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Chelated mineral supplement for boosting milk production

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Abstract
India being an agrarian country has a wide agricultural base complemented by an ever-expanding livestock sector which contributes 4.11% of total GDP and 25.6% of total agricultural GDP. As the ownership of livestock is more evenly distributed with landless labourers and marginal farmers, the progress in this sector will result in a more balanced development of the rural economy. So, it is quite imperative to boost this sector especially when it determines livelihood of millions of people. Increase in milk production and its sustainability are associated with both genetic and nutritional improvement factors. Chelated supplements are helps in enhance milk production. The effect of supplementing chelated minerals (fedamin) manufactured by 'Guybro chemicals' with the concentrate mixture was evaluated in terms of milk production, composition & mineral status of the animals on lactating 'Sahiwal' & 'Haryana' cows at 'Gowshala' Dairy farm, BHU, Varanasi. 1st group were put on control feeding, i.e. fed concentrate mixture without chelated minerals. The 2nd & 3rd group were given 50g (25+25 g morning & evening) & 75g (37.5+37.5 g morning & evening) of chelated mineral supplement/ head/ day respectively (fedamin). The chelated minerals were fed to the animals with concentrate mixture during milking time (Morning & Evening). The observations were recorded for 21 days. The milk composition was checked in Department of Animal Husbandry & dairying lab by 'Ekomilk' machine.It was concluded that the inclusion of amino acid chelates in the feed of lactating cows show statistically and economically significant positive effect such as 15-16 % increase in milk production when fed at the rate of 25 g/day.

Keywords: Chelated minerals, Fedamin, dairy, milk production

Introduction
Chelated minerals are minerals that have been combined chemically with amino acids to change its form and make it "complexes." Chelated minerals are used for supporting normal growth, stabilizing bipolar disorder, building strong muscles and bones, and improving immune system function and overall health. Promoters sometimes market chelated minerals as dietary supplements that are superior to other mineral supplements, claiming chelated minerals are used more easily by the body (more bioavailable) than non-chelated minerals. But there is no evidence to support this claim. In fact, there is very little scientific information about chelated minerals. One of the basic needs of ruminants along with a source of nitrogen and a source of energy is perhaps some vitamins and sources of minerals. Mineral supplements are nutritional devices to fortify the dietary needs of grazing or stall-fed livestock to prevent deficiency condition or to sustain production. In number of countries, chelated mineral supplements are available in market. Different organic ligands, e.g. EDTA, amino acids, peptides, etc. are used for mineral chelation. The advantage claimed with proteinases is on the basis that the proteinases and amino acids, as ligand in the metal chelate, are natural feeding components as against EDTA and thus, are likely to be utilized better (Kalimullin *et al.,* 1985) [2]. Chelation of mineral elements improves mineral availability in animals by preventing formation of insoluble precipitate and / or interaction with other minerals in gastrointestinal tract (Donald *et al.,* 1966) [3]. Recent studies also indicated high bioavailability of trace elements when given as chelates viz. amino acid chelates, proteinases, caseinates (Kalimulin *et al.,* 1985, Kincaid *et al.,* 1986) [2, 4] compared with their inorganic counterparts. The chelated minerals are absorbed in a significantly higher quantity than their inorganic counterparts and metal chelates are not yet manufactured in India. Considering the probable advantage of organic chelates over ionic salt forms of the mineral supplements for livestock, present study was undertaken with the objective of evaluating the effect of dietary supplementation of amino acid chelated mineral supplements on the performance of lactating cows in terms of milk yield, composition and mineral status.

Material and Methods

The experiment was conducted on lactating 'Sahiwal' & 'Haryana' cows at 'Gowshala' Dairy farm, BHU, Varanasi. For this study 6 cows were taken 3 of each breeds (Sahiwal and Haryana) and then distributed into three different treatment groups on randomly basis. i.e. T1 (control feeding, without chelated minerals), T2 (concentrate mixture with chelated minerals 50 gm.) and T3 (concentrate mixture with chelated minerals 75 gm). For this experiment chelated mineral 'Fedamin' manufactured by Guybro chemicals were used. The animal was selected for the experiment is between 3rd & 5th lactation and having ad lib. Feeding. The animals were divided into equal groups based on breed, lactation number & milk yield of the previous lactation. The observations were recorded for 21 days.

Feed Treatment

During the experiment, three groups of animals were randomly allotted to the following three feeding treatments.

