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EFFECT OF SUPPLEMENTATION OF CHELATED MINERALS ON FEED CONVERSION EFFICIENCY OF BUFFALO CALVES

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ABSTRACT
The experiment was conducted to determine the effects of supplementation of chelated minerals on feed conversion efficiency in buffalo calves (6 to 12 months of age). Fifteen buffalo calves were divided into three groups each having five animals in such a way that mean body weight was similar (P>0.05) among the groups. Each group was assigned to one of the following diets as: control diet with conventional mineral mixture (T_1), diet with 50% conventional mineral mixture replace with chelated minerals (T_2) and diet with 100% conventional mineral mixture replace with chelated minerals (T_3). The results of the study revealed that on or after 45 days there was significantly higher (P<0.05) body weight gain in T_3 treatment as compared to control T_1. The average daily gain then follow similar trend till the end of experiment. Average daily weight gains at the end of experiment, for the corresponding groups were 560.00, 613.33 and 693.00 g/d, respectively. Daily dry matter intake on or after 45 days of experiment was significantly (P<0.05) higher in calves fed concentrate mixture supplemented with chelated minerals (T3) replacing 100% levels of inorganic mineral as compared to fed concentrate mixture supplemented with inorganic mineral mixture (T1). The results show that after 45 days feed conversion efficiency values were significantly (P<0.05) increased in T_3 treatments as compared to T_1. The present study concluded that feeding of chelated minerals has beneficial effect on feed conversion efficiency of buffalo calves.

KEY WORDS: calves, chelated minerals, feed conversion efficiency, dry matter intake.

INTRODUCTION
Minerals are essential for growth and reproduction and are involved in a large number of digestive, physiological and biosynthetic processes in the body. Animal obtain minerals through the consumption of natural feeds, fodders and supplementation of inorganic salts as mineral mixture in the ration. Minerals are supplied to the livestock through mineral mixture in the inorganic form. One of the major disadvantages of using such supplements is that the minerals from such sources are not fully absorbed due to antagonism and anti-nutritional factors present in the diet. In addition, higher levels of inorganic salt based mineral mixture resulted in increased excretion, which may cause environmental pollution. Therefore, in order to meet the increasing demand of bio-available elements and to reduce the contamination of surface water and soil, the concept of chelated mineral / mineral proteinase came up (Spears, 1989). A chelated mineral is a mineral such as copper, zinc, manganese, cobalt or iron (there are others) that is bonded to "small proteins", peptides or amino acids. The level of chelated minerals in livestock feeding is typically added at 25-30% of the total mineral in a feed (Jackson, 1993). There are several studies in different animal species with different sources of different mineral elements, which have revealed notable differences in the bioavailability of organic and inorganic minerals. Studies suggest that binding of Cu, Zn, Fe and Mn with amino acids and peptides can enhance the bioavailability of these trace minerals, thereby leading to improved milk production, growth, digestivity, reproduction and general health status in livestock (*Pal* and *Gowda*, 2015). Due to the paucity of the literature on the effect of chelated mineral on the digestivity of buffalo calves, the present study has been planned to evaluate the efficacy of chelated mineral mixture on the feed conversion efficiency of buffalo calves.

MATERIALS & METHODS
The experiment was conducted for the period of four months to study the effect of supplementation of chelated minerals on the growth performance of buffalo calves. The fifteen buffalo calves were randomly distributed into three treatment groups each having five buffalo calves in such a manner that average body weight and age of each experimental group was statistically similar. In treatment T_1 (control) animals were fed with seasonal green fodder, wheat straw and conventional concentrate mixture throughout the experiment period while treatment T_2 animals were fed similar to T_1 but 50% conventional minerals mixture were replaced by chelated minerals. Likewise in treatment T_3 conventional concentrate mixture was supplemented with 100% chelated minerals per animal per day. The amount of concentrate mixture was given to each group in such a way that the experimental ration remains iso-nitrogenous and iso-caloric. The quantity of different feeds given to each group was adjusted at fortnightly intervals so that the overall DCP requirements of buffalo calves were met according to the

