Factors affecting Somatic Cell Count in Milk

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ABSTRACT

Mastitis, an inflammation of mammary gland, causes huge economic losses in dairy industry. Mastitis is indicated by the abrupt increment of somatic cell counts (SCC) in the milk. Somatic cells are the immune response cells acting against any pathogens invading mammary tissues consisting primarily the macrophages, lymphocytes and polymorphonuclear cells. The normal SCC level in milk was considered to be 200,000 cells per ml in milk and SCC count above this threshold indicate intra-mammary infections. Apart from infections, different other animal and management related conditions affect the level of somatic cells. Some of the factors contributing the fluctuations of milk somatic cells were stress, milking frequency, age, breed, stage of lactations, parity, shed management conditions and body condition scores.

Keywords: *Infections, Mastitis, Somatic Cells.*

INTRODCUTION

Mastitis is commonly known as the inflammation of mammary tissues with significant changes in udder parenchyma caused due to the alteration in the interaction among host, pathogen and environmental factors (Ali et al., 2008). The major contagious pathogens that causes mastitis are Staphylococcus aureus *and* Streptococcus agalactiae while environmental pathogens includes Streptococcus uberis, Streptococcus dysgalactiae *and* Escherichia coli (Waller et al., 2009). Among these pathogens, Staphylococcus aureus was the most prevalent (Barkema et al., 2006). Mastitis has the potential to cause huge economic losses due to reduced milk production, veterinary cost, premature culling, increased labour, discarded milk and decreased milk quality (Fagiolo et al., 2005). The disease occurred in two forms, clinical and subclinical, classified on basis of clinical signs and symptoms (Dhakal, 2006). Clinical mastitis is symptomatic and characterized by fever, swollen and painful quarters, dehydration, remarkable change in milk yields and composition alterations while the sub-clinical mastitis is asymptomatic and is more hazardous as farmers are not aware of its development (Singh et al., 2018). The economic burden of mastitis in Nepal was estimated to be 63 USD/buffalo/lactation with additional costs for veterinary services, extra labour, and medicines (Ng et al., 2010). Similarly, the loss due to mammary gland infection in United States was recorded approximately 2 billion USD and similar trend was seen in European dairy industries (Donovan et al., 2005). The total annual loss of 35 billion USD worldwide was estimated only due to mastitis (Raza et al., 2011). The quality and hygiene of milk could be assured through the mastitis control strategies implemented in the farm that is possible through the regular monitoring of somatic cell counts (SCC), an indicator for udder health (Jadhav et al., 2016).

Somatic Cell Counts

The defense cells released against any intra-mammary infections (IMI) that have capacity to repair damaged cells in udder are somatic cells (Flere et al., 2016). Somatic cells are the immune response cells, part of natural defense and golden standard to evaluate IMI (Hamann, 2002). The somatic cells comprised of pathogen warning signals, epithelial secretions and leucocytes where macrophages (60%), lymphocytes (30%) and polymorphonuclear cells (10%) are present (Alhussien & Dang, 2018; Brahma et al., 2017). The leucocytes in blood stream gets massively influxed in milk when resident somatic cells activated due to IMI and showed the increment of SCC when measured as a regular monitoring (Schukken et al., 2003).

The overall milk quality and its suitability for further processing is determined by the monitoring of milk SCC and if above threshold level of 200,000 cells/ml is recorded, discarding of milk is recommended (Bytyqi et al., 2010; Dhakal, 2006). The main reason of reduced quality of milk-based products with higher SCC is because of lipolytic and proteolytic enzymes in somatic cells degrading quality of milk fat and proteins (Talukder & Ahmed, 2017). The legal limit of SCC varies in different countries for example 300,000 cells/ml in China; 400,000 cells/ml in Australia and 500,000 cells/ml in Brazil (Alhussien & Dang, 2018) whereas a researcher suggested the normal level of SCC to be up to 200,000 cells/ml in milk (Siatka et al., 2019).

