THE DAIRY PRACTICES COUNCIL®

GUIDELINES FOR TROUBLESHOOTING ON-FARM BACTERIA COUNTS IN RAW MILK

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ABSTRACT

This guideline is designed to help laboratory, field personnel, and producers determine the cause and methods of correction of high bacteria counts in raw milk.
It names possible causes of high bacteria counts, compares various methods of bacteria testing as tools for determining the causes, and lists practical ways to reduce these causes.

PREFACE

The first edition (1977) was written by Professor Sidney E. Barnard and was prepared with the assistance of F. R. Balliet, R. C. Hellensmith, W. J. Killough, and M. H. Roman. It was revised in 1981, 1989, and 1997. This 2015 revision is the fifth edition of this guideline and was authored by Wendy Landry (HP Hood, LLC) with assistance from Scott MacKenzie (Nova Scotia Department of Agriculture), Richard Hinds (DFA), Elizabeth Shade (DFA), and Keith Bohlander (DFA).

GUIDELINE PREPARATION AND REVIEW PROCESS

The Dairy Practices Council (DPC) Guideline development and update process is unique and requires several levels of peer review. The first step starts with a *Task Force* subcommittee made up of individuals from industry, regulatory and educational institutions interested in and knowledgeable about the subject to be addressed. Drafts, called "*white copies*," are circulated until all members of the subcommittee are satisfied with the content. The final "*white copy*" may be further distributed to the entire Task Force; DPC Executive Board; state and federal regulators; educational and industry members; and anyone else the Task Force Director and/or the DPC Executive Vice President feel would add strength to the review. Following final "*white copy*" review and corrections, the next step requires a "*yellow cover*" draft to be circulated to representatives of participating Regulatory Agencies referred to as "*Key Sanitarians*." Key Sanitarians may suggest changes and insert footnotes if their state standards and regulations differ from the text. After final review and editing, the Guideline is distributed in the distinctive DPC "*green cover*" to DPC members and made available for purchase to others. These guidelines represent our state of the knowledge at the time they are written. Currently, DPC Guidelines are primarily distributed electronically in pdf format without colored covers, but the process and designation of the steps remains the same. Contributors listed affiliations are at the time of their contribution.

DISCLAIMER

The DPC is not responsible for the use or application of the information provided in this Guideline. It is the responsibility of the user to ensure that the information addresses their needs and that any action taken complies with appropriate regulations and standards.

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INTRODUCTION

Good quality raw milk is essential for the production of dairy products acceptable to consumers. The key to their acceptance is the delivery of consistently high quality products having good flavor, odor and texture at the time of consumption. Minimizing bacterial contamination of dairy products is crucial and this guideline is designed to aid milk handler field representatives in assisting their producers in the maintenance of low bacteria counts. Bacteria counts of raw milk are routinely monitored by dairy testing laboratories.

A valid testing program must ensure that samples are taken, properly stored and that testing procedures follow acceptable laboratory procedures and methodology. All persons involved must be properly trained and regularly informed about the required practices and given adequate supervision. This includes training and informing all persons who collect, handle, and test samples. Routine checking must be done to be sure that their procedures and techniques are correct.

Much information is available to dairy field representatives or sanitarians to help dairy farmers produce good quality milk. However, when high bacteria counts do occur, it is helpful to have an understanding of the different tests available to determine the cause and the solution.

This Guideline will list a number of the bacteria tests commonly used and their specific purpose followed by a more detailed troubleshooting section that relates to the causes of the counts.

BACTERIA COUNTS

Samples are collected and held at 32-40°F (0-4.5°C) until delivered to the lab and processed. All testing must be performed within 48 hours of milk collection at the farm. All regulatory sampling and testing is performed under the precise procedures specified in the FDA/NCIMS 2400 Forms and Standard Methods for the Examination of Dairy Products (SMEDP). Most bacteria counts involve the spreading or mixing of milk in or on a nutrient medium (or agar) that encourages bacteria to grow. Historically, this was done in petri dishes and the term “plate” is used to refer to the petri dish and the agar. Some of today’s counts are done on thin films instead of petri dishes, but, for this guideline, the term “plate” is used to mean any of the approved methods. Bacteria counts can also be estimated with a stained smear under a microscope.

Bacteria counts are expressed as colony forming units that are the numbers of individual or tightly associated clumps of bacteria that grow on the specified media under the conditions of the test resulting in a visible colony. In regulatory tests, the milk is precisely measured so that the number of bacteria in a milliliter of milk is accurately determined.

