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Research Article

ASSOCIATION OF ELECTRIC CONDUCTIVITY, MILK PH AND MILK CONSTITUENTS WITH UDDER HEALTH IN ZEBU CATTLE

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ABSTRACT

The present study was conducted to the relationship of electrical conductivity, pH and Milk constituents with udder health in different breeds of zebu cattle in hot arid region of Rajasthan. We selected randomly 150 zebu milking cattle (50 from each breed) *viz*. Kankrej, Sahiwal and Rathi and collected 50 ml of milk sample from lactating cows as pool sample from different Livestock research station (RAJUVAS), Bikaner. Milk samples were analyzed in advanced milk testing laboratory and statistics done by Pearson correlation coefficient (SPPS 24) to associate electric conductivity (EC), pH and constituent of milk with somatic cell count (SCC). The fat per cent was significantly ($p<0.01$) correlated with Log_{10} SCC in Rathi but non-significant correlation was found in Kankrej and Sahiwal. Protein, lactose and SNF were significantly negative correlated with Log_{10} SCC in all three breeds.Electrical conductivity and pH values were significantly ($p<0.01$) positive correlation with Log_{10} SCC in all three breeds. The pH was higher in higher SCC milk than normal milk, because when cow expose with intra-mammary infection, pH of the milk increases due to an increased concentration of Na^+ and Cl^- in the milk. Our study concludes the variation of the EC, pH and milk composition in healthy and mastitis animals. The combination of all milk parameters is helpful to improve the confirmation of diagnosis of mastitis in early stage and control the spread of this disease in herds.

Keyword: Electric conductivity, Milk pH, Milk constituents, Somatic Cell Count, Indigenous cattle

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INTRODUCTION

Mastitis is an economical disease which directly affects the economy of the dairy farmers by decreasing milk production as well as milk quality and culling of animals. It is an inflammation of udder resulting fibrosis of milk secreting tissue which leads to reduced or permanent losses of milk production and decreasing nutrients flow in milk. Milk constituents and their composition are considered as an important attribute essential for dairy farmers to maintain raw milk quality, dairy manufactures to produce better quality milk products, and consumers to sustain health nutrition quality, and safety. Mastitis is found in clinical and sub clinical stage in dairy animal. Clinical mastitis is a chronically stage which lead to fibrosis of udder and chance of reparable is less but sub clinical stage is a first stage of mastitis, in this condition few changes occur in milk and this stage is reparable after -successful treatment. We required diagnosis of mastitis as soon as possible to effective treatment. So, various changing occur during subclinical mastitis in milk which are helpful to identifying of sub clinical mastitis in early stage. Milk pH and Electric Conductivity (EC) is primary components which are changed during subclinical mastitis and it is an important indicator to detect sub clinical mastitis (Sharma *et al.*, 2016). According to Sahu *et al.*, 2018 the values of milk SCC and EC were significantly (P less than 0.05) higher in crossbred cows having subclinical and clinical mastitis. Milk pH ranged from 6.48 to 6.62 in healthy and subclinical cases, whereas pH 7.03 in clinical mastitis cases. It means the value of SCC, EC, and pH are dependent to diagnose the mastitis in cow milk. EC showed similarity with the CMT and the SCC in the detection of subclinical mastitis; furthermore, its reliability would further increase when used together with the other diagnostic methods. The estimation of somatic cellcount (SCC) is a standard test for diagnosing of sub clinical mastitis and also predicts the health of mammary gland and bacteriological status. Studies on the relationship between milk composition, milk pH electric conductivity (EC), and somatic cell count for early detection of subclinical mastitis of the cow milk are of considerable importance to dairy farmers. Less information is available on the associations between milk traits in indigenous cattle. Most of studies conducted on exotic or cross breeds cattle.Therefore, in the text of the above discussion, the present study was carried out to find out association of milk constituents pH and EC with somatic cell count in various indigenous cattle breeds in hot arid region of Rajasthan.

MATERIAL AND METHODS

The present study was carried out at different cattle farms of Rajasthan University of Veterinary and Animal Sciences (RAJUVAS), Bikaner, India. The Bikaner city is situated in middle of the Thar Desert and hot semi-arid region of Rajasthan. During summer, the temperatures can

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rise up to 48°C and in winter comes below the freezing point.

Ethical approval

Research work on "Study on Quality and Bioactive Components in Milk of various Indigenous Cattle Breeds in Hot-Arid Region of Rajasthan"has been approved by institutional animal ethical committee (Approval No: PGIVER/IAEC/19-14).

Animals

For this study, 150 indigenous milking cattle (50 from each breed) viz. Kankrej, Sahiwal and Rathi were selected randomly which were reared under similar feeding and housing system. The cattle were kept under loose housing system with standard space of accommodation and fed according to standard feeding schedule along with ad lib seasonally available green fodder and free access to fresh drinking water. Hand milking was practiced during both morning (4.00 to 5.00 am) and evening (3.30 to 4.30 pm) milking.

Milk sample

About 100 ml of pooled milk samples of all individual cows was collected aseptically in the sterilized sampling bottle after discarding the first 4-5 streaks of foremilk. The milk composition was tested by an electrically operated automatic milk analyzer (Lactoscan SL20, Rajasthan Electronic and Instruments Limited), pH value was determinedby using the digital pH meter, EC valuewas determined by using the digital EC meterand smear for SCC were prepared within one hour of collection.The SCC in milk sample was done as per the method reported by Schalm *et al.* (1971).

Statistical analysis

The association among Electric Conductivity, Milk pH, milk constituents and SCCwas estimated by Pearson correlation coefficient using SPSS software statistical package 25.0 (IBM Corp, 2019). The significance level was set at 95%.

