

*Proceedings of the 12<sup>th</sup> Annual*  
***GREAT LAKES DAIRY  
SHEEP SYMPOSIUM***



**November 9–11, 2006**

**La Crosse,  
Wisconsin,  
USA**



*Proceedings of the 12<sup>th</sup> Annual*

***GREAT LAKES DAIRY SHEEP  
SYMPOSIUM***

November 9 – 11, 2006

Midway Hotel Riverfront Resort  
La Crosse, Wisconsin, USA

**Organized by:**

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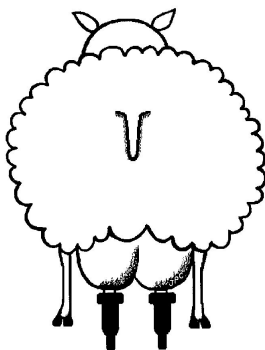
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Percheron draft horses, Hidden Springs Farm, Westby, Wisconsin – photo by  
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Hand-milked dairy ewes on a rotating parlor, Clover Dale Farm, Westby,  
Wisconsin – photo by Artak Khahcatryan

Aged Marisa award-winning sheep milk cheese, Carr Valley Cheese, La Valle,  
Wisconsin – photo by Carr Valley Cheese

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## Program of Events

### Thursday, November 9, 2006

8:30 a.m.     **Registration**, Midway Hotel Riverfront Resort, La Crosse, Wisconsin, USA

10:00 a.m.     **Welcome**

10:30 a.m.     **Sheep Dairy Farm Economic Analysis – Cost of Milk Production**  
Dan Guertin, Dairy Sheep Producer, Stillwater, Minnesota, USA  
Tom Kieffer, Dairy Sheep Producer, Strum, Wisconsin, USA

Noon           **Lunch**

1:15 p.m.     **The Dairy Business Innovation Center: A Catalyst for Innovation**  
Kate Arding, Consultant to the Dairy Business Innovation Center, Wisconsin  
Department of Agriculture, Trade and Consumer Protection, Madison,  
Wisconsin, USA

2:00 p.m.     **Organic Sheep Dairy: Markets and Production**  
Jody Padgham, Midwest Organic and Sustainable Education Service, Spring  
Valley, Wisconsin, USA

2:45 p.m.     **Dairy Sheep Production and Cheese Making in the French Pyrenees**  
Gilles Lagriffoul, Institut de l'Élevage - Comité National Brebis Laitières,  
INRA, Toulouse, France

3:45 p.m.     **Annual Meeting of the Dairy Sheep Association of North America**

5:00 p.m.     **Social Hour**

### Friday, November 10, 2006

8:00 a.m.     **Registration**, Midway Hotel Riverfront Resort, La Crosse, Wisconsin, USA

8:30 a.m.     **Ovine Progressive Pneumonia and Caseous Lymphadenitis – You Can  
Raise Sheep Without Them**  
Holly Neaton, DVM and Sheep Producer, Watertown, Minnesota, USA

9:15 a.m.     **Strategic Control of Gastro-Intestinal Parasites in Sheep**  
Don Bliss, Parasitologist, Mid America Ag Research, Verona, Wisconsin,  
USA

10:00 a.m.     **Break**

10:30 a.m.     **Somatic Cell Counts in Dairy Sheep Milk**  
Gilles Lagriffoul, Institut de l'Élevage - Comité National Brebis Laitières,  
INRA, Toulouse, France

## Program of Events (cont.)

### **Friday, November 10, 2006**

- 11:15 a.m.    **Dairy Sheep Grazing Research at the University of Wisconsin-Madison**  
Claire Mikolayunas, Ph.D. Research Assistant, Department of Animal Sciences, University of Wisconsin-Madison, Madison, Wisconsin, USA
- Noon            **Lunch**
- 1:30 p.m.    **Effect of Prepartum Photoperiod on Prolactin and Milk Production of Dairy Ewes**  
Claire Mikolayunas, Ph.D. Research Assistant, Department of Animal Sciences, University of Wisconsin-Madison, Madison, Wisconsin, USA
- 2:15 p.m.    **Sheep Behavior and Its Use in Sheep Management**  
Harold Gonyou, Animal Behaviorist, Prairie Swine Centre and the University of Saskatchewan, Saskatoon, Saskatchewan, Canada
- 3:00 p.m.    **Break**
- 3:30 p.m.    **A Continuum of Dairy Sheep Operations, Products, and Marketing Strategies**  
Moderators:  
Alice Henriksen Dairy Sheep Producer, Stillwater, Minnesota, USA  
Laurel Kieffer, Dairy Sheep Producer, Strum, Wisconsin, USA  
Panelists:  
Kim Curtis, Dairy Sheep Producer and Sheep Milk Soap Processor and Marketer, Anselmo, Nebraska, USA  
Javier Pérez Rocha Malcher, Organic Dairy Sheep Producer and Sheep Milk Cheesemaker and Marketer, El Marques, Querétaro, México  
Jodi Ohlsen Read, Dairy Sheep Producer and Sheep Milk Cheesemaker and Marketer, Nerstrand, Minnesota, USA
- 6:30 p.m.    **Symposium Banquet** (separate ticket required)  
Midway Hotel Riverfront Resort, La Crosse, Wisconsin, USA

### **Saturday, November 11, 2006**

- 8:30 a.m. –    **Board Buses for Farm and Cheese Plant Tours**
- 4:30 p.m.    Clover Dale Dairy Sheep Farm, Westby, Wisconsin, USA – John Henry and Mary Miller  
Hidden Springs Farm and Creamery, Westby, Wisconsin, USA – Dean and Brenda Jensen  
Carr Valley Cheese, Mauston, Wisconsin, USA – Sid Cook

## **Speakers**

at the symposium site on Thursday and Friday and on the farm and cheese plant tours on Saturday

Kate Arding, Consultant to the Dairy Business Innovation Center, Wisconsin Department of Agriculture, Trade and Consumer Protection, Madison, Wisconsin, USA

Don Bliss, Parasitologist, Mid America Ag Research, Verona, Wisconsin, USA

Sid Cook, Wisconsin Master Cheesemaker, Cheese Plant Owner and Marketer, Carr Valley Cheese, La Valle, Wisconsin, USA

Kim Curtis, Dairy Sheep Producer and Sheep Milk Soap Processor and Marketer, Anselmo, Nebraska, USA

Harold Gonyou, Animal Behaviorist, Prairie Swine Centre and the University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Dan Guertin, Dairy Sheep Producer, Stillwater, Minnesota, USA

Alice Henriksen, Dairy Sheep Producer, Stillwater, Minnesota, USA

Dean and Brenda Jensen, Dairy Sheep Producers, Farmstead Cheesemakers and Marketers, Hidden Springs Farm and Creamery, Westby, Wisconsin, USA

Tom and Laurel Kieffer, Dairy Sheep Producers, Strum, Wisconsin, USA

Gilles Lagriffoul, Institut de l'Élevage - Comité National Brebis Laitières, INRA, Toulouse, France

Javier Pérez Rocha Malcher, Organic Dairy Sheep Producer and Sheep Milk Cheesemaker and Marketer, El Marques, Querétaro, México

Jodi Ohlsen Read, Dairy Sheep Producer and Sheep Milk Cheesemaker and Marketer, Nerstrand, Minnesota, USA

Claire Mikolayunas, Ph.D. Research Assistant, Department of Animal Sciences, University of Wisconsin-Madison, Madison, Wisconsin, USA

John Henry and Mary Miller, Dairy Sheep Producers, Clover Dale Dairy Sheep Farm, Westby, Wisconsin, USA

Holly Neaton, DVM and Sheep Producer, Watrertown, Minnesota, USA

Jody Padgham, Midwest Organic and Sustainable Education Service, Spring Valley, Wisconsin, USA



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**River Ridge Stock Farm**, Larry and Emily Meisegeier, Bruce, Wisconsin, USA (donation of lamb for the banquet)

**Spooner Agricultural Research Station**, College of Agricultural and Life Sciences, University of Wisconsin-Madison, Spooner, Wisconsin, USA (donation of lamb for the banquet)

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# **SHEEP DAIRY FARM ECONOMIC ANALYSIS – COST OF MILK PRODUCTION**

**Tom Kieffer and Dan Guertin  
Wisconsin Sheep Dairy Cooperative  
Strum, Wisconsin, USA**

## **Introduction**

In 1996, the Wisconsin Sheep Dairy Cooperative (WSDC) was formed with an initial membership of 26 farms. Of these farms, only 6 farms were actually milking sheep. The remaining farms were in various stages of planning and/or setting up to milk. The primary question asked by the initial members was, “How much will I be paid for my milk?” In the ensuing 10 years, this question continued to be asked by everyone interested in either joining the co-op or setting up an independent sheep milking operation. Of the original 26 farms, 6 farms are still actively milking members of the WSDC. Three other farms became independent farmstead operations and are currently making their own sheep milk products. The remaining 17 farms went out of the sheep dairy business. The reasons for farms not succeeding are varied, some because of health issues, some because of lack of labor, but most because they were not able to make enough money milking sheep. Over the last 10 years, the co-op has had approximately 20 additional individuals who tried, or seriously investigated, sheep dairying. Of these, 14 have ended up leaving the sheep dairying business.

## **Approach**

The question of why some farms succeeded and others failed has been contemplated by the WSDC Board of Directors for a number of years. All of the member farms were being paid the same amount for their milk, yet some were able to cash flow their operations and other weren't. Trying to elucidate this answer has been very complicated because no two farm situations are the same. Some farms had additional sources of farm income beside milk, some farms carried heavy debt loads, some farms were milking 50 or fewer sheep while others were milking 300+ sheep, and each farm had different levels of direct and indirect costs.

Since the Great Lakes Dairy Sheep Symposium is focused on sheep dairying, this presentation is focused on developing a standardized system for recordkeeping and determining the direct cost of milk production. The approach we have taken is to segregate the various direct costs in a typical sheep dairy operation into ‘standardized’ categories, and then to address each of the categories related to the direct cost of milk production. Clearly, if a farm is being paid \$0.55/lb of milk, but is spending \$0.60/lb to produce the milk, the farm will not be viable over the long term.

We wish to clearly state at the outset that we fully realize that by focusing only on the direct cost of milk production, a farm will not be able to predict success or failure. We also realize that each farm may allocate direct and indirect costs differently across multiple farm enterprises for tax and overall farm budgeting purposes. The goal of establishing a standardized method for calculating the cost of milk production, in isolation from the rest of the farm operation, is to

allow a variety of farms with different situations to gauge their direct cost of production against other farms to determine if their cost of production is higher or lower than other farms.

By benchmarking the average and range of costs in each of these categories, farmers will be able to determine how they compare to others in the industry. If, by using the standardized calculation, a farm determines that their cost of production is significantly higher than other farms, that farm will be able to compare their costs across the different categories with other farms to determine in which category(ies) their costs are out of line. By being able to identify problem areas, the farm can concentrate on different ways to bring these costs down. Conversely, if a farm finds that their overall cost of production is at the lower end of the scale, they can help to establish 'best practices' in the sheep dairy industry that other sheep dairy farms can follow to be more successful. Today's presentation will follow the format outlined below.

We will start with an overview of farm accounting in order to establish the framework in which the standardized direct cost of milk production model is built. This will be followed by a discussion of the definitions for the various terms and categories used in our model. These definitions are essential in order to establish a 'common language' between sheep dairy farmers that can be used in future discussions. A good example of where the lack of having a common language is seen on a recurring basis in the sheep business is when farms discuss their lambing percentage. Some farms calculate the number of lambs born per number of pregnant ewes, others calculate the number of lambs born per number of ewes exposed, others count the number of lambs weaned per number of ewes exposed, still others count ... the variations are too numerous to describe. We will then discuss the types of records needed to calculate your direct cost of production and provide some tools that will make the record keeping process from becoming too cumbersome. Throughout these discussions, we will solicit feedback and comments from the audience. Clearly, the only way this project can be successful is if the majority of farms understand and agree with the approach. Following our presentation, we will make modifications to the proposed standardized approach based on the audience feedback. The finalized standardized approach, and supporting tools, will then be available by the end of December 2006 for anyone to download from the WSDC website (Sheepmilk.biz) so you can start using the tools in 2007. Prior to next year's symposium, we will solicit the results from participating farms for a presentation to the general membership. We will establish a process for you to anonymously provide this information so that your identity will be protected.

## **Outline of Approach**

- 1) Present the bigger picture of farm accounting
  - a) Farm Enterprises
  - b) Direct, Fixed and Overhead costs
  - c) Complexities of accurate accounting
  - d) Today's session goal as a subset of the big picture
  
- 2) Define basic parameters
  - a) Terms and definitions
  - b) Standardized set of cost/expense categories
  - c) Determination of direct vs. fixed cost

- 3) Recordkeeping
  - a) Degrees of detail and appropriate methods
  - b) Example forms and procedures
  
- 4) Calculations
  - a) Direct cost of milk production
  - b) Break even analysis
  - c) Considerations and limitations for decision making
  - d) How to evaluate your results
  - e) Available tools for cost of milk production

## **Conclusion**

In the fields of agricultural economics, accounting, and statistics, many models and methods for farm budgeting, recordkeeping and analysis have been developed and are used regularly in the cow dairy, beef, crop farming, and other segments. The tools used vary in scope and complexity from a single enterprise of one farm business to state and national analysis of whole farm operations. We have studied a variety of resources, models and methods, and have met with several professionals in these fields to gain an understanding of current practices. We have attempted to draw upon this work to develop some relatively simple, farmer friendly tools that can be used in our situation.

For those of you who have been to a number of these symposia in the past, look around and take note of the number of ‘new faces’. Five years ago, the estimated number of sheep dairy farms in North America was about 100. Today, the estimated number of sheep dairy farms in North America is still about 100. Of the 100 farms milking sheep 5 years ago, only about 30% are still milking. Based on these numbers, the phenomena of high turnover in the sheep dairy industry is not unique to the WSDC. It is now clear that the farmers currently milking sheep as well as those contemplating entering sheep dairying must ask both, “How much will I be paid for my milk”, as well as, “How much will it cost me to produce a pound of milk?”

The long-term viability of the sheep dairy industry in North America requires the long term success of its dairy farms. In order for the sheep dairy industry to flourish and grow, we need to identify the critical issues around sustainability and to establish best practices that can benefit individuals and the entire industry. We hope that today’s discussion will be a first step in making this happen.

**THE DAIRY BUSINESS INNOVATION CENTER:  
A CATALYST FOR INNOVATION**

**Kate Arding and Norman E. Monsen  
Dairy Business Innovation Center, Wisconsin Department of Agriculture Trade and  
Consumer Protection  
Madison, Wisconsin, USA**

**Introduction and Overview of the Dairy Business Innovation Center and the Wisconsin Value Added Dairy Initiative Program**

The Wisconsin Value Added Dairy Initiative Program traces its origin to the mid and late 1990's. This period was the culmination of a 15 to 20 year down cycle in the state dairy economy. During these years the number of active dairy farms in Wisconsin decreased by 15,000+ families along with a corresponding decrease in dairy manufacturing plants. Many factors can be listed as causes including; depressed milk prices, high interest rates, over expansion due to easy credit and government programs, and declining market share for cheese and other dairy products. Shortly after this period, Wisconsin lost its place as the nation's dairy leader.

During this time frame many Wisconsin dairy farmers approached the Wisconsin Department of Agriculture, Trade, and Consumer Protection to request assistance with looking at options so that they might continue to farm. Many of these farmers recognized that the milk they were producing was unique and that there should be potential to capture higher profits.

To respond to the requests for assistance, a number of agencies organized a value added dairy conference for late 1999. Two motives for the conference were identified: 1) to provide a means to distribute information, and 2) to measure interest. Conference organizers anticipated that approximately 40 to 50 would attend. All involved were shocked when registration totaled over 270.

As a result, state agencies began to assist Wisconsin farmers with activities that might help them with their efforts to capture more value/profits for their milk. Agency efforts were limited as staff and budget time hadn't been allocated. Included in activities/projects were field days, regulatory review and advocacy, grass root marketing efforts, and the development of a network of partners and resources.

In 2001/2002, the Federal Government began to recognize the strength of the artisan/specialty dairy movement in Wisconsin. Limited funding was allocated to Wisconsin projects as the USDA recognized that this area of work offered the potential of developing ways that farmers might stay on their farms as well as strengthening rural communities.

In late 2002, the Wisconsin congressional staff to Washington became aware of the grass roots artisan dairy movement. After review of current projects and evaluation of potential benefits, Congress allocated 2 million dollars to help the Wisconsin dairy industry build milk supply, develop new markets and products, and to improve efficiencies in the value chain.

Out of this allocation, the Dairy Business Innovation Center (DBIC) was created. The DBIC, as a non-profit organization, attempts to help the industry develop new markets, new products, and new processes. Clients range from small farmstead producers through some of Wisconsin's largest cooperative and private dairy manufacturers. The DBIC, a virtual center without buildings or office space, contracts with state and national dairy consultants and partners to bring expertise to approved clients. Among the DBIC partners are the Wisconsin Milk Marketing Board (WMMB), the Wisconsin Cheese Makers Association, the UW-System, Wisconsin state agencies (DATCP, Commerce, Tourism, etc) and the Center for Dairy Research. Further information on the DBIC can be found at [www.dbicusa.org](http://www.dbicusa.org).

## **An Overview of Challenges and Solutions Facing the Small-Scale Cheese Maker**

Within the last sixty years, the cheese industry has witnessed enormous changes and challenges both in Europe and the United States, and none has been more adversely affected than the small-scale cheese producer.

When it comes to cheese, the U.S. has traditionally looked to Europe for inspiration. However, the European cheese industry has faced tremendous challenges and changes over the last sixty years and as a result, the U.S. can learn from European mistakes and successes. Whilst Europe – and in particular the U.K. and France – have been primarily concerned with preserving the traditions of farmhouse cheese production, the U.S. is trying to establish those traditions.

In the U.K., many factors contributed to the decline of the traditional farmhouse cheese: the consequences of two world wars, subsequent changes in agricultural policy, the industrialization of agriculture, and the disappearance of the specialty retailer and cheese store led to near obliteration of small-scale cheese production. Equally worrying, was the parallel decline of the specialty knowledge needed to produce and sell such cheeses.

By the mid-1980's, the farmhouse cheese industry in the U.K. was in crisis. Traditional British cheeses had all but disappeared and had been replaced by factory-produced versions, carrying the same name but bearing no resemblance to the original thing. Unlike France or Italy, the UK has no AOC/DOP system designed to protect the names or recipes of specialist cheeses. For example in 1939, there were 405 on-farm producers of Cheshire. By 1986, there was one producer - the Appleby family - remaining.

However, despite this bleak picture, there was hope. It came in the form of a small group of people, spearheaded by Randolph Hodgson at Neals Yard Dairy, who were determined to prevent these producers from becoming extinct. In the early days, the key to success lay in establishing a knowledgeable retail and wholesale outlet that could handle and sell farmhouse cheese. The crucial part lay in establishing a close working relationship between store and producer, providing them with feedback, paying them a fair price (and on time) and selling their cheeses to the end consumer in the condition that the producer would wish it to be sold. The net result of all this was that the producer was left to do the thing that they do best – make cheese. The other crucial role of these stores was to provide an educational platform for the public and to

re-awaken people to the fact that these cheeses simply taste better than their factory produced counterparts.

As the farmhouse cheese industry began to regain some momentum, this same group of people also began to try and influence some of the legislative issues surrounding farmhouse cheese production. This is a slow and torturous process. However, it is essential for these producers to be able to continue in the face of the industrialization of the majority of our food sources.

By the mid 1990's, the industry was looking very different from one decade earlier. New cheese makers and cheeses were emerging, largely inspired by the revitalization of the traditional farmhouse cheese producers and the fact that a viable market was being established. New specialty cheese stores and wholesalers began to spring up, thus educating the public and generating demand for quality cheese on a wider basis.

So how does the DBIC fit into all of this? Well, essentially they are striving to achieve the same goals as those mentioned above. Not only is the DBIC bringing together dairy farmers and cheese producers with legislators and industry experts, and thus creating a viable future. They are also ensuring the longevity of this trend by providing an educational platform amongst the public and those interested in entering the industry.

It is a system that works. Proof of that lies in the U.K. model and the fact that there are now 280 small-scale cheese producers in the U.K. as opposed to approximately 33 in 1984. The same trend is happening in the U.S. and is exemplified by the increasing number of members of the American Cheese Society.

Two examples of the positive changes that are taking place in Wisconsin are at Uplands Cheese and Hidden Springs Farm. Uplands Cheese is a cow milk dairy and cheese production facility based near Dodgeville and Hidden Springs is a sheep milk dairy near Westby.

### **Uplands Farm, Dodgeville, Wisconsin**

Uplands Cheese is owned by two couples. Mike and Carol Gingrich and Dan and Jeanne Patenaude.

The business comprises a 300-acre farm and working dairy that was purchased in 1994. Up until 2004/5, cheese making took place at another cheese plant, using milk from the Uplands herd.

Mike and Carol Gingrich have lived on a small farm in Wisconsin since 1974. Dan also grew up on a small neighboring farm and, when he met the Gingriches, he owned and milked 30 cows.

The pattern of dairy farming in Wisconsin is such that, traditionally, there have always been a large number of small-scale farms. Typically, each farm would have between 15 and 30 cows.



The original plan for Uplands was to sell milk year-round. However, when Mike tasted the spring milk, he thought it was exceptional. Therefore, rather than ship it off to the co-operative, he began to look around for a specialty item that would reflect the quality of the milk. He considered many different products, including ice cream and yogurt, but kept returning to cheese.

Since Uplands is much smaller than other cheese making dairies in the state and therefore is unable to compete based on volume, Mike realized that in order to be successful they needed to produce an extremely high quality and unique cheese

Realizing that one of Uplands main assets is its high quality pasture, Mike began to focus on some European cheeses that are dependent on quality pasture in order to produce uniquely excellent milk. Excellent milk leads to excellent cheese. Another common denominator is the fact that the best pasture is a highly seasonal affair. Thus, the best cheeses are not only reliant on excellent pasture, but are only made at certain times of year – usually in the spring and summer. Armed with this information, Mike decided to experiment making cheese to a Beaufort recipe. Beaufort is well known both for its dependence on good pasture and its seasonality.

Mike took the Cheese Makers Short Course at the University of Wisconsin-Madison (UW-Madison) then followed through with a 12-month apprenticeship at a local cheese making facility. In order to produce cheese for sale in Wisconsin, it is a legal requirement to hold a cheese maker's license.

He then approached the UW-Madison to ask for their assistance in developing and adapting the Beaufort recipe.

The scientists at the Wisconsin Center for Dairy Research took up the challenge to help Mike develop his cheese. Working together, they developed the recipe, the original *B. linens* culture, procedure and methods. In the summer of 1999 at the Center's test facility, they produced eight different versions of four wheels with a view to taste-testing. The cheese that was chosen as best became the prototype for future production.

Production of Pleasant Ridge Reserve began in earnest in June 2000. Rather than build a facility, Mike approached one of the local cheese making facilities and set up a rental agreement to make his cheese there three times a week during the spring and summer months. However, since October 2005, cheese production has taken place in a purpose-built facility located at Uplands Farm. Maturation of the cheeses also takes place on site.

Uplands produces one type of cheese and markets directly to customers across the country. In addition, they use two distributors, but prefer to have control as to the final destination of their cheese. They have found farmer's markets to be unsuccessful since they only have one product to offer and the price point is high.

## **Pasture**

One of the deciding factors for the purchase of the farm, was that the buildings were centrally located. The advantage of this for a dairy farm is that the cows can move directly from the

pasture to the milking barn without having to traverse any roads, creeks or lakes. Thus the property is continuous pasture and the goal is to graze one cow per acre.

Since acquiring the farm in 1994, Dan has been actively working to improve the pasture. Frost broadcast seeding has played a major part in introducing clovers as well as orchard grass, both of which grow very well.

The farm has just transitioned to become organic. Therefore, it is a goal to increase the nitrogen levels through the introduction of legumes as opposed to the more conventional method of spreading liquid nitrogen fertilizer. In addition, a more thorough form of manure management is being introduced.

## **Cows**

The original herd of 130 Holsteins was acquired in 1994. Dan then added 30 cows from his own farm, some of which were crossbreds. Since then, Uplands have continued to crossbreed. Currently, the herd consists of Holsteins crossed with one of the following breeds: Normandie, Tarantaise, Abondance, New Zealand Jersey, New Zealand Friesian, Brown Swiss, Ayrshire or Jersey.

The main desirable traits that Dan is striving for in the breeding program are longevity of lactation and a good position of the udders. Additionally, they are looking more carefully at casein amounts in the milk since this has a very direct affect on cheese production.

Dan likes a Holstein/Jersey mix because he feels that the breed is docile and hearty. The Normandie crosses proved temperamental as did the Ayrshire who tended to be aggressive and difficult to milk. The Brown Swiss turned out to be large animals and not very agile.

All the cows are serviced via AI. Due to the importance of seasonality at Uplands, it is crucial to streamline most of the cows and for them to become impregnated in one AI cycle. Ideally, 150 cows would calf in April, then be milked for 200 days before drying them off together. Despite this, Mike also adopts a balanced approach. In the event that there is a good cow who for some reason has failed to become pregnant from the first service, they will keep her for a year and try again. If the second attempt fails, then she will be sold.

In 2003, Uplands hired a new AI technician from the local area who has helped change their system. This specialist looks at any problems they are encountering such as reproductive infections, cysts, etc. and checks every cow at 20 days into milking. If there is a problem, that cow is kept under surveillance until the problem is understood, solved, and kept under control. In 2003, the conception rate was 57%.

Cows are dried up in January. In mid-November the ground freezes and therefore the cows are fed on hay, silage and supplements. By May they are once again on a 100% pasture fed diet.

## **Cheese**

As previously mentioned, Pleasant Ridge Reserve is a firm, raw milk cheese in the style of Beaufort. Development of the cheese took two years, but largely due to the work and help from the Center for Dairy Research, there was no wastage during this time.

Traditional Beaufort is made in very large wheels weighing between 70-100 lbs. and measuring 3 ft. in diameter. For practical purposes, Mike chose to use traditional Gouda molds and adapted the recipe to accommodate the difference in maturation.

Their first year, 2000, saw the production of 600 wheels. At this stage, they had little idea as to how the marketing and sales of their cheese would evolve. However, also in 2000, Uplands received a hugely deserved but completely unexpected boost. They won Best in Show at the American Cheese Society competition.

## **Maturing rooms**

There are three aging rooms, side by side, each of which is 27' x 18' with a 10' ceiling. Refrigeration is provided by cold water pipes that run directly around the walls inside the room. These also negate the necessity for a fan which has a severe drying effect on cheeses with a *B. linens* culture.

The walls are 5" thick and made of styrofoam, covered by thin white plastic sheeting (RFP or 'glass board') that are easy to clean. Floors are sloped towards the door for drainage. For reasons of hygiene, there are no direct drains in the aging rooms.

The total capacity of the three maturing rooms is 7000 wheels.

Cheeses are aged for a minimum of four months, however most wheels are aged for longer which necessitates more space being available. Mike has been experimenting with some 2- and 3-year old wheels although somewhere between 4 and 11 months is optimum.

## **Hidden Springs Farm, Westby, Wisconsin**

Hidden Springs Farm, owned by Brenda and Dean Jensen, is a sustainable sheep dairy located in the Coulee Region amongst the beautiful rolling hills of southwestern Wisconsin.

Brenda and Dean started their dairy with just 50 sheep. Today they milk 116 Lacaune and East Friesian dairy sheep and have 110 lambs. They are constantly striving to improve the genetics of the herd. Friesians are known for being excellent producers and for having a calm temperament. Lacaune are renowned for producing milk with higher fat and protein than many other breeds.

Brenda grew up on a small farm and had a career as a corporate manufacturing manager. In June 2006, having gained her cheese maker's license, she left corporate America in order to pursue the sheep creamery and cheese making.

Dean is a mental health therapist with his own practice. He predominantly works with the Amish communities that surround the Jensen's farm, and both Dean and Brenda have a deep appreciation of Amish values and work practices. They employ Amish friends and neighbors for milking and construction. The fields at Hidden Springs are plowed by Percheron draft horses. Donkeys deter coyotes and other predators from bothering the sheep and lambs, and all the sheep graze seasonally on the Jensens' 30 acres of fenced pasture.

Brenda has only recently begun to make cheese. The cheese that she is currently producing is called Driftless and is named for the region in which Hidden Springs is located. The cheese is a soft fresh sheep's milk cheese, and it is already becoming popular amongst specialist retail stores and high-end restaurants in Wisconsin.

Brenda also travels to two farmer's markets each week to sell her cheese.

## ORGANIC SHEEP DAIRY: MARKETS AND PRODUCTION

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### The Organic Market

The International and U.S. organic markets are growing quickly, and have been for the past 15 years. Statistics show that the U.S. organic dairy market has been growing at a rate of over 25% for several years.<sup>1</sup> The Organic Trade Association ([www.ota.com](http://www.ota.com)) states that 66% of U.S. consumers report that they use organic products at least occasionally. A 2002 literature review from Canada states that “The intention to buy more organic food ranges from 16% in the U.S. to 53% in India; worldwide it is approximately 30%.”<sup>2</sup> Thousands of new consumers are buying organic products each week, as education about “the organic difference” and why one may choose organic products reaches a broader consumer base.

The availability of organic products has also expanded, even reaching into main-stream companies such as General Mills foods, Hunts and Heins, Dean Foods and recently Kemps Dairy products. These ultra-large companies would not be joining the organic market if they didn't consider the market demand to be strong and growing.

Buyers of specialty cheeses are also supportive of organic products. A 2000-2001 northern California study of specialty cheese consumers found that buying organic is very important to 21.2%, important to 51.5%, makes no difference to only 15.2% and is not important to only 12.1%<sup>3</sup>

In an article titled “Emerging Top Food Trends in the U.S. and Abroad”, the Institute of Food Technologists name “inherently healthy, fancy and farm-friendly” among their top five qualities that consumers will be seeking in the near future.<sup>4</sup> What a perfect description of organically produced sheep dairy products!

### Who Buys Organic?

An assessment of the organic market in *The Gourmet Retailer* notes that the organic consumer is not that different than the non-organic consumer. “Contrary to conventional wisdom, organic consumers are not significantly more affluent than the U.S. public as a whole, but instead have an average or slightly above-average income vs. that of all U.S. consumers. Neither are organic consumers a fringe or an “alternative” group culturally; they are basically

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<sup>1</sup> “Recent Growth Patterns in the U.S. Organic Foods Market” USDA-Economic Research Service, Agricultural Information Bulletin Number 777, September 2002.

<sup>2</sup> **A Profile of the Organic Industry and Its Issues**, Rosalie Cunningham and Betty Vladicka, Government of Alberta, Canada, 2002.

<sup>3</sup> **Test Marketing Pasture-produced Artisan Cheeses**. Tim Pedrozo, Pedrozo Dairy and Cheese Company. SARE funded grant research. 2002.

<sup>4</sup> **Emerging Top Food Trends in the U.S. and Abroad**, Institute of Food Technologists, April 2005

mainstream citizens who are similar to most U.S. consumers in the majority of their attitudes, beliefs, behaviors, and purchase patterns. The ethnicities of organic consumers are also similar to the overall U.S. population's ethnic makeup.”<sup>5</sup>

The article goes on to note, however, that organic consumers are a special group in one important way. Their education level is considerably higher than that of most Americans. The percentage of college and post-college graduates among organic consumers is nearly fifty percent higher than that of the U.S. population. The article concludes “this leads to the fact that they read and understand labels. Organic consumers possess knowledge about ingredients, both the good stuff and the bad stuff, far deeper than most U.S. consumers.”

### **Why Buy Organic?**

The Canadian review again states that “Roughly two-thirds of the population in most countries believe that organic food is safer and healthier and about the same proportion are willing to pay a ten percent premium for it. Consumer perception is that organic production practices address many of their health and safety concerns.”<sup>6</sup>

According to a national consumer opinion poll conducted by Roper Public Affairs, seven in ten Americans express some concerns about the health risks of pesticides, hormones, antibiotics and other chemicals used in food production. The survey found consumers felt smaller scale family farms were more likely to care about food safety than large-scale industrial farms, and that it was important to know whether food is grown or produced locally or regionally.

An article published in *The Gourmet Retailer* summarizes the motivations of the typical organic consumer:

“Following are four basic reasons in order of importance why consumers buy organic foods:

- *Taste*. Organic foods are chosen because they have strong positive taste associations. Consumers associate the taste of organic with simple, understandable benefits, such as freshness, purity, wholesomeness, less processed, etc. Organic food is seen as "the way nature intended," or "the way it should be," along with the belief that nature intended food to be delicious, as well as nutritious.
- *Health*. Organic consumers seek to have better personal health over a longer period.
- *Safety*. As a pathway to health, organic consumers think about food safety as it relates to purity. They are concerned about their food containing pesticides, hormones, antibiotics, and other chemicals. They seek foods they perceive to be more "pure" and less "tainted." Such concern is heightened for parents and other primary purchasers buying food for their families.
- *Environment*. Organic consumers are generally concerned about the environment. They also have an "action orientation," a belief that food dollars can be directed to enact positive change.”<sup>7</sup>

Studying the qualities listed above, it is clear that the average organic consumer would be a perfect candidate to choose an organic sheep milk product. Sheep milk produces excellent tasting

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<sup>5</sup> **Merchandising Organic Products**, By Clark F. Driftmier, *The Gourmet Retailer*, May 2001

<sup>6</sup> **A Profile of the Organic Industry and Its Issues**, Rosalie Cunningham and Betty Vladicka, Government of Alberta, Canada, 2002.

