term performance benefits of feeding a lamb milk replacer, follow a total management program.

Critical components of a total management program are offered in this proceedings, as follows:

1. Obtainable goals
2. Newborn care
  - a. Navel disinfection
  - b. Colostrum feeding and management
3. Choosing the right milk replacer
4. Choosing the right milk feeding system
  - a. Bottle feeding
  - b. Lamb bar feeding
  - c. Automated mixing and feeding system
5. Rumen development
6. Weaning management

## 1. Set obtainable goals

Before the first lamb hits the ground, analyze past performance of the flock and set goals. Setting tangible goals and determining a path for achieving these objectives can help you build on past flock performance.

Consider the following goals:

- **200 percent lamb crop:** Mature and well-conditioned ewes should be able to lamb at least two lambs. Extra lambs (triples and quads) may require additional care to reach their full potential.

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<sup>1</sup> Berger, Yves and Richard Schlapper. "Raising lambs on milk replacer." University of Wisconsin-Madison Spooner Agricultural Research Station. [http://www.ansci.wisc.edu/Extension-New%20copy/sheep/Publications\\_and\\_Proceedings/Pdf/Dairy/Health%20and%20Nutrition/Raising%20lambs%20on%20milk%20replacer.pdf](http://www.ansci.wisc.edu/Extension-New%20copy/sheep/Publications_and_Proceedings/Pdf/Dairy/Health%20and%20Nutrition/Raising%20lambs%20on%20milk%20replacer.pdf). 24 July 2014.

- **Less than 5 percent pre-weaning mortality:** The industry target for pre-weaning mortality is less than 5 percent. However, it's estimated that nearly 20 percent of lambs are lost before weaning, with 80 percent of those losses occurring during the first 10 days.<sup>2</sup> These early losses can impact the flock's future by limiting the flock rotation and delaying the inclusion of new genetics in the flock.

## 2. Newborn care

Newborn care is the first step in achieving the aforementioned goals. The first minutes after a lamb is born can influence its entire life.

Following birth, the lamb is exposed to bacteria and pathogens that its immune system is unfamiliar with. Without protection, the new life can be in danger – leading to an increase in pre-weaning health issues and mortality rates. Two ways to protect lambs against these pathogens are: navel disinfection and quality colostrum.

- Navel disinfection:** Immediately after birth, disinfect the newborn's navel with the proper disinfectant. Ensure the disinfectant covers both the outside and inside of the navel.



A 7 percent tincture of iodine is the first recommendation for a disinfectant. Betadine or Nolvasan has been used however lacks the drying effect. Don Sockett, DVM, Ph.D., at the Wisconsin Diagnostics Laboratory recommends a 50:50 blend of undiluted Nolvasan plus rubbing alcohol as a second best option.

The Land O'Lakes Animal Milk Products' research team has found the use of a syringe or bottle (Figure 1) to be helpful to achieve adequate and consistent navel disinfection.

University of Wisconsin research data shows that the mortality and treatments for pneumonia are significantly reduced in calves, when navels are disinfected, as shown in Figure 2. Similar results may be expected for sheep.

Treatment	No. Of Calves	% Mortality	% Treated for Scours	% Treated for Pneumonia
Disinfected	269	7.1	30.5	5.2
Not Disinfected	132	18.0	22.0	18.9

\* Source: Calf Survival Study. Univ. Of Wisconsin

- Colostrum feeding and management:**

Colostrum, or the first milk in lactation, is the primary protection lambs receive against environmental pathogens and bacteria. The immunoglobulins in colostrum are essential because antibodies in the ewe's bloodstream do not cross the placenta.<sup>3</sup> The lamb can only receive the protective antibodies by consuming colostrum.

<sup>2</sup> Schoenian, Susan. "Care of Newborn Lambs." University of Maryland. <http://www.sheep101.info/201/newborns.html>. 24 July 2014.

<sup>3</sup> "Sheep management: Colostrum and health of newborn lambs." Iowa State University Extension. June 1995. <http://www.extension.iastate.edu/Publications/PM989X12.pdf> 18 February 2013.

This protection hinges on high quality colostrum fed immediately following birth. Lambs should receive 10 percent of their body weight in colostrum by 18 hours of age. For example, a 10 pound lamb should be fed 1 pound (or 16 ounces) of colostrum in its 18 hours of life. At least half of this volume should be fed within 4 to 8 hours. Colostrum and colostrum replacements should be fed at about 105 degrees F.

Researchers at the University of Maryland recently stated that, when feeding the first colostrum, within “30 minutes is optimum while 18 hours is a must.”<sup>4</sup> Timing is crucial because the protective antibodies found in colostrum can only cross the intestinal wall and enter the bloodstream during this time. The intestinal wall begins to stop passive transfer of antibodies hours after birth, so immediate feeding of colostrum is desired.

To ensure proper consumption in the necessary time, colostrum can be hand-fed via bottle or stomach tube. The necessary levels can be fed in increments of 3-5 ounces at 3-4 hour intervals throughout the first 18 hours. Once in the system, the maternally-derived antibodies help fight off infections, while the lamb builds its own stable immune system.<sup>5</sup>

Though colostrum is a necessary ingredient to newborn lamb success, fluctuations in colostrum quality and quantity produced by the ewe are probable. Recent research shows large variability in colostrum production, with older ewes often producing higher levels of the protective first milk.<sup>3</sup> Research also indicates ewes that produce larger litters are often unable to naturally produce adequate protection for bonus lambs – often leaving bonus lambs unprotected.<sup>6</sup>

**One way to ensure all lambs receive high-quality colostrum, free from any disease, in adequate quantities is through a colostrum replacer. When selecting a colostrum replacement product, look for a product labeled to raise IgG concentration above 10 mg/ml. These products are typically made of dried bovine colostrum and contain at least 75 grams of IgG per liter as well as high levels of natural colostrum fat, protein, vitamins and minerals needed by the newborn lamb. In the United States, these products are regulated by the U.S. Department of Agriculture Center for Veterinary Biologics for quality control. Look for the U.S. Veterinary permit on the label.**

**Beyond this measure, selection of colostrum replacers should be based on research. Analyze the product for research results and determine if the supplier is a reputable source. In addition, the product should be made specifically for small ruminants (lambs and kids).**

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<sup>4</sup> Schoenian, Susan. “Colostrum: Liquid Gold.” University of Maryland Extension. <http://www.sheepandgoat.com/articles/colostrum.html>. 18 February 2013.

<sup>5</sup> Nowak, R., and P. Poindron. *From birth to colostrum: Early steps to lamb survival*. Reproductive Nutrition Development. Volume 46, pp 431-446. 2006. <http://vetsci.co.uk/2012/01/23/the-importance-of-colostrum-for-new-born-lamb/>.

<sup>6</sup> Lindsay, D. R., R. Nowak, I. Gede Putu, and D. M. McNeill. 1990. Behavioural interactions between the ewe and her young at parturition: A vital step for the lamb. Pages 191–205 in *Reproductive Physiology of Merino Sheep. Concepts and Consequences*. C. M. Oldham, G. B. Martin, and I. W. Purvis, ed. School of Agriculture (Animal Science), The University of Western Australia, Nedlands, Perth.



When a high-quality colostrum is fed in the right quantity, it can impact long-term performance. This is shown in a research study in the dairy cattle industry. Data shows that calves with failure of passive transfer had delayed time to first calving (Can Vet J., 1986, 50:314); decreased average daily gain (Nocek et al., 1984; Robison et al. 1988) and decreased milk and fat production at first lactation (DeNise et al., 1989).

Inadequate colostrum intake has also been shown to reduce long-term performance of dairy heifers (Faber, et. al. 2005).<sup>7</sup> In this study, Brown Swiss heifers fed 2 liters of colostrum vs. 4 liters, over the course of 6 to 8 feedings; had reduced average daily gain (1.76 lb. vs. 2.2 lb.), increased time to first conception in months (14 vs. 13.5), reduced survival through 2<sup>nd</sup> lactation (75.3 vs. 87.1%) and over 2000 pounds less milk production through the second lactation (35,297 vs. 37,558).

### 3. Choosing a Lamb Replacer

After lambs are fed a high-quality colostrum for the first feedings, they can be transitioned onto a milk replacer. Milk replacer selection can impact lamb growth.

When lambs are fed high quality milk replacer they can perform at least as

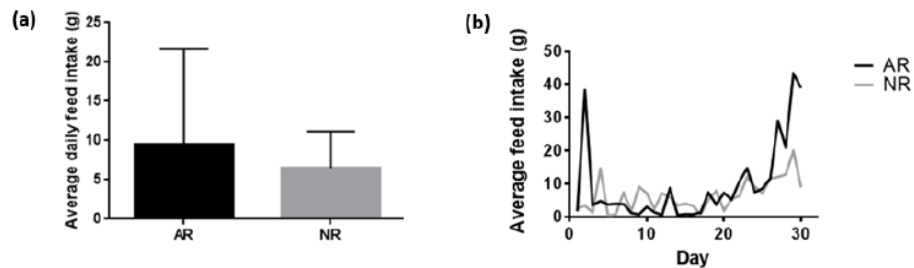
well as when on the ewe. Figure 3 shows a recent Cornell study by DiPastina (2015) that demonstrated this using a commercially available lamb milk replacer (LAND O LAKES® Ultra Fresh® Optimum).<sup>8</sup>

When selecting a milk replacer, first be sure it is made specifically for lambs. This is because an all-purpose, multi-specie milk replacer is built on compromise. Calves, lambs, kids, pigs, alpacas, puppies and kittens do not all have the same nutrient requirements. For example, the fat content of sheep milk is much higher than cow's or goat's milk and the lactose content is lower.<sup>1</sup>

Figure 3

Rearing method	Average growth rate (kg/day)
Artificial	0.30 ± 0.004
Natural	0.28 ± 0.004

No significant difference existed between growth rates of AR and NR lambs.



<sup>7</sup> Faber, S.N., Effects of Colostrum Ingestion on Lactational Performance, Prof. Anim. Scientist, 2005

<sup>8</sup> DiPastina, Ann. "Evaluating the growth of lambs under artificial and natural rearing methods." Honors Thesis, Cornell University. May 2015.

Milk replacers formulated for lambs are better able to provide the nutrients lambs require because they closely mimic the composition of ewe's milk. Composition of sheep's milk on a dry matter basis is at least 25 percent protein and 30 percent fat. The solids level of ewe's milk on as-fed basis is approximately 18 percent solids solution.

A lamb's milk replacer should closely match these numbers, with similar protein, fat and total solids.

A simple formula for calculating total solids in the final solution based on the mixing instructions for the lamb milk replacer is:

- $(\text{Weight of Powder} \div (\text{Weight of Water} + \text{Weight of the Powder})) \times 100 = \% \text{ Solids of Final Solution}$

Comparing feed analysis tags on various lamb milk replacers can be confusing. Although the ingredients and specifications may be similar based on the feed analysis tag, it is difficult to truly tell the differences between the product based on this comparison. For example; sometimes tags will have differences in vitamin A (i.e. 30,000 vs. 20,000 IU/lb.). If there is a higher guarantee on one product compared to another, does that make it better? Not necessarily since some nutrients in excess can cause issues.

A more informed decision can be made by asking some key questions of the supplier or manufacturer:

- What research has been done to prove this formula performs in lambs? Ask for a summary of those results.
- Do the ingredient sources utilized in the formula meet human food grade quality standards?
- What are the fat sources and has any consideration been made to formulating not only to a fat level, but to provide the lamb with a specific fatty acid profile?
- Copper considerations: The lamb milk replacer should contain copper at 7 to 11 ppm, since the lamb requires that for normal growth. Molybdenum should also be included in lamb milk replacer.

#### **4. Choosing the right feeding system**

There are three primary means of feeding lambs on milk replacer. Bottle feeding, free-choice feeding via a "lamb bar" or an automated system. Choosing the right milk feeding system should be based on which system best fits the lamb raisers facilities, size of operation, labor situation and performance objectives.

Regardless of the feeding strategy, consider the following guidelines:

- Assist lambs for the first few feedings as needed.
- Avoid placing younger lambs with older lambs to prevent competition.
- Hang a light over the milk replacer self-feeding devices for added visibility and warmth.
- Ensure lambs are housed in an area that is clean, dry, well-bedded and well-drained with enough bedding for the lambs to nest.

- Keep ammonia levels low by providing drainage and ventilation.
- Keep feeding systems clean to prevent bacterial build-up. A recommended process is: warm water rinse, hot alkaline detergent solution rinse, acid rinse, dry and disinfect.

Following is a breakdown of feeding strategies<sup>9</sup>:

- **Bottle feeding**

- Pros
  - Ensures an appropriate controlled volume of (usually warm) milk replacer
  - Useful for rearing small numbers of lambs
- Cons
  - Very labor intensive feeding and cleaning of the equipment
  - Must feed at the same time each day

- **Lamb bar feeding**

- Pros
  - Provides opportunity for several lambs to feed ad-lib, so they can drink several times a day
  - Milk can be fed warm or cold
  - Meals can be smaller and more frequently, thereby reducing the potential for digestive upsets
  - Faster growth rates compared with bottle fed lambs
  - Less labor involved: milk replacer is mixed in bigger volumes and it doesn't require holding bottles
- Cons
  - Diseases can spread more easily through shared nipples
  - Teats and tubing should be cleaned daily
  - Buckets must be emptied and cleaned regularly to reduce the risk of the build-up of pathogens and risk of scours
  - Requires milk replacer to include a preservative

- **Automated mixing and feeding systems**

- Pros
  - Milk consumed in small quantities and often
  - Low risk of digestive upsets
  - Highest growth rates
- Cons
  - Highest set up cost
  - Best hygiene critical. Tubing and mixing bowl must be cleaned daily and the machine calibration checked at least once a week

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<sup>9</sup> Sheep Management Feeding Systems, Mole Valley Feed Solutions Ltd, Head Office, Station Road, South Molton, North Devon EX36 3BH [www.molevalleyfarmers.com](http://www.molevalleyfarmers.com)

## 5. Rumen development

The rumen is the main site for nutrient breakdown and absorption in the animal and in other species has been highly correlated to health and performance of the animal.

Rumen papillae are the finger-like projections inside the rumen that are responsible for absorbing digested nutrients. If a lamb does not have well-developed rumen papillae the potential is there that it may not be able to capture all of the nutrients that are made available to it through the diet.

When a lamb is born, the rumen is not fully developed and neither are the papillae inside the rumen. Growth of the rumen papillae and rumen development can be correlated with what the lamb eats pre-weaning.

There are five requirements to achieve optimal rumen development:

- Substrate (a high quality grain mix)
- Liquid (water, saliva)
- Establishment of beneficial bacteria in the rumen
- Absorptive ability of the tissue (papillae)
- Outflow of material from the rumen (muscular action)

Acetate, propionate and butyrate are the main volatile fatty acids (VFAs) produced from ruminal fermentation. Research demonstrated that calves fed milk and high-quality hay diets to 6 weeks of age had minimal papillae development compared to calves fed milk and grain only.<sup>10,11</sup> Forage-based diets result primarily in the production of acetate rather than propionate and butyrate which is not optimal for papillae growth. Butyrate or butyric acid is implicated in the stimulation of papillae growth.<sup>11</sup>

In lambs, papillae development is initially triggered as the lamb begins to nibble on starter. During this period, adequate water in addition to starter is critical to create a rumen environment that supports fermentation and production of VFAs which in turn stimulate the beginning of rumen development.

Promote rumen development by starting lambs on high-quality starter feed at early in life and provide ample high quality clean, fresh water supply at all times.

If the rumen is not developed appropriately, weaning can be delayed, or unsuccessful. Remember, water is a critical ingredient in the development of bacterial growth and the beginning of rumen fermentation.

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<sup>10</sup> W.P. Flatt, R.G. Warner, J.K. Loosli. Influence of Purified Materials on Development of the Ruminant Stomach, *Journal of Dairy Science*, Volume 41, Issue 11, Pages 1593-16000, Nov. 1958.

<sup>11</sup> Baldwin, R. L., VI and K.R. McLeod. 2000 Effects of diet forage concentrate ratio and metabolizable energy intake on isolated rumen epithelial cell metabolism in vitro. *J. Anim. Sci.* 78:771-783.

