



COLLEGE OF AGRICULTURE AND LIFE SCIENCES  
DEPARTMENT OF ANIMAL SCIENCE

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With the recent completion of laboratory analysis from samples gathered last spring, we are now prepared to share the results obtained during our bedding and mastitis risk study of organic dairy farms! We would like to thank you for generously allowing us to visit your farm to conduct our research; with your participation, we will be closer to understanding the complex relationship between bacteria living in bedding material and a cow's risk of getting mastitis.

In this packet you will find bedding culture results, as well as two bulk tank milk test results from your farm visit last spring. For some of you, these individual results may be several months old; as this was a population survey, we wanted to collect and analyze all of the data before sharing the compiled results. It is important to keep in mind, a one-time sampling is not a reliable indicator for most bacterial tests, except for a positive test for *Staph aureus*. If we have indicated that we found *Staph aureus* in your bulk tank milk, it is probable that your herd is still positive for this pathogen, regardless of time that has passed since the sampling. For other milk quality tests, we recommend that individual producers monitor milk quality trends. Therefore, several samples over a period of time would have been necessary to provide you with a more accurate description of milk quality in your herd.

Although the results of your bacterial tests may be dated, we provide them to help you better understand the tests that are commonly completed for bulk tank milk. We also include an interpretation of what these results can indicate. In the past, we have found that many farmers do not know where to turn for bacteriological testing or interpreting results, and we are hoping that this report serves as an educational tool. **If you would like more time-sensitive diagnostic testing for your herd, we are happy to discuss further options with you.** We encourage you to share these results with your herd veterinarian, and with your permission we would be happy to provide them with a copy.

Later this fall, we will begin the second phase of our three-year USDA study, where we will be sampling ten farms once a month for five months over the winter. We will be contacting some of you that meet the qualifications for participation, and hope you will be interested in participating in this additional study. We will follow up later this month with more information. In Spring 2020, we will complete the rest of the 19 farm visits needed for our 40-farm study in which your farm visit was included.

Again, thank you for participating. Our goal is to support organic milk production through animal health and milk quality research. We hope that you find this summary useful, and we encourage you to contact us directly with any questions. Caitlin can be reached by email at [caitlin.jeffrey@uvm.edu](mailto:caitlin.jeffrey@uvm.edu), and John can be reached by phone at 802-656-1395, or by email at [john.barlow@uvm.edu](mailto:john.barlow@uvm.edu).

Sincerely,

Caitlin Jeffrey  
Tucker Andrews  
Deborah Neher  
John Barlow

## **Organic Herds Bulk Tank Milk Analysis and Bedding Cultures**

Sample Date \_\_\_\_\_

Farm name \_\_\_\_\_

### **Introduction**

Our lab is interested in quantifying the relationship between bulk tank milk quality, mastitis risk, and bedding material on organic dairy farms throughout the state. In the first half of our 2-year study, we visited 21 dairy farms that participated in our survey.

The bedding samples collected at your farm were sent to the Veterinary Diagnostic Laboratory at the University of Minnesota, and the milk samples you provided were analyzed by both Minnesota and the St. Albans Cooperative Creamery Laboratory.

### **How to use milk quality testing and the results from this analysis**

Consistency is the key to milk quality. Serial testing is the best way to evaluate consistent milk quality. A single milk quality test panel should be interpreted with caution as one random test result may not reflect the overall trend. We recommend producers develop a routine bulk tank milk testing program to monitor trends in milk quality.

**This report is a single random test and may not accurately reflect your individual milk quality trends. The purpose of this study is to understand mastitis risk used by a population of dairy farms. Care must be taken when evaluating the individual farm results from this study. We are providing your individual results so that you might compare them to the population averages and extremes. We are also providing a summary of the specific tests and how they can be used to diagnose milk quality problems.**

### **Bulk Tank Milk Analysis from St. Albans Coop – Methods and Interpretation**

**Total Bacteria Count (RAW CFU/mL)** – This is an estimate of total number of bacteria present in the bulk tank milk and able to grow in the presence of oxygen. This value is expressed as the number of bacterial colonies formed per mL of milk (in other words the number of colony forming units (CFU) per mL.) *A CFU count of under 5,000 is considered excellent; a count of 5,000 to 10,000 is acceptable, and a count of over 10,000 is concerning.* Raw, standard plate, and aerobic counts are all different names and methods for counting total bacteria. Increases in the total bacteria count can be caused by poor milking hygiene, unclean or unsanitized milking equipment, improper cooling of milk, and cows with cases of mastitis shedding bacteria in milk.