change in body weight. All the experimental animals were weighed before start of experiment, and thereafter at fortnightly interval using stander platform weighing balance. The weights were recorded in the morning for two consecutive days, before feeding and watering of the animals. Daily feed intake during the experimental period by individual buffalo calf was determined on the basis of feeds and fodder offered and weigh back. On the basis of feed and fodder consumption, dry matter consumed per day was estimated. The DM consumed and body weight gains were used to calculate FCE i.e. body weight gain (g) per kg of DM intake at fortnightly intervals by animals during the experimental period for each treatment.

Observation recorded

1. Body weight gain

The buffalo calves were weighted at the beginning of the experiment and thereafter at fortnightly intervals using standard platform weighing balance (Avery, capacity 1000kg) installed at animal farm, LUVAS, Hisar. The body weight was recorded in the morning before providing any water or feed to the buffalo calves. These body weights were used for determining the growth rate and also for the purpose of the computing the ration for the buffalo calves.

2. Feed intake

The buffalo calves were given weighted quantity of feed and fodder daily as per computed ration. Daily feed intake during the experimental period was determined on the basis of feeds and fodder offered and left over and data were compiled on monthly basis.

3. Feed conversion efficiency (FCE)

On the basis of feed and fodder consumption, DM consumed by the animals were estimated. The feed gain ratio is a measure of efficiency of utilization of feed. For the calculation of FCE, body weight gain (g) per kg of DM intake was calculated.

Statistical analysis

The data were analyzed statistically using standard methods (Snedecor and Cochran, 1994). The data were expressed as Mean ± SE and were analyzed by one-way ANOVA using general linear model of SPSS version 16 and Duncan's multiple range tests was applied to test the significance. Significance was declared when P value is less than 0.05 (Duncan, 1955).

Chemical composition of the concentrate mixtures (AOAC, 2005)

Chemical composition of the concentrate mixtures of various proximate nutrients and mineral contents has been presented in table 1, 2, 3 and 4.

TABLE 1: Ingredient composition of experimental concentrate mixture (kg)

Ingredient	T_1	T_2	T_3
Maize	15	15	15
Wheat	15	15	15
GNC	25	25	25
Mustard Cake	15	15	15
Wheat Bran	27	27	27
Common salt	1	1	1
Mineral mixture	2	2*	2**
Total	100	100	100

*supplemented @conventional mineral mixture replaced with 50 % chelated minerals
**supplemented @conventional mineral mixture replaced with 100 % chelated minerals

TABLE 2: Proximate composition (per cent) of concentrate mixture

Treatments	Attribute								
	DM	OM	CP	CF	EE	NFE	TA	NDF	ADF
T_1	89.77	89.3	19.93	6.97	4.12	52.36	10.70	37.44	18.60
T_2	90.01	89.31	19.90	6.92	4.05	52.12	10.69	37.40	18.25
T_3	89.04	89.35	19.80	6.88	4.09	52.26	10.65	37.47	18.44

TABLE 3: Chemical composition (%) of whole diet fed to the experimental animals

Ingredients	DM	OM	CP	CF	EE	ASH	NDF	ADF	NFE
Maize	92.20	97.50	9.03	2.65	3.39	2.50	67.70	44.36	82.43
Wheat	91.61	97.77	10.89	2.77	3.15	2.23	23.07	10.12	80.96
Wheat Bran	92.86	93.88	12.00	11.83	1.01	27.07	49.23	16.13	48.09
GNC	92.70	90.00	39.16	8.00	8.30	7.50	19.20	10.12	37.04
Mustard cake	93.46	93.17	34.62	8.33	6.25	6.83	23.50	13.27	43.97
Maize Green	25.00	14.30	7.45	27.00	3.40	10.70	64.87	37.84	51.45
Wheat Straw	90.00	78.00	2.81	35.00	1.05	12.00	74.83	51.90	49.14

RESULTS & DISCUSSION

Average daily gain (ADG)

After first fifteen days average daily weight gain were 480.00, 533.33 and 560.00 g/d in T_1, T_2 and T_3, respectively. The results of the study revealed that on or after 45 days there was significantly higher ($P<0.05$) body weight gain in T_3 treatment as compared to control T_1. The average daily gain then follow similar trend till the end of experiment. Average daily weight gains at the end of experiment, for the corresponding groups were 560.00, 613.33 and 693.00 g/d, respectively (Table 4).