In addition to the significant calf data that supports the feeding of grain vs. forage for encouraging rumen development, G.A. Abou Ward (2008<sup>12</sup>) reports that creep (grain) fed lambs had heavier ( $P<0.05$ ) rumen fresh weight (82%) relative to the total fore-stomach weight in comparison with only 70.2% for the solely milk-fed group. The papillary length was in favor of the creep fed lambs (2.24 mm vs 1.15 mm). The creep fed lambs also had higher ( $P<0.05$ ) circumference (mm), surface area (mm<sup>2</sup>) and total papillary surface area.

## 6. Weaning Management

Lambs are ready for weaning when they consume an equivalent of 1.5 percent of their body weight of a high-quality creep feed along with adequate water. This is typically when lambs are near 30 days of age or 35 pounds of weight. At weaning time, each lamb should have consumed at least 25 pounds of lamb milk replacer powder.

### Rules of Thumb for Weaning

1. Clean, fresh water available -- always
2. Creep feeding before weaning will encourage a smoother transition
3. Lambs may be weaned when eating at least ½ lb. of creep feed daily.
4. Provide a very high quality, high protein diet at weaning (18 to 25% protein). Some animal or other very high quality protein is required. Utilize partially processed grains in weaning systems; processing may be discontinued as animals reach 50 lb. of body weight
5. The diet must be highly palatable, more so than in any other stage of life. 4 to 6% molasses may be useful to minimize dust and sorting, and may improve palatability. A commercial pelleted diet may be considered to reduce sorting, but intakes tend to be lower than with molasses enhanced, rolled grain diets
6. Consult and follow the guidelines of a lamb ration program as set out by a qualified nutritionist

### Steps to Weaning

1. Plan weaning protocol, timing and facilities 14 to 21 days prior to weaning
2. Ensure animals are consuming creep feed
3. Ensure animals are utilizing water
4. Remove milk replacer or ewe (weaning)
5. Feed high protein ration (18 to 25% Crude Protein).

## Conclusion

Successfully raising lambs on milk replacer involves implementation of a total management system. Provide newborn care and colostrum, a lamb-specific milk replacer along with quality housing, feed and water to each newborn lamb. By setting goals and outlining attainable action

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<sup>12</sup> G.A. Abou Ward, American-Eurasian J. Agric. & Environ. Sci., 3 (4): 561-567, 2008 Effect of Pre-Weaning Diet on Lamb's Rumen Development

steps throughout the process, sheep producers can help their lambs thrive from day one, setting them up for long-term success.

# FINDING AND KEEPING GOOD FARM LABOR – MANAGEMENT PRACTICES AND LABOR LAWS

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## **Background**

Over 775,000 hired farmworkers make their living on U.S. farms each year. Forty-four percent work specifically with livestock.

Most farmers would say they know what it takes to be a good manager of their livestock. Some easy markers that reflect how well someone is managing their farm are: reproduction rates, animal health, and meat or milk production. But what does it take to be a good manager of people? If you are managing employees, do you know how well you are doing?

Regardless of the size of your farm, number of employees, or how long you've been a manager, there are certain practices every business manager should implement to be successful at managing labor on the farm. Listening, feedback, leadership, and training are some of the key skills and tools that are important for any manager to have in their human resource management toolbox. These skills and tools will also help you navigate through some of the potential landmines – or areas of opportunity – that present themselves.

## **Recruiting & Hiring**

Successful human resource management starts even before there is an employee working on your farm. How well you manage your employees can be influenced by the recruiting and hiring process.

### *Position Descriptions*

In order to recruit and hire the best employee for the job, it's important to have a clearly written and thorough position description. The position description not only helps you to identify an employee who has experiences to match the job responsibilities, but it also helps potential employees learn more about what is required in the position.

Position descriptions do not need to be extensive, but should cover the basics of the job. Job responsibilities are basic to a position description and should be clearly spelled out. If the position is responsible for cleaning the office or maintaining machinery, it's best if potential employees are aware of that ahead of time so they do not have any unexpected surprises. Listing responsibilities also helps you to weed out interested parties because they may self-select not to apply for the job if they know they cannot perform some of the tasks.

Listing benefits in a position descriptions can assist you in promoting your business by marketing the unique management tools you use to recruit and retain employees. Position

descriptions become far more attractive to potential employees when they include benefits, extra perks, and a description of the team they will be working with.

### *The Interview*

Too often farmers, in a rush to fill a vacant position, hire whoever shows up to the farm first. This is more out of necessity than any kind of lethargy because not only does the work need to get done and cannot wait, but the number of people clamoring for agricultural labor positions is low, and keeps dwindling. Interviewing potential hires, while requiring some time, ensures that your new hire is a good fit for the position and your farm.

Similarly to the position description, the interview does not need to be an extensive process. Interviews should accomplish two goals: first, determine if the potential hire sufficiency meets the qualifications for the position and second, provide you with an opportunity to “test” out the potential employee. “Testing” the employee assist you in identifying communication styles and personality traits that may be beneficial or harmful in the position. This can be accomplished with a small set of directed questions.

Table 1 below shows examples of possible interview questions to use. Legally, you are restricted from asking certain questions because it is illegal not to hire candidates based on their race, sex, religion, national origin, birthplace, age, disability or marital/family status. Ask only questions that are job related.

**Table 1. Legal and Illegal Interview Questions**

<b>Some Questions to Ask</b>	<b>Illegal Questions</b>
How long have you had experience...?	Are you married?
What skills do you have that makes you ideal for this job?	How old are you? -Instead ask, Are you over 18 years old?
Why did you leave your last job?	Where were you born? -Instead ask, Are you authorized to work in the U.S.?
What are your career goals?	Do you have any disabilities? -Instead ask, Are you able to perform the essential functions of this job with or without reasonable accommodations?
Why do you want to work here?	What is your native tongue? -Instead ask, What languages do you read, speak or write fluently?
Tell me about yourself.	How tall are you? How much do you weigh? -Instead ask, Are you able to lift a 50-pound weight and carry it 100 yards, as that is part of the job?

### *Paperwork*

Above all else human resource management, whether on farm or in the business world, involves maintaining records and keeping paperwork. Unique to other tools in your toolbox, paperwork is not only useful but it is also legally required. When hiring employees, you need to



collect and file forms from new hires. Every employee on your farm should have a folder with relevant and necessary hire forms. While not required, it is also recommended that copies of performance reviews, disciplinary actions, trainings, and other important information be kept in employees' folders.

These are the forms you as an employer are legally required to collect from each of your hired employees at the time of hire:

- W-4 Form – This form is for federal and state tax purposes.
- I-9 Form – This form is to show verification of employment eligibility of your new employee. This proves that the employee you are hiring is allowed to work in the U.S. for pay. You do not submit this form to any agency. The completed and signed form remains in the employee's folder on your farm for three years after the date of hire or for one year after employment is terminated. Copies of the supplemental documentation are not required to be kept on file, although employers are required to verify the documentation presented with the completed I-9 Form. Employees should fill out the form themselves. A list of acceptable supplemental documentation is in Table 2 below.

**Table 2. I-9 Form Supplemental Documentation**

<b>List A: Document that Establish BOTH Identity and Employment Authorization</b>	<b>OR</b>	<b>List B: Document that Establish Identity</b>	<b>AN</b>	<b>List C: Document that Establish Employment Authorization</b>
U.S. Passport;		Driver's license;		Social Security Card;
Permanent Resident Card;		State or government issued photo ID card;		U.S. Birth Certificate;
Foreign passport containing temporary I-551 stamp;		State or government issued ID card with information such as name, date of birth, etc.;		Certificate of Birth Abroad by U.S. Department of State;
Employment Authorization Document with photo		U.S. military card;		U.S. Citizen ID card;
		School ID card		Resident Citizen ID card

Unauthorized immigrants present a unique and challenging case for human resource management. In the agricultural industry, unauthorized immigrants make up a large percentage of the available workforce and are often the only workers available to employers in some locales. While not legally authorized to work in the U.S., most do have the necessary paperwork to fill out an I-9 form. And the documentation often appears quite genuine even though it may not be. It is quite possible you may not know whether your new hire is unauthorized or not. The only legal requirement of employers is, as stated on the U.S. Citizenship and Immigration Services, "[to] examine the employment eligibility and identity document(s) an employee presents to determine whether the document(s) reasonably appear to be genuine and to relate to the employee and record the document information on the Form I-9." Therefore, as long as the documents appear to be genuine and match the information the employee filled out on the I-9 Form, you have done your due diligence by the law. It is recommended that copies of the supplemental documents (driver's license, passport, social security cards, etc.) are not kept on

file on the farm for any employees. This is a risk protection for you as the employer in case you are audited by the federal government.

## **Keeping Good Employees**

Once an employee is hired, the next challenge is to retain them and improve their skillset. Your goal is to keep the best employees working for you on your farm. Why? Because research has shown that the best farm employees can consistently be two to four times more productive than the worst employees (Billikopf 2014). Productive, happy, and skilled employees improve the profits and efficiency of the farm business.

### *Communication*

A successful working relationship means being able to communicate effectively with those around you. Employees are not going to be able to do their job to your level of expectation if they do not understand what they need to do. Confusion about job responsibilities or how to do a certain task is a huge obstacle in employee performance. Unfortunately miscommunication happens all too often. According to the 2013 UW-Extension Human Resource Management on Wisconsin Farms Survey conducted by the Farm & Risk Management Team, communication barriers was the number one challenge to human resource management on Wisconsin farms. And it's not just about language, but a result of the more subtle aspects to communication, like body language and emotions.

According to Donna Stringer and Patricia Cassiday, authors of [52 Activities for Improving Cross-Cultural Communication](#), miscommunication happens as a result of the following six primary causes:

1. *Assumption of similarities* – When we interact with people similar to us all the time, we tend to assume everyone is “like us”. People like us communicate and behave in the same way as we do. Then when we interact with someone who communicates or behaves differently, we may perceive them in a negative way.
2. *Language differences* – Miscommunication happens when different languages are spoken, but also when people speak the same language. Think of regional slang or words which mean one thing to one group and have another meaning with another group. For example, people in the Midwest use “pop” to refer to a soda drink; while on the east coast the term refers to drug use or shooting someone. Even though this is an extreme example, these kinds of differences can have major implications for communication.
3. *Nonverbal misinterpretations* – Communication is not just verbal or spoken; body language, our facial expressions, eye contact, and manner of dress all contribute to how we communicate with each other. And how we interpret the meaning of nonverbal communication is often culturally dictated. Eye contact is an example of a form of nonverbal communication which can easily be misinterpreted due to the meaning and importance culture places on it. In the U.S. direct eye contact is required to establish trust in a relationship, whether it is in a business or personal setting; whereas in Asian cultures, direct eye contact is a sign of aggression and works against building trust.
4. *Preconceptions and stereotypes* – Oversimplification, misunderstanding, and fear of other cultures and groups of people create stereotypes and preconceived notions. Typically preconceptions and stereotypes are based on a true characteristic of a group of

people that has been exaggerated by another group. For example, Mexicans are sometimes portrayed in media and pop culture (i.e. films) as “lazy” and poor workers. This is a stereotype created out of the tradition for workers in Mexico to take a “siesta” or break during the afternoon. The reason for this break is due to the fact that in Mexico being near the Equator, the afternoon would be uncomfortably hot and sweltering, so workers would take their lunch break at the hottest part of the day and resume work later when it cooled down.

5. *Tendency to evaluate* – Many times without even thinking about it we are evaluating the people and things around us through our “lens”, which was developed by our culture and upbringing. Behaviors, actions, and types of communication may be interpreted as negative by our “lens”, even though we may not fully understand the intent or meaning.
6. *High anxiety* – When people are outside of their comfort zone or are in a situation that is uncomfortable, for example if they do not understand what is being said to them, it causes anxiety. While in an anxious state it is hard to be an effective communicator because your body is flooded with stress hormones and adrenaline, bringing on the ‘flight or fight’ response.

Listening is the foundation of good communication. And good communication is key to being a successful manager of people. While many people focus on how to say what you mean, it is just as important to be able to listen to what others are telling you. And listening is not just about using your ears, but focusing your whole body on what is being said to you. This is called active listening. Listening does not mean just being talked at; the listener is just as engaged in the conversation as the person doing the speaking.

Here are some ways to increase your listening skills to make you a more effective communicator:

- Rephrase back to the speaker what you heard them say;
- Ask questions;
- Lean slightly forward towards the speaker;
- Keep eye contact;
- Avoid uninterested behaviors like, crossing your arms, looking at a watch, or turning away from the speaker;
- Use nodding, smiling and other gestures that empathize with what the speaker is saying.

Why focus on listening? Besides the fact that it encourages clear communication, it also helps you develop a better working relationship with your employees. People feel more appreciated, cared for, and understood when they are listened to. Good listening also creates a sense of trust and openness, allowing for an easier time communicating when having more difficult conversations.

### *Standard Operating Procedures (SOPs)*

Standard Operating Procedures (SOPs) are routine in the business world. Farm businesses can also benefit from using SOPs in their labor management. From menial tasks to complicated activities, SOPs outline in detail and clarify job responsibilities. They ensure everyone knows how to manage certain areas of the farm, whether they are full-time, part-time or seasonal. By

explaining the correct steps in tasks, SOPs make certain everyone's work is consistent and there is little variability in how the work is being done.

When writing SOPs there are certain basics to cover:

- Title;
- Name of the person who wrote the SOP;
- Date the SOP was written;
- List of tools, supplies, or equipment needed;
- A detailed step-by-step list of directions, written simply and briefly.

Every work activity, especially those with safety concerns, should have a SOP. And when processes are changed or added, make sure that the SOPs are updated and a current version is available. It helps to have the people who will use the SOPs help you write them, so they are clear and easy to understand. Remember, you want to write your SOPs as if explaining the work to someone who has never done it before. If working with employees whose native language is not English, it is recommended SOPs are translated into the employee's language to facilitate understanding and use.

Lastly, it's important to make sure the SOPs you create are being used. Keep SOPs in areas that are readily accessible by employees, whether they are posted on a bulletin board, in the area where the processes they describe happen, or hanging on a clipboard.

### *Training*

Similar to the previous three human resource management practices, training needs to be an on-going process rather than a one-time activity. All employees, regardless of experience level, can benefit from – and often want – training opportunities. Training is a way employees can grow and develop in their job, improve performance, and increase their confidence. Remember training is not just about building skills, but changing attitudes too. A manager can teach skid steer safety practices to employees but without an attitude of valuing safety, the new knowledge will not be effectively used. Training can be as informal as reviewing proper milking procedures during an employee's shift, or as formal as taking employees to an educational workshop. Regardless, managers should provide regular training opportunities to employees based on need and interest.

As a relatively small investment, training results in more skilled workers and a more efficient labor force. Offering continuing training also improves employee and employer relationships, because employees tend to feel more appreciated when their managers offer opportunities for them to grow and develop.

### *Leadership*

Everyone has a leadership style: a set of the same leadership behaviors they default to regardless of the situation. Your leadership style determines how you interact with employees and how they perceive you as a manager. Do you know your default leadership style? David McClellan and researchers at McBer and Company have identified six leadership styles, which are explained below (taken from the UW-Extension *AgVentures: Human Resource Management* curriculum).

- *Coercive, or the “Do It or Else” Style* – This leadership style tends to be the most controlling and discipline-oriented of the six. Managers with this style expect employees to immediately act on orders, fully comply with directions, and to provide little to no input.
- *Authoritative, or the “Firm, but Fair” Style* – Managers using this style tend to provide clear directions and look for some input from employees, without putting into question who the boss is. This leadership style motivates both by discipline and reward and highly value their influence as manager.
- *Affiliative, or the “Good Buddy” Style* – Managers of this style feel that people come first and tasks second. The role of the manager is to ensure employees have a pleasant work environment, job security, and other amenities and benefits. Little direction and feedback, neither positive nor negative, is provided to employees.
- *Democratic, or the “Let’s Vote” Style* – This leadership style values participation. It is important for managers of this style to have employees working together. They also tend to provide very detailed instructions, use close supervision, and hold a lot of meetings.
- *Pacesetter, or the “Follow Me” Style* – Managers using this style like to work alongside employees, doing similar tasks. These managers have very high standards and expectations for themselves and also in employees. This style has less interest in interpersonal relations.
- *Coaching, or the “Developer, Delegator” Style* – This leadership style are most concerned with high performance and standards, focusing on developing employees potential and abilities. Managers of this style are more apt to delegate authority and allow flexibility in goal-setting and completing tasks.

