Himachal Journal of Agricultural Research 46 (1): 95-99 (2020)

Subclinical mastitis and its effect on milk components in crossbred cows

Pardeep Sharma*, Kanika Bhardwaj, D.R. Wadhwa and Shivani Katoch
Department of Veterinary Medicine
Dr. G.C. Negi College of Veterinary and Animal Sciences
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.

*Corresponding author: docpradeepsharma@gmail.com
Manuscript received:21.05.2020; Accepted: 01.06.2020

Abstract

The study was conducted in the organized dairy farm for sub clinical mastitis and its impact on chemical composition of milk. California Mastitis Test, Electrical conductivity and Somatic Cell Count were used for detection of subclinical mastitis and Ultrasonic Ekomilk Analyzer was used to analyze chemical composition of milk. A total of 160 quarter milk samples collected from 40 Jersey crossbred cows were examined and overall prevalence of 40% and 17.48% was observed for subclinical mastitis at cow and quarter level, respectively. The study showed that chemical components of milk samples such as Fat (3.37 ± 0.33 %), Solid Not Fat (7.82 ± 0.20 %), Total solids (11.19 ± 0.40 %), Protein (3.15 ± 0.06%) and Lactose (4.67 ± 0.06 %) contents of the subclinical mastitis milk was less than the normal milk. Electrical conductivity (5.87 ± 0.21 mS/cm) and Somatic cell score (SCS = log2 (SCC/100,000) + 3) (3.34 ± 0.01) of affected milk was significantly higher than normal milk. It was observed that the increase in SCS negatively influenced the composition of milk in dairy cows. Further, it was observed that incidence of subclinical mastitis increased with the age and lactation number of the animal.

Key words: Subclinical mastitis, somatic cell counting, electrical conductivity, milk components.

India is the world's largest milk producing nation, with around 70 million producers. In 2018-19, India has produced 187.70 million tonnes of milk. Worldwide demand for milk and its products has increased dramatically in recent years and through a combination of population growth and improved economic wealth in the developing world will certainly continue to increase. However, diseases like mastitis not only decreases the current production of the animal but also impacts the lifetime milk quality and milk production and hence pose difficulty in meeting per capita demand of milk (Payne and Wilson 1999). Mastitis is the inflammation of the mammary glands and one of the costly production diseases affecting dairy cattle industry. Clinical mastitis with visible signs of inflammation in udder and quarters is easy to diagnose but in subclinical mastitis no visible signs appear. A quarter was considered subclinically affected when it became positive by California Mastitis Test (CMT).

Mastitis is causing great financial losses due to decreased milk production, poor quality milk, increased cost of veterinary services, shortened productive life and replacement cost of dairy animals. Poor quality milk because of chemical compositional changes in fat, solid not fat, total solids, protein and lactose content of the milk are well marked and can be used as a basic indicator for diagnosis of subclinical mastitis. These changes not only alter nutritional quality of milk but also preservation quality. So, investigation on subclinical mastitis (SCM) affected milk is important.

Various diagnostic tests were used for the detection of subclinical mastitis are California mastitis test (CMT), Electrical conductivity and Somatic cell count (SCC) of milk. CMT is a simple, inexpensive, rapid and sensitive test and is frequently used for primary screening of mastitis. Quantifying the electrical conductivity for diagnosing mastitis is based upon the ionic alterations (rise in sodium and chloride ion concentration) in mastitic milk. Milk Somatic cell count is a useful predictor of subclinical udder infection; therefore, it is considered as an important component for assessing the quality and milk hygiene (Sharma *et al*., 2011).

To the best of authors knowledge limited studies have been done on detection of subclinical mastitis at dairy farms of Himachal Pradesh (Geetanjali *et al*., 2014). However, subclinical mastitis impact on chemical composition of the milk and correlation with milk somatic cell count has not been studied in detail in dairy farms. Keeping in view these facts, the present study was conducted for prevalence of subclinical mastitis and to assess its impact on composition and cow milk quality was undertaken in organized crossbred dairy farm of CSK HPKV Palampur.

Materials and Methods

Study design, sample collection and subclinical mastitis examination

The study was conducted on 40 lactating crossbred dairy cows (in different parities and were of mixed age groups) in organized dairy farm of CSK HPKV, Palampur. All the animals were housed in well ventilated sheds of farm and were fed with concentrate feed and generous allowance of mixture of green fodder, dry grass and wheat straw. All the cows had *ad libitum* access to the clean drinking water.

