Dairy Pipeline

School of Animal Sciences
Volume 46, No. 3 ● April 2025

Differential Somatic Cell Count: A Potential Tool to Improve Mastitis Detection

Authored by Anna Cappellina, M.S. Student with Dr. Ben Corl, Associate Professor—Nutrition Physiology, School of Animal Sciences, Virginia Tech; bcorl@vt.edu

Data that aid in the early detection of mastitis and provide a tool for monitoring mastitis can guide management decisions and help producers identify areas for improvement. Mastitis remains one of the most economically relevant diseases of dairy cattle, especially subclinical mastitis, contributing to decreased milk production and poor milk quality. This directly translates to economic losses in the dairy industry. The most common measurement used to monitor udder health is somatic cell count (SCC). Differential somatic cell count (DSCC) examines the *composition* of somatic cells. Both SCC and DSCC can be measured at the bulk tank level as well as individual cow level.

Understanding SCC and DSCC

SCC represents the *number* of immune cells per milliliter (cells/mL) in milk. However, SCC does not identify individual cell populations in milk. In contrast, a differential somatic cell count (DSCC), provides a more comprehensive view of udder health status by classifying the milk cell populations by percent of the total count. These populations include types of white blood cells such as neutrophils (PMN), lymphocytes (LYM), and macrophages (MAC). When foreign organisms enter the cow's mammary system through the teat end, the immune system sounds an alarm and white blood cells rush to the area to fight the invaders, which could be mastitis-causing pathogens. Changes in the proportion of cell populations in milk correspond with infection status and inflammatory response of the mammary gland, providing extra clues that SCC alone does not capture. A cow with mastitis has a greater percentage of neutrophils and lymphocytes making up the somatic cells in milk as compared to healthy cows where it is predominantly macrophages. New research explores the idea that SCC and DSCC, in combination, may be useful for identifying mastitis.

Research Findings

DSCC augments SCC in identifying and monitoring mastitis status by evaluating the cell profiles (%) contributing to the overall SCC. Researchers in Switzerland and Denmark (Wall et al., 2018) aimed to examine and describe changes in DSCC and SCC before, during, and after mastitis. While investigating SCC and DSCC during induced mastitis under controlled conditions, researchers discovered that even when a cow had low SCC (<200,000 cells/mL), DSCC showed a shift in cell populations. A low DSCC value corresponded to a higher proportion of MAC, while a high DSCC value corresponded to a higher

proportion of PMN and LYM associated with infection. Researchers suggested a DSCC of 86%, meaning 86% PMN and LYM in milk somatic cells, might be used as a first indicator of infection. Five hours after the initiation of mastitis, DSCC values significantly increased in infected cows and remained elevated for two days post-infection.

A group of Canadian researchers (Schwarz et al., 2020a) aimed to evaluate DSCC as a detection method for mastitis caused by major pathogens such as *S. aureus, E. coli, S. uberis,* and *S. dysgalactiae*. Milk samples from 11 dairy farms were tested and cultured for pathogen presence over four months. Researchers reported an increased prevalence of clinical mastitis when DSCC was greater than 60% even when SCC was low (<200,000 cells/mL). The percent of PMN and LYM as well as SCC were significantly greater when cows had mastitis caused by major pathogens compared to cows with no infection or infection caused by a minor pathogen.

A European study (Schwarz et al., 2020b) aimed to investigate associations of production among cows in separate udder health groups based on test-day DSCC and SCC values. For the purpose of this study, udder health groups were divided into healthy, suspicious, mastitis, and chronic mastitis based on SCC and DSCC thresholds from another study. Cows in the suspicious group had a DSCC > 65% (indicating elevated proportions of PMN) compared to the healthy group having a DSCC < 65%. Despite cows grouped into the healthy and suspicious udder health groups both having an SCC<200,000 cells/mL, cows in the suspicious group produced significantly less milk than cows in the healthy group. These results could indicate that these cows are in the early stages of mastitis. In this way, using DSCC in combination with SCC can result in a greater ability to detect positive mastitis cases in the low SCC area compared to using SCC alone and potentially move cows from lower production to higher production following detection.

These studies corroborated their findings of elevated DSCC during mastitis even when SCC was low (<200,000 cells/mL). Future research to develop reference threshold values for mastitis status using DSCC could help farmers identify mastitis in the early stage of disease and reduce the negative effects of mastitis on the bottom line.

Conclusion

If DSCC can be incorporated into the already existing milk testing framework in the United States, it may help identify changes in milk cell populations before total cell number increases. Using DSCC in combination with SCC might help identify subclinical cows that are infected with mastitis despite having a low SCC. The distribution of cell populations in milk can provide useful insight into inflammatory response of the mammary gland and provide more timely insight into the udder health status of a herd. Early detection of mastitis leads to more effective control. Differential somatic cell count could be a tool to identify more mastitis cases and better understand the cow's immune response to various mastitis-causing pathogens.

