Dairy Sheep Association of North America

19th Dairy Sheep Symposium

November 7-9, 2013
Cambridge Hotel Conference Centre
Cambridge, Ontario

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Program

Thursday, November 7th

8:30 am REGISTRATION

9:30 am How I Started Milk Sheep
Andrew Gordanier, Dairy Sheep Producer

10:15 am Thin Ewes—Maedi Visna, Johnes and Caseous Lymphadenitis
Dr. Rex Crawford, Dufferin Veterinary Services

11:00 am BREAK

11:15 am Orchid Meadow Farms
John Ryrie, Dorset, England

12:00 pm LUNCH

1:15 pm Managing Lambs on Milk Replacer - Challenges of Nutrition, Environment and Disease
Dr. Rex Crawford, Dufferin Veterinary Services

2:00 pm Development of an Udder Health Course for Dairy Sheep
Dr. Paula Menzies, Ontario Veterinary College, University of Guelph

2:45 pm BREAK

3:10 pm Genes Without Borders
Rick MacRonald, President, Agricultural Management Services Inc.

4:00 pm Dairy Sheep Association of North America Annual Membership Meeting

5:15 pm WINE AND CHEESE

Program

Friday, November 8th

9:00 am Seroprevalence of Q Fever (Coxiella Burnettii) and Associated Risk Factors in Ontario Sheep Flocks, Goat Herds and Their Farm Workers
Shannon Meadows, PhD Candidate, Population, Medicine, University of Guelph

9:45 am Ventilation for Dairy Sheep
Robert Chambers, Engineer, Swine, Sheep Housing and Equipment, OMAF & MRA

10:45 am How It's Done in the U.K.
John Ryrie, Dorset, England

11:30 am Spooner Research on Once a Day Milking
David L. Thomas, Professor, Sheep Management and Genetics, University of Wisconsin

12:15 pm LUNCH

1:30 pm Unlocking the Key to Successful Lamb Feeding Program
Megan Van Schaik, Nutrition Associate Grober Nutrition , Grober Nutrition

2:15 pm Board buses for Grober Nutrition Plant Tour

7:00 pm BANQUET

Saturday, November 9

9:00 am Board buses for tour of Ellis Morris and Steven Burkhart farms

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How I Started Milk Sheep

Andrew Gordanier, Dairy Sheep Producer

The last time the Dairy Sheep Symposium was in Ontario, I attended. I found it to be very informative. My interest in milking started well before that but this was really the catalyst that encouraged me to seriously pursue milking sheep. So three years ago we started milking. Of course, before that first drop of milk was put in a pail there was endless planning. I thought I had it all figured out before we started but after three seasons of milking we are still learning every day we milk, that it will take a life time to figure it all out.

Through my presentation I will share with you what equipment we bought, some new, some used. And the various challenges we faced getting started. I will show you the buildings that we renovated to create a parlour and milk house and touch briefly on our pasturing system.

I hope that the pictures and words that I share with you will help you to avoid some costly mistakes and make for an easier start for you.

Thank You,
Andrew Gordanier
Crombie Station

Thin Ewes—Maedi Visna, Johnes and Caseous Lymphadenitis

Rex G. Crawford DVM, Dufferin Veterinary Services Orangeville, Ontario, Canada

Introduction

Diseases that cause chronic, incurable weight loss can represent a major economic loss in dairy sheep flocks. Losses consist of dead ewes, premature culling, and milk production loss. This presentation will explore the cause, detection, and management of Maedi Visna, Johne's, and Caseous Lymphadenitis in North American Dairy Sheep Flocks.

Maedi Visna

Maedi Visna (MV), also known as Ovine Progressive Pneumonia (OPP), is caused by a virus that is carried by sheep and sometimes goats. MV causes white blood cells known as lymphocytes to infiltrate or fill up a number of areas in an infected sheep's body. The predominant sites of infiltration are the lungs, udder, brain and joints. Clinically, most infected sheep have increased respiratory rate and effort so that many producers mistake MV for chronic bacterial pneumonia. Once breathing becomes laboured, sheep lose weight very quickly, and will die if not culled first. Infected sheep often have "hard bags" that may become so severe that the udder looks normal, but produces essentially no milk. The udder swelling is generally smooth and symmetrical, as opposed to the one slack udder half or lumpy swelling of chronic mastitis. In the neurologic form, which is uncommon in North America, rapid weight loss and poor appetite along with lameness are generally seen. While joints are infected, we don't see the dramatic arthritic conditions that are the hallmark of Caprine Arthritis and Encephalitis (CAE) caused by a closely related virus in goats.

MV is primarily transmitted between sheep through respiratory secretions. The virus can spread through the air to potentially infect all sheep in the same air space in a barn. The virus is also found in milk and colostrum and often passes to the lambs of infected ewes very early in life. A small percentage of lambs are infected in utero, so even caesarian derived or colostrum deprived lambs can already be infected. Semen, embryos and blood are all considered low risk for causing infection. The virus does not survive outside sheep for long, so environmental contamination is not a major problem.

Characteristic lesions – infiltration of the lungs and udder – are generally found during post mortem examinations of ewes that have severe clinical disease. Further lab testing of the lungs and udder can confirm the presence of the virus. Blood tests are available that can detect infected sheep long before the sheep gets sick. Recent work at the University of Guelph suggests that only the Hyphen ELISA test is sensitive enough (finds enough of the infected sheep) for use as a screening test. Other tests that are available have been known to mis-classify truly positive sheep.

In the Ontario Dairy Sheep Flock, MV has been identified as a major problem in some flocks. I have found MV prevalence ranging from 0-100% in flocks that we have tested. The East Friesian sheep commonly bred as dairy stock in Ontario are possibly more susceptible to the virus than the typical meat sheep we deal with here. The dairy sheep I work with are also intensively raised indoors, meaning that the exposure to infected sheep is much greater than a typical meat sheep flock that spends much of the year on pasture. In flocks with high infection levels, it is not uncommon to lose 10-15% of the adult flock to clinical signs each year. From work in meat sheep, we know that decreased fertility and milk production are part of the subclinical disease. I have also dealt with flocks who found low to medium levels of the disease in their flock without having any sheep showing typical signs of Maedi Visna.

In Ontario, the Ontario Sheep Marketing Agency administers a successful MV Flock Status Program. The program involves testing all sheep and goats over 6 months old, and repeating the test to ensure that all animals remain negative. Test positive ewes and their lambs must be removed as soon as possible. There are a number of producers currently pursuing Negative Flock Status in this program.

I encourage all producers to test their flocks to determine their current MV prevalence. Flocks with low prevalence can easily cull positive animals to become negative. Flocks with higher prevalence should begin planning to eradicate the disease from their flocks. While initially expensive, the production and culling losses associated with MV add up over time, and the disease seems to spread fairly rapidly in Ontario dairy flocks. Producers have had good success raising lambs that have much lower disease levels than ewes by segregating lambs early in life, and ensuring that they do not share air space with adults. Some producers repopulate by keeping a large group of ewe lambs segregated, remove any test positives, and cull all adult ewes as the negative ewe lamb group begins to lamb. For best results, lambs are removed immediately after lambing and fed colostrum replacer. Some producers have had reasonable success by allowing colostrum nursing before removal. Purchasing ewe lambs from negative or low risk flocks is also a good way to repopulate. Remember that rams can carry the virus, so that all purchased rams need to be from negative flock or quarantined and tested. Sheep that are exposed to infected sheep can take 3-4 months to become positive on a blood test, so buying test negative sheep from a positive flock is strongly discouraged.

In summary, I believe that Maedi Visna is an important disease for dairy sheep producers to be aware of. While initially expensive, I feel that research indicates that MV is a disease no intensive dairy sheep producer can afford to live with.

Johne's Disease

Johne's Disease is caused by a slow growing bacteria called *Mycobacterium avium subspecies Paratuberculosis* (MAP). Johne's infects the intestinal tract and causes thickening of the wall of the intestine, particularly the ileum. This inflammation and thickening of the ileum reduces the sheep's ability to absorb nutrients, most importantly protein. Clinically affected sheep with Johne's become hypoproteinemic, and lose weight even though their appetite is normal. Diarrhea is not a normal clinical sign of Johne's disease in sheep.

Johne's Disease is spread by the ingestion of MAP in feces, colostrum or milk. Most clinically affected sheep show signs at 2 years or older, but were generally infected as young lambs. Infected sheep shed very low numbers of MAP in their manure until they become sick, and shed MAP in their milk late in the course of the disease. While relatively rare, lambs born to severely sick ewes can be born already infected.

Diagnosis of Johne's Disease can be challenging. In sheep, it appears that PCR of feces is the best test to find a Johne's infected adult sheep. Fecal culture can be performed, but is takes several weeks and most of the MAP found in sheep in Ontario is a strain that is very difficult to grow in the lab. Tests are also available that detect antibodies to MAP in blood or milk. The biggest challenge to diagnosing Johne's is that it is very difficult to detect MAP early in the course of infection. Sheep infected with Johne's disease have low blood albumin and normal globulin, allowing for low cost screening of thin sheep. Post Mortem diagnosis is not always easy. The classic visible thickening of the ileum is not always visible to the naked eye. Special staining can detect the presence of MAP in the intestinal wall and lymph nodes.

In a recent study of Ontario dairy sheep flocks by Bauman et al., it was estimated that 85.7% of the 21 flocks sampled had at least 1 out of 20 sheep sampled positive for Johne's. The estimated within flock prevalence was 2.8% based on serum ELISA, 14.3% based on fecal PCR, and 7.2% based on fecal culture. These numbers illustrate the relatively poor sensitivity of blood tests and the challenge of culturing sheep strains of MAP. These results indicate that Johne's is a significant issue in some Ontario dairy sheep flocks.

The control or reduction of Johne's disease is difficult, and an area that requires more research. Because of the impossibility of detecting infected sheep early, and before they begin to infect others, it is difficult to be certain that purchased sheep are not infected. Unlike MV, a test and cull approach is not effective. To reduce the prevalence of Johne's disease, controlling the amount of MAP infected manure that young lambs are exposed to is most important. Removing clinically affected sheep, and even all test positive sheep, from the flock and particularly lambing areas decreases the spread. Keeping lambing areas well bedded and clean reduces the exposure as well. In dairy cattle herds, it is recommended that calves are removed from dams immediately and fed artificial colostrum and milk replacer. The less time lambs spend with adult sheep, the lower the risk of becoming infected is. In flocks where Johne's disease is a major problem, immediate removal and artificial raising is the only way to reduce the prevalence of the disease. In other countries, vaccination of 4-16 week old lambs can be used can be used to reduce the shedding of MAP in infected adults. Currently vaccination is not available in North America.

Johne's disease can be a challenging disease to deal with in a flock. The loss of production and, then the premature loss of adult ewes infected with Johne's disease make controlling the disease essential to profitable production.

Caseous Lymphadenitis

Caseous Lymphadenitis (CL) is caused by the bacteria *Corynebacterium pseudotuberculosis*. CL is normally recognized as enlarged, abscessed lymph nodes full of thick, cheesy pus. While the external abscesses are unsightly and important to the transmission of the disease from sheep to sheep, it is the internal abscesses that are the true concern. The internal abscesses can become quite large and act as space occupying lesions, very much like a cancerous tumour. The lungs and liver are 2 commonly affected organs.

While the external abscesses are fairly easily recognized, other bacteria can cause similar lesions. Sending samples for bacterial culture confirms CL. Post mortem evaluation of thin ewes is the only way to confirm the presence of internal CL abscesses. There is a blood test available to confirm exposure to the bacteria which can be used to confirm a group of sheep are free of CL.

CL is transmitted primarily by contact with infected pus from ruptured abscesses. The bacteria can live in the environment for several months, and is easily transferred by things like shearing equipment and sharp edges in handling equipment and feeders. Because of the thick capsule that surrounds the pus, antibiotics are not effective at killing the bacteria.

Isolating animals with external abscesses before they rupture so the environment isn't contaminated is one way to reduce exposure. Ensuring that equipment is cleaned and disinfected prior to moving from farm to farm, and buying animals free of visible lesions helps decrease the risk of bringing CL into a clean flock. In infected flocks, vaccination can help reduce the impact of CL. To work well, vaccination must be completed before exposure to the bacteria. Culling severely infected animals can also reduce the transmission of CL in your flock.

CL can be a hidden problem in sheep flocks. With low levels of external abscesses, we are sometimes fooled into thinking a flock has very little of the disease present. If we know the bacteria is present in a flock, it should definitely be on the rule out list of diseases in thin ewes.

Summary

Maedi Visna, Johne's Disease, and Caseous Lymphadenitis are three important causes of chronic weight loss and death in ewes. All three diseases cause significant production loss prior to the chronic wasting, and are important even when mortality is low. Post mortem investigation of thin or dead ewes is the most important diagnostic tool for determining whether any of these diseases is present in your flock, and at what levels.

With proper control measures and testing, the effect of these diseases in your flock can be reduced or eliminated.

Orchid Meadow Farms

John Ryrie, Dorset, England

Orchid Meadow Farm – Owned by Crispin and Susie Tweddell, 120acres ploughable grassland and woods, all converted to organic.

As so to be a big player in a small field, a parlour was installed in 1999, with the first milking taking place in 2000.

John Ryrie arrived in Dec 2001 to find 200 Dorset ewes, Dorset ewe hogs/gimmers, Dorset ewe lambs and in lamb to Dorset. In March 2002 he bought a small pedigree Friesland Flock of males and females. At this point John was doing lambing, lamb rearing, milking and the feeding.

In 2004, East Farm was bought and converted to organic. This was 280 acres of grade 1 land, and was and is primarily for buildings, dry stock/early pregnant stock, fattening lambs and rearing replacement ewe lambs. It also allows for grazing, making silage and growing cereals.

In 2008, Hambledon Farm was bought and converted to organic, 220 acres of ploughable land mainly for growing cereals and silage ground.

Rented Land – 200-300acres all converted to organic, mainly for silage making and grazing, and means lots of electric temporary fencing!

Grazing/silage – High quality grass clover mixes.

Arable/cereal – Wheat, Triticale, Oats, Barley, Beans

Forage Crops – Kale, Forage Rape, Chicory/plantain, Red clover mix, Stubble turnips

Have our own labour and machinery;

Ploughing – Cultivating – Sowing
Self-propelled forage harvester
Round baler; straw handling
2 4wd fork lifts
2 keenan feeder wagons
2 quads
2 land rovers
2 sets of 3 collies

Staff

3 Full time milkers, 2 part time
1 tractor man
1 shepherd and 2 general farm workers
2 – 3 part time lamb rearing staff
John
We don't carry any slack, and use part time and flexibility to the max.

Current Sheep Numbers

Milking ewes; 1250
Female replacements; 450
Male Breeding Stock; 40
Male Fattening; 400
Female Fattening; 300
Culls; 50

Our Lambing/ Production year starts Mid December

Mid Dec – end Jan; 550 - 600
March - 300
April/May - 500
July - 200
October – 300

Lamb rearing

Lambs off ewes 2 days after birth, onto auto milk machines
30/35 days on milk
+ Creep
+ TMR
+ Grazing
Finished at 40 – 50kgs LW

Milking Ewes

9 month Lactation
Grazing and TMR
Tupped whilst lactating
Dry Period of 2/3 months

Tups

Stock Dairy Tups sourced from Germany/Holland for good genetics.
Terminal Sires; Suffolk, Dorset, Hampshire, Texel/Beltex

Health Issues – Adults;

Closed Flock except for Male Breeding Stock
MV accreditated
No EAE
All abortions tested (usually trauma)
No significant problems until March 13
March 13: Toxo storm, Campylobacter infection.
November 12 – SBV infection
Feet feet feet!!

Lambs Health

Pneumonia

Cryptosporidium
Orf
Feet!
Feeding/Fattening

Medicines
Some drugs not licensed for milking sheep
Being Organic – lengthy withdrawal periods
Future of fewer products in the armoury
Have our own worm egg counts kit
Do our own post mortems on lambs

General Health Issues
Very low incidence of metabolic disorder
Few ring wombs
Eye trauma
Mastitis Rate 0.03%
Keratin on ears
No watery Mouth

Routine Treatments
Clostridial vaccine
Homeopathic solutions for Orf, pneumonia,
cryptosporidium, pain relief
SBV vaccine since Nov 12
Toxo vaccine since March 13
Footvax (targeted) since June 13
Fly Strike prevention (pour on)

Procedures
Rubber rings for tail docking (non-dairy types)
Rubber rings for castration (all males at 3 weeks old)
Local anaesthetic used on ring site for tailing and castration
Annual shearing and throughout the year
Shearing at housing
Shearing as fly strike prevention
Crutching as fly strike prevention and for abattoir

Staffing Issues
Recruiting/selecting
Weekend working
Shift working
Flexible patterns
Fixed patterns
Limited choice
Female vs Male
Training
Retention
Social worker!
External and Internal issues

Cropping issues

- Rotation
- Crop/species selection
- Crop establishment
- Weed prevention/control
- Nitrogen Fixing
- Maintaining yields

General targets

- Happy Staff
- Make profit
- Reduce lamb mortality year on year
- Reduce feet problems year on year
- Increasing milk yield/head year on year
- increasing margin between lamb rearing and return

Priorities

- Staff
- Dogs
- Sheep
- Grazing/crops
- Building
- Equipment (sheep)
- Machines

Constraints

- Staff abilities
- Organic Farming
- Dependant on weather
- No 'Fire fighting' ability
- Ever increasing regulations

Positives

- Staff empowered through 'ownership' of area/job
- Training
- Organic Farming
- Need to plan 2 to 5 years ahead
- Demand for 'Sheep Milk' far greater than supply
- Challenges
- Staff enthusiasm – 4 out of 11 under 25yrs of age!

