UT Extension
W150

Tennessee Quality Milk Initiative

Using Milk Somatic Cell Count Information

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The level of mastitis infection in a dairy herd can have a significant impact on herd profitability. Losses due to mastitis include decreased milk production, increased treatment costs, discarded milk, premature culling, death, decreased genetic potential, decreased reproductive performance, load rejection due to violation of somatic cell counts (SCC) or antibiotic residues and loss of milk quality premiums (3, 9, 12). Most producers easily relate clinical mastitis with these losses. However, subclinical (or hidden) mastitis may actually cause more losses in a herd than clinical mastitis. Since the animal does not exhibit typical symptoms of the disease, the problem is often overlooked. A tool that producers can use to determine if subclinical mastitis is a problem in their herd is SCC. Somatic cells have long been utilized to gauge the infection status of the udder. Understanding their role in mastitis and how to use SCCs to estimate production and profit losses will allow producers to make better management decisions.

The Progression of Infection

Mastitis is an inflammation of the mammary gland, and the cause of inflammation is usually bacteria. The mammary gland's first line of defense against invading bacteria is the teat canal, which is typically closed tightly. During the milking process or due to damaged teat ends, the sphincter muscle is opened and bacteria can penetrate the mammary gland. Once inside the udder, the bacteria multiply and can cause significant and permanent damage to the mammary gland. After bacteria have passed into the gland, white blood cells (leukocytes) are the second line of defense. Normally, there are a small number of white blood cells in uninfected mammary glands. Their responsibility is to destroy invading bacteria. However, if they cannot, an immune response is elicited, and more white blood cells are called in to fight the infection. Somatic cells are predominately made of white blood cells and can be used to gauge the level of infection (17).

SCC and Infection Status

The primary factor affecting SCCs is infection status. Historically, many other factors have been blamed for high SCCs and poor udder health. Scientific studies have investigated many of these factors. Things such as lactation number, stage of lactation, estrus, exercise, heat stress, stray voltage and day-to-day variation may all be related to small SCC changes (1,6,7,8,10,14,15,18). However, it is important to remember that the relationship between these factors and SCC is not cause-and-effect. These factors may exert an effect on the SCC but only if the cow also has an intramammary infection. These factors will not have the same effect on an uninfected mammary gland. In other words, if an infection is present in the mammary gland and these other factors cause a drop in milk production, the SCC may be exaggerated because of a dilution effect (6).

Somatic Cell Counts

An uninfected udder will typically have a SCC less than 100,000 cells/ml. When the SCC is 100,000 to 199,999 cells/ml, the presence of infection can only be ruled out by bacteriological testing (16). A SCC of 200,000 cells/ml or more is a clear signal that an infection 1) is occurring, 2) has occurred recently or 3) the mammary gland is still recovering from an infection, which may take days, weeks or longer (13). Typically, the more severe the infection, the higher the SCC will be.

Estimating Production Losses

Too often, production losses due to mastitis focus only on clinical cases. The infection is recognizable in the milk; the drop in production is obvious; treatment costs can be calculated; and the amount of discarded milk is known. However, cows that are not showing clinical signs (i.e. abnormal milk, hard or swollen udders, etc.) and are subclinically infected can have a significant impact on profit losses. When an infection is present in a mammary gland, milk- secreting cells are damaged and their capacity for producing milk is lowered. Since SCCs are a reflection of infection, the SCC can be used to estimate production losses.

Table 1. Losses in milk production associated with elevated Bulk Tank Milk SCC

Bulk Tank Milk SCC	% Production Loss*	% Quarters Infected
200,000	0	6
500.000	6	16
1,000,000	18	32
1,500,000	29	48

*Production loss calculated as a percent of production expected at 200,000 cells/ml

Source: Eberhart, 1982

Using Bulk Tank SCC

Each bulk tank of milk that is received from a farm is tested for SCCs. The "Grade A" Pasteurized Milk Ordinance (2005) states that the SCC for individual producer milk should not exceed 750,000 cells/ml. Any level above this will result in action against the individual producer. Additionally, some milk processing plants and/or marketing cooperatives have adopted more stringent quality standards, requiring producers to maintain bulk tank SCCs below a certain level. In programs such as this, a penalty may be imposed for high SCCs (ex: $0.10/cwt penalty for SCC above 500,000 cells/ml) and/or a premium may be rewarded for low SCCs (ex: $0.25/cwt premium for SCC below 350,000 cells/ml). Although producers need to be mindful of legal limits and quality penalties or premiums, this should not be the primary reason for wanting to reduce bulk tank SCC. Bulk tank SCC levels are a good indicator of udder health in the herd and can be used to estimate production losses due to infections (Table 1). For example, herds with SCC higher than 500,000 cells/ml could be producing 6 percent or more below potential because 16 percent of quarters in the herd are infected.

