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Mineral mixture supplementation for enhancing milk yield of milch animals in Haryana

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ABSTRACT

Most of the Indian soils are deficient in one or more minerals and these minerals are important in numerous biochemical reactions and deficiency may lead to metabolic diseases resulting lowering production performance in dairy animals. The study attempts to evaluate status nutrient intake in dairy animals, effect of reappropriation of available feed resources and mineral mixture supplementation on production performance in lactating cows and buffaloes in Katesara and Amarpur villages under Farmers' FIRST project in Palwal district. The animals were in their early lactation (40±5 days in milk) and milk yield, its composition, body weight and body condition score was recorded. Among the cow, 28% deficit, 35% excess dry matter; 41% deficit and 11% excess crude protein; 33% deficit and 25% excess total digestible nutrients (TDN) was provided. In buffaloes, 36% deficit and 40% excess DM; 45% deficit and 15% excess CP; 25% deficit and 12% excess TDN was provided. Reappropriation of DM, CP and TDN was done using available feed/ fodders available to the farmers and after 15 days, mineral mixture was provided @ 50 g/d for 60 days. The production performance record reveals no change in body weight but BCS was improved. Milk yield, fat, protein in cows were improved and other composition were remain unchanged. In buffaloes, milk yield, fat and protein improved while others, viz. lactose, SNF, ash and TS were similar due to supplementation of mineral mixture. The results conclude that imbalance of nutrients existed to the tune of 10 to 45% among various nutrients. One of the best propositions could be supplementation of mineral mixture to improve milk yield (10 to 14%) and fat per cent under field condition in both cows and buffaloes.

Keywords: Farmer FIRST, Milch animal, Milk yield, Mineral mixture

Indian soils are deficient in Zn (48.1%), iron (11.2%), copper (7%) (Gupta 2005). Shukla *et al.* (2015) observed that 6.1% manganese, 5.2% copper and 15.3% zinc and 21.6% Fe is deficient in the soils of Haryana. Zn and Cu deficiency in berseem fodder of Haryana is to the tune of 53 and 27.45%, in wheat straw is ranging from 43.7–78.9%, Cu deficiency in paddy straw is ranging from 21–35.75%, Zn deficiency in concentrate is 7.1–45.8% and Cu deficiency in concentrate is 10–44.4% (Kumar 2006). Forages (which are generally fed to the buffaloes) and blood minerals were far below the critical limit in Punjab (Bhandari *et al*. 2015).

Minerals are micronutrients which play many important role in immunity, cellular functions, growth and other productive and reproductive functions in animal system. In addition to its own cellular functions, the dam nourishes its calf through providing milk which contains almost all nutrients including minerals. As minerals are mostly deficient in soil vis-à-vis in feeds/ fodders, animals are also deficient in these minerals. The quantity of micronutrients present in the feeds and forages or crop residues may not be sufficient and farmers in Punjab and Haryana are not willing to add mineral mixture in the dairy ration, resulted in loss of milk yield. Field studies, though indicated that minerals are deficient in many states like Jharkhand and area specific mineral mixture may be supplemented to sustain milk yield in dairy animals (Bhandari *et al.* 2016). Mondal *et al.* (2014) observed that supplementation of concentrate and/ or mineral mixture may improve production performance in medium producing crossbred cows in hilly region. In another study, supplementation of mineral mixture with energy supplements (ground corn) in energy deficient animals, improved milk yield and SNF under field condition of Karnataka (Lakshminarasimhaiah *et al.* 2018). Mudgal *et al.* (2003) also reported that major nutrients are deficient under field condition due to unawareness among the farmers. In the present study, initially survey in the study are to ascertain the level of nutritional status, their reappropriation and then supplementation of mineral mixture to the dairy animals in Palwal district, Haryana was observed on production performance.