Bacteria Count Ranges

To understand bacteria counts an understanding of the procedures used is necessary. Plates are best counted when they have 25-250 colonies. This most often requires that the milk be diluted in factors of 10 before plating (i.e. 1:10, 1:100, and 1:1000). If more than 250 or less

than 25 colonies are noted on the plate, the count is said to be estimated. If there are more than 250 colonies on a plate, the plate is too crowded to be counted accurately. If a higher dilution plate is not available then the reading is used, but designated 'estimated.' It can be said the count is higher than 250 times the dilution factor (e.g., at 1:1000 more than 250 colony forming units would mean over 250,000/ml count). If less than 25 are present, at 1:1000, it can be accurately stated as less than 25,000 bacteria per ml. The dilution should be designed around the desired range of results. For an SPC with a 100,000/ml limit a 1:1000 dilution is most often used. For a 500/ml level on a laboratory pasteurized count, a 1:10 dilution is used.

Note: Two dilutions are required for Standard Plate Counts. The Plate Loop Count procedure uses only a 1:1000 dilution.

Raw Milk Bacteria Count

To comply with Interstate Milk Shippers (IMS) requirements as set forth in the Grade "A" Pasteurized Milk Ordinance (PMO), at least one bacteria count shall be performed in four different months during any consecutive six-month period. There are several methods to test for bacteria including Standard Plate Count (SPC), Plate Loop Count (PLC), or Individual Bacteria Count (IBC). Most states require at least one such count each month. Some cooperative, dealer, and state quality control programs provide for twice-a-month testing and some even more often.

The SPC/PLC procedures are the determination of the number of visible colony-forming units (CFU) in one ml of milk after 48 hours at a 90ºF (32.2ºC) incubation temperature. IBC is analyzed by the equipment and calculated with the software to determine the CFU for the sample. These tests must be done within 48 hours of collection to estimate the number of bacteria present in the milk.

Many raw milk bacteria counts of fresh producer samples are less than 5,000/ml if sanitation is good and cooling is adequate. Most industry standards are 50,000/ml or lower, with quality premium levels often at 20,000/ml. Grade A regulatory maximums are 100,000/ml.

When raw milk bacteria counts of fresh samples exceed 5,000/ml, there is a reason. Usually, this involves poor cooling, sanitation, production and/or handling practices on the farm, while occasionally and infrequently, improper collection, handling, or testing of samples may result in high counts.

Preliminary Incubation Count

The Preliminary Incubation Count (PI) was developed to help narrow down the type of bacteria that may be causing a problem, and to relate the count to farm sanitation and production practices and finished product shelf life. After an SPC or equivalent is performed, the remaining sample is incubated at 55ºF (13ºC) for 18 hours. A bacteria count is then run on the incubated sample.

PI Counts should not exceed 100,000/ml on raw milk from a load, in a storage tank, or from individual producer samples. Desirable results are 25,000/ml or less. If raw milk has an SPC (or equivalent) greater than 25,000/ml and a PI count greater than 50,000/ml the cause of the high count (violative sample) should be determined and corrected.

Laboratory Pasteurized or Thermoduric Count

This is a determination of the number of bacteria that survive laboratory pasteurization at 145ºF (62.8ºC) for 30 minutes. All plating should be at a 1:10 dilution because most counts will be less than 2,500/ml. Bacteria levels in raw milk following laboratory pasteurization and in pasteurized milk should be less than 300/ml.

The presence of thermoduric bacteria usually indicates unclean equipment and/or improper sanitizing practices. Most thermoduric bacteria will not grow at refrigeration temperatures of 40º (4.5ºC) or below. However, thermoduric psychrotrophs do exist and may cause spoilage in pasteurized milk.

Coliform Count

This test may be used as an indication of unsanitary production methods and/or a mastitis infection. Coliform counts of less than 10/ml are achievable with good management practices.

The Common method used to check for coliform bacteria in the coliform plate method, using either pour plates or film plates. The pour plate method involves placing 1 ml of undiluted raw milk (or a decimal dilution) on a plate to which is added Violet Red Bile Agar (VRBA) as the growth medium. The pour plates are then overlaid with a second layer of VRBA to inhibit surface colony formation. The film plates are premade and sample ready to accept 1 ml of undiluted raw milk (or a decimal dilution). Both types of plates require incubation at 90ºF (32.2ºC) for 24 hours.

Blood Agar Cultures

Blood agar has long been used in identifying disease causing organisms. Some laboratories are using this test to help identify the causes of high bacteria counts. The test is performed by using a sterile loop to smear 0.01 ml of bulk tank milk, as evenly as possible, across a blood agar plate. Plates are incubated at
98.6 F (37ºC) for 48 hours before being read. Because the test is done with a 0.01-ml loop, it does not give an accurate count of bacteria and should not be used to determine the total bacteria count. On blood agar, certain bacteria can be differentiated and identified by colony morphology, blood hemolysis, and a few other characteristics. Knowing the organisms present is useful in identifying the type of bacteria problem on the farm.

