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EVALUATION OF ELECTRIC CONDUCTIVITY AND MILK LACTOSE AS A PRE-INDICATOR OF MASTITIS IN THARPARKAR DAIRY CATTLE

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ABSTRACT

Somatic cell count (SCC) in milk has been shown to be an excellent marker for subclinical mastitis but very difficult to execute at farm level. Due to the damage to the udder tissue, concentrations of lactose decrease and concentrations of Na+ and Cl increases in milk which results in increase in electric conductivity. The present investigation was carried out to investigate the correlation of milk lactose and electric conductivity with somatic cell count and can be used as an indicator to detect subclinical mastitis (SCM) in Indigenous zebu Tharparkar cattle. Total 466 milk samples were screened for somatic cell count, 198 samples were positive for subclinical mastitis. All the samples were analyzed for electrical conductivity (EC) and milk lactose by deluxe electric conductivity meter manufactured by Systronics India limited, Ahamdabad and ultrasonic milk analyzer manufactured by Rajasthan Electronics & Instrument Limited (REIL), Jaipur respectively. The result demonstrated statistically significant ($p<0.01$) increase in electric conductivity and significant ($p<0.01$) decrease in milk lactose. From the results a conclusion can be made that electrical conductivity and milk lactose exhibits a high correlation with SCC scores and can be used as the tools to predict subclinical mastitis at farm level.

Key words: Electric conductivity, Milk lactose, Somatic cell count, Subclinical mastitis.

Mastitis is a serious disease in dairy animals causing great economic losses due to reduction in milk yield as well as lowering its nutritive value. Subclinical mastitis is 15 - 40 times more prevalent than clinical mastitis and causes high economic losses in most dairy herds[8,11]. In Subclinical mastitis damage caused to the cells and to the blood capillaries and changes in the permeability of membranes causes alterations in the milk composition. Early detection of mastitic cows is important for most dairy farmers to reduce production losses and the diagnosis of subclinical mastitis is more difficult as milk appears normal. Somatic cells are indicators of both resistance and susceptibility of cows to mastitis and can be used to monitor the level or occurrence of subclinical mastitis in herds or individual cows. SCC is a useful predictor of intramammary infection (IMI), and therefore, an important component of milk in assessment of aspects of quality, hygiene and mastitis control. Unlike milk production loss, there is a direct relationship between SCC and milk quality. An elevated SCC in milk has a negative influence on the quality of raw milk.

Somatic cell count (SCC) in milk has been shown to be an excellent marker for subclinical mastitis but very difficult to execute at farm level. Therefore the present investigation was carried out in native Tharparkar cattle with the objective to evaluate the relationship between SCC and milk

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composition *i.e.* milk lactose and electric conductivity for development of new investigating criteria for diagnosis of subclinical mastitis at farm level.

MATERIALS AND METHODS

Location

The present study was carried out at dairy farm of Tharparkar cattle at Durgapura Gaushala, Jaipur and Livestock Research Station, Chandan (RAJUVAS), cattle yard located in Jaisalmer, Rajasthan. A total of 466 apparently healthy, clinical mastitis free quarter milk samples from 120 healthy dairy Tharparkar cows of different age groups (3 to 11 years), parities (1 to 7) and stage of lactation (early, mid and late) were collected in the study. All cows were housed in well ventilated barns and milked twice daily by hand milking method.

Collection of samples and diagnosis of Intra-mammary Infection

Representative milk samples were collected from all the four quarters of lactating cows. For this purpose, quarters were designated as Left Fore (LF), Left Hind (LH), Right Fore (RF) and Right Hind (RH). About 30 ml of milk was collected aseptically in the sterile clean sampling bottles after discarding the first 5-6 streaks of fore milk from each teat. Prior to collection of milk, udder was washed with water and cleaning of teats with cotton soaked in 70% ethyl alcohol. The collected samples were kept in ice box at 4^0 C and were brought to the laboratory immediately for further analysis. The lactose analysis, electric conductivity and smear for SCC were performed within one hour of collection. The SCC in milk was done by manual microscope count method[10] which were slightly modified.

The test milk samples were thoroughly mixed by gentle shaking the vials and 10ml of milk was taken on the pre drawn one cm square marked area over a grease free clean glass slide which was uniformly smeared with a standard sterilized bacteriological platinum loop. After drying the smears were fixed with alcohol, air dried and stained with the modified Newman's Lampert stain, by keeping the prepared slide in the staining solution for 1 to 2 minutes. Afterwards the smears were gently washed in tap water and dried. The dried stained smears were examined under the oil immersion lens of the microscope. Counting of cells in 30 different fields was done under oil immersion objective lens (100x) and the counting was repeated twice per smear to assess average number of somatic cells in 30 fields and average number of the cells per field. The average number of cells was multiplied by the multiplication factor of the microscope *i.e*. 393170 to obtain the number of cells per ml of the milk. The health status of individual quarters was defined on the basis of Somatic cell count of quarter milk samples which was predefined by National mastitis council. The quarters having somatic cell count <200,000 cell/ml comes under category of healthy quarters, while quarters having somatic cell count >200,000 cells/ml included in SCM infected quarters. Due to SCC not displaying a normal distribution, data of SCC were log transformed to base10. The Electric conductivity of milk samples were analysed through deluxe electric conductivity meter (Model 720 manufactured by Systronics India limited, Ahamdabad) and lactose content of milk was analysed through Lactoscan ultra-sonic milk analyser (Model LM2 manufactured by Rajasthan Electronics & Instrument Limited (REIL), Jaipur).