Remember, no one style is better than the others; ideally managers should use a mix of the styles depending on the situation. For example, people generally don’t like the coercive style and it tends to inhibit growth and development, but sometimes when discipline is an important and necessary tool in managing difficult employees, it can be a very useful style to utilize.

### *Feedback*

Providing clear, concise, and respectful feedback is another key aspect of good communication. Good managers know the value and importance of effective feedback. They also realize that feedback should be more than just addressing what is going wrong. Positive feedback is just as essential for employees to grow and develop.

Feedback can be given in various ways: formal or informal, written or verbal, in a performance review or during a side conversation. Effective feedback tells an employee how they are doing, where they have improved, and offers constructive suggestions for additional improvement where needed. Giving feedback should be a discussion, not just one-sided. Both you and the employee should provide input and suggestions, ideally developing a plan for the employee’s continued improvement, learning, and growth.

Regardless of how you give feedback, it is crucial that feedback be given to employees regularly. Do not wait until an issue becomes a crisis before talking with workers. The same is

true for positive feedback; give positive feedback regularly and often. At the same time though, ensure that any feedback you give is honest and accurate. Erroneous or made-up feedback will not help with employee-employer communication.

### Some Landmines (or Opportunities)

Employees not only provide fresh ideas and added energy to a business, but they can also bring with them challenges that test the cohesiveness of the farm business. Different personality traits, unique ways of handling conflict, and cultural differences all can create landmines for effective employee-employer communication. At the same time, these challenges should be viewed as presenting opportunities for you to improve your skills and abilities as a manager.

### Conflict Styles

Conflict happens; it's a natural process when interacting and communicating with others, whether they are similar or different to you. Regardless of the best intentions or tools, it is almost impossible to prevent conflict. No two individuals are going to share the exact same desires, goals, and expectations, and it is just this difference which causes conflict. When conflict occurs, individuals tend to respond in a similar way regardless of the situation. Much like personality traits and leadership styles, people have default conflict styles.

**Figure 1. Thomas-Kilmann Conflict Styles**

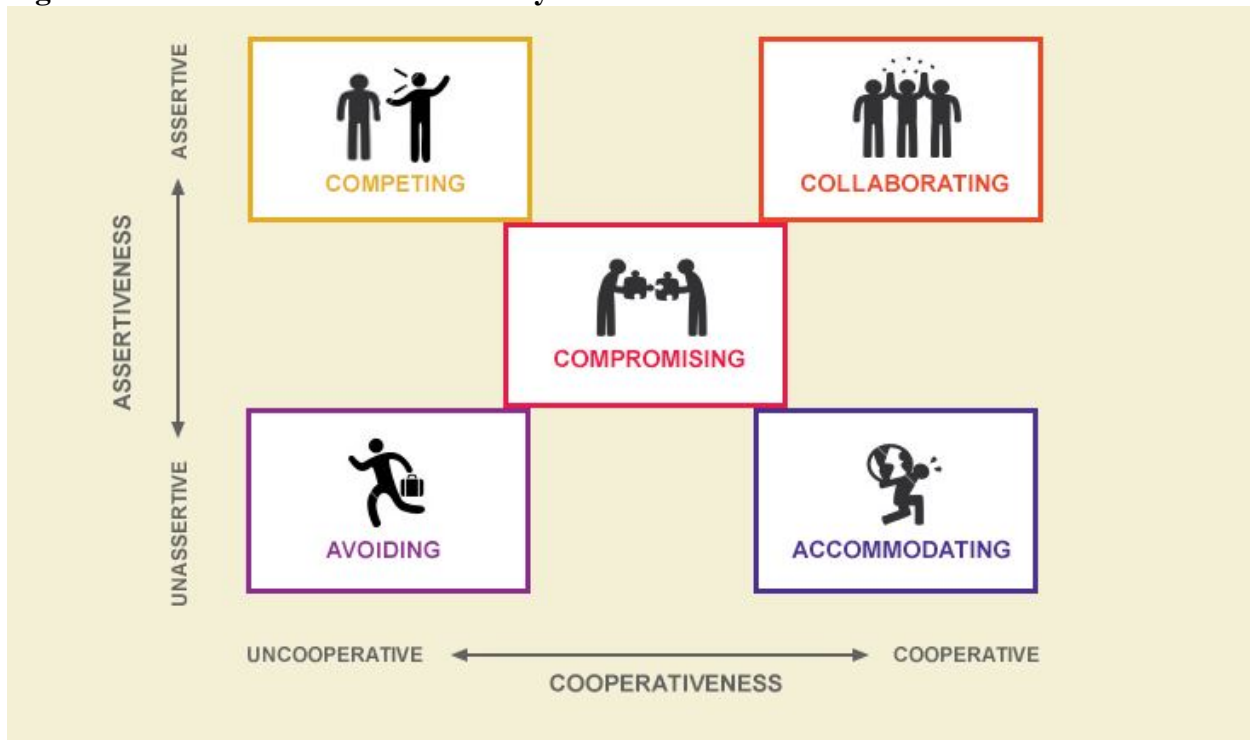


Figure 1 shows the five common conflict styles used by individuals and the relative scale of assertiveness and cooperativeness of each of the styles. This conflict instrument was developed by Kenneth Thomas and Ralph Kilmann to help understand managing conflict within a business

setting. The instrument has far wider reach, however, and can be applicable in many different conflict situations. Each style is explained in further detail below.

- *Competing* – This style is both highly assertive and uncooperative. It is all about power with this style and a person using this style is trying to win, whatever the cost. Their needs are the primary concern.
- *Avoiding* – Low in both assertiveness and cooperativeness, this person prefers to run away from conflict. They behave in a way where they do not need to deal with conflict.
- *Collaborating* – Both assertive and cooperative, this style works with the other party to come up with a solution to the conflict that satisfies the needs and concerns of both people. The person using this style digs into the issue and seeks to understand the needs and wants of the other person, without losing their own interest in the situation.
- *Accommodating* – This style is unassertive and cooperative and the complete opposite of competing. The person using this style neglects their own needs and instead sacrifices themselves for the benefit of the other person. This might take the form of yielding to another's point of view, following orders when they do not want to, or giving in.
- *Compromising* – Moderate in both assertiveness and cooperativeness, this style attempts to find some mutually acceptable solution to both parties. The solution may not completely fit the needs and wants of both parties, but in the end there is some kind of agreement. This might take the form of splitting the difference or quickly coming up with a middle-ground solution.

In order to use this instrument when managing employees, it is important to first understand your default conflict style as a manager. Which style is most like how you normally react to conflict? Do you try to avoid conflict whenever possible (avoider)? Or do you want to win arguments (competitor)? Once you identify your own style, you will be able to recognize the conflict styles of the people around you. Much like the leadership styles, there is no right or wrong conflict style. What is important is to use the style that will be most effective and is most appropriate for the situation. This may mean that you will need to utilize styles outside of your norm or comfort level. It is vital to recognize which styles work in what situations, and just as important, which styles should not be used in certain circumstances.

### *Culture*

Due to labor pool shortages and the stigma attached to farm work, more farms are hiring employees who are culturally, ethnically, and nationally diverse. It is more challenging for farms to hire Anglo populations in the U.S. as a result of competition from other industries, and largely due to the negative perceptions and stigmas attached to the nature of work done on farms. Even though there are some immigration and labor flow issues at play currently, the majority of available farm workers are foreign-born, from Mexico and Central and South America.

When the majority of farm owners and managers are Anglo-Americans and the majority of employees are Latinos, cultural differences and misunderstandings become a challenge in human resource management. And often, these challenges on farms do not necessarily pertain to language differences. While it is unrealistic for employers to become intercultural experts, there

are some simple practices you can implement in your manager toolbox to help you communicate and work more effectively and appropriately with culturally diverse employees. Just by using some of the tips explained below, you can show an interest in and appreciation of your employees' cultural diversity, which will greatly improve the employer-employee relationship.

- *Learn about your employees' culture* – Again, it is not necessary to become an expert in different cultures; although it is beneficial for you as a manager to know something about your employees' culture, especially if it is a cultural characteristic that may cause misunderstanding on your farm. For example countries in Latin America have more lax trash and recycling practices than here in the U.S. Littering in Mexico is a common practice, and therefore employees newly arrived to the U.S. may be unaware of the laws and general perceptions of cleanliness that exist here. It is an important cultural difference which requires training for employees.
- *See the similarities between your culture and your employees' culture* – Not all cultures are completely different; common values can include religion, family, and hard work. Relate to your employees with some of the values you hold in your own culture. For example, in Latino cultures family is of primary importance; extended family members will live in the same household as nuclear families. Farmers in the U.S. also place a high value on family as the majority of farms are family farms. Employees will require time off for certain family-orientated holidays, such as birthdays; be understanding and try to accommodate these requests within reason because most likely you also value time with your own family.
- *Make attempts to learn some of the language* – It takes years to become fluent in a language and many do not have the natural aptitude for languages, but it is the effort that counts. By taking the time to learn a little of your employee's language, you are not only showing a desire to be a better communicator, but you are also attempting to learn some of their culture. Learning words used commonly on the farm in your employee's language is an important step towards good communication.
- *Understand that language and cultural differences cannot be changed overnight* – Too many people believe that the solution to communication challenges is for employees to "just learn English". Unfortunately that is easier said than done as languages take years to learn, and English is one of the most challenging languages in the world to learn. While training and education can help employees to navigate cultural and linguistic differences on the farm, it is also vital for managers to appreciate that communication is a two-way street. Understanding, acceptance, and empathy are necessary tools in human resource management, in particular when managing culturally diverse employees.

While often viewed as a landmine in employer-employee interactions, culture is a great opportunity for personal and professional development for both managers and employees. Agriculture industry trends and U.S. population demographic changes show that the U.S. is becoming more diverse, and farm business managers will need to manage employees who may be linguistically, culturally, and ethnically diverse than themselves. Both employers and employees benefit from working and learning from diverse people, and with awareness and understanding on both sides, cultural diversity can be an advantage to the farm business.



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# COMPARATIVE DIGESTION STRATEGIES AND PROTEIN NUTRITION OF LACTATING DAIRY COW, SHEEP AND GOATS<sup>13</sup>

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## **Summary**

As ruminant herbivores cattle, sheep and goats have unique evolutionary adaptations to high fiber low protein diets. However, each species has its unique features and abilities to thrive on stems (high fiber), leaves (high protein), or fruits/seeds (storage carbohydrate) of the plants. For example, cattle have greater fiber fermentation capacity than sheep and goats, but goats are the most selective feeders of the three species. A common feature, however, is the ability to conserve nitrogen (N) and recycle it to the gastro-intestinal tract. Recent research, especially with dairy cattle indicated that high milk production can be achieved with levels of crude protein much lower than once thought possible. These advances may contribute to decreasing ration cost (protein supplements are expensive diet ingredients) and reduce the risk of environmental concerns associated with livestock production including air and water pollution and climate change. A better understanding of evolutionary adaptation and feeding behavior of sheep and goats in rangeland condition might offer clues to avoid or alleviate nutritional problems associated with intensive systems. Pasture management and strategies of supplementation are the main factors impacting dairy sheep production. Goats can adapt to either poor pastures or high-energy diets. In properly balanced diet, dairy goats can be fed an all concentrate (high in by-product) diet without developing the type of digestive disturbance (rumen acidosis) that would be observed with similar diet fed to sheep or cows.

## **Introduction**

Cattle, sheep and goats, are ruminant herbivores with particular evolutionary adaptations to utilize high fiber, low protein diets. In these proceedings, we have attempted to provide a foundation to understand these adaptations with the premise that emulating the animal's natural behavior and ecology when placed under intensive management would contribute to efficient and economical production systems that minimize the risk of nutrition related disorders and the risk of environmental pollution. Although there is a vast body of literature, efforts to bridge what is known of cattle, sheep and goat nutrition is relatively rare. In doing so, our focus will be mainly on nitrogen (N) utilization.

## **Evolutionary Adaptations to High Fiber – Low Protein Diets**

The digestive tract of animal species has evolved to take advantage to specific feed resources. Herbivores consume herbaceous plant parts including stems, leaves and fruits. Stems are rich in fiber and poor in nitrogen. In contrast, leaves are rich in protein and poor in fiber. In turn, fruits (seeds) has highly concentrated nutrients in the form of storage carbohydrates

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(starch), lipids (oilseeds), or proteins, as well as minerals and vitamins. The digestive tract of herbivores tends to have at least one voluminous digestive compartment inhabited by a microbial population that has the enzymes to breakdown fiber (Van Soest, 1994). The fermentation of carbohydrates in the fiber (cellulose and hemicellulose) is a process that requires more time than the digestion of simpler carbohydrates (sugars or starch) or proteins that can be digested by mammalian enzymes in the acid-secreting stomach and the small intestine. Thus one of the functions of the fermentative compartment is to slow down the rate of passage (i.e., increase retention time) to allow sufficient time for the microbial population to extract the energy from the fiber.

The fermentative compartment in a horse, a rhinoceros, or an elephant is the caecum (and the colon), which is located after the acid-secreting stomach and the small intestine. Thus these animals are referred to as “hindgut” fermenters. Other (wild) animals such as kangaroo, sloth, Columbus monkey or hippopotamus have a fermentative compartment located before the acid-secreting stomach. These animals, which do not ruminate, are referred to as foregut fermenters. In contrast, cattle, sheep and goat combine pre-gastric fermentation with rumination (chewing their cud) and hindgut fermentation. As ruminating pre-gastric fermenters, cattle, sheep, and goats have not only the greatest potential to extract energy from fiber (i.e., greater fiber digestibility) among all animal species but also they have a guaranteed supply of amino acids. Indeed, the protein-rich microbial population that grows in the rumen while fermenting fibrous carbohydrates and other forms of carbohydrates (e.g., starch) will eventually pass through the gastric and intestinal compartments where their digestion will yield substantial amounts of amino-acids that will be absorbed by the host. In short, this digestive physiology explains how ruminants are able to thrive on high fiber low protein feed sources.

The main source of N for microbial protein synthesis is ammonia and secondarily pre-formed amino acids (NRC, 2001). Amino acids and ammonia arise from the partial and complete degradation of dietary protein, respectively. However ruminal ammonia originates also from dietary non-protein N (NPN), and from the recycling of urea, from the body of the host to the fermentative compartments of the gastro-intestinal tract. However, as indicated above, the protein content of the feed resources upon which herbivores rely tend to be low. Thus evolution has provided them with mechanisms to guarantee that gastro-intestinal tract microbes are provided with the N necessary for their growth. Compared with other animal species, herbivores re-route a substantial amount of urea to the digestive tract both with the saliva mixed with the ingested (or ruminated) feeds and through the supply of blood to the rumen and the viscera. Urea, which is synthesized in the liver, is the end-product of N metabolism of the host and is excreted in the urines. There is a strong relationship between blood urea N concentration and daily excretion of urinary N in mammalian species. However, the research of Kohn et al., (2005) showed that the clearance rate of the kidney was lower in herbivores (cattle, sheep, goats and horses) than in pigs or rats, which highlighted the herbivores’ ability to salvage N before it is lost from the body.