Interpretation of blood agar plates should be made with caution. One needs to think about the locations where bacteria types will come from to properly use the results.

The following are a number of organisms that might be detected using blood agar plates:

- Staphylococcus aureus is often from mastitis, but it is a form of mastitis that grows more prevalently in the tissue of the udder more than in the milk ducts. It is usually shed into the milk in low numbers. It also prefers to grow in the presence of butterfat. When large numbers are found, especially if the herd is a low SCC herd, a greasy film on equipment is suspected and the water heater should be checked as well as wash temperatures and wash procedures.

- Staphylococci species are commonly found on the skin of animals. When large numbers of these organisms are present inadequate teat prepping is suspected. Staphylococci species will also grow in greasy build-ups. The information that pertains to

Staphylococcus aureus and greasy buildups is also true of Staphylococci species.

- Streptococcus agalactiae is a highly contagious mastitis pathogen. Its source is usually an infected udder. Large numbers of colonies in a bulk tank sample do not necessarily relate to the number of animals infected, but indicate that at least one animal is infected. While not a common cause of high PI's, a few strains of Streptococcus agalactiae will also grow at PI temperatures.

- Environmental streptococci are common in the animals' environment and can be in the milk from mastitis or contamination. Levels of streptococcus have been shown to come out of worn rubber goods. Other common sources are hair, chopped hay bedding, dirty equipment and poor cooling.

- Coliforms may be either from mastitis or from environmental contamination, as they are common in the dairy barn environment. Generally, if from mastitis, large numbers of the same type of coliform will be present. If they are from contamination (dirty equipment, poor cooling, etc.), there will generally be a variety of types with other contaminants present. One exception is a single spot build up (i.e. a cracked pump seal) where one type of coliform of a single type may be established in very high numbers.

- Yeasts are generally from dirty equipment (i.e. milk residue build-ups) in places where milk only occasionally contacts, like a tank bridge or a trap U-bend. Yeast in rare cases can cause mastitis, usually the result of poor treatment procedures, reused infusion syringes or contaminated medicines.

- Pseudomonades are common in the dairy environment, especially in wet locations. They will grow under a wide variety of conditions and temperatures. Many strains grow readily at refrigeration temperatures and will become more prominent with long cold storage times. It can be in the water supply at low numbers that can result in a severe PI problem. Incidental water contact (flushing milk lines, rinsing off equipment, etc.) is a common way it gets into the milk. It can also grow in dirty equipment.

Organisms reported as miscellaneous on a blood agar culture are a total of all unidentified organisms. The test was designed for pathogen identification and most laboratories do not identify every organism on the plate. Unidentified organisms are generally from dirty equipment and/or animals.

The art of reading the blood agar plates is to look for the relationships. You cannot always tell what is happening, especially if the milk sample is adulterated or grossly contaminated, but you can generally rule certain issues out which saves the field personnel considerable time and money.

For more information on blood agar culturing and other culture techniques refer to National Mastitis Council Laboratory and Field Handbook.

Direct Microscopic Procedures

Rapid estimates of bacterial numbers can be made using the Direct Microscopic Clump Count (DMCC) procedure described in FDA/NCIMS 2400d IMS#12 or SMEDP (Besides providing a

rapid estimated count, the DMCC can sometimes provide insight to the types of bacteria that might be causing high bacteria counts. This concept has been used by a number of laboratories and has been documented in the "The Microscopic Examination of Milk", (S.C. Murphy, 2004) available on-line at http://foodsafety.foodscience.cornell.edu/mqip/information-sheets. As with any troubleshooting procedure interpretation should be made with care. Bacteria that occur from different sources may appear very similar under the microscope. The more obvious bacterial types that can be characterized by this method are as follows:

- Streptococcus agalactiae mastitis appears as long chains (rarely less than four cells) of spherical bacteria (cocci). Chains may be observed being engulfed by somatic cells.

- Large numbers of shorter chains or pairs of cocci are often associated with poor cooling (>50°F). These organisms may also occur in high numbers due to poor cleaning and sanitizing procedures. In some cases it may be a combination of both poor cleaning and poor cooling. In rare instances, bacteria responsible for cases of "environmental mastitis" may result in high numbers.

- Spherical bacteria in pairs, tetrads (groups of four) or irregular clusters may be associated with milk stone or areas of persistent poor cleaning. Mastitis may also be a source of these types of bacteria in milk (i.e. Staphylococcus aureus) though numbers would rarely be high.

