Tools for Milk Quality

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Take Home Message

- There are well developed and economical diagnostic tools that can greatly enhance the ability of producers to achieve mastitis control.
- The use of differential bulk tank cultures, along with individual cow somatic cell count information, can determine where mastitis control emphasis should be placed to be most effective and economical by determining when infections are occurring.
- For many years the major emphasis was on controlling mastitis caused by contagious organisms. However with changes in management practices and more effective control of contagious mastitis, mastitis due to environmental organisms has become a more significant problem.
- Control of environmental mastitis is difficult because it depends on consistency in housing maintenance and milking procedures. Monitoring of exposure to environmental pathogens at milking time needs to be done on a regular basis to help maintain environmental sanitation and milking procedures at an effective level.

Introduction

Traditionally, veterinarians working with milk quality and mastitis control programs have used records to some extent but have relied mostly on farm and milking time observation for evaluation and diagnosis and problem solving. However, in recent years, developments in computer handling of data along with newer techniques for bacterial culturing have provided a set of tools that allows diagnosis and monitoring to be done more easily and accurately. The increase in herd size, use of multiple milkers and overall changes in operation have made direct observations more difficult and less accurate simply because it is not practical to observe every milker. The purpose of this presentation is to discuss the use of these tools and interpretation of the data obtained.

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Diagnostics

The most basic method for controlling mastitis is to reduce the number of new infections. While there is also some benefit for reducing the duration of infections, preventing them is the most important factor.

There are three general areas where infections occur:

- Contagious mastitis is spreading through the herd,
- Milking cows are becoming infected with environmental organisms,
- Cows are becoming infected during the dry period.

If we can determine the primary area (or areas) where infections are occurring, we can more effectively and economically target control measures.

Somatic cell count data obtained from DHIA or computer programs such as DairyComp 305 used along with properly conducted differential bulk tank cultures can provide such information easily and effectively.

SCC data can provide:

- % of herd infected,
- New infection rate,
- Dry cow infection rate and infection pattern,
- Milking cow pattern of infection which may suggest whether infection is mainly contagious or environmental.

Differential Bulk tank culture can provide:

- Types of infection (generally),
- Degree of exposure to environmental organisms.

Cell Count Data

When evaluating cell count data some idea of the factors that are most meaningful, along with goals or standards, are needed. The information in Table 1 is based upon observations of numerous herds over time. It is also presented with the idea of what is average, but more importantly what is achievable and what is needed to reduce or maintain low cell counts and infection rates.

Table 1

Herd Name _____ _____

Date: _____No. Cows_____ Lbs. of Milk:_____SCC: 200,00 or less

Somatic Cell Count Analysis **10-30%** from **4** Cows (number) **fairly common in small herds**

Milking Cow Infection Status this Month

_____ % over 200,000 state average **35% (20% achievable**)

_____ % New
- **At 4 to 5% herd level decreases ↓**
- **At 10 to 12% herd level remains same ↔**
- **Above 10 to 12% her level increases ↑**

_____ % Chronics 15% or less

_____ % Cures higher than new infections

Dry Period

_____ % Over 200,000 first test (all cows)
- **35% state average**
- **20% achievable (do see lower**)

Dry off Infection status compared to freshening (Older Cows)

No. Cows

_____ % New xxxxxx

_____ % Chronics _____ → **Below 15% (preferably below 10%)**

_____ % Cures _____

Total Cures +Chronics _____ Cures Divided by total **60-70% fairly good** = % cure over dry period

Patterns

_____In & Out ? _____Continuous ?

Average Linear score – **below 3 (2.5 to 2 achievable)**

-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	**This Month**

■ The Use of Bulk Tank Cultures in Problem Solving and Herd Monitoring

The use of bulk tank culture procedure has become somewhat commonplace in recent years. It is a useful technique for determining the general types of bacteria present in cows within a herd, as well as the amount of exposure to environmental bacteria. Bulk tank culture procedures are certainly not a stand alone type test, and in most instances need to be supplemented with individual cow somatic cell counts and in some cases with individual cow cultures. However, it is a relatively rapid, inexpensive way to determine some types of information when trying to "troubleshoot" problems in a dairy herd or for monitoring environmental exposure.