Enhancing Herd Management with Protocols

Authored by David Winston, Extension Dairy Scientist—Youth, School of Animal Sciences, Virginia Tech; dwinston@vt.edu

Protocols, defined as sets of guidelines that instruct how certain processes should be done, are extremely valuable in dairy herd management. The reason for having protocols is to provide well-defined strategies to facilitate consistent day-to-day management and problem-solving. The larger the herd and the more people who are involved in a management area, the more important protocols become. Protocols are excellent for training new employees and retraining existing ones. They should be written and posted at the point of action. They should also be kept centrally in the office for reference and training purposes. Well-defined, consistently practiced protocols can improve herd management and provide context when analyzing herd performance.

Examples of milking cow protocols include proper milking procedures, cleaning milking equipment,

feed mixing and delivery, pen movements, and dry cow procedures. Protocols for calves and heifers include feeding, disbudding, removal of extra teats, weaning, pen movement and vaccinations. Health protocols could be developed for diseases frequently encountered on the farm. Examples are scours, pneumonia, retained placentas, metritis, mastitis, milk fever, ketosis, and foot rot. Additional protocols might encompass handling of downer cows and necropsies. Reproduction protocols include estrous synchronization, semen handling, artificial insemination, and pregnancy determination.

Protocols should be tailored for each dairy but can be based on existing protocols. The National Mastitis Council has a time-tested protocol for proper milking procedures. The Dairy Cattle Reproduction Council has developed protocols for estrous synchronization programs. A variety of animal care protocols are available from the National Dairy FARM Program.

A farm's protocols should be written using a team approach. The team should include the department manager and other workers in the department. The herdsperson, veterinarian, nutritionist, and other consultants may also be part of the team depending on the nature of the protocol.

Farm data can be used to evaluate the effectiveness of protocols. Useful data may come from milk plant laboratory tests, DHIA records and related herd management programs, parlor management software, and vet checks. Of course, the data needed will vary depending on the protocol being evaluated. Consider the following examples. Suggested goals are shown for each. Goals for the herd for each parameter should be based on industry benchmarks but tempered with realistic expectations.

Table 1. Protocol examples and suggested farm data to analyze.

Protocol example	Data to Analyze (Suggested goal)
Proper milking procedures	▪ Somatic cell count (<200,000 cell/ml) ▪ Standard plate count (<5,000 cfu/ml) ▪ Monthly clinical cases of mastitis per 100 cows (<3) ▪ Bimodal milk flow rate (<10%)
Cleaning milking equipment	▪ Standard plate count (<5,000 cfu/ml) ▪ Preliminary incubation count (<10,000 cfu/ml)
Diseases*	▪ Incidence ▪ Percent cures ▪ Percent chronic cases ▪ Percent mortality ▪ Percent sold because of the disease
Artificial insemination	▪ First service conception rate (>45%) ▪ Overall conception rate (>40%)
Estrous synchronization	▪ Pregnancy rate (>24%) ▪ Conception rate (>40%) ▪ Average days to first service (Voluntary waiting period + 10 days) ▪ Percent of first services within targeting range (>95%)

***Note**: Analyze each disease prevention and treatment protocol separately. Goals will be disease dependent.*

If a herd is not getting the desired results, it may be time to reevaluate the associated protocol. Are there steps missing? Are the steps clear? Has there been protocol drift, meaning that gradual changes or bad habits have crept into the practice over time? Are all workers consistently following the protocol?

One way to prevent protocol drift is to observe workers periodically. Periodic retraining is also a good way to reduce protocol drift. During initial training and subsequent retraining, it can be helpful to explain the why of each step. If workers understand the importance of a step, they may be less likely to resist carrying out a task.

Protocols are living documents that should be evaluated and updated routinely. Keys to success are making sure that protocols are well-written, easy to understand, and posted at the point of action. New workers should be trained using protocols. Retraining should be routinely scheduled to avoid protocol drift. Finally, protocols should be translated for non-native English speakers.

Upcoming Events

April 2 & 3, 2025
Dairy Management Institute
Rocky Mount – April 2
Dayton – April 3

April 9, 2025
Agribusiness Producer meeting
Harrisonburg, VA

April 12, 2025
Little All-American
Blacksburg, VA

April 22, 2025
Dairy Skillathon Contest
Rockingham Fairgrounds

May 10, 2025
Dairy Foods workshop w/ Dr. Bob Horton
10:00 – 12:00: Orange, VA
2:00 – 4:00: Harrisonburg, VA

May 2025
Youth Dairy Quiz Bowl reschedule date TBA

May 13-14, 2025
VFGC Basic Grazing School
Madison, VA

If you are a person with a disability and require any auxiliary aids, services, or other accommodations for any Extension event, please discuss your accommodation needs with the Extension staff at your local Extension office at least 1 week prior to the event.

Additional Notes:

▪ The dairy extension group is working with VDH to assist in distributing PPE to dairy farms. Request a kit online at https://shorturl.at/ethov or contact your local extension agent. Requests will be filled as supplies allow.

▪ Your input could guide future programming! Please complete the short survey at https://tinyurl.com/dairy-extension.

For more information on Dairy Extension or to learn more about our current programs, visit us at VTDairy—Home of the Dairy Extension Program online at www.sas.vt.edu/extension/vtdairy.html

Dr. Christina Petersson-Wolfe,
Dairy Extension Coordinator &
Extension Dairy Scientist,
Milk Quality & Milking Management

Visit Virginia Cooperative Extension: ext.vt.edu

2025 VCE-176NP