



Mini Review Article

Effect of Somatic Cells on Milk Quality and Human Health

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Abstract | Somatic cells (SCs) are significant to both susceptibility and resistance of dairy cows to intramammary infections. It is used as an authentic tool for dairy farm operations in order to improve the milk quality. Broadly dimension of SCs of milk well represents the comfort and welfare of dairy cows and helps deciding efficient mastitis control strategies. Again, the safety margin evaluated though SCs ensures safe and healthy milk at consumer level devoid of bacterial presence in milk. This review highlights a brief overview of the importance and demand of estimating somatic cell count (SCC) and its effects on milk quality and human health.

Editor | Muhammad Abubakar, National Veterinary Laboratories, Park Road, Islamabad, Pakistan.

Received | November 21, 2020; **Accepted** | January 08, 2021; **Published** | February 22, 2021

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Citation | Hossain, D., S. Singha, C.M.V. Thof, S. Gough and AHMM. Uddin. 2021. Effect of somatic cells on milk quality and human health. *Veterinary Sciences: Research and Reviews*, 7(1): 31-34.

DOI | <http://dx.doi.org/10.17582/journal.vsr/2021/7.1.31.34>

Keywords | Somatic cells, Somatic cells, Count milk, Milk quality, Human health

Introduction

Somatic cell count (SCC) is a widely used technique for the assessment of subclinical mastitis at the individual quarter, cow-level, and herd-level (Schukken *et al.*, 2003; Petzer *et al.*, 2017; Wollowski *et al.*, 2019). It is also used to measure farm level improvements after the adoption of mastitis control strategies. The objective of this review is to give a brief overview of somatic cell count and its effects on milk quality and human health.

Somatic cells and its function

Somatic cells (SCs) are found in milk. They are comprised of two broad cell categories: milk secreting

glandular epithelial cells and while blood cells (leucocytes) (Sharma *et al.*, 2011; Alhussien and Dang, 2018). Leucocytes make up the majority of SC (75%) and include neutrophils, macrophages, and lymphocytes. These cells provide a rapid response to udder infection. Epithelial cells (25% of SC) are frequently regenerated with older cells being shed into the milk (Boutinaud and Jammes, 2002; Albenzio *et al.*, 2019). A very small number of erythrocytes can be found in milk, ranging from 0 to 1.5×10^6 cells/ml (Sharma *et al.*, 2011).

Each somatic cell has its own individual function, but all contribute to protecting the udder from infection. The mammary epithelial cells activate neutrophils

and inflammatory mediators after the release of bacterial toxins and enzymes within the teat canal results edema, vasodilatation and increased vascular permeability (Nonnecke and Harp, 1986; Goldstein *et al.*, 1992). Neutrophils defend against infection by engulfing and destroying bacteria that gain entry to the teat canal. Monocytes turn into macrophages when activated, and play a similar role to neutrophils by phagocytizing bacterial cells. They also release proteases and reactive oxygen molecules to damage nearby bacteria (Park *et al.*, 1992). Lymphocytes provide a more refined immune response than neutrophils or monocytes. Through membrane receptors lymphocytes identify and remember the antigenic structures of bacterial proteins so that the body can more rapidly mount an immune response in the future. SC composition varies depending on the type of mammary secretion (colostrums, milk, or dry gland secretion). For example, leukocytes are present in a much higher concentration in colostrums when compared to milk and dry gland secretion (Sharma *et al.*, 2011).

Effect SCs on milk quality and human health

A higher SCC in milk is attributable to inflammation in the udder, typically due to a bacterial infection (Wollowski *et al.*, 2019; Stocco *et al.*, 2020). A high SCC alters milk quality and composition, making it unfit for safe human consumption (Sharma *et al.*, 2011; Dos Reis *et al.*, 2013; Kull *et al.*, 2019; Stocco *et al.*, 2020). Some reviews showed that a BMSCC >500,000 cells/mL was associated with higher proteolytic activity, whey protein (serum albumin and immunoglobulin) and lower the concentrations of fat and protein which reduces the cheese quality (Skeie, 2010; Moradi *et al.*, 2020). Accurate SC measurements are not available in many developing countries, so SCC data and guidelines are often insufficient. In general, a bulk milk somatic cell count (BMSCC) greater than 300,000 cells/mL of milk is considered a clear indication of herd infection and warrants further identification of individual lactating animals (Constable *et al.*, 2017). However, the reported threshold level of SC varies widely between countries. The European Union, New Zealand, Switzerland, Australia and Canada have all ruled that a BMSCC exceeding 400,000 cells/mL is not allowed for consumption. In contrast, the United States pasteurized milk ordinance (2015) considered up to 750,000 cells/mL acceptable (Alhussien and Dang, 2018; Kelly *et al.*, 2018).

A high milk SCC is a human health concern, a fact which has recently gained attention in national mastitis council (NMC) discussions. Many causative pathogens of human diseases (i.e. *E. coli*, *Staphylococcus aureus*, *Streptococcus agalactiae*) also cause of intra-mammary infections in cattle and high milk SCC, making the milk hazardous for human consumption (Petzer *et al.*, 2017; Ewida and Al-Hosary, 2020; Yun *et al.*, 2020). While pasteurization is capable of killing the majority of pathogenic bacteria found in milk, some bacteria, such as *Mycobacterium avium*, *Mycobacterium paratuberculosis*, *Listeria monocytogenes*, *Bacillus* spp. and *Clostridium* spp. can still survive (Grant *et al.*, 1996; Binderova and Rysanek, 1999; Gunasekera *et al.*, 2002; NMC, 2016). Pasteurization also cannot neutralize the toxins already released by the pathogenic bacteria in milk (NMC, 2016). To relate this information mentioned, level of SCC is a good indicator of farm hygiene and unpasteurized milk and milk products can transmit even wider range of pathogenic bacteria for human health risk.

Emphasis on milk SCC measurements can greatly improve milk quality and farm level hygiene (Ruegg and Pantoja, 2013; Ndahetuye *et al.*, 2020). An increased SCC reflects an intramammary infection, so monitoring SCC provides farms with an opportunity to check for disease progression/improvement. A monthly assessment of SCC in a herd can also be indicative of the overall farm management and validate changes in management practices. Overall, SCC is a very efficient and convenient technique to incorporate in a mastitis control program to ensure that milk meets the safety standard for human consumption.

Novelty Statement

Somatic cell count is a crucial indicator for estimating mammary health and milk quality. Our review paper independently focuses on the new concept based relationship of human health with SCC.

Author's Contribution

All authors contributed to write and read the manuscript and agree to be responsible for any aspect of the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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