Statistical analysis

Due to SCC not displaying a normal distribution, data of SCC were log transformed to base 10. The data were examined by general linear model procedure of SPSS statistical package (ver. 16.0) software. Secondly, Pearson's correlation coefficients (r) were also established to determine the relationships between the various studied parameters. The results were considered significant if the associated P-value was <0.05 and highly significant if P-value were <0.01.

RESULTS AND DISCUSSION

Milk lactose, electric conductivity of milk and milk somatic cell count of Tharparkar cattle varied between healthy and sub-clinical mastitic animals. The average milk Log_{10} SCC in healthy and sub-clinical mastitic milk was 5.083 and 5.812. The mean

electric conductivity of milk was 5.489 mS and 5.928 mS and the mean lactose content was 4.54% and 4.18% in healthy and sub-clinically mastitic group milk respectively. The correlation between SCC, EC and milk lactose percentage (Table 2) showed significant positive correlation between SCC and electric conductivity of milk ($p< 0.01$) and significant negative correlation between SCC and lactose percentage of milk ($p< 0.01$).

Lactose content in natural milk of Tharparkar cattle ranges between 4.4 and 4.6 percent[19] but in case of mastitis, it reduces upto 4.2 and less. Mastitis causes decreased milk lactose through damaging the secretary cell that produce milk in mammary glands[14]. Several studies have reported decrease in lactose concentration in the milk of cows presenting high SCC[1, 2, 4, 5]. Lactose was one of the most useful markers[7] and one of the most promising parameters for monitoring sub-clinical mastitis[9]. In our study, negative significant correlation ($P<.01$) was found between mean SCC and mean lactose. According to different research reduction in lactose contents occurred with the severity of sub-clinical mastitis due to the passage of lactose from milk into blood and increased permeability of tissues between milk duct of udder and the blood, which leads to increased leakage of blood components into the udder and changes the milk composition[2, 3, 12].

Electric conductivity of milk has also been introduced as an indicator trait for mastitis. The EC is determined by the concentrations of anions and cations. The altered concentrations of Na+, K+, and Cl- in mastitic milk cause the EC of milk to be increased. The EC of milk has also been expressed as a concentration of NaCl with the same conductivity as the examined milk. The mean value of EC was found 5.48 mS in healthy that increased 5.92 mS with the presence of sub clinical mastitis based on Somatic Cell Count. Several previous studies also indicate that the electric conductivity is significantly increased with somatic cell count [6, 3, 13]. Different researchers [3, 14] determined that electrical conductivity was higher in infected quarters and added that the mean EC of $\log_{10}$ SCC/mL >6.0 milk was 6.06 mS/cm, while the mean EC of $\log_{10}$ SCC/mL between 5.6 and 6.0 was 5.84 mS/cm[3, 14]. These changes might be linked to the increase permeability of the mammary epithelium cell lead to the transfer of components from blood to milk which leads to increasing the amount of sodium and chloride ions in milk, whereas the amount of potassium phosphorus, zinc and magnesium has decreased, So when cattle exposed into infection of mammary glands, milk electrical conductivity increases [3].

Table 1. Means (±SE) of Log_{10} SCC, EC and milk lactose of healthy and sub-clinical mastitis infected cows

Characteristics	Healthy cows	SCM infected cows	significance
Log_{10}SCC	5.083 ±0.011	5.812 ±0.020	**
Electric Conductivity (mS)	5.489 ±0.017	5.928 ±0.025	**
Milk Lactose %	4.544 ±0.016	4.186 ±0.031	**

** Highly significant ($P <0.01$)

Table 2. The Pearson correlation between SCC, EC and Milk Lactose percentage

	SCC	Milk Lactose	Milk E.C.
SCC (Cells/ml)	1.00	-0.459**	0.574**
Milk Lactose (%)	-0.459**	1.00	-0.498**
Milk E.C.(mS)	0.574**	-0.498**	1.00