**Lab Pasteurization Count (LPC CFU/mL)** – This is a count of the number of colonies of bacteria that are able to survive laboratory pasteurization at 143°F for 30 minutes. This is also called a

pasteurized count. *A LPC of under 100 is considered excellent; a count from 100-200 is acceptable, and a count of over 200 is concerning.* Because most mastitis-causing bacteria are killed in the pasteurization process, this test is a good indicator of function and cleanliness of the milking equipment and udder hygiene. The LPC (Pasteurized counts) from your milk were obtained from the St. Albans Cooperative Cheese maker milk quality panel.

***Preliminary Incubation Count (PI CFU/mL):*** This is a measure of the bacterial colonies counted after the sample is allowed to sit at 55°F for 18 hours. This test measures bacteria in the milk that originate from the environment outside of the udder such as from soiled surfaces. These bacteria can often survive in cold environments. This count is generally higher than the RAW CFU count; however, if the PI count is 3 to 4x higher than the RAW count, this is a concern. *Under 10,000 CFU/mL is considered an excellent count; 10,000-50,000 CFU/mL (or 3-4x the RAW CFU count) is acceptable, and over 50,000 CFU or over 3-4x the RAW CFU count is concerning.* The PI counts reported here were obtained from the St. Albans Cooperative Cheese maker milk quality panel. PI counts above the concern level suggesting more attention to cleaning of milking equipment surfaces or udder preparation or milk cooling is indicated. If a herd had excellent or acceptable LPC counts, herds with high PI counts might look into milk cooling deficiencies or challenges.

***Total Coli CFU/mL:*** This count measures the colonies of coliform bacteria grown from the milk sample. Coliform bacteria can be found in several places, but are always found in manure: therefore, coliform counts can be a good indicator of the hygiene practices of the farm. Manure contaminated bedding is a notorious source of coliform bacteria, and dirty teats can be a source of high coliform counts. High total coliform counts can also be associated with unclean milking equipment and milk residues on milking equipment. Coliform bacteria include *E. coli*, *Klebsiella*, *Enterobacter* and *Citrobacter*. *Under 10 CFU/mL is considered an excellent count; 10-50 CFU/mL is an acceptable count, and over 50 CFU/mL is concerning.* Identifying the species of coliform bacteria may help pin-point the cause of high counts.

***E. Coli CFU/mL:*** This count is specific for *Escherichia coli*. This count is a subset of the total coli count and is also an indicator of hygiene and sanitation practices on the farm. Some authors have suggested that transient increases in these counts may be associated with cases of coliform mastitis, but this would be true only if a cow with coliform mastitis is milked into the tank. Because *E. coli* mastitis most commonly causes clinical mastitis with abnormal milk that is recognized by the farmer, it has been suggested that milking cows with coliform mastitis into the tank is relatively uncommon. Therefore, it is more likely that spikes of *E. coli* counts (which also contribute to spikes in total coli and raw counts) are caused by environmental (manure and soiled bedding) contamination or equipment cleaning malfunction and flushing of bacteria from a build-up of milk residues on the milking equipment. A comparison of total coliform and *E. coli* counts can help target potential sources of contamination when dealing with sporadic spikes in bacteria counts. *Under 10 CFU/mL is considered an excellent count; 10-50 CFU/mL is an acceptable count, and over 50 CFU/mL is concerning.* Both the total coliform and the *E. coli* counts are reported on the St. Albans Cooperative Cheese maker milk quality panel.

