

ENVIRONMENT AND MASTITIS



BASICS

OVERVIEW

- Three factors influence the occurrence of mastitis: microorganisms, host susceptibility, and the environment.
- The environment plays a major role in the occurrence of mastitis. It affects the rate and degree of microorganism growth. The environment can also influence the cow's defenses against invading microorganisms.
- Environmental factors influencing the microbes and host susceptibility are considered in this chapter. Some of these factors influence both microbes and the host.

SYSTEMS AFFECTED

Mammary

GENETICS

N/A

INCIDENCE/PREVALENCE

N/A

GEOGRAPHIC DISTRIBUTION

Worldwide, depending on species and environmental conditions

SIGNALMENT

Species

All lactating ruminant species

Breed Predilections

N/A

Mean Age and Range

Adult lactating females

Predominant Sex

Female

MICROORGANISMS AND THE ENVIRONMENT

- The numbers of bacteria impacting the teat end is a key factor in determining the occurrence of mastitis.
- Reducing the numbers of bacteria in the cow's environment limits mastitis. The key to limiting environmental mastitis is to keep the cow's environment dry and clean.

Primary Microorganisms Involved

- The specific microbes involved are covered in separate chapters in this volume and are only briefly considered here.
- The primary organisms influenced by the environment include the coliform bacteria and the environmental streptococci. The environmental streptococci are the streptococci other than *Streptococcus agalactiae* and the closely related enterococci. The coliform bacteria include lactose-fermenting bacteria of the family Enterobacteriaceae, primarily *Escherichia coli*, *Klebsiella* spp., and *Enterobacter* spp.

Cows and the Environment

- The cow's environment influences mastitis either by providing contact with greater numbers of microorganisms or by contributing to various stresses on the cow.
- Exposure of the mammary gland to environmental pathogens can occur at milking time, between milkings, while cows are in the dry period, and before first calving in heifers.

GROUPS AFFECTED/AT RISK

- Dry cows and pregnant heifers
- Calving cows and heifers
- Lactating cows and heifers

AREAS OF CONCERN

- Housing and lots or pastures for dry cows and pregnant heifers
- The calving area(s) for both heifers and cows, and stalls, lots, and pastures
- Lactating cow housing, including stalls, lots, and pastures
- The milking parlor

ENVIRONMENTAL FACTORS INFLUENCING THE MICROORGANISMS AND/OR COWS

- Season of year and climate: Growth of environmental pathogens is greatest during warm, wet weather.
 - In the US, summer is associated with the highest rates of new infections for cows in confinement facilities.
 - When cows are kept in dry lots and exposed to the weather, clinical mastitis rates are highest in rainy weather. Growth of microbes is greatest during warm, wet weather.
- Bedding materials: Environmental streptococci and coliform bacteria don't survive on teat ends for long.
 - The number of environmental bacteria on teat skin relates directly to exposure of cows to environmental bacteria.
 - Microorganism concentration in bedding influences bacterial exposure and clinical mastitis rates. Inorganic materials are preferred bedding materials.
 - Environmental organisms are in lower concentration in inorganic materials such as sand or crushed limestone.

- Bedding particle size influences levels of bacteria; smaller sand particles provide more surface area for bacterial growth and attachment. It is recommended that bedding materials be stored in dry areas to limit bacterial growth. It has also been recommended that stalls be raked/cleaned a minimum of twice daily to keep bacterial exposure at a minimum.
- Facility design: Facility design is very important in maintaining dry, clean, and comfortable areas for cows.
 - Poor facility design (i.e., poorly drained lots, inappropriately sized or designed stalls) can increase exposure to environmental pathogens and lead to increases in new infections by environmental pathogens.
- Ventilation: Adequate ventilation controls against build-up of excess moisture and accumulation of ammonia and can mitigate against detrimental effects of heat and humidity in facilities.
 - A lactating cow can excrete large volumes of moisture to the environment each day from urine, feces, breathing, and sweating, making effective ventilation necessary.
- Stage of lactation: More than one-half to two-thirds of coliform and streptococcal infections in the first 2 months of lactation are from dry period intramammary infections.
 - The new infection rate is higher in the dry period than the lactating period.
 - New infection rate is increased the first 2 weeks of the dry period and the period just before calving.
 - The rate of environmental mastitis is greatest in early lactation and decreases as lactation progresses.
- Parity: The rate of infection by environmental pathogens has been reported to increase with parity, during both lactation and the dry period.
- Milking machine function and hygiene: The function of the milking machine, as well as the cleanliness and the general level of hygiene in the milking process, can greatly influence the rate of environmental mastitis.

ASSESSMENT OF THE ENVIRONMENT

Some of the factors used to assess the impact of the environment as related to mastitis include:

- Clinical mastitis rates
- Cause of mastitis, as determined by bacterial culture of milk samples collected from clinical mastitis cases
- Bulk tank bacterial count assessment: high levels of environmental pathogens indicate a need for better milking hygiene and/or improved bedding management
- Bacterial counts in bedding: Guidelines for targets for bacterial counts in bedding have been published, but interpretation must be done very carefully. It is best to use a laboratory with experience in culturing bedding materials and use their interpretation guidelines
- Degree of cleanliness of lots, pastures, and housing areas
- Air quality assessment, including evaluation of humidity and levels of gases such as ammonia
- The number of free stalls compared with the number of milking cows. It is generally recommended that there be approximately 1 stall/cow, especially in the high risk dry period and fresh-cow period.
- Animal density: over-crowded conditions lead to increased injury and stress
- Design and use of free stalls: guidelines for evaluation have been published
- Physical bedding tests: performed using what has been described as the “knee test”:
 - Kneel in a stall, rock back and forth on one knee, and evaluate the degree of comfort
 - From a standing position, drop suddenly to the knees and assess comfort, and then look at knees for wetness and manure
 - Ask yourself: Would you lie in the stall?