- Rod shaped bacteria are difficult to differentiate under the microscope. However, the most common rods associated with high bacteria counts in milk are Gram-negative bacteria, either Pseudomonas or coliform. These would most likely occur due to poor cleaning/sanitizing and/or prolonged marginal cooling. Coliforms are often associated with manure contamination although generally this is not found to be a cause of significantly high counts. In some cases, bacteria responsible for cases of "coliform mastitis" may result in high numbers of these types of bacteria in the bulk tank.

- Mixed microflora is generally considered to be due to poor production/sanitation practices that can include dirty animals, poor cleaning, poor cooling and/or mastitis.

No single monthly test can be expected to reflect the daily conditions of cleaning, sanitizing, and milking practices

CAUSES OF HIGH COUNTS

General

Most high bacteria counts involve improper cleaning and sanitizing of dairy equipment, poor production practices, inadequate cooling or mastitis problems.

All milk handling equipment must be properly cleaned after use and sanitized before reuse. A cleaning program based on water conditions should be set up and followed. One should seek advice and technical assistance from their cleaning supplier.

Cooling should be adequate to decrease temperature at the first milking to 40ºF (4.5ºC) within one hour of milking. Blend temperatures should remain below 45ºF (7ºC) during all subsequent milkings. Milk should be held below 40ºF (4.5ºC) at all times.[1]

Causes of high PI Counts include dirty animals, poor udder sanitation practices, slow or poor cooling, failure to thoroughly clean equipment after each use, improper sanitizing of equipment, a contaminated water supply, improperly drained milking equipment and worn rubber or plastic parts.

Industry field personnel may be very discouraged by the first results of PI Counts. Initially, counts from some farms may exceed 1,000,000/ml and a large percentage of the counts may be over 100,000/ml. Adopting a PI Count program requires time, patience and some changes in farm sanitation practices.

Sanitation includes using proper measures when taking small volumes of milk for personal use from the bulk tank at the bottom valve. When milk is removed, the exposed parts of the valve should be cleaned and sanitized to prevent contaminating all milk passing through it. **Samples for any testing purposes should not be taken through the outlet valve.**

For a detailed list of possible problem areas refer to the Fact Sheets attached to this guideline.

Cleaning and Sanitizing

Cleaning and sanitizing is the primary key to good bacterial quality. Cleaning of all milk contact surfaces must be done after each use. These same surfaces must be sanitized just prior to reuse. Follow established procedures for cleaning and sanitizing chemicals as outlined by the manufacturer.

When problems persist, check solution concentrations and temperatures at the end of each cycle. The temperature should be a minimum of 120ºF (49ºC) at drain on the detergent wash.

All cleaning and sanitizing chemicals should be designed and approved for dairy equipment. Quality products that are backed by service should be used. Never use pine, phenol, or floral scented cleaners or sanitizers, because they will taint the milk and make
it unusable.

[1] Many states and the PMO allow a regulatory milk temperature of 45°F (7°C). This guideline recommends lower holding temperatures and faster cooling times because they help minimize bacterial growth.

Automatic cleaning systems are equipped with predetermined wash and rinse cycles. The manufacturer sets time, temperature, and solution strength. These should be equipped to acidify final rinse water.

When cleaning problems arise, contact the technical representative of the chemical supplier. They know their products and will correct the problem. More details on cleaning and sanitizing are provided in:

DPC 2, Effective Installation, Cleaning and Sanitizing of Milking Systems,
DPC 4, Installation, Cleaning and Sanitizing of Large Parlor Milking Systems,
DPC 9, Fundamentals of Cleaning and Sanitizing Farm Milk Handling Equipment,
DPC 25, Cleaning and Sanitizing Bulk Pickup and Transport Tankers,
DPC 58, Sizing Dairy Farm Water Heater Systems.

Facilities and Animals

Animal areas should always be clean. Animals should not be permitted in areas where mud and stagnant water can get on udders and teats. Bacteria such as coliforms, psychrotrophs, and other types are usually found in large numbers under such conditions causing high bacteria counts, PI counts or mastitis.

Udders, teats, and flanks should be clipped to make udder preparation easier. Animals should be provided with clean, bedded stalls for resting.

Proper teat preparation using an effective sanitizing solution is required. A clean, nonporous pail or applicator should be used. Teats should be wiped dry with an individual towel. The goal is to milk clean, dry, sanitized teats.

Chores that stir up dust such as sweeping floors and distributing bedding should not be performed during milking. Feeding should be avoided during milking, if possible, though grain may have to be fed. Silage and hay should be fed only after milking is completed.