Group- I: Concentrate mixture without addition of chelated minerals. This group contain 1 Sahiwal cow & 1 Haryana cow.

Group- II (50 gm. chelated mineral supplement): In this group 1 Sahiwal cow & 1 Haryana cow were selected & fed the chelated mineral along with concentrate mixture half an hour before the milking. 25 + 25 gm. each milking time.

Group- III (75 gm. chelated mineral supplement): In this group same method were apply. 1 Sahiwal cow & 1 Haryana Cow put on the feeding of chelated mineral along with concentrate mixture half an hour before the milking. 37.5 + 37.5 gm. each time.

Feeding Schedule

Roughages: Chopped maize (*Zea mays* L.), MP chari, legume forage, green grasses were used as the green roughage throughout the experiment. The maize was cultivated on the plots of Agriculture farm at Institute of Agricultural Sciences BHU, Varanasi. Chopped maize was offered daily to all the animals at the rate of 10-12 kg. Paddy straw, sorghum Stover was fed all the animals ad lib. As the source of dry roughage throughout the experiment.

Concentrate: Concentrate mixture was prepared from commercially available ingredients in bulk quantity & was offered to all the experimental cows at the rate of 1.5 kg for maintenance and 1 kg/ 2.5 kg milk produced as per the practice of the farm. Concentrate mixture, as production allowance was calculated based on average milk production of the cows during previous week. Feeding of concentrate mixture was undertaken two instalments, half an hour before each milking.

The effect of supplementing chelated minerals (Fedamin) with the concentrate mixture was evaluated in terms of milk production, composition & mineral status of the animals. Comparison was made in terms of body weight, body measurement parameters, dry matter intake, feed conversion ratio and cost of feeding.

Statistical Analysis

Data obtained were subjected to statistical analysis as per Snedecor and Cochran (1994) [6] using Completely Randomized Design (CRD). All the data were subjected to ANOVA using the General Linear Models procedure of SAS software. The mean differences among different treatments were separated by Duncan's multiple range tests. Consequently, a level of significant ($P<0.05$) was used as the criterion for statistical significance (Duncan, 1955) [7].

Table 1: Composition of chelated mineral 'Fedamin' manufactured by Guybro chemicals (nutritional value per kg

Mineral	Amount (per kg)
Vitamin- A	700000 IU
Vitamin- D3	70000 IU
Vitamin- E	250 mg
Nicotinamide	1000 mg
Cobalt	150 mg
Copper	1200 mg
Iodine	325 mg
Iron	1500 mg
Magnesium	6000 mg
Potassium	100 mg
Sodium	5.9 mg
Manganese	500 mg
Sulphur	0.72 %
Zinc	9600 mg
Calcium	25.5 %
Phosphorus	12.75 %

Results & Discussion

Dry Matter Intake

It is observed that the inclusion of chelated minerals in feed significantly affected the daily dry matter intake of the cows. The comparison of means of groups revealed that the daily dry matter intake of cows receiving 25 g chelated minerals was significantly higher than that of control and those receiving 75 g chelated minerals. However, the intake in 75 g cheated mineral group was significantly lower than other two groups. This indicated that the level of supplementation of chelated minerals significantly affected the dry matter intake of cows.

Milk Yield

The average daily milk yield of cows from groups I, II and III was 11.34, 14.43 and 7.53 kg, respectively. It is noticed that the cows receiving 25 g chelated minerals produced 15.54 % more milk than those of control. However higher level i.e. 75 g chelated minerals in the diet produced 8 % lower milk than that of control. Also, the cows receiving 25 g chelated mineral produced more milk than those receiving 75 g chelated minerals. It is observed that the feed treatments had significant effect on milk yield of cows. Further comparison of treatment means indicated that the milk yield of cows from group II receiving 25 g chelated minerals was significantly higher than that of control and group III. Similarly, it was also seen that the cows from group III produced significantly lower milk than control. This suggested that feeding of only 25 g chelated minerals is beneficial in increasing the milk yield of cows. The higher dry matter intake by group II was also reflected in corresponding higher milk yield.