Managing Lambs on Milk Replacer—Challenges of Nutrition, Environment and Disease

Rex G. Crawford DVM, Dufferin Veterinary Services Orangeville, Ontario, Canada

Introduction

Many Ontario dairy sheep producers raise all lambs on milk replacer and milk ewes for sale of milk as soon as the milk is saleable. Raising lambs on milk replacer presents a number of different challenges compared to the weaning of lambs onto solid feed.

Nutrition and feeding strategies present both opportunities and challenges. In our northern climate maintaining an acceptable environment can be challenging. Generally, the diseases that affect nursing lambs also affect milk replacer lambs, but the degree of disease challenge and importance of specific diseases vary.

Nutrition

Milk replacer is obviously going to be the most important part of young lamb's nutritional intake until they begin to consume solid feed. It is critically important to feed a high quality milk replacer that is designed for lambs. While there are a number of milk replacers that claim to be good for multiple species, those designed to meet the needs of lambs will show better health and growth, and decrease problems associated with feeding. As the biggest single cost in raising lambs, research into different milk replacers is important. The differences in growth rate, weaning age and improved health associated with a higher quality milk replacer make the increased cost worthwhile.

The feeding system employed may be as important as the milk replacer quality. Most of the farms I work with use an automated feeding system that mixing small batches of milk replacer and delivers warm milk to nipples that lambs have free choice access to. When managed properly, these automated feeders provide a consistent supply of properly mixed milk replacer to lambs with no opportunity for gorge feeding. It is important that these machines be maintained properly or issues can arise. In any milk replacer system the consistency of temperature, total solids, and access or delivery timing are all critical. In automated systems it is important to monitor total solids or the amount of powder added to a consistent volume of water. Depending on the machine, bridging or build-up of powder can be a problem, as can the scale used to measure the powder dispensed. Water flow or inconsistent temperatures can also cause problems. Nipples need to be cleaned regularly and replaced when the milk flow becomes too great, or they risk leaking.

Bottle feeding is not practical for the number of lambs fed in most dairy situations, but nipple bars or pails can work for meal feeding of lambs. The risk of engorgement by some lambs is increased, leading to more problems with bloat and clostridial disease. Increasing the feeding frequency, improving consistency of mixing and temperature, and vaccination can decrease these problems. Another feeding system alternative is the use of ad libitum acidified "cool" milk. In these systems, formic acid is added to prepared milk replacer and fed from a barrel or other container free choice through nipples at 20-24°C. The acid keeps bacterial growth at bay while the milk is consumed. This system allows ad lib feeding without the investment in an automated feeder. Note that the acid added to "acidified milk replacers" marketed promotes improved digestion, and is not at high enough levels to slow bacterial growth in these ad lib systems. Acid must be added to alter the pH of the final mixed product.

Because of the relatively high cost of milk replacer, we encourage lambs to begin consuming a creep feed as soon as possible. The development or choice of creep feeds needs to consider the nutritional requirements of young lambs, but palatability is also important. Many producers use mashed or mini pellets to make it easier for small lambs to consume. Most producers I work with used a pellet/mash rather than a textured feed where grains are visible.

Hay feeding to stimulate rumen development is still controversial in dairy calves, and I am not aware of any studies studying the effect on rumen development or daily gain in lambs. I do not recommend feeding ensiled feeds to lambs until they are at least 4 months old. Access to clean; fresh water is important for promoting the consumption of creep feeds, and preparation for weaning.

Environment

Managing young lambs' environments can be a significant challenge in Northern climates. Providing enough fresh air to keep lambs healthy, while keeping a room warm enough and free of drafts take planning and a different air space from the milking ewes. Lambs grow best if temperatures are at least 15°C, and absolutely need to be kept above freezing in free choice milk environments.

To keep rooms warm enough, with enough fresh airflow supplemental heat is generally required through the winter months. It is important to allow for outflow of stale air in a way that minimizes drafts. Lambs huddling together, or totally avoiding one area of a pen indicate that the room is too cold, or has a draft problem. If the room is too cold, too much energy is used to keep warm and growth is inhibited.

Stocking density also plays an important role in keeping a healthy environment. $0.55m^2$ ($6 ft^2$) is generally recommended per lamb. To help visualize this space think of 20 lambs requiring $120ft^2$ - a 10'x12' pen. It is important to keep lambs well bedded and dry, especially if the pen has been cleaned out recently. For best results, a pen needs to be filled quickly (within days) and remain together until weaning. Keeping poor growing lambs on milk and dumping them into a pen of younger lambs is an excellent way to spread disease. When setting up pens to share an automatic feeder I prefer to have solid partitions or gaps between pens so that lambs don't have nose to nose contact with other pens.

Disease

Colostrum is the most important protection against disease that we can provide newborn lambs. In most situations allowing lambs to nurse for the first 12-24 hours should provide the recommended 20mL/lb. of colostrum in the first 4 hours and 100mL/lb. in the first day. Weak lambs may need to be supplemented with colostrum from the dam, another ewe, or colostrum replacer. Cow's colostrum may be used, but considerations of disease transmission (particularly Johne's disease) and lack of vaccination must be taken into account. Proper vaccination of ewes approximately one month before lambing with a clostridial vaccine is very important in preventing enterotoxemia. Feeding ewes properly to keep them in good health (protein, energy, and minerals) allows them to produce high quality colostrum and vigorous lambs.

Scours

Diarrhea or scours in young lambs can be caused by a number of infectious agents. E. coli, Salmonella, Coronavirus, and Cryptosporidium are the most common agents. E. coli and Salmonella both produce toxins that make lambs sick as well as dehydrated, and generally affect lambs less than 5 days old. Keeping lambs hydrated using oral electrolytes designed for calves is the most important part of treatment. Cryptosporidium are protozoa that causes diarrhea, often in 4-10 day old lambs. We also see cryptosporidiosis in older lambs when transmission is from pen to pen. Cryptosporidium is passed via fecal oral route, and infection often occurs in lambing pens with lambs becoming sick a few days later. Lambs do not seem very sick, but essentially starve to death because they cannot absorb nutrients from milk. A drug called Halocur can be used as a preventive measure in outbreaks. In outbreaks, changing the lambing environment and pens where young lambs are raised reduces exposure to the protozoa. There is no effect treatment for sick lambs beyond maintaining hydration.

Pneumonia

Pneumonia is the most significant disease of milk replacer raised dairy lambs. Challenges of maintaining adequate ventilation play the most important role in most flocks with pneumonia challenges. *Mannheimia haemolytica* is the most important bacterial cause of pneumonia in lambs. Affected lambs have fevers, are lethargic, cough, and increased respiratory rate and effort. Early detection and treatment with antibiotics are necessary in affected lambs. In some cases, treatment with anti-inflammatories or steroids may increase the success of treatment. Some lambs do not recover completely or have recurrent episodes of pneumonia. It is important to have a treatment plan for lambs that do not respond to our regular treatment plans, and to make decisions about the economic and animal welfare considerations of continuing to treat chronically infected lambs.

There are no effective vaccines against the strains of *M. haemolytica* that infect North American lambs. Cattle vaccines are totally ineffective. Improving ventilation and decreasing stocking density are the most important changes that can be made if pneumonia is a problem in your flock. Some producers use antibiotics in milk replacer or creep feed to reduce the number of lambs treated for pneumonia. I am not aware of any good research to support the use of fed antibiotics in reducing the amount of pneumonia in lambs. I advise against injecting all lambs with antibiotics before weaning or pen moves to prevent pneumonia, but sometimes treat whole pens metaphylactically in an outbreak.

An important consideration when treating lambs for pneumonia in lambs is the meat withdrawal time. None of the long acting antibiotics that we commonly use to treat pneumonia are labelled for sheep, and some have considerably longer recommended withdrawal times than the cattle label.

Coccidiosis

Coccidiosis in lambs is caused by a parasite called *Eimeria*. Lambs with coccidiosis have pasty diarrhea along with weight loss or poor performance. Lambs are generally 3 weeks old before they become sick. The parasite infects lambs by fecal oral transmission, and builds up in pens over time. In group lambing situations, younger lambs are always more severely affected than older lambs, and the same holds true is a pen is filled over a few weeks in the nursery.

Coccidiosis plays an important role in weakening lambs, and makes them more susceptible to other diseases. On its own, coccidiosis doesn't kill a lot of housed lambs but can contribute to increased mortality from other causes.

Treatment for coccidiosis is difficult and requires daily dosing with amprolium or sulpha drenches. I advise all sheep producers to include a coccidiostat in creep feed as a preventive. I prefer to use

Decoxx over Bovatec or Rumensin because the safety range is much greater. It is important to calculate feed consumption and bodyweight to ensure that lambs are consuming enough coccidiostat. Compared to nursing lambs, creep feed consumption is often lower in lambs that are consuming ad lib milk replacer.

Enterotoxemia and Bloat

Enterotoxemia, or overeating disease, is caused by *Clostridium Perfringens* Type C and D. Affected lambs are often found dead and generally the best lambs in a pen. The disease is caused by overgrowth of *C. Perfringens* in the gut, which then produces toxins that kill the lamb. We see enterotoxemia with lambs that are eating creep feed very well, or just after weaning when eating patterns change. Inconsistent milk replacer feedings can also cause enterotoxemia or abomasal bloat. Abomasal bloat is likely caused in part by bacteria called *Sarcinia*, and consistent feeding of milk replacer mixed just before feeding prevents bloat.

Enterotoxemia is prevented by vaccinating ewes 4-6 weeks prior to lambing and ensuring lambs receive adequate colostrum. In cases where colostrum intake is suspect, lambs may be vaccinated earlier than the usual 12 weeks old. In outbreak situations, an antitoxin is available, but should not generally be required.

White Muscle Disease

White Muscle Disease is caused by a deficiency in Selenium. Most of the Great Lakes basin is made up of soil deficient in Selenium, so it is added to feed. Selenium does not cross the placenta efficiently, so we generally supplement newborns with 1/4mL injectable Selenium. Milk replacers are fortified with Selenium, and may actually decrease the risk of White Muscle Disease compared to nursing lambs. Lambs with White Muscle Disease are very stiff, or found bright but down. In severe cases, muscle damage of the heart can cause sudden death.

Polioencephalomalacia

Polioencephalomalacia is caused by Thiamine (Vitamin B1) deficiency. Affected lambs are blind, and are often found down and showing neurologic signs. Classically lambs stretch their heads backwards as if trying to touch their forehead to their spines. If detected early, lambs respond very quickly to injections with Thiamine. Normally Thiamine is made in the body by bacteria in the intestinal tract. Sheep with polio have often had a disruption of normal gut flora by a sudden feed change.

Urolithiasis

Urolithiasis is the blockage of the urethra by bladder stones. Ram and whether lambs will strain to urinate, and can develop “water belly” after the bladder ruptures if not discovered quickly. Some blocked lambs can be saved by amputating the urethral process of the penis. Struvite crystals that then form stones are more prone to formation in lambs fed diets with a low Calcium:Phosphorus ratio. Diets that are 2:1 Calcium:Phosphorus decrease the risk of stone formation. Some diets are formulated with additional ammonium chloride to decrease the pH of urine to decrease crystal formation. Additional salt can be added to the diet to encourage increased water intake as well.

Summary

Management of lambs on milk replacer is more intense than raising nursing lambs. With properly designed facilities and appropriate nutrition disease in young lambs can be managed without difficulty. The diseases of milk replacer fed lambs are the same as nursing and weaned lambs, but different diseases become more prevalent.

Development of an Udder Health Course for Dairy Sheep

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Introduction

Dairy sheep producers want to produce the highest quality product – specifically, milk – for their consumers. Part of the process of achieving this goal is to maintain the health of the animals that produce that milk, and in particular the health of the udder.

This guide is designed to help educate producers, veterinarians, and extension and dairy support personnel on how to best do that. The information in this guide has come from a number of sources but includes extension information from both the small ruminant and cow sectors, and new information from the latest research from around the world.

What is meant by quality milk?

Quality milk is defined by its characteristics:

- The level of bacteria in the milk;
- The number of somatic cells (which are a measure of inflammation or mastitis);
- The freezing point as affected by water contamination;
- Presence of residues of veterinary drugs and other chemicals or toxin; and
- By its colour, flavour and odour

Most processors have standards and some provinces have legislation governing what is acceptable quality milk. None of the components of this guide are part of a regulatory process but its contents will help us to understand how to produce better quality milk, with particular reference to the health of the udder.

What is meant by udder health?

The term "udder health" refers to those measures, which keep the udder healthy so that it can produce high quality milk. But of course, the udder is attached to the ewe and the ewe lives with other sheep – so really "udder health" refers to those practices designed to keep the flock healthy so that the ewes can produce healthy milk. Mastitis is the number one reason for poor udder health and will be a major focus of this guide, but overall ewe health also influences the ability for it to produce quality milk. Udder health is an integral component of producing quality milk – in terms of the level of somatic cells (a measure of mastitis), some aspects of bacterial counts, and of course residues of drugs in the milk. So in summary, this guide will emphasize milk quality within the context of udder health.

Organization of the Guide

The guide is divided into 7 sections and 3 appendices. Each section is identified by a coloured coded page and is supported by definitions of unfamiliar words and phrases (Appendix 1) and a self-assessment quiz (Appendix 2). There is some overlap between sections where we believe the topic needs emphasis and connection.

Section I: Introduction, Normal Lactation and Flock Health

The first part of this section covers normal lactation and includes normal anatomy, how milk is produced by the ewe and what happens during the dry period. It covers normal hormonal control of milk production and provides the producer, veterinarian or adviser a more in-depth understanding of what is happening inside the ewe when it produces milk.

It also provides a background to understanding what happens when things go wrong, i.e. when a ewe develops mastitis.

The second part of this section gives an overview of basic flock health of the dairy sheep flocks. It covers common diseases, vaccination programs, and touches on nutritional needs as they relate to animal health and prevention of nutritional diseases (e.g. pregnancy toxaemia, white muscle disease). It also refers to nutritional issues and milk quality, e.g. bacteria in the milk, off flavours. It reviews the lambing period and includes management of lamb births and lamb health. Reproductive management is covered as it relates to improved reproductive efficiency of dairy ewes. Programs developed in Canada are referred to which offer guidance to producers and veterinarians on how to maintain or improve the health of their flocks and protect public health.

Section II: Mastitis – What Causes It and How It is Detected

This section begins by addressing the costs of mastitis in terms of lost production and treatment, welfare and public health risk. The signs of mild to severe mastitis are presented as well as the important pathogens, including contagious and environmental bacteria, viruses and other organisms. Factors which predispose a ewe to developing mastitis are then discussed. How mastitis is detected, either because of clinical changes or subclinical mastitis – terms of physical inspection, somatic cell counts and their interpretation (including using the California Mastitis Test) and bacterial culture of the milk – both obtaining the sample and interpreting the results.

Section III: Milking Management

Milking management starts with preparing the udder and teats for milking including disinfecting, drying and examining the foremilk. Hygiene of the hands is emphasized because of their roll in contagious mastitis. The actual milking procedure including applying the teat cups and set-up of the milking equipment is covered. Time for milk-out is reviewed as it is quite different from dairy cattle. Machine stripping and its potential role in mastitis is discussed. Pre and post teat dipping and technique are reviewed. Other issues of milking management covered are post-milking environment, risk of iodine residues in the milk to human health, and milking order.

Section IV: Proper Maintenance and Use of Milking Equipment

Types of milking systems and set-up are introduced here. In more depth are the procedures to effectively clean milking equipment including both systems which use bulk tanks as well as pails for freezing milk. Set-up and maintenance of equipment is covered in more depth than in Section III.

Section V: Milk Quality

This section reviews how milk quality may deteriorate if animals are not properly milked or if equipment is not properly set-up, cleaned and maintained. The first part covers how milk quality is measured – with most emphasis on bacterial counts in the milk. Troubleshooting the most common sources of high bacterial counts is covered as well as freezing point, presence of chemicals and off-flavour of milk.

Section VI: Treatment and Control of Mastitis

Because there are no drugs approved in Canada for lactating dairy sheep, this chapter starts off with explaining the implications of using veterinary drugs in this class of animal. Drugs of concern are antibiotics, dewormers, hormones and anti-inflammatory pain killers. Antibiotics are the most common class of drugs used to treat and control mastitis and so their detection in the milk is covered in-depth. The role of the veterinarians in proper prescribing of use of these drugs is also discussed. Keeping good records, accurate animal ID and communication between milkers and other farm staff to make sure that treated animals are not accidently milked for human consumption – which may result in rejection of loads. Storage of livestock medicines, how to proper administer a treatment intramammary as well as systemically is covered. The Canadian Sheep and Lamb Food Safe Farm Practices program is described and it is advised that producers enrol to more accurately ensure that the milk stays safe for consumption.   Finally issues of treating lactating and / or at dry-off are presented. Specific issues covered are the control of *Staphylococcus aureus* mastitis in the flock, eradication of maedi visna and selection of ewes to cull and ewes to retain. Finally, a brief overview of the current Canadian requirements for organic milk production is covered.

Section VII: Monitoring Udder Health and Goal Setting

In order to know how to improve udder health, it is first important to know where the flock currently is. Having an accurate benchmarks and reasonable goals, allows proper prioritization of the necessary changes to achieve those goals. This section describes what a SMART goal is and what measures are most useful for monitoring udder health and suggests some appropriate goals.