Milk filters should be checked to determine if proper production practices are followed. Filters should remain relatively clean and should not plug or break under pressure. Filters are not a good indicator of lack of mastitis as not all types of mastitis cause can be seen on the filters. Remember a milk filter is a safety net, not a management cover-up Sediment testing and nylon screens at outlet valves are suggested ways of determining if proper practices are followed during milking.

Cooling

Milk should be cooled to 40ºF (4.5ºC) within one hour after milking. On subsequent milkings, the blend temperature should not rise above 45ºF (7ºC) and milk should be cooled back down to between 33°F to 40ºF (0.0 - 4.5ºC) within one hour after milking is completed and maintained at that temperature until collected.

Bulk tank thermometers should be checked monthly to be sure they are accurate. Milk haulers should regularly check the temperature of the milk in each tank every time milk is collected from the bulk tank and show this on the patron's receipt.

Condensers should be kept clean. Frequently condensers become clogged with dust and dirt which may cause them to operate poorly. Air-cooled units should be provided with adequate air and water-cooled units should be kept free from scale. Most bulk tanks are designed for every-other-day collection. They should not be filled to more than 25% of capacity for each milking, unless designed for everyday pickup or assisted with an inline cooler. When production exceeds tank capacity, a larger tank should be installed.

If pre-coolers are installed at the farm to aide in the cooling of the milk the gaskets should be changed on a regular basis according to the manufacturer's specification. These are often installed and forgotten about.
Compressors should be equipped with automatic controls. It is recommended that milk in bulk tanks be agitated every hour.

Recording thermometers are a useful tool to monitor milk cooling and cleaning practices. They are also a valuable tool as a warning system. The recording thermometer can be wired to indicate improper cooling or to trigger a warning device when the tank is not functioning properly. If the loss of one or more tanks of milk can be avoided, the cost of the system is recovered. Bulk tanks manufactured after January 1, 2000 shall be equipped with an approved temperature recording device. The chart recorder/recording thermometer should be checked for accuracy monthly against a standardized thermometer and recorded. The charts should be changed as needed. Portable recording thermometers should be available for field representatives or sanitarians to use when problems are suspected.

Other Possible Causes

Mastitis

Herd infection problems may contribute to an increased bacteria count. Appropriate bacteria culturing (i.e. blood agar) should be run to determine what is the cause. Mastitis actively spreading in a herd may give bacteria counts in excess of 100,000 before the SCC reaches actionable levels. If mastitis pathogens are found to be the cause, the farm needs to contact the appropriate people to solve the problem (see DPC 18, Fieldperson's Guide to Troubleshooting High Somatic Cell Counts).

Sampling and Laboratory

Occasionally improper sample collection, handling or testing may contribute to increased bacteria counts. Samples must be collected under aseptic conditions, held at temperatures below 40ºF (4.5ºC), and tested within 48-60 hours of collection. Milk samplers should carry sampling dippers in proper strength sanitizer solution such as 25-ppm iodine solution or a 200 ppm chlorine solution. After sampling, collection dippers must be rinsed thoroughly before they are returned to their sanitizing solution. Sanitizer strength should be checked at both ends of the collection route. Sampling containers must be protected from contamination with dirt or moisture.

Laboratory analyses of producer milk samples are given increasing scrutiny through the certification process of the FDA/NCIMS and licensing requirements of some states. Unfortunately, the same scrutiny is not given to sampling and care of samples. Routine and frequent surprise inspections should be made of milk samplers in the course of obtaining samples to determine compliance with Pasteurized Milk Ordinance (PMO) or SMEDP

Laboratory technicians should be trained and under the supervision of an experienced laboratory director. Technicians should be trained to use the proper laboratory procedures and methods in FDA/NCIMS lab forms such as 2400 Cultural Procedures – General Requirements, 2400a Standard Plate Counts and 2400d DMSCC. The program requirements may be found in the current Evaluation of Milk Laboratories (EML).

Dairy field representatives or sanitarians should receive written results of all high (violative) bacteria counts within 7 days after collection. This permits them to determine causes of all high counts before rechecks are taken. Notification of field representatives or sanitarians by telephone or e-mail the day plates are counted is recommended for all results over the recommended level of the milk handler.

TROUBLESHOOTING HIGH COUNTS (VIOLATIVE SAMPLES)

When a high count occurs the following steps should be taken by the field representative or sanitarian. Using blood agar culturing or a microscope to determine what type of bacteria is present may save time on some of the following steps.