TABLE 4: Average daily body weight gain (g) of experimental buffalo calves at fortnightly intervals

Days	T_1	T_2	T_3
15 Day	480±13.33	533.33±12.16	560.00±15.31
30 Days	506.66±16.66	586.66±15.00	586.66±21.00
45 Days	533.33^{a}±20.30	586.66^{ab}±36.98	666.66^{b}±12.65
60 Days	506.66^{a}±18.66	560.00^{ab}±16.66	613.33^{b}±15.65
75 Days	533.33^{a}±14.16	586.66^{ab}±19.65	666.00^{b}±22.21
90 Days	560.00^{a}±29.88	613.33^{ab}±22.65	693.23^{b}±.26.66
105 Days	586.66^{a}±15.65	640.00^{ab}±17.66	720.00^{b}±16.65
120 Days	560.00^{a}±26.66	613.33^{ab}±23.33	693.00^{b}±21.66

Values are means ±standard errors
The means in a row with different superscripts differ significantly between the treatments (P<0.05)

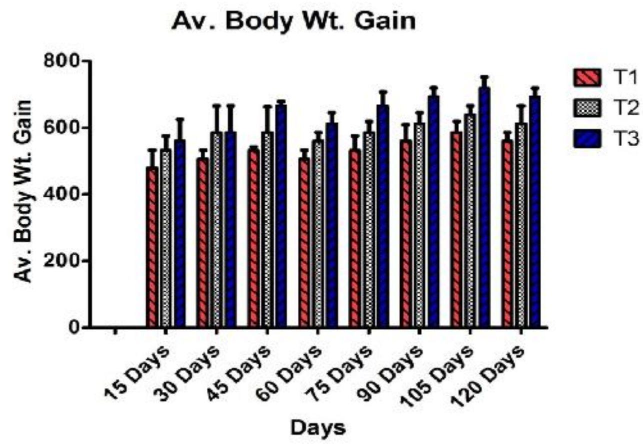

FIGURE 1: Average daily body weight gain (g)

Mowat *et al*. (1993) and Hong *et al*. (2002) observed that there was increase in daily weight gain of beef steer when basal diet was supplemented with chelated chromium. Mallaki *et al.* (2015) also found similar pattern of significant (P<0.05) improvement in average daily weight gain in lambs by supplementing zinc peptide in treated group over control. Similarly Bhanderi *et al.* (2010) concluded that supplementation of MBOTMs at NRC requirement in male calves can improve the body weight gain than that of inorganic trace minerals. Our results are in agreement with previous finding of Mondal *et al*. (2008) who reported the similar pattern of significant (P<0.05) improvement in average daily weight gain in male calves by supplementing chelated minerals in treated group over control. Improvement in body weight due to feeding of chelated minerals in T_2 and T_3 treatments respectively might be due to the better availability of minerals at absorption site in small intestine as chelated minerals escape the rumen and being available for the absorption in the small intestine and helps in better growth of Buffalo calves.

Dry matter intake (kg/day)

It was observed that there was a linear increase in DMI during progressive growth period of calves under different dietary treatments. The dry matter intake values did not differ significantly up to 45 days of experiment between different treatments, however, on or after 60 days DMI increased significantly (P<0.05) in calves of treatment group T_3 which were fed diet supplemented with chelated minerals as compared to T_1 fed inorganic mineral mixture (Table 5).