- Score cow leg and udder hygiene, also known as the herd cow cleanliness score; the level of manure on the udder, and less directly on the legs, has been associated with somatic cell count. Several scoring systems are available, including :
 - <http://www.milkquality.wisc.edu/wp-content/uploads/2011/09/udder-hygiene-scoring-chart.pdf>
 - <http://www.vetmed.wisc.edu/dms/fapm/fapmtools/4hygiene/hygiene.pdf>
- Rate of teat and leg injuries

RECOMMENDATIONS FOR MINIMIZING THE IMPACT OF THE ENVIRONMENT ON MASTITIS

- Maintenance of an appropriate environment is considered a key factor in a recommended mastitis control program.
- A strong relationship has been shown between herd udder health status and the number of stress factors acting in a herd.
- The goal of an udder health management plan should be to minimize the number and degree of stressors in the herd.
- Environmental control steps can include:
 1. Assure proper stall design and sizing: guidelines for stall assessment and design have been published elsewhere.
 2. Design barns and all housing areas (including barns, pastures, dry cow housing, stalls, lots, etc.) and waste handling system to favor clean, dry, and comfortable conditions and reduce exposure to manure.
 3. Outside yards should be covered with cement where feasible and manure should be removed frequently; it is very important to assure that mud holes don't develop where cows exit from cement.
 4. Reduce exposure to muddy areas:
 - Eliminate or fence off wet areas in pastures as well as ponds and mud holes.
 - Design and maintain feeding areas to avoid wet areas.
 5. Maintain appropriate animal density and number of stalls/cow (guidelines have been published elsewhere).
 6. Proper stall maintenance: Select appropriate bedding materials and maintain stalls properly:
 - (a) The gold standard is clean sand
 - (b) Organic materials
 - Straw: if used, should be clean and dry; of organic materials, straw has the highest levels of streptococci, and low to moderate levels of coliform bacteria.
 - Wood shavings/sawdust: if used, should have very low levels of bark, be dry, and not green; wood shavings/sawdust may have the highest coliform concentrations (including *Klebsiella* spp.) and low concentrations of environmental streptococci. There are differences among wood shavings based upon wood source; softwoods do not appear to support the same degree of growth as do oak and other hardwoods. Kiln-dried sawdust has been described as preferable to green sawdust.
 - Manure products: of the organic materials, manure products are the most difficult to manage; composting is a method used, with variable degrees of success, to manage manure products used for bedding.
 - (c) Maintenance of bedding:
 - The goal is to have the cow lying on a comfortable, dry, and clean surface.

- Raking free stalls at least twice daily (at every milking) has been recommended; can include removing all soiled bedding at intervals and replacing it with fresh bedding.
 - Cleaning urine and soiled bedding from the back one-third of stalls and replacing with fresh bedding will decrease bacterial numbers.
 - Some recommendations are made to clean out all bedding material and replace with new at appropriate intervals; the interval is determined by many factors, including animal density, weather changes, bedding materials used, drainage, and others.
 - Bedding treatments:
 - a. Powdered lime has been shown to change the pH of bedding materials and reduce bacterial growth, but the effect is very short-term.
 - b. Other products have been used or tested and may have benefits (usually short-term); new products will likely be introduced.
 - c. Use of disinfectants applied to bedding and addition of powdered lime may decrease bacterial numbers, but only in the short-term.
7. Management of the environment of dry cows:
 - Limiting exposure to environmental pathogens will decrease new intramammary infections.
 - The environment must be clean and dry, and include adequate space, ventilation, bedding, and lighting.
 - Fly control is important as they contribute to mastitis spread and may cause teat-end damage.
 - Maintain adequate levels of vitamin E and selenium in the diet.
 - Use dry cow therapy as indicated and apply external teat sealants or teat dips (e.g. barrier dips) after dry treatment.
 8. Manage pre-fresh and calving areas
 9. Flame or clip hairs on udders.
 10. Keep cows standing after milking by providing fresh feed.
 11. Use core antigen vaccines to reduce severity and duration of coliform cases.
 12. Use appropriate milking management and assure proper milking machine function:
 - Premilking udder hygiene, including predipping
 - Stimulation of milk letdown
 - Efficient removal of milk (routine milking machine maintenance important here)
 - Postmilking teat disinfection
 - Reduction of water use in parlor
 - Use of barrier dips where appropriate

PRODUCTION MANAGEMENT

- Three factors influence the occurrence of mastitis: microorganisms, host susceptibility, and the environment.
- Facility design: very important in maintaining dry, clean, and comfortable areas for cows.
- Ventilation: adequate ventilation controls against buildup of excess moisture and accumulation of ammonia and can mitigate against detrimental effects of heat and humidity in facilities.



MISCELLANEOUS

SEE ALSO

- Mastitis: Bulk Tank Monitoring and Somatic Cell Counts (www.fiveminutevet.com/ruminant)
- Mastitis: coliform
- Mastitis: Involvement of Milking Equipment and Stray Voltage (www.fiveminutevet.com/ruminant)
- Mastitis: Milking Procedure and Teat Disinfection
- Mastitis: Streptococcal

ABBREVIATION

gm = gram

Suggested Reading

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