



Wisconsin Veterinary
Diagnostic Laboratory
UNIVERSITY OF WISCONSIN-MADISON

Interpretation of Bulk Tank Milk Results

Introduction

Culturing bulk tank milk (BTM) to monitor milk quality has limitations based on the amount and frequency of sampling and the amount and types of microorganisms isolated. Samples taken over days or weeks are most helpful to understanding a problem. BTM culturing can provide information about the presence or absence of a bacterial group and the identity of predominate bacterial group(s). BTM results are most useful when examined along with other records such as somatic cell counts (SCC), clinical mastitis incidences, environmental conditions and other information. BTM cultures are not a substitute for quarter milk samples. Additionally, **milk samples must be collected aseptically and immediately stored on ice in order to provide valid information upon culture.**

Contagious Mastitis

Contagious mastitis is caused by bacterial species that are resident in the infected udder or are normal flora of the skin and teat and thereby transmission mostly occurs from animal-to-animal, ungloved or unwashed hands or from contaminated milking equipment. A good mastitis control program, emphasizing udder preparation and teat sanitation, is necessary to reduce transmission, infection, and bacterial counts. Properly maintained and cleaned milking equipment and overall dairy management is important for controlling mastitis.

***Staphylococcus* species:**

Staphylococcus aureus- a coagulase-positive Staphylococci, is a contagious pathogen, which is transmitted from infected glands or teats during the milking process. It does not readily colonize the skin.

- Typically chronic and subclinical with periodic mild clinical signs
 - May cause gangrenous mastitis
- Fresh heifers can be a source of introduction
- Bacterial Counts:
 - Bacteria are shed variably and often in low numbers
 - Seldom seen at high levels
 - Correlation between bacterial counts and somatic cell counts (SSC) (when *S. agalactiae* is not present)
- Attainment: < 50 CFU/mL in BTM



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- Reduction of *S. aureus*-infected quarters to <1% of the herd may be possible through a regimen of identification, segregation, strict milking-time hygiene, efficacious treatment, and culling.

Staphylococcus species- also called non-coagulase positive or coagulase-negative Staphylococci (CNS), which are normal flora of the teat. CNS are often the bacterial group most frequently isolated from infected glands. CNS group includes *S. chromogenes*, *S. hyicus*, *S. simulans*, and *S. epidermidis*.

Note: *S. xylosus*, *S. saprophyticus*, *S. sciuri*, and *S. cohnii*, the novobiocin-resistant Staphylococci, are found free-living in the environment and are considered environmental causes of mastitis.

- Infections are usually subclinical, but can result in a 2-3 times increase in SCC
 - The amount of increase in SCC is reflective of the *Staphylococcus* species causing the infection
- Cows in first lactation are at a higher risk
- Milk clean, dry udders
- Bacterial Counts:
 - Low levels represent normal flora
 - High levels indicate poor udder preparation and teat sanitation
- Attainment: < 1,000 CFU/mL in BTM
- Elevated *Staphylococcus* species counts can arise from environmental contamination of equipment

Streptococcus agalactiae- is a bacterium where the only reservoir is infected udders in which *S. agalactiae* is an obligate parasite of the udder of dairy cows.

- Subclinical and mild to moderate clinical mastitis
 - Subclinical infections cause elevated SCC without abnormal milk
 - Often causes more than one infected quarter
- Fresh heifers can be a source of introduction
- Bacterial Counts:
 - High numbers of bacteria are correlated with high SCC
- Attainment: Can be eradicated within 2-3 years if the herd remains closed
 - Emphasize control program which includes washing and drying teats, good milking-time hygiene, post-milking teat disinfection, and antibiotic dry cow therapy
 - Test new additions to the milking herd

Mycoplasma species- reservoir is infected udders or other mucosal surfaces of the cow. Transmission is primarily cow-to-cow, but other sources can include contaminated



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intramammary treatments and treatment devices, contaminated hands, and airborne transmission from poorly ventilated barns. Additionally, care should be taken to eliminate the contact of nasal or vaginal discharge with the udder.

- Antimicrobial therapy is unsatisfactory and not recommended
 - Early culling of infected cows or strict lifetime segregation needed
- Maintain a closed herd and culture all replacements prior to commingling, and culture pregnant cows and heifers at calving
- Strict hygiene is necessary in both milking and management practices to control the spread of *Mycoplasma*
- Mastitis outbreaks can occur after respiratory diseases with *Mycoplasma*
- Bacterial Counts:
 - Bacteria are shed variably and intermittently
- Attainment: eradication can occur with strict management of the herd

Environmental Mastitis

Isolation of high numbers of environmental streptococci and/or coliform/Gram-negative bacteria in BTM indicates poor hygiene during equipment cleaning and sanitation. Either during milking, between milkings, or both. Contamination likely occurs from bedding, soil, manure and water.

Coliform/Gram-negative bacteria- includes, but is not limited to, *E. coli*, *Klebsiella* species, *Enterobacter* species, *Serratia* species, *Pseudomonas* species, *Proteus* species, and *Pasteurella* species. If coliform/Gram-negative bacteria are a predominate group in the BTM culture, then the source(s) of contamination must be identified. Less than 500 CFU/mL is considered low contamination. High coliform/Gram-negative counts may be associated with mastitis, but may also be associated with improper cleaning of the milking system, improper milking procedures, inadequate cooling of the milk or other environmental sources. Environmental factors that contribute to elevated BTM counts may lead to increased rates of intramammary infections. The information below is specific for environmental mastitis caused by coliform/Gram-negative bacteria.