Full hand milking was done twice a day at regular intervals among all the animals. Milk samples for the study were collected from individual quarter of each animal aseptically during evening time. Initial few milk streaks were discarded and the next 100 ml, freshly drawn milk from each quarter was collected separately in clean well sterilized and previously dried sample bottle. A cow which had one or more positive quarters by California mastitis test was considered positive for subclinical mastitis. There after electrical conductivity and somatic cell count estimation was also done. Before withdrawing portion for chemical analysis, milk samples were brought to the room temperature and mixed thoroughly into a clean receptacle to get homogenous samples.

The data regarding subclinical mastitis of each individual quarter were recorded on a data sheet. At the same time information regarding age, type of animal, stage of lactation etc. of each animal was recorded to see the effect of these factors on the incidence of subclinical mastitis. Electrical conductivity was measured at room temperature using Electronics India 611 Digital Conductivity Meter. Somatic cell count in the milk samples was done as described by Presscot and Breed (1910). The somatic cell score was transformed logarithmically into SCS (SCS = log2 (SCC/100,000) + 3) before statistical investigation to obtain the distribution close to normal. Sixteen somatic cell scores were obtained for determining their effects on milk composition.

Milk Analysis

All the composite milk samples from forty cows were subjected to chemical analysis comprising Fat, Solid not fat (SNF), Total solids (TS), Protein and Lactose contents using Ultrasonic Ekomilk Milk Analyzer (Everest, India). Samples have been warmed at 30ºC if they were preserved at 4ºC.

Statistical Analysis

A student 't' test was used to test the significance between normal milk and subclinical mastitis milk of cow. Correlation between the somatic cell count and milk constituents was also worked using Pearson's correlations coefficient.

Results and Discussion

Prevalence study

A total of 40 Jersey crossbred cows and 160 quarters were screened for prevalence study by California mastitis test (CMT). Out of 40 cows, 16 cows were found to be positive for subclinical mastitis. The cow-wise 40.00% prevalence and 17.48% quarter-wise prevalence was recorded for subclinical mastitis. Older aged cows (11-15 years) and in late lactation (7-10) were mostly affected with the subclinical mastitis than younger aged cows (Table 1). This could be due to increased milk production, nutritional stress and less immunity of older aged and late lactating animals. The findings of the present investigation are corroborated with the findings of Sharma *et al*. (2012) who reported prevalence of subclinical mastitis, animal wise 42.18% and quarter wise 19.14%. The results of prevalence for present study for parity wise are in accordance with Saini *et al*. (1994) who reported that the incidence of subclinical mastitis was the lowest during first parity, which increased with subsequent parities. Increased incidence of subclinical mastitis cases during late lactation might be due to lowered resistance of cows and weakening of teat sphincter. However, the future studies with a greater number of cases should be done to confirm these findings.

Chemical composition of milk

The chemical composition of milk showed different degree of alteration in subclinical mastitis and normal (non-mastitic) cows in the study area (Table 2). The calculated means of milk samples was analyzed, and statistically significant difference was observed in protein, solid not fat and total solids. The mean of the fat and lactose showed non-significant difference between normal (non-mastitic) and subclinical mastitis.

Table 1. Prevalence of Subclinical mastitis in crossbred cows

Total crossbred cows examined	Number of crossbred cows positive for Sub clinical mastitis	Prevalence	
40	16	40.00%	
	Age wise Prevalence		
Age (years)	**Total crossbred cows**	**Positive**	**Prevalence**
1-5	15	3	20.00%
6-10	16	6	37.50%
11-15	9	7	77.77%
	Lactation wise Prevalence		
Lactation No.	**Total crossbred cows**	**Positive**	**Prevalence**
1-3	23	6	26.08%
4-6	10	4	40.00%
7-10	7	6	85.71%

Table 2. Effect of subclinical mastitis on milk composition, somatic cell score and electrical conductivity of milk