A form is provided to record culture results and response to treatment as this is an important part of monitoring udder health. Treatment records are available from the Canadian Sheep and Lamb Food Safe Farm Practices program and SCC data is available from CanWest DHI. A second form to be used to monitor and assess specific measures of udder health, e.g. incidence of clinical mastitis; proportion of flock with an SCC greater than 400,000; incidence of new infections during lactation; prevalence of chronic infections; losses due to mastitis. Suggested actions if goals are not met are also included in the form. Both forms are included so that they can be removed and copied.

Appendix I. Word or Phrase Definitions

Some sections of the guide may contain words or phrases not familiar to readers. If a word is printed in blue, then a definition is available in Appendix I. It is organized by section and sub-section and then in order in which it is mentioned.

Appendix II. Self-Assessment Quiz

This section contains simple multiple choice and true or false questions to allow the reader to determine if he/she recalls important points of the text. These questions are designed to prompt readers to self-assess their understanding of the contents of this guide. All information needed to answer the questions is found in the section indicated. The correct answers are located at the end of this section. An answer form is provided to allow other people to use this quiz or to test yourself before reading the guide and then repeat to see how much you have learned.

Appendix III. References and Additional Reading Materials

Development of this guide has relied heavily on other's work: technical manuals, review articles, proceedings from meetings, and original research publications. If a reader wishes to find out more information – citations for these references are provided. We expect that, if this guide proves valuable to producers, veterinarians, extension personnel and support personnel – that updates will occur as more information becomes available.

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Genes Without Boarders

Rick MacRonald, President, Agricultural Management Services Inc.

Seroprevalence of Q Fever (Coxiella Burnettii) and Associated Risk Factors in Ontario Sheep Flocks, Goat Herds and their Farm Workers

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Objectives of this Study

To determine the prevalence of infection with *Coxiella burnetii*, and factors which affect risk of infection in sheep and goats and the people who care for them in Ontario, Canada.

Introduction

Coxiella burnetii is a bacterium which causes Q fever in people. In sheep and goats, infection with *C. burnetii* can cause outbreaks of abortion, stillbirth and increased early lamb / kid death or may be present in the flock without signs. The bacteria are shed in the birth fluids, milk and faeces and are aerosolized in the barn environment as well as present in dust and bedding. Risk of human infection is from inhalation of bacteria which have been aerosolized from abortive materials, materials from a normal birth, or from manure that becomes dry and dusty (e.g. when barns are cleaned or manure spread) – and less commonly from consuming raw milk products.

Although important as a cause of infectious abortion in sheep and goats (#3 cause in sheep and #2 cause in goats in Ontario flocks and herds), *C. burnetii* is more important because its risk to the health of people. The time from exposure to the bacterium and disease is approximately 2 to 3 weeks. Approximately 60% of infected people do not become ill. Approximately 20% develop a flu-like illness with mild fever and headaches and recover usually without treatment. Approximately 20% of people become ill enough that they seek medical attention. These cases have significant fevers, pneumonia or hepatitis and about 5% may require hospitalization. Acute Q fever is very responsive to antibiotic treatment (doxycycline) and full recovery is usual.

Approximately 1-5% of untreated Q fever cases progress to chronic Q fever. Chronic Q fever is more serious and people require prolonged and aggressive treatment to recover. It most often presents as endocarditis (inflammation of the inner layer of the heart), and chronic fatigue syndrome (Roest et al., 2011). People with a previous heart valve damage, or those who are immunocompromised or pregnant at the time of exposure are more likely to develop chronic Q fever (Angelakis and Raoult, 2010). A large human Q fever epidemic in the Netherlands from 2007 to 2009 associated with goats, raised awareness of the public health implications of infection with *C. burnetii* in small ruminants and both sheep and goats have been shown to be an important source of Q fever in humans. *C. burnetii* infection has long been recognized as occurring endemically in Ontario, yet it is likely that the true prevalence of exposure in people is underestimated. Given that abortion due to *C. burnetii* is not uncommon in Ontario sheep and goat farms, we wished to better understand how prevalent exposure is to this bacterium both in sheep and goats – meat and dairy, and in the people who care for them. This will allow for more proactive approaches to both controlling this disease in sheep and goats and protecting the health of the people that work with them.

Methods

The study was conducted starting in 2010 and completed in 2011. A random sample of sheep and goat farms was contacted and producers were invited to participate in the study. In total 148 sheep and goat farms (meat and dairy) were enrolled, including 22 dairy sheep flocks. Blood was collected from 35 randomly selected ewes or does that had given birth in the last 12 months. Additionally, farm workers in contact with the animals were invited to provide a blood sample. Antibodies in the blood to *C. burnetii* were detected using an IDEXX ELISA test kit for sheep and goat samples, and Focus Diagnostic's IFA for human samples.

Questionnaires were used to collect information on how animals were managed on the farm and on specific human behaviours. The questions were formulated based on suspected practices or behaviours that we thought may affect the risk of infection with *C burnetii*. For example, how placentas and fetuses from aborted ewes are disposed may change the risk of animals getting infected, so we asked producers how they were usually managed. We then compared the responses to the risk of an animal being seropositive. If there was a significant correlation (e.g. if composted promptly decreased risk of being seropositive and leaving them in the pen increased risk of being seropositive) then that was included in the final mathematical model. If there was no correlation, then that factor was excluded from the model. The final model only includes those risks which were significant.

In this model, the risk is described as an "odds ratio" (OR). An OR is a numerical way of explaining either increased risk (a number greater than 1); or decreased risk (a number between 0 and 1). For example, as a veterinarian if I drive 30 km over the speed limit while going to a farm to assist in a difficult lambing, the OR of me getting a speeding ticket is likely much greater than 1. If instead I obey all speed limits and traffic rules, the OR is likely less than 1. In this case, the OR explains the risk of being seropositive. The P-values indicate whether or not the OR is significant (P-value must be ≤ 0.5 or 5% for the OR to be considered statistically significant). The referent is the practice that others are compared to (i.e. compare one practice to another – one practice has a higher or lower OR than the referent practice).

Results

Sheep: At the farm level 48.1% (35/72) of sheep farms had at least one sheep test positive, and by sector 63.6% (14/22) of dairy sheep farms and 42.0% (21/50) of meat sheep farms had at least one seropositive sheep. The overall individual sheep seroprevalence (prevalence of test positive animals) was 17.2% (347/2016), with 24.3% (181/744) of dairy sheep and 10.3% (166/1619) of meat sheep testing positive.

Goat: At the farm level 63.2% (48/76) of goat farms had at least one seropositive goat, and by sector 78.6% (33/42) of dairy goat farms and 44.1% (15/34) of meat goat farms had at least one seropositive goat. The overall individual goat seroprevalence was 32.5% (714/2195), with 43.7% of dairy goats (633/1447) and 10.8% (81/748) of meat goats testing positive.

People: Among the farm workers tested on these farms, the overall individual seroprevalence was 67.4% (116/172). When divided by sector the farm worker seroprevalence was 30.7% (4/13) for dairy sheep farm workers; 54.1% (20/37) for meat sheep farm workers; 85.2% (69/81) for dairy goat farm workers; and 43.2%(19/44) for meat goat farm workers. Note that 3 farm workers worked on both sheep and goat farms, so the total overall denominator differs by 3. Of the farms that provided human samples, 78.7% (59/75) had at least one seropositive farm worker.

Risk Factors - Sheep: The model describes which risk factors significantly influence the odds of an individual (animal or person) of being seropositive. The results from the sheep model are presented in Table 1. This model tells us that lambing pen cleaning practices; housing lambing ewes in a separate air space; loaning animals; and flock size all significantly influence the odds of a sheep being seropositive. Again, an OR > 1 when the P<0.05 means that the risk increases for the management practice. If the OR is <1 when the P<0.05, the risk decreases.

Risk Factors – Goat: The full results are not included. The odds of goats being seropositive increases significantly (p<0.05) with: increases in female and male herd size; being within 5kms of other goat or sheep farms; having pigs on the farm; and replacement animals have access to kidding area after weaning. Disinfecting the kidding pens, and kidding outdoors showed decreased the odds of goats being seropositive.

Risk Factors – People: The full results are not included. The following factors increased the odds of farm worker seropositivity (p<0.05): working on a dairy goat farm (compared to meat goat or dairy sheep farm); the proportion of sheep or goats on their farm testing positive; and ever having smoked tobacco. Tobacco smoking may be important because it may harm the immune response of the lungs allowing for increase chance of inhalation of the bacteria and infection, or because contaminated fingers touch the end of the cigarette which then is placed in the mouth and the contamination is inhaled.

Conclusions

Exposure to *C. burnetii* among Ontario sheep, goats and their farm workers was common. Seropositive farm workers were identified in all small ruminant sectors, but dairy goat farm workers had higher odds of exposure to *C. burnetii* than meat goat or dairy sheep farm workers, but were not different from meat sheep farm workers. Since the proportion of seropositive sheep or goats was highly predictive of human seropositivity, this provides evidence supporting control programs for people based on reducing exposure in animals, such as vaccination and biosecurity programs. The Coxevac® vaccine (CEVA Animal Health), has been shown to be effective at decreasing the bacterial shedding in sheep and goats (Hogerwerf et al., 2011). This reduces environmental contamination, and lowers the risk of human exposure and associated human cases of Q fever (Hogerwerf et al., 2011). It is available in Canada for use in sheep and goats through the farm's flock veterinarian. Producers from larger flocks should be mindful that there is an increasing risk of exposure on their farms. Therefore, more stringent hygiene practices and biosecurity may be required on large farms to offset this effect.

Lambing and kidding area hygiene was highlighted as an important factor protecting against animal exposure. Therefore lambing pens should be regularly cleaned and disinfected to prevent the accumulation of potentially contaminated materials. As well, there are a number of measures that can be taken to protect people on farm such as: always wearing disposable gloves and sleeves when handling birth products and aborted/stillborn fetuses; washing hands thoroughly with disinfected soap several times a day after contact with animals, before entering the house, handling food or smoking; only consuming pasteurized milk products; ensuring that visitors wear freshly laundered coveralls, boots left on premise, disinfected boots or disposable boot covers; and restricting barn access during lambing to those at high risk of Q fever including pregnant women, and those with weakened immune systems due to poor health.

The risk factor models from this study allow a better understanding of the risk factors and protective measures associated with *C. burnetii* exposure, and will provide support for the development of prevention and control guidelines to help reduce the risk of *C. burnetii* exposure in sheep, goats and their farm workers.

If you suspect a *C. burnetii* infection in your sheep, contact your flock veterinarian to investigate abortion and stillbirth events. If diagnostic testing indicates disease is present in your flock, veterinarians can get access to the Coxevac® vaccine in Canada through an application process. If you are concerned about Q fever in yourself or your family, contact your physician to discuss the likelihood of Q fever infection.

Table 1. Farm management variables associated (<0.05) with sheep seropositivity for *C. burnetii*, as observed through multivariable mixed-effects logistic regression of data collected from 72 sheep farms in Ontario, Canada (Aug 2010-Jan 2012).

Risk Factors	OR	P-value
Lambing pen cleaning practices [a]		
Add bedding, remove birthing materials and disinfect	Referent	-
Add bedding and remove birthing materials	8.96	0.002
Add bedding only	5.94	0.038
Do nothing	0.97	0.986
Lambing ewes housed in separate airspace from flock [b]		
Always	2.08	0.362
Sometimes	11.26	<0.0001
Never	Referent	-
Not Applicable (do not lamb indoors)	0.44	0.614
Loaning animals that return to farm	8.14	0.006
Log of female flock size	3.24	<0.0001

[a] Likelihood ratio test for lambing pen cleaning practices variable $\chi^2 = 11.71$, P-value = 0.0084.
[b] Likelihood ratio test for lambing ewes housed in separate airspace from flock variable $\chi^2 = 11.77$, P-value = 0.0082.

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Frequently Asked Questions Regarding *Coxiella burnetii* in Small Ruminants and Q Fever in Humans

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Infosheet

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1. WHAT IS COXIELLA BURNETII?

Coxiella burnetii (*C. burnetii*) is a bacterium that is commonly found in domesticated and wild animals throughout the world. These highly infectious bacteria can be spread from animals and their environment to humans. (Rodolakis. 2006. Q fever, state of art: Epidemiology, diagnosis and prophylaxis. Small Ruminant Research)

C. burnetii is very hardy and resistant to heat and drying conditions. The bacteria can survive for long periods of time in the environment, and may be spread by wind and dust. A dilution of bleach (final concentration of 0.05% hypochlorite), 5% peroxide or a 1:100 solution of Lysol® may be effective disinfectants. The bacteria are destroyed in milk by high temperature pasteurization.
(Q fever. 2007. Center for Food Security & Public Health, http://www.cfsph.iastate.edu/Factsheets/pdfs/q_fever.pdf; Centers for Disease Control and Prevention, 2011, http://www.cdc.gov/qfever/)

C. burnetii infection in animals is not a federally reportable disease in Canada.
(Canadian Food Inspection Agency, 2011, http://www.inspection.gc.ca/animals/terrestrial-animals/diseases/reportable/eng/1303768471142/1303768544412)

In Ontario, veterinary laboratories and veterinarians who use a lab outside of Ontario must notify the Ontario Ministry of Agriculture and Food (OMAF) following a diagnosis of *C. burnetii*. OMAF will work with the flock/herd veterinarian and producer to answer any questions they may have regarding *C. burnetii* and discuss biosecurity practices aimed at limiting the spread of disease. Since *C. burnetii* can be spread from animals to humans, OMAF will also work with public health officials to assess the risk to people exposed to *C. burnetii*, answer any questions they may have and encourage them to see their family physician if they have concerns regarding their health.
(Ontario Ministry of Agriculture and Food, 2013, http://www.omafra.gov.on.ca/english/food/inspection/ahw/aha-regs-guidelines.htm)

2. WHAT ANIMALS CAN BE INFECTED WITH C. BURNETII?

Cattle, sheep and goats appear to be commonly infected with *C. burnetii*. However, other animals such as cats, dogs, rabbits, horses, pigs, rodents, wildlife, birds and ticks are often infected and can spread the bacteria to other animals and humans. It is difficult to prevent animals from becoming infected and there are no formal control programs or vaccines licensed in Canada. (Centers for Disease Control and Prevention website, 2011, http://www.cdc.gov/qfever/; Ontario Ministry of Health and Long-Term Care, 2003, http://www.health.gov.on.ca/english/providers/pub/disease/qfever.html)

3. WHAT ARE THE SIGNS OF C. BURNETII INFECTION AND DISEASE IN ANIMALS?

Most animals do not show signs of disease; however, infected sheep and goats may abort in late gestation or deliver stillborn or weak offspring. Pregnant cats and dogs may also have an abnormal birthing event. Antibiotic treatment of individual animals is not effective at decreasing bacterial shedding and has not been proven to prevent further abortions.
(Rodolakis. 2006. Q fever, state of art: Epidemiology, diagnosis and prophylaxis. Small Ruminant Research)

4. IN WHAT ANIMAL SECRETIONS ARE THE BACTERIA SHED?

Infected animals shed high numbers of the bacteria in the placenta and birthing fluids at the time of an abortion or normal delivery. Higher numbers of organisms are shed if the birth was abnormal. *C. burnetii* organisms are also shed in the milk, feces, semen and urine, whether after an abnormal birthing event or from infected animals not showings signs of disease. When infected fluids dry out, the spore-like form of the bacteria can remain alive in the resulting dust for long periods of time.
(Rodolakis. 2006. Q fever, state of art: Epidemiology, diagnosis and prophylaxis. Small Ruminant Research; Rousset, et al. 2009. *Coxiella burnetii* shedding routes and

antibody response after outbreaks of Q fever-abortion in dairy goat herds. Applied Environmental Microbiology)

5. HOW LONG ARE THE BACTERIA SHED IN THOSE SOURCES?

Shedding is most prevalent just after birth and tends to decrease thereafter but there are differences between species. *C. burnetii* can be shed in vaginal discharge(s) for 14 days in goats and up to 71 days in sheep. In manure, the bacteria can be shed up to 20 days in goats, up to 8 days after lambing in sheep and 14 days in cattle. In milk, the bacteria can be shed for up to 2 months in goats and sheep but shedding is intermittent and shed persistently up to 13 months in cattle. These numbers describe the longest observed times of shedding the bacteria during the follow-up of naturally or experimentally infected herds/flocks.
(Arricau-Bouvery and Rodolakis. 2005. Is Q fever an emerging or re-emerging zoonosis? Veterinary Research)

6. HOW DO PEOPLE BECOME INFECTED WITH C. BURNETII BACTERIA?

People most commonly contract Q fever when they breathe in air contaminated with the *C. burnetii* organism from animals aborting or birthing—but also from dried contaminated materials that become air-borne when cleaning the barn or spreading manure. People also become infected through direct contact between infected materials (tissues, fluids, wool, straw, manure, etc) and skin abrasions or mucous membranes (e.g. infected material being splashed into the eye), by drinking unpasteurized milk or via tick bites; but most infections are contracted by breathing in air containing the bacteria. Very few organisms are required to cause infection in a human.
(Q fever. 2006. Center for Food Security & Public Health Factsheet, http://www.cfsph.iastate.edu/FastFacts/pdfs/qfever_F.pdf; Canadian Centre for Occupational Health and Safety, 2009, http://www.ccohs.ca/oshanswers/diseases/qfever.html; Australian Q fever Register, Meat and Livestock Australia, 1997, http://www.qfever.org/aboutqfever.php

