PRACTICAL USE OF BULK TANK ANALYSIS FOR MASTITIS AND MILK QUALITY PROBLEMS

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Introduction

Dairy farmers need to produce high quality milk and have a low incidence of clinical mastitis in order to satisfy consumer demands. Low levels of bacteria and somatic cells maximize food safety, processing ability and lengthen shelf life, while minimal disease ensures optimum animal welfare.

Veterinarians and other advisers use a wide range of tools to identify the good points in relation to milk quality and mastitis and use these to motivate and congratulate milkers. These tools are equally useful in identifying potential problem areas.

Bulk Tank Analysis (BTA) is widely used by this author in dealing with problems with high somatic cell and Bactoscan (TBC) counts, and high levels of clinical mastitis. BTA can help pinpoint problem areas in high Bactoscan herds, while providing useful information in somatic cell count and clinical mastitis problem herds. BTA is a useful screening and monitoring tool which may be used in its entirety or using individual screening tests to monitor specific problem areas.

BTA ~ What Tests Are Carried Out?

Eight routine tests are routinely carried out along with a differential bacterial screen. All the bacteria in milk have originated from the udder, environment or a dirty plant.

The methodology of the testing is described in Blowey et al.1997. The tests routinely carried out include:

The TBC gives a quantitative indication of the numbers of bacteria in milk. The TBC can be misleading as it does not measure bacteria but counts colony-forming units (cfu) and does not measure psychotrophic bacteria. The Bactoscan, which is more commonly used as the measure of bacteria in milk, gives a far more accurate measurement as it measures all bacteria including psychotrophs and measures individual bacteria and not colony forming units.

The LPC (Laboratory Pasteurized or Thermoduric Count) measures thermoduric bacteria, which withstand high temperatures of pasteurization. High Counts indicate problems with plant washing.

The Coliform Count gives an indication of environmental contamination which is commonly due to poor teat preparation or poor hygiene. Coliforms act as a marker for all the environmental organisms such as faecal Streps, Yeasts and Fungi.

Pseudomonas Count gives another indication of non-enteric environmental contamination although the source of these organisms is very different. Pseudomonas bacteria are psychotrophs and so multiply in cold conditions.

Strep uberis, Staph aureus and the Total Staph Counts give a measure of these individual bacteria. The Total Staph Count measures all Staphs including Staph aureus. These counts are useful in herds with contagious mastitis problems. Strep uberis is predominantly an environmental bacterium associated with the use of straw bedding and is a common cause of clinical and subclinical mastitis in the UK.

The somatic cell count of milk gives an indication of the level of subclinical mastitis.

A differential bacteria screen identifies all bacteria in milk no matter what their origin. These are roughly quantified as + for small numbers to +++ for high levels. The presence of Strep dysgalactiae suggests problems with teat condition or damage. Corynebacterium bovis suggests problems with post milking teat disinfection. Strep agalactiae will be a cause of high cell count. In the UK screening for Mycoplasma is not routinely carried out as this is a rare mastitis pathogen. In parts of the world where this is a problem it should become a regular part of the BTA.

Targets

Targets will depend on the milk quality requirements of individual countries and milk buyers. Dairy farmers who have good mastitis management regularly achieve targets listed below.

	Attainable targets
TBC	< 5,000
Thermoduric Count	< 175
Coliform Count	< 20
Pseudomonas Count	< 500
Strep uberis Count	< 200
Total Staph Count	< 200
Staph aureus Count	< 10
Somatic Cell Count	< 150 (x1,000/ml)

Sample collection and transport to the lab

Specialist milk labs generally carry out BTA and it's essential that the milk is collected and stored correctly from farm to lab. The tank needs to be thoroughly agitated and a 30 ml sample is collected into a sterile sample pot. This is packed into a polystyrene container filled with ice bricks and bubbles to fill up all empty air space. The pack is carefully sealed and dispatched for next day delivery to the lab. On arrival the temperature is always checked and provided it is below 6 C processing takes place.

When To Use BTA Testing?

Raised Bactoscan (TBC) Counts
Bacteria in milk come from one of three different sources, the udder, environment or a dirty plant. BTA results will identify problems with the wash-up routine from a raised LPC Count, and poor udder preparation or hygiene from the Coliform Count. Raised Strep uberis and Staph Counts indicate that the problem is from the udder.

There are times when there is a fluctuating Bactoscan and in these cases we freeze samples of bulk milk and then match the frozen sample to a high Bactoscan reading and then dispatch this sample to the lab for processing. Freezing can affect the Coliform Count but when the levels are high enough to influence the Bactoscan, they are well above the target levels this has little effect on diagnosing the problem.

Raised Somatic Cell Counts
Many herds do not have any individual cow cell counts or bacteriology results. The BTA can give a good indication of problem areas through the Strep uberis, Staph aureus and Total Staph Counts along with the differential bacteriological screen. A BTA screen is always carried out when investigating problem herds.

