Original Research

Supplementation of Ground Maize Grain and Mineral Mixture to Improve Milk Solid-Not-Fat Content in Dairy Cattle

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Abstract

A participatory research was conducted under Sujala III watershed project with an aim to improve milk solid constituents of the dairy cattle showing low solid-not-fat (SNF) syndrome by supplementation of ground maize and mineral mixture in their conventional diets. For the purpose, sixteen crossbred cows in mid to late lactation producing milk containing SNF less than acceptable standard (8.5 %) set by the co-operative milk union were selected in two villages of Chamarajanagar District, Karnataka State. Data on feeding practices of the selected animals were collected and its analysis has revealed that the cows were deficient in most of the nutrients required for milk production, particularly energy and minerals. Based on this information, the farmers were suggested to supplement ground maize grains @ 200 g and mineral mixture @ 10 g/kg milk yield to the existing cow diet (dry sorghum ad lib + cattle feed @ 1-1.5 kg/animal). The study was conducted during summer for a period of 21 days. The data on milk yield and its constituents (fat and SNF) were recorded seven days prior to suggested intervention and fourteen days afterwards. The results revealed that the average milk yield significantly ($P<0.05$) increased after intervention. The milk SNF content also significantly ($P<0.01$) improved after supplementing maize grain powder when compared to previous feeding practice. The milk fat remained statistically similar during before and after the intervention except in one village. It was concluded that feeding of energy rich concentrate feed ingredients along with mineral mixture improves the SNF content of milk of crossbred cattle.

Key words: Dairy Cattle, Ground Maize Grain, Mineral Mixture, Milk Fat, Milk Solid-Not-Fat

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Introduction

Solid components (fat, protein, lactose, minerals) in the milk are economically important to milk producers and processors and nutritionally important to consumers. Both quality and quantity of milk produced are determined mainly by genetics and feeding practices. Though other factors such as breed, stage of lactation, level of milk production, age of cow, environment and disease condition affect milk composition, low milk fat and SNF problem in dairy cow is largely of nutritional origin (Rook and Line, 1961; Annison and McDowell, 1977). Feeding practices of dairy animals will have major impact on levels of fat and SNF concentration in milk. Fat and SNF components of milk will vary with changes in the diet. However, the variation in SNF component is to a lesser degree compared to that of fat content of milk. This problem is more common during summer season due to scarcity and poor quality of feedstuffs. The low milk fat condition is due to inadequate fiber in the diet. However, low SNF problem is almost invariably associated with underfeeding. Several on-farm trials indicated that the possible reason for low SNF in milk in field animals could be on account of deficiency of various critical nutrients (Garg, 2012; Garg *et al.*, 2016). Thus nutritional factor plays a major role and is the key tool available in the hands of the dairy farmer whereby he can modify the milk composition accordingly. In this context, the present study was undertaken to identify the cause for low fat and SNF problem in milk of certain cows of the farmers in the watershed area and to undertake appropriate intervention to overcome the above situation.

Materials and Methods

During the base line study conducted in the sub-watershed area in Chamarajanagar District, Karnataka State, India under Sujala III watershed project, many farmers expressed the problem of low fat and SNF in the milk of their cows. Hence, a technical committee was formed to investigate the nutrient status of field animals having low SNF in milk and whether or not the correction of major nutrient deficiencies help in ameliorating the situation. For the purpose, two villages viz. Kethahalli and Maleyur under Harave sub-watershed area were selected and the experiment was conducted during the months of April-May 2016 and during July-August 2016, respectively. The list of farmers facing low fat and SNF problem was prepared with the help of Milk Producers' Co-operative Societies. All the milking animals belonging to the enlisted farmers were screened and 16 animals with low SNF in each village were identified for the study. The body weight of the animals were calculated using Shaeffer's formula-

$$\text{Body weight (kg)} = [(\text{heart girth in inches})^2 \times \text{length of the body in inches}] /660.$$

Prevailing feeding practices for these animals were measured right at the milk producers' doorstep for three consecutive days. The details of the animals under study are presented in Table 1. Thereafter, based on body weight and milk production amount of nutrients required by the animals, particularly for digestible

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crude protein (DCP), total digestible nutrients (TDN), calcium and phosphorus were calculated. By taking into account all the components of the ration, the supply and balance of selected nutrients of the animals were tabulated.

Table 1: Details of animals under the study

Particulars	Kethahalli	Maleyur
Avg. cow body weight (Kgs)	345	330
Avg. milk yield per day (Kgs)	6.34	5.44
Avg. dry fodder intake (Kgs)	6.21	5.50
Avg. green fodder intake (Kgs)	-	11.88
Avg. concentrate mixture offered (Kgs)	2.14	2.13

Based upon the nutrient balance, feeding strategy to be followed to maximize the solid components of milk was recommended to the farmers. Since the energy and minerals are the important nutrients for milk production, the farmers were suggested to supplement the animal ration with ground maize grain @ 200 g per liter of milk produced along with mineral mixture @10 g per litre of milk. The milk yield and its composition viz. fat and SNF were recorded from one week prior to the intervention and up to two weeks post intervention.