<sup>7</sup> **Merchandising Organic Products**, By Clark F. Driftmier, *The Gourmet Retailer*, May 2001

products that, especially combined with the benefits of a grass-based product, have strong health qualities. Organic sheep milk products are pure, generally with no pesticide residues and without antibiotic residues. Recently a sheep dairy producer reminded me that sheep are known as “The Golden Hoofed Animal,” due to their ability to increase pasture fertility and their gentle impact on the landscape.

### **What About the Price?**

Organic cow dairy producers receive a price premium for their raw products. They have avoided the path of typical commodity price competition and low price pressures by controlling supply and working together to support price to marketers and distributors. Farmer alliances, such as the Northeast Organic Dairy Producers Association (NODPA) and its sister here in the Midwest, MODPA, have been important in assuring fair prices to organic dairy producers. With organic cow dairy demand currently outstripping supply, pay price to farmers is the highest it has ever been, with some pay prices double conventional milk prices.

Organic prices to the consumer have been 10 to 50% higher than that for similar non-organic products. With the entrance of large retailers such as WalMart into the organic equation, this trend may be changing. In industries such as sheep dairy, where the producers can control supply to processors, a premium for organic products could likely be maintained.

An Ohio study done of upscale natural foods customers in 2004 reported “Loyal organic consumers may not be highly sensitive to organic food prices.” And “Consumers would be willing to pay the largest price premium for products made with 100% organic ingredients.” (Labels as “100% Organic” vs “made with organic ingredients.”) Other qualities consumers were willing to pay a premium for, at a lesser rate than for organic, were “pesticide free,” “locally grown,” and “non-GMO.”<sup>8</sup>

Although sheep dairy products tend to be in high priced categories, it is likely that the average organic consumer will be willing to pay a moderate premium for an organic product. Although organic sheep dairy products are currently rare in the U.S., they are available in Europe and do demand moderate price premiums there.

### **Cost of Production**

Data analyzing the cost of organic dairy production has just recently begun to be collected. Tom Kriegl, from the University of Wisconsin-Madison, Center for Dairy Profitability, is currently collecting data from organic cow dairies in Wisconsin, the Northeast U.S. and Quebec for an ongoing study on organic dairy profitability. Preliminary studies show that organic dairies in the Midwest are profitable, and have lower costs for purchased feed, veterinary and medicine, depreciation of purchased livestock, chemicals and non-dependant labor. However, the organic farms studied have higher costs for: repairs, fuel, supplies, marketing, seeds, fertilizer and lime. Dairy herds in the Northeast have much higher purchased feed costs, and so profitability there for organic systems may be lower unless the price premium is higher. Many cow dairies report

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<sup>8</sup> **A consumer Survey of Specialty Food Shoppers: Understanding of the National Organic Program and Willingness to Pay.** Neal H. Hooker, Marvin T. Batte and Jeremy Beaverson, Ohio State University, May 2004.

that lowered animal stress in their organic systems results in longer milking tenures for their cows, with many organic dairies getting strong production from 10 and even 15 year old cows. This reduces replacement costs and helps raise profitability.

Studies have not been done to compare costs of a U.S. organic sheep dairy operation with a non-organic system. However, based on what is beginning to be understood about organic cow dairies, and the differences in production systems between cows and sheep, it is not unreasonable to assume that organic sheep milk production will not increase costs of production significantly.

## **Marketing the Organic Difference**

*The Gourmet Retailer* highlights how to appeal to the organic consumer: “The stories behind the food products must be told accurately to preserve authenticity. If the food truly is what is described, then organic consumers will embrace the products and over time, become more emotionally involved. However, organic consumers are likely to uncover any miscommunication, inaccuracy, or false description, thereby leading them to permanently reject the products. In certain cases, not only will organic consumers reject the product, but some of the more activist ones will use e-mail, chat rooms, and the like to expose and communicate what they perceive to be false presentations of the products' identities to friends or even the media.

Organic consumers will be fascinated by information about the place of origin, the farmers, the farm, the region and its special qualities, the methods of growing and harvesting, the care taken of the land, and the way that the food fits within the region's culture. If presented in a compelling way, organic consumers will hungrily absorb every word about the food -- they may even plan a visit to the farm itself.

The food and its "story" are also important to organic consumers. They genuinely care about food, its origins, its history, and who produced it. Organic consumers are also more likely to be "foodies" and are willing to pay more for good food -- up to double in certain cases -- and they have fewer price barriers where food quality and taste are concerned.”<sup>9</sup>

Organic sheep dairy producers would have a great story to tell, with lively sheep on green pastures and a quality product with complex flavors. Consumers would respond well to a well-told organic sheep dairy story.

## **Organic Market Conclusions**

Looking at what the average organic consumer wants, and is willing to pay for, it is logical that the organic market is ready to support organic sheep dairy products. High quality, good tasting, nutrient-rich, chemical-free, pasture-based, family-farmed are all qualities the rising number of organic consumers are looking for and willing to support. They will even pay a higher price to be assured that they are supporting these qualities. The sheep dairy industry is well poised to enter the organic market with quality specialty products.

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<sup>9</sup> **Merchandising Organic Products**, By Clark F. Driftmier, *The Gourmet Retailer*, May 2001



## Organic Milk Production Requirements

Most sheep dairying is a relatively low-input farming system. Especially grass-based systems will have relatively few major changes to convert their herds to organic production. However, a few of those changes represent significant alterations in management perspective. The major challenges in organic sheep milk production may be access to pasture, feeding lambs, parasite control and production or purchase of organic feed.

Because organic production systems are limited in their use of non-natural inputs, the focus of the farm activity must be on *preventative* management - creating environments where problems are least likely to happen. This concept relates to feed and pasture production as well as animal health and management. The basis of any successful organic system, animal or crop, is through effective soil management. This involves supporting diverse soil biology, balancing minerals and improving soil organic matter. With a focus on improving soil, feed quality will improve and ultimately, animal health will become optimized, reducing the need for health interventions. Many farmers who have transitioned to organic animal management systems are amazed by the long-term improvements in animal health, reduction in veterinarian visits and improved longevity of their herds or flocks. Animal health relies on building the animals' immune system so that a natural reaction can fight off the common hazards and infections. An animal with a compromised or weak immune system will fall prey to things a robust animal will fight off. Stress is a significant catalyst to injury or illness, and all management practices should be planned to reduce flock and individual animal stress. Breeding and selection for disease and parasite resistance is a valuable tool in organic systems.

The basics of an organic dairy system:

1. Organic management for one year before the sale of organic milk. This involves feeding 100% certified organic feed (including pasture) or feed in its third year of transition from your own farm.
2. Only organic grains and forage. No GMO feed.
3. Animals must have access to pasture, representing a significant percent of feed intake as seasonally appropriate. Pasture must be certified organic (3 years of only approved practices).
4. The entire flock must be transitioned at one time, animals may not be taken in and out of organic production.
5. No non-approved practices for health care. Vaccines are allowed, antibiotics are not allowed\*, chemical wormers only in emergencies, no routine use. Herbal health products, homeopathic remedies, etc. allowed as long as they do not include non-approved materials, such as fillers or flowing agents. (see resources) (\*antibiotics must be used if they are seen as the only way to save an animal's life. If antibiotics are used, however, the animal must be taken out of organic production or sold, and will only produce non-organic milk after this time.)
6. Natural parasite control, involving proper pasture management and animal rotation and allowed herbal or mineral formulations. For more information see "Internal Parasites and Ruminants: Organic Answers."  
<http://www.mosesorganic.org/broadcaster/13.6intparisites.htm>

7. White salt and minerals are allowed, as long as they do not include non-allowed flowing agents or fillers. (Mineral oil is NOT allowed for internal consumption, yellow prussiate of soda, a common flowing agent, is not allowed).
8. Tail docking and de-horning are allowed.
9. Rams do not need to be managed organically, except during the time they are pastured with ewes.
10. Housing should be well-planned with appropriate air circulation.
11. There is no specification as to the timing of removing lambs from mothers. However, any milk replacer must be produced from only dairy products that are from non-rBGH cows. As of fall 2006, there is no allowed milk replacer available. In lieu of milk replacer, organic whole milk must be fed (may be cow, sheep, goat).
12. Pure iodine teat dip is allowed, but some dips are restricted.
13. Milk house cleanup is basically the same as for non-organic systems, as long as procedures are installed to ensure pure wash water is the last product used before organic milk contacts a surface.
14. Pest control in barns and milk houses is regulated.
15. Treated wood is not allowed for new construction where there is animal contact. Some certifiers do allow painted treated wood, check before you use it. Any treated wood in production systems before organic certification may be grandfathered in. Alternatives include plastic, cedar, black locust, metal, fiberglass, etc.
16. Comprehensive farm records must be maintained, including individual animal health, pasture management, and crop production etc. All animals must be somehow identified. Sample record keeping systems are available.

#### To sell organic meat (Lamb)

1. To produce an organic lamb for meat, the mother must be treated organically (feed, pasture, health, etc) for the last third of gestation (150 days / 3 = 50 days).
2. Mothers may not be taken in and out of organic production.
3. Lambs must be managed organically.
4. Any animal not born of an organically managed mother may never be sold as organic meat.

### **Organic Farm Certification**

In the United States, organic production is, since Oct 2002, regulated by the USDA. There is a 46-page law that describes what is allowed and not allowed in organic production. Canada is in the process of defining their own national organic law. To sell organic products in the U.S., you must abide by the regulations outlined by the USDA.

Any farm with gross sales of organic product over \$5,000 per year must be certified by a third-party organization in order to market organic products. You must also be certified to sell any ingredient that will be turned into an organic product (such as raw milk made into organic cheese.)

To become certified, you must first find an organic certification agency. These agencies have been accredited by the USDA. A list of certification agents that operate around the U.S. may be found at the National Organic Program website at <http://www.ams.usda.gov/nop/>.

The certification agency will send you an application packet; there generally is a fee for this packet, commonly \$50. It is recommended that you request this packet at least six months before you are ready to sell organic product. This will be months into your transition practices (the number of months will depend on the complexity of your farm operation, 36 months for crop land or pasture, 12 months for animals). You will want to educate yourself about the complexities of what is allowed and not allowed in organic production. To help with this, see the Resources at the end of this paper. There are lists of products that are allowed and not allowed in the NOP Rule and on the website of the Organic Materials Review Institute ([www.omri.org](http://www.omri.org)).

The application packet will contain a copy of the National Organic Rule (also available at [www.ams.usda.gov/nop](http://www.ams.usda.gov/nop)) and other useful resources. You will be asked to fill out a comprehensive farm plan, which outlines your farm practices. This includes describing flock health practices, environmental management practices, weed and pest control strategies, manure management practices, etc. and will require that you draw a map of your farm.

Once you have completed the application, you return it to the certification agency. They will let you know if they have any questions. If not, they will forward the application to a farm inspector, who will call you to set up an inspection appointment. When the inspector comes, they will go over your application, your farm records, tour your farm and look at your animals. The inspector will complete a report, and turn it into the certification agency with any supporting documentation. The certification agency will make a determination as to if you are abiding by the NOP and qualify for organic certification. They will issue you a certificate if you qualify, and then you can sell organic product. Each product you wish to sell (i.e. milk, lambs, corn) must be listed on the application and the certificate. Certification generally costs between \$350 and \$550 annually, depending on how many products you are certifying and how much organic product you sell.

For more information on organic certification, including how to certify organic crops, see the MOSES Fact Sheets at (<http://www.mosesorganic.org/factsheets/intro.htm>).

## **Organic Cheese Production**

To produce organic cheese, the certified organic milk must be transported in clean equipment to a facility that has been certified to process organic products. It is not especially difficult for a cheese or yogurt plant to become certified, even if they also produce non-organic products. Generally organic products are produced the first run of the day/week so they are produced in a clean system. Segregation must occur at all stages to isolate organic milk and products from non-organic. There are a few specific practices and products that organic cheese makers must comply with:

- Certified organic milk must be used. Any additions, such as powdered milk, cream or other kinds of milk must be certified organic to produce a 100% organic product. If other ingredients are not organic, the product can only be labeled as “made with organic

ingredients.” For guidelines on this distinction and labeling requirements, see the NOP Rule.

- Any other agricultural ingredients, such as flavorings (i.e. dill, basil, etc.) must be certified organic, if commercially available.
- Any non-agricultural ingredients, such as salt, or calcium chloride, unless they are on the non-allowed list of the NOP, are allowed as long as they do not have prohibited additives such as flowing agents.
- Cultures and coagulants must be non-GMO. This will be a big issue, as although non-GMO are available, the GMO products are most commonly used. The cheesemaker must source non-GMO products and closely record their use and storage to prove no contamination has occurred.
- Most sanitary practices are the same as for non-organic, but all surfaces touched by organic raw or finished products must be well flushed by water after any cleaning or sanitizing products have been used. Either testing must be done or protocols developed to prove that the surface residue only contains pure water.
- Any pest control must be mechanical within areas where organic raw or processed product is. If non-approved pest control methods are used (ie spraying cracks) a withdrawal period is mandated. Chemical fogging to prevent bacterial contamination is not allowed.

## **Conclusion**

Organic production will not be for everyone. Organic cow dairy producers have said that organic production requires more overall management of the farm system. But they also say that organic production is “less stressful and more fun.” Organic success is frequently based on the development of custom solutions for each unique situation. Animal health tends to improve under organic management, as concentration on immune system function develops stronger animals. Breeding selection and culling are important tools; over time a flock with specialized traits to thrive within a given organic farm system can be developed. Organic systems are kind on the environment and when well managed, build soil and preserve resources.

Consumers continue to show growing support for organic products. They identify organic with health, good taste and quality. They are loyal consumers, willing to pay for the qualities organic products encompass. Combined with family-farmed, pasture-raised or local, as many organic sheep products are, organic is a strong sales incentive. Organic sheep dairy products make sense and would offer a quality product to a willing audience.

## **Resources:**

**Midwest Organic and Sustainable Education Service**, MOSES . PO Box 339, Spring Valley, WI 54767. [www.mosesorganic.org](http://www.mosesorganic.org), 715-772-3153. Fact sheets, Guidebook to Organic Certification, Largest Organic Conference in the U.S., annually in Feb. in WI. Organic Broadcaster Newspaper, Upper Midwest Organic Resource Directory.

**ATTRA**- the National Sustainable Agriculture Information Service. [www.attra.org](http://www.attra.org), PO Box 3657 Fayetteville, AR 72702. 800-346-9140. Online and published resources on organic and sustainable production.

**USDA National Organic Program (NOP)** 1400 Independence Ave SW, room 4008 South, Washington, D.C., 20250. 202-720-3252. [www.ams.usda.gov/nop](http://www.ams.usda.gov/nop) The full listing of the National Organic Rule, plus comments and any updates.

**NewFarm**- [www.newfarm.org](http://www.newfarm.org) Website with resources, articles, stories, price lists for organic farmers.

**OMRI- Organic Materials Review Institute**- PO Box 11558, Eugene, OR. 541-343-7600. [www.omri.org](http://www.omri.org). Lists of approved products for organic production.

# DAIRY SHEEP PRODUCTION AND CHEESE MAKING IN THE FRENCH PYRENEES

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Dairy sheep have been traditionally farmed in three mountainous areas in southern France. With 10 million liters, Corsica represents about 5 % of the French production. With 177 million liters (71 %), Roquefort area is the biggest and the most famous. The dairy sheep production in French western Pyrenees (Béarn and Basque countries) represents 53 million liters, 21 % of production. At the beginning of the 1970s, the production in the Pyrenees was about 10 millions liters and reached 16 million liters in 1980. During the last 25 years, the production was increased regularly by about 1 to 1.5 % per year, with an acceleration in the five past years to 2.5 % per year.

All the milk produced in the Pyrenees is processed into cheese: a typical Pyrenean sheep milk cheese produced under “official sign of quality” like Protected Designation of Origin (PDO) is Ossau-Iraty.

The context of production is characterised by three local breeds, Basco-Bearnaise, Manech Red Face, and Manech Black Face and a traditional management system based on pasture and use of collective mountains. The climate, with mild winters (in the valley) and wet summers, allows the sheep grazing all through the year. The hilly relief limits the area of arable fields.

The objective of this paper is to present an overview of the dairy sheep production and cheese making in western Pyrenees.

## 1 – Breeds, Breeders and Milk Production

### 1.1. Recent evolution

During the last twenty years, the number of dairy farms in the Pyrenees has decreased from 3,300 to 2,220 (- 30 %). In the same time, the number of dairy ewes increased from 380,000 in 1985 to 481,000 in 2005 (+ 25 %). By itself, the evolution of the number of ewes can not explain the increase of milk production in the Pyrenees : + 40 % between 1985 to 2005 (Table 1). Both the improvement of the management systems and, above all, the efficiency of the genetic program have contributed to this evolution.

Table 1. Recent evolution of dairy sheep production in the western Pyrenees (Pâtre 2006)

	1985	1995	2005
Number of dairy sheep	380,000	463,300	481,400
Number of breeders	3,300	2,648	2,223
Total milk production (million liters)	21.8	37.5	54.0

## 1.2. The average western Pyrenees dairy sheep farm

A small area with a large part of pasture:

- total farmland: 24.4 ha (60.3 acres)
- principal forage area: 23.1 ha (57.1 acres). 67 % with permanent grassland.
- For 74 % of the farms, the principal forage area is supplemented by 12 ha (29.7 acres) of “ drift pasture ”.
- 80 % of the flocks are located in mountainous or hilly areas and 74 % use “collective mountain pastures”.

A flock with local dairy sheep breed:

- size of the flock: 260 dairy ewes (Manech Black Face, Manech Red Face, or Basco-Béarnaise)
- annual milk production: 27,000 liters
- milk production per ewe (all ewes present in the flock): 100 liters
- milk composition: fat content 71.7 g/l, protein content 53.5 g/l
- milk quality: SCC 858,000 cells/ml, bacterial count 82,900 germs/ml
- number of sold lambs: 195
- culling rate: about 20 %

A herd of 15 beef cows in association with the dairy sheep flock:

- In 90 % of the farms, the dairy sheep flock is in association with another production:
- beef production: 75 % (with an average 15 cows of the breed “Blonde d’Aquitaine”)
  - dairy cow production: 11 % (with an average 17 dairy cows)
  - horses: 24 %

A very busy family farm:

The farm is a “family unit” with in average 1.8 “man-work-year” and the average age of the producer is 43 years old.

Nowadays, 40 % of the flocks are still hand-milked. When machine milking, the milking parlour is a pit with 24 places and 12 milking units

20 % of the farmers make cheese on their farm.

## 1.3. The diversity of the systems

Beyond this average description, the systems are diverse. Four types of systems of production are summarized in the Table 2.

The four systems mainly differ in the local breeds used, the size of the farm and the percentage of farmstead cheese makers.

Table 2. Description of the dairy sheep Pyrenees systems of production : results of the 800 flocks of the extension program in 2003 (E. Morin and al. 2006)

	Non-transhumance system	Intermediate transhumance system	Traditional transhumance system	System of Bearn area
Percentage of the farms	33 %	30 %	20 %	10 %
Total farm land	32 ha (79 acres)	28 ha (69 acres)	18 ha (44 acres)	27 ha (67 acres)
Size of the flock*	291	221	244	240
Dairy sheep breed	Manech Red Face	Manech Red Face	Manceh Black Face	Basco-Bearnaise
Size of the beef cattle herd	16	17	12	18
Farm dairy milk production (l)	36,200	20,500	21,500	21,100
Percentage of farmstead cheese makers	4 %	8 %	14 %	60 %

\* On average, the flocks involved in the extension program are larger.

#### 1.4. The breeds

Nowadays, the local breeds represent 96 % of the dairy sheep in French Pyrenees. The proportion of the different breeds are :

- Manech Red Face (MRF) 56 %
- Manech Black Face (MBF) 23 %
- Basco-Bearnaise (BB) 17 %
- Lacaune 4 %

Until now, several reasons have limited the development of the Lacaune breed :

- local Pyreneans breeds are well adapted to their production systems with pasture and transhumance,
- in accordance with the PDO “Ossau Iraty cheese”, only local breeds are allowed,
- the Manech and Basco-Bearnaise breeding schemes are fully efficient.

#### 1.5. Breeding program

The Manech and Basco-Bearnaise breeding program became fully efficient at the end of the 1980s. The program is based on a pyramidal scheme. The breeding tools are mainly used within the nucleus (flocks in official milk recording), firstly to create genetic gain, and secondly to organize its diffusion by AI or natural mating towards the base population (Barillet, 1997). The rams to be progeny tested were born from assortative matings between elite rams and ewes of the nucleus, and were chosen from 320 rams entering the breeding centers at 1 month of age. The best 210 entered the AI center of CDEO to be progeny tested in the nucleus. The rate of AI in the nucleus ranged from 40 to 50 %.

In 2005, 361 flocks (107,000 ewes) in official milk recording were in the nucleus flocks : 220 MRF flocks (70,000 ewes), 66 MBF flocks (18,000 ewes) and 75 BB flocks (19,000 ewes).



During the last 15 years, the average milk yield (in the milking-only period) increased from 64 liters (61 %) for the MRF, 37 litres for the MBF (42 %) and 45 liters for the BB (44 %). In 2005, the milk production recorded in the nucleus was :

- Manech Red Face : 168 liters in 150 days milking only period
- Manech Black Face : 126 liters in 134 days milking only period
- Basco-Bearnaise : 147 liters in 142 days milking only period

Due to the pyramidal organization of the genetic program, the level of production in the nucleus flocks, submitted to an official milk recording (in average, 158 liters in 146 days) is higher than in the rest of the population. The difference represents about 15 years of selection. The annual genetic gain for milk yield explained a large part of these evolutions.

According to the cheese maker demand, the dairy selection objective was revised at the beginning of the 2000s in order to take into account milk composition (fat and protein contents). The new goal is to improve the cheese quantity, both by improving the quantity of milk yield and stabilizing the milk composition. In 2002, the selection for scrapie resistance was implemented.

## **2. The Management System**

### **2.1. Breeding system**

Like other Mediterranean dairy sheep livestock, the Pyrenees breeding system is based on out-of-season lambing, from October to January for adult ewes. The ewes are milked after a suckling period of about one month and dried off in July or August, when dairy factories stop or reduce their activities. During summer, traditional mountain cheese making goes on, particularly in Béarn. The lambs are slaughtered at weaning (1 month old) for Christmas (traditional period of consumption of this type of lamb, particularly in Spain). The young ewes lambed in February/March, and the lambs are slaughtered during Easter period. After the suckling period, the ewes are milked twice a day. The cooled milk is collected every day, or more often every 2 days, from November to August.

### **2.2. Feeding**

Sheep graze all through the year, but during winter, pasture represents only about 25 % of the ration. Other forage is given in the barn. For a daily production of 1.75 liters (early lactation), example rations are:

Ex1: 1.4 kg dry matter hay + 0.55 kg corn (grain) + pasture

Ex2: 0.35 kg hay + 0.30 kg corn silage + 0.25 alfalfa hay (lucerne)

+ 0.3 corn (grain) + pasture

The amount of stored feed for one ewe for the year is 210 kg of forage and 80 kg of concentrate (yc concentrate for the young female). We can estimate that pasture represents about 50 % of the feeding resources. Sheep graze separately from the cattle. In general, the best forage of the farm is given in priority to the sheep. In May or June, sheep and cattle go to collective pasture (sometimes located in high mountains). The ewes are milked by hand and the milk is

processed into cheese in mountain huts. Nowadays, the transhumance concerns about 70 to 75 % of the ewes.

### **2.3. Economic point of view**

In 2004, the average milk price was about 0.94 €/l (1.19 \$/l). The price depends on the milk quality :

- hygienic factors : bacterial count, coliform count, butyric count, presence of antibiotic
- milk composition : fat and protein contents
- PDO rules of production

The price of the home cheese, directly sold by the producer ranges from 14 €/kg (17.75 \$/kg) to 15 €/kg (19.01 \$/kg).

On average in 2004, for the farmer's that sell milk to a processor, the total income was about 131 € (166 \$)/ewe: the portion from milk was 73 % (96 € / 122 \$) and the portion from lamb was 22 % (29 € / 37 \$).

### **3. Cheese Production**

All the dairy sheep milk produced in the French Pyrenees is processed into cheese. In 2004, 8 dairy factories processed 51 millions liters into 11,000 tons of cheese : 91 % pure ewe milk cheese and 9 % mixed cattle x ewe milk cheese.

The size of the milk factories varies from 0.7 millions liters (28 producers) to 16.6 millions liters (700 producers). In addition to the two international firms of Lactalis and Bongrain, we can find local cooperatives and private processors. In 2006, there were 1,765 producers that sold milk.

About 400 farmers make cheese on their farm. The estimation of the farmstead production is 1,600 tons of cheese (8 million liters of milk).

The cheese belongs to the family of the unpasteurized pressed semi-hard cheeses. Full-cream milk is used. After resetting, the curd is separated, stirred and scalded in a vat at between 36 and 44 °C. The curd is moulded and pressed before being salted. The cheese is ripened for at least 90 days. This time allows producers to sell cheese all through the year even though the production of milk stops from August to November.

PDO Ossau-Iraty cheese represents a third of the production. The name of the cheese came from two areas of the western Pyrenees: one located in Béarn (valley of Ossau) and the other in the Basque region (forest of Iraty). While a large part of the cheese made in the Pyrenees is not Ossau-Iraty cheese, 80 % of the milk is produced under the PDO rules whose the main are :

- milk must come from the PDO area (the western Pyrenees, south of the river "Gave de Pau")
- the dairy ewe must be a local breed : Manech Black, Red Face, or Basco-Béarnaise
- the feed must come from the PDO area.

The growth of the market of Pyrenees cheese explains the evolution of dairy sheep production. From 1992 to 2004, the cheese production more than doubled (5,000 tons to 11,000 tons).

In conclusion, dairy sheep production and cheese making is an important activity for the western French Pyrenees. Despite their moderate size, a large majority of farms remain viable and the sector is dynamic.

#### **4. Some Addresses**

##### **Interprofession Lait de Brebis des Pyrénées Atlantiques**

124 boulevard Tourasse – 64 000 Pau - France

Association in charge of the management of the relationship between the milk producers and the dairy factories

##### **Syndicat de Défense du fromage d’AOC Ossau-Iraty**

Baratchartenea Bourg, 64120 Ostabat Asme - France

Association in charge of the PDO Ossau-Iraty cheese : definition of the PDO rules, technical support of the farm house producers...

##### **Centre Départemental de l’Elevage Ovin (CDEO)**

Quartier Ahetzia – 64 130 Ordiarp – France

Cooperative in charge of the breeding program of the Pyrenean local breeds Manech and Basco-Bearnaise : milk recording, artificial insemination, extension services...

##### **GIS ID64**

Quartier Ahetzia – 64 130 Ordiarp – France

The objective of the GIS ID64 is to carry out research and development programs focused on dairy sheep production and cheese making in the western Pyrenees.

The research or the extension programs are conducted with the support of the national institute of research like **INRA** (national agronomical research institute - <http://www.inra.fr>) and **Institut de l’Elevage** (national livestock institute - <http://www.inst-elevage.asso.fr>). The **CNBL** (national dairy sheep committee – CNBL – Campus INRA de Toulouse – SAGA – BP52627 – 31 326 Castanet-Tolosan Cedex - France) ensures the links with the national programs and the other areas of production like Roquefort or Corsica.

#### **References**

Revue Pâtre n°536. 2006. Numéro Spécial lait de brebis. 126p.

Morin E., Oçafrain M., Millet F., Barrère C., Arranz JM., 2006. La filière ovin Lait des Pyrénées-Atlantiques. Document de travail

Barillet F., 1997. Genetics of milk production. In: Pipper, I., Ruvinsky, A. (Eds), The Genetics of Sheep. CAB International, pp 539-564, Chapter 20.

Astruc JM. 2006. Bilan du contrôle laitier ovin en France. Campagne 2005. Compte rendu n°010678015. Institut de l'Elevage collection résultats.

## **OVINE PROGRESSIVE PNEUMONIA AND CASEOUS LYMPHADENITIS – YOU CAN RAISE SHEEP WITHOUT THEM**

**Holly Neaton, DVM  
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### **Ovine Progressive Pneumonia – OPP – Maedi Visna Virus**

“We bought our 50 Texel Sheep at a livestock auction in 2001. When we got them home, we noticed some of them coughing, but being ignorant about sheep thought they just had a cold or were bothered by the dust. The veterinarian said the older ones were probably getting pneumonia so we gave them all LA200 and it did NOTHING! Then we started to notice that some of the younger ewes in the prime of their lives would get this cough, start to lose weight and then die about a year later. That’s when we started to get serious about this cough! So I started searching on the internet and ran across OPP. The listed symptoms explained other things we noticed about these sheep. Like the hard udders (we called them tennis ball udders) because they would just get a lump but it wasn’t mastitis. Or the way some of them would start to go around in circles or come up limping until they lose weight. But the main symptoms are heavy breathing.”-----  
quote from a producer in the western United States.

Ovine Progressive Pneumonia (OPP or Maedi-Visna) is a wasting disease caused by a slow growing lentivirus that lives in the white blood cells of sheep. It was recognized in 1915 in the United States and has been a brewing problem in the sheep industry since. It has only been truly recognized as a threat to sheep production in the last 10-20 years. OPP is known as Maedi-Visna (maedi = difficult breathing, visna = wasting) in other countries of the world. There are several countries that claim to be MV free – Iceland, Australia, New Zealand and Finland.

You may be familiar with similar lentivirus caused diseases in other species:

- CAE in goats (caprine arthritis and encephalitis virus)
- EIA in horses (equine infectious anemia or swamp fever)
- Fe LV in cats (feline leukemia virus)
- BIV in cows (bovine immunodeficiency – like virus)
- HIV in humans (human immunodeficiency virus)

OPP has caused much controversy among sheep producers and health professionals over the years. This virus has become more accepted as a major deterrent to sheep producers who work hard to raise sheep that will live up to their genetic potential. It is possible to eradicate this virus from a flock – those that have done so will testify to the fact that it is economically justified. And it makes it much more fun to raise sheep.

### **USDA’s NAHMS (National Animal Health Monitoring System) 2001 Sheep Study\***

Data on sheep health and management practices were collected from 682 flocks in 22 states (US). These producers agreed to have blood drawn from up to 40 ewes from each flock and have

them tested for OPP using the cElisa test method. 21,369 samples were tested. The results are eye-opening:

- 36.4% of the 682 flocks had at least one positive
- 24.2% of the sheep tested were positive
- Open range flocks had highest incidence: 80.7% of flocks, 45.1% of sheep
- 36% of farm flocks were positive with 17.1% of sheep positive
- Central region revealed 46.6% flocks positive, 24.4% of sheep
- 31.3% of operations had never heard of OPP and 92.4% had never tested for the disease

\* USDA-APHIS Safeguarding American Agriculture; Veterinary Services, Center for Epidemiology and Animal Health: Ovine Progressive Pneumonia: Awareness, Management, and Seroprevalence Info Sheet December 2003

### **Signs of Infection**

- Signs are rarely seen before 2 years of age
- Chronic, unresponsive pneumonia – labored breathing, lagging behind the flock, coughing, nasal discharge, fever that may be due to secondary bacterial infection
- Weight loss despite normal appetite
- Hard udder: udder is symmetrically enlarged, meaty and doesn't collapse when dry. Little or no milk produced and therefore hungry or starving lambs. This progresses with each lactation.
- Arthritis: swollen hock and knee joints
- Unsteady gait, twitching, stumbling, paralysis due to central nervous system involvement

### **Other Diseases to Rule Out**

- Scrapie
- Paratuberculosis (Johne's disease)
- Caseous lymphadenitis
- Parasitism
- Dental disease
- Mastitis
- Nutritional deficiency

### **Transmission and Occurrence**

- The virus lives in the lymphocytes. The infected cells replace healthy lung, mammary, joint, CNS tissue causing an almost scar tissue like mass.
- The virus cannot live outside of the sheep's body for more than a few minutes – an important fact to remember during eradication
- The virus infects other sheep in 2 ways – through colostrum and milk to lambs and through respiratory secretions and nasal discharge to everyone else
- Shared taggers, needles, tattooing equipment may possibly cause transmission
- Semen and intra-uterine transmission is doubtful

- In my personal experience, I have never diagnosed a Suffolk or Hampshire sheep with OPP though I have had testimony from producers that have purchased positively infected black-faced rams.
- Certain breeds seem to have a higher rate of infection. Note the breed alliance list at the end of this paper.