Another evolutionary mechanism that has allowed herbivores, including ruminants, to thrive on high fiber diets is body size. The total volume of the digestive tract is directly related to animal size and weight. Compared with shorter and lighter animals the taller and heavier ones have longer gastro-intestinal tract, which slows down the rate of passage and thus provides

additional time for fiber digestion. The nutritional implications of the difference in body weight between sheep and goats on the one hand and cattle on the other hand will be explored further below. However, before leaving the topic of evolutionary adaptation, there is one more key concept that needs to be address in order to shed light on an important implication of pre-gastric fermentation combined with retention of fiber in the rumen and further processing by rumination. As indicated above, these physiological adaptations allow for a great ability to extract energy from fiber, but they impose a major limitation on the amount of feed the ruminant can consumed per day. Fiber is bulky and has a low density (low mass per unit of volume). Thus the selective retention of fiber in the rumen creates the potential of a “*physical fill*” effect. When diets are high in fiber, the slow rate of digestion and passage of the fiber results in an overall slow rate of disappearance of fermenting material from the rumen, which in turn may force the animal to slow down or even stop the rate of feed consumption (i.e., the amount of feed consumed per day; [Mertens, 1987](#)). This phenomenon may be at the origin of metabolic disorders observed in early lactating ruminants, such as dairy cattle that have been subjected to intense genetic selection for milk production. High producing cows have extremely high energy requirements in early lactation but a limited ability to increase feed consumption (i.e., dry matter intake) due to rumen fill limitation. Consequently a high producing cow may stop eating, although she may still be “hungry” for more energy because her dairy requirement has not been met. In this case, the cow will enter a period of negative energy balance during which body reserves must be used to compensate for the lack of dietary energy intake. If not properly managed, this situation may lead to severe ketosis, fatty liver, and low fertility.

### **Comparative Feeding Behavior and Digestion Strategies in Dairy Cows, Sheep and Goats**

Cattle, sheep and goats have a number of similar digestive anatomical and physiological features, but also many differences. An obvious difference is adult body weight, which range approximately from 40 to 75 kg in sheep and goats compared with 550 to 680 in beef or dairy cattle. The fact that sheep and goats are approximately 10 times lighter than cattle has profound implications on their ability to process dietary fiber. Compared with starch or other sources of carbohydrates, the utilization of the fibrous carbohydrates is a process that requires long contact hours between the fiber particles and the microbes to provide the time needed for enzymatic degradation. The fermentative capacity of the gastro-intestinal tract or its ability to provide sufficient time for fiber fermentation varies linearly with the body weight of an animal. Heavier animal have longer the gastro-intestinal tract and longer retention time. In contrast the amount energy required for maintenance (NEm) is a function of metabolic body weight (body weight to the 0.75 power;  $BW^{0.75}$ ). [Cannas \(2004\)](#) quoted the work of INRA (Institut National de Recherche Agronomique) French scientists to indicate that in sheep  $NEm \text{ (Mcal/d)} = 0.0561 \times BW^{0.75}$ , but in cattle  $NEm \text{ (Mcal/d)} = 0.070 \times BW^{0.75}$ . Thus fermentative capacity can be calculated by dividing the kilos of feeds that the digestive tract can accommodate (estimated as volumetric kilograms of water to fill the gastro-intestinal tract of slaughtered animals) by the calories of energy required for maintenance to obtain an indication of the animal’s ability to rely on fiber fermentation to support their daily energy needs. Figure 1 was constructed to illustrate that cattle (heavier animal) have a greater fermentative capacity than sheep and goats (lighter animals). In other words compared to sheet and goats, cattle can accommodate larger amounts of feed in the gastro-intestinal tract in relation to the amount of energy required to insure basic (maintenance) body functions. Thus we can understand now why cattle can thrive on a diet that

contains more fiber (plant stems), compared with sheep and goats that may have to be more selective in choosing plant parts that are richer in nutrients (leaves, fruits, seeds) in order to meet their energy requirements.

Although early ruminant nutritionists were hoping to use sheep as a model to study cattle nutrition (because of cost involved in doing the research), the distinction between sheep and cattle nutritional physiology was clearly established when [Van Soest \(1994\)](#) summarized the literature to show that sheep tended to have higher digestion coefficients than cattle when fed high digestibility diets (i.e., diets low in fiber), but cattle tended to have higher digestion coefficients than sheep when fed diets low in digestibility (i.e., diets high in fiber). More recently [Cannas](#)

[\(2004\)](#) compared these two species and concluded that compared to cows, sheep:

- have to eat more to satisfy their maintenance requirements; and higher intake results in a higher passage rate and lower fiber (forage) digestibility.
- tend to have more selective feeding pattern;
- are more affected in their intake by the particle size and the fiber content of the forage;
- have to spend more time eating and ruminating each kg of feed;
- tend to have higher digestibility for grain and high-energy diets.

Digestion studies comparing goats, sheep and cattle should be interpreted with caution because of many possible confounding factors. However the results of [Uden and Van Soest \(1982\)](#) will be used to compare them because in this trial, animals were offered the same timothy grass as the only feed sources in the diet. Data presented in Table 1 summarizes dry matter intake (DMI), digestibility and retention time of forage particles. Although sheep and goats exhibited similar behavior, the greater fermentative capacity of cattle (DMI, g/kg BW<sup>0.75</sup>) allowed them to consume less DM per unit of body weight (DMI, g/kg BW). Furthermore the longer retention time in the rumen (and total gastro-intestinal tract) of cattle was associated with higher neutral detergent fiber (NDF) digestibility compared with sheep or goats. Some authors, however, have argued that with forage low in nitrogen and high in fiber, and not properly supplemented, goats have better digestive efficiency than other ruminants ([Tisserand et al., 1991](#)). Greater ability to reduce particle size during chewing in comparison to sheep ([Hadjigeorgiou et al., 2003](#)), higher concentration of cellulolytic bacteria in the rumen and higher efficiency of urea recycling from the blood to the rumen may contribute to these advantages.

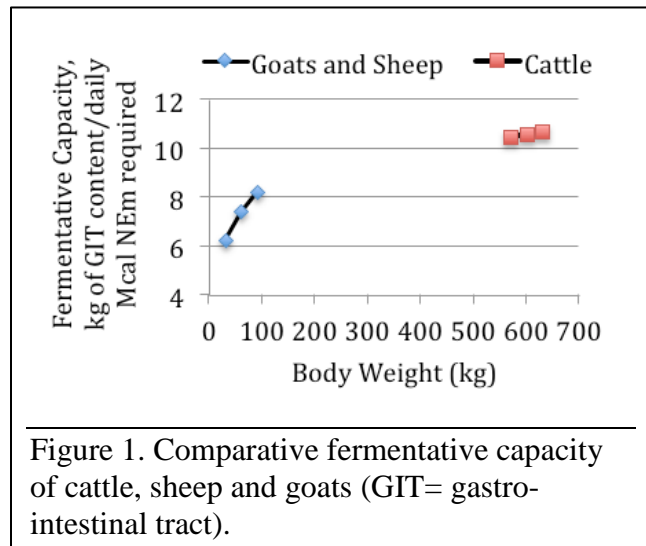


Figure 1. Comparative fermentative capacity of cattle, sheep and goats (GIT= gastro-intestinal tract).

Table 1. Comparative analysis of intake, digestibility and retention time of forage particles in goat, sheep and cattle.

Item	Goat (Caprine)	Sheep (Ovine)	Cattle (Bovine)
Body weight (BW), kg	29	30	555
Dry Matter Intake, g/d	700	650	7830
Dry Matter Intake, g/kg BW	24	22	14
Dry Matter Intake, g/kg BW <sup>0.75</sup>	56	51	68
Digestibility of Dry Matter, %	47	47	54
Digestibility of NDF, %	44	44	52
Rumen retention time of forage particles, hr	28	35	47
GIT retention time of forage particles, hr	52	70	79
Rumen/ Gastro-intestinal Tract, %	54	50	59

Source: Uden and Van Soest (1982), cited by Cannas (2004).

<sup>1</sup>: GIT = gastro-intestinal tract.

### Recent Research in Lactating Dairy Cow Protein Nutrition and Nitrogen Use Efficiency

Not enough crude protein in dairy cows diets may limit dry matter intake, fiber digestion (i.e., energy yield) and milk production of dairy cows (NRC 2001). On the other hand, excess crude protein may result in both economic and environmental concerns. When expensive protein supplements do not contribute to improving lactation performance, the excess N is lost primarily as urinary urea-N in the manure (Olmos Colmenero and Broderick, 2006). In many parts of the world, manure N has been associated with degradation of water in lakes and rivers, degradation of air quality because of ammonia (NH<sub>3</sub>) volatilization to the atmosphere, which contribute also to the emission of nitrous oxide (N<sub>2</sub>O), a potent greenhouse gas that contribute to climate change.

Table 2 was constructed to illustrate in part the expected change in dry matter intake and manure production of cows producing milk in the range of 10 to 50 kg/d. The nitrogen balance and nitrogen use efficiency data were obtained assuming that 14 and 17% dietary crude protein diets were provided for milk production of 25 kg/d or less and 30 kg/d or more, respectively. These levels of crude protein should not be interpreted as "requirements", but rather as levels of that are likely to suffice to meet the cow's requirements for amino acids, assuming other dietary nutrients, and especially rumen fermentable carbohydrates are in adequate supply. The important take-home messages in regard to N balance and N use efficiency can be summarized as follows:

1. Efficiency of conversion of intake-N to milk-N ranged from 16 to 35%, which is to say that 65 to 84% of the N consumed by a cow is excreted in manure daily.
2. If at first glance it appears that N use efficiency increases with milk production, it is true only when milk production increases at a fixed level of dietary CP. For example, data in Table 2 indicate that in the low production range, a cow can produce twice as much milk (20 vs. 10 kg/d) and milk-N (100 vs. 50 g/d) at a fixed 14% dietary crude protein level simply because as the cow produces more she eats more, and the increase in dry matter intake (16.7 vs. 13.6 kg/d) is sufficient to supply the necessary nutrients for higher milk production.

- Nitrogen use efficiency is a function of both level of milk production and dietary crude protein concentration. For example, the data in [Table 2](#) indicated a cow producing 25 kg of milk with a diet of 14% CP has essentially the same efficiency as a cow producing 40 kg of milk with a diet of 17% CP (31 and 32% conversion rate, respectively).
- As illustrated by the data for milk production of 25 kg/d obtained with either a 14 or 17% crude protein diet, at a given level of production an increase in dietary crude protein reduces N use efficiency (in this case from 31 to 25%), and increases urinary-N more (52 g/d = 184 - 132) than fecal-N (36 g/d = 188 - 152). Conversely, regardless of level of milk production, reducing dietary crude protein with no change in milk production has the beneficial effects of increasing feed N use efficiency and simultaneously reducing daily excretion of urinary-N.

Table 2: Relationship between milk production, dry matter intake (DMI), and manure excretion (as-is) in lactating dairy cows according to [NRC \(2001\)](#) and [ASAE \(2005\)](#) and predicted N balance and efficiency of use assuming dietary crude protein (CP) concentration of either 14 or 17% (DM basis).

Amounts			Diet	Nitrogen Balance					N Efficiency	
Milk kg/d	DMI kg/d <sup>1</sup>	Manure kg/d <sup>2</sup>	CP % <sup>3</sup>	Milk g/d <sup>4</sup>	Intake g/d <sup>5</sup>	Manure g/d <sup>6</sup>	Urine g/d <sup>7</sup>	Feces g/d <sup>8</sup>	Milk % of Intake N	Manure
10	13.6	42.9	14	50	305	254	118	136	16	84
15	15.2	47.7	14	75	340	265	123	142	22	78
20	16.7	52.5	14	100	374	274	127	146	27	73
25	18.3	57.3	14	125	410	285	132	152	31	69
25	18.3	57.3	17	125	498	372	184	188	25	75
30	19.9	62.0	17	150	541	391	193	198	28	72
35	21.4	66.8	17	176	582	407	201	206	30	70
40	23.0	71.6	17	201	626	425	210	215	32	68
45	24.5	76.3	17	226	666	441	218	223	34	66
50	26.1	81.1	17	251	710	459	227	232	35	65

<sup>1</sup>According to [NRC \(2001\)](#), assuming a 600 kg BW cow in the 8<sup>th</sup> week of lactation producing milk with 3.6% fat;

<sup>2</sup>According to [ASAE \(2005\)](#) assuming a cow of 600 kg BW;

<sup>3</sup>Assuming a diet of 14% CP (DM basis) for 10 to 25 kg/d of milk and 17% for 25 to 55 kg/d of milk;

<sup>4</sup>Milk N = (milk production (g/d) x (% Protein / 100)) / 6.38; assuming milk contains 3.2 % protein;

<sup>5</sup>Intake N (g/d) = (DMI (g/d) x (% CP / 100)) / 6.25;

<sup>6</sup>Manure N (g/d) = Intake N (g/d) - Milk N (g/d);

<sup>7</sup>Assuming Urine N is 46.5 and 49.4% of Manure N when diet CP is 16 and 17%, respectively; as calculated from [Olmos Colmenero and Broderick, 2006](#);

<sup>8</sup>Fecal N (g/d) = Manure N (g/d) - Urine N (g/d).

Given the type of properly balanced diets fed in the Midwest of the United States, milk production is generally not penalized, even in early lactation, when dietary crude protein is approximately 16.5% of the diet (DM basis; [Broderick, 2003](#); [Wattiaux and Karg, 2004](#)). Milk production of 25 kg of milk or less can be achieved with less than 14% CP ([Olmos Colmenero and Broderick, 2006](#)). In a recent experiment, we collected data with a 128-cow trial in which four diets with crude protein levels of 11.8, 13.1, 14.6 and 16.2% were offered over a 12-week period on late lactation. The average production of fat-and-protein corrected milk was 26.1, 30.0, 31.9 and 32.6 kg/d per cow for the respective dietary levels of crude

protein. The production of fat-and-protein corrected milk was not significantly different when feeding the 14.6 versus a 16.2% crude protein diet (Quaassdorff, et al, 2014).

Important take-home messages from Table 2 in regard to the relationships among milk production, dry matter intake and manure excretion can be summarized as follows:

1. Cows producing more milk must consume more feed and they produce more manure.
2. Regardless of milk production, cows always produce more manure than milk.
3. As milk production increases, the amount of manure produced per unit of milk produced decreases sharply. For example 4.3 kg of manure is produced per kg of milk when a cow produces 10 kg of milk, but only 1.6 kg of manure is produced per kg of milk when a cow produces 50 kg of milk.
4. Furthermore, the total amount of manure (and manure-N) excreted for a given amount of milk depends on the number of cows needed to produce that amount of milk. For example, 40 kg of milk produced by one cow results in 71.6 kg of manure. In contrast the same amount of milk produced by two cows, each producing 20 kg/d, would result in a total manure production of 105 kg/d (2 x 52.5 kg/d; Table 2).

### **Sheep Nutrition Under Rangeland Conditions**

Rangeland support a substantial proportion of the world's sheep population and play a vital role in supporting low-cost, low-input, wool- and meat production systems (O'Reagain and McMeniman, 2002). These authors defined rangeland as any extensive (unfenced), uncultivated and (or) unfertilized area that supports production of free-ranging herbivores (limited confinement facilities), and they drew attention to the following unique characteristics of rangeland systems:

1. The carrying capacity and animal performance are low compared with more intensive systems (cultivated pastures). Rainfall and soil conditions are oftentimes major limiting factors. Any management inputs must therefore be economical, easy to implement and must have an extremely high probability of substantial return over "investment" cost.
2. Rangelands are characterized by marked spatial and temporal (seasonal and yearly) variability in both forage supply and quality.
3. Plants communities of nearly all rangelands include toxic plants. Toxicity effects may range from subclinical depression in animal performance to causing death.
4. Drinking water is poorly distributed in rangeland and thus may severely limit dry matter intake and animal performance; a problem that is rarely of any concerns in conventional systems of production.
5. Feed resources management of rangeland should be of concern because the loss of vegetation may have irreversible consequences in contrast to conventional system of production in which reseeding and fertilization may help remedy the consequence of poor management (such as overgrazing).