7. WHAT IS Q FEVER?

Q fever (the Q stands for Query) is the disease in humans caused by *C. burnetii*. The disease has a worldwide distribution, with the exception of Antarctica and possibly New Zealand.
(Q fever. 2006. Center for Food Security & Public Health Factsheet, http://www.cfsph.iastate.edu/FastFacts/pdfs/qfever_F.pdf)

8. WHAT ARE THE SIGNS OF Q FEVER IN HUMANS?

Most people (up to 60%) do not develop any signs of illness due to Q fever. In approximately 38% of cases, Q fever strikes as a sudden illness—"acute" Q fever—with flu-like symptoms. Signs may include: high fever, headache, fatigue, muscle pain, sore throat, chills, chest pain and occasionally pneumonia. Generally, people become ill 2-4 weeks after contacting the bacteria. The illness usually lasts 1 to 2 weeks and is self-limiting. Roughly half the people with "acute" Q fever become ill enough to seek medical attention. Chronic Q fever is an uncommon and serious condition that develops in 2% of infected individuals where the infection has persisted for more than six months. It tends to occur in individuals who are immunocompromised or have pre-existing damage to their heart valves. Research is mixed as to the effects of Q fever infection on pregnant women and their fetus. The antibiotic doxycycline is the first line of treatment for people with severe illness. People who recover fully from infection may have life-long immunity against re-infection. Please see your physician if you have health concerns.
(Public Health Agency of Canada website, 2011, http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/coxiella-burnetii-eng.php; Canadian Centre for Occupational Health and Safety, 2009, http://www.ccohs.ca/oshanswers/diseases/qfever.html; Q fever. 2007. Center for Food Security & Public Health, http://www.cfsph.iastate.edu/Factsheets/pdfs/q_fever.pdf; Ontario Ministry of Health and Long-Term Care website, 2003, http://www.health.gov.on.ca/english/providers/pub/disease/qfever.html)

9. HOW PREVALENT IS C. BURNETII IN RUMINANTS AND Q FEVER IN HUMANS IN ONTARIO?

In 2009, bulk tank samples from approximately 28% of Ontario's dairy cow producers and approximately 95% of the province's goat milk producers were collected and tested for *C. burnetii*. The herd-level prevalence of C. burnetii in raw cow milk was 62% and 24% in raw goat milk. A 2013 study of 148 farms in Ontario found that the proportion of sheep flocks and goat herds with one or more animal testing positive for antibodies to *C. burnetii* was 42% (21/50) (meat sheep); 64% (14/22) (dairy sheep); 44% (15/34) (meat goat); and 79% (33/42) (dairy goat). The proportion of farm workers who had serological evidence of past infection with *C. burnetii* was 67% (116/172).
(Meadows, et al. 2013. Seroprevalence of Q fever (*Coxiella burnetii*) and associated risk factors in Ontario

2

sheep flocks, goat herds and their farm workers. Proceedings of the Small Ruminant Research Day, January 31st, 2013, University of Guelph, Ontario; Ontario Ministry of Agriculture, Food & Rural Affairs: Dairy Goat Digest, 2009, http://www.omafra.gov.on.ca/english/livestock/goat/news/dgg0908a2.htm)

Q fever is a reportable disease in people in Ontario. Between 2000 and 2010, the number of reported human cases varied between 1 and 12 cases per year, with the average being 6 cases per year.
(Ontario Ministry of Health and Long-Term Care, 2011)

10. WHAT IS THE RISK OF CONTRACTING Q FEVER?

Q fever is an occupational concern for workers who have contact with animals, animal products or animal waste. People at risk include farmers, farm workers, veterinarians, abattoir workers, shearers, dairy service providers, building contractors and laboratory personnel. Most human infections are associated with exposure to cattle, sheep and goats, particularly when exposures include animals which have recently given birth – exposure to abnormal animal birth events (abortions, stillbirths, delivery of weak offspring) increases the risk of human infection. Less commonly, human infections may be associated with cats, dogs and other animals. While healthy individuals can contract acute Q fever, those at highest risk of developing chronic Q fever are those with heart valve problems or suppressed immune systems. It is possible to be exposed to the bacteria via inhalation at the time of milking, if an infected animal has recently given birth (first 14 days but possibly up to 28 days).
(Canadian Centre for Occupational Health and Safety, 2009, http://www.ccohs.ca/oshanswers/diseases/qfever.html; Q fever. 2007. Center for Food Security & Public Health, http://www.cfsph.iastate.edu/Factsheets/pdfs/q_fever.pdf)

11. IS THE RISK OF CONTRACTING Q FEVER GREATER FROM SMALL RUMINANTS THAN CATTLE?

The exact source of Q fever infection in humans is often unknown; however, sheep and goats are more frequently involved in human disease than other animal species, likely because of the higher level of shedding of the bacteria in birth fluids.
(Rodolakis. 2006. Q fever, state of art: Epidemiology, diagnosis and prophylaxis. Small Ruminant Research)

12. CAN Q FEVER BE TRANSMITTED FROM PERSON TO PERSON?

Person to person transmission occurs rarely, if ever.
(Canadian Centre for Occupational Health and Safety, 2009, http://www.ccohs.ca/oshanswers/diseases/qfever.html)

13. IS THERE A VACCINE THAT CAN PROTECT ANIMALS FROM C. BURNETII INFECTION?

The Coxevac® vaccine (CEVA Sante Animale) is provisionally licensed for use in cattle and goats in Europe. In a recent study it was shown to decrease the number of abortions due to *C. burnetii* and to decrease the amount of bacterial shedding into the environment. Unexposed replacement breeding stock must be vaccinated annually prior to breeding.
(Hogerwerf et al. 2011. Reduction of *Coxiella burnetii* prevalence by vaccination of goats and sheep, the Netherlands. Emerging Infectious Diseases)

Although the vaccine is not licensed in Canada, veterinarians do have access to it through an application to the Canadian Centre for Veterinary Biologics (CFIA) . The flock/herd veterinarian is required to write a letter indicating owner name, location of the farm where the vaccine is to be used, the animal species to be vaccinated and the reason for deciding to use the Coxevac® vaccine (ie. incidence of disease, test results, preventive measures taken to date). In Canada, there is a 60 day meat withdrawal time following the use of the vaccine.

14. WHAT ABOUT HUMAN VACCINATION?

A vaccine to protect against Q fever is available in Australia (Q-VAX®, CSL). People must be tested to make sure they are not already immune to Q fever before they are vaccinated with Q-VAX, otherwise they can have a severe reaction to the vaccine. Testing involves a blood test and a skin test. If both tests are negative, and the person is not allergic to eggs, they can then be vaccinated with Q-VAX. However, the vaccine is not readily available in Canada.
(Canadian Centre for Occupational Health and Safety, 2009, http://www.ccohs.ca/oshanswers/diseases/qfever.html)

15. AS A HERD OWNER, IF C. BURNETII IS SUSPECTED OR CONFIRMED IN THE HERD/FLOCK, WHAT COMMUNICATIONS SHOULD BE TAKEN WITH REGARDS TO EMPLOYEES AND/OR SERVICE PROVIDERS VISITING THE FARM?

Owners have a duty of care to educate their employees about Q fever and inform service providers of the risk of disease when *C. burnetii* is known or suspected in the herd/flock, particularly when abortions are occurring.

16. WHAT PERSONAL PRECAUTIONS CAN A PERSON WORKING WITH RUMINANTS, PARTICULARLY SMALL RUMINANTS, TAKE?

There are a number of protective measures that can and should be taken by people working with small ruminants.

- √ During kidding and lambing, disposable gloves and sleeves should always be used when handling kids/ lambs and birth products. It is preferable that birthing should occur indoors out of the wind and in a location that can be thoroughly cleaned and disinfected.
- √ Wash hands thoroughly and several times a day with an effective disinfectant soap after any contact with animals and before entering the house, handling food or smoking.
- √ Wash animal manure, urine, milk and other body fluids from equipment and disinfect where practical.
- √ All protective barn clothing (including hats) should be kept in the barn, and not worn back in the house or elsewhere. Clothing should be washed and dried using laundry procedures at high water temperatures.
- √ Visitors should wear farm coveralls or freshly laundered coveralls, farm boots or disinfected footwear. They should not visit ewes or does giving birth.
- √ Consume only pasteurized milk and milk products.
- √ Pregnant women and those most at risk of Q fever should not assist in lambing or kidding and should avoid contact with sheep and goats during the lambing/kidding season. Other high risk people include infants and young children, the elderly and those whose immune systems are weakened from poor health.
- √ Wildlife or pets should not be able to scavenge birth products. Bury and compost or dispose in a closed container.
- √ Regularly clean and disinfect lambing and kidding areas to prevent accumulation of potentially contaminated materials.
- √ Maintain a closed herd or flock. This means do not purchase, loan or borrow animals. Attending livestock shows and sales may also present a risk to the health of your flock/herd.
- √ Contact your veterinarian and investigate abortion and stillbirth events.
- √ Increase awareness of *C. burnetii* and Q fever across the agricultural industry through education.

IF Q FEVER IS KNOWN OR SUSPECTED IN A HERD OR FLOCK:

- √ Contact your flock/herd veterinarian for more advice on control measures to protect your family's health.
- √ A N95 or higher mask, gloves and protective clothing should be used when assisting with births and abortions. N95 masks must be fitted properly—contact your local public health unit or a workplace health and safety service at Health and Safety Ontario.
- √ Bury and properly compost (according to local regulations) placentas and aborted fetuses. Do not burn as it may increase the risk of aerosol spread.
- √ Isolate aborted animals until discharges cease; restrict access to these isolation areas.
- √ Access to the barn containing infected animals should be restricted, particularly to children and infants, pregnant women, the elderly or those with compromised immune systems.
- √ Manure should be thoroughly composted for at least 90 days before spreading on infected farms. When spreading, the conditions should not be windy. Do not spread manure on pastures.

(Q Fever—The Basics. 2010. Ontario Veterinary College; Canadian Centre for Occupational Health and Safety, 2009 http://www.ccohs.ca/oshanswers/diseases/qfever.html; Q fever: information for farmers. 2010. Health Protection Agency, UK, http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1210834106356)

17. IF YOU ARE CONCERNED ABOUT YOUR HEALTH, WHAT SHOULD YOU DO?

If you are at all concerned about your health, please contact your physician or local public health unit and discuss the likelihood of Q fever infection. We recommend providing them with this document.

Ontario
Ministry of Agriculture and Food
Ministry of Rural Affairs

University of Guelph

Ontario
Ministry of Health and Long-Term Care

Ventilation for Dairy Sheep

Robert Chambers, Engineer, Swine, Sheep Housing and Equipment, Ontario Ministry of Agriculture and Food and Ministry of Rural Affairs

Happy sheep and lambs are essential to having a productive and profitable flock. Animals perform at their peak when they are in their thermoneutral zone. Ventilation allows producers to achieve this goal. Sheep, like other livestock and poultry are homoeothermic; they maintain a relatively constant body temperature during changes in the environmental temperature changes. For sheep the core body temperature is 39°C (102.2° F). Internal body temperatures varying by only a few degrees from this temperature can be fatal.

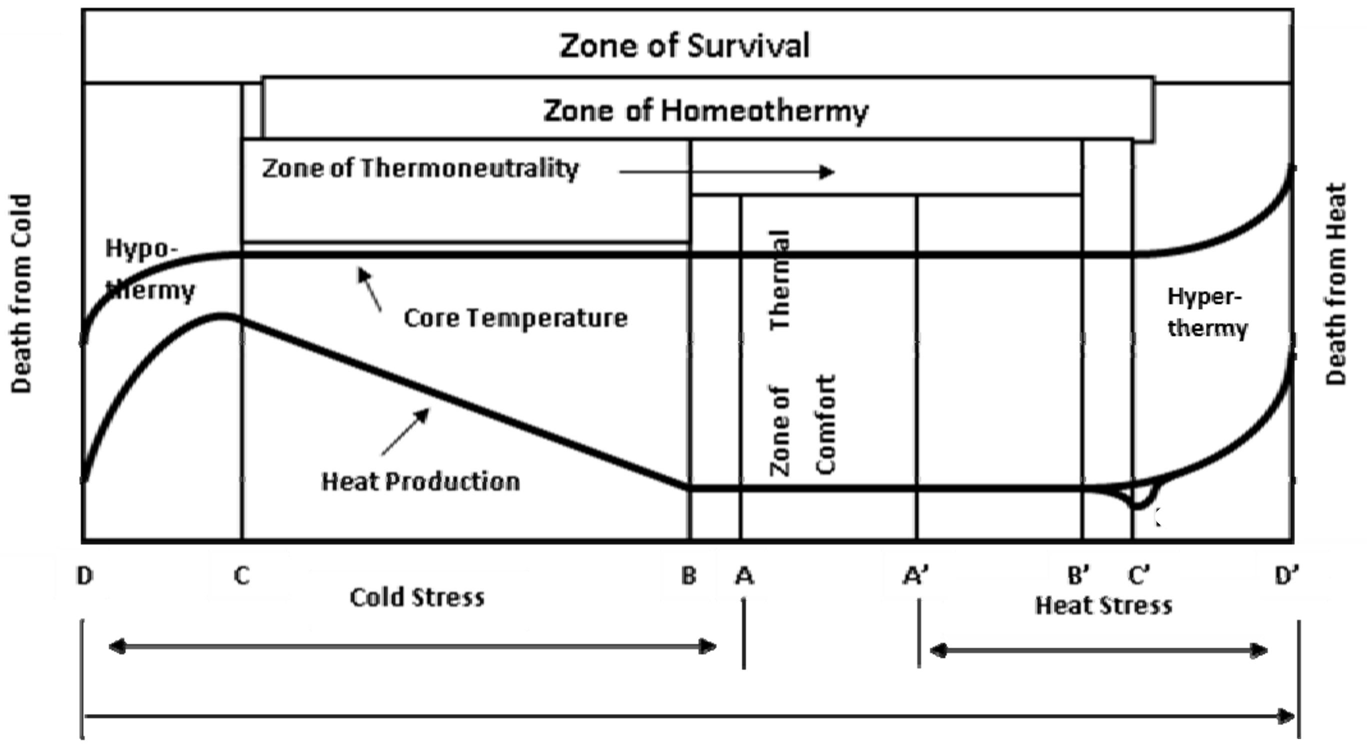

Figure 1. Homeothermic Heat Production and Body Temperature as Affected by Environmental Temperature. Midwest Plan Service Structures and Environment Handbook, 11th edition 1983.

Figure 1 shows the relationship between homoeothermic heat production and body temperature. In the **Zone of Thermal Comfort**, blood vessels in the skin are neither all dilated nor all constricted, evaporation of moisture from the skin and respiratory tract are minimal, hair is not erected nor is there no observed behavioural response to heat or cold.

When the temperature falls below point **A**, the blood flow is diverted to the body core away from the skin surface to reduce the heat flow from the skin. Hair tends to fluff up to reduce convective heat losses by increasing the insulation value of the hair/wool cover.

As the temperature falls below point **B**, the lower critical temperature, heat production rises. This added heat protects the core temperature from falling and homeothermy is maintained. Increased feed intake sustains the increased metabolic rate.

Below point **C**, the extra heat produced cannot balance the heat lost, homeothermy fails, and the core temperature and heat production decline. Exposed for long enough, this can lead to death from cold, point **D**.

Heat stress starts when the environmental temperature rises above point **A'**. The blood vessels in the skin surface enlarge so as to increase blood flow and the skin's surface temperature. This increases the heat transfer rate to the environment. Sweating and increased respiration functions to increase the water vapour output and consequently latent heat output. The appetite is depressed to reduce body heat production in an attempt to reduce the body heat output (sensible heat).

The upper critical temperature, point **B'**, is the limit to a radical change in heat production. At this point the respiration increases in intensity (panting) and heat production decreases partly due to decreased feed intake.

At point **C'** the animal looses homeothermy because it can no longer increase moisture loss through mainly increased respiration and sweating. The ability for the animal to cool itself is maxed out. The animal may pant harder but the evaporation rate is almost constant. Hot, high humidity weather is detrimental to animals and humans, because the principle heat transfer method to cool the body, evaporation, is reduced by this type of weather. The core temperature begins to rise. This rise in body temperature triggers increased biochemical reactions which further increase heat production (the van't Hoff effect). Without relief, the cycle leads to death, **D'**, though like extreme cold, exposure for only a few hours cause no lasting harm in most animals.

Sheep, like all mammals attempt to gain and loose heat to the their surrounding environmental temperature in 4 ways, Conduction, Thermal Radiation, Convection and Evaporation in order to maintain their Zone of Homeothermy.

Conduction is heat transfer between contacting bodies at different temperatures. Heat transfer from the body core to the skin surface occurs by conduction through the body tissue and also by convection associated with blood flow. Sheep adjust conductive heat loss simply by changing the contact area. In sheep an example is young lambs huddling together with other animals and laying down on a heating manure pack in cold weather, or ewes standing up and away from other animals in warm weather.

Thermal Radiation is the exchange of thermal energy between objects by electromagnetic waves. The rate depends on their temperatures and the nature of the surfaces. Radiation can pass through a vacuum and it warms the receiving body. The sun radiant heat load can be reduced 30% to 50% by shade. In sheep production practical examples include using an open front south facing building. Properly designed these structures allow the low angle winter sun to enter the barn in winter to warm and dry the interior of the barn. In summer, the high angle summer sun is blocked out allowing the majority of the barn to be shaded, reducing the solar heat load provided the underside of the roof is insulated.