## Diagnosis of OPP

Diagnosis of this disease is best provided through finding antibodies in the blood (serology). Because the virus is slow growing and hides in the cells, the sheep will be slow to make antibodies to it. The tests available are not perfect but, if used properly, will help in eradication. Diagnosis with a positive serological test in a clinically affected sheep is only a start. Testing to determine who may be infected and spreading the virus is the tricky part.

There are two commonly used serological tests available.

- AGID (agar gel immunodiffusion)
  - Very specific and rare to get false positives.
  - Only about 75% sensitive. The sheep has been infected a while before seroconverting.
  - May give false negatives early in infection – or suspects.
  - Difficult test to read so the lab technician reading it is very important.
  - Use a lab that runs them regularly and has a record of accuracy.
- cELISA (competitive enzyme-linked immunoabsorbent assay)
  - More sensitive test therefore can detect antibodies earlier in infection (2 weeks?)
  - Less specific due to sensitivity. Other factors can trigger false positives.
  - Laboratory differences confuse results.
- Other tests available
  - PCR (polymerase chain reaction) reads DNA
  - Postmortem ID of virus

## Control of OPP

If you decide to embark on an eradication program for your flock, testing every sheep over 6 months of age will tell you what your incidence is. With this information, you can make decisions whether to cull and retest over a series of 6 month intervals or keep separate flocks and orphan raise your replacements. Don't forget the rams.

There are many factors that need to be considered in these decisions – do you have genetics that you want to save, do you have time to orphan lambs, facilities to keep positive and negative flocks separate?

- > 50% positive, probably orphan the females, maybe some ram lambs for breeding. Need to catch the wet lambs prior to nursing, preferably before they hit the ground. Leave the wether lambs and feeder ewe lambs on the positive dams. The lambs need to be raised in

separate facilities and tested at 4 months (?) and before lambing as yearlings to verify negative status.

- < 50% positive, consider culling and retesting every 6 months. Three 100% negative tests are comforting. Testing a percentage of older ewes annually can be validating.

The choice to eradicate this virus will also:

- Give you the chance to choose other diseases to eradicate – Johne's and caseous lymphadenitis for example.
- Breeding stock will have more value (remember scrapie and the genotyping requests?).
- Save feed costs.
- Allow your flock to perform to its full potential – you can truly evaluate your genetics.

### **What Have We Learned About OPP?**

- This is a very prevalent virus that is silently passed from sheep to sheep within a flock and between flocks through purchases of both ewes and rams.
- Through the NAHMS study, we see that the incidence of OPP estimated 20 years ago was correct.
- Flock owners (and veterinarians) all over the United States are ignorant about this virus
- Many shepherds accept the signs of the disease as normal – would they be amazed at how productive their flocks would be without the virus?
- It is possible and economically prudent to eradicate this virus from a flock – especially a sheep dairy flock.
- CAE virus in goats is not known (?) to infect sheep but could confuse testing results in an eradication program if goat colostrum/milk is used from CAE positive goats.
- Possible to pass the virus from infected sheep in fair and show environments.

### **Breed Association Alliances**

- American Border Leicester Association
- Finnsheep Breeders Association, Inc
- Icelandic Sheep Breeders of North America
- Jacob Sheep Conservancy
- North American Clun Forest Association
- Texel Sheep Breeders Society

### **Ovine Progressive Pneumonia Concerned Sheep Breeder's Society (OPPCSBS)**

- Started in 1990 when a group of frustrated shepherds wanted more information and understanding of this disease they were trying to eradicate from their flocks.
- Over 100 members from 27 states, 3 provinces. Flocks range from 10 to >1000 sheep.
- Newsletter and website ([www.oppociety.org](http://www.oppociety.org)) includes general information and guidelines for OPP testing, a membership directory and a Veterinary referral list.
- Videos describing blood collection techniques and handling
- Educational materials available for distribution at events

- Good source for purchasing replacement sheep as many producer members are interested in overall health of their flocks.
- Started a pilot program with the USDA in Minnesota in 2006 to evaluate an OPP eradication program for flocks also enrolled in the Voluntary Scrapie Control Program.

### **Testimonials from Producers**

- ◆ 195 ewes (Ile de France, Hamp, Rambouillet cross) “We used testing and culling to rid the flock of OPP. The flock tested 100% neg in 12/02 and 4/03. Will continue to test every other year and all new sheep that enter. We are very glad that we are OPP negative. Lambing is now a total joy!”
- ◆ 70 crossbred ewes – “life without OPP is good!”
- ◆ 750 crossbred ewes – “used whole flock testing and culling to achieve 100% negative status. Have seen an all around improvement in flock health.”

### **Caseous Lymphadenitis – CL – Abscesses - Boils**

CL is a very common, highly contagious disease seen in sheep and goats caused by the bacteria *Actinomyces (corynebacterium) pseudotuberculosis*.

#### **Basic Understanding of the Disease**

- The animal’s body reacts to this bacteria by building thick walls around the infection – abscesses that are usually filled with very thick, white-greenish non-odorous pus.
- Abscesses can be located anywhere in the body but most likely in internal or external lymph nodes around head and chest area.
  - parotid lymph nodes under ears
  - submandibular lymph nodes in throatlatch
  - mediastinal lymph nodes in chest between lungs
  - prescapular and prefemoral lymph nodes in front of front and rear legs
- The ruptured abscess will shed millions of bacteria into the environment
- The bacteria is quite stable and will live in organic material for weeks to months.
- Very easy to culture.
- Rare to find abscesses in animals under 6 months of age
- This disease is brought on to a farm through purchased infected animals, shows, or shearing equipment
- Goats and sheep most likely infected. Rare cases of human infection reported.

#### **Differential Diagnoses**

- Other *Actinomyces* species – be sure to have abscesses cultured before you panic. Sheep and cows are good at making abscesses to wall off foreign bodies and organisms.
- OPP, Scrapie and Johne’s disease – internal CL abscesses can cause weight loss, coughing, and rarely CNS signs.



- Neoplastic tumors

## Treatment

- Cull, cull, cull or at least isolate before abscesses rupture
- When isolated, have DVM lance abscesses (or teach you how to do it properly). Wear gloves and burn abscess pus and material. Flush with dilute iodine or chlorhexadine. Keep isolated until totally healed. Disinfect pen and equipment with bleach when done. Sheep are still considered contagious as they may have abscesses internally that are spread through coughing, etc.

## Diagnosis

- Culture – take swab from outer edges of abscess. Quite easy to isolate in lab.
- Necropsy – take advantage of the death of older ewes. Especially thin ones that die from unknown causes. For a reasonable fee, they can be checked for mineral levels in liver and kidneys, chronic diseases and parasite loads.
- Serology – can be used as a tool for eradication programs or pre-purchase screens. The serum is tested for the sheep's response to toxins that are released by the bacteria. The results give a range of results depending on whether the sheep is actively abscessing, has been exposed but not abscessed, or has never been exposed. This test needs interpretation and knowledge of the flock history.
  - California Animal Health and Food Safety Lab  
West Health Sciences Drive  
University of CA Davis 95616 530-752-7577

## Control and Eradication

- Cull, Cull Cull!
- Vaccinate
  - Colorado Serum's Casebac and Caseous DT work well in eradication schemes. Vaccinate lambs at weaning (6-8 weeks) with a booster 2-4 weeks later. Repeat vaccination annually.
    - Do not use in pregnant ewes
    - Inject subcutaneously behind elbow - will leave permanent knots. Do not inject anywhere else - Leaves severe swellings.
    - Causes lethargy and lameness for 24-48 hours.
    - Suggest using at dry-off in ewes – helps to dry-off
  - Autogenous vaccines can be made using pure cultures of the abscess material from your own sheep. I have heard good reports from DVMs who have used Hygieia Biological Laboratories, California. 888-494-4342. Follow same schedule as Colorado Serum's vaccines. Cost is about \$1 per dose.

## Summary

- Be diligent about observing and culling before the abscesses rupture and contaminate environment.
- Remove wood objects that cause splinters, feed that has awns and stickers that can drag in bacteria.
- Be very careful when purchasing animals and don't use anyone else's show equipment.
- Provide your own shearing boards, insist that your shearer disinfects his equipment and stop to clean equipment if abscess is nicked or ruptured.

## References

- **Sheep and Goat Medicine, D.G. Pugh DVM, MS. W.B. Saunders Company.**
- **“Caseous Lymphadenitis (CLA, Boils, Abscesses) in Goats – with supplemental comments about Sheep”, John Glenn, DVM, PhD, Extension Veterinarian – UC Davis. January 21, 2003.**

# STRATEGIC CONTROL OF GASTRO-INTESTINAL PARASITES IN SHEEP

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## Gastro-Intestinal Parasitism in Sheep

Internal parasites often cause severe problems in sheep. If left untreated, sheep will suffer from levels of parasitism which not only interferes with efficient production but can also lead to death. Compared with cattle, clinical parasitic disease is a much greater problem with sheep although production losses are equally high in both species. From a production stand point, internal parasites, even in low numbers, cause considerable economic loss from reduced milk production, reduced breeding efficiency, reduced weight gains, reduced feed efficiency, reduced carcass quality, reduced hair or wool quality, and reduced immune status of the infected animals to fight off other disease conditions such as coccidiosis.

Sheep develop high levels of parasitic worm burdens and suffer from heavy parasitism for a number of reasons:

- First of all, sheep graze closer to the ground than cattle where parasitic larvae are often concentrated. Parasitic larvae hatch from eggs passed in the fecal material; these larvae undergo several molts until they reach an infective stage. This infective stage is mobile and moves with moisture trails onto nearby vegetation to be eaten by its intended host. Parasitic larvae can build up to very high numbers on summer pasture as the animals constantly re-infect themselves.
- Secondly, fecal material excreted by sheep is very concentrated and, therefore, worm egg counts in sheep are often very high. Fecal worm egg counts from sheep can be 5 to 10 times greater than normal counts found in cattle. A small amount of sheep feces can produce a high level of parasite contamination. Preventing worm egg shedding during the first part of the grazing season in sheep is critical to prevent environmental contamination later on.
- Thirdly, parasite control programs for sheep over the years have been more therapeutic, aimed at controlling high worm burdens after they have occurred rather than trying to prevent parasite contamination of the animal's environment. Treating sheep after heavy parasite loads are encountered has little impact on reducing future contamination. Furthermore, once high worm burdens are encountered, complete control is hard to achieve and, often, heavily infected sheep continue to shed worm eggs even after treatment. A commonly recommended practice over the years has been to deworm sheep every eight weeks while on pasture. The time it takes for adult worms to develop after the animals ingest infective larvae is approximately three weeks or less, depending upon the particular species of parasite ingested. The recommended practice of treating every eight

weeks has allowed sheep to be clean for three weeks, then wormy for five weeks, clean for three weeks, etc. For an efficient parasite control strategy to work in sheep, parasite challenge needs to be significantly reduced early in the grazing season; otherwise, high burdens will develop as the season progresses.

- Fourthly, parasite resistance to dewormers has been reported for over thirty years in sheep. The biggest problem is that resistance causes ineffective treatment and continued contamination of the animal's environment, often leading to severe parasite problems later in the year. Once parasite resistance occurs, multiple treatments are often needed just to keep the animals alive.

## **The Most Common Parasites of Sheep**

### **A. Stomach worms**

*Haemonchus* (the barber pole worm) is a blood-sucking parasite. This parasite is a very economically damaging parasite in sheep and is becoming one of the most important causes of death in these animals. Larval stages are found in the abomasal tissues and are extremely hard to kill (see section on the inhibition of *Haemonchus*). Eggs are easily identified in a fecal exam.

*Ostertagia* (brown stomach worm) and *Trichostrongylus* (bankrupt worm) can be important in sheep but mostly low infections are found with these parasites.

### **B. Intestinal nematode parasites**

*Cooperia* (coopers worm) disrupts digestive functions of the intestine. Not very prevalent in sheep.

*Nematodirus* (threadneck worm) is a very important parasite of sheep and most commonly is found in young animals but can be found in older animals and adult ewes. Larvae survive well in cold weather and can live for two years on pasture or in the environment of the animals. This parasite survives well off pasture and is considered an important "barnyard" infection. This parasite is a common cause of diarrhea and often times death in young animals. Because it is very pathogenic, older animals acquire a strong immunity against this parasite. The egg is very large and is easily identified in fecal exam.

*Trichuris* (whipworm) is another very important and damaging parasite in sheep, especially in young animals. This parasite is most commonly encountered under "barnyard" conditions in pens or on dirt lots. Often times symptoms are confused with coccidiosis because of the bloody diarrhea associated with this parasite. Several hundred worms can kill a young lamb. The egg is very characteristic and looks like a small football with polar caps on each end. The female worm is not prolific and eggs are often missed in the fecal exam unless carefully conducted.

*Bunostomum* (hookworm) and *Oesphagostomum* (nodular worm) is becoming more important in recent years because intestines are often condemned at slaughter if nodules caused by the nodular worms are found in large numbers. Parasites are most commonly found in ewes and older yearling animals.

### **C. Intestinal cestode parasites (tapeworms)**

**The tapeworm** (*Moniezia*) is very common in sheep. This parasite undergoes an intermediate stage when it develops in the soil or grain mite, which is then ingested by sheep to keep the infection going. The develop time to reach an adult after ingestion is reported to be from six to eight weeks. The adult tapeworm lives in the small intestine and can grow to be 1 inch wide and six feet long. They absorb nutrition through their cuticle. In high numbers tapeworms can block the intestine. Tapeworm eggs are distinct and easily picked up on a fecal exam.

### **D. Lungworms (*Dictyocaulus viviparous*)**

**Lungworms** are acquired almost exclusively through grazing. Lungworm larvae are not very mobile and, therefore, often require a heavy rain to move out away from the manure pat. Sheep on rotational and intensive grazing systems are often exposed to lungworms. Deer are thought to contribute to lungworm infections in sheep. The eggs are coughed up and hatches as it moves down the intestinal tract so lungworm is hard to diagnose through a general fecal exam but rather the fecal must be subjective to a separate test called a “baermann test” to find lungworm larvae. Post-mortem check for lungworms entails removing the lungs and trachea intact, filling with warm water with a garden hose and then pouring the contents on a flat surface to look for lungworms which are easily visible with the naked eye.

### **E. Trematodes parasites (liver flukes)**

*Fascioloides magna* (**deer fluke**) found in the Great Lakes region is relatively untreatable in sheep. Diagnosis can be done accurately only upon necropsy. Infections can be spread with deer with an intermediate snail host. Keeping animals away from wet areas and streams where deer congregate is currently the only method of control.

### **F. Protozoan parasites of sheep**

**Coccidia** are single celled protozoan parasites that all sheep are believed to be exposed to sometime in their life. Coccidia are very host specific such that coccidia of cattle, swine, dogs, and chickens won't infect sheep. The reverse is also true. Coccidia are ingested through fecal contaminated feedstuff. Wet muddy conditions usually increase infection levels. Sheep housed in dirt lots often become heavily infected with coccidia.

Sheep become infected when they ingest oocysts (egg like structure) containing sporozoites, which escape the oocysts and penetrate the intestinal wall. A disease condition called coccidiosis occurs when coccidia numbers become high and the immune system of the animals becomes low. Coccidiosis often occurs when an animal becomes stressed. Sheep shedding high number of oocysts indicate cell damage is ongoing. Coccidia oocysts can easily be found in a fecal exam.

## **The Inhibition of *Haemonchus* (Barber Pole Worm)**

Once high worm burdens occur in grazing sheep, (which usually occurs in mid-spring to late-spring under southern climatic conditions and in mid-summer to late-summer under northern climatic conditions), the physiology of the gastrointestinal tract changes. This change, especially the decreased in acid content of the abomasum (4<sup>th</sup> stomach) and an increase in the pH levels of the stomach, causes parasite development to slow down and larvae present in the gastrointestinal wall and gastric glands begin to inhibit or become arrested. These arrested larvae may stay in this state for six months or longer.

Once larvae become inhibited, they are very difficult to eliminate or remove by conventional deworming. Thousands of these larvae can become inhibited and require repeated dewormings just to keep the animals alive. It is often thought that some of the “parasite resistance” to drug treatment is noted incorrectly because many of the dewormers used for sheep have reduced efficacy against inhibited parasites but once the parasite matures, the parasite is easily removed by the dewormer. The best method of controlling these parasites is to prevent high levels of parasitism from building up on the pastures and in the animals themselves. Strategic deworming is designed to prevent parasite build-up on the pastures creating “parasite-safe grazing.”

### **Parasite Diagnosis**

Parasite diagnosis is best conducted using a fecal exam. Fecal exams simply float eggs out of the feces and can provide accurate information regarding the types of parasites present and the level of worm-egg shedding by a particular animal or, in the case of random sampling, by a particular group of animals. The fecal exam used needs to be sufficiently sensitive to detect low levels of egg shedding by *Nematodirus* or *Trichuris* (Whipworms) to be effective. High levels of *Haemonchus* eggs (> 300 eggs/sample) in a fecal exam indicated inhibited larvae may be a problem.

A second method for classifying animals for levels of *Haemonchus* is to test for anemia (a primary pathologic effect of *Haemonchus*) by observing the color of ocular mucus membranes and compare to a laminated card with illustrations of eyes from sheep with varying levels of anemia. This system is called the FAMACHA test but is only valuable once animals have become heavily infected and clinical levels of *Haemonchus* have occurred. Immediate treatment is usually required once mucus membranes become white (severe anemia is present).

### **Strategic Parasite Control Strategy**

Successful parasite control should include several key goals:

- 1). Ewes should be free of parasites at lambing time.
- 2). Sheep should be free of parasites during periods of low or reduced nutrition such as during the wintertime when infectivity is usually low or non-existent.
- 3). Prevent worm egg shedding on the pasture for the first three months of grazing. All animals should be parasite free at the time of turn-out.
- 4). All purchased animals or animals arriving from another operation should be thoroughly dewormed to insure parasite-free status.

## Strategic Timing of Treatment

**Phase I:** A late fall deworming (given after the first of November or after the first heavy frost) will reduce the chance of winter parasitism. Depending on location in the country, this treatment should also help ensure that the ewes are clean at the time of lambing. If it is determined that the ewe is not clean at lambing time, the ewe should be retreated just prior to lambing.

**Phase II:** The next phase of strategic deworming is to instigate a spring deworming schedule to eliminate worm egg shedding during the first three months of grazing. Since the life cycle of gastrointestinal parasites is 18-21 days from the time the animal ingests the infective larvae until an egg laying adult parasite is present in the animal, the treatment interval should be no more than 21-days. The treatment clock starts ticking as soon as grass growth begins in the spring. To make the program work, all animals need to be free of parasites at the beginning of the season. Depending upon location in the country, the animals treated in the fall or at lambing should still be parasite-free. If winter grazing takes place, the animals should be checked in the spring, if positive, all animals should be treated prior to the beginning of spring grazing.

**0-3-6-9 Spring Treatment Schedule:** Once grazing starts, all sheep grazing the same pasture should be dewormed every three weeks for a minimum of three times beginning three weeks after the start of spring grazing. If, for example, the animals are parasite-free when grazing starts around the middle of April, the first spring treatment would be given the first week of May, followed by a second deworming given the last week of May followed by a third treatment given the middle of June, leaving the animals free from shedding parasitic worm eggs until at least to the first of July.

Strategic deworming works because the parasitic larvae that survived the winter and are present on the pasture in early spring naturally die off if they're not eaten by the animals grazing the pasture during the first 90-days of grazing. If the animals grazing spring pastures can be prevented from shedding additional worm eggs and re-contaminating the pastures during this time (approximate three month period), parasite safe grazing can be maintained and parasite burden developing in the animals over the summer grazing season can be greatly reduced.

Strategic deworming is designed simply to time the treatments to kill the parasites after development in the animal has occurred but before the parasites have developed sufficiently to an adult stage and before they begin laying eggs, which would pass back on the pasture. The animals work like vacuum cleaners eating the parasitic larvae present on the herbage. The animals pick up larvae; the treatment kills these larvae before they develop into adults. This process is repeated three times thus allowing the pastures to naturally become "parasite-safe pastures. Over time with strategic deworming, pasture contamination can be significantly reduced.

## SOMATIC CELL COUNTS IN DAIRY SHEEP MILK

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Special attention is given to intramammary infections (IMI) of dairy sheep due to economic consequences (loss of milk production, price penalties for milk, costs of involuntary culling...), decreases of hygienic quality of milk (contaminants in milk as *S. aureus*, salmonella...) and legal control (as established for instance in Europe by EU directives defining the bacteriological quality of milk). In dairy sheep, IMI are characterised by a low percentage of clinical IMI, generally lower than 5 %, and a greater percentage of subclinical IMI in the range of 10 to 50 % or more. 80 % of the subclinical IMI are due to Coagulase Negative Staphylococci (CNS) which cannot be considered as minor pathogens in dairy sheep as it is the case in dairy cattle. Some of them cause a high increase of somatic cell counts (SCC) and there is accumulative evidence showing that IMI constitute the major cause of SCC. It is well established that SCC are the best indirect test of bacterial status of a gland. As a consequence, the control of udder health (in particular subclinical IMI) may focus on the control of SCC. But such plans of SCC control have to take into account specificities of dairy sheep production, as the size of the flocks, the milking routine and throughput, the costs of the analysis and the control measures... Recent advances make it possible to control the somatic cells of dairy sheep milk. However, knowledge for some critical points needs to be improved in order to make the plans more efficient and less expensive.

The aim of this article is to make a rapid review of the knowledge of somatic cells in dairy sheep milk. After some general background regarding the origin and the counting methods of somatic cells in sheep milk, we will focus on the consequences of high somatic cell counts on the cheese making properties and finally conclude with mammary gland disease control.

### 1 – Origin of Somatic Cells in the Milk

#### 1.1. Somatic cells composition for normal milk

For sheep as for the other dairy species, somatic cells are a natural component of the milk. Ewe's milk contains the same types of cells as cow's milk. For normal milk (from an udder without any intra mammary infection), the range of the percentage of the different types of somatic cells are the following (Bergonier *et al*, 2003) :

- epithelial cells, less than 5%,
- polymorphonuclear neutrophil leukocytes (PMNL), 10-35 %,
- macrophages, 45-85 %,
- lymphocytes, 10-17 %.



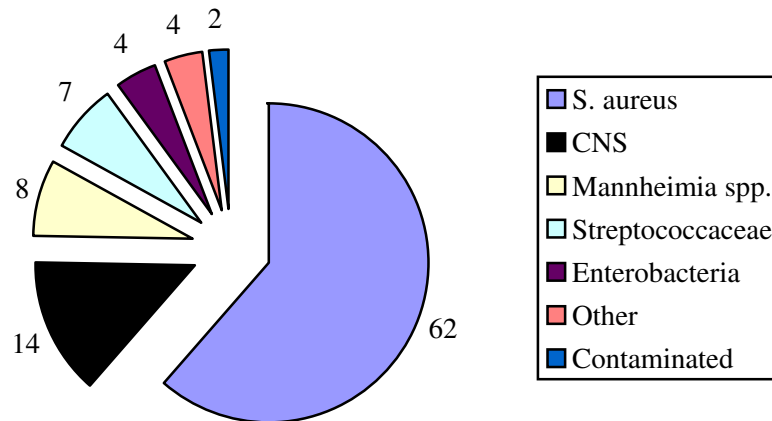
## 1.2. IMI is the main factor influencing SCC

The inflammation caused by an infection is responsible for the increase of SCC, particularly the PMNL cells. The increase of the SCC depends on several factors like the virulence of the pathogen, the host, *i.e.* the sheep...

### 1.2.1. Clinical IMI

In case of clinical IMI, SCC are in general very high, usually over several million cells/ml. But in this situation, SCC have no practical interest for the diagnosis since it can be based on a clinical examination of the gland or the milk. Due to the gravity of the IMI, the first objective would be the survival of the ewe. The prevalence of such clinical IMI is about 5%. *Staphylococcus aureus* is the major etiologic agent in more than 50 % of the samples in case of clinical IMI. In an epidemiological survey carried out in France on 302 clinical mastitis cases in 72 flocks, the prevalence of *Staphylococcus aureus* was 62 % (Fig. 1). On the other hand, with a prevalence in the range of 14 % in dairy sheep, Coagulase-negative *staphylococcus* species (CNS) cannot be considered as minor pathogens.

Figure 1. Aetiology of dairy sheep clinical IMI (Bergonier *et al.* 2006)



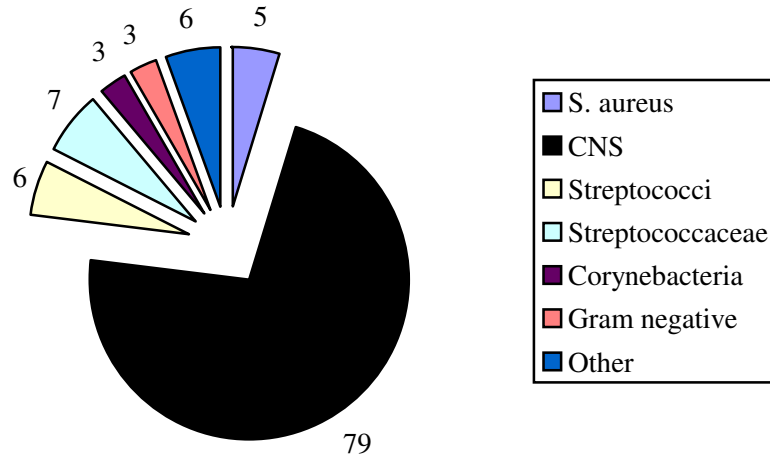
Taking into account these results (low % of clinical IMI + high prevalence of *S. aureus* + gravity of the infection + antibiotic treatment), the hygienic guidelines (in France) recommend isolation of the ewe, stop milking this ewe with the rest of the flock, and if possible, cull the animal.

In some rare cases, clinical IMI outbreaks are reported, and the prevalence may reach 50 % of the flock. These outbreaks are due to *S. aureus* (or other *S. uberis*, *agalactiae*, *suus*...) or to opportunistic pathogens such as *Aspergillus fumigatus* and *Pseudomonas aeruginosa*.

### 1.2.2. Subclinical IMI

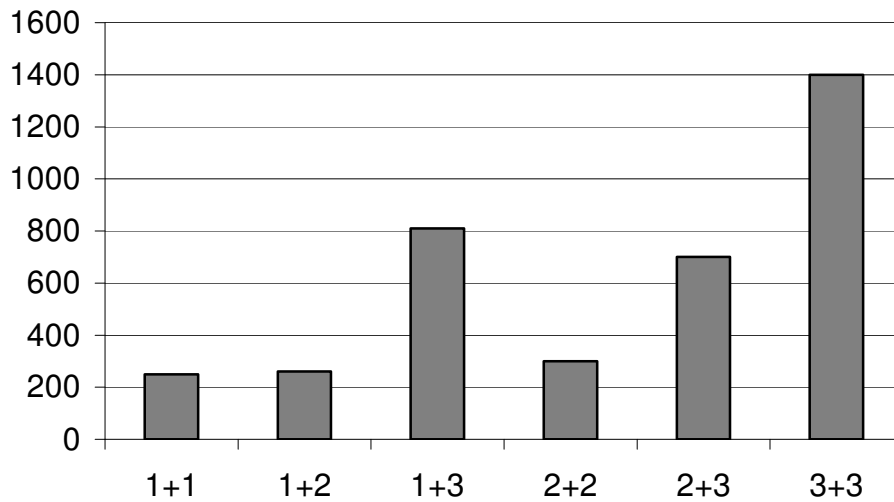
It is now well documented that CNS are the most prevalent agents responsible for subclinical IMI: 80 % of subclinical IMI in dairy sheep are due to CNS (Fig. 2).

Figure 2. Aetiology of dairy sheep subclinical IMI (Bergonier *et al.* 2003 and 2006)



The increase of SCC depends basically on the gravity of the inflammation / infection and its persistence. An illustration is shown on the Figure 3: for healthy ewes, the geometric mean of SCC during all the lactation is about 250,000 cells/ml, while it reaches 800,000 cells/ml for long-term infected sheep and is 1,400,000 cells/ml for both glands long-term infected sheep.

Figure 3. Annual geometric mean of SCC from 346 ewes according to the level of infection of the 2 glands: both glands healthy or briefly infected (1+1, 1+2, 2+2), one gland long-term infected (1+3, 2+3), long-term infected for both glands (3+3)



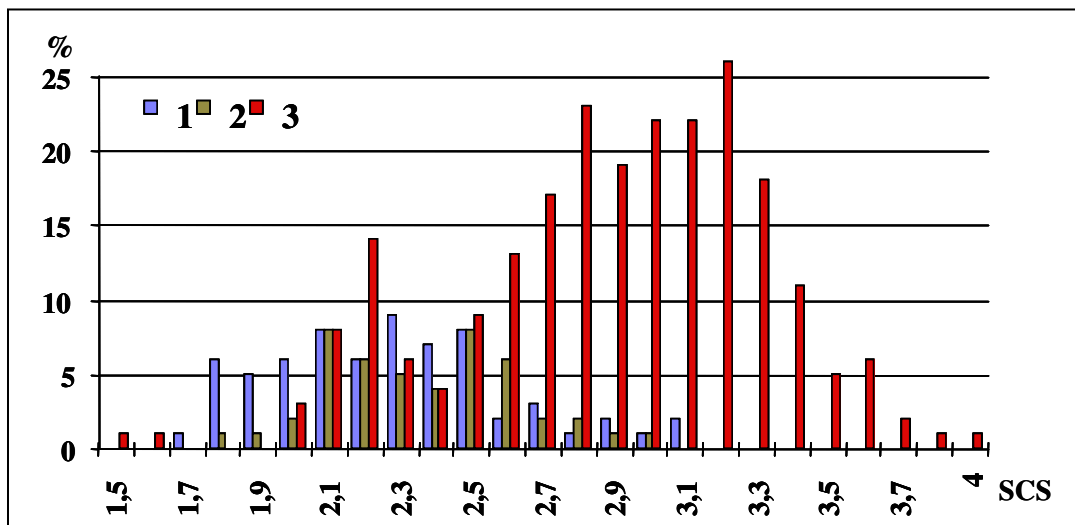
### 1.3. Use of SCC in order to detect subclinical IMI in sheep

Various thresholds of individual SCC have been proposed to determine the healthy or infected status of the udder, depending on the approach carried out.

#### 1.3.1. Punctual approach and single threshold

Some authors have proposed a punctual approach, thus a single threshold. The cut-off point is based on the punctual comparison of SCC of infected and uninfected udder halves. The choice may take into account the best compromise between sensitivity and specificity. As shown in Figure 4, the level of somatic cell score (SCS) of the three IMI statuses are partly overlapping. In the ewe, the most common level proposed is below or over 500,000 cells/ml (SCS =2.7 on the Figure 4) to distinguish between healthy and infected udders (Bergonier *et al.* 2003, Berthelot *et al.* 2006).

Figure 4. Distribution of the punctual SCS from 346 ewes according to the IMI status : 1 - healthy, 2 - briefly infected, 3 – long-term infected

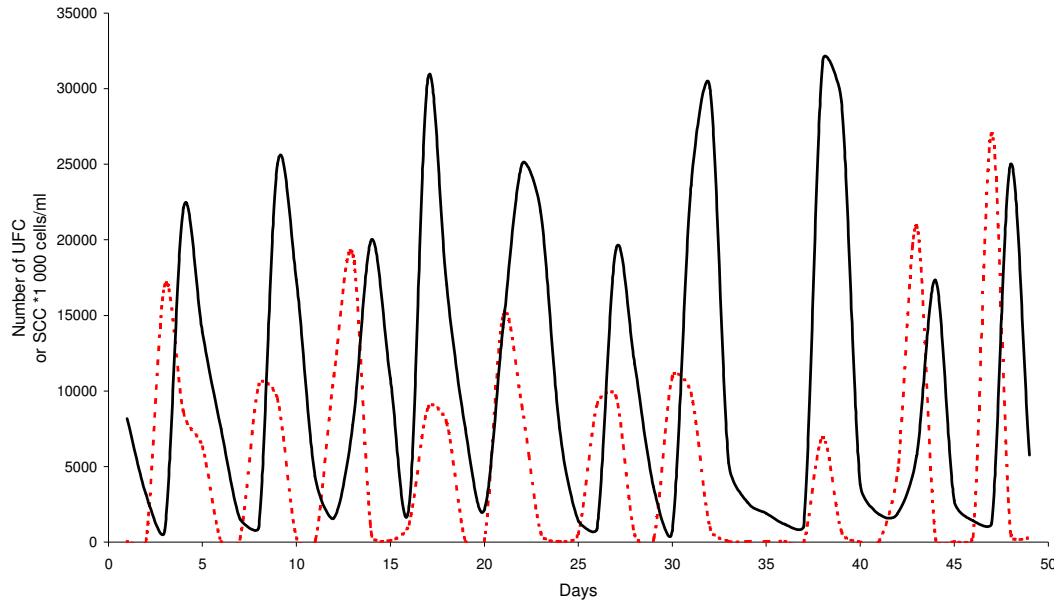


This approach has the advantage to be simple. But it is necessary to modulate its use depending on the objective: detection of infected sheep to be confirmed by a second analysis, detection of infected sheep to be treated at drying-off, or to be culled. Moreover, according to the chosen cut-off point, the power of detection of the truly infected (or uninfected) sheep could change, which is a drawback of this punctual approach.