### **Sheep Nutrition Under Improved Pasture Grazing Conditions**

Herbage availability on pasture has an important impact on sheep feeding behavior. Summarizing the Australian literature, Weston (2002) identified three distinct situations. Under high accessibility, such as with sward heights of at least 9 cm (corresponding to approximately 4.8 tons of dry matter per hectare), sheep have no problem to maintain the level of intake



required to meet energy requirements by adjusting grazing time (hr/day), bite rate (bites/ min) and bite size (grams organic matter ingested/bite). Under this situation, sheep can demonstrate preferences for legume species (clover) over grasses, in part because of lower resistance of leafy materials to bolus formation and faster clearance rate from the rumen. However as herbage quality and availability declines and bite size decreases, sheep increase time grazing and bite rate to reach the necessary level of intake to meet energy requirements. When sward height is however less than 3 cm, the ability of the sheep to use compensatory mechanism is no longer sufficient to maintain the desired level of intake. Although sheep are capable of grazing for 13-14 hr/day, in harsh environment and sparse pasture, grazing time is often limited to 7-9 hr/day. The author hypothesized that grazing at or near ground level may involve abrasion of the lips and other parts of the mouth, which in turn could have a negative impact on feeding behavior. Furthermore, under arid conditions, the need to travel long distance to water may reduce time available for grazing.

### Supplementary Feeding

Both in temperate and rangeland environments, there are times of the year that nutrient demands may not be met by pasture alone given the seasonality of pasture growth. Supplementary feeding may appear as a simple concept, but it actually involves a difficult decision-making process with important implication both in term of biological efficiency of production and financial outcomes. There is a long list of elements to consider including for example, the current physiological state of the animal (body reserves, state of pregnancy, etc.), the amount and nutritive value of the pasture, the availability and cost of supplemental feeds. [Table 3](#) illustrates the impact of energy versus protein supplementation of lactating ewes grazing a perennial ryegrass pasture of 750-850 kg dry matter ha<sup>-1</sup> as reported in [Dove et al. \(1985\)](#).

Table 3. Influence of “energy” and “protein” supplements on digesta flow, and performance of grazing ewes and their lambs.

Item	Pasture alone	Energy supplement <sup>1</sup>	Protein supplement <sup>2</sup>
Rumen ammonia, <i>mM</i>	24.1	16.4	20.1
Flow of dry matter to abomasum, g/d	1065	1288	1340
Flow of crude protein to abomasum, g/d	276	344	431
Flow of microbial crude protein, % of total Flow	93.4	85.1	77.2
Milk production of the ewe, g/d	2048	2133	2846
Weigh change of the ewe to day 80 of lactation, kg	0.0	5.1	-0.9
Lamb weight gain, g/d	254	308	331

Source: [Dove et al. \(1985\)](#), cited by [Dove \(2002\)](#).

<sup>1</sup>: Energy supplement = 600 g/d (air-dry) of sugar beet pulp with molasses (9% crude protein).

<sup>2</sup>: Protein supplement = 600 g/d (air-dry) of a mixture (1:1) of energy supplement and formaldehyde treated soybean meal (48% crude protein).

One of the major issues related to supplementation of free-ranging animal is the substitution between supplement and herbage. [Dove \(2002\)](#) summarized the literature as follows:

1. Substitution is likely to be greater when more pasture is available. With abundant pasture availability (> 4.5 tons dry matter per ha), observed rate of substitution may reach approximately 67%. However a substantial substitution (~ 38%) may occur even when

pasture is sparse (< 0.8 tons dry matter per ha) indicating a general disinclination to graze when supplement is freely available.

2. The greater the quality of the pasture the greater the substitution rate. However, energy supplement high in starch may have a depressing effect on fiber fermentation in the rumen leading to an undesirable reduction in daily dry matter intake.
3. The substitution is generally greater when higher-quality supplements are fed compared with lower-quality supplements.
4. The substitution rate may be greater when greater amounts of supplements are fed, but there are conflicting results in the literature. The complexity of understanding the substitution behavior is illustrated with the data of a controlled experiment presented in [Table 4](#). Increasing the restricted amount of supplement increased the substitution rate. However when the supplement was fed without restriction (ad libitum), the substitution rate was reduced in spite of the fact that intake of hay was reduced by 90%.
5. The substitution rate depends also upon the physiological state of the animal. In general, animals with a greater demand for nutrients (e.g., lactating ewes) will show lower degree of substitution than animals with lower demand of nutrients (e.g., pregnant ewes).
6. The method and frequency of feeding the supplement may influence the rate of substitution.

Table 4. Intake of low quality hay and supplements of lambs in controlled feeding situation.

Item	Weight of air-dry supplement offered (g/d)				
	Min.	200	400	600	Free
Intake of supplement, g/d	75	176	313	446	1076
Intake of hay, g/d	386	366	271	114	39
Total intake, g/d	461	542	584	560	1115
Substitution rate <sup>1</sup> , %	--	20	48	73	35
Reduction in intake of hay, %	--	5	30	71	90
Lamb weight gain, g/d	- 25	- 17	39	54	142

Source: [Freer et al. \(1988\)](#), cited by [Dove \(2004\)](#).

<sup>1</sup>: Increased in intake of supplement divided by decrease in intake of hay relative to Min.

## Nutrition of the Lactating Ewes

In the majority of production systems around the world, sheep are kept for meat or wool production and ewes rear their lambs until weaning, at 3 or 4 months of age. During this period, lamb growth is largely determined by milk intake. Early lactation is the period of highest nutrient requirements in the ewe's whole productive cycle and failure to manage the nutritional status of the ewe may impact lamb growth substantially ([Treacher and Caja, 2002](#)). In meat breeds selected for lamb production, yield at lactation peak varies between 2.0 and 4.0 kg/d, with a total three-month lactation yield of 150-200 kg for ewes with twin lambs and from 90-160 kg for ewes with a single lamb.

In a number of Asian and European countries ewe's milk has been a major source of animal protein in the human diet. Furthermore in other countries such as France, Spain, Greece, and increasingly in the U.S. ([Thomas, 2004](#)) dairy sheep milk is processed in expensive cheese. There are many factors influencing milk production of dairy ewes. Highly selected dairy breed

(East Friesian, Assaf) may have lactation performance greater than 1,000 kg collected over more than 200 days of lactations, but production performance lower producing dairy sheep may not be higher than approximately 350-375 kg per lactation (Thomas, personal communication). The slow increase in dry matter intake in early lactation means that ewes are invariably in negative energy balance for a few weeks after lambing. Managing body condition score is thus an important management tool to avoid loss of milk and minimize risk of metabolic disorders.

Pasture and lambing management are critical to sheep production systems. Aside of operational constraints, lambing is usually timed to coincide with the start of the herbage growth so that peak herbage production coincides as much as possible with the period of greatest nutrient requirements of the flock. In many northern-hemisphere temperate pasture regions, spring lambing is constrained the timing of the winter-spring transition. In intensively grazed systems, achieving a particular sward height in concert with fertilization and proper feed supplementation are the basis of a sound management system (Treacher, 1990). In contrast in southern-hemisphere temperate pasture regions, winters are milder but pasture senesce in late spring and there is often a pressing need to minimize supplementary feeding. In this case, lambing in the winter may be more appropriate than lambing in spring (Treacher and Caja, 2002).

In a recent experiment, Mikolayunas et al., (2008) demonstrated that supplementation of grazing dairy ewes with either a mixture of whole shelled corn and soybean pellet or shelled corn alone resulted in greater milk production compared with un-supplemented ewes. Increased levels of corn supplementation resulted in a positive, linear increase in milk yield and an improvement in pasture protein utilization, as indicated by a decrease in milk urea Nitrogen (MUN) levels. However, similarly to dairy cattle, feeding excess concentrate in the diet of dairy sheep may result in milk fat depression but not milk yield (Goodchild et al. 1999). This problem is likely more common in intensive dairy sheep system where high quality forages are expensive relative to concentrate feed, such as in Mediterranean countries. As in dairy cattle, this problem may be partially corrected with the use of buffer to help maintain rumen pH near neutrality.

The use of rumen undegradable protein sources in the diet of dairy ewes have resulted in variable results. Responses are more likely be positive in early lactation when dry matter intake has not peaked yet, and the ewes are in negative energy balance. The results of Robinson (1983) indicated a milk production response inversely proportional to the estimate protein degradation in the rumen. When ewes were fed a basal diet of hay and barley, urea supplementation resulted in negligible milk production response above the approximately 2.0 kg/d of milk, but supplementation with soybean and groundnut meal (70 g/d; 35-55% ruminal degradability) resulted in an increased milk production from to approximately 2.4 kg/d, and supplementation with fish meal and blood meal (60 g/d; 0-30% ruminal degradability) resulted in an increased milk production from approximately to approximately 2.8 kg/d. In a recent experiment conducted in Wisconsin, Mikolayunas et al., (2009) observed a 14% increase in milk yield, 14% increase in milk fat and 13% increase in protein yield when lactating ewes were fed a diet with 12% rumen degraded protein (RDP) and 6% rumen undegradable protein (RUP) compared with a diet containing 14% RDP and 4% RUP or 12% RDP and 4% RUP. Supplementation of dairy ewes' diet with protected source of lysine and (or) methionine remain inconclusive. In doing so, Bocquier et al., (1994) observed an increased in protein content of milk, but Baldwin et al., (1993) found no response for either the yield of protein or milk protein content.

## **Adaptations and Feeding Behavior of Goats**

Goats are known for their ability to thrive on harsh environments, which would not support other grazing livestock such as cattle and sheep. Part of their adaptation includes the ability to utilize a broad range of herbaceous species, shrub and trees, and to select from among them the material with the highest nutritive value. It has been shown that goats traveled longer distance in search of forage compared to sheep in arid conditions, they tend to select more browse than do other domestic ruminants (Narjisse, 1991) and they consume less water per unit of intake compared with sheep on arid lands (Tisserand et al., 1991). In contrast to earlier suggestions, goats are not obligatory browsers or fibrous eaters but they rather tend to be flexible in dietary habits and adjust their behavior to the availability and quality of feed resources. For example goat rely heavily on herbaceous species during the growing season. Work in north Africa has shown that sheep and goats do overlap for the preference for herbaceous species during the spring. However during the dry season while the dietary contribution of grasses to sheep's diet was maintained around 70%, this contribution did not exceed 32% for goats. Goats are highly selective eater, (select specific plants and specific plant parts with high nutritive value) compared with sheep and cattle that are categorized as grass eaters with much less selective in grazing habits (Van Soest, 1994). There are ample evidence that animals of many species, including ruminants, are capable of making choices between different food source that provide a more balanced diet that would be obtained by eating at random (Forbes and Mayes, 2002).

The versatility of goat's feeding behavior seems to be enabled by several anatomical and physiological adaptations. For example their agile and mobile upper lips allow them to graze herbage as short as can the sheep, but also graze plant species with thorns and spine. In addition their tendency to assume bipedal stance provide them with an advantage over other small ruminants to reach higher vegetation layers. In addition goats tolerate a variety of chemical produced by plants to deter grazing ruminants from ingesting them. Examples of such compounds include tannins, alkaloids, and cyanogenic glucosides. For example tannins extracted from oak leaves stimulated rumen microbial activity and nitrogen balance in goats, but inhibited these functions in sheep (Narjisse and El Honsali, 1985). It has been hypothesized that these attribute may be in part the result of higher salivary production compared with sheep (Narjisse, 1991).

In confined environment, goats have demonstrated a particular ability to discriminate feeds according to their palatability. In general goats eat more slowly than sheep because of their very marked selecting behavior. In goats meals are numerous, but they do not last so long. A meal of the goat fed forages alone at the trough is divided in three phases: a phase of exploration of the feed offered, a phase of intense feed intake and a phase of slower intake during which the goat select the plant fractions to ingest. They select the most nutritive fractions of forages, the leaves more than the stems, the thin stems from then the thick ones, the fractions richest in proteins and poorest in fiber.

## **Feeding Dairy Goats in Intensive system**

Goats can easily adapt to intensive dairy systems. They can tolerate high amounts of concentrate rich in starch but also diets with high amount of forages due to their efficiency in

chewing and selecting feeds. In intensive dairy systems, total mixed rations are advantageous to balance nutrient supply and to reduce feed selection. Moreover goats are able to eat and efficiently utilize diets without forages as long as particle size of the ration and its fiber level are carefully balanced (Rapetti and Bava, 2008). Considering the high adaptability to different diets researcher recently tested the hypothesis that the utilization of by-products or concentrates rich in fiber in substitution for forage could be useful for dairy goats. Table 5 shows diet ingredients, chemical composition and milk performance of Saanen goats when fed a grass-based diet, a hay-based diet and a non-forage diet during the mid-lactation (Rapetti et al, 2005). Milk production was similar, but milk fat percentage was lower for the goats fed the non-forage diet compared with grass-based or hay-based diets (Table 5). However, the author indicated that in a second experiment in which dietary lipids were increased in the non-forage diet, no milk fat depression was observed. An interesting result of Table 5 is the significant reduction in MUN, which suggested better N use efficiency when goats were fed the non-forage diet compared with the grass-based or the hay based diets. There is limited information on the benefits of increasing rumen undegraded protein (RUP) in the diets of lactating dairy goats. However Rapetti and Bava (2008) indicated that no benefits had been observed in their own unpublished data in which soybean meal was replaced with treated canola meal or in the work of Lu et al, (1990ab) in which soybean meal was replaced with feather meals or meat and bone meal.

Table 5. Diet ingredients, chemical composition of grass-based, hay-based and non-forage diets, and corresponding milk production when offered to Saanen goats in mid-lactation.

Item	Grass-based Diet	Hay-based diet	Non-forage diet
Diet Ingredient composition, % of DM			
Grass fresh	55.3	--	--
Hay	--	55.2	--
Soybean meal, solvent extracted	10.3	10.3	12.0
Corn meal	29.0	29.1	9.8
Corn gluten meal	2.1	2.1	2.0
Additional Concentrates <sup>2</sup>	--	--	73.2
Vitamins and minerals	3.2	3.2	3.0
Chemical Composition			
Dry matter, % of as-fed	54.1	89.2	90.0
Crude protein, % of DM	17.5	18.7	16.6
Neutral detergent fiber, % of DM	34.2	31.5	30.2
Ether extract, % of DM	1.8	2.3	2.9
Non-Fibrous Carbohydrates, % of DM	38.8	38.7	44.7
Goat performance			
Dry matter intake, g/d	2054	2354	2101
Dry matter digestibility, %	69.7	70.5	74.1
Milk production, g/d	3011 <sup>b</sup>	3688 <sup>a</sup>	3212 <sup>ab</sup>
Milk fat, %	3.37 <sup>a</sup>	3.24 <sup>ab</sup>	2.96 <sup>b</sup>
Milk protein, %	3.11	3.32	3.29
Casein, % of total N	68.4 <sup>b</sup>	70.7 <sup>ab</sup>	73.7 <sup>a</sup>
Milk urea N, mg/dl	18.8 <sup>a</sup>	18.6 <sup>a</sup>	12.7 <sup>b</sup>

Source: [Rapetti et al., \(2005\)](#), cited by [Rapetti and Bava \(2008\)](#).

Additional concentrates: whole corn grain: 9.6%, Whole cottonseed:11.3%, sugar beet pulp: 26.5%, cracked Carob bean: 25.8% of diet DM.

<sup>a,b</sup>: Lsmeans within a row with different superscript letters were different (P<0.05).

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## **ADAPTATIONS FOR FEEDING DAIRY SHEEP**

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### **Background**

Sheep, like all ruminants, have evolved the unique ability to convert plant-based nutrients into protein-rich products to be used for human use. This allows sheep to utilize nutrients from many different sources such as fiber, carbohydrates, lipids and proteins. This can be advantageous to producers because various feedstuffs can be utilized to meet nutrient demands of their sheep. Several considerations should be evaluated when choosing a nutrition program including eating habits of sheep, achieving the required production level, maintaining animal welfare and maximizing production efficiency. Several commercial dairy nutritionists are available throughout the U.S.; however, few have experience formulating rations for small ruminants. As literature is limited for the feeding of dairy sheep in the U.S., personal observations may be useful in assuring adequate nutritional intake of the flock.

### **Feeding Habits of Sheep**

Relative to cattle, sheep have a greater tendency to sort their feedstuffs. This is likely due to the decreased efficiency of fiber fermentation compared to cattle; therefore sheep must consume certain parts of plants that are more digestible. This propensity to sort feed is evident in both grazing and confinement feeding situations and needs to be considered when designing a nutritional plan.