MATERIALS AND METHODS

A survey was conducted in two villages of Palwal district

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on number of milk producing animals, their production, productivity, feeds, and fodders available, feeding practices of dairy animals with basic information of 85 farmers. During the initial phase, feeding practices among the farmers were recorded to calculate the tune of deficiency or excess of nutrients in the ration. The nutrients were DM, CP, TDN, Ca and phosphorus. The data were compared with ICAR (2013) standard for every animal and expressed in terms of percent of total. Based on the data, 30 farmers selected who were ready to provide their animals (one cows and buffalo, respectively) for the experiment and ready to feed as per the experimental protocol. Available feed resources were wheat straw, oat fodder, berseem, sorghum fodder, oat hay, concentrate mixture (cotton seed cake, gram *churi*, mustard cake, maize grain, wheat bran home made concentrate mixture and type II compound feed). The ingredients were determined for its chemical composition (Table 1) as per standard technique (AOAC, 2005) and fibre fraction as per Van Soest *et al.* (1991). TDN calculated as per NRC (2001) equations based on chemical composition. Ca, Cu and Zn in the feeds and fodders were estimated in AAS (Hitachi) using standard protocol and P estimated spectrophotometrically.

Total 30 cows and buffaloes (separately) were selected in their early stage of lactation (40±5 days in milk) based on their milk yield and fed as per farmers' practice but requirement was calculated and fulfilled as per ICAR (2013) for every animal. Animals in each species were divided into two groups based on their milk yield and Group I was fed as per the farmers' practice while Group II animals were provided with 50 g mineral mixture per day per animal uniformly mixed with concentrate mixture available with the farmers. Body weight was calculated using Shaeffer's formula BW= [(heart girth in inches)^2 × length of the body in inches]/660; BCS by observation using 1–5 point scale where 1 is emaciated and 5 is fatty; dry matter intake (kg/d) fortnightly interval while milk yield daily and milk composition weekly during 105 days trial period. During the second year another group of farmers were selected and same experiment was conducted as in the first year.

Statistical analysis was done using SPSS software to observe the effect of supplementation in each species.

RESULTS AND DISCUSSION

Study suggested that farmers used a variety of ingredients to raise their dairy animals. Sometime they also used concentrate mixture with available ingredients and very few of the respondents purchased compound feed from market due to high cost. Chemical composition of the ingredients suggested that values were well within biological range (Table 1). No farmers used common salt or mineral mixture to their animals, due to unawareness of importance of these micronutrients. Perception of the respondents was that mineral mixture and common salt used for therapeutic or sub-therapeutic purposes to treat diseases. The study revealed that, most of the farmers were not feeding animals as per their requirement in the area. Figure 1 shown that among the cow, 28% deficit, 35% excess dry matter; 41% deficit and 11% excess crude protein; 23% deficit and 45% excess total digestible nutrients (TDN) was provided. In buffaloes, 36% deficit and 40% excess DM; 45% deficit and 15% excess CP; 25% deficit and 12% excess TDN was provided. Hence, it is clear from the initial study that farmers are not fulfilling the nutritional requirement of dairy animals due to unawareness of the nutritional demand of the cows and buffaloes. So, before providing any supplementation, requirement of animals and salt and mineral mixture, awareness camps were organized and meeting was held one to one to individual farmers under the project and then 30 farmers were mobilized to be the part of the programme to feed their animals as per our schedule.

Table 1. Chemical composition of various ingredients commonly used for feeding of animals (%)

Ingredient	DM	OM	CP	EE	NDF	ADF
Oat fodder	24.65	92.35	9.24	2.29	54.68	42.36
Berseem	23.48	87.54	16.57	2.78	49.35	35.82
Sorghum	21.09	91.58	7.91	1.09	65.27	46.51
Wheat straw	89.54	90.57	2.65	1.29	82.51	68.35
Cotton seed cake	91.65	92.65	34.68	6.57	52.38	35.61
Gram churi	89.61	93.57	16.54	2.57	55.35	34.06
Mustard cake	89.67	92.68	35.95	6.94	24.21	21.91
Maize grain	91.51	93.76	8.94	3.54	25.61	10.19
Wheat bran	89.46	92.51	13.04	3.76	45.61	20.19
Concentrate mixture (home)	86.59	91.58	16.71	3.51	37.21	21.49
Concentrate mixture (Type II)	89.25	91.65	18.21	4.52	28.57	20.75