#### 1.3.2. Dynamical approach and multiple thresholds

An important reason for the utilisation of such dynamic approaches is that staphylococcal IMI are characterised by dynamic fluctuations and consequently SCC cyclic variations (Fig. 5).

Figure 5. Example of daily fluctuations of SCC (—) and bacterial count (----) for an infected udder-half (Bergonier *et al.* 2006).



The use of a combination of several successive individual SCC (iSCC) or a lactation geometric mean of all the iSCC may give better results than a punctual approach leading to about 75/80 % of sensitivity and specificity. Such an approach results in the definition of a third class of udders: doubtful udders which are not truly infected or truly healthy.

At the lactation level, the thresholds of 250,000 cells/ml and 500,000 cells/ml geometric means could allow to distinguish healthy and infected ewes.

Using such a dynamic approach, results in the following rules: an udder will be considered as healthy if every iSCC is below 500,000 cells/ml (possibly allow two iSCC greater than 500,000 cells/ml), or infected when at least two iSCC are over 1,000,000 cells/ml, and doubtful in other cases (Berthelot *et al.* 2006).

This approach has the advantage to take into account the dynamics of the inflammation due to staphylococcal IMI. But it is necessary to have several iSCC per lactation to define the status of the ewe. These rules were developed from an experimental milk recording flock where the ewes were monthly sampled throughout lactation. In practice, the rules must be adapted to the information available (i.e. iSCC or California Mastitis Test).

#### 1.4. Non-pathological variation factors for SCC

Bacterial IMI is the main factor influencing SCC, but many non-pathological factors also will elevate SCC of a healthy udder. In order of decreasing importance, the main known factors are the following: day in milk (increase at the end of lactation), parity (increase with the parity),

within-day fluctuation (SCC level at the evening milking is higher than the morning one), milk fractions (increase with the milk fractions), flock, year...

The range of variation of the non pathological factors are:

Flock \* year effect: 130,000 cells/ml

Day in milk effect: 60,000 to 100,000 cells/ml

Age, lactation number effect: 40,000 cells/ml (from parity 1 to parity 5 or more)

Evening/morning milking effect: 60,000 to 90,000 cells/ml (depending on the interval between the two milkings)

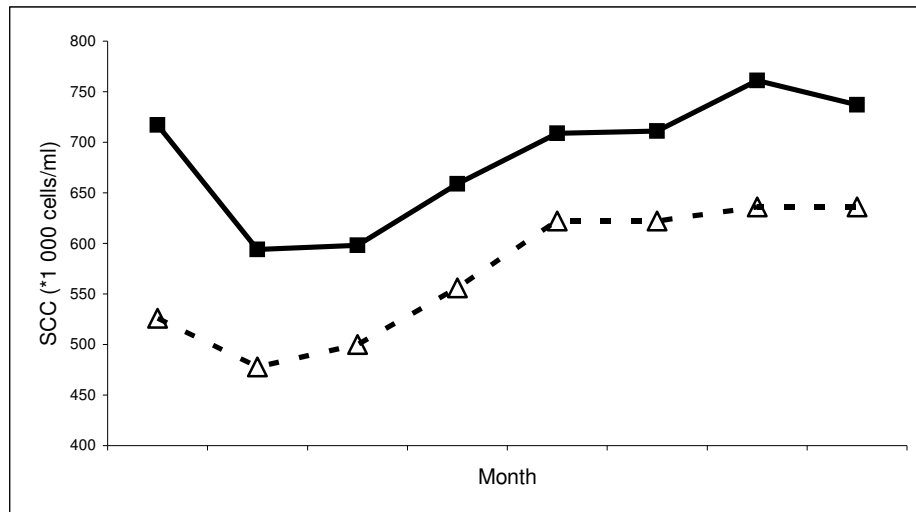
Some other minor or punctual SCC factors of variation may exist depending on the management of the flock: suckling/milking period, number of suckled lambs, the milking routine, the type of milking (by machine or by hand), sudden dietary transitions cause punctual fluctuation of SCC...

### 1.5. Conclusion

Dairy sheep IMI are mainly due to staphylococci. This fact has 2 main consequences:

1) The primary sources of IMI are carried by the animal (teat cutaneous infection, skin...) and subclinical IMI. Thus, milking is the principal vector for the spread of IMI in dairy sheep. Despite this key role, additional work is needed to clearly identify the effect of milking equipment, routine, management... In France, in a survey carried out in 2003, it was pointed out that bulk SCC of flocks milked by machine with major defaults was higher (+100,000 cells/ml) throughout the year (Fig. 6). In Spain, C. Gonzalo in 2005 and 2006, established that machine milking in a parlour was associated with better udder health than using a bucket-milking machine or milking by hand.

Figure 6. Monthly evolution of the geometric mean of bulk tank SCC of flocks milked by machine with 2 majors defaults (—) or no default (----) (Bergonier *et al.* 2005, Billon *et al.* 2003).



2) The persistence of subclinical IMI during lactation may be high. In a survey carried out in France in 6 flocks (768 udder-halves), the average duration of a pathogen was 3 to 4 months (Bergonier *et al.* 2003).

It is clearly established that IMI is the major cause of variation for SCC in dairy sheep:

- with all SCC (or geometric mean) below 250,000 or 500,000 cells/ml an udder may be considered as healthy,
- with two SCC over 1,000,000 cells/ml, an udder may be considered as infected,
- in the other cases, an udder may be classified as doubtful

Sometime, it would be interesting to take into account the non-pathological variation factors for the interpretation or the comparison of the SCC. For example, we can observe large fluctuations of SCC (at the individual level but also at the bulk milk level) during the suckling x milking period, or some days just after the weaning of the lambs, or at the beginning of a grazing period after a barn period...

## **2 – Somatic Cell Counting**

### **2.1. Direct method**

The principal methods for somatic cell counting are:

- counter coulter method: the principle is based on the count of the particles in the milk. The count may be influenced by the size of the particles, the presence of grass globules...
- fluoro-opto-electronic method: the principle is based on the count of the DNA nucleus in the milk after coloration. It is the method currently used now. Due to the high level of SCC found in dairy sheep, the counter should be calibrated using samples from 0 to 2,000,000 cells/ml.
- the reference method (International IDF standard 148A/1995) is based on a DNA coloration and microscopic counting.

The influence of sample conservation on the counting results has been well established by Gonzalo and Martinez (Gonzalo *et al.* 2003, Martinez *et al.* 2003):

- for unpreserved milk (temperature of conservation 4°C): the first 2 days of conservation have little quantitative influence on SCC.
- for preserved milk (temperature of conservation 4°C): the age of the milk has little quantitative influence on SCC within the first week of conservation.
- frozen milk: on average SCC is lower after freezing compared to refrigeration. But using a good analytical temperature (40°C), the Fossomatic device can be used for frozen samples over 60 days of conservation.

### **2.2. Indirect method**

The California Mastitis Test (CMT) is based on the following principle: a reagent destroys the milk cells and reacts with DNA. The gelling of the milk is correlated with the quantity of DNA. CMT is an on-farm method, easy to be performed for trained people and not very

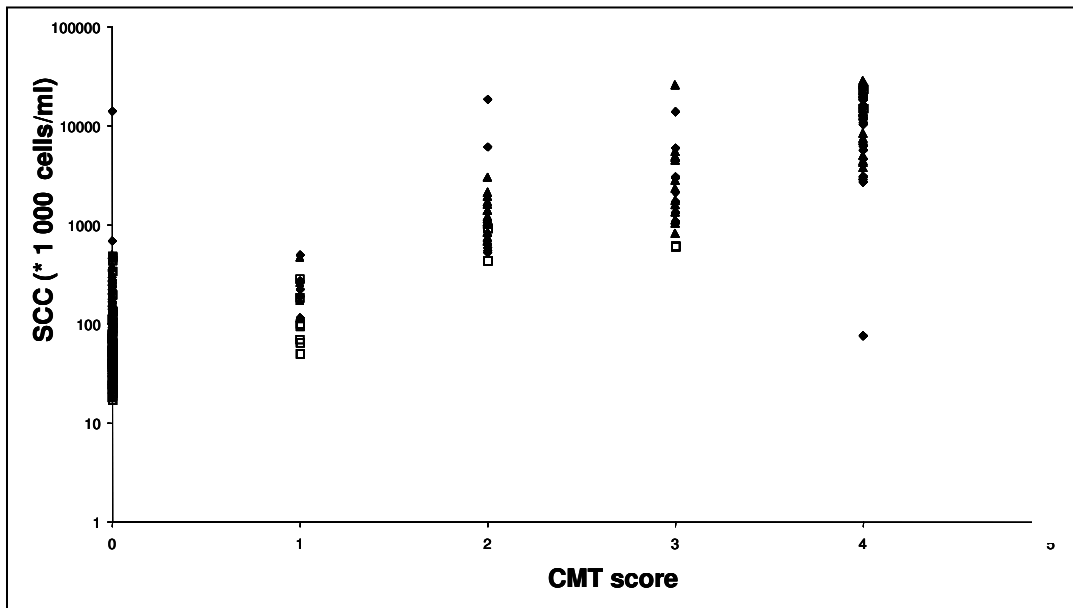
expensive. But it is necessary to be well organized to carry out regular CMT in suitable conditions for large flocks of sheep.

In France, we proposed the following interpretation for the results:

CMT reaction (CMT score)	Interpretation	SCC equivalence
No reaction (0)	Healthy or briefly infected	Below 500,000 cells/ml
Small amounts of gel disappearing after 10 seconds (1)	Small inflammation, briefly infected	Below 800,000 cells/ml
Small persistent amounts of gel (2)	Subclinical mastitis; long term infection	500,000 to 1,000,000 cells/ml
Significant gel, deep, sticking to paddle (3)	Idem	1,000,000 to 5,000,000 cells/ml
Very deep gel, looking like egg white (4)	Idem Acute subclinical mastitis	Over 5,000,000 cells/ml

If we take into account that CMT is a subjective test, there is a good correlation between CMT and SCC as shown on figure 7. The distribution of CMT and SCC are in agreement.

Figure 7. Relationship between CMT and SCC for 320 udder-halves in 4 flocks (Lagriffoul 2001, unpublished result)



Other indirect methods like conductivity of the milk have been proposed. In general, there are few available results in dairy sheep regarding these other indirect methods, and their relationships with SCC are not yet as well validated as the CMT.

## 2.3. Conclusion

The SC methods of counting are validated in dairy sheep. With the Fossomatic method and good conditions of conservation, it appears possible to perform analysis several days after the sampling date. For frozen milk, the analysis may be done over 60 days after the sampling date provided that a suitable analysis temperature is respected.

For these direct methods, representative samples of milk are required. Depending on the milking routine, the milking throughput, the size of the flock, and the milk recording device, the collection of milk samples for analysis may be difficult or easy to perform and may require an increase in the number of technicians in the milking parlour.

With an appropriate subjective interpretation, CMT is well correlated with SCC in dairy sheep. CMT is less expensive than SCC (no analytical cost) to be performed, but its practical realisation may be very time consuming in large dairy sheep flocks. Taking into account the persistence of the subclinical IMI in dairy sheep, it is therefore useful to get several results per ewe at relevant days in milk (i.e. dynamic of the infections). In that way, CMT results can be combined with previous SCC results, or vice versa, to confirm the “infected” udders.

## 3 – Phenotypic Relationships Between SCC and Other Traits

### 3.1. Relationships between SCC and milk production

The phenotypic correlation between SCC and milk production is negative, about  $-0.1$  to  $-0.2$ : IMI causes a reduction of the milk yield secretion ability of the udder. Some authors report a reduction of milk production over 20 to 30 %. At the INRA La Fage flock (Lacaune breed), the estimation of loss of milk production was about 10 % to 15 % for the sheep with SCC over 500,000 to 700,000 cells/ml. C. Gonzalo in 2002 found the same range of loss of production: between 9 to 10 % for Churra ewe with a pathogen and high SCC (1,000,000 cells/ml).

### 3.2. Relationship between SCC, milk composition and technological properties of milk

The relationships between SCC and milk composition can be summarized as follows (Pirisi *et al.* 2000, Albenzio *et al.* 2002, Bianchi *et al.* 2004, Leitner *et al.* 2003., Vivar-Quintana *et al.* 2006):

- the pH value of the milk increases with SCC
- the lactose content falls with SCC
- An increase of soluble proteins with SCC. The whey protein content of high SCC milks may induce an increase in the protein content of the milk, but the casein/protein ratio will tend to be lower in such high SCC milks. SCC has no significant incidence on non-protein nitrogen and urea values.
- SCC seems to have no significant influence on total calcium and phosphorus contents, while the modification in the filtration system of the infected udder modifies soluble calcium, soluble phosphorus and potassium.
- SCC does not affect the milk fat content.



The influence of high SCC on cheese making properties of the milk depends on the cheese technology. However, the relationships between SCC and rheological properties (Pirisi *et al.* 2000, Vivar-Quintana *et al.* 2006, Bianchi *et al.* 2004.) are mainly due to the change in native pH. Indeed, pH has a strong influence on the rheological parameters. Milk with a high SCC and a high native pH value displays a significant lengthening in milk clotting time, and the curd firming time is significantly higher. The hardness is decreasing with SCC level. Pirisi in 2000 demonstrated that standardization of the milk's pH provides in practice milks with identical rheological characteristics whatever the SCC level. Thus, for an unpasteurized cheese type, it shows that milk SCC does not have significant effect on the qualitative characteristics of the final product.

For yoghurt production, Vivar-Quintana in 2006 recommends that the SCC of the milk should not exceed 1,500,000 cells/ml. From 0 to 1,500,000, SCC does not influence the texture and the quality of the yogurt. But yoghurts made with high SCC milk (more than 3,000,000 cells/ml) have a very soft consistency and a reduced ability to retain serum and flavours are described as piquant and bitter.

### **3.3. Relationship between SCC, udder morphology and machine milking ability**

There are few results describing the phenotypic relationships between SCC, udder morphology and machine milking ability. The recent results obtained in France in the Lacaune breed indicated negative correlations (-0.04 to -0.10) thus slightly favourable relationships between udder (teat angle, udder cleft, udder depth) and SCS, while the relationship between SCC and machine milking ability (milking speed) is in the same range but slightly unfavourable.

### **3.4. Conclusion**

If the relationships between SCC and milk production (milk yield and composition) are now established, it is not the case for the relationships between SCC and other traits like machine milking ability estimated for a few breeds. The cheese properties of the milk are negatively influenced by high levels of SCC. For this reason, plus possible human health problems linked to pathogenic contaminants in high SCC milk, it is recommended to limit the SCC level in dairy sheep milk below 1,500,000 cells/ml.

## **4 – Control of SCC**

### **4.1. Bulk milk SCC**

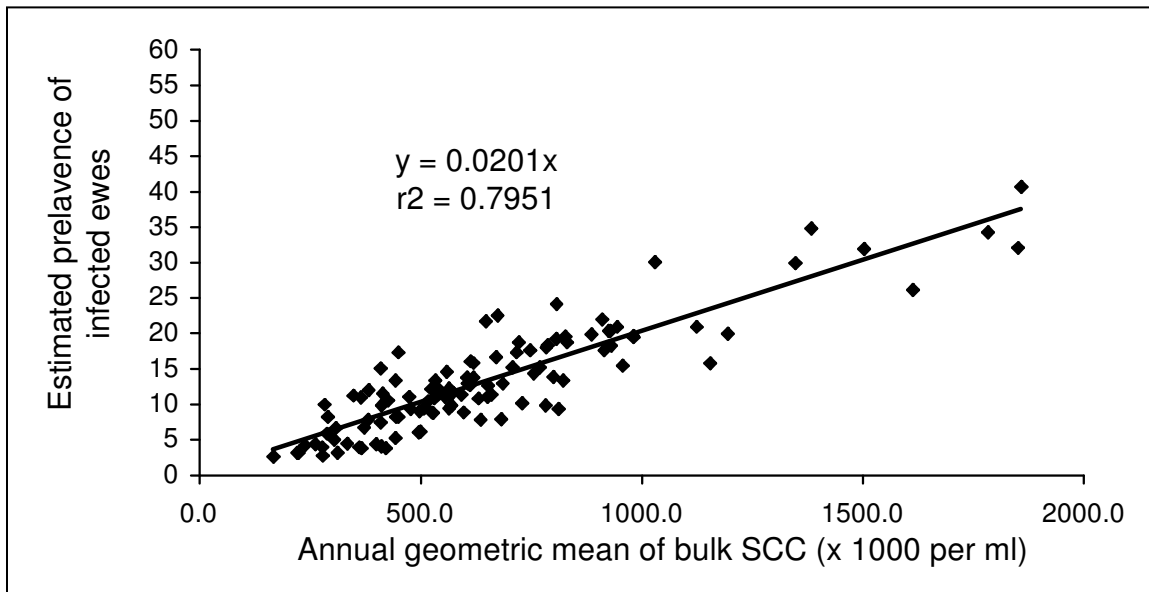
In dairy sheep, the bulk milk SCC is an important tool in the control of SCC, since it is, first - the main available information to define a given control strategy, and second - this control strategy must be adapted to the level of bulk SCC.

#### 4.1.1. Annual level

There is a strong relationship between the annual geometric mean of the bulk SCC and the estimated prevalence of infected ewes, based on a decision rule considering an udder as infected if at least two individual SCC (iSCC) are higher than 1.2 million cells/ml.

As shown in Figure 8, an annual bulk SCC of 650,000 cells/ml corresponds to a prevalence of 15 %. A change of 100,000 cells/ml of the annual bulk SCC reflects a 2 to 3% change in prevalence of infected ewes.

Figure 8. Relationship between the annual geometric mean of bulk SCC and the estimated prevalence of IMI (from Berthelot *et al.* 2006)



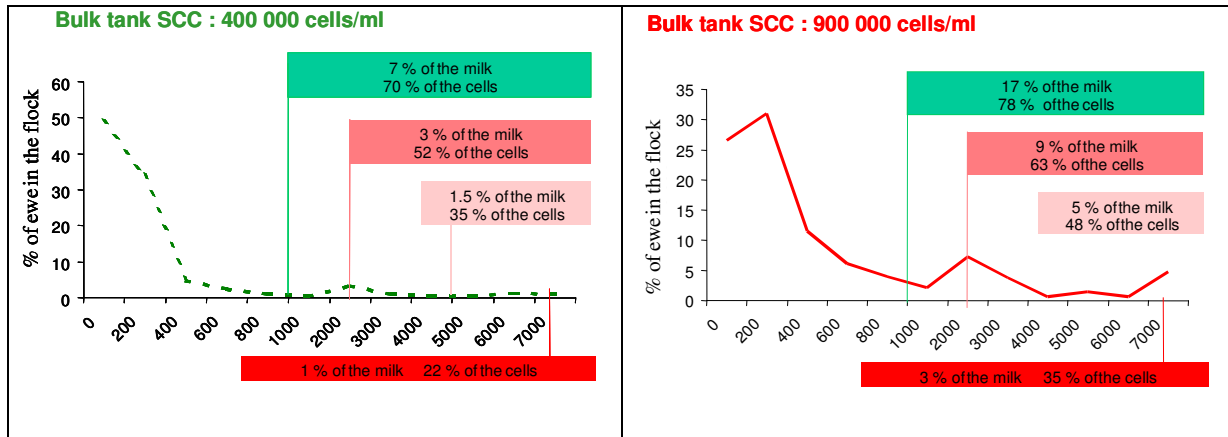
#### 4.1.2. Punctual level

As shown in the Figure 9, the punctual SCC of the bulk milk reflects the repartition of SCC of the ewes:

- for a tank SCC equal to 900,000 cells/ml, ewes with more than 1,000,000 cells/ml represent more than 75 % of the bulk cells but only 17 % of the production of milk,
- for a tank SCC equal to 400,000 cells/ml, the SCC contribution is comparable but the milk contribution of the high SCC ewes is limited to 7% of the dairy production.

Thus it is obvious that control of SCC has to focus on these “infected” ewes which are not so numerous (have a limited contribution to the milk production of the flock), but have a great contribution to bulk tank SCC and are an important source of IMI and reservoir of bacterial infections for healthy ewes.

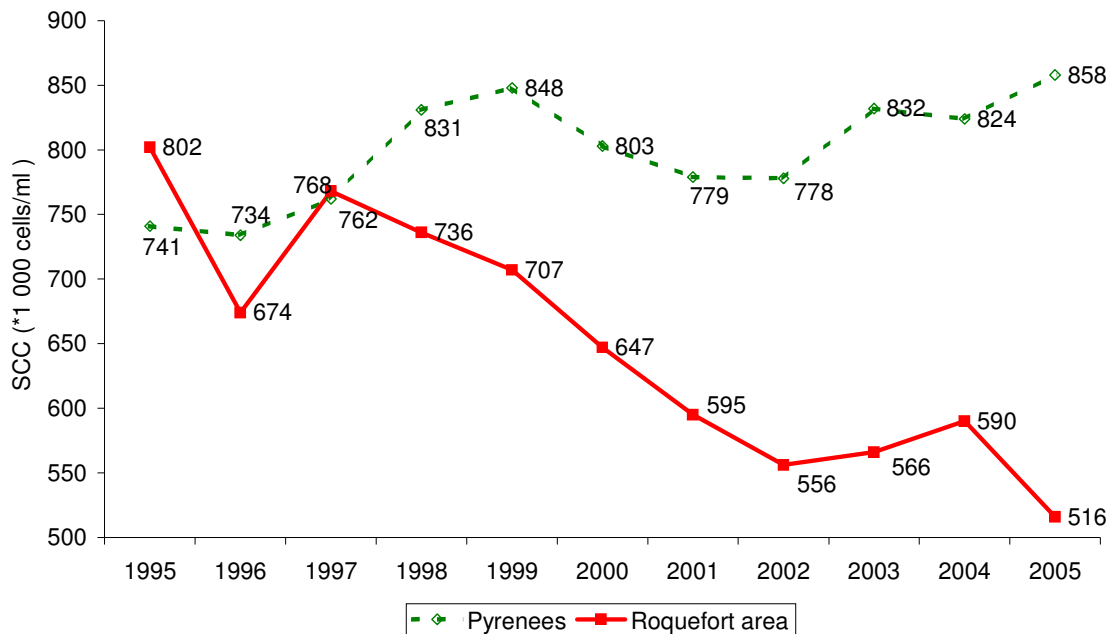
Figure 9. Contribution to bulk tank milk or bulk tank cells from ewes with iSCC over 1,000,000, 2,500,000, 5,000,000 or 7,500,000 cells/ml when bulk tank SCC is 400,000 cells/ml or 900,000 cells/ml.



#### 4.2. Is it possible to control SCC?

In France, the comparison of the evolution of annual SCC between Roquefort and Pyrenees areas gives an indirect positive answer to this question (Fig. 10).

Figure 10. Evolution of the annual arithmetic mean of bulk SCC in the Pyrenees and the Roquefort area (Lagriffoul, 2005)



During the period 1995/1997, the level of SCC was comparable in the two areas of production. During the last 10 past years, the average SCC of the Roquefort flocks dropped from 750,000 cells/ml to 500,000 cells/ml; a 33 % reduction. In the same time, there is no clear evolution of the average SCC in Pyrenees flocks. In the Roquefort area, SCC is one of the

criteria with high penalties (over a given threshold) to determine milk price since 1993. Therefore producer organizations and dairy plants have implemented a control plan for subclinical mastitis in the Roquefort area. In Pyrenees mountains, the producers (except for the home cheese makers) and the dairy industry give no particular attention to SCC.

### **4.3. Definition of a control program**

To be efficient, a control plan has to combine preventive and curative action. Efficiency of vaccination to control IMI is not yet clearly established and large scale controlled trials are still needed on this topic. Therefore, we will not consider vaccination as an operating control tool in the presentation.

#### **4.3.1. Preventative actions**

Since mastitis in dairy sheep results mainly from bacterial infections whose reservoir is generally in the udder or teat and transmission between ewes is favoured by milking, the first objective, both preventative and curative actions, is control of the reservoir, i.e. the infected ewes.

The control of environmental sources consists in applying good housing recommendations mainly to reduce staphylococcal pressure (density, air humidity...). This may be an important feature during the lambing period characterized by a high concentration of animals.

Bacteriological transmission during milking is a key point for control actions. Thus the milking machine must be cleaned and controlled regularly (once a year). The liners must be replaced every year for rubber ones and every two years for silicone ones. The milking technique must avoid teat impacts (and air inlets in general): brutal stripping, removal of the cluster without cutting off the vacuum... The milking time must be adapted to avoid over or under-milking.

Teat-dipping or spraying is an efficient tool for reducing IMI incidence. But this technique is antagonistic to a high milking throughput, specially for large flocks. Therefore, it can be promoted, in a high prevalence situation, during a limited period, to deal with an unfavourable situation with the aim of reducing IMI incidence.

To implement a milking order may also reduce the infection pressure, i.e. to first milk the primiparous ewes, since they are less infected, and then the adult healthy ewes, followed by groups of ewes of increasing IMI or SCC.

#### **4.3.2. Curative action**

The main curative action corresponds to the reduction of animals carrying infection can be achieved in two ways :

1. culling of “infected” ewes

To reach this goal, the practical question is how to select the ewes to be culled?

Regarding the dynamics of the infection, the decision can be taken using several possible criteria, as for instance :

- ewes with several iSCC over 1,000,000 or 1,500,000 cells/ml during the lactation;
- ewes who experienced acute or severe chronic IMI : strong udder asymmetry, diffuse hardness, abscesses... (caution : abscesses must be differentiated from cysts)
- a combination of iSCC results and udder indicators.

## 2. antibiotic treatment at drying-off

The implementation of a dry therapy significantly reduced the bulk tank milk SCC (Gonzalo *et al.* 2005 and 2006). In dairy sheep, the cure rate of drying-off intramammary antibiotherapy ranged from 65 to 96 %. Considering the length of the dry period in dairy sheep, the preventative interest of the drying off treatment can be discussed. Without drying-off treatment, the dynamic of infection during the dry period would be (Bergonnier *et al.* 2003):

For infected udders:

- cure rate: 45 %
- rate of new infection (substitution): 23 %
- persistence of the IMI: 32 %

For uninfected udders:

- rate of new infection: 10 to 25 %

Taking into account all the above parameters, a selective drying-off antibiotic treatment (devoted to infected and doubtful udders only) may be preferred to a systematic one. Limiting the number of treatments may cover the cost of iSCC or CMT which are needed to select the candidate ewes for such a selective treatment.

In dairy sheep, the use of drying-off intramammary antibiotherapy may be associated, in a few cases, to acute mastitis caused by opportunistic pathogens (*P. aeruginosa* or *A. fumigatus*). Hygienic precautions may reduce this risk: before the treatment (for example *P. aeruginosa* in the water), during the treatment but also at lambing (contact with moldy forage).

At last, but not least, considering the dry period duration, it can be assumed that the risk of residues in the milk after lambing is very low. If the drying-off treatment is made by waves, the treated ewes must be clearly marked to avoid the risk of milking them (i.e. antibiotic in the milk).

### 4.3.3. Genetic control

Contrary to cattle, no genetic antagonism between milk yield and clinical mastitis has been demonstrated for sheep (Barillet *et al.*, 2001a). Thus in practice, improving udder health in dairy sheep could be limited, in a first approach, to selection against subclinical mastitis using milk somatic cell count (SCC). Estimates of heritability of the lactation somatic cell score (LSCS) computed as in Wiggans and Shook (1987) ranged for sheep between 0.10 to 0.18 (El Saied *et al.*, 1999, Mavrogenis *et al.*, 1999, Barillet *et al.*, 2001a, Othmane *et al.*, 2002, Rupp *et al.*, 2003, Serrano *et al.*, 2003, Legarra and Ugarte, 2005). Relationships between milk yield and LSCS were close to zero, from slightly favourable (-0.29) to slightly antagonistic (0.20). It can be pointed out that several estimates in the Lacaune breed always showed a moderate antagonism; confirmed in addition by a selection experiment with divergent selection for milk yield (Barillet

*et al.*, 2001b), these results being in agreement with the dairy cattle literature (Rupp and Boichard, 2003). Moreover, the genetic correlations between LSCS and several udder-type traits such as teat placement or udder depth were moderately favourable as already shown in cattle and ranged from -0.10 to -0.32 (Legarra and Ugarte, 2005, Barillet *et al.*, 2006). There is evidence that selection on milk traits only would lead in the long term to “baggy” udders more difficult to milk by machine and more susceptible to mastitis. Therefore it is relevant to include in the breeding objective functional traits related to udder morphology (udder scores) and udder health (SCS) for dairy sheep breeds profiting for several decades from efficient selection on milk traits only. Since 2005, the Lacaune breed has been selected on a total merit index giving the same relative weights to milk production and udder morphology and health (Barillet *et al.*, 2006). It is expected that SCC of the ewes will decrease by 54 % in 10 years, corresponding roughly to a genetic decrease of about a third of the bulk milk SCC.

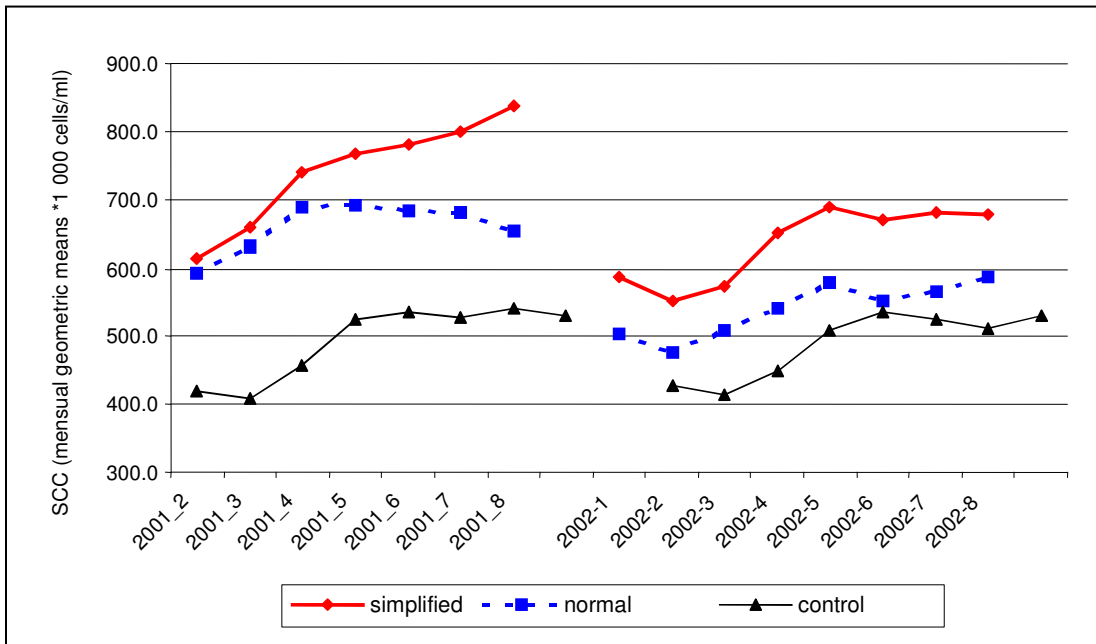
Currently the selection for mastitis resistance is based on a linear decrease of milk SCC. To validate this strategy, in the INRA Lacaune flock, an experiment based on SCC divergent lines has been in progress since 2003 (Rupp *et al.*, 2006) to study the consequences of such a SCC selection on different components of the host’s resistance to IMI . The preliminary results are promising: in 2005, the production during the first lactation of the two SCC lines was similar: closed to 0.9 liters per milking, while the SCS difference was 1.6, i.e. 400,000 cells/ml for the low SCC line versus 850,000 cells/ml for the high SCC line. Moreover, low SCC line ewes showed no clinical cases of mastitis, lower infection rate and better ability to recover from infections during lactation.

#### **4.4. Conclusion**

At the flock level, the control of SCC has to be based on several complementary approaches:

- lessening of the infection pressure: decrease of the new infections by culling the most infected ewes (if possible) or carrying out a “selective” drying-off treatment. An “exhaustive individual SCC picture” by sampling all the milked ewes would be recommended to select the sheep to be culled or treated. The Figure 11 illustrates the evolution of bulk tank SCC between 2001 and 2002 for flocks involved in a control program in 2001. There were 2 levels of “control”: normal or simplified differing from the realization or not of an exhaustive SCC (all the other actions being comparable). It can easily be noticed the decrease of SCC after the iSCC results: the sheep with high SCC had been dried off (or culled) during the year 2001. For the year 2002, a better SCC bulk level was noticed for the flocks involved on the normal action, the decrease of SCC being about 100,000 cells/ml or minus 20 %.
- the limitation of new infections using all the preventive possible actions, at a reasonable cost, in accordance with the management of the flock.
- the genetic control for the breeds profiting for several decades from an efficient selection on milk traits only.