First High Count

Go to the producer and find out if something unusual happened. If the producer does not know what happened, give them a copy of the Fact Sheet attached to this guideline and review it with them. Have them go over the list of possible concerns. Fill out any reports required by your state or company and discuss any findings with the producer.

Second High Count

If possible, arrange for a visit sometime when the tank is empty and the producer is not milking.

Non Milking Time Visit

(See attached Fact Sheet)
Visibly inspect the milking system from the tank valve back through to the inflations. Are all the surfaces clean? Look for films on milk contact surfaces, broken gaskets, overused inflations, or other softened worn or old rubber parts. Check the whole system. Inspect at least two sections of a pipeline (high and low end). On systems with a splitter always remove the splitter and check the sections of milk line on both sides.

Be sure that the system is washed after dismantling and inspection. Watch the milking system wash. Is the air injector forming solid slugs of solution? Is the temperature of water at the wash cycle drain above 120° F (49° C)? (See attached Fact Sheet.)

Talk with the producer about pertinent procedures surrounding the milking of the animals and the handling of the milk. How is household milk collected? Do they sanitize all milk contact surfaces before use? Is the equipment washed after each milking?

If problems are found, have them corrected and resample the bulk milk. If no problems are noted, then arrange for a check sample and see if the high count is still present.

If High Count Persists

If the non-milking time visit was completed and the problems noted were corrected, arrange for a milking time visit.

Milking Time Inspections

(See attached Fact Sheet)

The field representative or sanitarian should arrive well before milking starts and check cleanliness of all equipment. Then observe animal cleanliness, housing conditions, pasture conditions, equipment sanitizing, udder preparation and milking practices.

Be thorough in your checking. Do not hesitate to ask questions of the dairy producer, their family, or employees who may do milking and cleaning.

Water may be another source of bacterial contamination. This may be from the water supply or condensation that gets into milk. All water used for sanitizing should contain an approved sanitizer. A potable water supply is necessary on all dairy farms. A water sample should be collected and tested by the laboratory. Be sure to tell the lab the situation so that they run a total bacteria count as well as a coliform and E. Coli tests.

Avoid rinsing the top of the bulk tank with a hose. Water frequently splashes under covers and into the milk. Disconnect pipelines or transfer systems from the bulk tank before rinsing them...

Containers should not be dipped into the bulk tank to remove milk for household use or for sale. Rinse and sanitize the bulk tank valve before and after use and replace the valve cap.

Note any deficiencies and go over them with the owner and the employees. Arrange for a resampling of the milk.

If Count Remains High

Assuming the above steps were taken and corrective action was taken, it is time to contact a specialist. Most cleaning supply companies, some State Departments of Agriculture and some Universities have specialists who can help identify what is causing the problem.

Erratic Counts

Counts that are erratic are the most difficult to resolve. Pull duplicate samples on these farms and have the lab freeze the duplicate. Then when a high count is found, take that frozen duplicate along with the previous 5 to 10 samples to a lab that does bacteria culturing to identify what bacteria is causing the erratic count.

Mastitis is a common cause of erratic counts. Many more bacteria are shed in the early stages of mastitis than are white blood cells. A single animal will have a much higher impact on the bacteria count of a tank than on the SCC. Many animals that become infected with a mastitis organism spontaneously cure (cure themselves) and the milker often does not know anything happened. This is especially common in herds where the animals are in excellent

condition. If cultured results indicate this is happening, then refer to DPC 18, Fieldperson's Guide to Troubleshooting High Somatic Cell Counts and have the producer contact the state mastitis control program, the equipment dealer and/or the veterinarian.

Other common causes of erratic counts include:

- Relief milker that does not follow good milking time hygiene.
- Pastures that are muddy whenever it rains.
- Marginal wash systems.
- Cooling not turned on for first milking.

SUMMARY

When trying to determine the cause of a high bacteria count one should ask all kinds of questions. Frequently the answers will be surprising. Do not assume that common sanitation practices are being followed. Be thorough and check all possibilities even after the apparent cause has been determined. Consider the areas of animal preparation, milking practices and cleaning and sanitizing of equipment. For persistent problems observe conditions during milking time when unsuspected causes frequently may be observed. Bacteria culturing (i.e. blood agar) can save field personnel considerable time and effort when troubleshooting high counts. It often indicates the general area to look for a problem.

FACT SHEET: TROUBLESHOOTING BACTERIA COUNTS IN RAW MILK-MECHANICAL (CIP) WASH SYSTEMS

Summary of Critical Control Points for Bacteria Reduction in Milk

1. Effectively clean and care for the animal's teats and udder.
2. Examine filters for foreign matter.
3. Effectively clean milking units, milker buckets, and utensils.
4. Effectively clean air or vacuum lines and milk transfer systems.
5. Effectively clean and operate the farm (bulk) milk tank.
6. Effectively clean pipeline milkers.
7. Test the water supply and check the cleaning/sanitizing program.