To measure the amount of sorting that occurs, feed samples can be visually analyzed before and after a feeding period. For example, visually observing a pasture and identifying plant species before and after grazing can indicate if ewes prefer a certain species to another. Ideally, feed samples will be collected for analysis before and after a feeding period and comparing the results. For example, a hay sample can be collected at feeding time, and then another sample of feed refusals can be selected before the next feeding. If the hay at feeding time measures 18% crude protein, 40% NDF, and 30% ADF at feeding and the feed refusals measure 3% CP, 20% NDF and 70% ADF, the ewes are probably consuming the leaves from the hay and leaving all the stems.

Some level of feed sorting will always be present and sorting is not always a bad characteristic. In pasture-based systems, the ability to sort forages helps ewes to avoid noxious plants that may be present. Also, the feeding behavior of ewes will change as their nutrient demands change as they progress through the production cycle and as forages change in composition throughout the growing season. This is particularly evident in pastures containing multiple species of forages and less evident in monoculture pastures. Having multi-species(multiple plant species) pastures allows ewes to sort the plants that are needed at that particular time. At the University of Wisconsin-Madison Spooner Agricultural Research Station, sheep are grazed on orchard grass-kura clover pastures. Early in lactation, ewes tended to

consume more orchard grass than clover and more of the kura clover later in lactation (unpublished data). This was in part due to a decrease in growth of orchard grass late in the growing season but may also be due to different nutrient demands of the ewes as they progressed into lactation. This may be used to lengthen the grazing season on pastures but care must be taken to not allow ewes to overgraze the species of choice. Transitioning from a continuous grazing to a more intensive grazing system like rotational grazing or mob grazing will reduce the selectiveness of the animals and maximize forage utilization. The economics of a more intensive system need to be analyzed considering additional ewe performance with additional labor and other inputs.

The feeding habits of sheep have more potential to have a financial impact in intensively managed systems or during times of confinement feeding than in grazing operations. Purchased and stored feeds are generally more expensive than pasture and have a greater impact on the overall finances of the operation. Therefore, maximizing utilization of these feeds is critical. First, feeds should be stored in a way that minimizes wastage and spoilage. Second, they should be delivered to the flock in a manner that encourages intake and minimizes wastage due to sorting. The largest source of feed wastage is often with stored forages. Reducing the particle size of forages fed to sheep will reduce the amount of sorting and wastage because a more homogenous feed is being offered. Particle size of long-stem forages can be reduced by tub grinding or grinding in a vertical feed mixer but equipment must be properly calibrated and operated to assure a homogenous mix. Chopping and ensiling forages can also be utilized to minimize sorting rather than feeding long stem forages.

Another method to reduce the natural feed sorting behavior of sheep is to offer a properly balanced ration. Research from Utah State University shows sheep have the ability to consume only the feeds that meet their metabolic needs and even choose feeds that contain compounds to counteract digestive upsets and disorders (Villalba et al., 2011). If a ration is properly balanced for the stage of production, sorting will be minimized because the exact nutrients needed will be provided. However, rations need to be properly mixed and delivered to the ewes for this to be an effective method. There are three different rations: the ration formulated, the ration delivered to the sheep and the ration consumed by the flock. Ideally, all three of these are the same but each step in the mixing process introduces a source of variation from the formulated ration. Therefore, every step should be carefully checked to assure proper ration delivery and consumption by the flock.

## **Supplemental Feeding**

Although sheep evolved to utilize forages for nutritional demands, often times, sheep require supplemental feeding. Sheep in high metabolic stages such as late gestation and early lactation are physically limited on the amount of forage they can consume and thus cannot meet their nutrient requirements. During these times, nutrient dense feeds like cereal grains are needed to prevent metabolic upsets and to maintain performance. These periods in the production cycle are critical to the subsequent lactation performance of the animal as well as lamb survival. Ewes that suffer metabolic disorders such as ketosis or milk fever during late gestation will have reduced colostrum quality and quantity (Klimes et. al., 1989) and also have the potential for decreased milk yields throughout lactation. The total milk yield through a lactation can be

predicted based on the production level at peak lactation so if production is limited at peak lactation, the production will be limited through the entirety of the lactation.

To properly formulate a grain ration, the intake and nutrient composition of forages is needed to identify the shortcomings in the ration. Again, a sample of the forage offered does not adequately depict the nutrient intake of the ewes so forage refusals should also be evaluated. A grain ration should be formulated to meet any shortcomings in energy, protein, fiber, lipids, vitamins and minerals and thus may require cereal grains, vitamins and mineral mixes. The nutrient category most often limiting in a forage-based ration is the energy content so energy-dense cereal grains should be considered primarily. Increasing the energy content of a forage-based diet with starch-based grains has varied results on fiber fermentation, generally decreasing fiber fermentation but increasing nitrogen utilization. This is likely due to increasing the population of starch-fermenting bacteria in the rumen and decreasing pH, which limits fiber-fermenting bacteria. Ruminants have the ability to recycle nitrogen through the GI tract and to utilize microbial protein (utilize the nitrogen from rumen microbes as they pass through the GI tract) so protein is not usually a limiting nutrient. However, Mikolayunas et al., (2009) demonstrated an increase in milk production of 14% when rumen undegraded protein (RUP) was increased from 4% to 6%. Therefore, rumen protected protein sources like soybean meal or canola meal may be advantageous in a grain ration.

Anytime multiple feedstuffs are offered, the opportunity for sorting is present. Pelleting grain mixes will reduce the amount of sorting and assure balanced intake of nutrients, however, pelleting is an additional cost. If a grain mix or pellet is offered with forages in a total mixed ration, proper mixing time is critical for a homogenous ration which reduces sorting and balances nutrient intake.

### **Maximal vs. Optimal Production**

An important and often overlooked decision for managers to make is whether to maximize or optimize production. For some, these may be synonymous. Increasing milk production increases the revenue of the operation but it often comes at a price. To properly manage this decision, production efficiency should be calculated by dividing the output of the flock (milk production) by inputs (feed, labor, veterinary, etc.). Before a decision is made, the impact of that decision on cost of production and production efficiency should be analyzed. Other factors that will have merit in decision making will be the impact on animal welfare, flock health and personal goals of the producer.

### **Summary**

Several factors can affect nutrient intake of dairy sheep. Rations should be formulated to provide the meet requirements for the various stages of production. Routine observation of feeds offered and feeds consumed should become part of every operation's management strategy to maximize production efficiency. Flock nutrition represents over half of the cost of most dairy sheep operations so maximizing the return on that investment should be paramount.

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## DEVELOPING AND MAINTAINING A HEALTHY DAIRY SHEEP FLOCK

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Today's talk is going to be centered on two broad concepts. How to prevent (minimize) disease and if it occurs, how to manage it. But before we get into the nuts and bolts of today's presentation, I want to highlight a couple of concepts. The first is a valid veterinary client patient relationship (VCPR).

The FDA's website has this definition: A veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;

There is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and

The practicing veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

The next term I want to familiarize you with is "extra-label drug use". Extra-label drug use happens when you use a drug at a dose, frequency, route of administration or for an indication or species that is not on the label. Veterinarians can prescribe medicines in this manner, when they have a valid VCPR.

The USDA Animal and Plant Health Inspection Service (APHIS) conducts periodic surveys by the National Animal Health Monitoring Service (NAHMS). In 2011 they conducted a survey and found that only 23.9% of the sheep operations had a private veterinarian visit the farm the past year for any reason. The same survey also indicated that dairy comprised around 1% of the total sheep operations. I suspect the dairy sheep industry is making better use of the veterinary profession.

If you are developing a new flock or purchasing new breeding stock, then you have to solve the same problem, which is how to bring in new arrivals without purchasing new diseases. Biosecurity is the series of management practices that are employed to prevent the importation of infectious agents from entering the farm.

Quarantine is described as separation of new arrivals from the resident herd for a period of time to assure that they are not carrying latent (hidden) pathogens. How long the animals are quarantined depends on what pathogens you are trying to exclude, but a common duration is 21 days.

Acclimation is a period of time that allows an animal to adjust to the new environment, feeds and social hierarchy. This concept is very established in a research setting, however it has application to the farm also. Do you think an ewe will respond better to a vaccination given when she gets off the truck from an 8-hour drive or after she has adjusted to her new surroundings?

Finally, the quarantine period is a good time to collect samples (e.g., blood, manure, etc.) for diagnostic testing. What diseases are endemic on your farm? What diseases do you want to keep out? It usually takes a week to get diagnostic lab results back.

We can see from the APHIS NAHMS 2000 survey that at best case, 40% of flock operations quarantined new arrivals. A likely reason that producers do not adopt this practice is because they do not have housing or pens available for their new arrivals. The APHIS NAHMS 2011 survey sheds light on how many sheep producers practice these biosecurity management practices (vaccinations, dewormings, shearing and disease testing) on recently purchased sheep.

Biocontainment is the management plan aimed at controlling the spread of infectious agents within the farm. Examples of infectious agents that cause disease and economic loss for sheep producers include: Ovine Progressive Pneumonia, Staph. *aureus* mastitis, Johnes Disease, Coccidiosis, Parasitism, Caseous Lymphadenitis, Orf and Scrapie.

Working with your veterinarian you can develop plans to minimize the economic impact of these diseases. Here is an example of our OPP control program initiated in 2012.

1. Test ewes prior to lambing and create separate groups (positive/negative) within the flock. Subsequent years, negative ewes will be bred to lamb before positive ewes. Positive ewes are housed and managed with maximum separation from negative ewes.
2. Designate jugs for positive ewe/lamb pairs and negative pairs. Jugs are cleaned and disinfected between pairs.
3. Cross-foster lambs from positive ewes to negative ewes to the extent as possible (discontinued after 2012 lambing season).
4. Create colostrum bank from high producing negative ewes and/or secure source for vaccinated (*Clostridium perfringens cd/tetanus*) bovine colostrum.
5. Employ artificial rearing (limited basis) to separate lambs from positive dams (discontinued after 2012 lambing season).
6. Use separate needles on all sheep. Disinfect all management tools that are used with ewes between animals (drenching gun, tattoo pliers...). When possible handle negative flock for management tasks (vaccinations, shearing...) before positive flock.

Vaccinations are a common component of biocontainment plans. There are many types of vaccines and they should all be used according to label directions. Examples of different types of vaccines include: modified live, killed or toxoids. As I discuss our vaccine schedule and other common diseases of sheep, I will highlight their differences.

Below is a table of the Spooner ARS sheep vaccination schedule:

Vaccine	Class of Animal	Timing	Comments
Clostridium perfringens type C+D and tetanus antitoxin	Lambs	~ 10 days of age	Also given to treat enterotoxemia
Clostridium perfringens type C+D/Tetanus toxoid	Lambs	~ 30 days age	Booster ~21 days later
Clostridial 8-way bacterin	First parity ewes	6 weeks before start of lambing season	Booster 3 weeks before the start of lambing season
	Mature ewes	Annual booster 3 weeks before the start of the lambing season	
Campylobacter vaccine (vibriosis)	Ewes and Rams	Annually 30 days prior to breeding	Booster 60-90 days later for maiden ewes and rams

Orf is a viral disease of sheep that we see periodically as the flock immunity waxes and wanes. The signs are proliferative, crusting growths, and ulcerations of the mouth and nose. Lesions resolve in 3-6 weeks. One of the most significant aspects is when ewes develop lesions on their udders. While the entire lamb crop may be affected (morbidity 100%); the mortality is usually low (<1%).

“Sore Mouth” vaccine is available. This is a good example of a modified live vaccine. Modified live vaccines are usually “attenuated” (modified to reduce ability cause disease) and therefore given once. The vaccine actually replicates in the lambs providing the immune system a prolonged opportunity to develop antibodies.

Blackleg is one of a group of Clostridial diseases of sheep and all livestock. Clostridial bacteria live everywhere in the soil. Areas with marshy land and high amounts of rainfall are favorable environments for this bacteria. The general theme of this disease is that bacteria or spores get into the animal from a laceration, shearing or docking wound and go into a dormant state. Then months or years later an injury occurs that creates an area with poor oxygenation of the tissues and the spores proliferate. Producers will usually find a dead sheep with a swollen extremity. If an animal is caught early in the disease you will see a depressed, painful animal with an edematous swelling of the affected area. Animals can survive if given therapy, however the affected area may become necrotic. Other examples of Clostridial disease include Bighead Disease of rams and Red Water Disease.

Luckily, there is an inexpensive combination vaccine that is very effective if used properly. They are commonly known as 8-way vaccines and this is one vaccine that I think all livestock should receive. This is an example of a killed vaccine. The bacteria are grown up in a fermentation vat and then treated with formaldehyde to inactivate “kill” them. That suspension

is cleaned up and then injected into the animals as a vaccine. In contrast to a modified live vaccine, there is no replication in the host. Therefore, it is critical that these vaccines are “boostered” in 21-28 days (read label).

Enterotoxemia of lambs is another common Clostridial disease that affects the sheep industry. Similar to “Blackleg” these lambs are frequently found dead. If lambs are found alive they commonly are bloated with signs of colic. This disease is also termed “over eating disease,” affecting the biggest and healthiest lambs. If found early in the disease, treatment with oral penicillin and C+D antitoxin may be effective. Control is achieved by vaccination, regular feed delivery and milk feeding equipment hygiene.

The vaccines against enterotoxemia are “toxoid vaccines.” They are specific to the toxin the bacteria produce. There is no replication in the lamb, therefore a booster immunization is necessary for good immunity. We vaccinate the ewes with this toxoid in the 8-way vaccine so that the lambs have passive immunity from day one.

The APHIS 2011 survey shows how many operations used different vaccines on any class of sheep. The C+D toxoid and tetanus are the most widely adopted. This is likely due to the high mortality rate associated with the disease. Conversely, Orf vaccination has a low mortality rate.

Earlier we discussed our Ovine Progressive Pneumonia (OPP) control program as an example of a practical biocontainment program. This disease is caused by a virus with a very long incubation period (2-4 years). It causes a chronic, worsening pneumonia and fibrosis of the udder. These ewes will become emaciated despite a good appetite and be poor milk producers. Mortality rate is 100% within one year of developing clinical signs. Currently, we have no vaccines available. Testing and separation are the basic components of a control program.

Caseous lymphadenitis is a bacterial disease of sheep and goats that causes internal and external abscesses. This organism invades the body through wounds of the skin of mucous membranes. It is a hardy organism that persists in the soil, manure and skin of an infected flock. Sheering is a management practice that can facilitate the spread. External abscesses can be lanced and treated, but then these animals should be isolated because their wounds will contaminate the environment. Vaccination is an option, however using it will eliminate serologic testing as a management tool.

Abortions are a concern with dairy sheep operations because they affect the available replacement ewes and can disrupt lactation if they occur early in gestation. The list of infectious agents is extensive. The point I want to make is that if you are experiencing abortions due to infectious causes, you need to submit the aborted fetuses to a diagnostic lab. You have to identify the problem in order to manage it. Toxoplasma and Coxiella are also zoonotic agents, meaning they can cause sickness and abortion in humans as well.

Pneumonia is caused by a host of bacterial, viral and parasitic organisms. Fever, labored breathing and nasal discharge characterize pneumonia. We have a variety of effective antibiotics and anti-inflammatories to treat the condition. Preventing its occurrence will be more cost effective than treatment. This can be a real challenge for the dairy sheep industry in northern



climates. We experience a slug of lambs during late winter and early spring when the weather can be severe and fluctuations dramatic. Ventilation and immunity are two important areas to evaluate in herd outbreaks of pneumonia.

Mastitis is usually caused by a bacterial infection of the udder. These infections can be subclinical (undetected) or clinical (abnormal milk). Clinical mastitis is characterized by abnormal milk (clots, watery or bloody), fever and udder swelling. The animal may also be depressed and off feed. We treat mastitis with intramammary and systemic antibiotics and anti-inflammatories. It's important to note, that no antibiotic preparations are approved to treat mastitis in sheep. What this means is that the FDA has a zero tolerance for the detection of the medicine in sheep's milk. Whereas for approved species a threshold level is established.

