SHORT COMMUNICATION

Serum Mineral Profile in Holstein Friesian Crossbred Cows with Normal and Low Solids-not-fat Milk Syndrome

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Abstract

A study was undertaken to compare the serum mineral profile in Holstein Friesian crossbred cows with low solids-not-fat (SNF) syndrome and normal SNF content during 4th and 8th week of 3rd and 5th lactations. A total of 24 cows were selected for the present study and based on the SNF content in their milk, the animals were divided into four groups, *viz.*, Group I (> 8.5% SNF milk in 3rd lactation), Group II (< 8.5% SNF milk in 3rd lactation), Group III (>8.5% SNF milk in 5th lactation) and Group IV (< 8.5% SNF milk in 5th lactation) with six animals in each group. The blood samples collected at 4th and 8th weeks of lactation from all the selected animals were processed and serum samples were stored at -20°C till completion of the study. Stored serum samples were later utilized for determination of serum calcium, phosphorus, sodium, potassium, and magnesium with the help of autoanalyzer using specific reagent kits. Serum phosphorus and sodium levels were significantly (p<0.05) higher, and the serum potassium levels were significantly (p<0.05) lower in normal (>8.5%) SNF content cows compared to low SNF (<8.5%) syndrome cows at 4th and 8th weeks of 3rd and 5th lactations. However, the serum calcium and magnesium levels did not differ significantly between the groups. It was concluded that the significantly lower levels of serum sodium and phosphorous in cows with low SNF could be one of the contributing factors for the low SNF content.

Keywords: Comparative study, Crossbred cows, Normal SNF, Serum minerals, Low SNF Syndrome.

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Introduction

The problem of low SNF is creating a major distress to the milk producers as the price of the milk is decided based on its fat and SNF contents and milk samples regularly fail to reach the prescribed SNF levels of 8.5%. The milk consists of water, fat, proteins (α, β and κ-caseins, β-lactoglobulin and α-lactalbumin), lactose and ash that are most considered to evaluate the composition of milk. Milk is mainly composed of two important components, *viz*., fat and SNF. The SNF consist of solids like lactose, protein, and minerals apart from the fat. The minerals are essential elements required for growth, reproduction, lactation, and performance (Mbassa and Poulson, 1991). Lack of minerals especially calcium and phosphorus upset the proper functioning of mammary gland (Acharya, 1960). The yield of milk and prevalence of low SNF in milk are strongly and negatively correlated. Decrease in SNF content of milk is attributed to increase in the exotic blood levels especially with more than 50 % exotic inheritance. The animals with their milk samples having less than 8.5 % SNF are considered as low SNF syndrome cows as per FSSAI (2006). Prevalence of low SNF in milk of crossbred and Holstein Friesian cows is common (Wakchaure *et al.,* 2015; Murthy, 2014). The nutritive value of the milk is based on its components in which milk fat and SNF plays an important role in physico-chemical, sensory, textural characteristics and the shelf life of any milk based sweet (Chaudhary *et al.,* 2015). The sodium and potassium concentrations are usually constant in milk to maintain osmotic equilibrium along with chloride (Park, and Lindberg, 2005). Lactating dairy cows are in larger requirement of minerals for synthesis and drainage of milk components. However, owing to the availability of the limited information on serum minerals profile of Holstein Friesian crossbred cows suffering from low SNF syndrome, the present study was undertaken.

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Materials and Methods

The study was carried out in the milk producer's cooperative society of Byadarahalli and Pandarahalli villages, Nelamangala Taluk, Bangalore Rural District, Karnataka, India. The Holstein Friesian crossbred cows were selected from different dairy farms and different farmers, which were maintained with iso-nutritional and iso-managemental conditions. Initially, the milk samples were screened for mastitis using California mastitis test (CMT) to rule out mastitic animals and then mastitis free milk samples were analyzed for solids-not-fat content by using the automatic electronic milk tester (Softrosys Technologies, Basaveshwar Nagar, Bengaluru, Karnataka).

A total of 24 Holstein Friesian crossbred cows were selected based on lactation interval and SNF content of milk. The records of inheritance of crossbreeding of these animals were not available. The selected animals were divided into four groups, *viz*., Group I (> 8.5% SNF milk in 3rd lactation), Group II (< 8.5% SNF milk in 3rd lactation), Group III (>8.5% SNF milk in 5th lactation) and Group IV (<8.5% SNF milk in 5th lactation). The blood samples collected from each animal at 4th and 8th week of lactation were processed for serum samples which were stored at -20˚C till completion of the study. The stored serum samples were later analyzed for calcium, phosphorus, sodium, potassium, and magnesium by using biochemical analyzer (STAR-20, Rapid Diagnostic Pvt. Ltd.) with the help of specific reagent kits manufactured by Lab-Care Diagnostics (India) Pvt. Ltd., Sarigam, Valsad, Gujarat, India. The obtained data were analyzed by two-way ANOVA with the application of Bonferroni post test using computerized statistical GraphPad Prism version 7.04 (2018) software.