Effective Pre-Milking Udder Preparation

1. Udders clipped?
2. Animals reasonably clean?
3. Animals fenced from swampy, muddy areas?
4. Animals free of disease (mastitis and others)?
5. Teats cleaned with an effective teat sanitizer used at the proper concentration?
6. Single-service paper towels used?
7. Teats/udders dry before attaching milkers?
8. Check for abnormal milk and withhold from the milk supply.

Filtration

1. Does examination of the filtering material reveal an absence of foreign matter (sediment, straw, or sawdust)?

Effective Mechanical Cleaning of Pipeline Milkers

1. Pipeline washed after every milking and sanitized just prior to milking?

2. Inflations and all other rubber, plastic, glass and rubber-like parts clean, free from cracks or deterioration and changed on a routine schedule?

3. Has a specific cleaning and sanitizing program, based upon a water hardness test, been developed and is it followed? The program should specify materials, amounts of water and cleaner, circulation times, and temperatures to use.

4. Are specified wash temperatures maintained?

5. Is non-mechanical cleaned equipment disassembled, manually hand-cleaned and sanitized daily?

6. Does the entire line and milk inlets drain completely?

7. Gaskets flush with joints and free from cracks and deposits?

8. Milk port opening, swinging joints, milk pumps and claw assemblies free from deposits?

9. Main vacuum supply line slope away from the receiver toward the sanitary moisture trap?

10. Sanitary moisture traps installed and properly located and free of soil deposits?

11. Alternate water and air slugs maintained throughout the line during cleaning?

12. Do you know where the system is most likely to be dirty? This may be the swing line or the last straight piece of pipe before the water returns to the receiver or the high point. In some systems, milk meters or weigh jars are the critical areas.

13. Is filter sanitized prior to milking?

14. Who cleans the fresh animal bucket and how is it stored?

15. Can you see through plastic milk hoses with the aid of a flashlight?

16. When was the milk system last analyzed and by whom?

17. When were the pulsators last cleaned and analyzed?

18. When was the main vacuum line and tank last cleaned? Is it clean now?

19. Are the unit hookups checked during the flush/rinse cycle?

20. If using an automated milk system are all the steps working properly to ensure proper sanitizing and cleaning of the system?

Effective Mechanical Cleaning and Operating of Bulk Tank

1. Bulk tank washed and sanitized after every pick up?

2. Surfaces clean, with no evidence of milkstone or protein deposits?

3. Outlet valves, agitators, bridge surfaces, and gaskets around the manhole clean with no evidence of milkstone or protein deposits?

4. Has a specific cleaning and sanitizing program, based upon a water hardness test, been developed and is it followed? The program should specify materials, amounts of water and cleaner, circulation times, and temperatures to use.

5. What hour of the day is the bulk tank normally washed? Is there adequate volume of hot water at that time? What is the wash water temperature at the end of the wash cycle?

6. How long after the milk is picked up is the bulk tank washed?

7. Is the automatic washer (CIP system) functioning as designed? Auto drain? Velocity of spray? Timer?
   Chemical feed? Does agitator run constantly during washing?

8. Spray ball clean and free of blockage? Is the spray ball positioned as designed?

9. Temperature of the milk down to 40°F (4.5°C) or less within 1 hour of milking?

10. Does the blend temperature remain below 45°F (7.2°C) at all times during the second and subsequent milkings?

11. Is the tank thermometer correct? When was the last time it was checked against a calibrated thermometer?

12. Does the agitator run at least 5 minutes every hour?

13. Is it possible for contamination to occur due to condensation from dripping pipes and ceilings?

14. Is care used in rinsing the top of the bulk tank to prevent the entrance of water when milk is present?

15. Is the milkhouse area free from dust or dirt that might be drawn into the cooler vent?

16. Is the last rinsing of the bulk tank, before milking, done with an approved sanitizer in the proper concentration?

Limiting Conditions for Effective Cleaning

1. Adequate supply of quality water available?

2. Water heater capacity to maintain specified end point temperatures?

3. Has the water been tested for bacteria other than coliform?

4. Has a cleaning program been developed after water analysis, reviewed with principle operator, demonstrated and posted?

5. Is chemical concentration compatible with water source?

6. Time of washing appropriate?

7. Vacuum pump capacity sufficient to create the physical turbulence needed for washing?

8. Air injector adequate capacity and functioning?

9. Chores of feeding, bedding animals, and sweeping floors avoided during milking?

10. "Wet hand" milking or stripping avoided?