Pregnancy toxemia is a disease of late gestation sheep that have multiple fetuses (3 or more). Clinical signs are anorexia, depression and an inability to rise. Ketones are elevated in the urine. This is a metabolic condition due to an energy imbalance. Ketone bodies in the blood, depress the ewes appetite, making the condition worse. Treatment is aimed at correcting the energy imbalance. We will give an intravenous injection of dextrose and induce parturition. Additional therapies include B vitamins, transfaunation, oral dextrose drenches and calcium.

Bloat occurs when the ewe is unable to eructate (belch) trapped gas in the rumen. Enlargement of the rumen compresses the diaphragm leading to respiratory distress and potentially death. Bloat can be caused by free or frothy gas. Passing a stomach tube can relieve free gas. Frothy bloat must first be treated with a de-foaming agent and then relieved by passing the stomach tube. Bloat is a hazard of grazing sheep on legume (alfalfa or clover) pastures.

Coccidiosis is a parasitic disease of sheep characterized by watery diarrhea. The diarrhea can be blood tinged. Lambs are most susceptible at time of stress (weaning, shipping or feed changes). Placing coccidiostats in the milk replacer or mineral supplements is a means of control. Clinically affected individuals should be treated with amprolium and replacement fluid therapy.

Parasitism is a significant animals health issue for dairy sheep. Each parasite causes its own pathological changes in the sheep, but rarely are infections due to a single species. Most infected animals will not show outward disease. When infections are severe, signs include diarrhea, weight loss anemia and edema. *Haemonchus contortus* is the species associated with anemia. FAMACHA scoring is performed to assess the severity of anemia and select sheep in need of treatment. The anemia is specific to this particular nematode infection. Parasite resistance to anthelmintic medications (dewormers) is a great concern to the sheep industry. Deworming effectiveness should be monitored by use of fecal egg counts before and after treatment. Integrated control programs can be developed and may decrease the reliance on anthelmintics.

Foot scald and foot rot are common causes of lameness in sheep. Foot scald is limited to an infection of the skin between the toes. Foot rot is more severe and involves distorted hooves with deep tissue infection. Foot rot occurs when two anaerobic bacteria infect the foot, one with an enzyme that dissolves the keratin of the hoof. Treatment for both infections is similar. Trim the toes and apply topical coppertox, formalin or zinc sulfate. Separate out the affected animals

into one group for isolation. Footbaths of zinc sulfate or formalin solution are effective in controlling this condition. Move the sheep to a dry environment.

Abrasions and lacerations occur with all types of livestock. If the laceration is extensive and exposes underlying tissue, it should be cleaned and sutured. The window for suturing lacerations is six hours. After that, the wound is considered too contaminated to close. Treat with broad-spectrum antibiotics if underlying tissue is exposed. Remember to apply fly spray during warmer months.

Rectal prolapse is associated with a short tail dock length. But other risk factors are conditions that produce straining and coughing. The treatment depends on the severity of the prolapse. Commonly, prolapse rings are applied to amputate the prolapsed tissue. The animals should be placed on antibiotics. Mineral oil or enemas can be used to ensure that the animal does not become impacted.

This presentation provides examples of vaccination schedules and treatment protocols that have been developed by a close working relationship between the veterinary staff and animal care staff at our facilities. Each farm presents its own unique set of challenges and no one approach will work for all. I encourage you to work with your veterinarian to develop a preventative health program for your flock. Thanks for your attention and I will be glad to answer any questions.

# ESTIMATED BREEDING VALUES DO PREDICT FUTURE PERFORMANCE

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## Introduction

Selection is the process by which man or nature determines whether an individual is fit enough to pass its genetic information to the next generation of its breed, line, or species. The criteria to determine fitness is generally very different whether man or nature is making the selection decision. This is evident when comparing domesticated species to their wild ancestors. For example, the field corn we are all familiar with as livestock feedstuff bears little resemblance to its forebear, teosinte. Likewise the wild mouflon and the domestic sheep breeds of North America have very different characteristics. However, regardless of the vehicle which drives selection, the basic laws of inheritance remain true. That is, an animal passes one half of its genes on to the next generation.

An animal's phenotype is its performance for a trait that we can see or measure. A phenotype is determined by the combined effects of the genes of the animal and the environment under which the animal is raised, both of which can have a negative or positive effect on performance. The number of lambs a ewe gives birth to is dependent upon the versions of genes she contains which may affect prolificacy (e.g., ovulation rate, embryo survival, uterine capacity) and also non-genetic (environmental) factors (e.g., age at breeding, breeding season temperature, flushing). The degree to which a phenotype is affected by non-genetic factors can vary considerably between traits, but non-genetic factors are not inherited in future generations. This leads to the question: "when you buy a ram based on his phenotypes, how much of his birth farm's environment are you paying for?"

Selecting sheep based on their phenotype or the phenotype of their close relatives has been the gold standard since their domestication over 10,000 years ago. Development of wool follicles, out of season breeding, high prolificacy, rapid growth rates and many other traits that separate domestic breeds from wild species can all be attributed to phenotypic selection. However, phenotypic selection is inaccurate which makes progress painfully slow. Since the mid-1900's, advances have been made in statistics and computing power that enable us to accurately estimate an animal's true genetic potential for one or more traits. This estimate, called an estimated breeding value (EBV), takes into account the performance of the individual and all of its relatives while adjusting for known sources of non-genetic variation.

EBVs are available for most livestock species in both individual traits and multiple trait indexes. The National Sheep Improvement Program (NSIP) has been providing American sheep producers with EBVs since the late 1980's. Despite this, modern genetic evaluation programs like NSIP have not been widely adopted by U.S. sheep producers. There are many reasons why this might be the case:

**"Genetic improvement has a negative connotation"**. To people not involved in animal agriculture, "genetic improvement" may conjure up images of someone in a white lab coat

“injecting genes” into a lamb fetus. Using EBVs to select replacement stock is fundamentally the same thing that has been occurring for several thousand years. The difference is that we now have more accurate ways of determining which animals genetically excel in a trait(s).

**“My flock is too small for genetic improvement to work”.** Given that flock records contain parentage information and individual performance traits, an animal’s genetic merit can be estimated no matter the size of your operation.

**“I have a commercial ewe flock, and EBVs are only available for purebred sheep”.** At present, NSIP calculates EBVs for purebred sheep; this may certainly change to include crossbred animals. At any rate, buying terminal rams with the aid of their estimated breeding values will give you more confidence in their future lamb crops’ growth and carcass characteristics.

**“My sheep are primarily raised on pasture, they can’t compare to confinement raised sheep”.** The statistical models used in genetic evaluation programs account for all management differences between farms (or even seasonal management differences on the same farm). They are able to do this provided that your farm is “genetically linked” to other farms in the program. Genetic evaluation programs will never ask you to fit the mold of the “traditional” sheep flock, they are extremely flexible like the future of the sheep industry will need to be.

**“I know what a productive sheep looks like, EBVs can’t tell me anything new”.** EBVs are another tool to aid in your selection decisions. They won’t tell you if a ram is poor structured or if a ewe is flat ribbed, that is for YOU to decide. They will, however, give you accurate and unbiased estimates of an animal’s true genetic merit for production traits that make YOU money.

**“Genetic improvement programs cost money”.** Estimating breeding values at a nation-wide level requires a lot of collaboration, data editing, computing power, and time. The people involved in this process aren’t going to work for free (unless they’re a graduate student). Like any production decision, there are costs and returns to consider. The returns from increased performance that EBVs provide far outweigh the costs of calculating them.

### **Selecting Replacement Sheep at Spooner ARS**

At present, there is no genetic evaluation program for dairy sheep in North America. Because of this, producers are left to select replacement animals based upon their dam’s (or other close female relative’s) production records. The procedure has largely been the same at Spooner ARS up until 2014. There are many non-genetic factors that can influence a ewe’s lactation performance. Some examples include: a ewe’s age, the quality of stored feed fed through winter, the quality of pasture, parasite load, disease, ambient temperature, and many more. If these effects aren’t accounted for, we will inevitably biasedly select replacement animals. For example, if a ewe’s milk yield peaks at 3 years of age, we may only select replacement animals from these females and miss the truly genetically superior animals from younger or older ewes.

Over the past year, I’ve been mining the Spooner flock database and combining production records with pedigree information in order to estimate breeding values of both rams and ewes.

The 2015 lamb crop was the first whose sire-dam combinations were determined with the aid of EBVs for total lactation milk yield. Recently, I've replaced total lactation milk and component yields with 180 day adjusted yields to account for differences in lactation lengths among ewes. The question remains whether or not selecting replacement animals with the aid of EBVs leads to actual gains in lactation performance in future generations. The following research results help shed light on this very important question.

## Materials and Methods

The trait I will be focusing on is 180 day adjusted milk yield (180d MY). Although component traits are certainly important for cheese production, milk is currently purchased from Spooner ARS on a weight basis. I will set up the following scenario: suppose I have a group of ewe lambs that I've grown out to 6 months of age, and I plan to keep half of them as replacements. Which half should I keep? I can select replacements using one of three pieces of information: 1) their dam's 180d MY from the current lactation (RAW 180d MY), 2) their dam's 180d MY from the current lactation adjusted for dam age and number of lambs born (ADJ 180d MY), or 3) their dam's estimated breeding value for 180d MY (EBV 180d MY).

The data set I will be using to address this scenario is from ewe lambs born in 2013. In reality, all of them were kept as replacements. That is, all of them have a first lactation 180d MY from 2014 - we'll pretend we don't know this at the time of selection. The actual first lactation 180d MY of the group of ewe lambs that were "selected" (based on one of the three selection criteria of their dams) can then be compared to the first lactation 180d MY of the group of ewes that were "not selected". The differences of actual 180d MY between these groups will give us a good idea of whether or not EBVs are indeed the best selection criteria, or if we're better off just selecting based on their dam's phenotype for lactation performance.

The actual first lactation 180d MY records from 2013 born ewe lambs ( $n = 75$ ) will be analyzed with the following simple general linear model for each selection criteria separately:

$$y_{ij} = \mu + \text{Dam Group}_i + e_{ij}$$

where  $y_{ij}$  are the first lactation 180d MY observations,  $\mu$  is the overall mean 180d MY,  $\text{Dam Group}_i$  is the fixed effect of the dam's ranking for a selection criteria (whether the ewe lamb's dam was in the top 1/2 or bottom 1/2 of all dams for RAW 180d MY, ADJ 180d MY, or EBV 180d MY), and  $e_{ij}$  is the random residual term.

## Results and Conclusions

The additive adjustment factors to transform 180 day adjusted milk yield records from RAW 180d MY to ADJ 180d MY are listed in Table 1. Age is a non-genetic factor that will influence the amount of milk a ewe will produce. At younger ages, a ewe's body is still growing and her udder may not be fully developed, while at older ages a ewe's conformation may have decayed somewhat. Similarly, ewes that give birth to two or more lambs produce more milk than ewes that have a single lamb. These adjustment factors were used in the mixed model equations to obtain 180d MY EBVs based on a single trait repeatability animal model (Meyer, 2007).

**Table 1.** Adjustments for 180 day adjusted milk yield for age of ewe in years and number of lambs born prior to lactation (NLB).

Effect	Level	Adjustment (kg)
Age	1	+67.9
	2	-24.8
	3	-46.6
	4	-42.2
	5	-19.7
	6	+0.0
NLB	Single	+15.4
	Multiple	+0.0

The results from the 3 separate selection criteria models are listed in Table 2. When ewe lambs were ranked by their dam's RAW 180d MY the top ½ milked, on average, 5.7 kg (12.5 lbs.) more than the bottom ½, but this difference was not statistically significant ( $P > 0.60$ ). Next, when the 2013 born ewe lambs were ranked by their dam's ADJ 180d MY, the top ½ milked 12.1 kg (26.6 lbs.) more than the bottom ½ in 2014, but this difference was also not statistically significant ( $P > 0.25$ ). Finally, when the ewe lambs were ranked by their dam's EBV for 180d MY, the top ½ tended to milk significantly more ( $P < 0.07$ ), 20.2 kg (44.4 lbs.) on average, than the bottom ½ in their first lactation.

**Table 2.** Least square means  $\pm$  standard errors for 180d MY between ewe lambs whose dam was in the top or bottom half among all dams for 3 selection criteria.

Dam Group	Selection Criterion		
	RAW 180d MY (kg)	ADJ 180d MY (kg)	EBV 180d MY (kg)
Top ½	212.7 $\pm$ 7.8 <sup>a</sup>	215.8 $\pm$ 7.6 <sup>a</sup>	219.8 $\pm$ 7.5 <sup>a</sup>
Bottom ½	207.0 $\pm$ 7.7 <sup>a</sup>	203.7 $\pm$ 7.7 <sup>a</sup>	199.6 $\pm$ 7.6 <sup>b</sup>

<sup>a,b</sup>Means within a column without a common superscript are different ( $P < 0.10$ ).

When the ewe lambs were selected based upon their dam's EBV for 180 d milk yield, they produced 7.1 kg (15.6 lbs.) more in their first lactation than the ewe lambs selected based on their dam's actual 180 d milk yield. This may not seem like much, but if milk were sold for \$0.95/lb, these 38 ewe lambs over 5 lactations stand to return **\$2,816** more in milk sales. Using the same logic, even if the ewe lamb's dam's 180 d MY was adjusted for known non-genetic effects, the ewe lambs selected based on their dam's EBV could still return **\$1,588** more in milk sales.

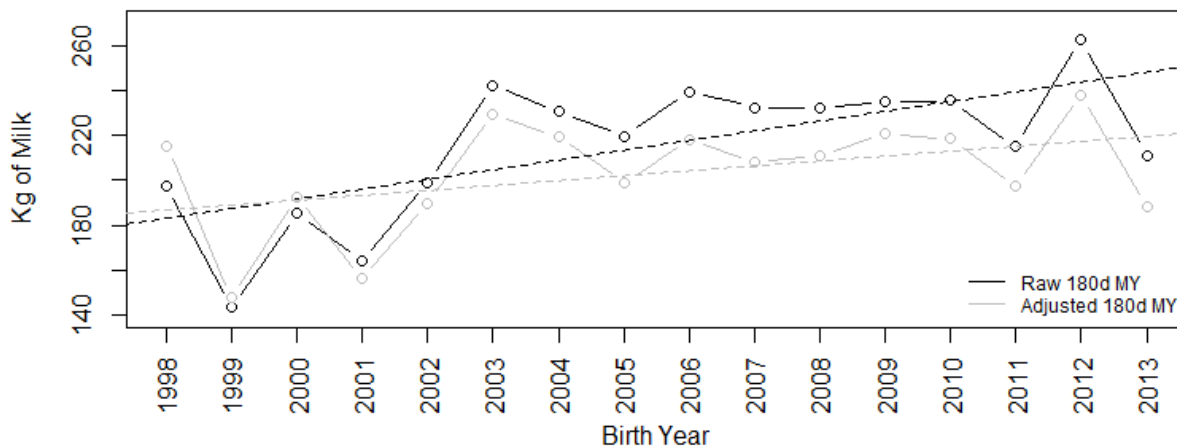
It is worth pointing out that only dam EBVs were used as a selection tool here, accounting for only ½ of the genetic merit of the ewe lambs. I only included dam EBVs because some of the ewe lamb's sires were purchased from outside flocks and had no daughters with milking records, i.e. their breeding values could not be estimated at the time of ewe lamb selection. If all sires of these ewe lambs had EBVs, we could have more accurately separated the genetically superior

half, and it is likely they would have realized first lactation 180 day milk yields higher than all three selection criteria.

The higher the heritability of a trait, the better an animal’s own phenotype (or phenotype of their close relatives) estimates their breeding value for the trait. In general, traits like frame size in livestock species are highly heritable (0.5 to 0.6). Estimates of breeding value for highly heritable traits are generally not necessary. For example, if we breed a large framed ram to a large framed ewe, we’re likely to get large framed lambs, that is, the environment is going to play much less of a role in the expression of these traits. The heritability of 180d MY estimated from this dataset was 0.35, which is moderate. That being said, the 180 d MY phenotype of a ewe lamb’s dam turns out to be a pretty poor estimator of the true genetic merit and predictor of future performance of the ewe lamb, as was shown in our selection scenario.