Parameters	No. of samples (16) N (Mean ± SE)	No. of samples (16) S (Mean ± SE)	P- value
Fat (%)	3.96 ± 0.43	3.37 ± 0.33	0.29
Solid not fat (%) *	8.77 ± 0.12	7.82 ± 0.20	0.00
Total Solids (%) *	12.72 ± 0.39	11.19 ± 0.40	0.01
Protein (%) *	3.33 ± 0.06	3.15 ± 0.06	0.04
Lactose (%)	4.76 ± 0.08	4.67 ± 0.06	0.34
Somatic cell score**	3.09 ± 0.02	3.34 ± 0.01	0.00
EC (mS/cm) *	4.84 ± 0.09	5.87 ± 0.21	0.00

N = Non-mastitic, S = Subclinical , ** SCS = log2 (SCC / 100,000) + 3). * (P <0.05).

Average fat per cent in normal quarter milk and subclinical mastitis milk was observed 3.96 and 3.37 per cent, respectively. The fat percentage of normal milk was ranged between 1.70 to 8.31 per cent and in subclinical mastitis milk it ranged between 1.04 to 5.62 per cent. In this study decrease of 14.89% in fat percentage was observed in subclinical mastitis milk samples. Similarly, Rajiv *et al.* (1998) observed the decrease in fat percent of subclinical mastitic milk and this decrease in fat content in milk might be due to impaired synthesis and secretory activity of the udder epithelial cell.

Normal milk samples showed average solid not fat percentages of 8.77 (ranged between 7.85 to 9.43 per cent), it was 7.82 per cent (6.67 to 8.70) in subclinical mastitic milk and reduced by 10.83 per cent. On an average solid not fat percent decreased significantly in subclinical mastitis milk samples which is in accordance with Rajiv *et al.* (1998). This decrease in solid not fat was mainly due to reduced lactose and protein contents in subclinical

mastitic milk as both these are the main constituents of solid not fat.

Total solids content of milk was found to be significantly lower in subclinical mastitic quarters (11.19 per cent) than normal quarters (12.72 per cent) which decreased by 12.03 per cent. In accordance with our study, Mohamed *et al.* (1998) also reported significant decrease in total solid contents of mastitic cow milk samples which could be due to decrease in fat and solid not fat contents of affected milk.

The study also showed a significant decrease in protein content of subclinical mastitis affected milk samples (average value 3.15 per cent with a range of 2.39 to 3.47 %) which was 3.33 per cent in healthy quarters (3.02 to 3.68 %). Similarly, significant decrease in buffalo milk protein content was reported by Ullah *et al.* (2005). As observed in the present study, decrease in protein contents in subclinical mastitic milk may be attributed to breakdown of milk protein as mastitic animals had remarkably high increase in the activity of a proteolytic enzyme which can cause extensive damage to the milk casein in the udder prior to milk collection from the animal. Our study also showed a decrease in lactose percent (4.67%) in all subclinically mastitis milk samples. It is well accepted that mastitis causes a decrease in the concentration of milk lactose because of the reduced synthesis capacity of damaged tissue.

Electrical conductivity

In the present research subclinically affected milk showed increase in electrical conductivity. The average electrical conductivity in normal milk was 4.84 ± 0.09 mS/cm and that of subclinical mastitis milk was 5.87 ± 0.21 mS/cm. This increase in electrical conductivity of subclinical mastitic milk was because of deterioration in udder health. Similar findings were reported by Spakauskas *et al*. (2006). Galfi *et al.* (2015) stated that electrical conductivity of the milk can give useful information about udder health status and in diagnosis of subclinical mastitis, however, it should be accompanied with milk somatic cell count.

Somatic Cell Score

Somatic cell counting in milk samples is the most widely recommended method of diagnosing onset of mastitis. Somatic cell score in normal milk was 3.09 and that of subclinical mastitis milk was 3.34 (Table 2) and was increased in subclinical mastitis. Santos *et al*. (2003) stated that elevated somatic cell count (>2 x 10^5 cells/mL) might cause alterations in milk constituents than samples with low somatic cell count ($\leq$2 x 10^5 cells/ml). Main factor that increases the somatic cell count happens to be bacterial and toxin invasion. Results of our study showed negative correlations among somatic cell score and fat, solid not fat, total solids, protein, and lactose contents (Table 3). It was observed that increase in somatic cell score influenced milk composition negatively in crossbred cows. It has been stated that somatic cell count was negatively associated with decreased lactose in milk from Gir cows (Malek dos Reis *et al*., 2013). Further suggesting that cows with subclinical mastitis had higher somatic cell score which inversely affected the milk composition. Cinar *et al*. (2015) studied effect of somatic cell count (SCC) on milk protein, milk fat, lactose and milk urea nitrogen and similarly to our study, somatic cell count inversely affected milk composition. This could be because of alterations in milk chemistry due to mastitis which can cause epithelial cell damage, change vascular permeability and proteolytic activity of udder tissue.