***Staph CFU/mL:*** This is an indication of the colonies of *Staph. aureus* grown from the bulk tank milk. *Staph. aureus* is most commonly associated with cases of subclinical mastitis. Presence of

this bacterium suggests that at least one animal in the herd has a *Staph. aureus* intramammary infection. This organism is able to live in the udder without showing any physical (clinical) signs of mastitis. Cows with chronic *Staph aureus* infections may show occasional clinical flare-ups of mastitis (abnormal milk). *Staph. aureus* is contagious (can spread from cow to cow, frequently on milking units or by milkers' hands), so efforts should be made to limit contact between cows. Good milking hygiene including use of post-milking teat disinfection is effective at reducing spread of *Staph aureus*. Individual cow SCC can be used to identify cows with subclinical mastitis, and individual cultures of high SCC cows can be used to identify the cause of subclinical mastitis. Repeated cultures are sometimes needed to determine the pathogen causing cases of subclinical or clinical mastitis. Cow composite or individual quarter culture or PCR test results can be used to support decisions on treating or culling cows. Culture can be an important component of *Staph aureus* mastitis control. For example, in tie-stall barns *Staph aureus* cows can be milked last (i.e. 'segregated' from other cows during milking). *Less than 10 CFU/mL is considered an excellent count; 10-100 CFU/mL is acceptable, and over 100 CFU/mL is potentially concerning.* We will often observe a positive correlation between *Staph aureus* counts and BTM SCC. The *Staph* count reported in the St. Albans Cooperative Cheese maker milk quality panel is a *Staph aureus* count. Our laboratory has been experimenting with alternative *Staph aureus* count methods, and we believe the method used by St. Albans cooperative may have fewer false negative results and is one method that we currently recommend.

Most of the farms participating in this study had a positive test for *Staph aureus* in their bulk tank milk. If your herd was positive for *S. aureus* on this single test, we believe this probably indicates that one or more of your cows has a *Staph aureus* infection. *Staph aureus* infections can remain undetected in many cows. Bulk tank milk testing cannot be used to predict how many cows are positive for *Staph aureus*, however, if your *Staph aureus* numbers are high, this could indicate that you may have several cows in your herd with *Staph aureus* mastitis.

**Somatic Cell Count (SCC)** - This is a measure of white blood cells found in milk. Because white blood cells enter the milk to fight infection, an increase in SCC can be used to identify individual cows with mastitis. Individual cows free of mastitis will have a SCC below 200,000 cells per ml. Many producers find a benefit in using monthly DHIA individual cow SCC testing to identify individual problem cows. SCC is also measured in bulk tank milk (BTM) and can be used to measure the general udder health of your herd; BTM SCC is a rough indicator of overall prevalence of mastitis in a herd. For example, herds with a BTM < 200,000 might expect to have fewer than 5% of their cows with an infected quarter. You should use bulk tank SCC to supplement your knowledge of mastitis in your herd; meaning, if your bulk tank SCC is high, this could indicate one or more problem cows. Using what you know about your herd in conjunction with this count will make the most of this information. Dairy industry fluid milk quality guidelines suggest that <200,000 cells per ml in bulk tank milk is an achievable goal for most dairy herds. Milk cooperatives provide BTM SCC testing and occasional individual animal testing. The Vermont Department of Agriculture provides SCC testing or when troubleshooting individual farm milk quality and mastitis problems. Some veterinary clinics can also provide SCC testing.

**Percent butterfat (BF), protein, lactose, other solids, and MUN:** These values were included as part of the Cheese maker milk quality panel done at St. Albans, and may be included as variables

in some of the statistical modeling done at a later time. As analysis of these components is outside of our scope of research, they are included as they may be helpful for you to look at with your nutritionist or other consultant.