Convective heat is transferred to or from the animal by the mass movement of fluid. Natural or free convection results from differences in density caused by temperature differences. An example is that one kg of -10^{o} C air has a volume of 750 litres and a density of 1.33g/litre, warmed to 20^{o} C it now has a volume of 835 litres and a density of 1.2 g/litre. This property is used in natural ventilation systems to aid in the removal of stale air through chimneys. Fans or pumps (including the heart) produce fluid motion and heat transfer known as forced convection. Sheep exposed to high wind velocities and cold temperatures suffer from rapid heat losses.

Evaporation or moisture removal through respiration and the skin surface is the fourth form of heat transfer with sheep. Every lb of water that is evaporated requires 1000 BTU's of energy from the animal. In cold weather, evaporative losses from respiration and perspiration are minimal with sensible (the heat that we feel) transfer making up the majority of heat transfer. Evaporative losses are largely from the upper respiratory tracts. Exhaled air has been heated to near body temperature, 39^{o}C, and saturated with vaporized water in the upper respiratory tract. Little water evaporation or air warming occurs in the lungs. Shorn sheep approximately double their evaporation rate over unshorn sheep due to the increased skin evaporation rate (sweating). Note though that shorn sheep are much more venerable to solar radiant heat gain lacking a wool cover. As the relative humidity in the air increases the rate of evaporation lowers.

In reality it is usually not just one heat transfer acting alone that causes an animal to suffer from cold or heat stress but a combination of factors. Newborn lambs for example lacking a wool coat, wet and having a high surface area to mass ratio are particularly vulnerable to hypothermia (chilling). Figure 2 illustrates the different heat losses resulting from the combinations of wind and wet. A lamb having low brown fat reserves (its energy) and/or exposed for long enough duration with out colostrums soon lacks fuel for its furnace and dies from exposure.

Sheep producers benefit in that that they can modify the ewe's and mature lamb's heat transfer rate by allowing the wool to grow for cool weather exposure or by shearing ewes for indoor winter lambing to approximately increase the ewe's sensible heat output from 74 to 197 Watts thereby warming the barn and providing a drier indoor environment. The price of this though is the energy comes from increased feed consumption.

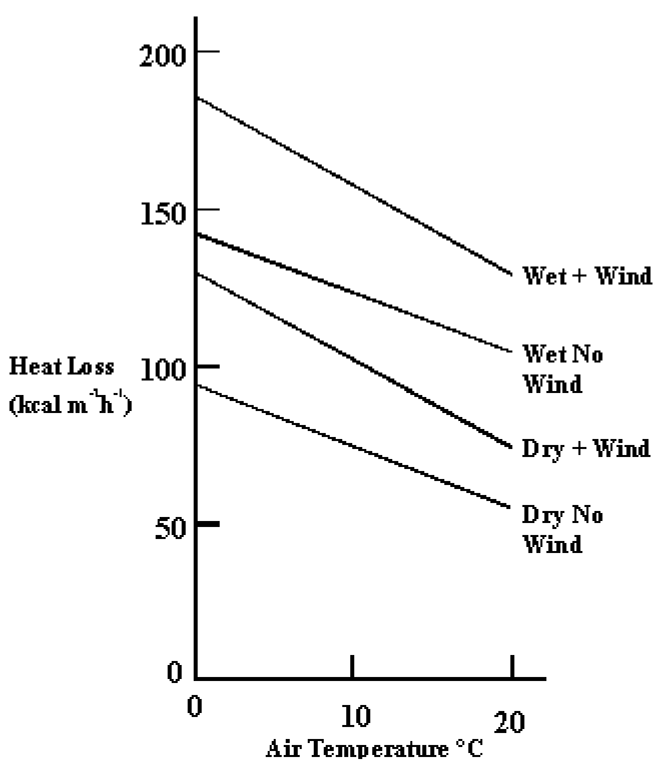

Figure 2. The effect of wind, environmental temperature and wetness on heat loss in newborn lambs. [From Alexander, G. (1962), *Australian Journal of Agricultural Research*, 13, 82

Cold stress

Cold stress is when the net heat transfer out of the animal is greater than the animal's digestive and metabolic heat production. Cold stress primarily affects feed efficiency. The animals require more feed as extra feed is being used to maintain the core body temperature. All sheep can experience cold stress but newborn lambs are by far the most susceptible to its effects. The reason for this is that heat transfer is primarily a function of surface area and heat production is primarily a function of body mass or weight. Smaller animals are at a distinct disadvantage as their furnace (metabolic system) is small compared to their heat emitting surface. They have a minimal insulation (wool) and are born wet which increases the heat transfer and requires extra energy to evaporate. The only advantage they have if born from healthy, properly fed mothers is brown fat or BAT (Brown Adipose Tissue) whose sole function is to provide heat to the newborn animal in the first day of life. Lambs from underfed mothers and/or multiple births have lower amounts of brown fat and are smaller which puts them at a higher risk of cold stress.

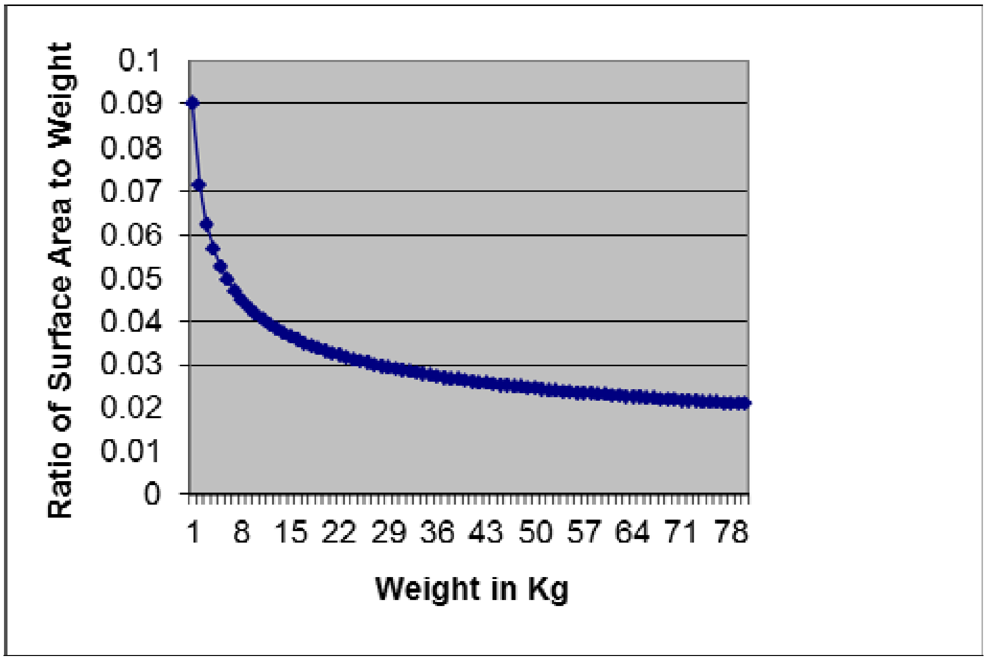

Figure 3. The effect of increasing weight on the ratio of surface area to weight

Though the temperature is important it is the combination of the four heat transfer methods, Conduction, Convection, Radiation, and Latent that determine the EET (Effective Environmental Temperature) that the animal is experiencing. Using an extreme example, if a well fed full fleeced ewe is lying on a dry well bedded pack in a south facing open front barn on a sunny -29 C day in February, the animal should be experiencing only minor cold stress if any. The conduction and convection losses will be minimal, the radiation heat transfer may even be a positive from the sun and latent heat losses will be minimal. If that same animal is underfed, and kept outside in a muddy yard with a soaked fleece at 1C in the pouring rain and strong winds; there is a near certainty that it will soon die from cold stress, even though the temperature is 30 C warmer. It's the rate of heat transfer that is more important than the actual temperature.

While producers cannot change the laws of heat transfer physics there are several things that can be done to reduce or eliminate cold stress.

For those lambing indoors in winter with prolific sheep, cold stress can be a major factor in mortalities. Prolific breeds commonly have multiple births with low individual birth weights. Even with proper feeding programs and management there is an increased risk that these lambs will be susceptible to cold stress. Again as these lambs have a high surface area to weight ratio and usually have lower amounts of BAT, they are at a distinct disadvantage to the cold. While producers cannot change the principles of heat transfer, there are many simple things that can be done to reduce the heat loss and give these lambs a better chance of survival.

Whether lambing in a barn or out on pasture by providing a shelter from draughts and the wind by using lambing clamps with solid sides, at least on the bottom 16". Provide windbreaks with trees, hay or straw bales or windbreak fencing in pastures to provide a micro climate for the lamb to seek relief from the wind. Lambing areas in the barn need to well bedded with dry bedding and lambing pastures should be well drained and preferable south facing. Again the colder the temperature and the higher the lambing percentage the more important these techniques become.

Due to the low mass density of housed sheep, compared to swine or beef cattle, sheep barns need to well insulated and /or be provided with supplemental heating systems. Radiant type heaters can effectively warm the surface of the lambing area without having to heat the entire barn.

Heat Stress

As mentioned in the previous article, happy sheep and lambs are essential to having a productive and profitable flock. Animals perform at their peak when they are in their thermo neutral zone. Generally speaking, as sheep evolved in a desert environment, they handle hot dry temperatures well. However, they can experience heat stress and a corresponding loss in production.
Heat stress occurs when the environmental temperature rises above point where the animal is producing more heat from digestion and/or receiving more heat from its surroundings than it is releasing to the surrounding environment. Its first reaction to this situation is the blood vessels in the skin surface enlarge so as to increase blood flow and the skin's surface temperature. This increases the heat transfer rate to the environment. Sweating and increased respiration functions to increase the water vapour output and consequently latent heat output. This is the point of Heat Stress Alert.

The upper critical temperature is the limit to a radical change in heat production. The animal is in Heat Stress Danger. At this point the respiration increases in intensity (panting) it reduces its feed intake to slow the internal heat of digestion (sensible heat) being produced. This causes the animal to reduce its growth, i.e. feeder lambs, or milk production i.e. lactating ewes.

As the animal's internal temperature increases it reaches a point where it can no longer increase moisture loss through mainly increased respiration and sweating. This is the Heat Stress Danger point. The ability for the animal to remove more heat than it is producing and/or receiving is maxed out. The animal may pant harder but the evaporation rate is almost constant. Hot, high humidity weather is detrimental to animals and humans, because the principle heat transfer method to cool the body, evaporation, is reduced by this type of weather. The core temperature begins to rise. This rise in body temperature triggers increased biochemical reactions which further increase heat production (the van't Hoff effect). Without relief, the cycle leads to death, though for only a few hours causes no lasting harm in most animals.

As mentioned earlier, sheep gain and loose heat to the their surrounding environmental temperature in 4 ways, Conduction, Thermal Radiation, Convection and Evaporation in order to maintain their ideal core body temperature of 39°C. Under heat stress conditions the goal is to minimize heat coming into the animal from the surroundings and maximize heat transfer out of the animal. By doing this we lower the animal's Effective Temperature, that is even though the animal has the potential to be in a heat stress condition due to the ambient temperature, effectively the animal "feels" comfortable because its core temperature is near normal as incoming heat transfer in minimized and heat transfer out of its body is maximized.

Conduction is heat transfer between contacting bodies at different temperatures, the higher the temperature differential the more rapid the conduction. Heat transfer from the body core to the skin surface occurs by conduction through the body tissue and also by convection associated with blood flow. Producers can aid in maximizing conduction out by ensuring that the manure pack is kept to a minimum depth and dry. Deep, damp manure packs start to compost and release heat and moisture. As the stomach is the heat generation centre by giving the animals minimal bedding allows them to transfer heat to the cooler ground below when they lay down. Slatted floor systems for dry ewes and feeder lambs work well in hot weather as the animal is in direct contact with the floor surface when lying down and therefore maximizing conduction. Bunk and pen space should also be increased if possible so that the animals can eat and lay down without having to touch one another. Anybody that has traveled on public transit during rush hour in a major city during a heat wave can relate to this.

Radiation heat transfer to the animals can be minimized by providing shade for those animals outside. Shade can reduce the incoming solar heat load by 30% to 50%. Sheep with a medium to long fleece also benefit from the insulating effect of the wool from the radiant heat load from the sun. Sheep housed indoors can also have a radiant heat load. With naturally vented barns if the eve overhangs are short the sun can shine into the barn warming both the animals and the barn space. Another common issue is the as the sun shines on the metal roofs of single story barns, a dark coloured or tarnished roof can rise as much as 15°C above the ambient air temperature. If the underside of the roof is uninsulated, this heat can radiate down in the barn space or heat an unvented attic that then radiates down. By adding insulation (R5 minimum) to the underside of the steel roofing the radiant heat load is lowered considerably. Enclosed attic spaces should have a minimum ventilation of 1 ft^2 of total opening for 300 ft^2 of ceiling area. Half of this area is the exhaust located on the peak and/or gable ends and half along the roof eave and /or soffit areas. If we have a barn that's 120' by 60', flat bottom truss and insulated ceiling, the roof vent exhaust total minimum area would be 12 ft^2, distributed along the peak and the soffit vent continuous slot minimum opening of 0.6" on each side. Gable end vents are only recommended for buildings less than 50' long unless used in combination with ridge vents.

Convective heat is transferred to or from the animal by the mass movement of fluid, in this case by air. Air moving past an animal provides a cooling effect, sometimes referred as the wind chill effect. Table 1 shows the air speed effects on effective temperature in Swine. Freshly sheared sheep would have a similar effect decreasing with increasing fleece length. For sheep in pasture having access to the top of hills or wind swept areas on hot days and/or underneath large trees such as maples or oaks that provide shade as well cause the wind to accelerate as it passes under and around the foliage will assist to decrease the effective temperature.

Sheep kept in barns can benefit from natural or mechanical induced wind speed. Naturally ventilated barns should have minimum opening of 5% of the floor area on each side of the building. For example for a barn 60' by 120' with a 12' sidewall, the minimum clear opening should be 3' and rough opening of at least 4' to account for the curtain folding. Many barns have even larger openings to take full advantage of breezes on the hot days. Naturally ventilated barns are located with the ridgeline on a southeast to northwest axis so as to be perpendicular to the summer breezes that come predominately out of the south, southwest and west during the summer in southern Ontario. Barns should be sited so that they are not in the wind shadow of trees or other buildings. This shadow distance extends 10 times the height of the obstacle downwind. For example a tree line that has a height of 40' would have a wind shadow extending 400' from it.

Table 1. Air Speed Effects on Effective Temperature for Swine

Air Speed (ft/min)	Air Speed (km/hr)	Effective Decrease in Temperature (°C)
30	0.55	-4
90	1.65	-7
300	5.5	-10

Producers with mechanically ventilated barns should have a ventilation system that delivers one air exchange per minute during hot weather. For example a 50' by 60' bank barn with a 10' ceiling should have a combined fan capacity of at least 30 000 CFM (Cubic Feet per Minute). This system with reduce the heat build-up from the animals and will keep the temperature of the barn within one degree C higher than the outside temperature.

Producers can also enhance the system by adding circulating fans to provide the wind chill effect. Naturally ventilated barns that have hot weather issues due to location or design can also benefit from the additional air movement that circulating fans provide. Figure 1 shows the proper placement of basket or panel fans in a barn. Large overhead HVLS (High Volume Low Speed fans can also provide the required air speed of approximately 300' per minute. These systems should be on a thermostat so they shut off when not required to ensure animal comfort and electrical efficiency. New born and young lambs should be protected from the direct path of this air as they run the risk of being chilled if exposed to these air speeds, even at warm temperatures.

Latent heat transfer or moisture removal through respiration and the skin surface is the most important of heat transfer in hot weather for sheep. Every lb of water that is evaporated requires 1000 BTU's of energy from the animal. More importantly, as the temperature warms up, the ability of the animal to transfer energy out of its body through sensible heat transfer is reduced. The latent heat transfer rate approximately triples as the environment warms up along with a corresponding increase in water consumption. By providing cool, fresh, readily available drinking water drinking, producers can ensure that this important cooling system is fully functional. Guides suggest that there should be 1ft2 of water surface per 40 head on animals. For pasture supply systems by burying the supply line in the ground this keeps the water much cooler and more palatable that pipes placed on the surface.

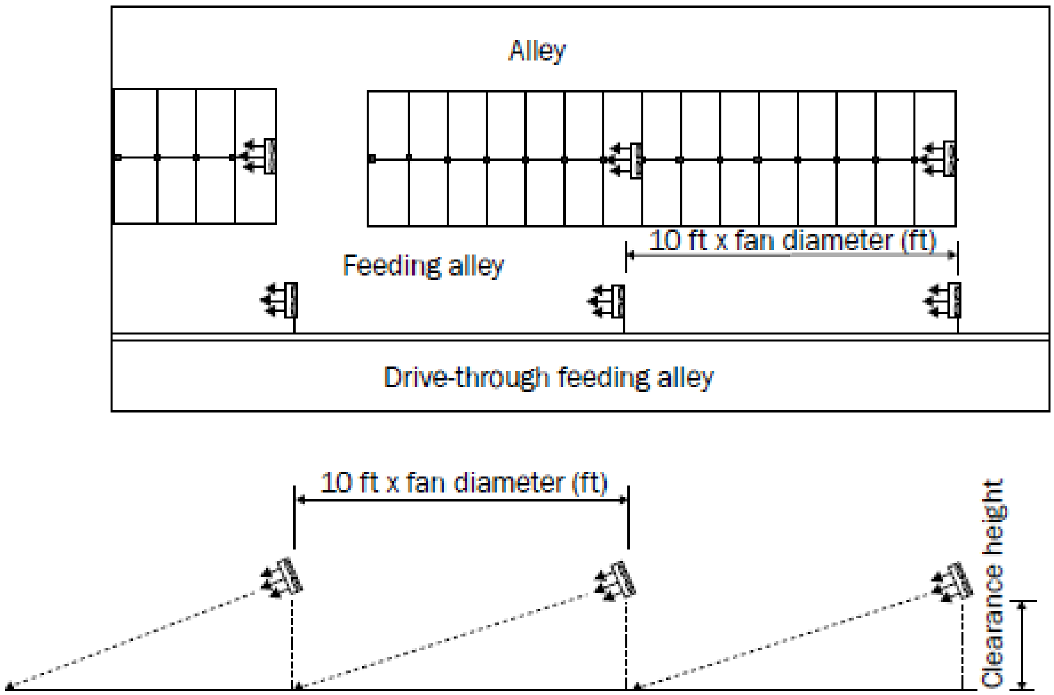

Figure 4. Placement of Panel or Basket Fans in a Free Stall Barn.