Results and Discussion

Serum phosphorus (P) and sodium (Na) levels were significantly ($p < 0.05$) higher in normal (> 8.5%) SNF cows compared to low SNF (< 8.5%) cows at 4th and 8th weeks of 3rd and 5th lactations (Table 1). Significantly higher serum phosphorus level in normal SNF cows compared to low SNF cows might be to ascribe to genotypic variation (Glantz *et al*., 2012). It could also be due to higher drainage of phosphorus into the milk and due to higher feed intake to cope up with higher heat tolerant capacity in crossbred cows as opined by Naser *et al*. (2014). Significantly higher serum sodium levels in normal SNF cows compared to low SNF cows could also be due to increased sodium transportation from blood to milk which is required for synthesis of normal milk components (Rowlands *et al*., 1975).

The serum potassium (K) levels were significantly ($p<0.05$) lower in normal (> 8.5%) SNF cows compared to low SNF (< 8.5%) cows at 4th and 8th weeks of 3rd and 5th lactations (Table 1). This significantly increased serum potassium levels in low SNF cows during early part of lactation could be due its involvement in glucose metabolism, amino acid uptake and protein synthesis, all of which aids in milk production or

Table 1: Mean ± SE values of serum macro-minerals in normal and low and milk SNF groups of HF crossbred cows (n=6) during 4th and 8th weeks of lactation

Groups	*Calcium (mg/dL)*		*Phosphorus (mg/dL)*		*Sodium (mmolL^{-1})*		*Potassium (mEq/L)*		*Magnesium (mg/dL)*	
	Weeks of milking		*Weeks of milking*		*Weeks of milking*		*Weeks of milking*		*Weeks of milking*	
(n=6 each)	*4th*	*8th*	*4th*	*8th*	*4th*	*8th*	*4th*	*8th*	*4th*	*8th*
Group I	9.51 ± 0.55	8.46 ± 0.34	6.73 ± 0.22^{a}	7.33 ± 0.20^{a}	152.59 ± 2.88^{a}	152.04 ± 6.02^{a}	3.95 ± 0.30^{a}	3.99 ± 0.15^{a}	1.94 ± 0.11	1.94 ± 0.05
Group II	8.61 ± 0.47	10.02 ± 0.61	5.52 ± 0.20^{b}	6.05 ± 0.50^{b}	137.74 ± 1.44^{b}	133.53 ± 1.94^{b}	5.43 ± 0.39^{b}	4.86 ± 0.50^{ac}	1.97 ± 0.05	1.95 ± 0.05
Group III	8.04 ± 0.32	9.18 ± 0.50	7.15 ± 0.23^{a}	7.78 ± 0.20^{a}	149.04 ± 2.57^{ab}	147.95 ± 4.24^{a}	4.03 ± 0.20^{ab}	3.96 ± 0.38^{a}	1.95 ± 0.07	1.98 ± 0.03
Group IV	7.67 ± 0.25	9.27 ± 0.72	6.00 ± 0.21^{b}	6.28 ± 0.15^{b}	137.31 ± 2.36^{cb}	132.71 ± 5.48^{b}	5.59 ± 0.52^{c}	5.58 ± 0.38^{bc}	1.99 ± 0.07	2.02 ± 0.05

Group I & III, Normal milk SNF, Group II and IV, low milk SNF syndrome; The values with different superscripts within column (a, b and c) for a specified mineral differ significantly ($p < 0.05$)

reduced transfer of potassium from blood to milk along with sodium.

The serum calcium and magnesium levels did not differ significantly (p>0.05) between 4th and 8th weeks of lactation for a given group (Table 1). Serum calcium levels were numerically higher in normal SNF cows than low SNF cows which might be due to higher drainage of calcium from the bone to cope up with normal calcium secretion in milk (Nozad *et al*., 2012). The calcium is also known to sensitize the mammary muscles as a second messenger for hormonal action involved in the milk secretion (Shenkin and Wretlind, 1978). It was concluded that the lower level of serum calcium might be an attributing factor for lowering SNF content in milk. Numerically higher serum magnesium levels in low SNF cows might be due to higher calcium drainage from the blood for secretion of calcium in the milk during early part of lactation in turn, leading to increased serum magnesium levels owing to higher magnesium absorption through intestine or might be due to adequate supply of dietary magnesium.

Conclusion

The study showed that there was ignificant reduction in the serum sodium and phosphorus levels in low SNF cows which could partly be responsible for reduced SNF content in the milk. Therefore, supplementation of mineral mixtures containing high concentrations of sodium and phosphorus might be of some help to improve the level of SNF in the milk of low SNF cows.

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