Although a useful tool in estimating infection level and production losses, bulk tank SCCs are merely a guideline with general indications of overall udder health status. It is more useful to study trends in bulk tank SCCs over a period of months to determine changes in udder health status than to take a snap-shot based on one sample. Additionally, bulk tank SCC has limitations. It is impossible to determine an individual cow's or a group's infection status using bulk tank SCC. Also, it is important to remember that bulk tank SCC is determined by each individual cow's SCC and production level. A few cows can have a significant impact on bulk tank SCC. For example, assuming the same production level, four cows at 100,000 SCC plus one cow at 1,600,000 SCC would give the same bulk tank average as five cows at 400,000 SCC, while production losses would be quite different for these two groups of cows.

Using DHI SCC

Although future publications will address the use of Dairy Herd Improvement (DHI) records to make udder health management decisions, it is important to mention at this point that DHI somatic cell count (DHI-SCC) scores can be used to estimate losses of an individual cow, group or herd (Table 2). When using this information for determining individual cow losses, the DHI-SCC score should be averaged over the lactation of that cow. For example, if a cow averages 400,000 SCC (DHI-SCC score = 5) for the lactation, her milk loss from mastitis would be estimated at 1,200 pounds. For a group of cows, their estimated milk loss would be 1,200 pounds per cow. Table 3 uses the herd average DHI-SCC score to estimate yearly cost of loss in milk production due to mastitis.

Table 2. Estimated change in milk yield associated with increase in somatic cell

DHI-SCC Score	Average SCC	Decrease in Yield (lbs/305d)*	
		Lactation 1	Lactation 2
0	12,500	---	---
1	25,000	---	---
2	50,000	---	---
3	100,000	200	400
4	200,000	400	800
5	400,000	600	1,200
6	800,000	800	1,600
7	1,600,000	1,000	2,000

* Comparisons are with lactation yield at SCC score of 2.

Source: Raubertas, 1982

Table 3. Yearly economic loss from lost milk production due to mastitis of a 50-cow herd with 30% 1st lactation cows and a milk price of $12/cwt.

DHI-SCC Score	Cows in 1st Lactation	lbs Lost in 1st Lactation	Cows in 2nd + Lact	lbs Lost in 2nd + Lact	Total lbs Lost	Total $ Lost
3	15	200	35	400	17,000	$2,040
4	15	400	35	800	34,000	$4,080
5	15	600	35	1,200	51,000	$6,120
6	15	800	35	1,600	68,000	$8,160
7	15	1,000	35	2,000	85,000	$10,200

To estimate annual losses for an individual herd, average the DHI-SCC herd scores over a one-year period. Use Table 2 to determine corresponding production losses for first-lactation cows and second-lactation or higher cows. Then use this formula:

(No. cows in 1st lactation) X (lbs lost for 1st lactation)
+ (No. cows in 2nd or higher lactation) X (lbs lost for 2nd or higher lactation)
= Total lbs lost for herd
X (average milk price per lb)
= Total $ lost from lost milk production due to mastitis

It is important to remember that generally with the herd average DHI-SCC score, half of the cows will be above the average and half below. Level of milk production is not a factor, and this number will not be the same as the bulk tank SCC on that same test day. The herd average DHI-SCC score is useful in estimating production losses and evaluating overall udder health. However, monthly herd averages should be studied over a period of time to identify changes in udder health status. Additionally, the herd average has its limitations, as it cannot be used to determine an individual cow's or a group's infection status. Group averages and/or individual cow records will need to be examined. Using detailed DHI data for detection of problems with the mastitis control program will be addressed in a later publication.

SCC Not a 'Stand-Alone' Tool

Although information derived from either a bulk tank SCC or DHI-SCC score is useful, it should not be a stand-alone diagnostic procedure for evaluating udder health. However, it is a good place to start when determining if subclinical mastitis is causing production and profit losses and when reviewing effectiveness of mastitis control practices. Major management changes should not be based solely on these analyses. Realistically, if either the bulk tank SCC or DHI-SCC score indicates a potential problem, then information from other procedures such as milk cultures (bulk tank and/or individual cow), parlor routine evaluations, milking machine evaluations and observations of management, housing, etc. must be included before specific conclusions and recommendations can be made for an individual herd.