In summary by providing the conditions for animal to decrease it's heat transfer in cold conditions and increase its heat transfer rate in hot conditions allows it to maintain a comfortable effective temperature.

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How's it Done in the U.K.

John Ryerie, Dorset, England

How it's done in the UK!
Capital expenditure
Spend lots…or spend as little as possible! Milking on a budget can be done, and done well!

Relevant Factors:

- **Available Funds**
- **Available resources:**
  - Land – Buy/Rent
  - Buildings – Refurbish existing/New build
  - Final Flock Size
- **Labour**
  - Family Farm own labour
  - Family Farm hired labour
  - Independent business – OMF!

Value can be added by in house processing or by selling raw milk onto others.

Final flock size determined by grazing restraints:

- Acres
- Quality
- Winter Forage
- Available Labour
- Financial
- Winter Housing
- Seasonal milking
- 12month milking
- Once a day milking

Traditional sheep farming

- Stick and a dog!

More modern sheep farming:

- Quad bike and a dog
- Winter Lambing/Housing
- Mobile race handling system – take race to the sheep not vice versa!

Eastern Europe sheep dairying

Western Europe sheep dairying means there are regulations to be complied with:

- Animal Welfare
- Hygiene
- Food Standards Agency

European Standards
Movement regulations between farms
Livestock Haulage
Competency Licence
Vehicle Licence
Abattoir Regulations
Organic Standards

Decisions:

Location

- Close to buyer, processor, consumer
- Topography
- Suitable for quality grazing
- Ease of access
- Available labour
- Power – water etc.

Milking Aims:

Be the best – produce the best – produce what your buyer requires, when they require it!
High quality
Long shelf life
High cheese yielding milk
Maximise production per animal
Make a profit
Repeat the above, but reduce costs! Improve output, simplify and expand?

Lambs Aims:

Maximise birth weights
Minimise stress
Prevent brown fat loss
Maximise dry matter intake – Lamb Milk Replacer – Concentrate – Total Mixed Ration
Constantly review mortality levels and reduce
Never be content with last year's/months results
Monitor
Record
React

Staff:

Select
Educate
Train
Empower
Reward

Milking Intervals For Dairy Ewes

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Background

Dairy ewes produce relatively small amounts of milk at each milking relative to dairy cows and dairy does. Therefore, it is very important to have an efficient milking system that results in the maximum amount of milk produced per unit of labor. Good parlor design and milking routine are both very important for fast throughput of ewes at each milking. Most flocks are milked twice per day at approximately 12 hour intervals during the majority of the lactation period. Increasing or decreasing the milking interval from the normal 12 hours may be another method to improve the economic efficiency of milk production.

The alveoli are the milk secreting units of the udder. The alveoli are bag-like structures with an inner lining of epithelial cells that secrete milk into the inner cavity or lumen of the alveoli. The milk then moves through small ducts connected to the alveoli into larger ducts and eventually into cavities in the udder gland and teat known collectively as the "cistern". Therefore, milk within the udder of dairy ruminants can be divided into two fractions: the cisternal fraction, which has already been transferred from the alveoli to the cistern during the intermilking interval and is immediately obtainable at the time of milking without oxytocin release and milk ejection, and the alveolar fraction, which can be removed from the udder only if oxytocin is released and milk ejection occurs (McKusick et al., 2002).

Large differences between dairy species exist with respect to the proportion of total milk that can be stored within the cistern. For example, following a normal milking interval of 12 to 14 hours, the dairy ewe and goat can store up to 75% of the total milk volume within the cistern (Marnet and McKusick, 2001), whereas the cisternal fraction in dairy cattle accounts for approximately 20% of total milk volume (Pfeilsticker et al., 1996). Dairy ewes may be more amenable to longer milking intervals than dairy cows because they have larger cisterns, relative to their udder size, capable of storing larger volumes of milk between milkings than do dairy cows. However, large differences between dairy sheep breeds in the size of their udder cisterns and in the proportion of total milk that is cisternal milk has been reported (Rovai et al., 2008) so some dairy sheep breeds and individuals within breeds with larger than average cisterns may be more adaptable to a longer milking interval than breeds or individuals with smaller cisterns.

Once Per Day Milking

Several older studies, conducted primarily in France and Italy, have compared once-daily milking with twice-daily milking during the entire lactation period. These studies have been reviewed by Marnet and Komara (2007) and are summarized in Table 1. The authors summarized these results by stating, "In ewes, once-daily milking is not used and has been tested only in older studies despite a renewal of interest. Decreases in milk yield varied between 5 and 41% depending on the studies and breeds of ewe, with a lower decrease in milk yield in ewes with greater cisternal storage capacity." The most recent study (Nudda et al., 2002) reported a decrease in lactation milk yield of 18%

with Awassi ewes and 24% with Sarda ewes with once-daily milking compared to twice-daily milking. Giving up approximately 20% of the milk yield by going to once-daily milking for the entire lactation is probably not an economically viable option for most family-operated sheep dairies.

Table 1. Decrease in milk yield of ewes from once-daily milking compared to twice-daily milking during the entire lactation reported in various studies.

Decrease in milk yield, %	Breed	Reference[1]
5	Sarda	Casu and Labussière, 1972
6	Sarda	Casu and Boyazoglu, 1974
10	Sarda	Flamant, 1974
10	Friesian x Sarda x La-caune	Partearroyo and Flamant, 1978
10 to 19	Lacaune	Partearroyo and Flamant, 1978
12 to 15	Sarda	Casu and Boyazoglu, 1974
13 to 28	Chios	Papachristoforou et al., 1982
18	East Breed	Bagdasarov, 1960
18	Awassi	Nudda et al., 2002
20	Israelian	Morag, 1968
23	Merino	Nudda et al., 2002
24	Sarda	Nudda et al., 2002
25	Sarda	Partearroyo and Flamant, 1978
41	Sarda	Labussière et al., 1983
35 to 51	Prealpes de Sud	Labussière et al., 1974

[1]See Marnet and Komara (2007) for the complete citations.

Different Milking Intervals Within a Lactation

Dairy ewes peak in daily milk yield during the third to fourth week of lactation, and decrease steadily thereafter until they are dried-off in the 7th to 9th month of lactation. This suggests that milking intervals may be longer in mid- to late-lactation, when milk production is low, than in early lactation, when milk production is high, without significantly affecting total milk yield. Following are descriptions of studies conducted at the Spooner Agricultural Research Station at the University of Wisconsin-Madison and other institutions that have evaluated the use of different milking intervals within a lactation.

16-Hour Milking Intervals from Mid-Lactation

A trial was conducted at the Spooner Station in 2001 to determine if the milking interval could be extended from 12 to 16 hours starting in mid-lactation without a significant drop in milk yield (McKusick et al., 2002). Forty-eight third lactation East Friesian crossbred ewes were utilized. Twenty-four ewes were kept on the 12 hour milking interval (12H, milked daily at 6:00 a.m. and 6:00

p.m.), and 24 ewes were switched from the 12H interval on an average of day 90 of lactation to a 16 hour milking interval (16H, milked at 6:00 a.m. and 10:00 p.m. one day and at 2:00 pm. the following day and then repeating). Lactation performance was measured through day 180 of lactation.

During the 90-day treatment period, 16H ewes produced about 28% more ($P < .05$) milk at each 6 a.m. milking than 12H ewes, and there was no difference between treatments in the total amount of milk produced (Table 2). The percentage of fat and protein and somatic cell count was not different between the two treatments. From mid- to late-lactation, it appears that dairy ewes can be milked at 16 hour intervals, reducing the number of milkings by 25%, without a decrease in milk production.

Table 2. Lactation performance of ewes milked at 12 or 16 hour intervals from day 90 to 180 of lactation.

	Milking interval	
Trait	12 hour	16 hour
Total number of milkings	180	135
6 a.m. milk yield, lb.	1.43[b]	1.83[a]
Adjusted 24-hour milk yield, lb.	2.95	2.97
Total milk yield, lb.	262.0	259.6
Total parlor time, hours	38.1	27.9

[a,b]Means within a row with no superscript in common are different ($P < 0.05$). No test of statistical significance was possible for total number of milkings or total parlor time.

Initially, the drawbacks to this milking system appear to be the different milking routines between adjacent days and the necessity of a late night milking every other day. However, the routine can actually result in improved quality of life due not only to a reduced number of milkings but also to the actual milking times. Many people have social activities for themselves or their school-age children in the late afternoon or early evening. Milking twice-daily with the evening milking at 5:00 or 6:00 p.m. is disruptive to these social activities, but the 16 hour milking interval allows you to engage in these late afternoon or early evening activities either after a 2:00 p.m. milking or before a 10:00 p.m. milking. For some people, the 16 hour milking interval during mid- to late-lactation may be a viable option.

Once-Daily Milking from Mid-Lactation

The above trial indicated that U.S. dairy ewes could be milked at 16 hour intervals (3 milkings in 2 days) from mid-lactation without a reduction in lactation milk yield. The logical next step was to see if ewes could be milked only once-daily (24 hour interval) from mid-lactation without a large decrease in milk production.

A trial was conducted at the Spooner Station in 2013 to determine the effect of once-daily milking starting in mid-lactation on milk yield. Seventy-two crossbred East Friesian-Lacaune ewes in their second to seventh lactations were selected for the trial from the larger flock of milking ewes. All 72 ewes had been milked twice-daily from less than one day after lambing to the start of the trial at an average of 100 days of lactation. On the test day one week before the start of the trial, the 72 ewes produced an average of 6.0 lb. of milk.

The ewes were divided into 3 similar groups of 24 ewes each and the following treatments were applied starting on June 4, 2013: 1) Control – continued to be milked twice-daily, 2) 7/1 – milked once per day in the morning, and 3) 6/1 – milked once per day in the morning except not milked at all on Sunday. All 72 ewes entered the parlor twice a day during the milking times of the entire flock to receive their grain supplement, but only the control ewes were milked at each milking. The treatments were administered through August 9, 2013 (total of 67 days). All ewes were then milked twice -daily through August 20, 2013 to determine if once-daily milking had any effect on subsequent milk production. After August 20, 2013, the entire flock was switched from twice-daily to once-daily milking until the end of milking on September 28, 2013.

Figure 1 presents the daily milk production of the three groups. The control and 7/1 ewes had consistent, small decreases in milk production as lactation progressed, which was expected. The 6/1 ewes, however, had large swings in daily milk production with highs on Mondays after not being milked on Sundays followed by a large drop on Tuesdays and gradual increases from Tuesdays through Saturdays. By August 20, and after 11 days of twice-daily milking of all ewes, daily milk production of the three groups was similar.

Table 3 presents lactation performance during the 67-day treatment period. There was no significant difference in milk yield between the ewes milked twice daily (Control) and ewes milked once-daily (7/1). This study indicates that East Friesian-Lacaune ewes of the types found in North America can move from twice-daily to once-daily milking at mid-lactation (at approximately 100 days postpartum) with a large savings in milking labor and an insignificant drop in milk yield.

Interestingly, the two once-daily milking groups (7/1 and 6/1) had greater fat and protein percentages than the twice-daily control group. Individual ewe milk samples were collected for composition analyses once each week (10 sampling times) at the morning milking. Eight of the sampling days were on Fridays, one was on a Tuesday, and one was on a Wednesday. Previous studies have reported that longer milking intervals decreased fat percentage and had no effect on protein percentage (e.g., Castillo et al. 2009); in contrast to these results.

Table 3. Lactation performance of ewes milked twice-daily (Control), once-daily (7/1), or once-daily except not on Sunday (6/1) from mid- to late-lactation.

Treatment	Milk yield, lb.	Fat, %	Protein, %	SCC, $\log_{10}$
Control	241.1^{a}	5.61^{d}	4.98^{d}	5.30
7/1	231.5^{a}	6.37^{c}	5.26^{c}	5.25
6/1	189.3^{b}	6.64^{c}	5.34^{c}	5.28

^{a,b}Means in a column without a superscript in common are different ($P < 0.05$).
^{c,d}Means in a column without a superscript in common are different ($P < 0.01$).

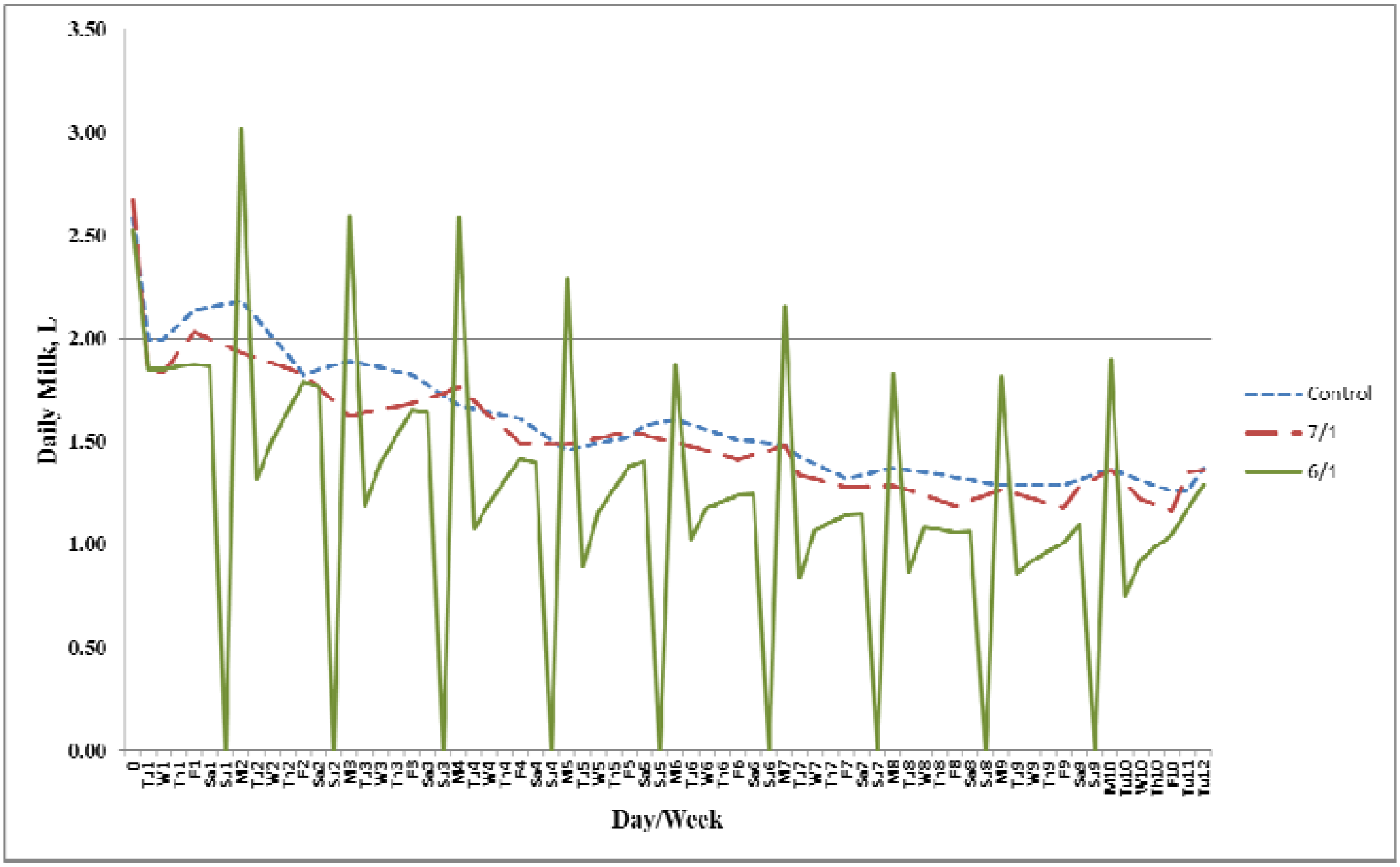

Figure 1. Daily milk yield (liters) of ewes milked twice-daily (Control), once-daily (7/1), or once-daily but not on Sunday (6/1) starting in mid-lactation (day 100). Treatments were applied on days Tu1 through F10. Day 0 is average milk yield with twice-daily milking at test days prior to the start of treatments. Days Tu11 and Tu12 are milk yields for two test days during the two weeks immediately following the end of the trial when all ewes were milked twice-daily.