### **Bedding Culture Analysis from University of Minnesota**

Please note there are currently no universal guidelines for interpreting bedding culture results, so there are no definitive standards or “cut-off points” that relate a certain level of bacteria to increased risk of mastitis. Bedding cultures may be useful to evaluate “clean” bedding, to compare “before and after” (used/unused) bedding samples, or to evaluate bedding management. The attached bulletin “**Bedding and Bacteria**” from the University of Minnesota Extension provides some general guidelines about bacteria levels in bedding. If you have specific questions about what your bedding cultures may mean for udder health on your farm, these cultures might be a jumping off point for a discussion with your herd veterinarian or other advisor.

That being said, higher bacterial loads in bedding material have been shown to be associated with an increased risk of mastitis. It is also generally acknowledged that increasing pathogen (disease-causing bacteria) load in bedding materials is associated with increased teat end contamination by bacteria that cause mastitis and increased risk of intramammary infection. However, the relationship between the distribution of pathogen species in various bedding materials, the distribution of potential pathogens on teat skin, and the distribution of environmental pathogens causing intramammary infections is poorly understood. This is a very active area of mastitis research at this time!

The only clear-cut guideline that has been put forth from research in this area is that exposing teats to bedding with coliform populations above 1,000,000 colonies/mL ( $1 \times 10^6$  cfu/mL) increases the probability of mastitis due to coliform organisms. The main mastitis-causing coliform organisms include *Escherichia coli* (*E. coli*), *Klebsiella*, and *Enterobacter* species, but can also include a wide number of other gram-negative rods including the genera *Citrobacter*, *Serratia*, and *Proteus*.

### **Bulk Tank Milk Analysis from University of Minnesota – Methods and Interpretation**

*Adapted from “Interpretation and Use of Laboratory Culture Results” from Minnesota DHIA (<http://www.mndhia.org/uploads/5/0/3/6/50366013/interpretingcultureresults.pdf>)*

**Coliforms (colonies/mL):** Coliform count is the number of colonies of *E. coli*, *Klebsiella*, *Citrobacter*, *Enterobacter*, and other related gram-negative organisms grown from the bulk tank milk. Coliforms are gram-negative bacterium commonly found in bedding, manure, water, and soil. *Klebsiella* in particular may be associated with the use of green sawdust or recycled manure bedding and rates of new infections are higher in the summer than in other seasons. Mammary

gland infections with coliforms can cause life-threatening illness. Most of these infections occur during the first two weeks prior to calving through the first 60 days of lactation. Infection occurs when the teat end contacts contaminated material between milking. Most *E. coli* infections are of short duration; approximately 50% last less than 10 day, but some may become chronic and last more than 100 days. *Klebsiella* infections are typically very difficult to treat, and the infected animals, or individual quarters, usually have to be culled. *Enterobacter* and *Citrobacter* are other coliforms found in bedding, manure and soil. Clinically, most severe coliform mastitis cases will look similar, with a sudden onset of fever, markedly decreased milk production, loss of appetite, and dehydration. Often these cows will go down and be unable to rise. Milk from the affected quarter may have large clots or be watery or bloody. Immunization with J5 vaccine can reduce the incidence of coliform mastitis and severity of clinical cases if administered appropriately. *Less than 100 colonies/mL is considered an excellent coliform count, 100-400 colonies/mL is moderate, 400-700 colonies/mL is high, and above 700 colonies/mL is very high.* For further information trouble-shooting a high coliform count, please see the above section on “**Total Coliforms**” within the **Bulk Tank Milk Analysis from St. Albans Coop** section.

