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Relationship Among Intramammary Infection and Raw Milk Parameters in Jersey Crossbred Cows under Hot-Humid Climate

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ABSTRACT

The raw milk quality has increasing importance for producer and consumer as it is directly related to processing, production and price. The aim of present study was to determine the relationship among intramammary infection (IMI) and raw milk parameters in Jersey crossbred cows. Total 24 lactating Jersey crossbred cows were randomly selected and representative animal wise morning milk samples were collected in monthly interval for four month. The level of somatic cell count (SCC) and milk parameters (fat (%), solid non-fat (%) and pH) was estimated from the collected sample. Test day milk yield for individual animals was also recorded and then the data obtained were statistically analyzed. A significant ($P<0.01$) negative correlation of Log_{10}SCC with test day milk yield, fat and SNF percentage was found, while, milk pH was highly positive correlated with Log_{10}SCC in milk. The mean±SE values of milk yield, fat and SNF were significantly ($P<0.01$) lower in subclinical infected group except for SCC and pH, which were higher in subclinical infected group. It can be concluded that IMI and higher SCC adversely affect the milk production and raw milk quality parameters and these parameters can be used as useful indicator as complimentary to SCC to monitor udder health and for early diagnosis of subclinical mastitis at dairy farm.

Keywords: Intramammary Infection, Jersey crossbred, Raw milk Parameter, Relationship

Milk characteristics in terms of milk composition and milk yield are important factors for the dairy farmer, dairy industry and consumer. Mastitis is a serious disease of dairy animals causing great economic losses due to a reduction in milk yield as well as lowering its nutritive value (Patil *et al*., 2015). Therefore, the positive advancement of milk intake by consumers should be encouraged by the high quality of raw milk in dairy practice (Tancin, 2013). Mastitis is an inflammation of the mammary gland and udder tissue which can occur in clinical and Subclinical forms (Gonzales *et al.,* 2008) and is characterized by physical, chemical, and bacteriological changes in the milk and pathological changes in the glandular tissue of the udder (Sharma *et al*., 2007). This disease negatively affects the physical-chemical characteristics, composition, and yield of milk (Cunha *et al*., 2008) and thus, it is essential to monitor intramammary infections (IMI) in dairy cows in order to maintain milk quality and herd health.

However, as IMI are usually followed by an influx of leucocytes into the milk, an increase in its somatic cell count (SCC) has been used widely as indicating mastitis (Hanan *et al*., 2015). SCC is a useful predictor of intramammary infection and, therefore, an important component of milk in assessment of aspects of quality, hygiene, and mastitis control (Patil *et al*., 2015). Individual somatic cell count is extensively available to dairy farmers and is also less expensive than microbiological culture (Schukken *et al*., 2003). There is considerable literature available suggesting the changes occur in milk composition and milk yield due to mastitis and increased SCC level in milk of different breeds of cows (Ballou *et al*., 1995; Kumaresan, 2013; Malek dos Reis *et al*., 2013) under different climatic conditions, but there is relatively limited information

available in the literature on relationship between IMI, SCC and raw milk parameters in Jersey crossbred cows particularly under hot-humid climate.

Therefore, the present study was aimed to determine the relationship among intramammary infection and raw milk parameter in Jersey crossbred cows under hot-humid climate.

MATERIALS AND METHODS

Animals and location

To conduct the present study, twenty four lactating Jersey crossbred cows were randomly selected from the lactating herd of Cattle yard of Eastern Regional Station, ICAR-National Dairy Research Institute located in Kalyani city of West Bengal. The altitude of Kalyani city is 9.75 meter above mean sea level, latitude and longitude position being 22°56′30″N and 88°32′04″E, respectively and the weather of Kalyani is hot and humid.

Collection of milk samples

Representative animal wise morning milk samples were collected from all experimental lactating cows in monthly interval for four months of duration. For the analysis of milk fat and solid non-fat (SNF) along with SCC and milk pH, about 100 ml of pooled milk samples from all individual cows were collected aseptically and separately in the clean and sterilized sampling bottles. The collected samples were brought to the laboratory immediately for further analysis. Test day milk yield for individual animals was also recorded.

Detection of IMI and classification of healthy and subclinical infected samples

Intramammary infection was detected using microscopic method of somatic cell count (SCC). The dried milk smears stained with modified Newman's Lampert stain were examined under the oil immersion lens (100X) of the microscope. Thirty different fields per smear were observed and average number of cells per field was then multiplied by the microscopic factor of the microscope i.e. 240807 to obtain the number of cells per ml of the milk. Milk samples were classified into healthy or subclinical infected using threshold level of SCC as 2,00,000 /ml of milk. The samples having SCC < 2,00,000 /ml of milk were considered as healthy while, samples having SCC ≥ 2,00,000 /ml of milk were classified as subclinical infected samples.