Problems with clinical mastitis
The majority of cases of clinical mastitis in the UK are due to environmental mastitis. In other countries where there are higher somatic cell count herds there may also be problems from the contagious bacteria. BTA provides helpful insight into hygiene from the Coliform Counts. A low Count indicates excellent premilking teat preparation. But the presence of high Coliform Counts along with the presence of faecal Streps, yeasts and fungi indicate gross contamination and will increase the risk of environmental mastitis. High levels of Streps and Staphs may also be contributing to the problems.

Screening Tool
Many producers want to have a regular check on milk quality so they can pass these results back to the milking team to provide motivation and encouragement. BTA can act as an early warning system for impending problems and allows early intervention.

Individual BTA tests
In some herds there may be a problem with teat preparation. Using the Coliform Count alone as a monitoring tool for individual milkings can have quite an impact on getting people to improve performance. We regularly use this as a separate test to monitor milkers whose hygiene may be marginal. They can argue with your interpretation of their hygiene, but it becomes much more difficult to argue with lab tests. These results support the decision making process.

Milk Quality Enhancement Programmes
When farmers have Bactoscan results below the target levels set by their milk buyer there may still be further room for improvement. This author set up an enhancement programme for a dairy company where BTA was carried out for every milk producer over a two-year period. The milk buyer wanted to have much lower Bactoscan results for commercial advantage and this was a novel way of persuading farmers to improve. Results and interpretation were returned to the farm.

While many of the farmers may have considered they had no areas for improvement it was surprising to find that only 6% had levels below the target figures for LPC, Coliform and Staph aureus counts. 78% had wash-up problems. 35% had high Coliform Counts indicating poor premilking teat preparation. 53% had above target levels of Staph aureus and 8% of herds were found to have Strep agalactiae infections. Over the two-year period the Bactoscan averages for all purchased milk fell from 38,000 to 20,000/ml. The scheme was highly successful and the results tailored to individual herds.

Examples of the Use of BTA in Problem Herds

Herd A ~ Somatic Cell and clinical mastitis problems, and the occasional high Bactoscan result.

Presenting problem is a rising cell count and a high level of clinical mastitis. Milking cows are housed in cubicles (freestalls) and on straw yards. The owner has a herdsman who is convinced that he is doing an excellent job. The herd has expanded by 50% over the past three years. Various recommendations have been made but rejected due to shortage of time.

Test	TBC	LPC Count	Coliform Count	Pseudomonas Count	Strep uberis Count	Total aureus Count	Staph aureus Count	SCC
Target	<5,000	< 175	< 20	< 500	< 200	< 200	< 10	< 150
Result	9,000	50	312	250	6,500	650	216	338
Differential bacterial screen				Yeasts ++, Strep faecalis +++, C. bovis +				

The TBC is above target and the results show major problems with teat preparation, Strep uberis, Staphs and Staph aureus counts and cell count. The presence of yeasts and Strep faecalis further confirm poor hygiene. C. bovis suggests problems with post milking teat disinfection.

The following were found during the farm visit. Teat preparation was poor as the milker was finding it difficult to milk on his own. Units were applied to dirty teats. There was no foremilking and mastitic milk frequently entered the bulk tank. As many of the cows were bedded on straw yards a common cause of clinical mastitis will have been Strep uberis which are shed at very high levels and can increase bulk tank Bactoscan results. Straw yards were cleaned out every six to eight weeks instead of three to four due to shortage of labour.

There were no separate clusters for milking cows with mastitis and any cluster used was not disinfected before milking the next cow. There were a lot of old cows with high cell counts and cultured positive to Staph aureus. The farmer was teat dipping but due to reduced profitability diluted the teat dip 1:5 rather than 1:4 to try and save money.

The bacteriology results helped to persuade the owner and his milker to make major changes to mastitis management and the problems were slowly resolved. Monitoring of the bulk milk continues.

Herd B ~ Somatic Cell and Bactoscan Problems

The request was to investigate a high somatic cell count of over 400,000/ml. The owner has another business which has been far more profitable than the dairy, and he had left control to the dairy staff for many years. Four months earlier the old staff left and two replacement staff with little experience of milking were recruited. They were given little training. The herd had a new parlour fitted two years ago and had never had a low Bactoscan count with levels always above 60,000/ml. The BTA was collected before the farm visit.

Test	TBC	LPC Count	Coliform Count	Pseudomonas Count	Strep uberis Count	Total aureus Count	Staph aureus Count	SCC
Target	<5,000	< 175	< 20	< 500	< 200	< 200	< 10	< 150
Result	22,000	950	87	590	150	1,600	330	421
Differential bacterial screen				Strep faecalis +++, Strep dysgalactiae +, C. bovis ++, Yeasts ++, Fungi +				

The TBC is well above target and the results show that there is a plant wash-up problem (raised LPC), poor teat preparation (raised Coliform Count and the presence of Strep faecalis, yeasts and fungi). The Total Staph and Staph aureus Counts are very high indicating that these are likely to be contributing to the high cell count of 421,000.

