

SECTION II-4 IMPORTANT RISK FACTORS FOR MASTITIS

4. IMPORTANT RISK FACTORS FOR MASTITIS

There are many factors that predispose a ewe to developing mastitis or influence how common mastitis is in a flock other than the presence of pathogenic microorganisms. These are summarized in Table II.2 and are covered in more detail in the following sections.

Table II.2. Risk factors for mastitis in dairy ewes

FACTOR	RISK
Lambing Time	Weakened immune system; number of lambs born; difficult lambing.
Stage of Lactation	Ewes will have a higher incidence of infection when lambs are allowed to nurse; and the prevalence of infection increases in late lactation.
Nursing Lambs	Teat biting; poor emptying of the gland from uneven nursing.
Dry-Off	Stress of separating lambs; timing and method of dry-off.
Lactation Number	Older ewes tend to be more at risk of mastitis.
Viral Infections	Maedi visna; contagious ecthyma (orf, soremouth).
Udder Shape and Size	Poor shape interferes with milk-out; poor size will reduce milk production; poor teat placement will interfere with milk-out.
Teats	Teat end calluses from over-milking or long milk-out times; warts; contagious ecthyma; bites.
Environment	High stocking densities; poor ventilation; wet and cold floor and dirty bedding; air temperature too hot or cold; high humidity; inclement weather; relocating and mixing ewes.
Milking Technique and Equipment	Poor udder preparation – cleanliness and milk let-down; dirty hands; cracked and worn teat liners; high vacuum levels; inadequate vacuum reserve; incorrect pulsation rate and ratio; over-milking.
Genetics	Resistance to mastitis; heritability of SCC levels.
Nutrition	Low energy; selenium and vitamin E.

4.1 STAGE OF LACTATION

4.1.1 LAMBING TIME

Research has shown that high producing dairy ewes have more poorly performing immune systems than meat-type ewes around

Fig. 1. Nursing lambs



lambling. This may translate into increased susceptibility to mastitis or other diseases.

4.1.2. STAGE OF LACTATION

Ewes that have first nursed lambs before entering the milking string have a higher prevalence of mastitis at the beginning of their exclusively machine-milked lactation – suggesting that nursing lambs are important in the risk of mastitis (See Section II.4.2). SCC levels increase when milk production starts to decrease – partly due to volume and partly because the udder is starting to involute through apoptosis (see Section I.1.2.3), when macrophage type cells congregate to “clean up” cellular debris.

4.2 RISK FROM NURSING LAMBS

The risk factors for mastitis from nursing lambs are multiple and are outlined below.

4.2.1 TEAT BITING

Several studies have noted that nursing lambs will bite teats, sometimes breaking the skin or even penetrating the streak canal of the teat. While the reason for this behaviour is not

completely understood, it is speculated that it could be because the ewe is producing insufficient milk for the lamb, or that multiple lambs are competing for teats.

4.2.2 POOR EMPTYING OF A GLAND

If a ewe is nursing a single lamb, that lamb may favour nursing one gland over another. Poor emptying of a gland can increase the risk of clinical mastitis in cattle, and it is likely also true for ewes. Also, because of the FIL protein (see Section I.1.2.3) – the gland will start to involute even if the other gland is continually emptied.

4.2.3 SEPARATING LAMBS DURING MILKING

When lambs are separated from ewes for milking, there is a measurable stress to the ewes, including changes in the immune system. The effect of this stress with respect to milk yield and mastitis needs to be assessed further.

4.3. DRY-OFF AT END OF LACTATION

Dry-off should be done when the ewe’s milk production has dropped below a specific level, which differs between breed and farm. Ewes at this point are undergoing a natural involution of the udder and the stress involved with milk cessation is mild. Dry-off should be done suddenly, when milk production has dropped sufficiently. A keratin plug forms within a few days of dry-off in the streak canal of the teat, which protects against mastitis bacteria from entering. Removal of this plug because of milking out a “full” udder has been associated with dry-period mastitis.

Fig. 3. Bite wounds on teats



Fig. 2. Uneven udder



4.4 LACTATION NUMBER / PARITY

First fresheners tend to have lower SCC values in the face of mastitis. Older ewes are more likely to have mastitis because of increased exposure to risk factors and changes to the anatomy of the udder and teats. Ewes 4 years and older are more likely to have elevated SCC counts (as measured by CMT) compared to younger ewes.