Figure 11. Evolution of the average bulk SCC of the 3 types of flocks according to the level of control : simplified, normal, control = not involved in the program) (Lagriffoul G., 2003)



## 5 – Final Conclusions

The results obtained during the past years have increased the knowledge on somatic cell counts in dairy sheep in several areas:

- the improvement of rapid animal-side tests
- the assessment of bacteriological cure and new infection rates
- the estimation of true efficiency of preventative actions
- the relationships with milk flow kinetics
- the development of vaccines

The lack of statistics for dairy sheep does not allow relevant comparisons of the SCC situation in different countries. At a large scale (country or area of production), the average value of bulk SCC ranges from 400,000/500,000 to 1,000,000/1,200,000 cells/ml, and sometimes more.

But the control of SCC is now being effective in several countries and “low” levels of average SCC are being described. For example, in 2005, the average SCC in Roquefort area (2,500 flocks – 180 millions liters) was about 500,000 cells/ml, corresponding to a 33 % decrease during the last 10 years based on preventative and curative actions; not yet including genetic control which just started in 2005.

## 6 – References

- Albenzio M., Taibi L., Muscio A., Sevi A., 2002. Prevalence and etiology of subclinical mastitis in intensively managed flocks and related changes in the yield and quality of ewe milk. *Small Ruminant Research* **43** (2002) 219-226.
- Barillet F., Astruc J.M., Lagriffoul G., 2006. Functional traits in small dairy ruminants: genetic variation and relationships with milk production. Proc. 8<sup>th</sup> World Congres. Genet. Appl. Livest. Prod., Belo-Horizonte, 13-18 August 2006, Brazil. CD-ROM communication 2-01.
- Barillet, F., Rupp, R., Mignon-Grasteau, S., Astruc J. M., Jacquin M. ,2001a. Genetic analysis for mastitis resistance and milk somatic cell score in French Lacaune dairy sheep. *Genet. Sel. Evol.* **33** : 297-415.
- Barillet F., Marie C., Jacquin M., Lagriffoul G., Astruc J. M. ,2001b. The French Lacaune dairy sheep breed: use in France and abroad in the last 40 years., *Livest. Prod. Sci.* **71**: 17-29.
- Bergonier D., Lagriffoul G., Berthelot X., 2006. Etiologie, épidémiologie et diagnostic des mammites ovines. Bulletin des GTV n°36-octobre 2006:98-108.
- Bergonier D., de Cremoux R., Rupp R., Lagriffoul G., Berthelot X., 2003. Mastitis of dairy small ruminants. *Vet. Res.* **34**:689-716.
- Bergonier D. 2005. Les mammites de la brebis laitière : étiologie et épidémiologie. In "Actualités sur la maîtrise des infections mammaires des brebis laitières", Intervet édit., 13-26.
- Bergonier D. 2005. Les mammites de la brebis laitière : diagnostic et maîtrise. In "Actualités sur la maîtrise des infections mammaires des brebis laitières », Intervet édit., 27-44.
- Berthelot X., Lagriffoul G., Concordet D., Barillet F., Bergonier D., 2006. Physiological and pathological thresholds of somatic cell counts in ewe milk. *Small Ruminant Research* **62** : 27-31.
- Bianchi L., Bolla A., Budelli E., Caroli A. Casoli C., Pauselli M., Duranti E., 2004. Effect of udder health status and lactation phase on the characteristics of Sardinian ewe milk. *J. Dairy Sci.* **87**:2401-2408.
- Billon P., Lagriffoul G., Maraval E., 2003. La traite mécanique des brebis : état du parc des machines à traire et relation avec la qualité du lait., CR 2033101, Institut de l’Elevage, janvier 2003 25p.
- El Saied U.M., Carriero J.A., De La Fuente L.F., San Primitivo F. ,1999. Genetic parameters of lactation cell counts and milk and protein yield in dairy ewes. *J. Dairy Sci.* **81**: 2956-2961.
- Gonzalo C., Carriero J.A., Blanco M.A., Beneitez E., Juarez M.T., De La Fuente L.F. and San Primitivo F. 2005. Factors of variation influencing bulk tank somatic cell count in dairy sheep. *J. Dairy Sci.* **88**:969-974.
- Gonzalo C., Carriero J.A., Beneitez E., Juarez M.T., Fuente L.F de la. and San Primitivo F. 2006. Bulk tank total bacterial count in dairy sheep: factors of variation and relationship with somatic cell count. *J. Dairy Sci.* **88**:969-974.
- Gonzalo C., Martinez J.R., Carriero J.A. and San Primitivo F., 2003. Fossomatic cell-counting on ewe milk : comparison with direct microscopy and study of variation factors. *J.Dairy Sci.* **86**:138-145.
- Gonzalo C., Ariznabarreta A., Carriero J.A., San Primitivo F., 2002. Mammary pathogens and their relationship to somatic cell count and milk yield losses in dairy ewes. *J. Dairy Sci.* **85**:1460-1467.
- IDF, 1995. Enumeration of somatic cells. International Dairy Federation (FIL-IDF Standard N° 148A), Brussels, Belgium.



- Lafi S.Q. 2005. Use of somatic cell counts and California Mastitis Test results from udder halves milk samples to detect subclinical intramammary infection in Awassi sheep. *Small Ruminant Research* **62**(2006) 83-86.
- Lagriffoul G. 2005. La maîtrise des infections mammaires : un enjeu de filière. In "Actualités sur la maîtrise des infections mammaires des brebis laitières », Intervet édit., 27-44.
- Lagriffoul G. 2003. Evaluation de l'action " maîtrise en élevage des comptages de cellules somatiques". Document de travail.
- Legarra A., Ugarte E. ,2005. Genetic parameters of udder traits, somatic cell score and milk yield in Latxa sheep *J. Dairy Sci.* **88**: 2238-2245.
- Leitner G., Chaffer M., Caraso Y., Ezra E., Kababea D., Winkler M., Glickman A. Saran A., 2003. Udder infection and milk somatic cell count, NAGase activity and milk composition-fat, protein and lactose-in Israleli-Assaf and Awassi sheep. *Small Ruminant Research* **49**(2003) 157-164.
- Martinez J.R., Gonzalo C., Carriedo J.A., San Primitivo F. 2003., Effect of freezing on Fossomatic cell counting in ewe milk. *J. Dairy Sci.* **86**:2583-2587.
- Mavrogenis A.P., Koumas A., Gavrielidis G. ,1999. The inheritance of somatic cell counts in Chios sheep. *EAAP Publication N° 95*, pp 389-392.
- McDougall S., Murdough P., Pankey W., Delaney C., Barlow J., Scruton D., 2001. Relationship among somatic cell count, California mastitis test, impedance and bacteriological status of milk in goats and sheep early lactation. *Small Ruminant Research* **40**(2001) 245-254.
- Othmane M.H., Carriedo J.A., San Primitivo F., de la Fuente J.A. ,2002. Genetic parameters for lactation traits of milking ewes: protein content and composition, fat, somatic cells and individual laboratory cheese yield. *Genet. Sel. Evol.* **34** : 581-596.
- Pirisi A. Piredda G. Corona M., Pes M., Pintus S. Ledda A. 2000. Influence of somatic cell count on ewes milk composition, cheese yield and cheese quality. 6th Great lakes dairy sheep symposium. Nov 2-4. 2000.
- Rupp R., Boichard D. ,2003. Genetics of resistance to mastitis in dairy cattle. *Vet. Res.* 34: 671-688.
- Rupp R., Lagriffoul G., Astruc J.M., Barillet F. ,2003. Genetic parameters for milk somatic cell scores and relationships with production traits in French Lacaune dairy sheep *J. Dairy Sci.* 86: 1476-1481.
- Rupp R., Bergonier D., Dion S., Hygonenq M.C., Aurel M.R., Foulon E., Foucras G. ,2006. Effects of SCC-based selection for mastitis resistance: first results from a divergent selection experiment in sheep. Proc. 8<sup>th</sup> World Congres. Genet. Appl. Livest. Prod., Belo-Horizonte, 13-18 August 2006, Brazil. CD-ROM communication 15-16.
- Serrano M., Perez-Guzman M.D., Montoro V., Jurado J.J. ,2003. Genetic analysis of somatic cell count and milk traits in Manchega ewes : Mean lactation and test-day approaches *Livest. Prod. Sci.* **84**: 1-10.
- Vivar-Quintana A.M., Beneitez De La Mano E., Revilla I., 2006. Relationship between somatic cell counts and the properties of yoghurt made from ewes' milk. *Int. Dairy Journal* **16**(2006) 262-267.
- Wiggans G.R., Shook G.E. ,1987. A lactation measure of somatic cell count *J. Dairy Sci.* **77**: 2666-2672.

## EFFECT OF SUPPLEMENTATION AND STAGE OF LACTATION ON PERFORMANCE OF GRAZING DAIRY EWES

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### Summary

A study was conducted in the summer of 2005 to determine the effect of stage of lactation and supplementation on the performance of dairy ewes grazing kura clover-orchardgrass pastures. Fifty-six three-yr-old ewes in early ( $21 \pm 10$  d in milk (DIM)) or late ( $136 \pm 9$  DIM) lactation and were fed 0 or 0.80 kg DM/d of supplement (18 % CP mixture of corn and a high protein pellet) in a 2 x 2 factorial arrangement of treatments. Average daily milk production and daily milk protein percentage was higher in early lactation ewes than late lactation ewes (1.74 vs. 1.21 kg/d and 5.02 vs. 4.86 %, respectively). Supplemented ewes had higher average daily milk production (1.59 vs. 1.36 kg/d respectively), lower milk fat percentage (5.75 vs. 6.00 %, respectively), and lower milk protein percentage (4.84 vs. 5.04 %, respectively) than unsupplemented ewes. Trial milk urea nitrogen (MUN) levels in all treatments (18 to 34 mg/dl) tended to be higher than recommended levels for sheep (14 to 22 mg/dl), indicating an excess of protein intake. This can be explained by high quality pastures, which ranged in crude protein from 16 to 30 %. Based on estimates of dry matter intake using the external marker titanium dioxide and the internal marker acid detergent lignin, there was no significant difference in pasture dry matter intake between supplementation or stage of lactation treatments.

### Background

The United States dairy sheep industry has grown over the past 25 years and in 2003 there were approximately 75 farms in North America producing over 1.5 million kg of sheep milk annually (Thomas, 2004). Despite this growth, the United States imported 33.2 million kg of sheep milk cheese worth over \$184 million in 2004 (FAO, 2006), indicating room for the domestic market to expand.

The United States dairy sheep industry has developed in two main regions, New England and the Upper Midwest, both well suited to pasture production. The development of flocks in these areas may be attributed to the sheep's ability to effectively utilize improved pasture along with a market and infrastructure for artisan cheeses and sheep-milk products. Since dairy sheep are relatively new to the United States, information regarding supplementation on pasture and pasture utilization remains inadequate. While supplementation had a positive effect on milk production of grazing lactating cows (Reis and Combs, 2000) and commercial sheep (D'Urso et al., 1993), little information is available regarding the supplementation of dairy sheep on high quality, temperate pastures. In a study of nursing ewes receiving low or high levels of supplementation while grazing, lamb growth was greater when dam supplementation was high

(Penning et al., 1988). Another study of lactating ewes grazing different pasture allowances (500 or 750 kg organic matter/ha) with three levels of cereal supplement (0, 0.48 or 0.96 kg organic matter/d) found no effect of ewe supplementation on lamb growth. There was an effect of herbage allowance on lamb growth; ewes grazing paddocks with high herbage allowance supported faster growing lambs (Milne et al., 1981). Therefore, forage availability has an important effect on animal intake and performance. This study was conducted to determine the effect of supplementation on milk production and milk composition of grazing dairy ewes at different stages of lactation. In addition, the study measured dry matter intake on pasture using titanium dioxide as an external marker and estimated protein utilization by monitoring milk urea nitrogen levels.

## Materials and Methods

**Ewes and pasture.** The study was conducted at the University of Wisconsin-Madison, Spooner Agricultural Research Station from May 25 to August 15, 2005. Twenty acres of pasture were divided into 1.5 acre paddocks and they ranged in composition from a mixture of approximately 60% kura clover (*Trifolium ambiguum* Bieb.) and 40% orchardgrass (*Dactylis glomerata* L.) and perennial ryegrass (*Lolium perenne* L.) to 5% kura clover and 95% orchardgrass, Kentucky bluegrass (*Poa pratensis* L.) and quackgrass (*Agropyron repens* L.). Ewes were moved to a new paddock at two to four day intervals, depending on forage availability. The interval between grazing events in each paddock was approximately three weeks. After grazing, each paddock was clipped to a height of 7.5 cm to allow for consistent regrowth.

Fifty-six three-yr-old ewes were arranged in a 2 x 2 factorial treatment design; in early or late lactation and receiving 0 or 0.80 kg DM/d of supplement. All ewes were weaned from their lambs at 36 to 48 h postpartum and machine milked twice per day in a double-twelve parlor from weaning and fed 0.80 kg DM/d of supplement and 1.9 kg DM/d of alfalfa silage in drylot until grazing began on May 25, when supplementation treatments were applied. The ingredient and nutrient composition of the supplement is reported in Table 1. All ewes were on pasture together for approximately 20 h/d and were milked twice daily at 0530 and 1700h. Ewes were provided water in the pasture and a free choice mineral-salt mixture in the parlor holding area; no shade was provided in the pasture.

In addition to the 56 three-yr-old ewes, there were 20 two-yr-old ewes and 19 four-yr-old ewes in late lactation that were divided between the unsupplemented and supplemented treatments. They were managed with the 56 three-yr-old ewes. The two- and four-yr-old ewes were not included in the analysis of the milk production data because this would have resulted in the confounding of the effects of ewe age and stage of lactation, but some of these ewes were used in the collection of dry matter intake (DMI) and milk urea nitrogen (MUN) data.

**Table 1:** Composition of supplement fed to grazing dairy ewes.

Ingredient	% of DM
Whole corn	75.0
Soybean meal	14.9
Wheat middlings	4.6
Canola meal	3.8
Distillers grain	1.3
Molasses	0.4
Composition	% of DM
Crude protein	18.0
Neutral detergent fiber	10.8
Non-fiber carbohydrates	66.6
Ash	2.7
Fat	3.8

**Sample collection, analysis and calculations.** Daily milk production of individual ewes was measured weekly using a graduated Waikato Goat Meter (Inter Ag, New Zealand) by combining the amount of milk obtained at an evening and subsequent morning milking. Bi-weekly milk samples from the morning milking were analyzed for percentage fat and protein (AgSource Milk Labs, Stratford, WI). A compiled milk sample from eight to ten ewes in each of the four stages of lactation and supplementation treatment combinations was analyzed for MUN biweekly (AgSource Milk Labs, Stratford, WI). Ewes were weighed biweekly and body condition scored once per month (1 = very thin, 5 = very fat; Boundy, 1982).

Daily milk production, milk fat percentage, and milk protein percentage were used to calculate 6.5 % fat corrected milk (FCM) and 6.5% fat and 5.8% protein corrected milk (FPCM) based on the following equations developed by Pulina et al. (1989):

$$\text{FCM} = \text{M} (0.37 + (0.097 \times \text{F}))$$

$$\text{FPCM} = \text{M} (0.25 + (0.085 \times \text{F}) + (0.035 \times \text{P}))$$

where:

M = milk yield (kg) and F and P = fat and protein concentration (%); respectively.

Total trial production of milk, fat, protein, FCM and FPCM were calculated based on the equations of Berger and Thomas (2004). Total percentage of fat and protein during the trial were calculated from values of total milk, total fat and total protein produced.

Pasture samples were collected from paddocks approximately twice per week. Four quadrats (0.37 m<sup>2</sup>) were tossed randomly throughout the paddock before a grazing event, and forage was harvested to 2.5 cm stubble height. Forage samples were weighed and oven-dried (37° C forced-air oven) until they reached a constant weight. A composite of the four pre-grazing forage samples from each pasture was ground to pass through a 1-mm screen in a UDY cyclone mill before laboratory analysis. Forage samples were analyzed for dry matter (DM), total nitrogen (N) and neutral detergent fiber (NDF).

Pre-grazing herbage mass (kg DM/ha) and pasture allowance (kg DM/ewe/d) were measured using a rising plate meter placed in 25 random locations throughout the paddock. The plate meter (1,254 g and 0.16 m<sup>2</sup>) was calibrated to each pasture by correlating the DM and rising plate reading of 20 clipped samples, as described by Bransby et al. (1977). Pasture calibration was repeated twice in early and mid-grazing season to account for changes in pasture composition and maturity over time. Post-grazing pasture residue was estimated once per week with the rising plate meter to verify sufficient pasture allowance.

**Marker.** Titanium dioxide (TiO<sub>2</sub>) was used as an external marker to estimate pasture intake of ten ewes randomly selected from each supplementation treatment. A pre-treatment fecal sample was taken from ewes in each treatment before administration of the marker. Gelatin capsules of 2.5 g of TiO<sub>2</sub> were administered to ewes twice daily for 11 days. After a seven day adjustment period, fecal grab samples were collected once per day, at 1630 h, for the following four days. A compiled fecal sample for each ewe was stored frozen and subsequently oven dried (60° C forced-air for 48 h) and ground to pass through a 1-mm screen in a UDY cyclone mill. Fecal samples were analyzed for the concentration of TiO<sub>2</sub> using the colorimetric technique described by Myers et al. (2004). Total fecal output (FO; g/d) was estimated by the equation:

$$\text{FO} = (\text{g TiO}_2 \text{ administered per d}) / (\text{g TiO}_2 / \text{g feces DM})$$

Forage fecal output (FFO) was equal to FO for unsupplemented ewes. For supplemented ewes, FFO was estimated by subtracting the estimated fecal output of grain (0.82 kg grain \* 97 % DM \* 90 % digestibility) from the total FO. Based on FFO, pasture DMI was estimated using the equation:

$$\text{Pasture DMI} = \text{FFO} \times (100/100 - \text{DMD}_{\text{pasture}})$$

Fecal and forage samples were analyzed for acid detergent lignin (ADL), using the technique of Robertson and Van Soest (1981), to determine apparent forage digestibility:

$$\text{Dry matter digestibility (DMD)} = 100 - ((\% \text{ ADL forage} / \% \text{ ADL fecal}) * 100)$$

For unsupplemented ewes, pasture DMI represents total DMI. For supplemented ewes, total DMI was estimated by adding pasture DMI to grain DM (0.82 kg/d \* 97 % DM) offered in the parlor.

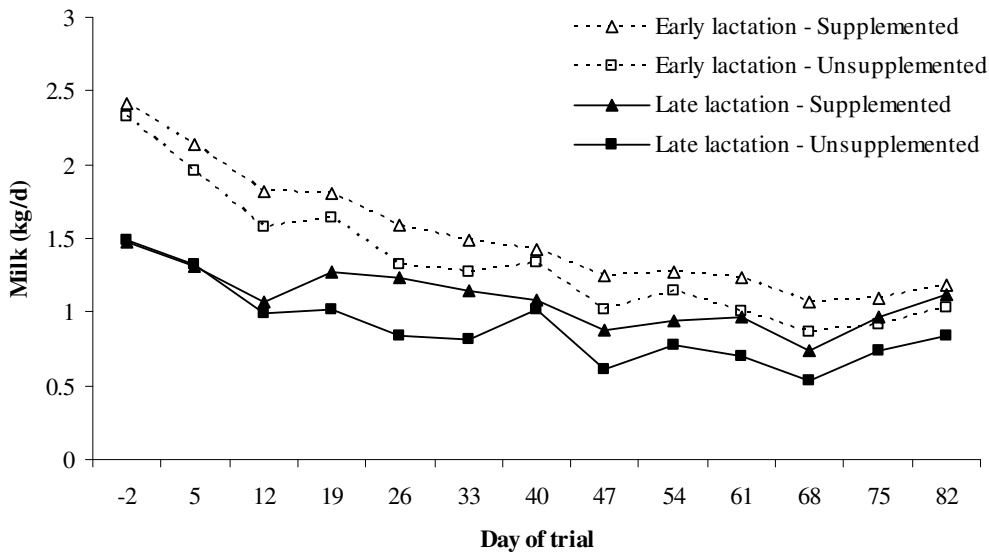
**Statistical analyses.** Weekly milk production, bi-weekly fat and protein percentage, BW and BCS were analyzed using the mixed model procedure of SAS 8.2 (PROC MIXED) for a factorial design (SAS, 1999) with repeated measures. The model for these repeated measures included the fixed effects of stage of lactation, supplementation treatment, test date and their two- and three-way interactions, and the random effects of ewe and the residual. The general linear model procedure of SAS (PROC GLM) was used to analyze DMI and the total trial period production of milk, fat, protein, FCM and FPCM, and percentage of fat and protein. The model included the effects of stage of lactation, supplementation treatment, their interaction, and the residual. All means presented are least squares means, and significance is declared at  $P < 0.05$  unless otherwise noted. Forage CP was related to MUN using the correlation procedure of SAS (PROC CORR).

## Results and Discussion

**Milk production and composition.** Figure 1 presents average test day milk yields for each of the four stages of lactation and supplementation treatment combinations. On the first test day,

2 d before the start of the supplementation treatments, average milk production for supplementation treatments within each stage of lactation was similar ( $P > 0.10$ ). In the analyses of test day milk yield, milk fat percentage and milk protein percentage, none of the two-way or three-way interactions were statistically significant. Therefore, the least squares means within test days for these three traits by the main effects of stage of lactation and supplementation treatment are plotted in Figures 2, 3 and 4, respectively. Least squares means, averaged over test days, are presented in Table 2.

**Figure 1:** Average test day milk production for stage of lactation and supplementation treatment combinations.



On each test day during the trial, early lactation ewes produced more milk than late lactation ewes and supplemented ewes produced more milk than unsupplemented ewes (Figure 2); however, none of the differences within a test day were statistically significant. When these differences were averaged across test days, large and significant differences were observed between stage of lactation and between supplementation treatments (Table 2). Early lactation ewes produced more ( $P < 0.0001$ ) daily milk (+ 0.53 kg), FCM (+ 0.36 kg), and FPCM (+ 0.34 kg) than late lactation ewes. Since milk production generally peaks in the fourth week of lactation and then slowly declines (Carta et al., 1995), the early lactation ewes are expected to have greater daily milk yield than late lactation ewes.

Supplemented ewes produced more ( $P < 0.01$ ) daily milk (+ 0.23 kg), FCM (+ 0.16 kg), and FPCM (+ 0.14 kg) than unsupplemented ewes (Table 2). This supports previous work in which supplementation increased milk production in lactating ewes (D'Urso et al., 1993). However, it is somewhat surprising that the response to supplementation was similar in ewes at both stages of lactation. Cannas (2002) suggests that supplementation in late lactation may contribute more to an increase in body weight than milk production. Changes in body weight (Figure 5) somewhat support this theory, but milk production also was positively affected by supplementation in late lactation ewes.

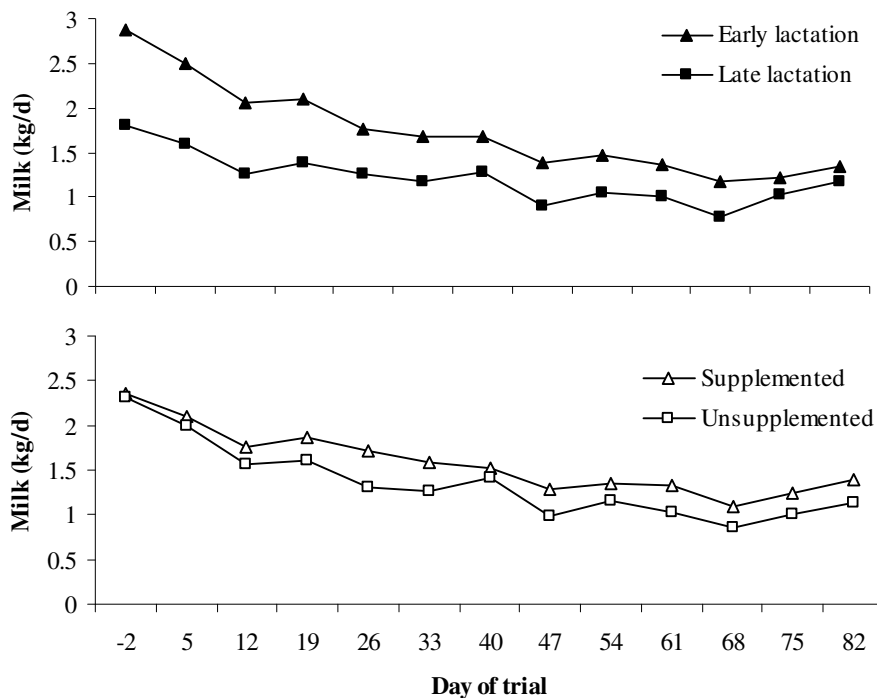
**Table 2:** Average test day milk production and milk composition of stage of lactation and supplementation treatments.

	<u>Stage of lactation</u> <sup>a</sup>					<u>Supplement level</u> <sup>b</sup>				
	Late		Early		<i>P</i> <	No supplement		Supplement		<i>P</i> <
	n	mean ± se	n	mean ± se		n	mean ± se	n	mean ± se	
Milk, kg	130	1.21 ± 0.05	598	1.74 ± 0.02	0.0001	364	1.36 ± 0.04	364	1.59 ± 0.04	0.0001
Fat, %	60	5.80 ± 0.11	276	5.95 ± 0.05	0.2526	168	6.00 ± 0.09	168	5.75 ± 0.09	0.0539
Protein, %	60	5.02 ± 0.05	276	4.86 ± 0.02	0.0057	168	5.04 ± 0.04	168	4.84 ± 0.04	0.0007
FCM, kg	60	0.86 ± 0.05	276	1.22 ± 0.02	0.0001	168	0.96 ± 0.04	168	1.12 ± 0.04	0.0071
FPCM, kg	60	0.85 ± 0.05	276	1.19 ± 0.02	0.0001	168	0.95 ± 0.04	168	1.09 ± 0.04	0.0073

<sup>a</sup>Late lactation ewes are 136 ± 9 DIM, early lactation ewes 21 ± 10 DIM.

<sup>b</sup> Supplement received 0.80 kg DM/d.

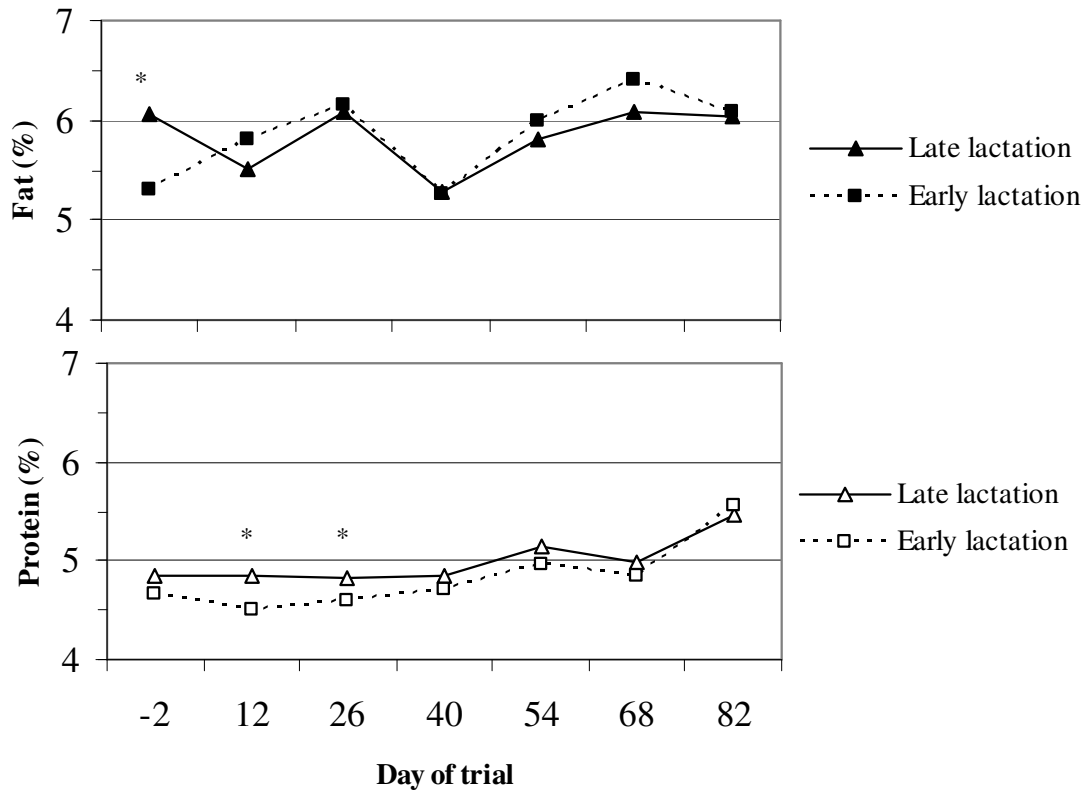
**Figure 2:** Average test day milk production for stage of lactation and supplementation treatments.



Late lactation ewes had a significantly higher milk fat percentage than early lactation ewes before the start of the trial, but the differences between stage of lactation treatments were not significant for any of the test days during the trial (Figure 3) or averaged over all test days (Table 2). This contradicts previous work, in which milk fat percentage tends to increase throughout lactation as milk production decreases (Pulina, 2002).

Supplemented ewes had a lower milk fat percentage than unsupplemented ewes on all test days except day 82, and the difference was significant at days 12 and 26 (Figure 4). The substitution effect of a low-fiber supplement may have affected total NDF intake, leading to milk fat depression in supplemented ewes (Bencini and Pulina, 1997). Averaged over all test days, unsupplemented ewes had a higher ( $P < 0.05$ ) milk fat percentage than supplemented ewes (6.00 vs. 5.75 %, respectively), which may be related to their significantly lower milk production (Table 2).

**Figure 3:** Average test day milk fat and milk protein percentages for stage of lactation treatments.

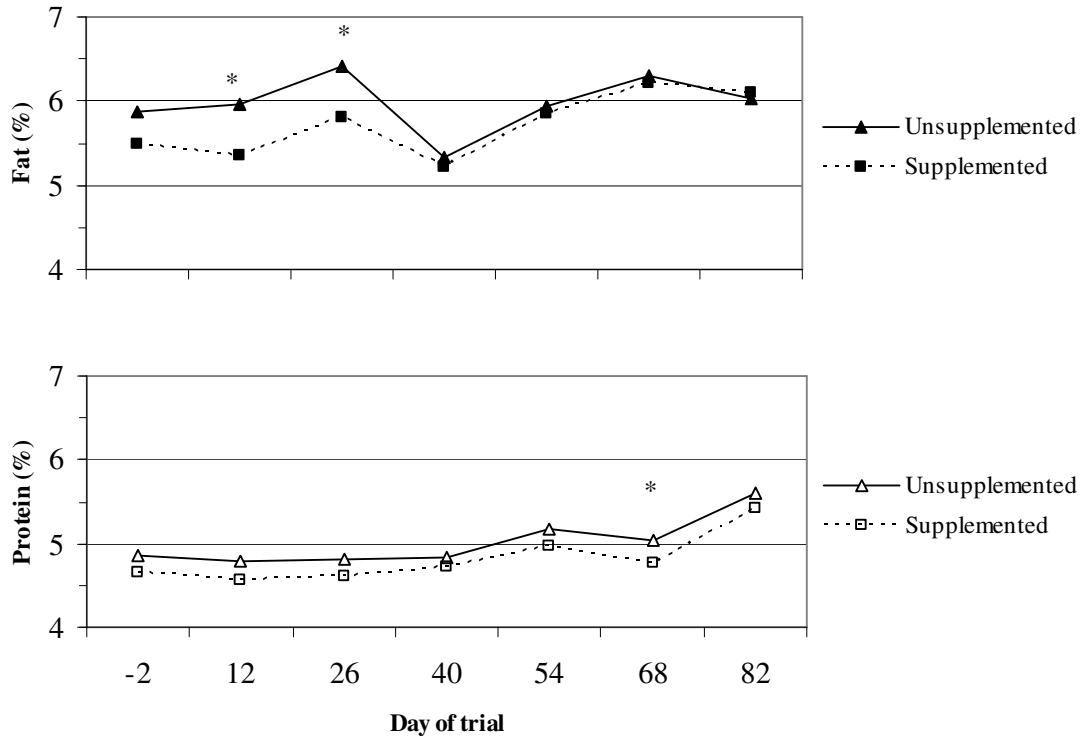


\* Least squares means within a test day are different ( $P < 0.05$ ).