Table 3. The results of Pearson correlation coefficients between somatic cell score (SCS) and milk composition

Parameters	Correlations
Fat (%)	-0.28
Protein (%)	-0.54*
Lactose (%)	-0.30
Solid not fat (%)	-0.49
TS (%)	-0.21

* (P <0.05).

Conclusion

Our study showed decrease in fat, solid not fat, total solids, protein and lactose contents with increased somatic cell count suggested that subclinical mastitis affect the milk quality and may decrease milk production. Taking together all above information provided by this study, researchers and various organizations working on dairy production should give emphasis on prevention and control of mastitis and further studies to improve milk production should be conducted.

Acknowledgements

Authors are thankful to the Rashtriya Krishi Vikas Yojna for providing funding and to the Department of Livestock Farm Complex, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur for providing samples for this study.

References

Cinar M, Serbester U, Ceyhan A and Gorgulu M. 2015. Effect of somatic cell count on milk yield and composition of first and second lactation dairy cows. Italian Journal of Animal Science **14** (1): 105-108.

Galfi A, Radinovic M, Milanov D, Bobos S, Pajic M, Savic S and Davidov I. 2015. Electrical conductivity of milk and bacteriological findings in cows with subclinical mastitis. Biotechnology in Animal Husbandry **31**(4): 533-541.

Malek Dos Reis CB, Barreiro JR, Mestieri L, Porcionato MA and Veiga Dos Santos M. 2013. Effect of somatic cell count and mastitis pathogens on milk composition in Gir cows. BMC Veterinary Research **9**: 67.

Mohamed IE, Osman AO, Elowni AO, Galaledein E and Mohamed. 1998. Factors affecting composition of mastitis milk of Friesian cattle in Sudan. Indian Journal of Animal Sciences **68**: 379-381.

Payne JA and Wilson RA. 1999. *An Introduction to Animal Husbandry in the Tropics*. Black well Science, Ames, pp 163-78.

Presscot JF and Breed RS. 1910. The determination of number of body cells in milk by a direct method. Journal of Infectious Diseases **7**: 632-640.

Rajiv Singh, Singh KB, Khera SS and Sudhan NA. 1998. Effect of subclinical and clinical mastitis on the milk compositions in crossbred dairy cows. Indian Veterinary Journal **75**: 462-465.

Saini SS, Sharma JK and Kwatia MS. 1994. Prevalence and etiology of sub-clinical mastitis among crossbred cows and buffaloes in Punjab. Indian Journal Dairy Science **47**: 103-106.

Santos MV, Ma Y and Barbano DM. 2003. Effect to somatic cell count on proteolysis and lipolysis in pasteurized fluid milk during shelf-life storage. Journal of Dairy Science **86** (8): 2491-2503.

Sharma A, Singh R, Beigh SA and Bhardwaj RK. 2012. Prevalence of subclinical mastitis in cross breed cattle from Jammu region. Veterinary Practice **13** (2): 356-357.

Sharma N, Singh NK and Bhadwall MS. 2011. Relationship of somatic cell count and mastitis: an overview. Asian-Australasian Journal of Animal Sciences **24** (3): 429-438.

Singh Geetanjali, Bhardwaj B and Verma S. 2016. Assessment of the common methods for diagnosis of bovine subclinical mastitis. Himachal Journal of Agricultural Research **42** (2): 170-74.

Spakauskas V, Klimiene I and Matusevicius A. 2006. A comparison of indirect methods for diagnosis of subclinical mastitis in lactating dairy cows. Veterinarski Arhiv **76** (2): 101-109.

Ullah S, Ahmad T, Bilal MQ, Rahman Zia-ur, Muhammad G and Rahman SU. 2005. The effect of severity of mastitis on protein and fat contents of buffalo milk. Pakistan Veterinary Journal **25** (1): 1-5.