4.5 VIRAL INFECTIONS

4.5.1 MAEDI VISNA VIRUS

As mentioned in Section II. 3.1.3, MVV causes mastitis in ewes with the presence of other bacteria. What is not clear is if MVV will predispose the udder to bacterial mastitis. Regardless, MVV infection is an important source of lost revenue in milk production.

4.5.2 CONTAGIOUS ECTHYMA (ORF) INFECTIONS

Contagious ecthyma, also called “orf”, “scabby mouth” and “sore mouth” is a common viral infection of sheep and goats. Lambs are most susceptible to disease but it can also be seen in adult sheep, particularly if not previously exposed. The virus prefers to infect regions of the lips and nose but can commonly infect the teats, coronary band above the hoofs, inside the mouth, around the eyes, tips of the ears and around the vulva or penis. Rams often get infected in the poll region, particularly if they fight. The lesions are raised and red, often covered with purulent debris and a scab and last about 6 weeks. Although the infection is painful, usually lambs handle it well.

Unfortunately the lesions almost always become infected with *Staph. aureus* bacteria. This increases the risk of mastitis to the ewe in one of two ways: either the lamb nursing with infected lip or mouth lesions bathes the end of the teat in *Staph.* bacteria increasing the risk of mastitis, or the ewe develops orf on her teat and then is at greatly increased risk of *Staph. aureus* mastitis. Either is very dangerous to the ewe.

Fig. 4. Contagious ecthyma infection



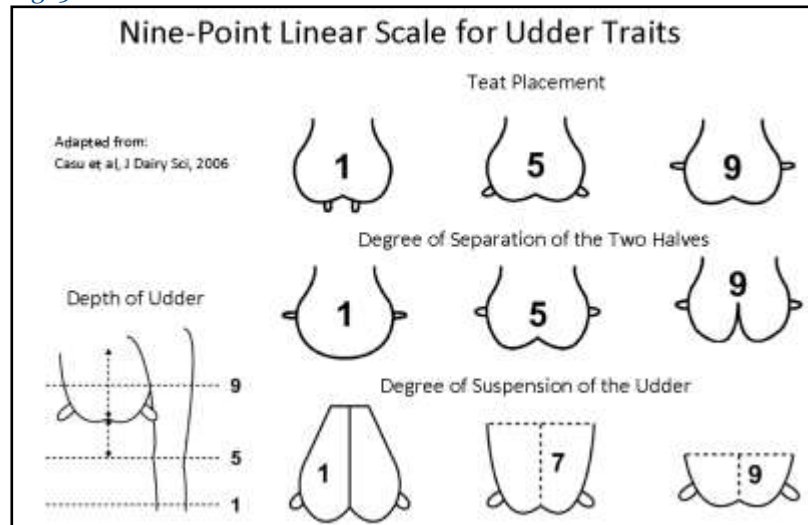
4.6 UDDER SHAPE AND SIZE

Quite a bit of research has been done on udder shape and size, and milk yield. Scoring systems have been developed for producers trying to select superior ewes to milk. Cistern size means that the ewe can store more milk between milkings allowing for less frequent milking after mid-lactation. Conformation of the udder means more efficient milk-out, allowing less residual milk and the need for machine-stripping. Caja et al, 2000 summarized the attributes of a good dairy sheep udder:

- Great volume, with globular shape and clearly defined teats
- Soft and elastic tissues, with palpable gland cisterns inside
- Moderate height, not surpassing the hock
- Marked suspensory ligament
- Teats of medium size (length and width), situated near to vertical

Fig. 5 is adapted from one of the 9-point systems developed for assessing udder conformation. Teat placement for machine milking should be closer to 1 in the scale of 1 to 9. However, keep in mind that what is optimal for the milking machine is not optimal for the lamb. Separation of the two glands should be closer to 9 on a scale of 1 to 9. Suspension and depth of the udder should be closer to 9 on a scale of 1 to 9. Degree of suspension and the depth of the udder appear to be highly correlated. Missing from this system represented below, which is usually present in other systems, is scoring of teat length (1 = short; 9 = long).