Milk protein percentage was higher ( $P < 0.05$ ) on all test days except day 82 for late lactation ewes compared to early lactation ewes and significantly higher on days 12 and 26 (Figure 3). Averaged over all test days, late lactation ewes had a greater ( $P < 0.01$ ) milk protein percentage than early lactation ewes (5.02 vs. 4.86 %, respectively). This supports previous reports in which milk protein percentage increases throughout lactation as milk production decreases (Cappio-Bolino et al., 1997). Milk protein percentage is less influenced by diet than milk fat percentage (Nudda et al., 2002) and shows less variation during the trial than milk fat percentage (Figures 3 and 4). Unsupplemented ewes had a higher milk protein percentage than supplemented ewes on each test day (only significant on day 68; Figure 4), and the values averaged over tests days were significantly different (4.84 vs. 5.04 %, respectively; Table 2).



**Figure 4:** Average test day milk fat and milk protein percentages for supplementation treatments.



\* Least squares means within a test day are different ( $P < 0.05$ ).

Estimated total milk production over the 82-d trial and average milk fat and milk protein percentage of the total milk produced is presented in Table 3. Early lactation ewes produced more ( $P < 0.01$ ) milk (+ 41.3 kg), FCM (+ 39.0 kg), and FPCM (+ 37.3 kg) than late lactation ewes during the trial period. Ewes in both stages of lactation produced milk with a similar fat percentage, and early lactation ewes produced more ( $P < 0.01$ ) milk fat than late lactation ewes (7.77 vs. 5.31 kg, respectively) due to the greater milk production. Late lactation ewes had a similar milk protein percentage compared to early lactation ewes, but they produced less ( $P < 0.01$ ) total milk protein (4.61 vs. 6.27 kg, respectively) due to lower milk production.

Even though supplemented ewes had greater mean values for total milk production than unsupplemented ewes (milk: + 19.7 kg; FCM: + 14.0 kg; FPCM: + 13.3 kg), the differences between supplementation treatments were not significantly different from zero (Table 3). Since supplemented ewes produced more ( $P < 0.01$ ) milk than unsupplemented ewes (Table 2) on individual test days, the lack of statistical significance between supplementation treatments for total milk production is probably due to the fewer number of observations for the latter trait. As in the case of total milk production, total fat and total protein production were greater for supplemented than unsupplemented ewes, but the differences were not statistically significant.

**Table 3:** Total milk production and milk composition during the trial of stage of lactation and supplementation treatments.

	Stage of lactation <sup>a</sup>			Supplement level <sup>b</sup>		
	Late	Early		No supplement	Supplement	
No. of ewes	10	46		28	28	
	mean ± se	mean ± se	<i>P</i> <	mean ± se	mean ± se	<i>P</i> <
Milk, kg	95.6 ± 12.7	136.9 ± 5.9	0.0047	106.4 ± 9.9	126.1 ± 9.9	0.1672
Fat %	5.58 ± 0.25	5.79 ± 0.12	0.4671	5.86 ± 0.20	5.50 ± 0.20	0.1983
Fat, kg	5.31 ± 0.67	7.77 ± 0.31	0.0016	6.16 ± 0.52	6.91 ± 0.52	0.3141
Protein %	4.80 ± 0.14	4.65 ± 0.06	0.3172	4.85 ± 0.12	4.60 ± 0.12	0.1033
Protein, kg	4.61 ± 0.52	6.27 ± 0.24	0.0059	5.09 ± 0.41	5.80 ± 0.41	0.2254
FCM, kg	85.9 ± 10.8	124.9 ± 5.0	0.0018	98.4 ± 8.4	112.4 ± 8.4	0.2401
FPCM, kg	84.1 ± 10.3	121.4 ± 4.8	0.0020	96.4 ± 8.1	109.7 ± 8.1	0.2419

<sup>a</sup> Late lactation ewes are 136 ± 9 DIM, early lactation ewes 21 ± 10 DIM.

<sup>b</sup> Supplement received 0.80 kg DM/d.

**Pastures.** Herbage availability in each paddock ranged from 854 to 2561 kg DM/ha with an average of 1504 kg DM/ha. Stocking rates were adjusted to allow for at least 2.84 kg DM/ewe/d. Post-grazing herbage allowance, measured once per week, was always greater than 4.24 kg DM/ewe, indicating that ewes had sufficient pasture DM available. Herbage mass per hectare and per ewe before grazing was highest at the beginning of the season and decreased towards the end of the summer.

The quality of available pasture remained high throughout the trial as a result of pasture management, which included intensive rotational grazing and clipping paddocks after grazing. Fiber and protein levels varied throughout the trial as a result of changes in pasture composition, including changes in the relative proportions of grass and legume. Pasture CP averaged 24.2 % but ranged from 16.6 to 30.6 %, and NDF averaged 36.0 % and ranged from 22.6 to 51.9 % (Table 4). The paddocks with the most kura clover and least orchardgrass had the highest CP and lowest NDF values, and the paddocks with the greatest percentage of grass and the least kura clover had the lowest CP and highest NDF values.

**Table 4:** Mean pasture quality measurements.

	n	mean ± s.e.
Neutral detergent fiber <sup>a</sup>	30	36.0 ± 9.1
Crude protein <sup>a</sup>	30	24.2 ± 4.1
Lignin <sup>b</sup>	3	3.2 ± 0.4
Digestibility <sup>c</sup>	40	66.9 ± 4.3

<sup>a</sup> Forage samples collected from May 25 to August 15.

<sup>b</sup> Forage sample collected during fecal sampling period for dry matter intake estimation.

<sup>c</sup> Calculated based on acid detergent lignin % of forage and individual ewe fecal sample.

**Intake estimates.** Estimates of pasture DMI and total DMI are presented in Table 5. Pasture DMI was not significantly different between supplementation or stage of lactation treatments. Pasture DMI averaged 1.63 kg/d for unsupplemented ewes and 1.53 kg/d for supplemented ewes. Early lactation ewes consumed, on average, more pasture DM than late

lactation ewes (1.66 vs. 1.50 kg/d, respectively). Total DMI of supplemented ewes was estimated by adding pasture DMI to the DM of grain offered in the parlor (0.80 kg DM/d). This calculation led to a significant difference ( $P < 0.01$ ) in total DMI between supplemented and unsupplemented ewes (2.33 vs. 1.63 kg/d, respectively). These results support a previous study of lactating ewes grazing pasture with a high forage allowance in which supplemented ewes consumed more organic matter than unsupplemented ewes (2.2 vs. 1.9 kg/d, respectively; Young et al., 1980). Total DMI was not significantly different between early and late lactation ewes (1.90 vs. 2.05 kg/d, respectively).

**Table 5:** Pasture dry matter intake and total dry matter intake of stage of lactation and supplementation treatments.

No. of ewes	Stage of lactation <sup>a</sup>			Supplement level <sup>b</sup>		
	Late	Early	$P <$	No supplement	Supplement	$P <$
	18	17		18	17	
	mean $\pm$ se	mean $\pm$ se		mean $\pm$ se	mean $\pm$ se	
Pasture DMI, kg/d	1.50 $\pm$ 0.14	1.66 $\pm$ 0.14	0.4374	1.63 $\pm$ 0.14	1.53 $\pm$ 0.14	0.6350
Total DMI, kg/d	2.05 $\pm$ 0.14	1.90 $\pm$ 0.14	0.4374	1.63 $\pm$ 0.14	2.33 $\pm$ 0.14	0.0011

<sup>a</sup> Late lactation ewes are 136  $\pm$  9 DIM, early lactation ewes 21  $\pm$  10 DIM.

<sup>b</sup> Supplement received 0.80 kg DM/d

While the DMI estimates of this study are similar to the findings of Young et al. (1980), DMI of lactating dairy ewes is stated to reach 4 to 6 % of BW (Cannas, 2002). Estimates of both pasture DMI (1.3 % of BW) and total DMI (1.8 % of BW) in this study were below those stated by Cannas (2002), but his recommendations are based on ewes with much lower BW (Cannas, personal communication). The larger ewes in this trial may have a greater intestinal capacity and may consume less DM as a % of BW due to increased feed retention time and fiber utilization. Analysis of the supplemented and unsupplemented rations using the Cornell Net Carbohydrate and Protein System for Sheep (Cannas et al., 2003), predicted total DMI estimates higher than calculated DMI for both groups (supplemented 3.28 vs. 2.25 kg/d, unsupplemented 3.01 vs. 1.63 kg/d, respectively), suggesting that the titanium dioxide procedure may have underestimated pasture DMI.

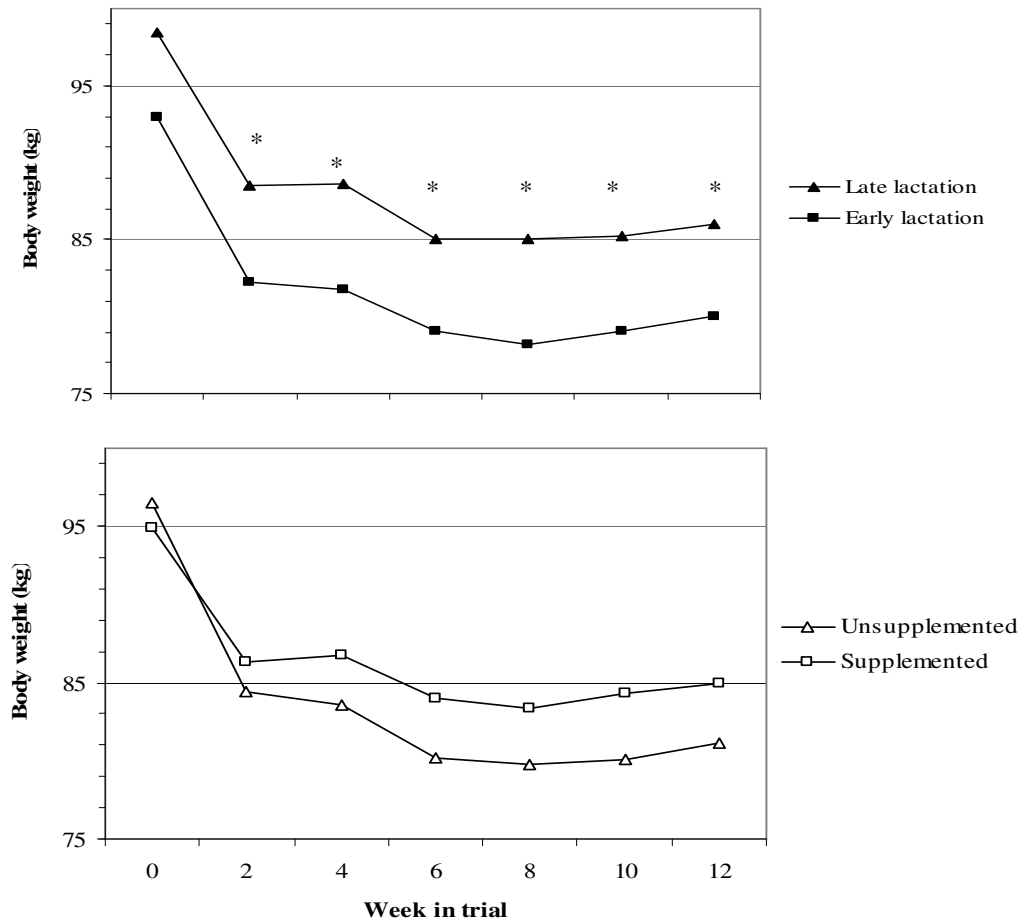
The fecal recovery of the external marker may be affected by forage type (Judkins et al., 1990). Support for the use of TiO<sub>2</sub> in sheep was demonstrated by the excretion pattern of TiO<sub>2</sub> and chromic oxide (Cr<sub>2</sub>O<sub>3</sub>) in sheep consuming bromegrass hay (Myers et al., 2006), which may have different recovery rates in ewes consuming the highly digestible kura clover- orchardgrass pastures used in this study. Myers et al. (2006) found that the concentration of TiO<sub>2</sub> in the feces was consistently higher than Cr<sub>2</sub>O<sub>3</sub>, which may account for low estimates of fecal output and DMI. In addition, estimates of digestibility based on ADL may be affected by the low lignin content in the forage sample, which averaged 3.2%. Van Soest (1994) recommended using ADL to determine digestibility in forage samples above 5% lignin due to incomplete recovery.

**Body weight and body condition score.** There was no significant interaction of stage of lactation and supplementation treatment for body weight (BW) or body condition score (BCS). The main effects of stage of lactation and supplementation on BW, change in BW, and BCS are plotted in Figures 5, 6 and 7, respectively. There was no significant difference in average body

weight of ewes between the supplementation treatments at the start of the trial. During the trial, supplemented ewes weighed, on average, more ( $P < 0.05$ ) than unsupplemented ewes (86.4 vs. 83.7 kg, respectively). Late lactation ewes were heavier ( $P < 0.05$ ) than early lactation ewes at the start of the trial and maintained significantly greater BW for the whole trial, weighing an average of 88.1 kg and 81.9 kg, respectively. All treatment groups reached their lowest weight during the eighth week and gained weight for the last four weeks (Figure 6).

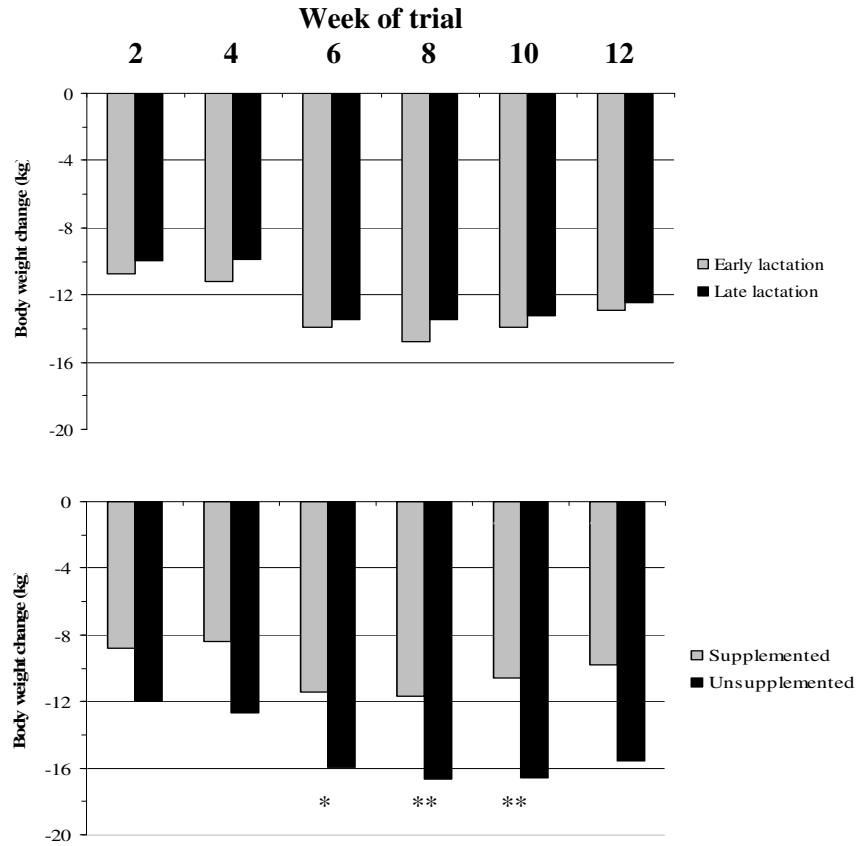
Body condition score values generally reflected changes in BW; by the end of the trial, supplemented ewes had a higher BCS than unsupplemented ewes, and late lactation ewes had higher average BCS than early lactation ewes (Figure 7). However, the differences in BCS were not significant on any test day between supplementation or stage of lactation treatments. Between supplementation treatments, the difference between average BCS over the trial approached significance ( $P = 0.059$ ), with supplemented ewes having a greater BCS than unsupplemented ewes.

**Figure 5:** Average body weight of ewes in stage of lactation and supplementation treatments.



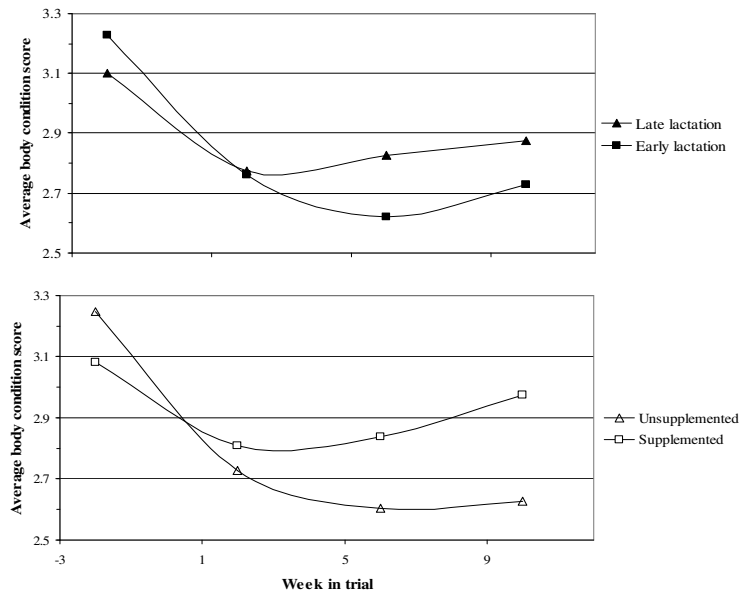
\* Least squares means within a test day are different ( $P < 0.05$ ).

**Figure 6:** Average change in body weight relative to initial weight for ewes in stage of lactation and supplementation treatments.



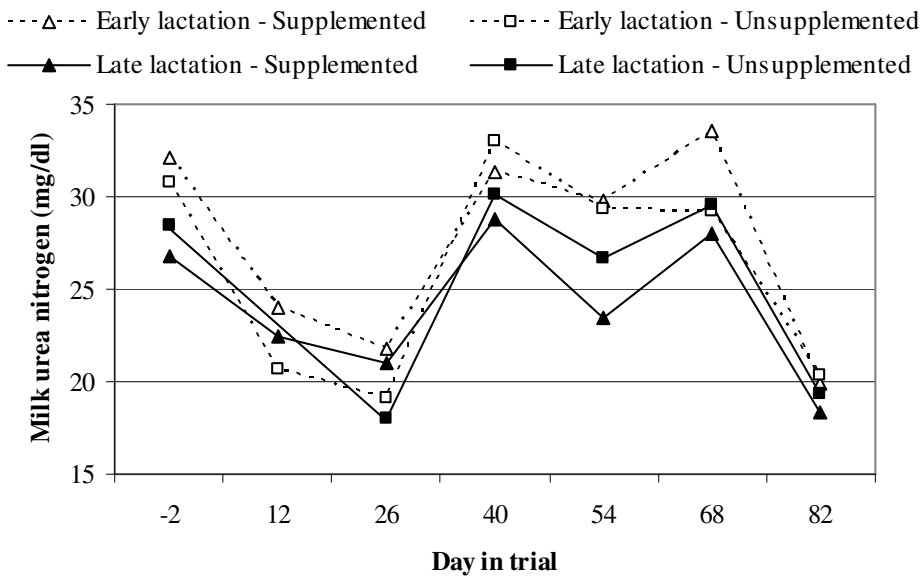
\* Least squares means within a stage of lactation treatment are different ( $P < 0.1$ ).  
 \*\* Least squares means within a stage of lactation treatment are different ( $P < 0.05$ ).

**Figure 7:** Average body condition score of ewes in stage of lactation and supplementation treatments.



**Milk urea nitrogen.** Milk urea nitrogen (MUN) levels are closely related to blood urea nitrogen levels in sheep and can be used as an indicator of protein utilization (Cannas, 2002). There was no significant effect of stage of lactation or supplement level on MUN levels ( $P = 0.96$  and  $0.41$  respectively). Trial MUN values (Figure 8) tended to be higher than recommended levels for sheep (14 to 22 mg/dl; Cannas, 2002), indicating an excess of protein intake. This can be explained by the high quality pastures, which ranged in CP from 16 to 30 %.

**Figure 8:** Milk urea nitrogen concentration for stage of lactation and supplementation treatment combinations.

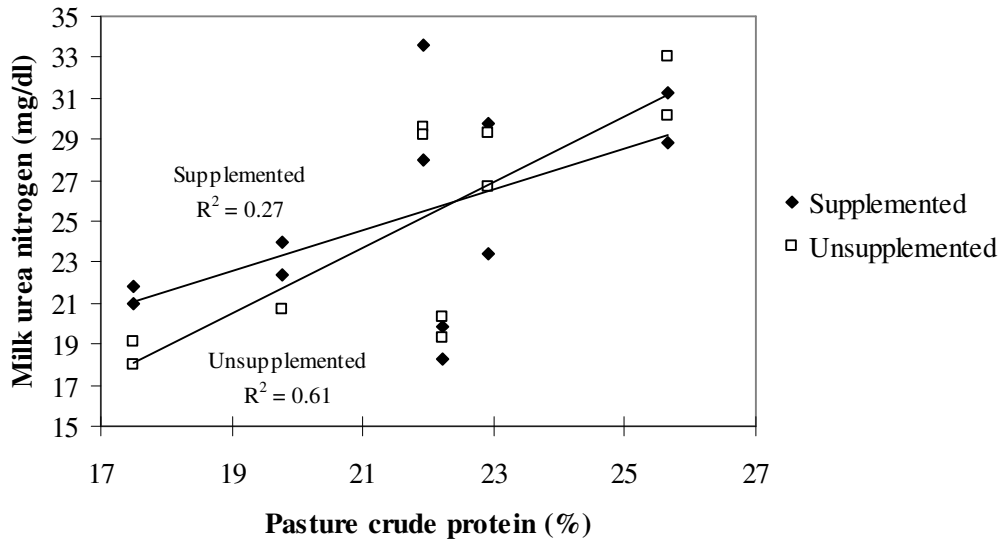


The utilization of dietary protein depends both on protein and energy intake. Across all treatments, the correlation between pasture crude protein and MUN was 0.65. Within the unsupplemented treatment, the correlation ( $0.78$ ,  $R^2 = 0.61$ ) was numerically higher, but not significantly different, than the correlation ( $0.52$ ,  $R^2 = 0.27$ ) within the supplemented treatment (Figure 9). Unsupplemented ewes were more dependent on pasture for both protein and energy than supplemented ewes so a higher correlation between pasture CP and MUN would be expected in unsupplemented ewes. Supplemented ewes had energy available from the concentrate to utilize dietary protein, but the supplement also was 18 % CP, confounding the effects of energy from the supplement on protein utilization from the pasture.

Milk urea nitrogen analysis, commonly used in the United States, measures the concentration of nitrogen, which makes up approximately 46.66 % of the urea molecule. Milk urea nitrogen values can approximate the concentration of the total urea molecule, or milk urea (MU), which is the general analysis in European countries. Cannas (2002) developed a linear relationship between MU and CP (% of DM), based on studies with varying sources of protein, in which  $MU \text{ (mg/dl)} = 4.5 \text{ CP} - 38.9$ . In this trial, the regression equation generated from MUN data collected on the unsupplemented ewes is  $MU \text{ (mg/dl)} = 3.43 \text{ CP} - 21.24$ . Both equations give similar

results, so an average pasture CP value of 23 % corresponds to 64.6 and 57.0 mg/dl MU, respectively, or 30.1 and 26.6 mg/d MUN, respectively.

**Figure 9:** Relationship between milk urea nitrogen and test day pasture crude protein for supplementation treatments.



These high MUN values in all treatments suggest that pasture protein content was sufficient to meet the nutritional requirements of the ewes. Additional energy in the supplemented treatment did not improve the utilization of pasture protein, due to the protein content of the supplement. High MUN values have been associated with excess protein intake and low reproductive efficiency in Italian dairy ewes and Cannas (2002) suggests that ammonia detoxification may increase the energy requirements of ewes. In addition, providing supplemental protein to grazing ewes is expensive and, if unnecessary, will reduce farm profitability.

### Summary and Conclusions

Total milk, fat, and protein production in grazing dairy ewes was higher for ewes in early compared to late lactation. Supplementation had a similar positive effect on daily milk yield of grazing ewes in both early and late lactation when compared to the unsupplemented treatment. In the United States, sheep milk prices are currently based on milk quantity without regard to milk composition. Based on an average increase in milk production of 19.7 kg valued at \$1.32/kg, and 0.82 kg of supplement provided for 82 days, as long as the supplement costs less than \$ 0.39/kg (or \$ 0.18/lb.), supplementation is profitable. While test day milk fat and milk protein percentages were significantly higher for unsupplemented ewes, the significant increase in test day milk production of supplemented ewes resulted in greater total milk fat and milk protein with supplementation. Pasture DMI was not significantly affected by stage of lactation or supplementation, but early lactation and supplemented ewes did consume numerically higher kg of pasture DM than late lactation and unsupplemented ewes, respectively, suggesting the ability of ewes to regulate intake to meet production requirements. Milk urea nitrogen values suggested that rotationally grazed, mixed grass-legume pastures provided excess protein to

lactating ewes. The high protein and high energy supplement did not significantly improve the utilization of pasture protein, suggesting the need for future research on supplementation with a feedstuff high in energy and lower in protein.

## References

- Berger, Y. M., and D. L. Thomas. 2004. Milk testing, calculation of milk production, and adjustment factors. Pages 55-62 in Proc. 10<sup>th</sup> Annual Great Lakes Dairy Sheep Symp. Univ. Wisconsin, Madison.
- Bencini, R. and G. Pulina, 1997. The quality of sheep milk: A review. *Aust. J. Exp. Agric.* 37:485-504.
- Bransby, D. I., A. G. Matches, and G. F. Krause. 1977. Disk meter for rapid estimation of herbage yield in grazing trials. *Agron. J.* 69:393-396.
- Boundy, T. 1982. Body Condition Scoring of Sheep. Pages 22-24 in *The Progressive Sheep Breeder*. Shoreham, VT.
- Cannas, A. 2002. Feeding of lactating ewes. Pages 123-166 in *Dairy Sheep Feeding and Nutrition*. G. Pulina, ed. Avenue Media, Bologna, Italy.
- Cannas, A., A. Cabiddu, G. Bomboi, S. Ligios, and G. Molle. 2003. Effects of dietary non-fibre carbohydrates concentration on intake, in vivo digestibility and milk yield in Sarda ewes. Page 344 in Proc. 54th Int. Meet. EAAP, Rome, Italy. (Abstr.)
- Cappio-Borlino, A., B. Portolano, M. Todaro, N. P. Macciotta, P. Giaccone, and G. Pulina. 1997. Lactation curves of Valle del Belice dairy ewes for yields of milk, fat, and protein estimated with test day models. *J. Dairy Sci.* 80:3023-3029.
- Carta, A., S. R. Sanna, and S. Casu. 1995. Estimating lactation curves and seasonal effects for milk, fat and protein in Sarda dairy sheep with a test day model. *Livest. Prod. Sci.* 44:37-44.
- D'Urso, G., M. Avondo, and L. Biondi. 1993. Effects of supplementary feeding on grazing behavior of Comisana ewes in a Mediterranean semi-extensive production system. *Anim. Feed Sci. Technol.* 42:259-272.
- Food and Agriculture Organization of the United Nations. 2006. Subject: sheep milk cheese. <http://www.fao.org/es/ess/toptrade/trade.asp>. Accessed August 21, 2006.
- Judkins, M. B., L. J. Krysl, and R. K. Barton. 1990. Estimating diet digestibility : A comparison of 11 techniques across six different diets fed to rams. *J. Anim. Sci.* 68: 1405-1415.
- Milne, J. A., T. J. Maxwell, and W. Souter. 1981. Effect of supplementary feeding and herbage mass on the intake and performance of grazing ewes in early lactation. *Anim. Prod.* 32:185-189.
- Myers, W. D., P. A. Ludden, V. Nayigihugu, and B. W. Hess. 2004. Technical Note: A procedure for the preparation and quantitative analysis of samples for titanium dioxide. *J. Anim. Sci.* 82:179-83.
- Myers, W. D., P. A. Ludden, V. Nayigihugu, and B. W. Hess. 2006. Excretion patterns of titanium dioxide and chromic oxide in duodenal digesta and feces of ewes. *Small Rumin. Res.* 63:135-41.
- Nudda, A., G. Battacone, R. Bencini, and G. Pulina. 2002. Nutrition and milk quality. Pages 197-228 in *Dairy Sheep Feeding and Nutrition*. G. Pulina, ed. Avenue Media, Bologna, Italy.
- Penning, P. D., R. J. Orr, and T. T. Treacher. 1988. Responses of lactating ewes, offered fresh herbage indoors and when grazing, to supplements containing different protein concentrations. *Anim. Prod.* 46:403-415.



- Pulina, G. 2002. Dairy Sheep Feeding and Nutrition. Avenue Media, Bologna, Italy.
- Pulina, G., A. Serre, A. Cannas, and G. Rossi. 1989. Determinazione e stima del valore energetico di latte di pecore di razza sarda. Pages 1867-1870 in Proc. XLIII Congress S.I.S.VET., Italy.
- Reis, R. B., and D. K. Combs. 2000. Effects of increasing levels of grain supplementation on rumen environment and lactation performance of dairy cows grazing grass-legume pasture. *J. Dairy Sci.* 83:2888-2898.
- Robertson, J. B., and P. J. Van Soest. 1981. The detergent system of analysis and its application to human foods. Pages 123-158 in *The Analysis of Dietary Fiber Food*. W. P. T. James and O. Theander, ed. Marcel Dekker, New York, NY.
- SAS. 1999. SAS/STAT. User's Guide, Version 8.2 SAS Institute Inc., Cary, NC.
- Thomas, D.L. 2004. Overview of the dairy sheep sector in Canada and the United States. Pages 166-177 in Proc. of the 10th Great Lakes Dairy Sheep Symp., Univ. Wisconsin, Madison.
- Van Soest, P. J. 1994. Nitrogen Metabolism. Pages 290-311 in *Nutritional Ecology of the Ruminant*. Cornell University Press, Ithaca, NY
- Young, N. E., J. E. Newton, and R. J. Orr. 1980. The effect of a cereal supplement during early lactation on the performance and intake of ewes grazing perennial ryegrass at three stocking rates. *Grass Forage Sci.* 35:197-202.

## EFFECT OF PREPARTUM PHOTOPERIOD ON PROLACTIN AND MILK PRODUCTION OF DAIRY EWES

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### Summary

Increased photoperiod during lactation increases milk production in dairy cattle (Peters et al., 1978) and dairy ewes (Bocquier et al., 1997), but decreased prepartum photoperiod has a positive effect on subsequent milk production in dairy cattle (Auchtung et al., 2005). The objective of this study was to determine the effect of prepartum photoperiod on milk production, milk composition, and prolactin levels of 22 multiparous dairy ewes. Ewes exposed to short-day photoperiods (8 h light; SDPP) for approximately six weeks prepartum produced an average of 0.12 kg/d more milk ( $P < 0.10$ ) on each test day over the first eight weeks of lactation than ewes exposed to long-day photoperiods (16 h light; LDPP). Average daily milk fat percentage was higher ( $P < 0.0001$ ) in SDPP ewes than LDPP ewes (6.02 vs. 5.44 %, respectively). Average daily milk protein percentage was higher ( $P < 0.10$ ) in SDPP ewes than LDPP ewes (4.55 vs. 4.44 %, respectively). Due to both more daily milk and higher milk fat and milk protein percentages, SDPP ewes produced more 6.5 % fat corrected milk (FCM; + 0.21 kg/d;  $P < 0.05$ ), and 6.5 % fat and 5.8 % protein corrected milk (FPCM; + 0.20 kg/d;  $P < 0.05$ ) than LDPP ewes. Over approximately 121 days in milk, SDPP ewes produced more test day milk ( $P < 0.01$ ) than LDPP ewes (1.68 vs. 1.48 kg/d, respectively), but there were no differences in milk fat or protein percentages. Both treatments experienced a prolactin surge at lambing, but SDPP ewes had lower circulating prolactin ( $P < 0.05$ ) than LDPP ewes from 7 d before to 0.5 d after lambing. Previous studies in dairy cattle also found that prepartum prolactin levels were inversely related to subsequent milk production. Decreased prepartum photoperiod may be important in increasing milk production in dairy ewes.

### Background

Annual milk production of dairy ewes at the Spooner Agricultural Research Station increased from 1996 to 2004 (Berger, 2005). In an analysis of factors contributing to this progress, Berger noted effects of dairy genetics, breed composition and weaning system, findings supported by previous authors (Bencini and Pulina, 1997; McCusick et al., 2001). Some of the increase in milk production was attributed to lengthening lactation due to lambing month. Lambing has gradually moved closer to January, and dry off has remained in early fall, increasing the number of days ewes are lactating. In addition, ewes are milking during the increasing daylengths of spring and summer and are likely responding to the known positive effects of increasing photoperiod during lactation on milk production (Bocquier et al., 1997). Lactating ewes exposed to long day photoperiods (16 h light; LDPP) for the first 5 months of lactation produced 25% more total milk than ewes exposed to short day photoperiods (8 h light; SDPP). At the end of the

light treatments, when all ewes were switched to equilibrated day lengths (12 h light), the LDPP ewes experienced a 37% decrease in milk production over the next six weeks while SDPP ewes only experienced an 8% decrease in milk production (Bocquier et al., 1997). A similar effect of LDPP on established lactation has been observed in dairy cows over a range of production levels and stages of lactation (reviewed by Dahl et al., 2000).