To further strengthen this point, Figure 1 displays the average first lactation 180 d MY of the Spooner ewe flock by birth year. The black trend line with circles shows the raw average 180 d MY of first parity females by birth year and the black dashed line is a least-squares regression for these points. There’s a lot of fluctuation from year to year but the slope of the regression line is positive, showing an increase of **+4.3 kg of milk/year** (+9.5 lb. of milk/year).

**Figure 1. Mean First Lactation 180 Day Adjusted Milk Yield by Birth Year**



As we all know, production can fluctuate from year to year not only because of things such as pasture conditions and the quality of our hired labor, but also because of the dynamics of our ewe flock. The breed makeup of the Spooner ewes has changed over time. The gray trend line with circles is the average first lactation 180 d MY further adjusted for percentage of dairy breeding (East Friesian + Lacaune) and NLB by year of birth. The gray dashed line is then the least-squares regression line between these points. Again, there’s still a lot of fluctuation from year to year, but substantially less than the raw 180 d MY. The regression line still shows a positive slope of **+2.2 kg of milk/year** (4.8 lb. of milk/year).

We can compare performance of ewes across birth years by using the gray regression line equation of:  $180d\ MY_i = -4181.3kg + 2.19kg \times BirthYear_i$ . The solutions from this equation show that ewes born in 1998 produced an average of **194.3 kg** (427.5 lb.) of milk

through 180 days of their first lactation in 1999, and ewes born in 2013 produced an average of **227.2 kg** (499.8 lb.) of milk in 2014. On average, a first parity ewe in 2014 milked **32.9 kg** (72.4 lb.) more than a first parity ewe in 1999. At a milk price of \$0.95/lb., a first parity ewe in 2014 grossed **\$69** more through 180 days of lactation than a first parity ewe in 1999. How much of this performance increase has been because of better management and nutrition?

Now imagine other traits of economic importance such as ability to breed out of season, prolificacy, weaning weight, and feed efficiency. These are traits that will make or break any commercial or purebred sheep operation, and they are lowly heritable (0.08 to 0.20). Phenotypic selection for these traits isn't going to cut it. The take home message is that the use of estimated breeding values for production traits is the only selection tool that allows us to make both rapid and permanent gains from year to year.

Yes, enrolling in a genetic improvement program costs money. Yes, the reports from a genetic improvement program may not tell you what you want to hear – that your sheep aren't as genetically superior as you may have thought. But computers and the formulations they use to estimate breeding values are not biased like a show ring judge or a producer's "stud" ram may be. We can assess structural soundness, breeding soundness, and udder and foot health by visually appraising an animal but we cannot visually evaluate productivity.

### **Literature Cited**

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## EFFECTS OF BREED AND HYBRID VIGOR ON LAMB SURVIVAL

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### Background

The introduction of new breeds into flocks in order to improve desirable traits (such as milk or meat production) can also have an effect on survival rates of lambs in the flock. This happens because different breeds have different rates of survival (e.g., Gamma et al., 1991; Thomas et al., 2000a and 2000b), which is most likely due to an additive genetic component. With increased lamb mortality, there are substantial economic losses and animal welfare concerns.

It is known that crossbred lambs have greater survival when compared to purebred lambs (Gama et al., 1991), indicating that lamb survival exhibits a high amount of 'hybrid vigor'. This term is familiar to sheep producers, and it is a result from crossbred animals having more pairs of genes that are different (heterozygous, e.g. AB) and fewer pairs of genes that are the same (homozygous, e.g. AA or BB). Since each parent of crossbred lambs comes from a different breed (or breed combination), there is a greater chance that the two genes at a given location will be different. Having more genes that are different is beneficial both because many of the deleterious genes that cause disease in livestock are recessive (e.g. AA is deleterious), so they will not be expressed if one of them is different (e.g. AB); and also because animals that are heterozygous (e.g. AB) will tend to present higher performance than the average of their parents for many traits.

In order to guide producer's decisions when inserting a new breed into the flock, it is important to determine the lamb survivability of different breeds as well as to quantify the extent to which crossing of breeds will be beneficial for survival.

### Our Flock and Analysis

The data was collected at the Spooner Agricultural Research Station of the University of Wisconsin-Madison, located in northwest Wisconsin. Our dairy sheep flock is composed by crossbreds of two or more breeds from 14 different breeds (East Friesian, Lacaune, Hampshire, Suffolk, Dorset, Texel, Polypay, Targhee, Romanov, Arcott Rideau, Katahdin, Rambouillet, Commercial, and Finnsheep), and is being upgraded to the dairy breeds of East Friesian and Lacaune. Because there were relatively small contributions of the 12 non-dairy breeds in the lambs in this study, these 12 breeds were grouped into either meat breeds (Hampshire, Suffolk and Texel) or maternal breeds (Dorset, Polypay, Targhee, Romanov, Arcott Rideau, Katahdin, Rambouillet, Commercial, and Finnsheep).

Survival was analyzed in three time periods, in order to determine the age of greatest susceptibility of death: up to and including 1 day of age (7,933 lambs), from 2 to 30 days of age (5,370 lambs) and from 2 to 60 days of age (5,216 lambs). All lambs were born from 1998 to

2011 and were reared on a milk replacer after ingestion of colostrum from their dams for the first 36 to 48 hours of life. The date of death (if the animal died), sex, age of the dam, birth type, month and year of birth, and breed composition were recorded for each lamb.

In order to determine the effect of crossbreeding separately from the effect of the individual breed in each cross, the proportion of retained hybrid vigor was calculated for each animal. This value is 100% for animals whose sire and dam are of completely different breeds, such as an F1 cross of two pure breeds (eg. Lacaune ram x Suffolk ewe) and is equal to 0% for purebred animals. The proportion of retained hybrid vigor is reduced when the same breed appears on both the sire and dam side of a cross, such as a backcross (Lacaune ram x Suffolk-Lacaune ewe, hybrid vigor = 50%), with the amount of reduction depending on how much of the common breed is found in each parent. Retained maternal hybrid vigor (the degree of crossbreeding in the dam of the lamb) was calculated in the same manner. More detailed information about the analysis can be found at Ferreira, et al. (2015).

### Breed Effects

Lacaune was set in the analysis as the baseline breed (all values deviated from the predicted survival percentage of purebred Lacaune lambs). We can see in Table 1 that the predicted survival of meat breed lambs and maternal breed lambs was significantly greater than either Lacaune or East Friesian lambs during all three time periods. The predicted survival of East Friesian lambs was numerically greater than for Lacaune lambs, but the difference was not statistically significant.

**Table 1.** Effect of breed of lamb on survival (%) and its significance level (*P*-value).

Breed <sup>1</sup>	Period of life		
	All animals through 1d	Artificially raised animals	
		2 to 30 d	2 to 60 d
East Friesian	5.98 (0.27) <sup>a</sup>	5.32 (0.14) <sup>a</sup>	6.06 (0.28) <sup>a</sup>
Maternal breeds	<b>13.41 (0.01)<sup>a,b</sup></b>	<b>14.13 (&lt;0.01)<sup>b</sup></b>	<b>18.01 (&lt;0.01)<sup>b</sup></b>
Meat breeds	<b>15.77 (&lt;0.01)<sup>b</sup></b>	<b>10.98 (&lt;0.01)<sup>a,b</sup></b>	<b>15.40 (&lt;0.01)<sup>b</sup></b>

<sup>1</sup>Difference of all breeds when compared to the Lacaune breed.

<sup>a, b</sup> Values with no superscripts in common are different (*P* < 0.05).

### Hybrid Vigor Effects

Increased individual hybrid vigor was associated with an increase in survivability in all periods analyzed, and statistically significant for the periods of 2 to 30 and 2 to 60 days of age. In Table 2 we can see that, the predicted increase in survival of F1 crossbred lambs compared to purebred lambs was +8.8% for 2 to 30 days of age and reached +14.6% for 2 to 60 days of age. These are the most important results of this analysis. Maternal heterosis did not significantly affect lamb survival during any of the periods. This finding is not unexpected since animals were artificially raised, and positive effects of crossbred dams for maternal care and milk production were not experienced by the lambs beyond a very short period immediately after birth.

**Table 2.** Non-genetic and heterosis effects on lamb survival (%) and its significance level (*P*-value).

Item	Group	Period of life		
		All animals trough 1 d	Artificially raised animals	
			2 to 30 d	2 to 60 d
Sex <sup>1</sup>	Female	<b>-5.64 (&lt;0.01)</b>	<b>3.27 (0.01)</b>	<b>6.02 (&lt;0.01)</b>
Birth type <sup>2</sup>	2	0.33 (0.83) <sup>a</sup>	-1.61 (0.45) <sup>a</sup>	-1.77 (0.45) <sup>a</sup>
	3 <sup>3</sup>	<b>-6.18 (&lt;0.01)<sup>b</sup></b>	-0.66 (0.80) <sup>a</sup>	-1.97 (0.50) <sup>a</sup>
Birth month <sup>4</sup>	December/January	-2.02 (0.32) <sup>a</sup>	-3.81 (0.11) <sup>a</sup>	-0.30 (0.90) <sup>a</sup>
	March/April/May	<b>-10.27 (&lt;0.01)<sup>b</sup></b>	<b>-6.55 (&lt;0.01)<sup>a</sup></b>	<b>-8.19 (&lt;0.01)<sup>b</sup></b>
Age of dam <sup>5</sup>	2	<b>4.50 (&lt;0.01)<sup>a</sup></b>	2.79 (0.15) <sup>a</sup>	3.97 (0.07) <sup>a</sup>
	3	1.00 (0.62) <sup>a,b</sup>	4.04 (0.10) <sup>a</sup>	<b>6.13 (0.02)<sup>a</sup></b>
	4 <sup>6</sup>	-1.47 (0.48) <sup>b</sup>	2.24 (0.39) <sup>a</sup>	4.28 (0.13) <sup>a</sup>
Individual heterosis <sup>7</sup>		15.64 (0.17)	<b>8.82 (&lt;0.05)</b>	<b>14.57 (0.04)</b>
Maternal heterosis <sup>8</sup>		-21.38(0.42)	-17.78 (0.44)	-22.43 (0.96)

<sup>1</sup>Sex: difference when compared to males.

<sup>2</sup>Birth type: differences when compared to a single birth.

<sup>3</sup>Includes 3, 4, or 5 lambs born per ewe per parturition.

<sup>4</sup>Birth month: differences when compared to February.

<sup>5</sup>Age of the dam: differences when compared to 1-yr-old ewes.

<sup>6</sup>Includes dams from 4 to 9 yr of age.

<sup>7</sup>Percentage survival of F1 lambs (100% retained heterosis) – percentage survival of purebred lambs (0% of retained heterosis).

<sup>8</sup>Percentage survival of lambs from F1 dams (100% retained heterosis) – percentage survival of lambs from purebred dams (0% retained heterosis).

<sup>a,b</sup> Values with no superscripts in common are different ( $P < 0.05$ ).

## Environmental Effects

Survival of females was 5.6% lower than males trough 1 day of age, but 3.3% higher from 2 to 30 days of age and 6% higher from 2 to 60 days of age. Lambs born in litters of 3 or more were 6.2% more likely to die than singles through 1 day of age and lambs from one year old lambs were 4.5% more likely to die than lambs from 2-year-old ewes in the same period. Lambs born in the months of March/April/May had significantly higher probabilities of death than animals born in December/January or February for all periods.

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- 2013 – Axel Meister, Markdale, Ontario, Canada – Dairy sheep producer and early importer of East Friesian dairy sheep into North America
- 2014 - Terry Felda, Ione, Oregon, USA – Dairy sheep producer

## **Locations and Chairs of the Organizing Committees of the Dairy Sheep Symposia**

- 1995 1st Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA; Yves Berger – Chair
- 1996 2nd Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA; Yves Berger - Chair
- 1997 3rd Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA; Yves Berger – Chair
- 1998 4th Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA; Yves Berger – Chair
- 1999 5th Great Lakes Dairy Sheep Symposium – Brattleboro, Vermont, USA; Carol Delaney - Chair
- 2000 6th Great Lakes Dairy Sheep Symposium – Guelph, Ontario, Canada; Axel Meister - Chair
- 2001 7th Great Lakes Dairy Sheep Symposium – Eau Claire, Wisconsin, USA; Yves Berger - Chair
- 2002 8th Great Lakes Dairy Sheep Symposium – Ithaca, New York, USA; Michael Thonney - Chair
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- 2005 11th Great Lakes Dairy Sheep Symposium – Burlington, Vermont, USA; Carol Delaney - Chair
- 2006 12th Great Lakes Dairy Sheep Symposium – La Crosse, Wisconsin, USA; Yves Berger - Chair
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- 2011 17th Great Lakes Dairy Sheep Symposium – Petaluma, California, USA; Cynthia Callahan – Chair
- 2012 18th Dairy Sheep Association of North America Symposium – Dulles, Virginia, USA; Laurel Kieffer – Chair
- 2013 19th Dairy Sheep Association of North America Symposium – Cambridge, Ontario, Canada; Eric Bzikot - Chair
- 2014 20th Dairy Sheep Association of North America Symposium – Chehalis, Washington, USA; Terry Felda, Brad and Megan Gregory – Co-Chairs
- 2015 21st Dairy Sheep Association of North America Symposium – Madison, Wisconsin, USA; Brenda Jensen and David Thomas – Co-Chairs

## **Brief History and Presidents of the Dairy Sheep Association of North America**

November 1-3, 2001 – Decision made at the 7<sup>th</sup> Great Lakes Dairy Sheep Symposium, Eau Claire, Wisconsin, to form the Dairy Sheep Association of North America. Nancy Clark, New York, elected the interim/organizational President.

June 26, 2002 – DSANA by-laws, written by Nancy Clark, New York; Alistair McKenzie, Quebec; Carol Delaney, Vermont; and Charles Capaldi, Wisconsin, were adopted.

November 7, 2002 - Charter Meeting of DSANA held at the 8<sup>th</sup> Great Lakes Dairy Sheep Symposium, Cornell University, Ithaca, New York

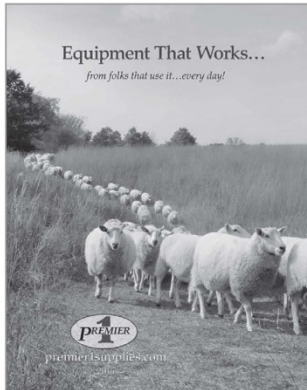
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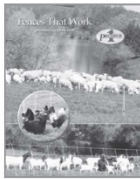
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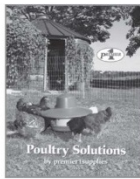
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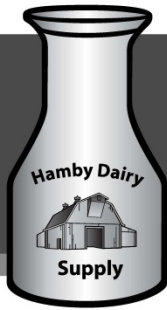
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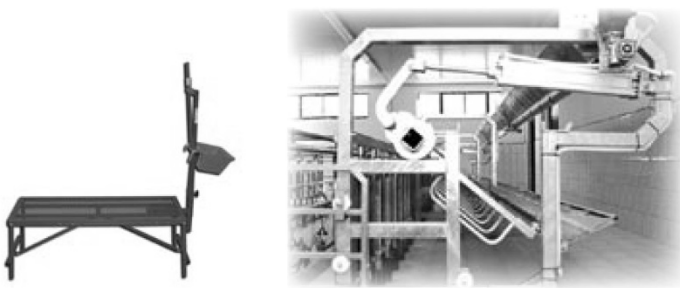


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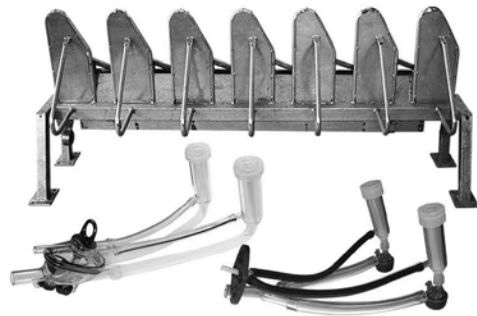
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