The variation in normal level of SCC differs by species as well. The normal level of milk SCC was found to be 200,000 cells/ml in buffaloes (Dhakal, 2006); 1,000,000 cells/ml in goat and 750,000 cells/ml in sheep in US (Paape et al., 2001). The SCC is estimated by utilizing several methods such as Newman-Lampert staining technique (Dhakal, 2006), flow cytometry (Li et al., 2014) and electrical cell counters with fluorescent dye (Alhussien & Dang, 2018). The implementation of udder health programs in farms and estimating SCC will help to prevent new IMI (Schukken et al., 2003). The dry cow management therapy, adequate vitamins and minerals in feed/diet, using vaccines against pathogens, supplementing antioxidants, post milking dipping and shed hygiene are common preventive measures applied to control of IMI and SCC elevation (Paape et al., 2001; Raza et al., 2011; Skrzypek et al., 2004).

Factors affecting SCC

The release of SCC in milk is a natural process but its increasing number is considered the indication for IMI or mastitis (Pyorala, 2003). Major factors affecting the release of SCC are discussed below.

a. Stress

In general, stress has negative influence in the SCC level. Dhakal (2006) found positive correlation between temperature and rainfall and outbreaks of mastitis. Confinement in harsh condition with higher humidity and ambient temperature increases susceptibility to mammary pathogens and leads to increase in SCC. Likewise, injections of ACTH contribute to significant increase in SCC in milk. Usually, stress leads to 10-20% decline in milk in dairy animals (Brahma et al., 2017). During stress, free radicals are produced that are unstable and react quickly causing injury in the tissues (Sharma et al., 2011). Vaccination and estrogen administration for estrus in dairy cows resulted in significant increase in SCC independent of the change in milk yield (Haenlein, 2002).

Transportation and storage methods in different preservatives such as potassium dichromate, azidiol and bronopol demonstrate to affect the SCC by increasing the cells per ml (Sharma et al., 2011).

b. Milking Systems and frequency

Milk removal from mammary glands can be done by calf, hand or machine. Nowadays, with an increase in milk yielding capacity of animals, milking machines have become integral part of larger dairy farms. If proper hygiene of the machine is not maintained, there is a increased risk of transferring infectious agents and may increase cases of sub-clinical mastitis (Brahma et al., 2017). Machine milking requires proper cleaning, functioning and maintenance for acquiring quality milk in terms of SCC (Alhussien & Dang, 2018). Even shifting the milking frequency from twice a day to thrice will decrease bulk milk SCC in cows of higher SCC but if milking intervals is shorter than 4 hours or less, it will raise the milk SCC (Pyorala, 2003; Sharif & Muhammad, 2008). SCC level is higher during stripping and lower before milking and after 4 hours of milking. Day to day variations are also observed up to 30% without any relevant changes in conditions (Sharma et al., 2011). Skrzypek et al. (2004) had well illustrated the association of lower SCC due to the manual massaging of udder before milking that may happen because of greater stimulus for oxytocin release.

c. Breed

Variations have been observed in SCC levels in different breeds and species. Higher milk producing cattle like Brown Swiss and Holstein shows cell counts ranging 300,000-400,000 per ml (Sharma et al., 2011). Udder and teat morphology also get affected due to breed type where well attached udder reveal lower SCC than pendulous ones but shorter teats with greater diameter have higher milk SCC (Alhussien & Dang, 2018). The prevalence of clinical mastitis is highly affected by the breed type and is present in decreasing order of Karan Swiss, Karan Fries, Sahiwal, Tharparker and Murrah buffaloes. This indicates buffaloes possess superiority in mastitis resistance. The higher resistivity may be due to tightly closed teat orifice and circular muscles thick squamous keratinized epithelium of streak canals (Jingar et al., 2014). However, the teat-end lesions have no significance unless there is a milk leakage. On quarter SCC, reduction in teat-end to floor distance has positive correlation to IMI (Bhutto et al., 2010). Significant difference in SCC level was not found by breed of cattle as compared to goats breeds (Paape et al., 2007). The study conducted in Slovania showed no considerable differences in SCC between the breeds, either crossbreed or pure lines among cattle (Flere et al., 2016).

