

SECTION II-3 WHAT MICROORGANISMS CAUSE MASTITIS

3. WHAT MICROORGANISMS CAUSE MASTITIS IN SHEEP?

Most mastitis is caused by bacterial infection by a wide variety of bacteria. Viruses and yeasts may also be involved. Some of these bacteria are contagious, i.e. picked up from another animal – and some are contracted from the environment. The important and common pathogens are summarized in Table II.1. There are many other organisms which occur less commonly.

Table II.1. Classification of important udder pathogens of ewes

TYPE OF ORGANISM	NAME OF ORGANISM	CHARACTERISTICS
CONTAGIOUS (Sheep to Sheep)		
Bacteria	<i>Staphylococcus aureus</i>	Most common cause of clinical mastitis in ewes. Very difficult to cure. Highly contagious from other ewes, milkers' hands.
Bacteria	<i>Mannheimia</i> species (Pasteurella)	Common cause of clinical mastitis in ewes. May come from throat of nursing lambs.
Bacteria	Coagulase negative staphylococcus (CNS)	A group of organisms which are the most common cause of mild clinical mastitis and subclinical mastitis
Bacteria	<i>Streptococcus agalactiae</i>	Occurs more commonly in cattle. Rare in sheep.
Mycoplasma	<i>Mycoplasma agalactiae</i>	Very rare in North America but common cause of mastitis in European sheep and goats. Uncurable.
Virus	Maedi visna virus (Ovine lentivirus)	Common infection in Canadian sheep. Causes inflammation and scarring of the udder with lower milk production.
Prion	Scrapie	Is shed in the milk but cannot be detected.
ENVIRONMENTAL (Environment to Sheep)		
Bacteria	<i>Streptococcus dysgalactia</i> <i>Streptococcus uberis</i>	From dirty environment and udder. Can also be transmitted ewe to ewe (contagious) and causes joint infections in lambs and abortion in ewes
Bacteria	Coliforms (E. coli)	From dirty environment. Common in dairy cattle. Less common in sheep.
Bacteria	<i>Pseudomonas aeruginosa</i>	From dirty water. Also contagious ewe to ewe. Incurable.
Bacteria	<i>Listeria monocytogenes</i>	From wet condition, rotting feed. Can be shed in the milk without signs of mastitis. Important public health issue.
Yeast	<i>Candida albicans</i> & <i>Cryptococcus</i>	Usually from overtreatment with antibiotics.

3.1 CONTAGIOUS ORGANISMS

Contagious organisms are **pathogens** transferred from animal-to-animal. This transfer of bacteria is usually done at milking, from sources such as milker's hands (Fig. 1), towels that are used on multiple ewes, or from milk remaining in liners of the milking machine. These infections tend to be a problem on-farm, as clinical infections are easier to treat, but the pathogens will remain in the udder, leaving the ewe's SCC levels to be consistently high, as compared with unaffected animals.

3.1.1 BACTERIA

STAPHYLOCOCCUS AUREUS

Staph. aureus is a contagious pathogen, which is an important threat to udder health in many flocks. It is generally transferred to ewes at milking from both the milk and teat skin of infected animals, and is transferred to uninfected animals. This transfer is done through milking equipment, milker's hands and from towels used to dry the udder if they are used on multiple ewes. At the initial stages of infection, *Staph. aureus* can cause clinical mastitis; however, most commonly *Staph. aureus* is a subclinical infection, but often with elevated SCC counts. Although these infections are generally subclinical, they are chronic, cause loss of milk production and are very hard to treat. The infection often results in the formation of small abscesses in the udder tissue, making it difficult for antibiotics to reach the bacteria.

Staph. aureus is identified through culturing of milk from suspected cases. Antibiotic treatment during lactation has low success of curing the infection; however, treatment during the dry period holds promise. Most importantly, the most effective way to control this pathogen on-farm is to take stringent prevention protocols when milking. These management practices include milking *Staph. aureus* infected animals in the group last, and thoroughly disinfecting the milking equipment after use on these animals, so pathogens are not transmitted to uninfected ewes. In some cases, if *Staph. aureus* is a major issue in a flock, a separate milking unit can be reserved for milking these problem animals.

MANNHEIMIA SPECIES (PREVIOUSLY PASTEURELLA)

Mastitis caused by *Mannheimia* bacteria is relatively common among sheep flocks, and results in severe clinical cases of mastitis. The strains of this pathogen that are isolated from the teat skin of infected udders are identical to those isolated from the throat area of lambs and the same strains which cause pneumonia. This association suggests that infections are transmitted to ewes from nursing lambs, which can be very detrimental early in lactation. Damage to the teat seems to be necessary for these bacteria to cause mastitis.