Accordingly, team members from the project visited door to door of the selected farmers, regarding the animals' requirement and re-appropriation of available feed resources to fulfil the requirements and monitoring every day to manage feeding of the experimental animals. Performances of the cows fed with or without mineral mixture have been shown in Table 2. Body weight of the animals was similar (around 375 kg) in both the groups during the first year and little lower in the second year. DMI was around 11.5 kg/d/animal ($P>0.05$); while BCS was around 3.25 in all the groups, also similar in both the groups, though with higher numerical value. Milk yield and its composition in cows have been presented in Table 2. There was increase ($P<0.05$) in milk yield, almost 900 g/d/animal in the supplemented group than the unsupplemented group during first and second year of experiment. Fat and protein percent increased ($P<0.05$) in supplemented group as compared to the unsupplemented group, however, the increase was within biological range. Though, other components, viz. lactose, total solids, SNF was similar in all the groups.

Milk yield and its composition in buffaloes have been presented in Table 3. Milk yield increased from 8.80 kg to 9.75 kg/day/animal ($P<0.05$), almost 950 gram fat and protein percent was also increased from 6.7 to 7.2 and 4.25 to 4.35%, respectively, due to supplementation of mineral

Table 2. Milk yield and its composition in cows before and after mineral mixture supplementation

Parameter	First Year		Second Year	
	Group I	Group II	Group I	Group II
BW (kg)	373.45 ±24.21	381.25 ±27.16	355.46 ±15.64	378.20 ±20.54
Dry matter intake (kg/d)	11.05 ±1.54	11.51 ±2.19	11.73 ±2.19	12.73 ±1.57
BCS (1–5 scale)	3.15 ±0.38	3.40 ±0.26	2.85 ±0.84	3.12 ±0.68
Milk yield (kg/d)	8.52[a] ±0.28	9.41[b] ±0.29	7.38 ±0.97	8.31 ±0.46
Fat (%)	4.21[a] ±0.04	4.46[b] ±0.00	4.35 ±0.24	4.47 ±0.19
Protein (%)	4.25[a] ±0.28	4.44[b] ±0.01	4.31 ±0.15	4.47 ±0.13
Lactose (%)	4.69 ±0.02	4.82 ±0.02	4.71 ±0.13	4.68 ±0.21
Ash (%)	0.74 ±0.00	0.75 ±0.00	0.75 ±0.01	0.77 ±0.01
Total solids (%)	13.90 ±0.75	14.46 ±0.93	13.75 ±1.05	13.91 ±0.68
Solid not fat (%)	9.68 ±0.69	10.01 ±0.63	9.65 ±0.84	9.91 ±0.43

Different superscripts (a,b) in a row, differ significantly ($P<0.05$).

mixture during first year. Persistency of lactation curve, was better indicator of higher production in cows. Other components, viz. lactose, total solids, ash and SNF were similar in all the groups, though the increase of the components was within biological range. This indicates that the physiological ability of the animals were much higher if nutritional requirements are fulfilled. During the second year, performance trend was similar as observed in the first year. Somkumar *et al*. (2011) observed that supplementation of minerals of organic origin have the influence to improve production performance in dairy animals. Valle *et al*. (2015) concluded that supplementations of organic minerals have the ability to improve fat corrected milk yield and its performance and can utilize dietary energy more efficiently than non-supplemented group. Though, Hackbarth *et al.* (2010) suggested that supplementation of organic minerals takes more time to obtain results in dairy animals.