Sample Collection and Handling

The number of samples varies but there is strong evidence that in some instances, especially in small herds, that multiple samples collected over several days produce more consistent results. Early in the development of this procedure, it was shown that four days milk is probably needed to overcome the variability in shedding that occurs with some organisms. It also gives coverage over a number of milkings, and also to some extent, environmental conditions. Samples need to be carefully taken from the top of the tank since bacterial growth tends to occur around the outlet valve. If a sample must be taken from the bottom of the tank, a fairly large quantity of milk should be allowed to flow through the opening before the sample is taken.

The samples should be frozen immediately and kept frozen until they arrive at the laboratory. A sample which thaws and warms is of virtually no value. If the sample is shipped to a diagnostic laboratory, this needs to be done in an insulated container containing a sufficient amount of ice-type material to allow the sample to arrive at least partially frozen.

Interpretation of Results

Benchmark numbers for interpreting bulk tank cultures have been established over the years by observing the relationship between bulk tank counts and herd events and other culture data. The numbers in Table 2 appear to be quite well proven and accurate.

It must be remembered that bulk tank cultures are basically estimates and may vary from time to time. As mentioned earlier, they are not a stand alone type of procedure.

University Of Minnesota **Table 2**

D-Lab #:
Date Received:
Condition of Samples:
Mastitis Lab#:

Laboratory for Udder Health
Minnesota Veterinary Diagnostic Laboratory
1333 Gortner Avenue
St. Paul, MN 55108
Phone: 612-625-7053
Toll Free: 1-800-605-8787
Fax: 612-624-4824
E-mail: mastlab@tc.umn.edu

Mastitis Bulk Tank Culture Report

Sample Description: Bulk Tank

Type of Bacteria	Colonies/ml	Low levels	Moderate levels	High levels	Very High
Strep agalactiae:	_____	<50	50-200	200-400	**>400**
Staph aureus:	_____	<50	50-150	150-250	**>250**
Non-ag Strep:	_____	500-700	700-1200	200-2000	**>2000**

High levels of Non-ag Streps usually indicate the degree of teat contamination at milking time, not infection of the gland. However, these organisms are good indicators for potential of infection with these organisms and/or elevated SCC.

Coliforms:	_____	<100	100-400	400-700	**>700**

High levels of Coliforms usually indicate the degree of teat contamination at milking time, not infection of the gland. However, these organisms are good indicators for potential of infection with these organisms and/or elevated SCC.

Staph species:	_____	<300	300-500	500-750	**>750**

The above table is intended to aid in interpreting your bulk tank sample results. If your results fall within LOW levels, you are probably doing a good job controlling mastitis. However, if your results are higher you may want to reconsider the effectiveness of your current mastitis control procedures.

Type of Bacteria	Usual Source of Infection	Major Means of Spread	Control Measures to be Improved
Strep agalactiae	Infected udders of other cows in herd	Cow-to-cow by contaminated udder wash rag, teat cups, etc.	Use separate towels to wash/dry; teat dipping; dry cow treatment; eradication in special cases
Staph aureus	Infected udder, contaminated bedding, etc.	Cow-to-cow by contaminated udder wash rag, Milking equipment or inadequate milking equipment.	Use separate towels to wash/dry; teat dipping; dry cow treatment; culling of chronically infected cows; establishing milking order.
Non-ag Strep	Environment of cow	Environment to cow by: wet, dirty lots; milking wet cows; poor cow prep; machine problems (reverse flow at teat); wet dirty bedding.	Improve barn and lot sanitation; milk clean, dry cows; avoid air leaks and liner slips; change bedding frequently.
Coliforms	Environment of cow	Environment to cow by: wet, dirty lots; milking wet cows; poor cow prep; machine problems (reverse flow at teat); teat injuries; hot humid weather; wet dirty bedding.	Improve barn and lot sanitation; milk clean, dry cows; keep cows standing 1-2 hours after milking; avoid air leaks and liner slips; change bedding frequently.
Staph species	Normal inhabitants of skin, some bedding	Poor teat dip coverage; poor cow prep; old bedding.	Teat dipping; adequate cow prep; more frequent bedding changes.