Result and Discussion

The data on lactating animals and the feeding practices followed by the farmers were analyzed to ascertain the nutritional cause for the low fat and SNF problem and the details are given in Table 2. The nutrient balance study revealed that all the animals were receiving lesser amount of nutrients particular energy and minerals than the amount required to sustain milk production.

Table 2: Nutrient balance of the cows in experiment

Nutrient, g	Kethahalli			Maleyur		
	Required	Provided	Deficit	Required	Provided	Deficit
Total Digestible Nutrients	4814	3060	1754	4428	3914	634
Digestible Crude Protein	582	270	312	525	375	150
Calcium	43	9.7	33.3	40	11.5	28.5
Phosphorous	30	3.9	26.1	28	4.8	23.2

The lower fat and SNF contents is common during the summer months of the year. This indicates that the fat and SNF are more vulnerable to the environmental temperature which indirectly reflect the plane of nutrition. Dry roughages such as sorghum stover, ragi straw and horse gram straw form the major portion of rations of dairy cows in Chamarajanagar region. These feedstuffs contain high amount of fiber and low in soluble carbohydrates. Such rations with minimal grains possess insufficient non-structural carbohydrates, increases fat percentage and reduce yield and protein percentage. Thus, feeding proper non-

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structural carbohydrates levels can improve milk fat and protein test. Hence, feeding limited quantity of cereals such as maize, sorghum, etc. will improve SNF content of milk. In the experiment maize grain mash was used to supplement the routine feeding practice.

The two most important major minerals affecting milk composition are calcium (Ca) and phosphorous (P). 2.8 g Ca and 2.0 g P should be provided per kg of milk produced. The trace minerals routinely included in mineral mixture of dairy cattle are Se, Mn, Zn, Fe, I, Co, Cu. Further, P, S and Co are also required by ruminal microbiota for fermentation of the plant cell walls and release of cell contents (Storm and Orskov, 1983); Sniffen and Robinson, 1987). Thus, they play an essential role in digestion and thus influence appetite and feed intake. In this context standard mineral mixture available in the market and containing the above minerals was provided. Thus, the recommended feeding practice included: maize grain mash @ 200g and mineral mixture @ 10 g per litre of milk produced. This was fed to animals daily in two divided doses in the morning and evening over and above the routine feeding done by the farmers.

The milk production and composition of cows before and after intervention is presented in Table 3. On feeding maize grain mash and mineral mixture, average daily milk yield and milk fat increased from 6.34 to 6.45 kg; 3.85 to 3.86 % in Kethahalli village and from 5.29 to 5.48 kg; 3.67 to 3.82 % in Maleyur village, respectively. The SNF content of milk increased from 7.96 to 8.06% in Kethahalli village and from 7.94 to 8.05 % in Maleyur village. The increase in SNF content of milk of crossbred cattle was significant ($P<0.01$) in both Kethahalli and Maleyur villages while the significant increase in milk fat percentage was observed only in Maleyur village.

Table 3: Milk production and composition of cows before and after intervention

Particulars	Kethahalli Village			Maleyur Village		
	Milk Yield Kg	Milk Fat %	Milk SNF %	Milk Yield Kg	Milk Fat %	Milk SNF %
Before Intervention	6.34±0.49	3.85±0.01	7.96±0.01	5.29±0.37	3.67±0.06	7.94±0.01
After Intervention	6.45±0.49	3.86±0.02	8.06±0.01	5.48±0.37	3.82±0.02	8.05±0.01
P-Value	0.016	0.726	<0.001	<0.001	0.016	<0.001
Increase, units	0.11	0.15	0.11	0.19	0.15	0.11

The low SNF content in milk before intervention may be due to high fiber in the ration which limit milk protein production because not enough energy is consumed. The improvement in milk yield and SNF after intervention may be due to balancing of nutrients which might have improved microbial protein synthesis and also due to supply of essential minerals. Energy and protein are the most important limiting factors for milk production and its supplementation in the diets of lactating ruminants increased milk yield. Findings are similar to Haldar and Rai (2003) who reported improvement in milk yield due to supplementation of energy and mineral mixture in lactating ruminants. Kumaresan *et al.* (2008) also reported that energy

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enrichment with environmental management will increase the fat and SNF yield and performance of the animals in summer.

Another important aspect in the physiology of lactation is the severe drainage of minerals through milk. Supplementation of minerals in the diet of lactating ruminants has been reported to enhance milk production along with an improvement in milk composition (Kannan *et al.,* 2010). The results are in agreement with that of Dutta *et al.,* 2010; Kannan *et al.,* 2010 and Khochare *et al.,* 2010. In general, maintaining optimum levels of protein, energy and minerals is essential for rumen functions and synthesis of milk components in mammary gland.

Conclusion

It was observed that the dairy animals exhibiting low fat and SNF problem were deficit of all the major nutrients mainly energy, protein and minerals. The recommended intervention viz. supplementing maize grain mash @ 200g/kg milk and mineral mixture @ 10g/kg milk/day to the existing feeding practice had significantly increased milk production and SNF. However, no significant change in milk fat percentage was observed. Thus, it was concluded that supplementing animal's diet with energy rich feed source (maize, sorghum) and mineral mixture can increase the yield and SNF components of milk of crossbred cattle under the watershed areas of Chamarajanagar district.

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