***Non-ag Strep colonies/mL:*** This is an indication of the colonies of Streptococcus and Enterococcus species grown from the bulk tank milk. The Non-ag streps include *Streptococcus uberis* and *Streptococcus dysgalactiae* as well as many other species of streptococci and enterococci. These organisms come primarily from the environment. Major sources of these bacteria are bedding material, manure, mud and infected cows. Infections with “environmental streps” frequently occur during the dry period, especially during the first 2 weeks following dry off and during the 2-3 weeks prior to calving. These bacteria may cause subclinical mastitis with no apparent signs, or clinical mastitis with abnormal milk, swelling of the udder, and fever. Individual cow somatic cell counts are frequently elevated. Most of the infections caused by Strep species are eliminated by the cow's immune system or by antibiotic therapy if a clinical case of mastitis occurs. However, some environmental Strep. infections (18%) will become chronic and refractory or poorly responsive to treatment. Minimizing exposure to the bacteria is essential for the prevention of environmental mastitis caused by non-ag. streps. Steps to achieve this include adequate amounts of clean, dry bedding in all stalls. Well-managed inorganic bedding (sand) is associated with fewer pathogens than organic bedding (straw, shavings, sawdust, etc.). Wet or soiled bedding should be removed at each milking. The back one-third of every stall should be bedded daily when using organic bedding material. *Less 500-700 colonies/mL is considered low, 700-1200 colonies/mL is moderate, 1200-2000 colonies/mL is high, and above 2000 colonies/mL is very high.*

***Staph aureus colonies/mL:*** This is an indication of the colonies of *Staph. aureus* grown from the bulk tank milk. Please see the above section on Staph within the **Bulk Tank Milk Analysis from St. Albans Coop** section. Because the two laboratories use different culture media to screen for the presence of *Staph. aureus*, the results from the two tests might disagree somewhat. Consider a positive result from either lab as positive, and if one test is positive and the other negative, it is likely the negative test is a false negative. Our lab and other labs are exploring the use of different culture methods to identify *Staph. aureus* from bulk tank milk samples.

**Staph sp. colonies/mL:** This is an indication of the colonies of non-*Staph. aureus* Staph species grown from the bulk tank milk. Coagulase-negative Staph (CNS, or Staph species) can be normal inhabitants of bovine skin or can be found in the environment in bedding and manure. They frequently gain access to the udder between milking and are normally not contagious. “Staph species” is one of the most common organisms cultured from dairy cows, although may often be a skin contaminant and not a cause of infection. Staph species infections are usually associated with subclinical mastitis resulting in moderate increases in somatic cell counts. If a herd is experiencing a high incidence of Staph species infections, post-milking teat dip products and their application should be re-evaluated. Staph species can be quite resistant to antibiotic therapy. However, most infections will resolve without treatment, given enough time. Persistent infections will likely clear during the dry period. Staph species infections can be managed by minimizing exposure to dirty environmental conditions, and providing adequate amounts of clean, dry bedding should in all stalls. Inorganic bedding (sand) is associated with fewer pathogens than organic bedding (straw, shavings, sawdust, and paper pulp). Wet or soiled bedding must be removed daily. Alleys, walkways, and holding areas should be scraped free of manure on a regular basis. Keep animals out of ponds, streams, and muddy areas.

**Strep-ag colonies/mL:** This is an indication of the colonies of *Streptococcus agalactiae* grown from the bulk tank milk. Strep. ag is a contagious (spreads from cow to cow) mastitis pathogen that may be common on some dairies, but was not seen in any of the herds included in this study. Oftentimes only 10-15% of the cows infected with Strep. ag will exhibit signs of clinical mastitis, but most will have decreased milk production and high somatic cell counts. Purchased animals are frequently the source of bringing Strep. ag into the clean herd.

**Mycoplasma culture:** This was a culture to see if any *Mycoplasma* organisms were present in the bulk tank milk. *Mycoplasma* species are contagious organisms that may be found in infected udders, respiratory tracts, and urogenital tracts of apparently healthy animals. This disease is frequently brought onto a farm through the purchase of infected milking cows or heifers. Many *Mycoplasma* infections are subclinical and the infected cow has a low SCC. Mastitis caused by *Mycoplasma* does not respond to therapy. None of the herds included in the study had a positive *Mycoplasma* culture on bulk tank milk.

## **References and recommended further reading**

If you are interested in exploring the research in this area more, below are some selected references. In addition, if you decide to share this packet with your veterinarian, he or she may these readings useful. We can provide copies of these references upon request.

### **Milk culture and mastitis risk:**

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Smith KL, DA Todhunter, and PS Schoenberger. 1985. Environmental mastitis: cause, prevalence, prevention. *Journal of Dairy Science*. 68:1531-1553.