While there is evidence that photoperiod affects milk production during lactation, recent studies in dairy cows have shown that prepartum photoperiod also affects mammary development and subsequent milk production. Cows experiencing short days during the dry period produced more milk than those exposed to long days. Milk production in short-day treated dairy cattle was 3.2 kg/d greater than long-day treated cattle during the first 16 weeks of lactation, following a prepartum treatment period of 60 d (Miller et al., 2000). The proposed mechanism of action is the effect of photoperiod on circulating prolactin.

Based on previous work on the interaction of prolactin and the mammary gland, there is an inverse relationship between circulating prolactin levels and the expression of prolactin receptor mRNA in the liver, lymphocytes and mammary tissue of steers (Auchtung et al., 2003) and cows (Auchtung et al., 2005). Auchtung et al. (2005) found that cows in SDPP treatments for 60 d prepartum had lower levels of circulating prolactin than those in LDPP at both 33 and 5 days before calving. Prolactin returned to similar levels 2 days after calving. Cows experiencing SDPP also had increased expression of prolactin receptor mRNA. Thus, SDPP cows would be more sensitive to the natural periparturient prolactin surge, possibly experiencing enhanced proliferation and survival of mammary cells (Auchtung et al., 2005; Wall et al., 2005) due to the critical role of prolactin in mammary gland development.

During mammogenesis, prolactin promotes expansion of mammary ducts in rats (Akers, 2002). The expansion of these alveolar ducts is critical for complete development of the mammary gland and maximization of milk producing surface area on secretory epithelial cells. In sheep, when prolactin production is blocked for 30 days prepartum, ewes produce significantly less milk during the first two weeks of lactation than untreated ewes (Hooley et al., 1978). Prolactin is thought to play a role in the commitment of mammary cells to produce milk, and manipulation of the signaling to these cells through prolactin mRNA may affect the number of cells available for milk production.

Initial analysis of prepartum prolactin levels in dairy sheep have found prepartum responses to photoperiod. Pregnant ewes (90 days in gestation) exposed to LDPP had higher prepartum plasma prolactin levels than ewes exposed to SDPP after 30 days of light treatment (Perier et al., 1986). Bassett (1992) found this difference in prolactin levels after three weeks of light treatment, but found no difference in growth of lambs nursing ewes in each photoperiod treatment. While this study noted an increase in udder size of long day ewes, this was substantially influenced by the number of fetuses, with larger udders found in ewes bearing two or more fetuses and may not have been affected by photoperiod. This study was conducted to determine the effect of pre-lambing photoperiod on circulating prolactin, milk production and milk composition in dairy ewes.

## Methods and Materials

The study was conducted at the University of Wisconsin-Madison campus and all procedures were approved by the Animal Care and Use Committee of the College of Agriculture and Life Sciences. Twenty-two multiparous, 4-yr-old dairy ewes were randomly assigned to one of two photoperiod treatments: LDPP (16 h light; 8 h dark; n=11) or SDPP (8 h light; 16 h dark; n=11). Previous year's mean milk production was not significantly different between ewes on the SDPP and LDPP treatments (123.5 vs. 117.6 kg, respectively). Previous year's milk fat and milk protein percentages also were not significantly different between SDPP and LDPP treatment groups (5.2 vs. 5.0 % fat, respectively; 4.3 vs. 4.2 % protein, respectively).

Photoperiod treatments began approximately 6 wk before lambing. Ewes were housed in a climate controlled environment (17° C and 30 to 70 % relative humidity). Light exposure averaging 365 lux at sheep-eye level (0.76 m above the floor) was provided by fluorescent lights and controlled by an automatic timer. Lights were turned on at 0700 h daily and turned off at 1500 h and 2300 h for the SDPP and LDPP treatments, respectively. Following parturition, lambs were removed within 12 h of lambing. Ewes were moved from photoperiod treatment rooms to the milking room, where all ewes were managed together and experienced a photoperiod of 12 h light and 12 h dark. Four SDPP ewes experiencing hoof problems related to the flooring in the light treatment rooms were moved to the milking room 6 to 9 days prior to lambing and blood samples during this time period were removed from the analysis. Milk production data from these ewes remained in the analyses.

Pre- and post-lambing feeding consisted of ad libitum alfalfa silage and 0.9 kg/d of whole corn. Ewes had free access to minerals and water. Following parturition, ewes were milked twice per day, at 0700 h and 1700 h. On April 10, all ewes were moved to the Spooner Agricultural Research Station and integrated into the resident milking flock. During this post-trial period, all ewes received the same amount of silage and corn supplement. All ewes were moved to pasture on May 16 and continued to receive corn in the milking parlor. Silage feeding was discontinued while ewes were on pasture, but due to a summer drought, silage feeding was resumed in mid-summer.

**Table 1:** Composition of alfalfa haylage fed to ewes during pregnancy and the trial period of lactation.

Composition	% of DM
Crude protein	17.53
Neutral detergent fiber	47.97
Non-fiber carbohydrates	22.80
Lignin	6.89
Fat	3.20

**Data and sample collection.** During the trial period on campus, daily milk production for individual ewes was measured twice weekly, using a graduated Waikato Goat Meter (Inter Ag, New Zealand) by combining the amount of milk obtained at an evening and subsequent morning milking. Weekly milk samples from the morning milking were analyzed for percentage fat and

percentage protein (AgSource Milk Labs, Stratford, WI). Daily milk production, milk fat percentage and milk protein percentage were used to calculate 6.5 % fat corrected milk (FCM) and 6.5% fat and 5.8% protein corrected milk (FPCM), based on the following equations developed by Pulina et al. (1989):

$$\text{FCM} = \text{M} (0.37 + (0.097 \times \text{F}))$$

$$\text{FPCM} = \text{M} (0.25 + (0.085 \times \text{F}) + (0.035 \times \text{P}))$$

where:

M = milk yield (kg) and F and P = fat and protein concentration (%), respectively.

Estimated total trial milk production from lambing until April 10 was calculated based on the equations of Berger and Thomas (2004). Due to the variation in lambing date, trial days in milk (DIM) ranged from 34 to 63 d and averaged 53 d. Once ewes returned to the Spooner Agricultural Station, monthly milk production and milk composition data were recorded through July 10. Total DIM ranged from 104 to 130 DIM and averaged 121 DIM. Test day values were used to estimate post-trial production of milk, fat, protein, FCM and FPCM (Berger and Thomas, 2004). Post-trial percentage of fat and protein were calculated from estimates of total milk, total fat, and total protein produced.

Blood samples (20 ml/ewe) were collected from each ewe between 0800 h and 1000 h via the jugular vein twice weekly starting 6 weeks before lambing. Blood samples were collected into two 10ml, sterile evacuated tubes containing sodium heparin and immediately put on ice. Plasma was harvested by centrifugation at  $1850 \times g$  for 20 min at 4°C within 1 hr of collection. Plasma was stored at -20°C and analyzed using the PRL radioimmunoassay, as described by Miller et al. (1999).

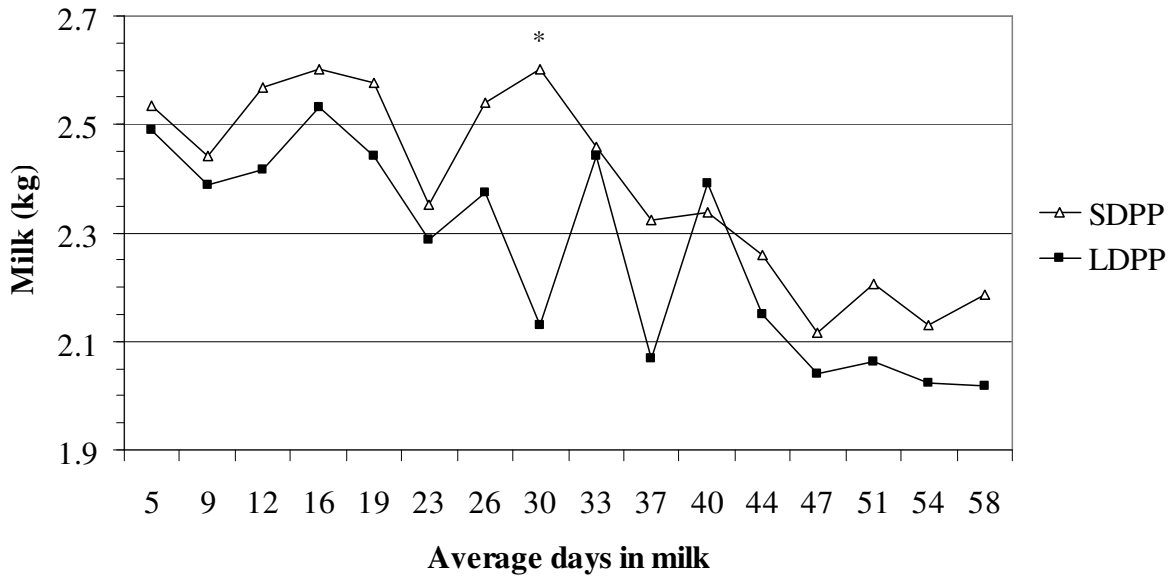
**Statistical analysis.** Statistical analyses were performed using SAS v.8.2 (1999). The PROC MIXED procedure was used to analyze test day milk production, milk composition, and prolactin concentrations; separately for the trial period and for the trial plus the post-trial period. The model for these repeated measures included the fixed effects of photoperiod treatment, test number and their interaction, and the random effects of ewes and residual. The PROC GLM procedure was used to analyze total lactation milk, fat, and protein production during the trial plus the post-trial periods. The model included the effects of photoperiod treatment, test number, their interaction and the residual. Least squares means and standard errors of the means are reported. Significance was declared at  $P < 0.05$  unless otherwise noted.

## Results and Discussion

Dairy ewes experiencing SDPP for six weeks prepartum produced more milk on most days of the trial (Figure 1) than LDPP ewes, and the difference was significant ( $P < 0.1$ ) on one test day. When averaged across all test days for the first eight weeks of lactation, SDPP ewes produced 0.12 kg/d more milk ( $P < 0.1$ ) than LDPP ewes (2.39 vs. 2.27 kg/d, respectively; Table 2). Average daily milk fat percentage was higher ( $P < 0.0001$ ) in SDPP ewes than LDPP ewes (6.02 vs. 5.44 %, respectively).

**Figure 1:** Mean test day milk production of SDPP and LDPP treatments during the trial period. Number of ewes in each treatment for each test:

DIM	5	9	12	16	19	23	26	30	33	37	40	44	47	51	54	58
SDPP	11	11	11	11	11	11	11	11	11	11	11	11	10	8	7	4
LDPP	11	11	11	11	11	11	11	11	10	10	9	9	9	8	8	5



\* Least squares means within a test day are different ( $P < 0.1$ ).

**Table 2:** Average test day milk production and milk composition of prepartum light treatment groups during 12 h light:12 h dark during the trial period (n=11 in each treatment; total DIM ranged from 34 to 63 and averaged 53).

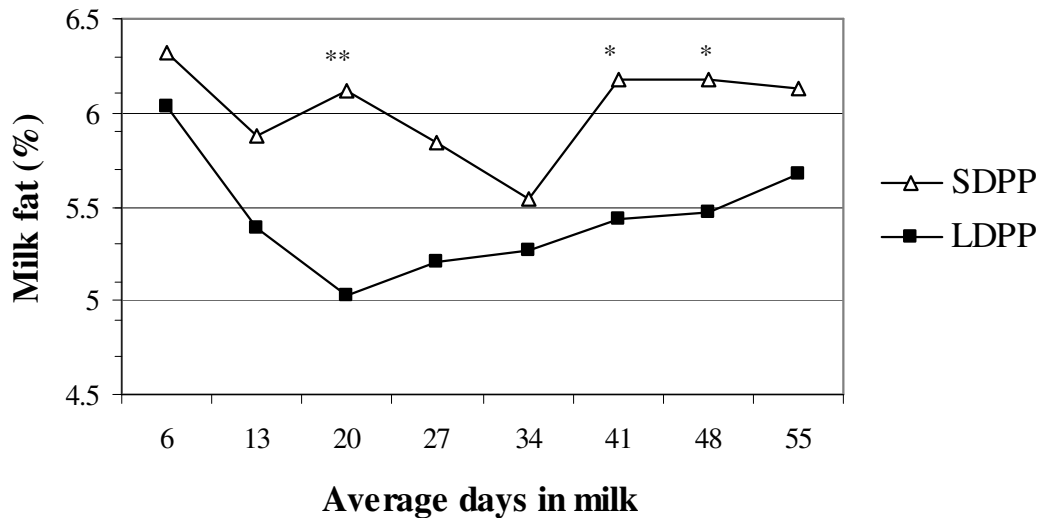
	SDPP mean $\pm$ se	LDPP mean $\pm$ se	$P <$
Milk, kg/d	2.39 $\pm$ 0.051	2.27 $\pm$ 0.051	0.0895
Fat, %	6.02 $\pm$ 0.102	5.44 $\pm$ 0.104	0.0001
Protein, %	4.55 $\pm$ 0.045	4.44 $\pm$ 0.046	0.0943
FCM, kg/d	2.29 $\pm$ 0.062	2.08 $\pm$ 0.063	0.0174
FPCM, kg/d	2.21 $\pm$ 0.059	2.01 $\pm$ 0.060	0.0185

Test day values for milk fat percentage were significantly different on three test days (Figure 2). Average daily protein percentage was higher in SDPP ewes than LDPP ewes (4.55 vs. 4.44 %, respectively,  $P < 0.1$ ). Test day milk protein percentages were different on one test day (Figure 3). Due to both greater daily milk production and higher milk fat and protein percentages, SDPP ewes produced, on average, more FCM (+ 0.21 kg/d;  $P < 0.05$ ), and FPCM (+ 0.20 kg/d;  $P < 0.05$ ) than ewes exposed to long days prepartum (Table 2). Ewes that experienced short day photoperiods produced more FCM than LDPP ewes on each test day, and

the difference was significant on one test day (Figure 4). Fat and protein corrected milk followed a similar pattern but none of the test day values were significantly different between light treatments (Figure 5).

**Figure 2:** Mean test day fat percentage of SDPP and LDPP treatments during the trial period. Number of ewes in each treatment for each test:

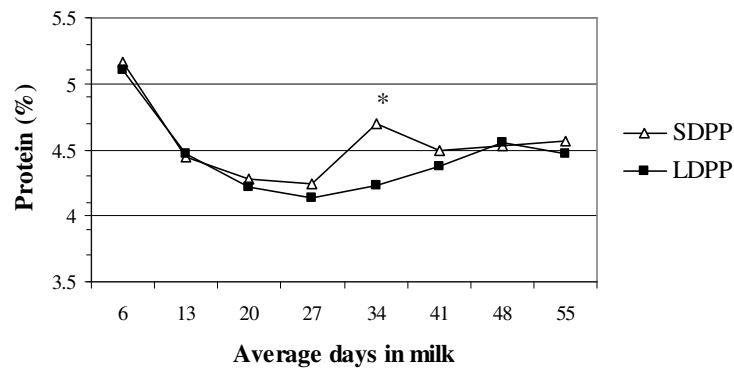
DIM	6	13	20	27	34	41	48	55
SDPP	11	11	11	11	11	11	10	7
LDPP	11	11	11	10	10	9	9	8



\* Least squares means within a test day are different ( $P < 0.1$ ).  
 \*\* Least squares means within a test day are different ( $P < 0.01$ ).

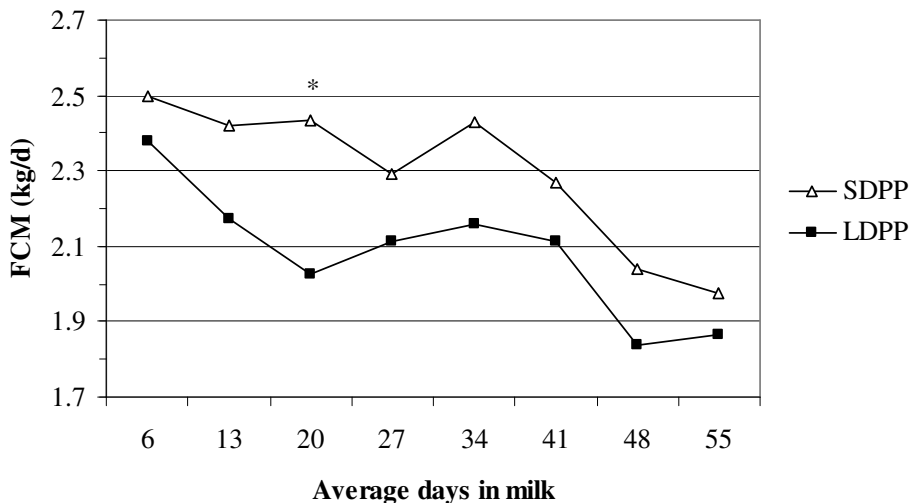
**Figure 3:** Mean test day protein percentage of SDPP and LDPP treatments during the trial period. Number of ewes in each treatment for each test:

DIM	6	13	20	27	34	41	48	55
SDPP	11	11	11	11	11	11	10	7
LDPP	11	11	11	10	10	9	9	8



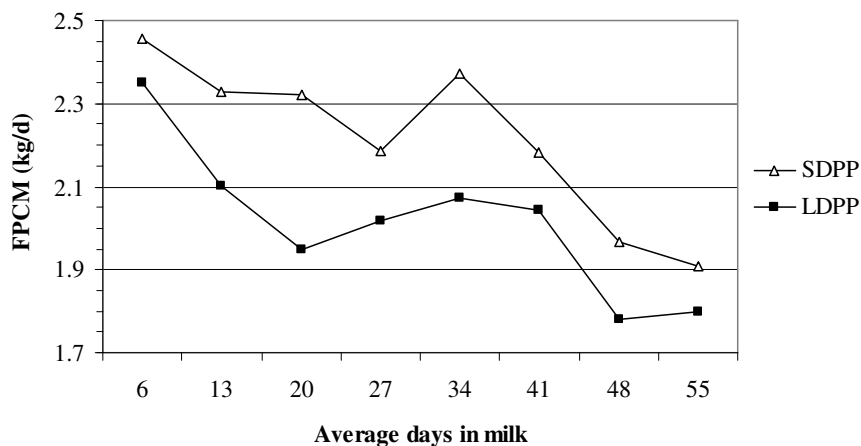
\* Least squares means within a test day are different ( $P < 0.01$ ).

**Figure 4:** Mean test day 6.5% fat corrected milk production of SDPP and LDPP treatments during the trial period.



\* Least squares means within a test day are different ( $P < 0.1$ ).

**Figure 5:** Mean test day 6.5% fat and 5.8 % protein corrected milk production of SDPP and LDPP treatments during the trial period.



Average test day and total milk production and composition from each treatment, which includes data from both the trial period on campus and post-trial period at the Spooner Agricultural Research Station, are presented in Table 3. During this time, SDPP produced an average of 0.2 kg/d more milk ( $P < 0.01$ ) than LDPP ewes (1.68 vs. 1.48 kg/d, respectively). While there was no significant difference in average test day milk fat or protein percentages, SDPP ewes produced more FCM (+ 0.18 kg/d;  $P < 0.01$ ), and FPCM (+ 0.17 kg/d;  $P < 0.01$ ) than LDPP ewes. After approximately 121 DIM, SDPP ewes produced more total milk (+ 26.5



kg), fat (+ 3.0 kg), protein (+ 0.9), FCM (+ 29.5), and FPCM (+ 28.4) than LDPP ewes (Table 3). However, these differences between treatments were not statistically significant ( $P > 0.20$ ). This lack of significance may result from reduced statistical power in analyses of the data; total production traits had only one measurement per ewe while test day traits had multiple observations per ewe.

**Table 3:** Average test day and total milk production and milk composition of prepartum light treatments during the trial and post-trial periods (n=11 in each treatment; total DIM ranged from 104 to 130 and averaged 121).

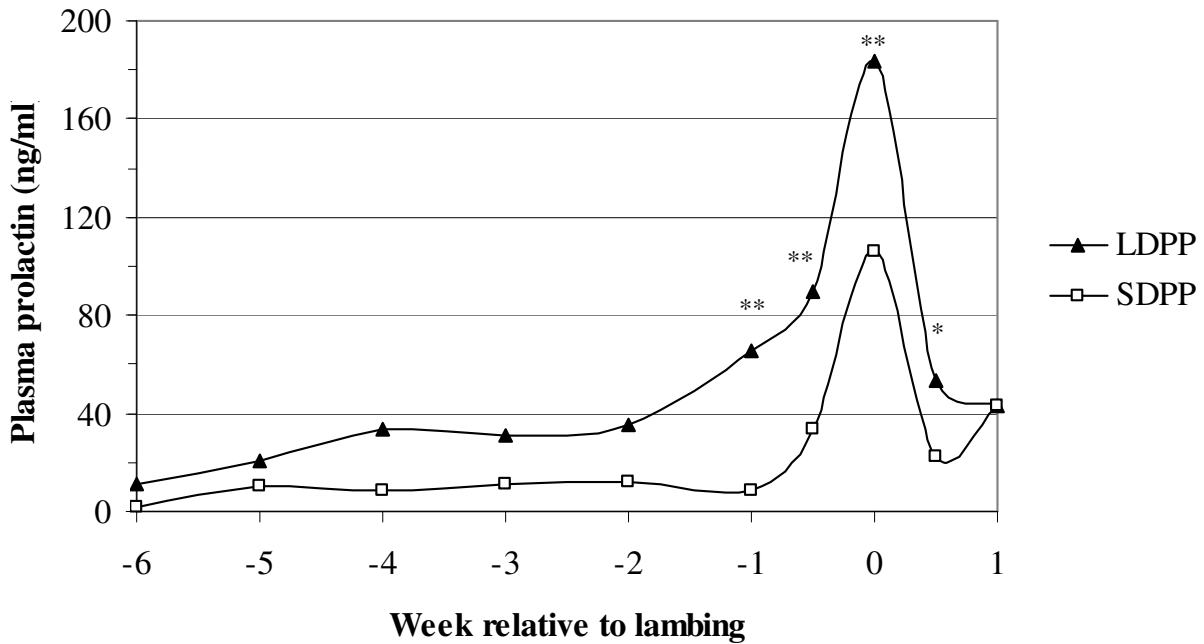
	SDPP mean $\pm$ se	LDPP mean $\pm$ se	$P <$
<u>Average</u>			
Milk, kg/d	1.68 $\pm$ 0.046	1.48 $\pm$ 0.046	0.0027
Fat, %	6.36 $\pm$ 0.114	6.51 $\pm$ 0.115	0.3527
Protein, %	5.16 $\pm$ 0.065	5.17 $\pm$ 0.065	0.9120
FCM, kg/d	1.65 $\pm$ 0.047	1.47 $\pm$ 0.047	0.0094
FPCM, kg/d	1.62 $\pm$ 0.046	1.45 $\pm$ 0.047	0.0098
<u>Total, kg</u>			
Milk	287.24 $\pm$ 16.1	260.72 $\pm$ 16.1	0.2580
Fat	18.83 $\pm$ 1.08	15.81 $\pm$ 1.08	0.2019
Protein	12.86 $\pm$ 0.88	11.95 $\pm$ 0.88	0.4748
FCM	279.65 $\pm$ 16.0	250.11 $\pm$ 16.0	0.2067
FPCM	272.75 $\pm$ 15.7	244.38 $\pm$ 15.7	0.2067

The results of this study support previous work in which cows exposed to SDPP for 42 (Velasco et al., 2006) or 60 d (Auchtung et al., 2005) prepartum produced more milk during the first 16 wk of lactation than animals exposed to LDPP. In our study, however, milk fat and protein percentages also were different between treatment groups; this has not been observed in previous prepartum photoperiod trials with dairy cattle.

Circulating prolactin levels were lower ( $P < 0.05$ ) for SDPP ewes than for LDPP ewes from 1wk before to 0.5 wk after lambing (Figure 6). These results support findings in dairy cattle, in which cows in SDPP treatments for 60 d prepartum had lower levels of circulating prolactin than those in LDPP at both 33 and 5 d before calving (Auchtung et al., 2005). In both studies, prolactin levels reached similar levels shortly after parturition.

Work by Akers et al. (1981a) demonstrated “ that the secretion of prolactin at parturition stimulates subsequent milk production in dairy cows and that prolactin plays a critical role in mammary differentiation for key biochemical steps involved in the synthesis of milk, especially those associated with lactose “. Therefore, a possible cascade of events to describe the effect of prepartum photoperiod on milk production may be: 1) short photoperiod in prepartum ruminants results in decreased circulating prolactin levels, 2) decreased prolactin levels stimulate the increased expression of mRNA for prolactin receptors, resulting in a greater number of prolactin receptors on mammary secretory epithelial cells, 3) the natural increase in circulating prolactin at parturition stimulates complete differentiation and commitment of mammary secretory epithelial cells to produce lactose, increasing milk production.

**Figure 6:** Mean concentration of plasma prolactin in SDPP and LDPP ewes.



\* Least squares means within a test day are different ( $P < 0.05$ ).  
 \*\* Least squares means within a test day are different ( $P < 0.001$ ).

### Summary and Conclusions

Dairy ewes exposed to SDPP for approximately 6 weeks prepartum produced more milk than ewes exposed to LDPP. Short days prepartum resulted in a decrease in prepartum circulating prolactin levels, which may have contributed to increased sensitivity of the mammary gland to circulating prolactin and an increase in milk production in the subsequent lactation. This may have implications for dairy sheep flocks, most of which lamb once per year. Dairy ewes in late pregnancy during times of the year with shorter day length (i.e. winter) might be expected to produce more milk than ewes in late pregnancy during times of the year with longer day length (i.e. spring). Prepartum photoperiod may be one of the factors contributing to the increase in milk production of the Spooner Agricultural Research Station flock from 1996 to 2004 (Berger, 2005).

### References

- Akers, R. M. 2002. Lactation and the mammary gland. Iowa State Press, Ames, IA.
- Akers, R. M., D. E. Bauman, A. V. Capuco, G. T. Goodman, and H. A. Tucker. 1981a. Prolactin regulation of milk secretion and biochemical differentiation of mammary epithelial-cells in periparturient cows. *Endocrinology*. 109:23-30.
- Auchtung, T. L., P. E. Kendall, J. L. Salak-Johnson, T. B. McFadden, and G. E. Dahl. 2003. Photoperiod and bromocriptine treatment effects on expression of prolactin receptor mRNA in bovine liver, mammary gland and peripheral blood lymphocytes. *J. Endocrinol.* 179:347-356.

- Auchtung, T. L., A. G. Rius, P. E. Kendall, T. B. McFadden, and G. E. Dahl. 2005. Effects of photoperiod during the dry period on prolactin, prolactin receptor, and milk production of dairy cows. *J. Dairy Sci.* 88:121-127.
- Bassett, J. M. 1992. Effects of additional lighting to provide a summer photoperiod for winter-housed pregnant ewes on plasma prolactin, udder development and lamb birthweight. *J. Agric. Sci.* 119:127-136.
- Bencini, R., and G. Pulina. 1997. The quality of sheep milk: A review. *Austr. J. Exp. Agric.* 37:485-504.
- Berger, Y. M. 2005. Evolution of milk production at the Spooner Agricultural Research Station between 1996 and 2004. Pages 6-13 in Proc. 11<sup>th</sup> Annual Great Lakes Dairy Sheep Symp., Ithaca, NY.
- Berger, Y. M. and D. L. Thomas. 2004. Milk testing, calculation of milk production, and adjustment factors. Pages 55-62 in Proc. 10<sup>th</sup> Annual Great Lakes Dairy Sheep Symp., Hudson, WI.
- Bocquier, F., S. Ligios, G. Molle, and S. Casu. 1997. Effet de la photopériode sur la production, la composition du lait et sur les consommations volontaires chez la brebis laitière. *Ann. Zootech. (Paris)*. 46:427-438.
- Hooley, R. D., J. J. Campbell, and J. K. Findlay. 1978. The importance of prolactin for lactation in the ewe. *J. Endocrinol.* 79:301-310.
- McKusick, B. C., D. L. Thomas, and Y. M. Berger. 2001. Effect of weaning system on commercial milk production and lamb growth of East Friesian dairy sheep. *J. Dairy Sci.* 84:1660-1668.
- Miller, A. R. E., R. A. Erdman, L. W., Douglas, and G. E. Dahl. 2000. Effects of photoperiod manipulation during the dry period of dairy cows. *J. Dairy Sci.* 83:962-967.
- Miller, A. R. E., E. P. Stanisiewski, R. A. Erdman, L. W. Douglas, and G. E. Dahl. 1999. Effects of long daily photoperiod and bovine somatotropin (Trobect®) on milk yield in cows. *J. Dairy Sci.* 82:1716-1722.
- Perier, A., F. Bocquier, G. Kann, and J. Martinet. 1986. Influence de la photoperiode et des apports energetiques pendant la gestation sur les taus plasmatiques de la prolactine, de l'hormone de crossiance et de l'hormone placentaire lactogene puis sur la production laitiere de la brebis traite. *Reprod. Nutr. Develop.* 26:391-391. (Abstr.)
- Peters, R. R., L. T. Chapin, K. B. Leining, and H. A. Tucker. 1978. Supplemental lighting stimulates growth and lactation in cattle. *Science.* 199:911-912.
- Pulina, G., A. Serre, A. Cannas, and G. Rossi. 1989. Determinazione e stima del valore energetico di latte di pecore di razza sarda. Pages 1867-1870 in Proc. XLIII Congress S.I.S.VET., Italy.
- SAS. 1999. SAS/STAT. User's Guide, Version 8.2 SAS Institute Inc., Cary, NC.
- Velasco, J. M., E. D. Reid, K. E. Karvetski, T. F. Gressley, R. L. Wallace, and G. E. Dahl. 2006. Short day photoperiod increases milk yield in cows with a reduced dry period length. *J. Anim. Sci.* 84(Suppl. 1):147. (Abstr.)
- Wall, E. H., T. L. Auchtung, G. E. Dahl, S. E. Ellis, and T. B. McFadden. 2005. Exposure to short day photoperiod during the dry period enhances mammary growth in dairy cows. *J. Dairy Sci.* 88: 1994-2003.

# **SHEEP BEHAVIOR AND ITS USE IN SHEEP MANAGEMENT**

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I am sure that we all stop now and again as we are working with our animals and just watch as they play, fight, groom themselves or eat. Animal behavior is an interesting part of raising animals. Behavior is also studied, not for amusement or idle curiosity, but to find ways to improve how we care for our animals. There are a number of different 'fields' of behavior that have developed, each of which has a major emphasis behind it. In this paper on the behavior of sheep, I will use examples from three of these fields: psychology, ethology, and behavioral ecology. There is a fair amount of overlap among these fields, even to the point that some of my examples would be classified differently by others. But the basic question is, "What behavior works well for an animal in a particular situation?"

## **Psychology: Learning**

The study of learning has been closely associated with the field of psychology. In most learning situations an animal must link the performance of a behavior with its outcome. You may have had sheep that learned to lift the latch on a gate, resulting in their being able to escape from the yard or pen. This was used in New Zealand as a means to move sheep through the various holding pens at the slaughter plant. One sheep, that was not to be slaughtered, was trained to open gates and move through the pens and eventually escaped through a final gate to obtain a food reward. The other sheep would calmly follow, and find themselves next to the stunning pen (Bremmer et al., 1980).

Another form of learning involves food selection. Most learning requires an immediate result for the animal to make the connection between its behavior and the outcome. However, it was recognized that animals would learn to avoid certain foods if they caused sickness, even if the effect wasn't apparent for several hours. This 'aversive conditioning' was seen as a means for animals to avoid poisonous plants. Fred Provenza, at Utah State University, began his study of food selection in sheep looking at the avoidance of toxic plants. He then shifted his attention to the selection of other foods based on the positive experiences the animals had with them. Based on their post-ingestive feedback, that is, the feelings the food created in the animal as it was digested, he has studied how sheep select a range of plant and feedstuffs to achieve a good nutrient balance (Provenza, 1995).

## **Ethology**

The field of ethology studies the natural behavior of a species, and how this would have evolved. Applied ethology was seen as a means of improving the care of domestic animals by trying to accommodate their nature behavior. The adage 'Fit the farm to the animal, not the animal to the farm' summarizes this approach. One of the most intriguing studies of the natural behavior of sheep was conducted on a small island off the coast of Scotland. St. Kilda was the

site of a small settlement for several hundreds of years. The islanders made their living primarily from the sea birds that nested on the cliffs of the group of islands. They paid a small amount each year to the owners of the islands, in the form of feathers and oil from the birds. They ate large quantities of eggs and sea birds. But they also had a few primitive sheep, from which they obtained milk for cheese and wool for cloth. The settlement was abandoned in 1930, but a number of sheep were left on the main island. This population was studied, some 30 years later, and provides an interesting look at how sheep behave when fending for themselves (Grubb and Jewell, 1966).