Fig. 5.



4.7 TEATS

Teat damage caused by nursing lambs, contagious ecthyma lesions and chapping have been discussed previously in Sections II.4.2.1 and II.4.5.2. The teat is an amazing structure – with the teat sphincter and lymphoid follicles just inside the teat cistern doing an amazing job keeping mastitis pathogens from invading further into the udder.

Other important teat conditions are listed below:

4.7.1 TEAT END CALLUSES

Quite a bit of research has been done in dairy cows with respect to mastitis and presence of teat end **calluses** – but none yet in dairy ewes. In cows, calluses are caused by:

- Pointed teats, as opposed to inverted or flat-ended
- Longer machine-milking times
- Low milk-flow (over-milking)
- Irritating chemicals used for udder washing
- High vacuum levels
- Factors associated with teat cup liners

Fig. 6. Teat end callus



These calluses can be seen around the teat orifice and vary from a smooth ring to a rough ring with severe proliferation of tissue (hyperkeratosis). In dairy cattle, presence of hyperkeratosis has been linked to an increase risk of *Staph. aureus* mastitis. More work needs to be done in dairy ewes and the relationship to milk-out time, but we can learn from work already done in cattle.

Fig. 7. Warts on teats



4.7.2 WARTS

Warts are caused by a papilloma virus and causes cauliflower like growths on the teats. These growths may interfere with proper application and function of the teat cups, and they may become infected with bacteria. If they occur close to the teat orifice, they may increase the risk of mastitis. They are also contagious to other sheep.

4.8 ENVIRONMENT

The environment that the dairy ewe is maintained in has a profound effect on milk production. Poor environment increases the risk of environmental causes of mastitis, and increases the stress to the ewe. The information is summarized in Section I.2.3 - Table I.4.

4.9 MILKING TECHNIQUE AND EQUIPMENT

4.9.1 UDDER PREPARATION

Regardless of how clean the environment is, there will be bacterial contamination of the udder and teats. Improper cleaning and drying will lead to opportunities for these bacteria to enter the teat during or after milking and cause mastitis.

In some jurisdictions dairy cows must have hair removed from the udder and teats to lower the risk of bacterial contamination. Sheep udders may have hair but some may also have wool, depending on the breed. Wool from the tail, escutcheon, thighs, and inside of the legs may also pose a risk. Feces, urine and birth fluids can contaminate this wool and skin. Ewes should be crutched at the beginning of each lactation to facilitate easy cleaning of the udder and remove the risk of manure tags contaminating the udder, hands and milking equipment (see Section I.2.1.5).

4.9.2 HANDS AND HAND-MILKING

Hands are easily contaminated with bacteria which can be transferred to the teats and milking equipment. These bacteria may be plentiful on the hands, even if they appear superficially clean. Wounds and cracks on the hands are often infected with mastitis causing bacteria, particularly *Staph. aureus* and CNS. Hand milking is, unfortunately a very efficient way to transfer mastitis pathogens from one ewe to the next. Because it is sometimes impossible to remove all risky bacteria from the hands – even with frequent washing with disinfectant soaps, it is advisable to wear disposable gloves. If gloves become soiled, change gloves or wash in a disinfectant soap and then dry.

4.9.3 MACHINE MILKING

Set-up and maintenance of milking equipment is covered in more detail in Section IV.3.

TEAT CUPS

Teat cups are well recognized as a common source of contamination with mastitis pathogens. Tiny cracks in the liners can harbour a teeming population of bacteria, which will mix with milk and impact the teat sphincter with a soup of microorganisms (Fig. 8).

Fig. 8. Liner cracks with bacteria



VACUUM LEVELS

Recommended vacuum level for dairy ewes at the teat level is between 32.5 to 39 kPa (9.6 to 11.5 inches of mercury (Hg)) although recommendations vary depending on the type of system used, e.g. 35.6 kPa (10.5 inches Hg) for lowline systems and 39 kPa (11.5 inches Hg) for highline. Overly high levels of vacuum can damage the teat end. Acutely this may cause problems with the return of blood flow back to the teat after milking, and for teat sphincter closure. Chronically, it may cause damage to the teat end – rings of scar tissue, which can harbour microorganisms that cause mastitis. However, too low vacuum levels may increase the risk of clusters dropping off and increase the risk of impacts (see below).