** Highly significant ($P <0.01$)

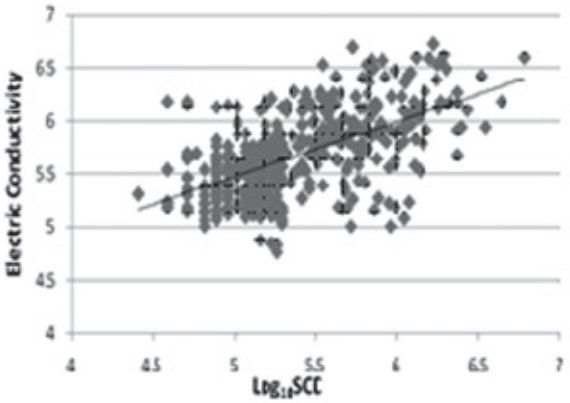

Fig. 1. Positive corelation between Log_{10}SCC and Electric Conductivity

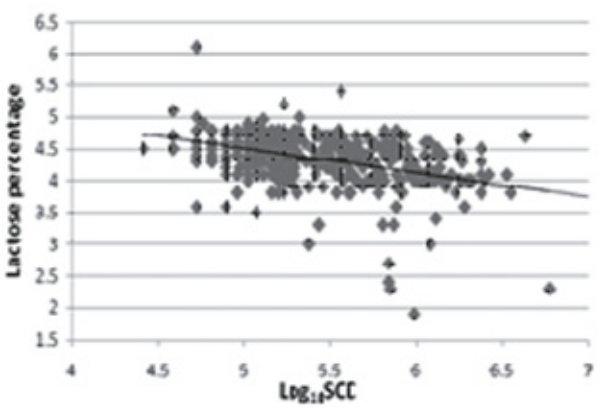

Fig. 2. Negative corelation between Log_{10}SCC and Milk Lactose

CONCLUSION

It is concluded that Milk lactose content and electric conductivity showed similarity with somatic cell count in detection of subclinical mastitis. Our study showed that the Lactose content and electric conductivity are highly significant with SCC.

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REFERENCES

1. Bansal B. K., Hamann J., Grabowski N. and Singh K.B. 2005. Variation in the composition of selected milk fraction samples from healthy and mastitis quarters, and its significance for mastitis diagnosis. *J. Dairy Res*. **72**: 144
2. Bharti, P., Bhakat, C., Ghosh, M.K., Dutta, T.K. and Das, R. 2015. Relationship among intramammary infection and raw milk parameters in Jersey crossbred cows under hot-humid climate. *J. Anim. Res.* **5** (2): 317
3. Bruckmaier, R. M., Ontsouka, C. E. and Blum, J. W. 2004. Fractionized milk composition in dairy cows with sub clinical mastitis. *Vet. Med. - tech.* **49**(8): 283 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. *Ital. J. Anim. Sci.* **14**: 105
4. Ghosh, C. P., Nagpaul, P. K. and Prasad, S. 2004. Sub clinical mastitis in cattle and buffaloes and its impact on somatic cell coun*t* and milk composition. *Indian J. Dairy Sci.* **57** (5): 329
5. Guha, A., Guha, R. and Gera, S. 2012. Comparison of somatic cell count, California mastitis test, chloride test and rennet coagulation time with bacterial culture examination to detect subclinical mastitis in riverine buffalo (*Bubalus bubalis*). *Afr. J. Agric. Res.* **7**(41): 5578
6. Hamann, J. 2002. Relationships between Somatic cell counts and milk composition. *Bulletin of the IDF*. **372**: 56
7. Harini, H. and Sumathi, B.R. 2011. Screening of bovine milk samples for sub-clinical mastitis and antibiogram of bacterial isolates. *Vet. World*. **4** (8): 358
8. Harmon, R.J. 1994. Physiology of mastitis and factors affecting somatic cell counts. *J. Dairy Sci.* **77**: 2103
9. Radostitis, O. M., Gay C. C., Blood D. C. and Hichiff, K.W. 2000. *Veterinary Medicine*, 9th Ed., W.B. Saunders Company, London, UK.
10. Schallibaum, M. 2001. Impact of SCC on the quality of fluid milk and cheese. Proc. 40th Annual Meeting, National Mastitis Council, Madison, USA. pp: 38
11. Sharif, A., Ahmad, T., Bilal, M. Q., Yousaf, A, and Muhammad, G. 2007. Effect of severity of Sub-Clinical mastitis on somatic cell count and

lactose of Buffalo milk. *Pakistan Vet. J.* **27**(3): 142

12. Sood R, Pachauri S. P. and Nauriyal D. S. 2008. Evaluation of markers of sub clinical mastitis for its early detection in dairy animals. *Indian J. Vet. Med.* **28**: 17-
13. Yarabbi, H., Mortazavi, A., Mehraban, M. and Sepehri, N. 2014. Effect of somatic cells on the physic-chemical and microbioal properties of raw milk in different seasons. *Int. J. Pl. Anim. Env. Sci.* **4**(3): 289
14. Young, C. W., Hillers J. K. and Freeman A. E. 1986. Production, consumption, and pricing of milk and its components. *J. Dairy Sci.* **69**: 272