Milking once-daily except not on Sunday (6/1) resulted in a significant decrease in total milk yield of 18% compared to once-daily milking (7/1). The labor savings from one less milking per week cannot compensate for the financial loss of an 18% decrease in milk yield in most flocks. In addition, the large drop in milk yield on Tuesday following the very high yield on Monday suggests that increased pressure in the udder from the large amount of milk accumulated from after the Saturday milking until the Monday milking may be causing some short-term stress to the udder that requires a few days for recovery. However, the somatic cell counts were similar among treatments (Table 3), indicating that once-daily milking treatments were not resulting in an increase in udder infections. We have collected both milk and blood samples, yet to be analyzed, that should provide more definitive evidence of any udder stress, if it exists, in the 6/1 ewes.

Twice-Daily Weekday Milking and Once-Daily Weekend Milking

In order to facilitate improved quality of life by providing more time away from milking, Spanish researchers have evaluated a milking routine where ewes are milked twice weekly during weekdays but only once-daily on Saturday and Sunday (Castillo et al., 2009). They compared this milking routine with typical twice-daily milking during both early-lactation (weeks 8 to 14) and mid-lactation (weeks 15 to 22) in both native Manchega ewes and Lacaune ewes. Twice-daily milkings occurred at 8:00 a.m. and 6:00 p.m., which resulted in milking intervals of 10 and 14 hours. Once-daily weekend milkings occurred at 4:00 p.m. on Saturday (22 hour Friday – Saturday interval) and 2:00 p.m. on Sunday (22 hour Saturday – Sunday interval, and 18 hour Sunday – Monday interval). Lactation performance is presented in Table 4.

Table 4. Lactation performance of ewes according to milking schedule, breed, and stage of lactation.

Item	Early-lactation 1X weekend	Early-lactation 2X daily		Mid-lactation 1X weekend	Mid-lactation 2X daily
Daily milk yield, lb.					
Manchega	2.24[b]	2.63[a]		1.76	1.87
Lacaune	4.57	4.64		4.20	3.83
Fat, %					
Manchega	6.61[b]	7.02[a]		7.62	7.74
Lacaune	5.86	6.16		5.79	6.01
Protein, %					
Manchega	5.59	5.72		6.15	6.22
Lacaune	4.80	5.06		5.08	5.10
SCC, $\log_{10}$					
Manchega	5.20	4.97		5.03	5.05
Lacaune	4.78	5.00		5.08	5.09

[a,b]Means within a row and stage of lactation without a common superscript tend to be different ($P < 0.10$).

No significant differences for any of the lactation traits were found due to milking schedule for the Lacaune ewes in either stage of lactation (Table 4). During early lactation, the Manchega ewes on the once-daily weekend scheduled tended to produce less ($P < 0.10$) milk with less ($P < 0.10$) fat than the Manchega ewes on the twice-daily schedule. No significant differences were found between milking schedules in mid-lactation for the Manchega ewes.

These results point out the importance of cistern size in the adaptability of ewes to longer milking intervals. Prior to the start of the study, cistern size of each ewe was estimated by measuring the cistern surface area from ultrasound images of each udder. Lacaune ewes had larger cisterns than Manchega ewes (15 cm^2 vs. 10 cm^2, respectively). During early lactation, the smaller cisterns of Manchega ewes did not allow holding of all the milk the ewes were capable of producing during the longer milking intervals of the once-daily milking on weekends so their milk production suffered.

Conclusions Regarding Longer Milking Intervals

From the studies summarized previously, it appears that producers can move from twice-daily to once-daily milking at mid-lactation without a significant decrease in milk yield. Extending milking intervals to 48 hours just once per week during will result in a significant loss in milk yield; even from mid-lactation to late-lactation. Ewes with large udder cisterns are more adaptable to longer milking intervals than ewes with smaller cisterns. Even in early lactation, large-cisterned ewes may not suffer significantly in total milk yield if the milking interval is occasionally extended up to 24 hours. None of the above studies included ewe lambs. Due to their smaller udder size, it would be expected that longer milking intervals would be more detrimental to the milk yield of ewe lambs compared to older ewes.

Shorter Milking Intervals – Milking More Frequently than Twice-Daily

The above discussion dealt with longer milking intervals for dairy ewes, i.e., milking intervals greater than 12 to 14 hours. However, the dairy cow industry in the U.S. has been moving toward shorter milking intervals. Many cow dairies now milk three times a day, and with the advent of robotic milkers, many cows are milked more than three times a day.

I was not able to find studies in the peer-reviewed scientific literature on the effects of milking dairy ewes more often than twice-daily. However, we conducted a study in 2000 at the Spooner Station comparing three-times-a-day milking (3X) (milking at 6:00 a.m., noon, and 6:00 p.m.) with twice-daily milking (2X) (milking at 6:30 a.m. and 5:30 p.m.), and the results were published in the Proceedings of the 6th Great Lakes Dairy Sheep Symposium (de Bie et al., 2000) held in Guelph, Ontario.

A total of 125 mature East Friesian crossbred ewes were utilized during the first 30 days of lactation. After day 30 of lactation, all ewes were milked twice-a-day. All lambs were weaned from their dams within 24 hours after parturition, and ewes were immediately assigned to a milking treatment. During the 30-day treatment period, 3X ewes produced a total of 29 lb. more ($P < .05$) (+15.2%) milk than 2X ewes (220 versus 191 lb.).

This study was conducted early in our sheep research program at the Spooner Station when the highest percentage dairy breeding among our ewes was 50% and milk prices were less than they are currently. The conclusion from the trial at that time was that even though 3X produced significantly more milk than 2X during the first 30 days of lactation, the value of the increased amount of milk was less than the labor costs for the extra milking each day. Under today's circumstances where a ewe might be expected to produce at least 210 lb. of milk in the first 30 days of lactation with twice-daily milking and milk is worth at least $.75/lb., milking three-times-a-day may make economic sense. See the simple economic example below:

Twice-daily milking for first 30 days = 210 lb. milk x $.75/lb. = $157.50
3-times-daily milking for first 30 days = 242 lb. milk x $.75/lb. = $181.50

Income advantage of 3X over 2X = $181.50 - $157.50 = $24.00/ewe x 200 ewes = $4,800/flock of additional income

Labor for additional milking: 2 people x 4 hours/milking x 30 days x $15.00/hour = $3,600/flock of additional labor costs

Net returns: $4,800 additional income - $3,600 additional labor = $1,200 increased net returns

Given these very rough calculations, it is probably time that we conduct another research trial looking at the effects of three-times-a-day milking in early lactation.

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Unlocking the Key to Successful Lamb Feeding Program

Megan Van Schaik, Nutrition Associate Grober Nutrition , Grober Nutrition

Unlocking the Key to Successful Lamb Rearing

Megan Van Schaik

Grober Nutrition

www.GroberNutrition.com

RIGHT FROM THE START

Presentation Outline

- Lamb physiology
  - The Newborn Lamb
  - Rumen Development
  - Bloat
- Feeding management
  - Feeding strategies
  - GYADC results
  - Automatic Feeding Machines
- Milk replacer formulation

RIGHT FROM THE START

Lamb Physiology

- Rumen very small
- Liquid passes through esophageal groove straight to the abomasum
- Sucking reflex causes muscular folds of the rumen and reticulum to meet
  - This enables the lamb to develop a healthy population of bacteria in the rumen
  - No bacteria present at birth

RIGHT FROM THE START

The Importance of Colostrum

- Colostrum provides immunity
  - Ig's are necessary to get lambs off to a healthy start – provides immunity to farm specific bacteria
  - A first defense against the environment
  - Quality of colostrum is an important factor

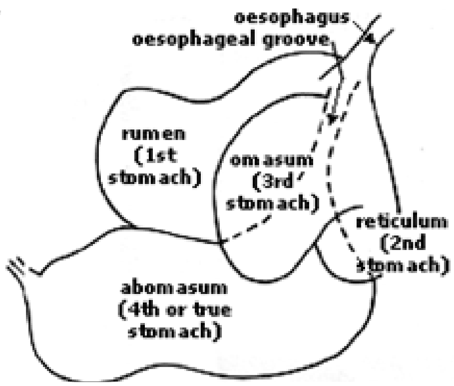
RIGHT FROM THE START

Colostrum Supplements

- Colostrum supplements can be a valuable tool if colostrum is poor quality, if there is disease on farm, etc.
  - Bovine colostrum supplement is acceptable in this case and better than no colostrum
  - Colostrum supplements formulated for lambs/kids are available on the market

RIGHT FROM THE START

A Look Inside the Lamb…



RIGHT FROM THE START

Whole Milk Digestion

- Whole milk enters the stomach
  - Forms a curd - calves and lambs are unique in the formation of a curd
- The acid in the stomach activates enzymes needed for digestion
  - Eg. rennin (same enzyme used to clot milk in cheese making)

RIGHT FROM THE START

Milk Digestion

- Milk proteins are 90-97% digested
  - unless heat damaged
- As the rumen develops and rennin activity drops, lambs can make use of other protein sources

RIGHT FROM THE START

Protein

- Protein is needed to lay down muscle
  - Helps build the immune system
- Slower release form of energy – stay full longer
  - Higher levels of protein = faster growth

RIGHT FROM THE START

Fat

- A lamb needs fat from milk or milk replacer for energy
  - energy = weight gain
- As the rumen develops
  - lambs need less and less fat because they will start to get their energy from volatile fatty acids

RIGHT FROM THE START

Rumen Development

- Fresh starter/creep feed should be offered daily right from the start
  - Starter is not contributing significantly to growth until after weaning
  - Grain encourages healthy rumen development and slow increase in microbe population
  - Fresh water is critical to help with intake

RIGHT FROM THE START

Bloat

- What:
  - An over production of gas caused by bugs (not necessarily disease) shortly after feeding in either the
    - Abomasum, or
    - Rumen
- Why:
  - Changing the diet quickly can alter the natural bacterial population in the gut
  - Consequence: different microbes start to grow quickly to adjust to diet change, excess gas is produced

RIGHT FROM THE START

Abomasal Bloat

- Distension of the right side
- Usually a secondary problem due to poor feed management practices
- Bacteria use protein, sugars and the lack of oxygen to multiply
- Over-eating, acidosis and abrupt changes in feed can create the right conditions

RIGHT FROM THE START

Abomasal Bloat

Acidosis

- Causes:
  - tube-feeding – esophageal groove reflex dysfunction
  - stress – weaken the immune system
  - weak suckling reflex – esophageal groove reflex
- Signs: Inappetance, loss of hair, clay-like faeces, inability to stand, dull coat

RIGHT FROM THE START

Ruminal Bloat

- Distension of the left side
- "Ruminal drinking"
  - milk fermenting in the rumen
  - Milk can sit in rumen up to 48 hours
  - Fermentation end products: lactic acid and volatile fatty acids
  - Lowers pH, alters bacterial population

RIGHT FROM THE START

Ruminal Bloat

- A starter too low in fiber will not fill their gut enough encouraging lambs to eat more and providing fermentable energy (sugars) = too much gas = bloat
- Starter with too many fines can lead to bloat by altering the microbial population

RIGHT FROM THE START

Feeding Management

RIGHT FROM THE START

Feeding Management

- Nipple feeding
  - Stimulates suckling reflex allowing milk to pass straight to the abomasum
- Pail feeding
  - Enables engorgement of feed especially if the abomasum has been empty a long time
  - Pail has been empty a long time
  - Not enough pails for the number of lambs

RIGHT FROM THE START

Feeding Management

- Feeding once or twice/day
- Stomach empties, lamb drinks warm milk too quickly
- Gut fill, spills into the rumen
- Feeding more frequently
- Allows the pH of the abomasum to remain more steady
- Lambs won't drink as much as quickly
- Allows for easier digestion

RIGHT FROM THE START

Grober Research - Woodstock

- To develop current, practical information on how to successfully raise milk replacer fed lambs
  - Evaluating the feeder
  - Evaluating flooring/bedding type
  - Evaluating ad-libitum and limit fed feeding management

RIGHT FROM THE START

Feeding Management

- Feeding once or twice/day
- Stomach empties, lamb drinks warm milk too quickly
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- Feeding more frequently
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RIGHT FROM THE START

Feeding options

Mob feeder

✓Inverted nipples
✓Easy to handle
✓Allows many lambs to have access
✓Needs careful cleaning
✓Needs multiple feedings per day

Automatic feeder

✓Lambs decide their intakes
✓Up to 6 lines from feeder
✓Calibration and cleaning need to be done frequently

RIGHT FROM THE START

Trial Design

- Access to 2 mob feeders multiple times per day
- Fed according to label for milk replacer
- Shavings for bedding
- n=13

- Access to automatic feeder
- Elevated floor with piggy deck
- n=9

- Access to automatic feeder
- Shavings for bedding
- n=10

RIGHT FROM THE START

Flooring Options

Piggy Deck	Shavings
	

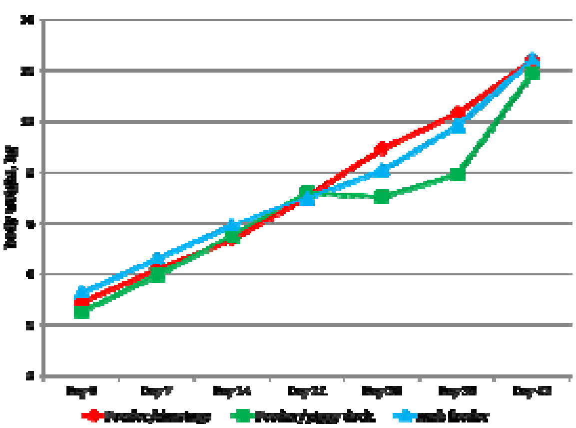
RIGHT FROM THE START

Health Assessment

- Understanding how to assess lambs physically
  - Using the correct therapy
  - Grober worked on developing a health scoring system for lambs
    - Similar to calf health scoring system
    - Once score is high enough, animal is treated

RIGHT FROM THE START

Results



RIGHT FROM THE START

Feeding more milk

		Feeder Shavings	Feeder Piggy Deck	Mob Feeder
# of lambs		9	8	12
Wean age (days)		37.8	34.8	34.8
Average weight (kg)	Start	2.89	2.50	3.29
	Wean	10.20	8.80	8.07
Total MR (kg)		9.28	7.63	6.54
Total Creep (kg)		3.34	7.52	11.26
$/kg of gain	MR	$4.82	$4.19	$4.29
	Weaned	$0.68	$1.15	$1.92
	Total	$5.00	$5.21	$7.09

Looking at feed efficiency

Grain ration	Sex	Body weight (kg)			Days to Market	Total Grain Intake (kg)	ADG (kg/day)		Feed:gain ratio	
		Start	Wean	Market			MR	Grain	MR	Grain
Corn	M	3.22	10.88	55.60	146.6	215.1	0.255	0.353	1.18	4.45
Corn	F	3.44	8.87	44.90	149.3	162.2	0.179	0.262	1.44	4.71
Barley	M	2.84	7.94	50.24	151.0	162.2	0.156	0.281	1.50	4.53
Barley	F	2.55	9.85	45.98	151.7	165.4	0.246	0.268	1.20	5.23

RIGHT FROM THE START

The bottom line for profit

Grain ration	Sex	# Lambs	Total Feed cost/lamb		Avg. Gross Return	Return over feed
			MR	Grain		
Corn	M	5	$28.29	$60.58	$185.72	$96.85
Corn	F	6	$21.51	$44.48	$156.29	$90.30
Barley	M	5	$22.12	$44.09	$160.93	$94.72
Barley	F	6	$27.46	$42.01	$147.15	$77.68

RIGHT FROM THE START

Key Findings

- Lambs need to consume minimum 8kg of milk replacer before weaning
  - Success rate of finishing milk-fed lambs is greater when they consumed ≥ 8kg
- Limit fed lambs (on mob feeders)
  - Min. 3 feedings per day (4 is better)
- Lambs < 2kg at birth were more likely to be culled

RIGHT FROM THE START

Key Findings

- Machine-fed lambs
  - Consumed more milk
  - Grew faster and more efficiently
  - Consumed less creep feed pre-weaning, but grew faster post-weaning when housed on bedding

RIGHT FROM THE START

Observations

- At the automatic feeder:
  - Less competition
  - Less "binge" drinking
  - Less bloating
- Lambs on elevated floor appeared duller after weaning compared to those on bedding pre-weaning

RIGHT FROM THE START

Milk Replacer Ingredients

Milk replacers are most often made from milk derived products:

- Skim milk powder
  - Skim milk in the milk replacer will form a clot in the stomach like whole milk (2-step digestion)
- Whey protein and WPC which are co-products of the cheese industry
  - Whey protein will pass directly into the small intestine for digestion (1-step digestion)

RIGHT FROM THE START

Milk Replacer Ingredients

- Milk ingredients are highly digestible in the young lamb
- They are born with gut enzymes to break milk proteins down and use the energy for growth
- Some milk replacers can be formulated with alternative proteins such as soy concentrate or hydrolyzed wheat
  - Grober trials found a small amount did not affect lamb growth or health
  - The cost of milk ingredients is leading the industry to consider adding alternatives

RIGHT FROM THE START

Milk Replacer Formulation

- Milk replacers are formulated for some vitamins and minerals depending on how important they are to the animal
- In lambs we pay attention to Vitamin A, Vitamin D, Vitamin E and copper (concern regarding copper toxicity)

RIGHT FROM THE START

Milk Replacer

RIGHT FROM THE START

Why Feed Milk Replacer?