An understanding of where the organisms originate and how they affect the mastitis process is helpful in planning mastitis control programs. The organisms *Streptococcus agalactia* (Strep. ag) and *Staphylococcus aureus* (Staph. aureus) in a bulk milk sample can be assumed to have originated from infected cows if the sample has been handled properly to eliminate the possibility of growth.

The significance of the numbers of these organisms cannot be over interpreted since there is a tendency for the amount of shedding to vary considerably. In general, there is an 85-90% correlation between the number of infectious organisms in the bulk tank cultures and the number of cows infected. However, in 10-15% of cases, there is not a general correlation. Therefore, determining the numbers of infected cows from DHIA counts or individual cultures will be needed to determine the true significance. However, it can be looked at as an indication that further examination is needed.

Perhaps one of the more useful aspects of bulk tank culturing is to determine the degree of environmental exposure. Environmental organisms such as the environmental strep, coliform, and staph, obtained in a bulk tank culture, can be assumed to have originated on the teats of cows. Therefore, it is not a direct measure of infection but a measure of potential for infection since we know that the more these organisms are present on the teat skin, the higher the potential for infection. This is particularly true with environmental strep and coliforms. Monitoring the numbers of these organisms can be used to determine potentials for infection due to changes in weather changes, management changes, milking practice changes, etc. This tool can be useful in evaluating the effects of changes on the potential for environmental mastitis possibility.

Long term observations suggest that the levels shown in Table 2 tend to be reasonably accurate. In addition, observations have shown that when the level of environmental organisms in bulk tank cultures, especially strep or coliforms are above the normal levels, we can expect an increase in clinical mastitis resulting from infections with these organisms.

Bulk tank cultures also provide a fairly direct assessment of factors such as milking practices. Though it may appear that the cow preparation procedure is resulting in clean cows, if elevated numbers of environmental bacteria are present, there is a hole in the procedure someplace and there is still a mechanism for these organisms to result in increased infection rates.

The number of environmental (coagulase negative) staph also tends to be related to the number of organisms on the teat skin. This observation has suggested that this relates, to some extent, to the efficacy and particularly

coverage of teat dip. In general, if teat dipping is not being practiced or coverage is not good, environmental staph will be present in higher numbers.

The way in which bulk tank results and interpretations are used needs to be carefully considered. Finding large numbers of environmental organisms suggests that a careful evaluation of stall maintenance and milking preparation procedures is needed to determine the source of these organisms. High numbers of contagious organisms suggest that it may be desirable to do individual cultures to find which cows are causing the problems so that they may be dealt with appropriately.

As mentioned, bulk tank culture is not a stand-alone technique, and should be used more for pointing out those areas that need further examination. It also needs to be emphasized that laboratory procedures are not perfect. If laboratory results do not agree with other observations such as herd history and somatic cell count patterns, a careful assessment needs to be made and a possibility considered that laboratory results may not be accurate due to improper sampling, sample thawing or handling, or an overgrowth of environmental organisms. In this case, repeating a bulk tank culture at a different point in time should help eliminate this possibility.

▪ The Use of Monitoring Bacterial Numbers for Controlling Environmental Mastitis

With the widespread adoption of control procedures for contagious mastitis and the changes of management systems, environmental mastitis due to non-agalactiae streptococcus and coliforms has become the major mastitis problem in many herds.

The use of procedures such as J5 vaccination and vitamin E - selenium supplementation to increase cows' immunity are of some benefit, but reducing the level of exposure to these organisms is still the most effective method of reducing the new infection rate with these organisms.

It has been shown experimentally that there is a good correlation between the number of these organisms present on the teat skin when the milking machine is applied and the new infection rate.

There are also numerous clinical examples where it has been shown that if the numbers of organisms on the teat are truly reduced, the new infection rate drops rapidly. There has been considerable discussion of the possibility of cow to cow spread of the environmental Strep; however the evidence for this is limited. It is the opinion of the author that while this may be possible, the

occurrence is extremely limited and for all practical purposes the exposure is from the environment.