Table 1. Correlation coefficients of Log_{10}SCC with test day milk yield (TDMY), fat (%), SNF (%) and pH

Traits	Correlation coefficient
Log_{10}SCC: test day milk yield	-0.488**
Log_{10}SCC:fat%	-0.337**
Log_{10}SCC:SNF%	-0.563**
Log_{10}SCC:pH	0.793**

**Correlation is significant at the 0.01 level (2-tailed)

Table 2. Mean±SE of Log_{10}SCC, test day milk yield (TDMY), fat%, SNF% and pH in Healthy and subclinical mastitis (SCM) infected group

Parameters	Healthy	SCM infected	Overall Mean
Log_{10}SCC	4.911±0.042^{A}	6.021±0.070^{B}	5.489±0.070
TDMY	8.413±0.477^{A}	5.570±0.466^{B}	6.932±0.362
Fat %	4.704±0.052^{A}	4.464±0.043^{B}	4.579±0.035
SNF%	8.898±0.032^{A}	8.628±0.016^{B}	8.757±0.022
pH	6.634±0.009^{A}	6.837±0.020^{B}	6.740±0.015

Mean showing different superscripts in upper case letters in respective categories in a row differ significantly (P<0.01)

Estimation of milk parameters

Among the milk parameters, milk fat, solid non-fat (SNF) and milk pH were estimated for individual samples. Individual milk samples pooled for all four quarters from the entire animal were used for estimation of fat% in milk by adapting Gerber's butyrometric method and milk SNF% were determined by lactometer method using the ISI formula. The pH of milk samples were determined by an electronically operated digital pH meter with glass electrode.

Statistical analysis

The SCC values were transformed into log scale to minimize the heterogeneity of variance and the data collected in this study were analysed by using SAS software package, version 9.3 (SAS Institute Inc., 2011).

RESULTS AND DISCUSSION

Correlation coefficients of Log_{10}SCC with different milk characteristics (test day milk yield (TDMY), fat (%), SNF (%) and pH) have been presented in table-1 and their mean±SE in healthy and sub clinically infected cows has been shown in table-2.

In the present study, test day milk yield (TDMY) was found to be significantly (P<0.01) negatively correlated (-0.488) with the SCC level in milk and mean±SE of TDMY of healthy animal (8.413 ± 0.477 kg) was significantly (P<0.01) higher than that of infected group (5.570 ± 0.466 kg). Several previous studies have been shown that increased SCC is associated with reduction in milk yield (Jia-zhong *et al.,* 2010; Guo *et al*., 2010; Kumaresan, 2013; Cinar *et al*., 2015), which are in consistent with present study. The decrease in milk yield might be due to physical damage to the epithelial cells of the affected mammary gland, and a consequent reduction in the synthetic and secretory capacity of the gland. Any retardation of the capacity of the mammary gland to synthesise and secrete lactose is of particular importance in this regard, given the key role of lactose as the osmotic regulator of milk volume (Auldist *et al*., 1998).

The results of the present study indicate that fat percentage tended to decrease with increase in somatic cell count in milk as we found significantly (P<0.01) negative correlation between fat percent in milk and Log_{10}SCC with correlation coefficient of -0.337. The mean±SE fat percent was significantly (P<0.01) lower in infected animals (4.464 ± 0.043) as compared to healthy group (4.704 ± 0.052). Other researcher have also been confirmed the similar relationship between fat content and SCC (Tahawy *et al*., 2010; Guo *et al*., 2010; Ghasemi *et al*., 2013). In contrast to present study, several researchers (Ouedraogo *et al*., 2008; Malek dos Reis *et al*., 2013; Kumaresan, 2013; Cinar *et al*., 2015) reported positive increase in fat content with increase in SCC level in milk. Gargouri *et al*. (2008) suggested that inflammatory cells, especially polymorph nuclear (PMN) cells could be responsible for sufficient lipolysis of milk fat globules.

The solid non-fat (SNF) content in milk was also found to be significantly (P<0.01) negatively correlated with the Log_{10}SCC with correlation coefficient of -0.563.The mean±SE SNF percent was 8.628 ± 0.016 and 8.898 ± 0.032, respectively for infected and healthy group. The negative correlation between SNF and SCC is well documented by many authors (Tahawy *et al*., 2010; Kumaresan, 2013; Malek dos Reis *et al*., 2013; Şahin and Kaşıkcı, 2014). A significantly (p<0.05) lower SNF in milk from cows infected with sub clinical mastitis as compared with milk from uninfected cows has been reported by Hassan (2013), decrease in SNF in infected cow's milk depend on the destroyed that occur by invasion of pathogens to the mammary tissue cause decrease in synthetic activity of mammary gland (BenChedly *et al*., 2009).

The findings of present study showed highly significant (P<0.01) positive correlation (r = 0.793) between SCC and milk pH and pH tended to increase with increase in SCC. The mean pH value for healthy group was lesser (6.634±0.009) as compared to subclinical infected group (6.837±0.020), which is in agreement with the results of previous reports (Batavani *et al*., 2007; Hassan, 2013), whereas, negative relationship between SCC and milk pH has been reported by Atasever *et al.* (2010). These changes might be linked to the increase permeability of the mammary epithelium cell lead to the transfer of components from blood to milk such as citrates and bicarbonates that cause elevated pH levels (Harmon, 1994).

CONCLUSION

This investigation showed that the raw milk parameters are adversely affected by intramammary infection resulting in negative changes in milk yield, fat (%) and SNF (%) whereas, SCC and milk pH increased due to IMI. Thus, the marked changes in these raw milk parameters like milk yield, fat and SNF could be used as useful indicator of udder health condition as complimentary to SCC, which can be used along with pH test as direct index of intramammary infection and for early diagnosis of subclinical mastitis at dairy farm.

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