VACUUM RESERVE

Having sufficient vacuum reserve is critical to prevent changes in direction of milk flow. When milking units are removed incorrectly or fall-off and vacuum levels drop, the milk from another ewe may backflow and hit the teat end with a spray of milk – which is open and susceptible to infection. If the milk is contaminated with contagious mastitis pathogens, the ewe is at risk of infection. Squawks, which indicate sucking of air around the teat cup and into the milk-line, can have a similar effect. Crimped-over milk lines to accommodate milking of ewes with a blind gland or a gland with less milk (usually a ewe that has mastitis), can also suck air – causing hits or impacts of milk on the teat end.

PULSATION RATE AND RATIO

The recommended pulsation rate for dairy sheep is between 90 to 180 cycles / min with a ratio of between 50 to 60% (International Dairy Federation, 2002). The higher rate of 180 cycles/min appears to have no detrimental effect on teat thickness or udder health when milked at a vacuum pressure of 36 kPa.

MILKING TIME

Sheep milk out very quickly, often in less than 2 min. Over-milking will tire the teat sphincter and over time will damage it. If the teat sphincter doesn't close properly after milking, there is an increased risk of bacteria invading the udder and causing mastitis.

Reasons for over-milking include:

- Too many units per milker so that the milker cannot manage udder preparation and unit management in a timely manner
- Improper stimulation of the udder for optimal milk ejection (milk let-down);
- Issues in the parlour that interfere with milk ejection e.g. too noisy, yelling and pushing

4.10 GENETICS

Levels of somatic cells and presence of bacterial infections are two ways in which researchers determine mastitis in a ewe for purposes of evaluating their ability to resist this disease.

4.10.1 LEVELS OF SOMATIC CELLS

Elevated somatic cell count (SCC) levels have been used to select against ewes that are susceptible to mastitis, however SCC levels are lowly heritable – with estimates of between 0.04 and 0.24 h^2 . This means that selecting ewes for low SCC values would make for slow progress in “resistance” to mastitis. In comparison, heritability of milk yield is 0.34, milk fat – 0.50, and milk protein – 0.63.

There is mixed evidence that in dairy ewes SCC and milk production are negatively correlated (i.e. high producing ewes are more likely to get mastitis). Regardless, the effect – if present – is much milder than seen in dairy cows, where high producing cows appear to be much more susceptible to mastitis than low producing. This difference could be because the dairy ewe has not been genetically selected as intensively as dairy cows – yet.

4.10.2 RESISTANCE TO CLINICAL MASTITIS

There is on-going research both in dairy cows and sheep looking for genetic markers and other indications of resistance and susceptibility to episodes of clinical mastitis. Most are based on the animal’s ability to fight infection.

4.11 NUTRITION

4.11.1 LOW ENERGY

In early lactation, ewes are often in a negative energy balance, which must be compensated for by improved quality and quantity of feed during this period and by having an adequate body condition score at the beginning of the period (covered in more detail in Section I.2.4). Underfed ewes in late gestation and early lactation have been shown to have increased SCC and changes to the fatty acid profile of the milk.

Being pregnant with multiple lambs appears to increase risk – possibly because of increased nutritional needs but perhaps because of reduced function of the immune system and therefore the ewes are less able to ward off infection. Because ewes carrying multiple lambs produce more milk, and the extra lambs provide additional income – it is necessary to make sure the environmental hygiene is excellent for these animals. It is important to note that both overfeeding and underfeeding of pregnant ewes can have a negative effect on udder size, birth weights of the lambs, and total levels of antibodies available in the colostrum.

4.11.2 SELENIUM & VITAMIN E

In areas where selenium is deficient – which is most of Canada, it is critical to supplement the ewes’ diet during gestation as well as lactation. Vitamin E, while present in green pastures in large amounts, degrades quickly in stored feeds and so must be supplemented to ewes that are not on green pasture grazing. Both are important in prevention of mastitis and general udder health. This is covered in more detail in Section I.2.4.