Table 2: Milk composition before feeding chelated mineral

		Sahiwal			Haryana		
		490	**399**	**551**	**524**	**574**	**553**
1	Fat	3.33	3.60	3.51	7.34	5.87	3
2	SNF	8.70	8.1	8.94	7.46	8.90	9.08
3	Density	30.5	28.4	31.30	22.20	29.20	34.20
4	Protein	3.40	3.14	3.4	3	3.51	3.50
5	F.P.	-77.2	-52	-58.6	-49.70	-57.30	-60.50
6	Temp (0C)	30	30	30.1	32.10	32.10	34
7	Lactose	4.33	4.36	4.76	3.87	4.69	4.88
8	Z	3.2	3.32	3.06	2.98	3.77	4.08
9	pH	6.21	6.1	6.16	6.25	6.22	6.25

Table 3: Milk composition after feeding chelated mineral

		Sahiwal			Haryana		
		490	**399**	**551**	**524**	**574**	**553**
1	Fat	4.31	3.21	4.16	5.41	6.81	3.24
2	SNF	9.33	8.51	9.43	8.90	9.67	9.38
3	Density	32.20	30.10	32.80	29.60	31.50	33.30
4	Protein	3.64	3.34	3.67	3.50	3.80	3.64
5	F.P.	-60.70	-56.30	-61.40	-57.60	-60.50	-61.60
6	Temp (0C)	33.20	32.20	32.60	33.20	33.70	32.80
7	Lactose	4.96	4.56	5.03	4.70	5.11	5.01
8	Z	3.61	3.82	4	4.33	3.62	3.72
9	pH	5.84	5.78	5.81	5.76	5.57	5.75

Fat Corrected Milk Yield

The average daily fat corrected milk yield for groups I, II and III was 9.92, 12.43 and 8.63 kg, respectively. Thus, cows receiving 25 g chelated minerals/day produced about 25% more FCM as compared to control. From the observation it is seen that supplementation of chelated minerals significantly ($P < 0.01$) affected the FCM yield. The comparison of group means revealed similar trend as observed for absolute milk yield from different groups.

Milk Fat

The milk fat percent during experimental period ranges between 3.36 to 4.38. The average milk fat percentage for groups I, II and III was 3.56, 5.34 and 4.91 respectively. This indicated that there was increase in milk fat content of cows receiving chelated minerals. It is noticed from that the feed treatment had significant ($P < 0.01$) effect on milk fat content. Further comparison of treatment means indicated that milk fat content was significantly higher for cows receiving chelated minerals as compared to control. Similarly, the cows receiving chelated minerals at 25 g level produced milk with significantly higher fat as compared to those receiving at 75 g level.

Solids Not Fat

The average SNF percentage for groups I, II and III was 8.60, 8.54 and 9.11, respectively. It is seen that the SNF percentage of the milk of cows receiving chelated minerals was lower than that of the control. The above data were analyzed statistically, and the results are presented in Table. From this, it is evident that the treatments had significant effect on the SNF content of the milk. The same was significantly reduced as compared to control when chelated minerals were used in the diet at either level. However, the difference between the groups receiving chelated minerals was non-significant.

Prasad *et al.*, (1995) [8] reported the higher yields of SNF in the groups supplemented with caseinates and chelates than the control. The reverse trend was observed in the present trial.

Protein

The average milk protein percentage was 3.34, 3.44 and 3.57, respectively for the groups I, II and III. Thus, the protein contents of milk from cows receiving various feed treatments were almost similar. The above data were subjected to statistical analysis and the results of the same are presented. The statistical analysis indicated no significant effect of treatments on the protein content of milk.

Kincaid *et al.* (1986) [4] and Moore *et al.* (1988) [9] reported that the milk protein percentage was not affected by supplementing Zn-methionine to the lactating cows. Similar trend was also noticed in the present trial. However, Prasad (1995) [8] reported higher protein yield in the groups supplemented with caseinates and chelates than the control.

Total Ash

The average total ash percentage was 0.742, 0.756 and 0.754, for the groups I, II and III, respectively. It is noticed from the table that the total ash content of milk from cows receiving chelated minerals was slightly higher as compared to control. However, when the above data were subjected to statistical analysis, it was observed that the apparent differences were statistically non-significant.

Conclusion

From this study, it is concluded that the inclusion of amino acid chelates in the feed of lactating cows show statistically and economically significant positive effect such as 15-16 % increase in milk production when fed at the rate of 25 g/day and enhanced milk fat in milk. Chelated supplements produce non-significant effect in protein and ash percentage but reduced the SNF percentage in milk.

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