Body weight of the buffaloes was around 425 kg and DMI intake was around 13.0 kg/d during the experimental period. BCS was around 3.2 (1–5 scale), which was also similar ($P>0.05$) in both the groups. Milk yield initially was around 8.0 kg/d while in supplemented group increased ($P<0.05$) as compared to unsupplemented group. The increase was around 95 g/d/ animal. Fat percent and protein percent along fat and protein yield was increased in supplemented group. Other milk components viz., lactose, ash, total solids and SNF were similar in both groups. The lactation curve indicated that the better persistency in the supplemented group and the effect was pronounced almost after 35 to 45 days of supplementation. Bhandari *et al*. (2016) concluded that many states in India is minerals deficient in general, and Ca, P, Mg, S, Cu, Zn and Co in particular deficient in Jharkhand and advocated for area specific mineral mixture for improving dairy animals' life time performance. Lakshminarasimhaiah *et al*. (2018) reported that under field condition, mineral mixture supplementation improved milk yield without affecting fat level. Energy and protein are most important major nutrient which maintains the production performance but micronutrients especially minerals are regularly excreted out through milk for nourishment of offspring, hence regular supply warranted through diet. But most of the farmers are not aware of or due to high cost of mineral mixture available in the market, are not providing to the lactating animals, resulting in decreased milk production. Haldar and Rai (2003) reported that providing energy supplement and mineral mixture milk yield can be improved. Kannan *et al*. (2010) reported that supplementing mineral mixture milk and its composition may be altered. Minerals are involved in rumen microbial protein synthesis and thereby availability of protein to the lower gut and various cellular mechanism and homeostasis thereby maintain normal function in the organism. Regular supply of minerals warranted the availability of minerals and improves cellular function and productivity in dairy animals. Concentrate mixture and mineral mixture alone and /or in combination increased milk yield by 9–13% in low producing animals with higher body weight and BCS in hilly crossbred cows (Mondal *et al*. 2014). Literature also suggested that there is deficiency of major and minor nutrients under field condition (Mudgal *et al*. 2003, Deen *et al*. 2019) and limit the lifetime production performance in the dairy animals.

Table 3. Milk yield and its composition in buffaloes with or without mineral mixture supplementation

Parameter	First Year		Second Year	
	Group I	Group II	Group I	Group II
BW (kg)	438.46 ±18.54	429.84 ±29.57	450.50 ±34.19	465 ±21.46
Dry matter intake (kg/d)	13.25 ±1.94	12.84 ±2.19	12.88 ±1.26	13.15 ±1.80
BCS (1–5 scale)	3.09 ±0.84	3.21 ±0.67	3.12 ±0.12	3.35 ±0.11
Milk yield (kg)	8.80[a] ±0.33	9.74[b] ±0.30	8.07 ±0.67	9.21 ±1.09
Fat (%)	6.79[a] ±0.05	7.25[b] ±0.05	6.21 ±0.16	6.48 ±0.15
Protein (%)	4.22[a] ±0.02	4.39[b] ±0.01	4.27 ±0.12	4.48 ±0.13
Lactose (%)	4.63 ±0.04	4.84 ±0.02	4.60 ±0.01	4.58 ±0.14
Ash (%)	0.72 ±0.00	0.74 ±0.00	0.75 ±0.01	0.73 ±0.01
Total solids (%)	16.36 ±0.85	17.23 ±0.76	16.15 ±1.09	16.24 ±1.15
SNF (%)	9.57 ±0.75	9.96 ±0.84	9.82 ±0.35	9.31 ±0.46

Higher productivity, immunity and thereby higher profitability can be achieved by ration balancing and reappropriation of available stock under field condition by fulfilling requirement of the animals which will trigger the physiological potential to optimize production performance in dairy animals (Deen *et al*. 2019). Fulfilling the requirement will keep rumen healthy and continuous nutrient supply in the lower gut warranted the higher production which observed in the present study.

From the study of two years in the area, it is concluded that the dairy animals were deficient of dry matter, crude protein and total digestible nutrients and re-appropriation of available feeds resources along with mineral mixture supplementation of 50 g/day/animals improved the production performance of cows and buffaloes under field condition in Haryana.

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