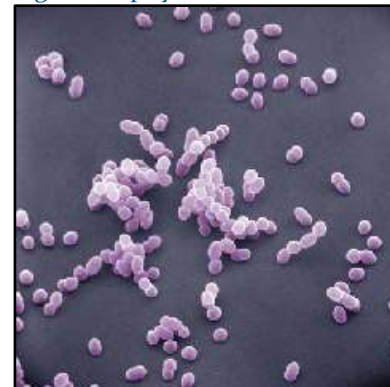
COAGULASE-NEGATIVE STAPHYLOCOCCI (CNS)

Coagulase-negative staphylococci (CNS) are a group of pathogens that are generally characterized as one type of pathogen. This characterization is done because in general, these species of CNS (which spans to over 50 different species) affect ewes in generally the same manner. Coagulase-negative staphylococci commonly present themselves in a subclinical form, and can be quite persistent in the

Fig. 1. Hands may carry contagious bacteria



Fig. 2. Staphylococcal bacteria



udder. Although these bacteria have historically been considered as contagious, some may actually be also contracted from the environment.

Coagulase-negative staphylococci are identified through culturing milk from suspected cases. Most laboratories do not determine the actual species of the bacteria routinely as this is expensive and tends not to change the approach to treatment. Research has shown that some of the more prevalent CNS species in flocks are *Staph. epidermidis* (often found in human skin infections) and *Staph. simulans*.

STREPTOCOCCUS AGALACTIAE

Although a **very rare** infection in sheep, *Streptococcus agalactiae* can be transferred to ewes during milking. If this infection is identified on-farm, it can be eradicated from the flock through treatment of affected ewes during lactation. Elevations in SCC levels are a good indication of *Strep. agalactiae* infections, and can be a key identifier of subclinical infections.

Strep. agalactiae are identified through culturing milk from suspected cases. Unlike *Staph. aureus*, with *Strep. agalactiae*, as antibiotic treatment can successfully kill these pathogens, and rid the infection from the udder.

3.1.2 MYCOPLASMA

MYCOPLASMA AGALACTIAE

This particular bacterium, which causes a disease called “contagious agalactia”, is considered not to occur in North America but is a common and important cause of mastitis of sheep and goats in Europe. *M. agalactiae* does not respond to treatment. Contagious agalactia syndrome can also cause arthritis and conjunctivitis; however, it is most importantly a cause of mastitis in ewes. Routine milk culturing will not grow these bacteria. If mastitis in the flock is severe and other bacteria are not isolated from milk samples, your flock veterinarian may decide to culture the milk for mycoplasma, which requires special milk culturing methods.

3.1.3 MAEDI VISNA VIRUS

Fig. 3. Ewe with maedi visna



Maedi visna is a very common disease in dairy sheep in Canada. It is caused by a slow virus (maedi visna virus – small ruminant lentivirus). Animals can be infected at any age but infection as lambs likely has the most effect on the ewe later in life. It becomes infected through the colostrum, from respiratory secretions and sometimes while the lamb is still in the uterus. The sheep remains infected for life and there is no cure.

The virus targets the udder and lungs. As mastitis, it causes uniform hardening of the udder and loss of milk.

The virus causes an influx of lymphocytes into the udder tissues, which causes severe inflammation, scarring and loss of milk producing alveoli. Recent research suggests that infected ewes produce as

much as 15% less milk than healthy ewes. Ontario has a voluntary program designed to help producers eradicate this important and common infection, and remain low risk¹

3.1.4 SCRAPIE

Scrapie transmitted through milk can be a concern in dairy flocks, but does not cause mastitis. Prions, which are the infectious proteins that carry scrapie in the body, have been isolated from the brain, tonsil and lymph nodes, as well as mastitic mammary glands, which suggest that these prions can be transferred to the ewe's milk. This could pose a problem with the transfer of these prions from a ewe's milk or colostrum to her lambs, which could increase the potential of scrapie in these young animals. At this point, scrapie is not considered to be a zoonotic disease (i.e. doesn't infect humans). Canada has a voluntary scrapie certification program². To assure that this disease is not allowed into the flock, only sheep from certified flocks should be purchased.

Fig. 4. Ewe with scrapie



3.2 ENVIRONMENTAL ORGANISMS

Environmental organisms are pathogens that are transmitted by the environment into the udder. These pathogens are typically found where the animals are housed, and can be transmitted through manure, bedding, or even water sources. This group of pathogens tend to cause acute, and sometimes severe, cases of mastitis, with an increase of SCC during the time of infection, but tend to cure quite effectively with the use of antibiotics.