TABLE 5: Average dry matter intake (kg/day) of experimental buffalo calves at fortnightly intervals

Days	T_1	T_2	T_3
15	2.90±0.05	2.97±0.06	2.99±0.06
30	3.13±0.06	3.22±0.05	3.26±0.04
45	3.51±0.04	3.57±0.04	3.56±0.05
60	3.73^{a}±0.06	3.85^{ab}±0.03	3.89^{b}±0.01
75	3.85^{a}±0.03	3.96^{ab}±0.03	4.00^{b}±0.05
90	4.09^{a}±0.01	4.19^{ab}±0.01	4.21^{b}±0.02
105	4.23^{a}±0.01	4.36^{ab}±0.01	4.46^{b}±0.02
120	4.38^{a}±0.01	4.47^{ab}±0.01	4.61^{b}±0.02

Values are means ±standard errors
The means in a row with different superscripts differ significantly between the treatments (P<0.05)

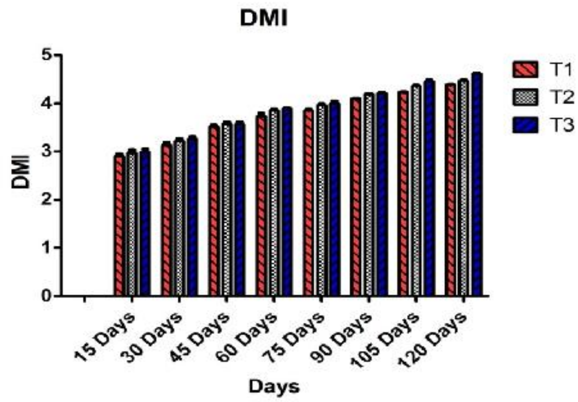

FIGURE 2: Dry matter intake (kg/day)

The findings of the study are in agreement with earlier reports of Mallaki *et al*. (2015) who found that nutrient digestibility and dry matter intake was higher in the lambs fed the diet supplemented with the chelated mineral.

Feed conversion efficiency (FCE):

After first fifteen days FCE values was 15.87, 13.40 and 18.33 in T_1, T_2 and T_3, respectively. The results did not show any significant difference in FCE values among the different treatments up to 30 days but after 45 days FCE values were significantly (P<0.05) increased in T_3 treatments as compared to T_1. The FCE values then follow similar trend till the end of experiment i.e. up to 120 days. The FCE values at the end of experiment, for control T_1, T_2 and T_3 treatments was 13.13, 10.61 and 9.81, respectively (Table 6).

TABLE 6: Feed conversion efficiency (BW gain g/kg DMI) of experimental buffalo calves at fortnightly interval

Days	T_1	T_2	T_3
15	15.87±1.12	13.40±1.00	18.33±1.49
30	13..72±2.58	16.65±2.05	18.38±3.12
45	13.06^{a}±0.62	15.38^{ab}±1.94	17.89^{b}±1.20
60	13.19^{a}±0.96	14.55^{ab}± 0.81	17.25^{b}±0.96
75	13.03^{a}±1.06	14.09^{ab}±0.64	16.49^{b}±1.16
90	12.32^{a}±0.84	14.84^{ab}±0.72	16.01^{b}±1.69
105	12.40^{a}±0.75	14.83^{ab}±0.90	15.24^{b}±0.85
120	13.13^{a}±0.76	14.81^{ab}±0.81	16.24^{b}±1.27

Values are means ±standard errors

The means in a row with different superscripts differ significantly between the treatments (P<0.05)

The finding are in agreement with the study of Mallaki *et al.* (2015) who reported improved FCE in lambs fed chelated minerals. Similarly Dey and Garg (2004) observed significantly improved feed efficiency in weaned albino rats given organic Zn compared to unsupplemented and ZnSO4 supplemented groups.

CONCLUSION

From the result obtained in the present study it can be concluded that feeding of chelated minerals has beneficial effect on the feed conversion efficiency of buffalo calves.

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