RESULT AND DISCUSSION

Relationship of milk SCC with milk constituents

The results pertaining to correlation coefficient in Log10 SCC and milk constituents are presented in table 1. It observed that protein, lactose and SNF were significant negatively correlated with Log_{10} SCC in Kankrej, Rathi and Sahiwal cows. The fat percent was significantly ($P<0.01$) correlated with Log_{10} SCC in Rathi, while non-significant in Kankrej and Sahiwal. The negative correlation of SCC with protein, lactose, and SNF indicated that when SCC increases in milk, there is decrease in the Protein, Lactose, and SNF content in milk. An infection in the udder triggers an inflammatory response characterized by recruitment of white cells from the bloodstream and altered secretion of various molecules (Wellnitz and Bruckmaier, 2012) because cell numbers in milk are associated with inflammation. Inflammation damages of the mammary gland tissue, inhibiting the biosynthesis of protein, and lactose, and thereby decreasing milk production (Schallibaum, 2001). Boas *et al.* (2017) revealed that the per cent lactose content and milk production decreased with the progressive increase of SCC. Percent Lactose showed the strongest correlation with somatic cell score (-0.66), indicating that an increase in this trait leads to a reduction in per cent lactose, probably as a result of a decline in lactose synthesis in infected mammary glands due to the damage caused to secretory cells, the utilization of lactose by intramammary pathogens and also the loss of lactose from the gland to the bloodstream because of increased permeability of the membrane that separates milk from blood, leading to the excretion of lactose in urine. Lactose is a major osmotic component of milk and is a major driver of water secretion into milk. Thus, lower lactose content results in a smaller volume of milk produced (Boas *et al.*, 2017). As lactose content decreases, the concentrations of certain minerals (sodium and chloride) increase to maintain the osmotic equilibrium (Batavani *et al.*, 2007). Lower values of protein might be observed in high SCC in milk because increased plasmin- and somatic-cell-protease-mediated activity against proteinespecially αS1- and α-casein (Urech *et al.*, 1999). Higher enzymatic activity is responsible for decreasing protein content especially casein. According to Televicius *et al.*, (2021) inline registered milk lactose concentration can be used to indicate the health status of fresh dairy cows. Cows with an increased lactose concentration showed more activity and had less risk of mastitis. Registered lower levels of milk lactose can be used for early identification of mastitis. similar trends were observed in indigenous cows as taurine cows. Boas *et al.* (2017) observed a positive correlation between fat and somatic cell in dairy Gir cow. The positive correlation estimated among fat percent and Somatic cell score suggested that the increase in Somatic cell score could be responsible for an increase in fat percentage (Boas *et al.*, 2017). Therefore, correlation with somatic cell count varied from breed to breed. These effects may be breed specific governing by genetic effects and affect some specific breeds of cattle and some breeds were not affected by these effects.

Relationship of milk SCC with milk pH

It observed that the milk pH value was significantly ($P<0.01$) positive correlated with Log_{10} SCC in Kankrej,

Table 1. Pearson correlation coefficients of Log10 SCC with milk constituents (N- 50 each breeds)

Breeds	Parameters	Fat	Protein	Lactose	SNF
Kankrej	Log_{10} SCC	.132	-.359*	-.342*	-.363**
Rathi	Log_{10} SCC	.382**	-.610**	-.577**	-.624**
Sahiwal	Log_{10} SCC	.177	-.327*	-.286*	-.422**

* Significant ($p<0.05$) ** Highly Significant ($p<0.01$)

Table 2. Pearson correlation coefficients of Log10SCC with EC and pH (N- 50 each breeds)

Breeds	Parameters	EC	pH
Kankrej	Log_{10} SCC	.322*	.420**
Rathi	Log_{10} SCC	.358*	.391**
Sahiwal	Log_{10} SCC	.442**	.464**

*Significant ($p<0.05$)** Highly Significant ($p<0.01$)

Rathi, and Sahiwal (Table 2). According to Bobbo *et al.* (2016) the changes in the ionic environment and the degradation of casein due to a higher enzymatic activity is responsible for the increase in milk pH observed during mastitis. Batavani *et al.* (2007) compared milk samples collected from healthy quarters and quarters with sub-clinical mastitis and found that the pH of mastitis milk was significantly higher than that of healthy milk.

Relationship of milk SCC with milk Electric Conductivity

The correlation coefficient between the Log_{10} SCC and milk EC are presented in Table 2. Significant positive correlation was observed between milk EC and Log_{10} SCC in Sahiwal ($P<0.01$), Kankrej and Rathi ($P<0.05$). The concentration of anions and cations (Na^+, K^+, and Cl^-) determines the EC of milk. As a result of the cell damage, Na^+ and Cl^- leak into the lumen of the alveolus and K^+ and lactose move together out of the milk. The correlation between EC and SCC was positive and moderate (0.41) observed by Boas *et al.*, 2017 in dairy Gir cow. The possibility is difficult to confirm the identification of subclinical or clinical mastitis based on single milk parameters. Possible reasons for this are physical changes in mastitis milk, which may affect milk flow. A combination of the variation of EC, Milk pH, and milk traits may improve the confirmation of the diagnosis of subclinical or clinical mastitis. The present study concludes that the variation of the EC, pH, and milk composition in healthy and mastitis animals were found. The correlation of these milk parametersmay be helpful to improve the confirmation of the diagnosis of subclinical or clinical mastitisand control the spread of this disease in herds. In addition to the association between these traits, the measurement of EC, pH, and milk composition is an inexpensive, simple, and rapid method when compared to SCC.

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