3.2.1 BACTERIA

STREPTOCOCCUS DYSGALACTIA

Infection from this bacterium is not as common as those caused by CNS or *Staph aureus*. Although *Strep. dysgalactia* is classified as an environmental pathogen, it does have some contagious characteristics. This pathogen has been isolated from the teat skin, but tends to be quite present in the environment as well. It has also been shown to be transmitted by flies, and infections tend to flare up during the warmer summer months. Treatment with intramammary products containing penicillin has been shown to be an effective intramammary treatment for *Strep. dysgalactia*. Consult your flock veterinarian on the best way to approach management of this infection.

Strep. dysgalactia can cause other problems in sheep, notably it is an important cause of infectious polyarthritis in lambs. Infection occurs shortly after lambing, especially in poor environmental housing conditions. The bacteria enter the bodies of the lambs through a wide potential of entries, and subsequently enter the bloodstream, targeting the joints. Lambs with polyarthritis generally fair poorer in condition than healthy lambs, and are very lame.

STREPTOCOCCUS UBERIS

¹ http://www.uoguelph.ca/~pmezies/mv/OMVFSP_Index.html

² <http://www.scrapiecanada.ca/certification.html>

Strep. uberis is a common problem in both cow and goat milking operations and less common in sheep. Much like *Strep. dysgalactia*, *Strep. uberis* was once thought to be solely environmental, however, current research has shown that there are some contagious characteristics for different strains of this pathogen. These infections cause a very acute and sometimes severe case of clinical mastitis, with severe udder swelling and redness, and high body temperatures.

This pathogen is identified through milk culturing. It is important to treat these infections quickly with antibiotics; however, the cure rate is not always favourable. Infections have the possibility to become subclinical, and can subsequently be transmitted to other animals.

COLIFORM BACTERIA

Although unusual in sheep, coliform infections can potentially cause severe cases of mastitis, with both local signs of inflammation in the udder, as well as systemic signs throughout the body. Common coliform bacteria include *E. coli* and *Klebsiella pneumoniae*. As these infections are extremely sudden and severe, antibiotic treatment of the intramammary infection may not be effective, however, treating the systemic signs of pain and dehydration are essential to lessening the adverse effects on the ewe. Coliform mastitis is a veterinary emergency. Salmonella bacteria are an uncommon infection in sheep and pose most risk because the bacteria can be transmitted through consumption of unpasteurized milk and cheeses.

PSEUDOMONAS AERUGINOSA

Pseudomonas aeruginosa bacteria are classified as environmental coliforms; however, they also have some contagious properties. This pathogen is found in contaminated water sources, which could be present anywhere on-farm, but can commonly be isolated from wash water in the milking units. These cases of mastitis lead to extreme cases of infection, and can present itself in acute, toxic cases, or chronic cases, with elevated SCC. Antibiotic treatment is rarely successful; therefore it is common to cull these animals from the flock, to both reduce SCC levels from chronic cases, and to decrease the potential for pathogens to be contagiously transferred to other ewes.

LISTERIA MONOCYTOGENES

Listeria monocytogenes is the cause of the zoonotic disease, listeriosis. Transmission of this disease is through feeding poor quality ensiled forages, usually with evidence of spoilage and contamination of raw milk, most frequently seen when the milk is unpasteurized (see Section I.2.4.6). The bacteria are often shed in the milk without signs of infection. However, in some cases, *Listeria* can be the cause of mastitis in ewes. It can also cause disease of the nervous system and abortion in sheep. *Listeria* is more often present as a subclinical infection, and causes slight local swelling in the udder, but infected ewes generally do not show any systemic signs. *Listeria* bacteria are shed continually throughout the time of infection, with elevated SCC. It is important to monitor and control these cases of *Listeria* mastitis, as it could potentially be transferred to humans through consumption of unpasteurized milk and cheeses, or by post-pasteurization contamination of milk.

3.2.2 YEAST

Mastitis caused by yeast is not common, however, if it does occur; it is very difficult to manage. Yeasts are environmental organisms, and are frequently found in water sources. They have an increased potential for causing an intramammary infection during milking if the teats are wet when the milker is put on. Overtreatment with antibiotics or poor hygiene when inserting mastitis ointment tubes is

commonly associated with outbreaks of yeast mastitis. Yeast infections present as acute clinical infections, with high body temperatures in ewes. Yeast mastitis does not respond to standard antibiotic therapy and antibiotics should not be used to treat infections. However, the symptoms of these infections could be addressed with the use of pain management therapies and frequent stripping of the affected glands.