One recommendation for control of environmental mastitis is to “milk clean dry cows”. This is a noble try but what is clean? And dry? What is really required is to milk cows with low numbers of bacteria on the teat skin. And yes, a cow that looks “clean and dry” probably has a lower number of bacteria on the teat skin than one with manure on the teats but is it low enough? There is also a problem with the definition of clean. What is clean to one person may not be to another.

Another issue is consistency. Every teat needs to have a low bacteria load every milking to effectively prevent infections. Dairy producers frequently adapt a cow prep procedure that has been shown to reduce bacteria loads and assume that because they are using a proven procedure they have reduced the load. However, even a proven procedure will not have the desired effect if not done correctly. For example, teat ends are frequently missed, in fact unless a special effort is made to contact teat ends they will be missed.

Milker training, compliance, and conscientiousness are always on going issues in herds with hired or multiple milkers. Monitoring milker performance by watching on an occasional basis does not assure consistency. The use of videotapes can show if a procedure is being followed but will not show enough detail to evaluate quality of cow prep. To assure consistency, milkers need to be well trained and monitored on a continuing basis.

A variety of monitoring programs such as video taping, observing milk filter socks and cultural methods have been used. However, for any system to be effective it must have sufficient accuracy and sensitivity and be reasonably easy to use. Culturing bulk tank or inline samples to accurately determine the numbers of non-ag strep and coliforms fulfills these requirements and has the major advantage of directly measuring the parameter that most concerns us; i.e., bacterial load on the teat at milking time.

When it is determined that the bacterial load is too high the next step is to determine the reason. This level is the result of two factors, the amount of bacteria that got on the teat between milkings (obtained from the stalls and other environmental areas) and the number that were removed by the cow prep procedure. Both of these areas need to be controlled. If the cows are excessively dirty, no amount of cow prep effort can be completely successful. On the other hand even though cows appear clean, it is unlikely the bacteria load will be low enough that cleaning is not needed.

There are some factors, that can result in incorrect numbers being obtained form this monitoring method. Samples must be correctly taken, handled,

shipped correctly and processed by a competent lab. However, on farm factors such as system cleaning and cooling problems can also produce inaccurate results. Cooling can be evaluated by following temperatures on a recording thermometer. Cleaning problems may be determined to some extent by using lab-pasteurized counts along with a system cleaning analysis.

Sampling Techniques for Use with More Detailed Analysis Needs.

It may be desirable in some cases to use bulk tank type techniques to look into special situations such as:

- looking at the Strep ag, Staph aureus or mycoplasma status of individual groups of cows,
- looking at the cow prep performance of individual milkers,
- obtaining samples when tankers are direct loaded and the top hatch is sealed.

Some of these sampling problems can be solved by proper timing and milking the desired group or cows or specific milking into an empty tank and obtaining the sample at the proper time. However the use of in line sampling has been shown to be a useful tool which, if properly done, can provide accurate results.

Studies at the University of Minnesota (Godden et al, 2002), where results obtained from in line samples were compared with samples collected from the bulk tank with the same cow's milk in the tank, showed essentially identical results. There was no statistical difference in the results between the different methods of collection for both milk components and bacterial cultures.

There are some major factors which may cause inaccurate results when using in line sampling techniques

- Improper cleaning and sanitizing of all sampling equipment,
- Inadequate sample size. At least 200 ml. and more for extremely large herds or groups is needed.
- Carry over of organisms. When looking for contagious type organisms in groups of cows where we are more or less asking yes or no, it must be remembered that a lot of milk is still left in the system when a group of cows is finished. Unless you started with a washed system for this group or rinse between groups, the possibility of contagious organisms remaining in the system from a positive group is high. This of course results in the possibility of a false positive in the next group.

Carry over is not as much of a factor when looking at environmental organisms because we are looking at numbers rather than yes or no and dilution reduces the variation to essentially a non problem situation.