Conclusions

Mastitis causes tremendous financial losses to dairy producers. The problem is often overlooked because the disease is subclinical yet the affect on production and performance is still profound. An elevated SCC (above 200,000 cells/ml) is a clear indicator that an animal has experienced an infection. Producers can use SCCs to gauge the level of subclinical infections within the herd and to estimate production and profit losses due to this hidden disease. Recognizing that subclinical infections are robbing profits is the first step of controlling the disease.

References

1. Eberhart, R.J., H.C. Gilmore, L.J. Hutchinson, & S.B. Spencer. 1979. Somatic cell counts in DHI samples. 18th NMC Annual Meeting Proceedings, Louisville, KY. p. 32.
2. Eberhart, R.J., L.J. Hutchinson, & S.B. Spencer. 1982. Relationships of bulk tank somatic cell counts to prevalence of intramammary infection and to indices of her production. J Food Prot 45:1125.
3. Fetrow, J. 2000. Mastitis: an economic consideration. Proc. 29th Annual Meeting of the National Mastitis Council, Atlanta, GA. NMC, Inc., Madison, WI. pp. 3-47.
4. Grade "A" Pasteurized Milk Ordinance, 2005 Revision. U.S. Department of Health & Human Services, Public Health Service, Food and Drug Administration.
5. Guidry, A.J., M.J. Paape & R.E. Pearson. 1975. Effect of estrus and exogenous estrogen on circulating neutrophils and milk somatic cell concentrations, neutrophil phagocytosis and occurrence of clinical mastitis in cows. Am J Vet Res 36:1555.
6. Harmon, R.J. 1994. Physiology of mastitis and factors affecting somatic cell counts. J Dairy Sci 77:2103.
7. Laevens, H.H., Y.H. Deluyker, L. Schukken, L. de Meulemeester, R. Vandermeersch, E. de Mulenaere & A. de Kruif. 1997. Influence of parity and stage of lactation on the somatic cell count in bacteriologically negative dairy cows. J Dairy Sci 80:3219.
8. Lefcourt, A.M., ed. 1991. Effects of electrical voltage/current on farm animals: how to detect and remedy problems. Agric. Handbook No. 696. USDA, Washington, D.C.
9. Oliver, S.P., F.N. Schrick, M.E. Hockett & H.H. Dowlen. 2000. Clinical and subclinical mastitis during early lactation impairs reproductive performance of dairy cows. Proc Regional Meeting of the National Mastitis Council, pp. 34-51.
10. Paape, M.J., A.J. Kral, C. Desjardins, W.D. Schultze & R.H. Miller. 1973. Failure of either corticosteroids or ACTH to increase the leukocyte concentration in milk. Am J Vet Res 34:353.
11. Raubertas, R.F. & G.E. Shook. 1982. Relationship between lactation measures of somatic cell concentration and milk yield. J Dairy Sci 65:419.
12. Ruegg, P.L. & D.J. Reinemann. 2002 Milk quality and mastitis tests. University of Wisconsin Extension Service.
13. Schultz, L.H. 1977. Somatic cells in milk – physiological aspects and relationship to amount and composition of milk. J Food Prot 40:125.
14. Sears, P.M. B.S. Smith, P.B. English, P.S. Herer & R.N. Gonzalez. 1990. Shedding pattern of *Staphylococcus aureus* from bovine intramammary infections. J Dairy Sci 73:2785.
15. Sheldrake, R.F., R.J.T. Hoare & G.D. McGregor. 1983. Lactation stage, parity and infection affecting somatic cells, electrical conductivity and serum albumin in milk. J Dairy Sci 66:542.
16. Smith, K.L., J.E. Hillerton & R.J. Harmon. 2001. Guidelines on normal and abnormal raw milk based on somatic cell counts and signs of clinical mastitis. NMC, Inc., Madison WI.
17. Wattiaux, M.A. 1999. Mastitis: The disease & its transmission. Dairy Essentials. The Babcock Institute. pp 89-92.
18. Wegner, T.N., J.D. Schuh, F.E. Nelson & G.H. Scott. 1976. Effect of stress on blood leukocyte & milk somatic cell counts in dairy cows. J Dairy Sci 59:949.