The sheep on St. Kilda organized themselves into two types of social groups. The ewes, their recent offspring, and juvenile males formed groups of 25-35 individuals and would live on a particular area of the island. These 'home ranges' would be grazed by the same group year after year. The home ranges would overlap, but the groups of sheep did not intermingle in the same area at the same time. The other type of social group was comprised of mature rams. These groups were smaller, but covered larger areas of the island. During rut the male groups would disperse, and individual rams would join the ewe groups for mating.

This social pattern has several implications for managing domestic sheep. Ewes in large grazing areas maintain home ranges similar to those of the sheep on St. Kilda. Attempts to provide supplemental feed, an additional water source, or mineral blocks can be thwarted by the sheep's tenacity of not leaving their home range. If the manager doesn't know which areas each group of sheep use, then he may place the resources in places that one or more groups never visit.

The seasonal nature of the sex-based flocks is also relevant to sheep management. In species with a seasonal separation of the sexes, we often see a 'male effect' when the males separate and join the females. The presence of the male may induce young females into puberty, induce older females out of a seasonal anestrus, or synchronize cycling among the females. We use rams, introduced to the ewes in early fall, to do all of these in our normal management programs.

Lambing season was another time of the year when there was some break up of social groups. As a ewe approached giving birth, it would separate from the flock. In many cases it would use a small storage hut, left by the former inhabitants, as a place to give birth. The ewe and her young lamb would rejoin the flock within the next couple of days. The use of a hut could have been as a means of protection from the weather, or protection from the remainder of the ewes. In a series of studies in Australia, Justin Lynch was able to reduce lamb mortality by providing grass shelter belts in the lambing paddock. Ewes giving birth were attracted to these protected areas to a greater extent than were non-parturient ewes (Lynch and Alexander, 1977). In my own work at Illinois, we demonstrated that ewes would move into cubicles placed around the periphery of the lambing barn just prior to giving birth, and that this protected their lambs from being stolen from other parturient ewes (Gonyou and Stookey, 1983).

The period during which the ewe and her lamb were together apart from the flock is the time during which bonding occurs. The natural bonding behavior of ewes and lambs was used as a basis for testing the sheep's sense of colour. Merino lambs, which are normally white, were

painted various colours and left with their mothers for several days prior to the colour test. Ewes were then given the choice of a lamb coloured the same as their own, or others coloured in various shades of grey. Ewes were attracted to lambs that were the same colour as their own if they were red, orange, yellow or white. However, if their lambs were blue or green, they were as likely to be attracted to the grey shaded lambs. Thus, sheep have the ability to see red, but have difficulty with green or blue (Alexander and Stevens, 1979).

## **Behavioral Ecology**

Behavioral ecology develops theories that will predict how animals would behave under a particular set of circumstances. Often these theories relate to resources, such as food, and the cost of obtaining them. The sheep on St. Kilda normally did not give birth to a lamb until they were two years old. When yearlings gave birth to a lamb it was almost always abandoned. Older ewes would also abandon lambs at birth, but only if the ewe was in poor body condition. Behavioral ecology theories would predict that young or thin ewes would have insufficient body stores to successfully raise a lamb, maintain themselves, and rebreed that following fall. In extreme cases, perhaps when the life of the ewe was in danger, the ewe would 'cut her losses' and abandon the lamb without investing additional energy into it.

A similar balance between available forage, milk production, and weaning was found in sheep by Arnold et al. (1979). If forage was plentiful, the ewe would be in good condition and produce a large amount of milk. Even though good forage was available, lambs were late to be weaned from their ewes. If forage was poor, ewes gave little milk, and lambs would wean early even though the grass was of low nutritional value. The timing of major energy costly events such as rearing, breeding and weaning is affected by the animal's body condition and availability of feed.

## **Conclusion**

The study of sheep behavior can be both interesting and practical. A number of our management practices are based on the behavior of sheep, reflecting their natural behavior or their ability to adapt to environmental conditions. Even under very intensive management it is important to consider the behavior of the animals.

## **References**

- Alexander, G and Stevens, D. 1979. Discrimination of colours and grey shades by Merino ewes: tests using coloured lambs. *Appl. Anim. Ethol.* 5:215-231.
- Arnold, GW, Wallace, SR and Maller, RA. 1979. Some factors involved in the natural weaning processes in sheep. *Appl. Anim. Ethol* 5:43-50.
- Bremner, KJ, Braggins, JB and Kilgour, R. 1980. Training sheep as leaders in abattoirs and farm sheep yards. *Proc.N.Z.Soc.Anim. Prod.* 40:111-116.
- Fisher, A and Matthews, L. 2001. The social behaviour of sheep. In (Ed.) Keeling, LJ and Gonyou, HW. *Social Behaviour in Farm Animals*. Pp 211-245. CABI Publishing, Wallingford, UK.

- Gonyou, HW and Stookey, JM. 1983. Use of lambing cubicles and the behaviour of ewes at parturition. *J. Anim. Sci.* 56:787-791.
- Grubb, P and Jewell, PA. 1966. Social grouping and home range in feral Soay sheep. *Symp. Zool. Soc. Lond.* 18:179-210.
- Lynch, JJ and Alexander, G. 1977. Sheltering behaviour of lambing Merino sheep in relation to grass hedges and artificial wind breaks. *Aust. J. Agric. Res.* 28:691-701.
- Provenza, FD. 1995. Postingestive feedback as an elementary determinant of food preference and intake in ruminants. *J. Range Manage.* 48:2-17.

## CONTINUUM OF DAIRY OPERATIONS, PRODUCTS AND MARKETING STRATEGIES

Alice Henriksen<sup>1</sup> and Laurel Kieffer<sup>2</sup>

<sup>1</sup>Shepherd's Pride Farm, Stillwater, Minnesota, USA

<sup>2</sup>Dream Valley Farm, Strum, Wisconsin, USA

This session involves a panel discussion with three dairy sheep operators. All are making value-added products with their sheep milk. The purpose of the discussion is to share their stories behind the products they chose to create and their marketing strategies including what worked and what didn't work in their particular situation. They will start with a brief description of their operation and then we will ask questions of the group about their products and marketing. At the end, we will allow questions from the audience.

### Introductions:

Panelists will share the following information about themselves and their farm:

- Number of sheep / number of ewes milked
- Location of farm, how long farmed, type of production (natural, conventional, organic)
- Labor – e.g. family, hired (if hired – source of employees)
- Briefly describe all farm enterprises (how long for each)
  - Sheep based, other species, crops

### Questions:

1. What products did you consider when deciding on the kinds of value added products to make?
2. How did you decide which products to develop?
3. What kinds of supports and expertise did you utilize? (examples – Grants, consultants)
4. What method(s) of production do you incorporate? (examples - farmstead, contract)
5. What marketing strategies did you explore? Decide on? Why?
6. Where do you sell your product? (examples – direct sales, to retail, to wholesale, institutions, restaurants)
7. What has and hasn't worked along the way? Describe failures as well as successes.
8. What barriers did / do you face?
9. How does the specialty product fit into your whole farm profitability picture?
10. Is value-added worth the extra effort? Why or why not?
11. How do image and farm values impact success in marketing?
12. How does geography, proximity to population centers and population demographics impact product marketing strategies?

### Additional questions to ask if time permits:

- Do you / can you use frozen milk? How does it affect production?
- Do you produce your product seasonally or year round?
- Do you use your own milk only or do you purchase milk from other sources?
- Do you co-market your product with other products / complimentary products (your own or others products)?
- Do you utilize discounts / coupons / promotions / volume discounts for your product?



## **SHEPHERD'S DAIRY**

**Kim Curtis**  
**Anselmo, Nebraska, USA**

Shepherd's Dairy, Nebraska's first Grade A dairy, was established in 1993. As one of the founding members of WSDC, we have now been milking for 14 years. We began with a flock of 60 Polypay ewes. In 1996 we began improving production by importing East Freisan rams from Peter Welkerling (Canada). We have purchased Lacaune cross rams in recent years. Our flock average has increased from 1.7 lbs of milk for 60 days to an average of 4.5 lbs of milk per day for 220 days. Since we lamb in December/January, we begin milking in the winter months and feed the ewes corn/barley and dairy quality alfalfa for the milking season. We have kept pretty steady records of the milk production of our ewes since the beginning, taking milk weights every two weeks using metered jars. Ram lambs and replacement ewe lambs are kept on the mothers for one month. The mothers are kept with the lambs exclusively for the first 3 days and then are put on the schedule of milking twice a day. Lambs are left with the ewes during the day but kept in a shed with creep feed at night. The lambs are approximately 35 lbs when weaned. The wethers are sold at 3 days old to a farmer who bottle feeds them and sells them as feeders.

In 1999 we started our own business of making soap from the sheep milk. To set us apart from other soap makers, all of our soaps are made in molds with a vintage/Victorian look. Sales have grown from selling locally to selling to about 300 stores nationwide. We have a web site, [www.shepherdsdairy.com](http://www.shepherdsdairy.com), that is the instrument for most of our sales. We advertise in wholesale magazines, newspapers, radio, retail and wholesale markets and the internet.

We have been able to streamline production of products so that we now have just two people employed, a secretary and Kim. At our peak we had 10 part time employees. The number of products has increased to include Soap, Lotions, Milk Baths, and Bath Teas available in 10 scents.

## MILKING EWES IN THE CENTER OF MEXICO

**Javier Pérez Rocha Malcher**  
**“Santa Marina” Farm**  
**El Marques, Querétaro, México**

### **Introduction**

Santa Marina Farm is a medium-sized farm providing organic products such as cheese and lambs. Our 350 ewes graze all the year thanks to our great weather and 40 hectares of irrigated fields.

### **History**

Santa Marina farm is located 200 km north of Mexico City, at 2000 meters above sea level in a semi-desert region. This place has been in our family since early 1980's, and we grew vegetables until 2003. Then we started to milk ewes. It's important to note that we never had ewes before, but after my attendance at the 2003 Great Lakes Dairy Symposium at Cornell University at Ithaca, New York, we decided to start our milking operation. The tradition for sheep in Mexico is only for meat, and that's why it was so difficult to start. There are only three other ewe milk producers in all Mexico; one of them started in 1996 and the other started in 2002.

First we started with 60 black-faced cross ewes and a pure breed East Friesian ram. After that, we met a person who studied cheese making in France and had a little factory near our farm. He had experience in making many types of cheeses including aged cheeses from ewe milk. We started to milk the ewes right away, but the success was far away. These ewes produced, at that time, 200 milliliters per day per ewe, and it was very disappointing. Two months later one of the guys who milked crossbred ewes (3/4 Friesian, 1/4 St. Croix) quit milking and sold his 200 ewes to us.

These ewes performed better and had a longer lactation (250 days) with 600 milliliters per ewe per day on average. At the same time, we started to learn how to make cheeses. We continued to deliver all the milk to our friend in his cheese factory for him to produce the cheeses while we kept learning how to produce our own cheese. Right away we started to sell cheeses in many cities near ours including Mexico City. By the end of 2004, we had our own small cheese factory, and we got our organic certificate. This certificate gave us a bigger market to increase our sales.

Right now we participate a lot in fairs and have many buyers looking for our cheeses. People are starting to be interested in buying ewes and rams to start milking.

## **Breeds**

As I stated above, we started with the black-face crosses, and right now we have none of them. Daughters of them are milked at this time at the farm. A ewe that doesn't produce at least 100 liters a year is not profitable on our farm, and that's why our original black-faces are done.

With the arrival of the East Friesian crosses, we increased our production and improved our genetics, but the deception comes when we started to milk purebred East Friesian, because they are not well adapted to our dry and hot weather, and they start suffering from sunburn (ears, head and back) and pneumonia because of the difference in the temperature within the day and throughout the year. So we think at this time, that the solution is to have East Friesian crosses no more than 7/8 East Friesian along with 1/8 or more of any hair sheep breed well adapted to the dry weather. Right now we imported semen of a Lacaune ram from Canada to start a new line to, hopefully, increase our milk quality and the health of the flock.

## **The Process**

For milking, the ewes are brought in from the pasture and crowded into the holding area near the parlor.

Our parlor is a twelve line with manual head gates. It has four milking units and two Waikato testing jars to measure the milk once a week.

We have an insemination program of 30 ewes per month with a 65 % pregnancy rate with fresh semen all the year. After lambing, we take the lambs at 3 days from the mother and start to milk them once a day. The lambs are fed artificially with milk lamb replacer three times a day for about 40 days or 15 kg. That's when lambs are weaned and sold. Ewe lambs stay at the farm as replacements.

The milk is kept in a bulk tank for two days, and after that is used to make cheeses. Cheeses are made three times a week and stored in a cave for 5 to 8 months. This cave controls the temperature (12 C to 16 C) and humidity (70 % to 80 %). After that they are ready for the market.

The price of that kind of cheese is between \$22 to \$30 U.S. Dollars for a kilogram. That makes a liter of milk, taking out the direct costs, worth \$1.3 to \$1.6 U.S. dollars.

## **Goals and Plans**

Our goals for 2008 are to have 600 ewes in order to produce at least 150 liters of milk per ewe per year with an average of 18 % of solids and keep selling the cheeses.

Our plans are to start making different type of cheeses.

## **Conclusion**

This business in our country is going to grow more in the next few years. More people in México are getting interested in the consumption of sheep milk cheeses; especially the made in Mexico cheese - “our cheese”. People have tended to buy imported sheep milk cheese such as the Spanish types. We are the first organic sheep cheese producers in Mexico, and people will have the opportunity to eat fine Mexican sheep cheese.

## **ARTISAN SHEEP MILK CHEESE**

**Jodi Ohlsen Read  
Shepherd's Way Farms  
Nerstrand, Minnesota, USA**

### **Summary**

Shepherd's Way Farms, Sheep Dairy/Farmstead Cheese – Steven Read & Jodi Ohlsen Read

Farming since 1994; Cheesemaking since 1998

Products: 5 artisan sheep milk cheeses (two fresh, three aged – waxed and washed rind)

Labor: Currently primarily family run; Designed to operate with 10-15 employees – 3-5 full-time, 7+ part-time.

### **Background**

Shepherd's Way Farms is located just outside Northfield, Minnesota, approximately one hour south of Minneapolis. Currently, we have 450 ewes, and this season will milk 350-400. Prior to 2005, the flock was at 800 ewes and 500+ were milked.

Shepherd's Way Farms' objective is to be a profitable family-based, value-added farm combining innovative technology, sustainable animal and land stewardship, holistic integration and community outreach. We use sustainable farming methods with cheese production on site. Dairy sheep and cheesemaking are the primary enterprises of Shepherd's Way Farms. We have been making cheese since 1998 and have been at the current farm since 2001.

Initially, we began Shepherd's Way Farms to produce sheep milk to be sold through the Wisconsin Dairy Sheep Co-operative. After our milk production increased beyond the pace of contract fluid milk sales, we began our cheese market research. Through the research, we determined which styles of sheep milk cheese were in demand, which cheeses would directly compete, and how wholesale and retail pricing was structured. During this process we also established some early retailer relationships. After defining our audience and selecting the first cheese we wanted to make, we identified the necessary expertise and facilities to create an appropriate recipe and process.

Friesago, an aged, waxed sheep milk cheese, was quickly well-received in the Minneapolis/St. Paul retail and restaurant circles. We carefully paced our sales not to outrun our supply. Our second cheese, a fresh cheese – Shepherd's Hope (originally called Queso Fresco), was introduced to complement the Friesago and also did well. Each type of cheese we have added was chosen to balance the variety of cheeses we offer and to make best use of the milk, equipment and facilities, and cheesemaking skills available.

## Marketing and Sales

Shepherd's Way has established a presence in the specialty cheese market with a distinct product line, brand identity, and promotional strategy. Currently produced Shepherd's Way Farms cheese has been easily absorbed by the existing demand – production is the only current limit on sales.

The principles behind how we farm and how we make cheese are ultimately important to our target consumer. Consumers are looking for a connection to their food and to the people who make it. Providing that connection – through demos, print materials, and our story – is essential to developing a brand identity and customer loyalty.

Shepherd's Way Farms strives to sell products through outlets that represent and support the mission of the farm – high quality, handcrafted foods, locally produced. We sell the majority of our cheese within the Twin Cities area, with secondary markets in Chicago, Washington DC, Boston, and California.

Initially, all sales were direct, wholesale, by the wheel. As production grew, we expanded sales to 70+ stores nationwide. At this level, a direct sale approach was not efficient; sales were refocused, a local distributor identified, and the Twin Cities area sales were increased. A small percentage of cheese is sold retail through a select Twin Cities farmer's market and at our on-farm shop.

## Outlook

American artisan cheeses are in great demand and the industry is growing rapidly. Consumers are already becoming savvier in their cheese selections and the cheese cases reflect the increased sophistication of taste. Consequently, some of the inherent obstacles for new artisan cheesemakers are becoming more manageable – equipment, expertise and training, and supporting resources are easier to identify and will likely continue to become more available.

Shepherd's Way Farms      8626 160<sup>th</sup> Street East      Nerstrand, MN  
[farmfriends@earthlink.net](mailto:farmfriends@earthlink.net)      507-663-9040

# **ACCURACY OF THE PORTASCC® MILK TEST FOR THE DETECTION OF SOMATIC CELLS IN SHEEP MILK**

**Yves M. Berger**  
**Spooner Agricultural Research Station**  
**University of Wisconsin- Madison, Spooner, Wisconsin, USA**

## **Introduction**

Cheesemakers are more and more concerned about high somatic cell count in milk because of lower cheese yield and possible cheese flavor alteration. Many of them are including financial premiums or penalties for milk with low or high somatic cell count. It is therefore important to be able to identify, quickly and accurately, animals that consistently have high somatic cell counts (indicators of chronic mastitis). Up to now the CMT (California Mastitis Test) was the only animal side test available, but was often found to be inaccurate or insensitive. Recently, Portacheck ([www.portacheck.com](http://www.portacheck.com)), a division of Portascience Inc., developed a quick, affordable on-farm somatic cell test for sub-clinical mastitis screening. This test could be an excellent management tool for dairy herds. No trial, however, has been performed to control the accuracy of the test on sheep milk. During the course of the 2006 milking season, the Spooner Research Station tested the product for a possible application as part of its management routine.

## **Description of the Product**

PortaSCC® consists of a strip (2.75 inch long, 5/8 inch wide, and 1/8 inch thick). At one end, there is a small circular cut out forming a well. A drop of the milk to be tested is poured in the well through a calibrated pipette included in the kit. Three drops of an activator solution are poured in the same well. Both, milk and solution are quickly absorbed by the material of the strip. The test strip is allowed to dry for 45 minutes during which chemical reactions occur. Reading of the strip can be done either by examination of the color changes in the well which gives a range of somatic cell counts (<200,000, 200,000 to 750,000, 750,000 to 2 million and > 2 million cells) or through a small hand held electronic reader for more accurate information. The test is easy to perform and does not require any special equipment

## **Description of Tests Performed**

A total of 242 sheep milk samples were tested with the PortaSCC® according to manufacturer information at four different stages of the lactation. Ewes were chosen at random at each test.

- 54 early lactation ewes on 2/21/06
- 52 early-mid lactation ewes on 3/21/06
- 18 ewes on 4/17/06 and 7 ewes on 4/20/06
- 30 in mid lactation ewes on 5/30/06
- 41 late lactation ewes on 8/22/06, repeated twice (2 different strips)

At each test, the color changes were observed by two different persons in order to detect possible different color perception. The reading with the hand held device was also done twice at a few second intervals to measure the repeatability of the reader. All milk samples used in the trial were sent to a certified laboratory where the somatic cell count in the milk was detected through a Fossomatic 360. The laboratory machine is not especially calibrated for sheep milk. Its accuracy, however, has been tested by comparing the results of a microscopic count (DMSCC) with the electronic count (ESCC). Results of the PortaSCC® were tested against the results from the Fossomatic count.

On 8/22/06 each sample of milk was tested twice at a few minute intervals on two different PortaSCC® strips in order to detect the repeatability.

At each test we looked at:

- the repeatability of the reading of color by two different persons
- the accuracy of the color compared to the laboratory results using the same range
- the accuracy of the hand held reader compared to the color
- the accuracy of the hand held device compared to the laboratory results
- the repeatability of the PortaSCC® on the same sample (last test only).

The accuracy is simply a percentage of identical results between the Fossomatic and the PortaSCC®. Repeatability is a percentage of identical results for 2 identical milk samples measured by PortaSCC®

## Results

The 18 tests done on 4/17 and the 7 tests done on 4/20 were discarded from the results because the strips used on those dates were past the expiration date. All other results are shown in Table 1.

**Colors.** The colors were generally perceived to be the same by two different people. The percentage of time that the two people had the same reading varied from 75% to 96%. The differences between the two technicians came mostly from hesitation between a no color change and a slight coloration meaning that the accuracy of the test is affected mostly in the low range of SCC up to 200,000. This is quite an acceptable result knowing that an animal with a somatic cell count of 200,000 or less is considered as having a healthy udder (Bergonnier et al., 1997).

**Correlation between laboratory results and colors.** All laboratory results that were less than 200,000 SC were considered 0 and corresponding to a no color change in the PortaSCC® test. The percentage of identical results between the laboratory and the colors shown in the PortaSCC® varies between 81% and 94%. Most of the discrepancies occur in the middle ranges. Therefore, a no color change is definitively an indication of low SCC (less than 200,000) and a deep color change an indication of a high somatic cell count (more than 1 million). However the PortaSCC® does not seem to give quite as accurate results for intermediary ranges (between 200,000 and 1 million), meaning that it is less reliable to distinguish a count of 250,000 from a count of 750,000 just looking at the color on the strip. Also, the repeatability of the color change on the same sample of milk was high at 93%.



**Correlation between laboratory results and readings from the hand held device.** The hand held device is easy to use, small and gives a quick digital reading. After calibrating the device with a blank strip, the strips to be counted are introduced in a slot and read in a few seconds. Theoretically the numbers read ( $\times 10^6$ ) should correspond to the level of somatic cells per ml of milk. All laboratories results that were less than 200,000 SC were considered 0. Results show that the accuracy of the hand held device when compared to the Fossomatic results varies from 55% to 73%. The repeatability on the same sample was 66%. A high count detected by the hand held device always corresponded to a high count detected by the Fossomatic counter, but a high count from the Fossomatic did not always correspond to a high count from the hand held reader.

**Correlation between colors and readings from the hand held device.** The correlations varied between 61 and 77% with a repeatability of 61%. Those results have to be expected knowing that there is not a very high correlation between lab results and color in the intermediary ranges of somatic cells level.

## **Conclusion**

The PortaSCC® appears to be a good tool for the detection of either healthy ewes with no somatic cell or with a very low count (less than 200,000) and for the detection of chronic mastitis ewes with high somatic cell count (more than 1 million). However, for the doubtful ewes with intermediary ranges of somatic cell count (between 200,000 and 1 million) the PortaSCC® as tested in 2006 shows a low accuracy and repeatability. The hand held digital reader does not appear to add any accuracy because of what appears to be erratic readings in the middle range of somatic cell level.

In view of our results and of the results of the University of Nevada, PortaCheck has concluded that the enzyme activity of the white blood cell in sheep's milk is about 4 times lower than the enzyme activity of the white blood cell in cow's milk (Personal communication, September 2006). To account for this difference a recalibration of the hand held reader will be necessary for direct reading of sheep milk somatic cells.

## **Literature cited**

Bergonier D., M.C. Blanc, B. Fleury, G. Lagriffoul, F. Barillet and X. Berthelot. 1997. Les mammites des ovins et des caprins laitiers: étiologie, épidémiologi, contrôle. 4ème Rencontres autour des Recherches sur les Ruminants. Paris, December 4 and 5, 1997. Publication INRA- Institut de l'élevage.

Table 1. Number and percentage of identical results between PortaSCC® and Fossomatic.

Test	n	Color		Fossomatic/Color		Fossomatic/Reading		Reading/Color	
		Same	No	Same	No	Same	No	Same	No
2/21/06	54	40 74%	14	51 94%	3	30 55%	24	39 72%	15
3/2/06	52	50 96%	2	42 81%	10	38 73%	14	37 71%	15
5/30/06	30	25 83%	5	27 90%	3	22 73%	8	23 77%	7
8/22/06 <sup>1</sup>	41	35 85%	6	35 85%	6	28 68%	13	25 61%	16
8/22/06 <sup>2</sup>	41	37 93%	4	36 88%	5	30 73%	11	33 80%	8
Repeatability <sup>1-2</sup>		90%		93%		66%		61%	

**1, 2** Same samples tested at the same date on 2 different strips.

## **CLOVER DALE SHEEP DAIRY**

**John Henry and Mary Miller  
Westby, Wisconsin, USA**

Mary and I started milking cows in November of 1994. The first two years, we purchased all our feed. In 1997, we purchased our farm and continued milking cows until 2004.

In 2004, we purchased 50 Polypay ewe lambs. We crossed them with an East Friesian ram. The first two years, we just raised lambs, and I milked sheep for my neighbor, Dean Jensen. We also raised lambs for him.

This year (2006), we started milking sheep on our own farm in March. We hand-milked our 35 ewes on a rotating platform. The ewes have their head in a stanchion while they are being milked. This system worked out very well for us. Mary, three of our boys, and I do the milking. We can milk 35 ewes in 35 minutes.

Our goal is to milk 100 ewes by hand next year. For the first few years, we will select for long teats more than for the amount of milk. As far as I am aware of, we are the first commercial hand-milked sheep dairy in the U.S.

We do all our farming with horses. We have 45 acres tillable, and we raise hay, corn, and barley and peas for silage.

We have done a lot of fencing for our sheep. We hope to have enough pasture to rotationally graze 100 ewes. We graze our ewes from May through November. We then feed hay and silage till lambing. After lambing, we add whole corn to the ewe's ration. We buy a complete pellet feed for our lambs.

Mary and I also make Bent Hickory furniture. We steam the hickory to bend it. We make rockers, footstools, kitchen chairs, bookshelves, and more.

## **HIDDEN SPRINGS FARM AND CREAMERY**

**Dean and Brenda Jensen  
Westby, Wisconsin, USA**

Brenda and Dean Jensen's Hidden Springs Farm is housed in a series of charming buildings, at the end of a winding road, perched on top of a high, beautiful, green ridge in the heart of the Coulee, on the patchwork terrain of Wisconsin's "Driftless Area" - the perfect environment to raise sheep for their artisan/farmstead dairy products.

Hidden Springs Farm is currently milking 115 Lacaune and East Friesian dairy sheep. The sheep graze seasonally. The farm's creamery has crafted a fresh soft sheep milk cheese. It is very rich and creamy, almost dreamy, and named "Driftless Cheese" because it is made the "Driftless Area." (During the ice ages, all the glaciers passed it by, hence the "Driftless" name.)

Hidden Springs Farm is situated in a heavily populated Amish family community. Brenda and Dean work closely with the Amish, and Dean serves as a community counselor, clinical therapist and friend to these folks. The Jensen's farm the old fashioned way, with draft power and no tractors or heavy equipment ...only Percheron draft horses. However, their dairy and milking parlor is a Grade A farm with completely modern, new equipment.

Brenda left her management position in the corporate world to become the full-time Hidden Spring's cheesemaker/marketer, shepherd and gardener; investing her time in growing their farming business.

Their vision for Hidden Springs Farm and Creamery is to be sustainable environmentally as well as financially: an all-natural, back-to-basics, old-fashioned, original farmstead approach to farming; crafting their food products, as well as their marketing. No GMO'S or antibiotics are used at Hidden Springs Farm.

"Driftless Cheese" is made traditionally, using only natural products. Nothing is added to this natural product except fresh sheep's milk, culture, rennet and salt. Please contact Brenda Jensen at 608-634-2521, Hidden Springs Creamery, Westby, WI 54667 ([www.hiddenspring'screamery.com](http://www.hiddenspring'screamery.com)).

**CARR VALLEY CHEESE -  
WISCONSIN'S PREMIER SPECIALTY CHEESE FACTORY SINCE 1902**

**Sid Cook  
Wisconsin Master Cheesemaker and Owner  
Carr Valley Cheese, La Valle, Wisconsin, USA**

Carr Valley Cheese is one of America's finest specialty cheese plants, owned and operated by Wisconsin Master Cheesemaker, Sid Cook. A Wisconsin Master Cheesemaker is one who participates in a 15 year program achieving excellence in their trade. Sid is a fourth generation cheesemaker with 35 years of cheesemaking experience; his family has been making cheese for over 116 years.

In the past four years, Carr Valley cheeses have won more than 90 top awards in U.S. and international competitions. Many of these have been won by Sid's one-of-a-kind American Originals—artisan cheeses you won't find made anywhere else in the world. In addition to processing cow and goat milk, Carr Valley is the largest processor of sheep milk in Wisconsin.

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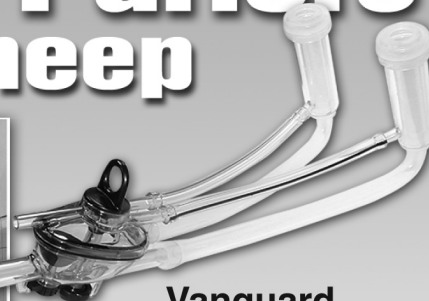
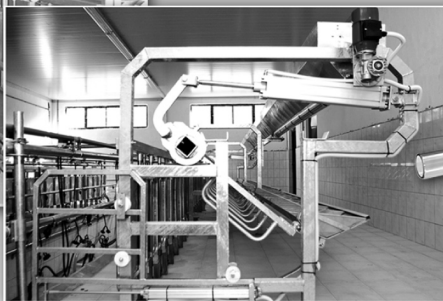
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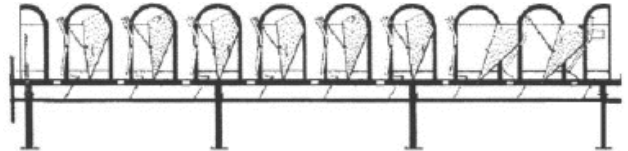
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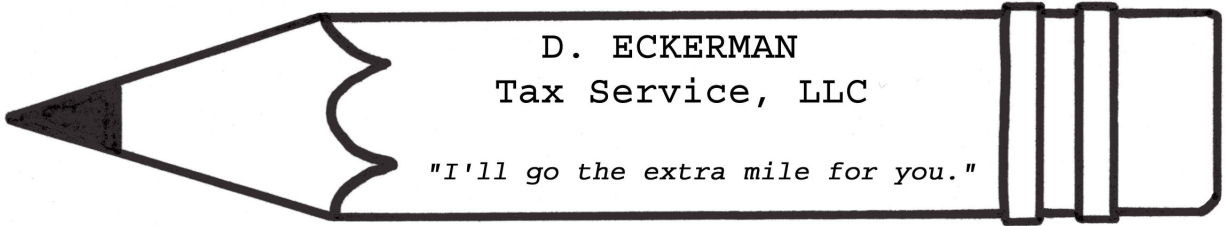
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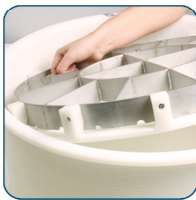
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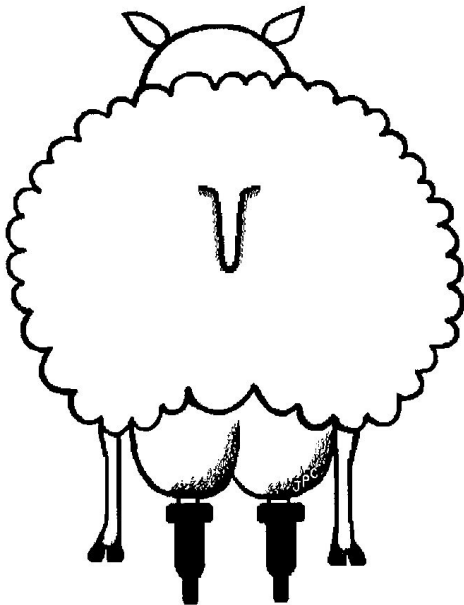


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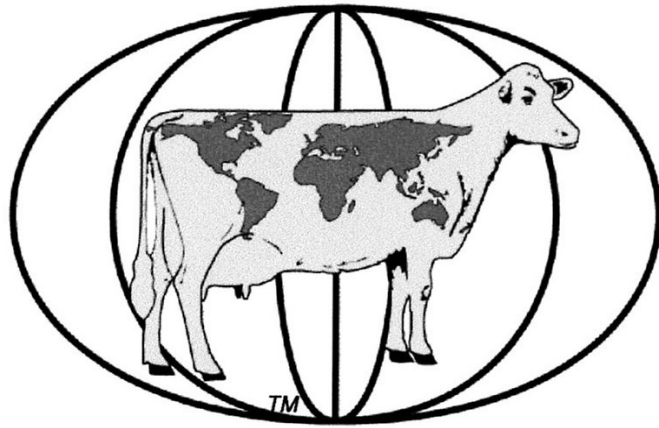


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