11. Equipment rinsed immediately after use with warm water?

12. Milkhouse environment clean of molds and deposits?

FACT SHEET: TROUBLESHOOTING BACTERIA COUNTS IN RAW MILK-MANUAL WASH SYSTEMS

Summary of Critical Control Points for Bacteria Reduction in Milk

1. Effectively clean and care for the animal's teats and udder.
2. Examine filters for foreign matter.
3. Effectively clean milking units, milker buckets, and utensils.
4. Effectively clean air or vacuum lines and milk transfer systems.
5. Effectively clean and operate the farm (bulk) milk tank.
6. Effectively clean pipeline milkers.
7. Test the water supply and check the cleaning/sanitizing program.

Effective Pre-Milking Udder Preparation

1. Udders clipped?
2. Animals reasonably clean?
3. Animals fenced from swampy, muddy areas?
4. Animals free of disease (mastitis and others)?
5. Teats cleaned with an effective teat sanitizer used at the proper concentration?
6. Single-service paper towels used?
7. Teats/udders dry before attaching milkers?
9. Check for abnormal milk and withhold from the milk supply.

Filtration

1. Does examination of the filtering material reveal an absence of foreign matter (sediment, straw, or sawdust)?

Manual Wash Items

1. Equipment washed after every milking and sanitized before use?

2. Inflations and all other rubber, plastic, glass and rubber-like parts clean, free from cracks or deterioration and changed on a routine schedule?

3. Milk hoses (including air hoses) cleaned after each milking with proper brushes or burrs and stored to dry?

4. Absence of rust or open seams?

5. Gaskets and shut-off valves removed, cleaned and brushed daily?

6. Claw pieces disassembled and thoroughly brushed or automatically washed after each milking?

7. Check valves in good repair, in place, and seating properly?

8. Are the pulsator air ports clean?

9. Vacuum line slope to drain with drain valves at low points?

10. Vacuum lines cleaned and flushed regularly (at least every three months) or whenever milk enters the line?

11. Equipment stored to dry?

12. Has a specific cleaning and sanitizing program, based upon a water hardness test, been developed and is it followed? The program should specify materials, amounts of water and cleaner, brush and soak times, and temperatures to use.

13. Brushes in good condition and the appropriate brushes available?

Dumping Stations

1. Milk pumps/releasers clean?
2. Filtered air used to dry long lengths of plastic tubing?
3. Sanitary traps installed and properly located?

Effective Manual Cleaning of Bulk Tanks

1. Bulk tank washed and sanitized after every pick up?

2. Surfaces clean, with no evidence of milkstone or protein deposits?

3. Outlet valves, agitators, bridge surfaces, and gaskets around the manhole clean with no evidence of milkstone or protein deposits?

4. Has a specific cleaning and sanitizing program, based upon a water hardness test, been developed and is it followed? The program should specify materials, amounts of water and cleaner, circulation times, and temperatures to use.

5. How long after the milk is picked up is the bulk tank washed? (The sooner the better to retard bacterial growth at room temperature).

6. Brushes in good condition and are the appropriate brushes available?

7. Is the temperature of the milk down to 40°F (4.5°C) or less within 1 hour of milking? Does the blend temperature remain below 45°F (7.2°C) at all times during the second and subsequent milkings?

8. Is the tank thermometer correct? When was the last time it was checked against a calibrated thermometer?

9. Does the agitator run at least 5 minutes every hour?

10. Is it possible for contamination to occur due to condensation from dripping pipes and ceilings?

11. Is extreme care used in rinsing the top of the bulk tank to prevent the entrance of water when milk is present? (Rinsing the top of the bulk tank when the tank contains milk, is strongly discouraged).

12. Is the milkhouse area free from dust or dirt that might be drawn into the cooler condenser unit?

13. Is the last rinsing of the bulk tank, before milking, done with an approved sanitizer in the proper concentration?

Limiting Conditions for Effective Cleaning

1. Adequate supply of quality water available?

2. Water heater capacity to maintain specified end point temperatures?

3. Has the water been tested for bacteria other than coliform?

4. Has a cleaning program been developed after water analysis, reviewed with principle operator, demonstrated and posted?

5. Is chemical concentration compatible with water source?

6. Time of washing appropriate?

7. Vacuum pump capacity sufficient to create the physical turbulence needed for washing?

8. Air injector adequate capacity and functioning?

9. Chores of feeding, bedding animals, and sweeping floors avoided during milking?

10. "Wet hand" milking or stripping avoided?

11. Equipment rinsed immediately after use with warm water?

12. Milkhouse environment clean of molds and deposits?