■ Procedures For In-Line Sampling

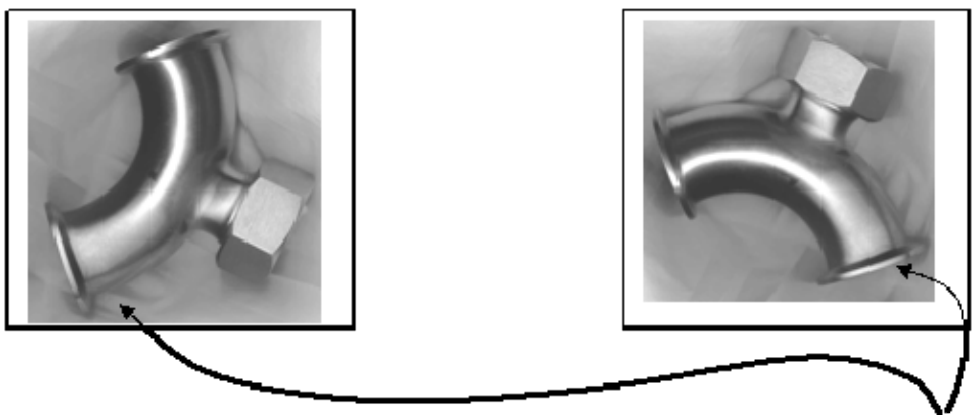
There are a number of systems that have been used with considerable variability in results. The use of the QMI sani-elbow has been the simplest and easiest in our hands.

The two areas where mistakes are most likely to occur are:

- Not taking a large enough sample. It appears that 3 to 5 ml per cow is needed with a minimum of 200 to 500 ml regardless of the herd size. There is no problem with too large a sample as long as the equipment does not overflow.
- Contamination or inadequate cleaning of the sampling equipment.

The QMI sani-elbow should ideally be placed in the line past the receiver and past the plate cooler if one is present in the system.

Bottom Placement Top Placement



The sampler should be placed so that the nut and sampling port is on the bottom or side of the line. Avoid placing so the port is on the top of the line if possible.

If the port is on the bottom or side, a 16-gauge, 1.5-inch needle usually gives good results.

If the port is on the top of the line, it may be necessary to use a needle long enough to reach across the elbow so that the opening is actually on the bottom of the line to get sufficient flow rate. A 16-gauge, 3.5-needle is needed for this use. The bevel of the needle needs to be pointed toward the flow of milk in the line.

A fluids administration set makes an ideal collecting tube. To use, simply cut off the drip chamber, plug into the needle and establish the needed flow rate with the flow regulator already present as a part of the set.

There is a difference in flow regulation depending if the flow in the line is intermittent or continuous.

- If flow is intermittent, collect 20 to 30 ml each time the milk pump operates.
- If flow is continuous, collect with a steady drip or stream to obtain the necessary amount.

The flow should be measured for each receiver dump or timed per minute by letting it flow in a syringe or calibrated vial.

The collection container can vary as long as it is large enough. A gallon jug that has been cleaned well and any disinfectant removed by repeated flushing can be used. A hole can be drilled in the cap to insert the collecting line while keeping dirt out.

Bags, which can be used to make a totally closed system, are also available and can be used where contamination problems have occurred.

The sample needs to be kept cool while being collected. It is best to have the collection vessel completely in an insulated cooler surrounded by ice or cold packs. Rubbermaid makes a 5-gallon tall cooler that can have a hole drilled in the lid to make an ideal system. Sub samples should be immediately frozen and transported to the lab frozen. It is not necessary to send a large volume sample to the lab, once the larger sample is obtained it can be well mixed and sub sampled to send to the lab. The standard 20 to 30 ml vials are adequate.

The use of cell count data and differential bulk tank cultures cannot totally replace on farm observation for milk quality and mastitis control. However if properly used they can increase the efficiency of diagnostic procedures and are extremely valuable in monitoring the necessary factors to reduce infections and somatic cell count.

References

Godden, S., R. Bey, J. Renau and R. Farnsworth. 2002. Field validation of a milk line sampling device for monitoring milk component data. J. Dairy Sci. 85: 2192-2196.