- Account for 40% of clinical mastitis cases in well-managed herds
- Source: fecal matter, soil, organic matter and water
- Most cases will be limited to visible milk changes and mild to severe swelling of the infected quarter
 - 10% of Gram-negative intramammary infections present during lactation will result in peracute clinical mastitis requiring intensive therapy
- New infections by coliforms/Gram-negative bacteria occur during the 2 weeks after drying off and the 2 weeks before calving. During lactation, susceptibility is highest at calving and decreases with time.



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- Infections increase during hot and humid conditions
- Bacterial Counts:
 - Dependent on the load of contamination
 - Cows infected with coliforms/Gram-negative bacteria shed microbes for a short time
- Attainment: < 500 CFU/mL in BTM

***Streptococcus* species:**

Streptococcus uberis- is found in the dairy environment as well as isolated from the udder, skin, lips and genital area of dairy cows, but infections are typically caused by the environment. This is the most common cause of mastitis during dry period and are isolated frequently from cows with clinical mastitis during early lactation. A good mastitis control program along with post-milking teat disinfection, antibiotic dry cow therapy and maintaining a clean, dry environment will control this pathogen.

If *Streptococcus* bacteria are a predominate group in the BTM culture, then the source(s) of the contamination must be identified.

- Bacterial Counts:
 - Dependent on the load of contamination
- Attainment: < 500 CFU/mL in BTM

Other *Streptococcus* species isolated less frequently are *S. acidominimus*, *S. alactolyticus*, *S. canis*, *S. zooepidemicus*, *S. equi*, *S. equinus* (formally *S. bovis*), and *S. parauberis*.

***Enterococcus* species**- *E. durans*, *E. faecalis*, *E. faecium*, and *E. saccharoluticus* causes clinical and subclinical mastitis, but infrequently. Cows are infected from the environment and effective mastitis control procedures will control these pathogens.

Contagious/Environmental Mastitis

Streptococcus dysgalactiae- can be spread from cow-to-cow or from the environment. Good mastitis control program along with post-milking teat disinfection, antibiotic dry cow therapy and maintaining a clean, dry environment will control this pathogen.

Miscellaneous microorganisms- are present in the environment (soil, water, plants, decaying organic matter, exudates of animals or contaminated treatment preparations) of every dairy farm and/or can be found in the infected udder or residents of the respiratory, reproductive, and digestive tracts. The potential always exists for these microorganisms to gain access to the mammary gland during favorable conditions. When these isolates are found, it is possible that the samples were not collected aseptically and care should



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be taken when deciding if an infection is occurring or contamination. Therefore, it is important to evaluate the BMT culture results using all available information.

- Yeast- if causing intramammary infection, they are often eliminated spontaneously within 2 months. Avoid antibiotic treatment as this can exacerbate clinical signs.
- *Nocardia* species- hard nodules or extensive fibrosis may be found upon palpation. Udder secretion may be purulent and affected quarters may develop draining sinus tracts. Mild or high fever may be seen. Infections are refractory to antibiotic treatment.
- *Prototheca* species- achlorophyllic algae, caused most often by *P. bovis* (formerly *P. zopfii* genotype 2) and rarely *P. wickerhamii* and *P. blaschkeae*. These species can cause acute as well as subclinical and chronic mastitis with very high somatic cell counts. Infections are often refractory to antibiotic treatment. Infections can be sporadic or endemic to the herd. The algae is found in drinking water, sand bedding, or manure, especially in environments that have high temperature and humidity. The infection spreads cow-to-cow during milking. Individual quarters are usually affected, but this can eventually lead to whole udder infections. The algae is pathogenic if it is found in the milk, unless the milk was contaminated by dirty water. These infections are not self-limiting or curable. A good mastitis control program will prevent the emergence of this pathogen in the herd.
- *Corynebacterium bovis*- is spread cow-to-cow at milking and primarily colonizes the teat canal and is generally considered mildly pathogenic causing mild infections with a slight increase in SCC and reduction in milk production. Pure culture from a milk sample, *C. bovis* can be the cause of subclinical or chronic mastitis.
- *Trueperella (Arcanobacterium) pyogenes*- can cause acute, purulent mastitis, most often seen during humid weather, with poor prognosis once established in which function can be lost. Infections occur most frequently in dry cows or heifers before calving.
- *Mycobacterium* species- can cause intramammary infections, and if the infection is confirmed affected cows should be removed from the herd.
- *Bacillus* species and other Gram-positive bacilli- *Bacillus cereus* and *B. subtilis* rarely cause intramammary infections. *B. cereus* infections may cause an acute and sometimes fatal gangrenous mastitis. Other Gram-positive bacilli may be isolated from BTM and can reflect poor aseptic technique upon sampling.

Many bacterial species may be isolated from BTM. It is important to utilize all information along with the culture report in order to identify problems. Please contact the WVVDL if you need further assistance.



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Acceptable Levels of Contamination

Bacterium:	Level (colony forming unit (CFU)/mL):			
	Acceptable	Moderate	High	Very High
<i>Staphylococcus aureus</i>	<50	50-150	150-250	>250
<i>Streptococcus agalactiae</i>	0	1-200	200-400	>400
<i>Mycoplasma</i> ¹ species	0	+1 - +2	+3	+4
Coagulase-negative <i>Staphylococci</i>	<300	300-500	500-750	>750
<i>Streptococcus</i> species	500-700	700-1200	1200-200	>2000
Coliforms	<100	100-400	400-700	>700

¹*Mycoplasma* colonies are not counted, but scored subjectively as 0 (none seen), +1 (very few), +2 (few), +3 (moderate) and +4 (numerous).

References:

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