- The product is consistent
  - leads to better digestion and less occurrence of animal going on and off feed due to changes in product consistency
- It reduces the spread of disease carried through milk

RIGHT FROM THE START

Milk Replacer

- A successful feeding option
- Formulated for optimal digestion
- Lamb milk replacer
  - Meets specific protein and fat needs (formulated with higher fat than protein)
  - Smaller meals, more calories – reduce bloat
  - Opportunity to provide consistency with each meal

RIGHT FROM THE START

Using Milk Replacer

- Proper milk replacer mixing
  - Ensure proper concentration is used
  - Hot water mixed with milk replacer, stirred vigorously, then cold water added to make 1 L of solution
  - If not mixed well, globules of product – hard to digest, can end up in the underdeveloped rumen
  - Too cold – fat may not be liquefied

RIGHT FROM THE START

Take Home Messages

- Smaller meals more often lead to better growth and less digestive problems
- Milk replacer is a healthy way to rear lambs
  - It promotes consistency and lower incidence of disease
- Young lambs require a lot of attention!

RIGHT FROM THE START

Quality Sheep Milk (Ellis and Hazel Morris)

383747 Salford Rd,R.R.#1,Salford,Ontario.N0J 1W0
519-485-5405
sales@qualitysheepmilk.com www.qualitysheepmilk.com

Quality Sheep Milk is a part of a family farm enterprise that has 350 head of dairy sheep owned by Ellis and Hazel Morris and their son Sion. The Morris's emigrated from Wales in August 2007. In the U.K. the Morris family gained 20 years of dairy experience, milking about 70 registered Holsteins cows on a rented farm. In 2007 the family decided invest in land, and moved to Oxford County, Ontario, Canada. The Morris's recently expanded the dairy sheep housing. In September 2012 a new barn was completed that will hold a further 500 dairy sheep and this will take housing capacity to over 900. The new barn is designed to give excellent ventilation and comfort to our milking ewes.

Quality Sheep Milk markets and delivers raw milk direct to many dairies in the province with their own milk tanker from their own farm and a number of other sheep dairy farms in the area. Sion Morris is a licensed Bulk Tank Milk Grader. Quality Sheep milk works with co packers to produce Greek style yogurt, Greek style feta and sheep milk cheddar. There is strong commitment is to supply wholesome and nutritious food products for the diversity of urban and rural consumers. Management and production protocols are strictly implemented through the personal commitment of owning and operating the family farm.

Thank you for the farm tour lunch at the Salford Hall

Ellis and Hazel Morris

Nature Feed *Centre Inc, 593797 Hwy. 59, Burgessville*

Oxford Feed and Supply Ltd, 360 Harris St. Ingersoll

Salford Feed and Supply, 384636 Salford Road, Burgessville

Steven and Lucille Burkhart

4232 Lichty Road, RR#1 Wallenstein ON N0B 2S0

Steven and Lucille Burkhart started milking dairy sheep in October of 2012. They presently milk 150 east friesian sheep with plans to expand to approximately 250. They will be milking year round. The Burkhart's did extensive research in planning the new barn and renovating existing facilities. The new barn is 120 feet long by 51' 4" wide. The barn is naturally ventilated featuring side curtains and chimneys. Animal health and labour efficiency were the most important areas of consideration. The barn is very well ventilated. The penning is easily accessed for manure removal. Planning has resulted in efficient movement of sheep to and from the milking parlour. The sheep are fed a total mixed ration (TMR). A self propelled Vertablend TMR mixer is used to dispense a balanced ration. The Burkhart's work closely with their feed company and nutritionist to ensure proper nutrition is provided for all sheep. A 16 x 70 foot silo is used for alfalfa haylage storage. Two 22 x 84 foot bunker silos are used for corn silage. The farm also has 150 beef cattle which are brought from 500 pounds to finished market weight. A focus on continuous improvement is evident. The Burkhart's feel milk recording is important. Every 5th week, Waikato milk meters are used to record individual sheep milk production.. The lambs are weaned at two or three days. A lamb feeding machine is used in lamb rearing. Lambs raised for market, are brought to 80 to 100 pounds. The milking parlour is well designed featuring a double 20 rapid exit with a 2 inch lowline pipeline and GEA Westfalia surge milking units. The parlour and milkhouse were built with an in floor heat option.

Excellent management and attention to detail shine through on this dairy sheep farm.

Thank you:

North Wellington Co-op for supplying coffee break.
Shepherd Gourmet Dairy for providing the yogurt.

Recipents of the William J. Boylan Distinguished Service Award
(The DSANA Distinguised Service Award prior to 2009)

2003 — David Thomas, Madison Wisconsin, USA—Dairy Sheep Researcher

2004 — Daniel Guertin, Stillwater, Minnesota, USA—Dairy Sheep Researcher

2005 —

2006 — Pat Elliott, Rapidan, Virginia, USA—Dairy Sheep Producer and Artisan Cheese Maker

2007 — Tom and Nancy Clark, Old Chatham, New York, USA—Dairy Sheep Producers and Sheep Milk Processors

2009 — William Wendorff, Cross Plains, Wisconsin, USA—Sheep Milk Processing Researcher

2010 — Eric Bzikot, Conn, Ontario, Canada—Dairy Sheep Producer and Sheep Milk Processor

2011 — Tom and Laurel Kieffer, Strum, Wisconsin, USA—Dairy Sheep Producers

Locations and Chairs of the Organizing Committees of Previous Symposia

1995 – 1st Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA
Yves Berger – Chair
1996 – 2nd Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA
Yves Berger - Chair
1997 – 3rd Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA
Yves Berger – Chair
1998 – 4th Great Lakes Dairy Sheep Symposium – Madison, Wisconsin, USA
Yves Berger – Chair
1999 – 5th Great Lakes Dairy Sheep Symposium – Brattleboro, Vermont, USA
Carol Delaney - Chair
2000 – 6th Great Lakes Dairy Sheep Symposium – Guelph, Ontario, Canada
Axel Meister - Chair
2001 – 7th Great Lakes Dairy Sheep Symposium – Eau Claire, Wisconsin, USA
Yves Berger - Chair
2002 – 8th Great Lakes Dairy Sheep Symposium – Ithaca, New York, USA
Michael Thonney - Chair
2003 – 9th Great Lakes Dairy Sheep Symposium – Québec, Québec, Canada
Lucille Giroux - Chair
2004 – 10th Great Lakes Dairy Sheep Symposium – Hudson, Wisconsin, USA
Yves Berger - Chair
2005 – 11th Great Lakes Dairy Sheep Symposium – Burlington, Vermont, USA
Carol Delaney - Chair
2006 – 12th Great Lakes Dairy Sheep Symposium – La Crosse, Wisconsin, USA
Yves Berger - Chair
2007 – 13th Great Lakes Dairy Sheep Symposium – Guelph, Ontario, Canada
Eric Bzikot - Chair
2008 – 14th Great Lakes Dairy Sheep Symposium – Maryville, Tennessee, USA
Claire Mikolayunas - Chair
2009 – 15th Great Lakes Dairy Sheep Symposium – Albany, New York, USA
Claire Mikolayunas - Chair
2010 – 16th Great Lakes Dairy Sheep Symposium – Eau Claire, Wisconsin, USA
Claire Mikolayunas - Chair
2011 – 17th Great Lakes Dairy Sheep Symposium – Petaluma, California, USA
Cynthia Callahan – Chair
2012 – 18th Dairy Sheep Association of North America Symposium – Dulles, Virginia, USA
Laurel Kieffer - Chair
2013 – 19th Dairy Sheep Association of North America Symposium, Cambridge, Ontario, Canada
Eric Bzikot - Chair

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Eric & Elisabeth Bzikot
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ee.bzikot@everus.ca

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[1] Land O'Lakes Animal Milk Products Research Trial on 423 lambs. Spring 2012.
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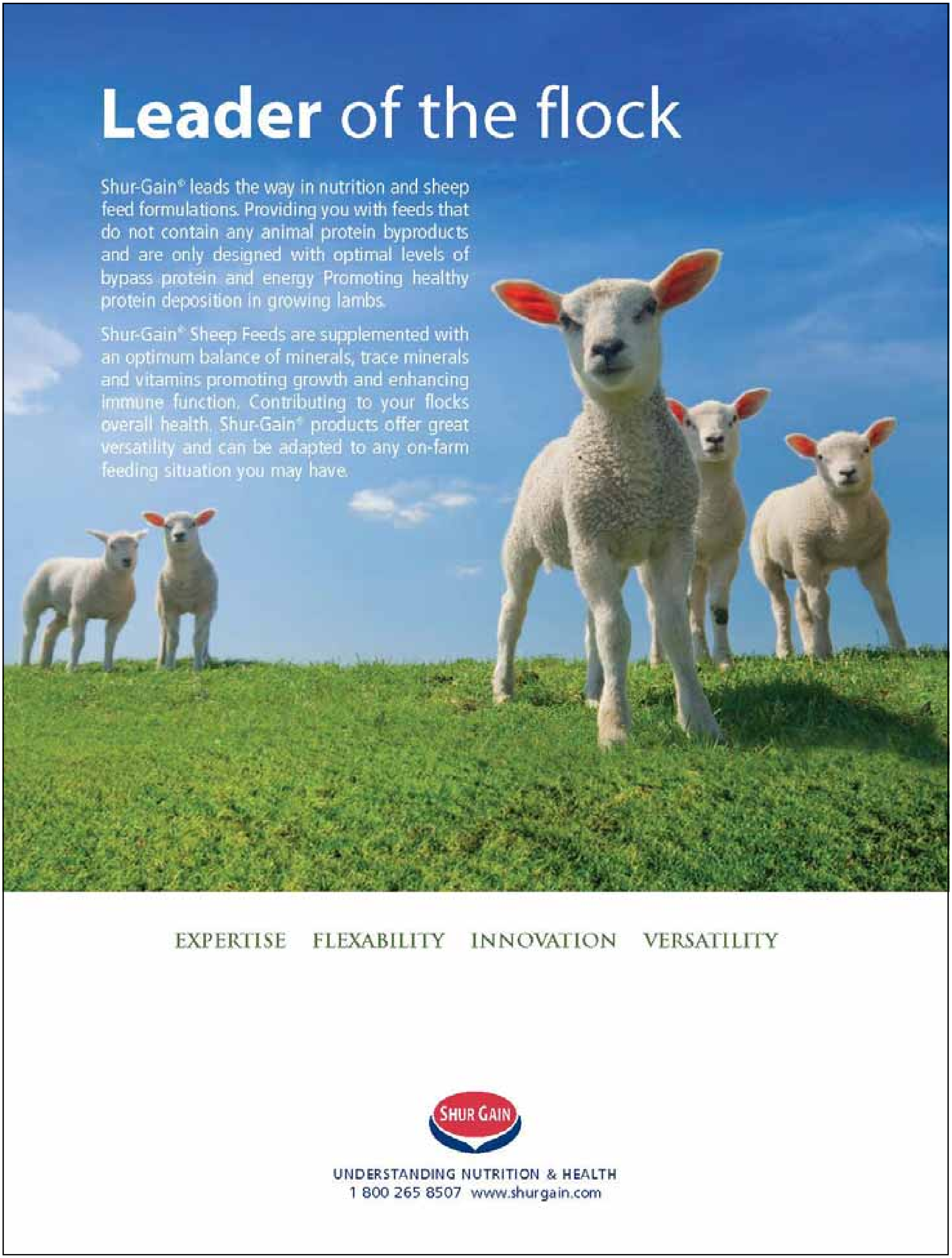
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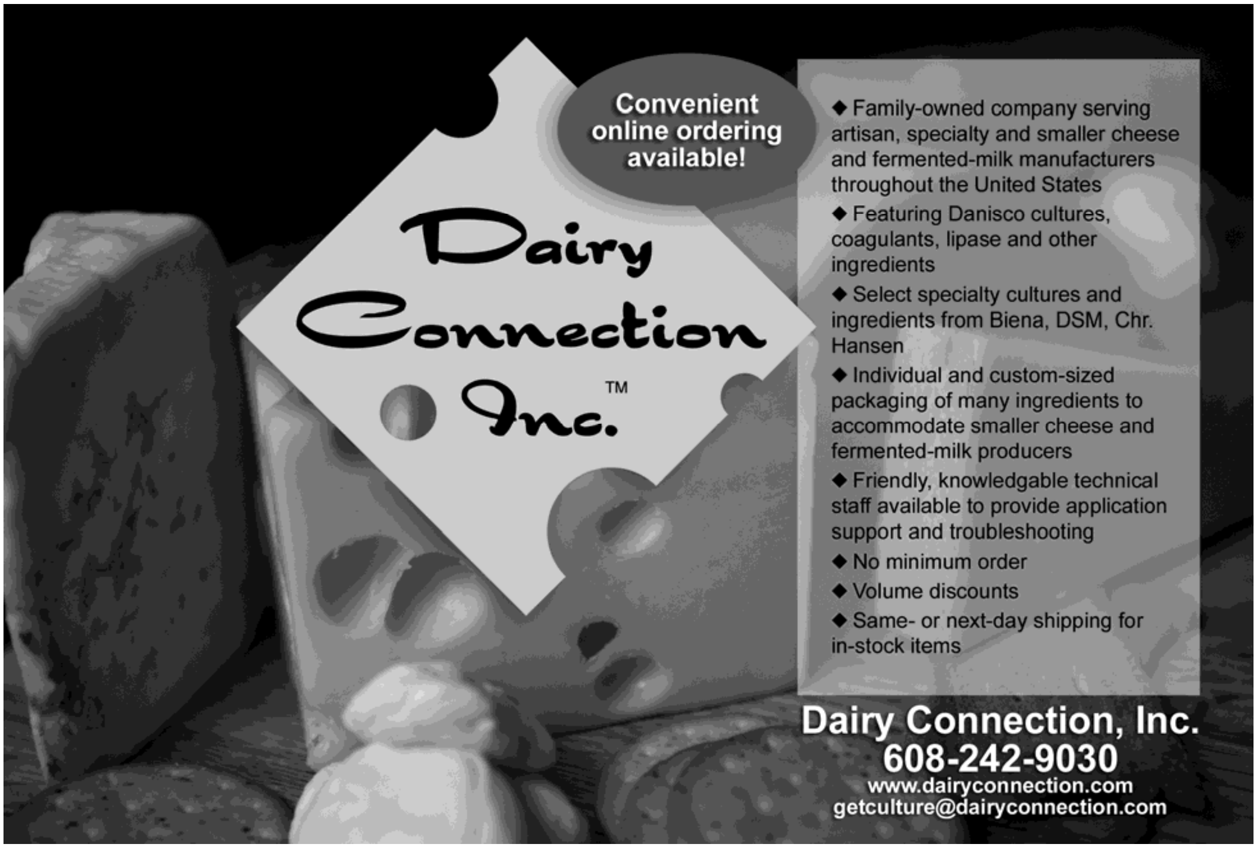
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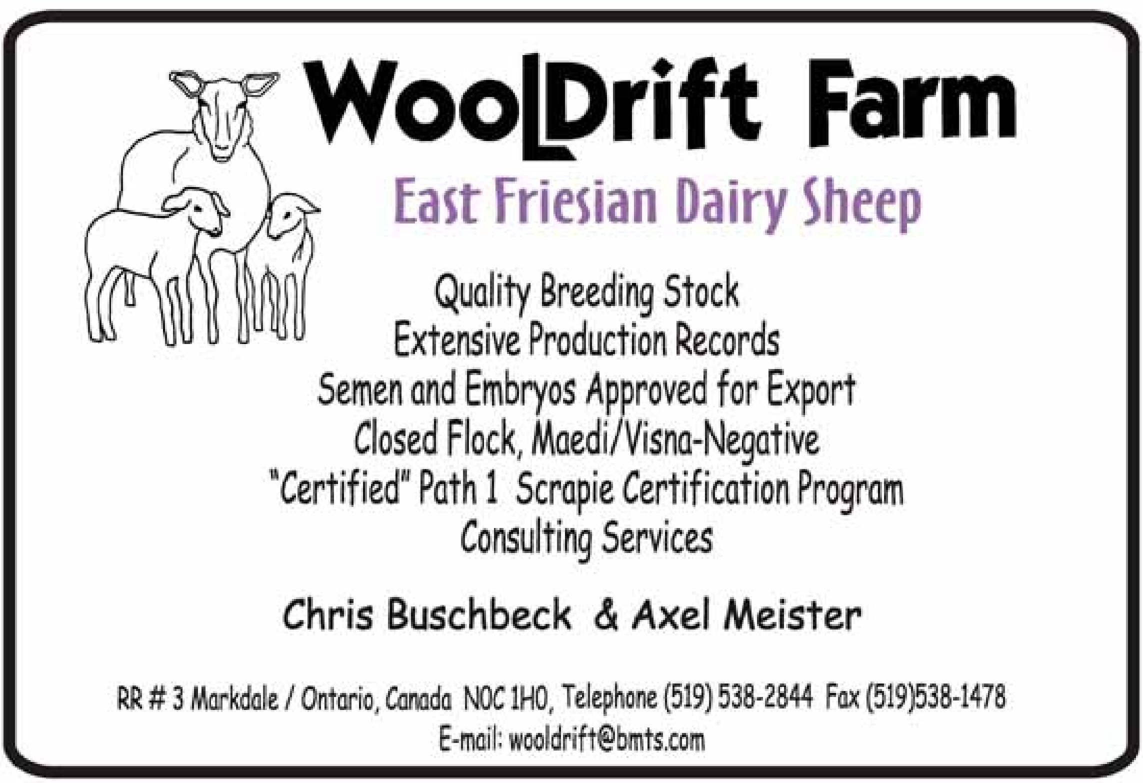

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