d. Age and Parity

Advancing age will influence towards increment of the SCC level due to higher possibility of exposure to pathogenic agents in cows (Flere et al., 2016; Sharma et al., 2011). The incidence of clinical mastitis may also increase with the increased parity in both the cattle and buffaloes (Jingar et al., 2014). The increased prevalence of mastitis was observed in older buffaloes where age group 9-11 years was found at higher risk compared to 3-5 and 6-8 years old buffaloes (Ottalwar et al., 2018). It might be due to the breakdown of streak canal barriers and udder tissues.

The mammary gland immunity of primiparous cows is higher as compared to multiparous throughout the lactation period. Cattle more than 4th parity shows increased diurnal variations in SCC levels (Alhussien & Dang, 2018). Multiple births and short duration of lactation is also associated with the elevation of milk SCC (Paape et al., 2007).

e. Shed Managements

Farm practices such as post milking feeding, teat dipping, flooring and milking procedures reveal lower SCC whereas unhygienic condition of farm and utensils increases the cells count (Savić et al., 2017). Proper interventions for good managerial practices in shed can have positive effects to lower the SCC count (Bytyqi et al., 2010). Somatic cells were found lowest (129,500 cells/ml) in clean and comfortable environment while it was found to be much higher (1,013,400 cells/ml) in moist and dirty environment (Dhakal, 2006).

SCC levels are lower during winter and highest in the summer season as the number of environmental pathogens increases during warmer temperature (Sharma et al., 2011). In countries where non-seasonal calving pattern exists and more influenced by temperatures and humidity, the possibility of IMI is higher and SCC levels are elevated (Alhussien & Dang, 2018). The probable reason for increased IMI and SCC in summer besides warmer temperature and higher humidity may be due to irritation and spreading of pathogens in udders by flies (Skrzypek et al., 2004).

f. Stages of lactation

Stages of lactation may be classified as early, mid and late lactation. There is a positive correlation between SCC and stages of lactation whereby scores is higher in early phase, gradually decrease in mid and then again increase in late stage (Alhussien & Dang, 2018; Pyorala, 2003). The high yielding cow experiences negative energy balance during early stage of lactation due to which non-esterified fatty acids (NEFA) and β-hydroxy butyric acids (BHB) are increased which impairs phagocytic activity of mammary gland thereby leading to increased susceptibility to mastitis (Ottalwar et al., 2018). Whether the cow is infected or not, late lactation phases have shown elevated SCC which is linked with preparation for calving and enhancing of mammary defense mechanisms (Sharma et al., 2011). The uninfected quarter demonstrate SCC of 83,000 per ml in 35 days post-partum but raised to 160,000 by day 285 (Sharif & Muhammad, 2008).

g. Body condition score (BCS) and body weight

BCS is a method of evaluating fatness or thinness of dairy animals referring to the well-defined scale. Lower SCC is associated with increased BCS and weight loss during early stage of lactation (Alhussien & Dang, 2018). Similarly, BCS and amount of body weight change from 60 to 120 days in milk is significantly associated with the higher SCC across lactation but the probability of clinical mastitis cannot be justified (Berry et al., 2007). BCS, practical indicator of feeding adequacy is highly associated with the impairment of udder health where even slight deviations will lead to significant effects (Skrzypek et al., 2004).

CONCLUSION

Udder health is one of the major issues in modern dairy industry for production of quality milk and milk products. The milk somatic cell counts can be an indicator for monitoring the dairy udder health for easy and early identification of intra-mammary infections. Factors affecting the fluctuations of SCC need to be considered and necessary actions should be adopted to maintain milk SCC level.

Conflict of Interest

Authors declare that there is no conflict of interest.

Funding Source
None.

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