The presence of C. bovis would indicate that there are problems with post milking teat disinfection. Strep dysgalactiae suggested teat damage or poor teat skin condition.

From further investigation the following were identified. Post milking teat disinfection had stopped and teat skin condition was very poor with quite a few teat lesions. Teats were dirty on entering the parlour and were washed but not dried before units were attached. A hot wash was carried out once daily with inadequate amounts of hot water, insufficient chemicals and running the wash cycle with the plate cooler still operating!

Once the wash cycle was modified the Bactoscan results fell to under 30,000/ml immediately. The predominant cause of the high cell count was Staph aureus. This was identified from bacteriology of the high cell count cows and the fact that it was the older cows that had the high cell counts.

Herd C ~ High Bactoscan Counts

Presenting problem were consistently high Bactoscan results of over 70,000 in a herd which normally had excellent milk quality and low levels of clinical mastitis. Prior to being asked to investigate, the owner had stripped the parlour and plate cooler and cleaned all areas thoroughly as he thought it might have been due to a fault with the wash-up routine after milking. He had also replaced all the rubberware in the plant.

Test	TBC	LPC Count	Coliform Count	Pseudomonas Count	Strep uberis Count	Total aureus Count	Staph aureus Count	SCC
Target	<5,000	< 175	< 20	< 500	< 200	< 200	< 10	< 150
Result	11,000	190	3	995	70	325	65	98
Differential bacterial screen				Strep faecalis +				

The initial results failed to identify any specific problem which could be responsible for the high Bactoscan result apart from a slightly raised LPC, and raised Pseudomonas, Total Staph and Staph aureus Count. The LPC was slightly raised but did not seem to support a failure of washing sufficient to cause such a high Bactoscan.

A farm visit was arranged to check the acid boiling wash procedure which showed that the plant temperature was only 71°C. The boiler was serviced and wash temperatures adjusted but the high Bactoscan counts persisted. Another bulk sample was collected and showed low thermoduric counts but a Pseudomonas Count of over 5,000.

The only possible source of high levels of Pseudomonas was from the chilled water from the bulk tank which circulated around the plate cooler to cool milk rapidly. The plate cooler was bypassed and the Bactoscan results fell immediately back to their normal level of under 10,000/ml. It transpired that there was a minute leak in the plate cooler which allowed small amounts of the chilled water contaminated with Pseudomonas to enter the milk as it passed through the plate cooler. Pseudomonas continued to multiply in the bulk tank and was responsible for the high Bactoscan. This highlights the advantages of the differential tests in diagnosing causes of the problem.

Herd D ~ Herd With Problems With Teat Preparation Due to Large Numbers of Milkers.

This herd had a very high mastitis rate and used up to seven different milkers. 600 cows were milked three times daily through two separate parlors. Poor teat preparation was one of the main problems contributing to the high levels of clinical mastitis, which was predominantly due to environmental organisms. Milkers blamed each other for failure to prepare teats properly.

Milker schools were carried out during Week 2 to provide a uniform agreed milking routine and to explain why changes were necessary. Coliform Counts were carried out over a period of time from individual milkers which showed almost all had poor teat preparation. A league table was organized to rank milkers according to Coliform counts. This had an impact on most milkers, and any who remained consistently high were assigned other duties outside the parlour.

	John	Sean	Martin	Mike	James
Week 1	35	8	944	28	142
Week 2	24	20	254	22	95
Week 3	15	12	165	25	18
Week 4	18	16		18	14
Week 5	12	9		12	17
Comment	Improved	Always a clean milker	Stopped milking Wk 3	Improved	Significant improvement

This approach stopped milkers blaming each other, highlighted Sean as a consistently good milker and removed Martin from the milking team. The other three milkers have been shown that their improvements following the milking school has paid dividends in their performance with a concurrent reduction in clinical mastitis cases.

Summary

BTA gives you a snapshot into milk quality and pathogens on a specific day. In most cases it allows causes of high Bactoscan to be identified easily, even if they are quite difficult problems. It gives much useful background information into problems with high cell counts and clinical mastitis problem herds. There are many downsides. Results can vary between milkers if they don't operate to standard procedures. Problems with collection and storage to the lab can cause misleading results.

BTA is an invaluable tool to mastitis investigators and is an underused technique however it is a tool and should not be used in isolation. Data, bacteriology and on farm investigations all build up the complete picture of what is going on within a herd. This allows for successful problem solving and maintaining excellent milk quality and low levels of clinical mastitis.

References

Blowey R.B., Edmondson P. W. & Davis J. 1999. Bacterial Counts in Bulk Milk - an update In Practice 21 No 9. 531-535

Blowey R.B., Davis J. & Edmondson P. W. 1997. Bacterial Counts in Bulk Milk - an underused investigation technique In Practice 19. 122- 127

Edmondson P. W. 2000.Bactoscan reduction following a bulk tank analysis monitoring scheme in England. Proc. of the Pacific Congress on Milk Quality and Mastitis Control, Japan. 106-111