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Effect of chelated mineral supplementation on productive and reproductive performance of lactating buffalo

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ABSTRACT

The present study was conducted to assess the effect of chelated mineral mixture supplementation on the productive, reproductive performance and economics of lactating buffalo. Trial was conducted on 40 buffaloes of nearly at the same lactation stage, milk yield and parity selected from village- Bhakhrana, Block- Kotputli, District- Jaipur, Rajasthan. Buffaloes were divided in two groups; 20 buffaloes were kept in each group, viz. control and treatment group. Two buffaloes of each farmer were selected to maintain similarity in feeding and management practice. Treatment group was fed with chelated mineral mixture @ 40 g/buffalo/day till 90 days of early lactation period, whereas the control group was not supplemented. The data were recorded by the farmers daily in the morning and evening and by the researcher at fortnightly interval. Analysis of data revealed that supplementation of chelated mineral mixture increased the milk yield by 1.55 lit/day (15.82%) in treated group. Similarly, reproductive performance traits such as onset of first estrum after calving, no. of AI required for conception and service period were also recorded at the same interval between these groups. The B:C ratio of chelated mineral mixture supplementation was observed 1:7.75 under farmer management practices. These findings may suggest that supplementation of chelated mineral mixture enhanced the productive and reproductive performance for getting higher return and sustainable profit from buffalo farming.

Keywords: Chelated mineral mixture, Lactating buffalo, Production, Reproduction

India has the largest buffalo population in the world and ranked first in milk production (187.75 million) during 2018–19. The per capita milk availability in the country is 394 g/day which is much more than the world average consumption of milk 302 g/day (BAHS). However, per animal productivity is very low in the country which is mainly due to poor genetic makeup along with compromised nutritional status of the dairy animals which leads to various metabolic disorders and reproductive inefficiencies such as anestrous, repeat breeding, and infertility (Bach 2019). Hence, balanced nutrition is very essential for maintaining good body condition score (3 to 3.5) which render them enhancing the production and reproduction efficiency of dairy animals. Mineral deficiency in dairy animals is the foremost cause of poor growth rate; suppress body immunity, decreased milk yield, and various reproductive disorders (Bindari *et al.* 2013). During the past decade, significant research has been conducted for understanding the effect of macro/micro mineral supplements on the production efficiency in dairy animals (Griffiths *et al.* 2007, Garg *et al.* 2008). Various minerals are being depleted gradually in soil and cultivated fodder which reflect in dairy animals as deficiency syndrome of that particular mineral (Sharma *et al.* 2009). Hence, the quantity of minerals present in fodder/grasses may not be adequate for optimal growth, production, and reproduction performances, when fed to dairy animals (Griffiths *et al.* 2007). Livestock is mainly maintained on grazing without access to mineral supplement (McDowell *et al.* 1993). A large number of livestock in the tropics suffer from deficiencies or imbalances in mineral nutrition. 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 proteinate came up

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(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 oramino acids. The level of chelated minerals in livestock feeding is typically added at 25–30% of the total mineral in a feed (Jackson 1993). The present study was conducted in lactating buffaloes maintained under a semi-intensive management system in Jaipur district of Rajasthan State, India, under field conditions. Therefore, the present investigation was conducted to assess the effect of chelated mineral mixture supplementation on productive and reproductive performance of lactating buffalo.

MATERIALS AND METHODS

The present study was conducted under on-farm trial laid out during 2018–19 and 2019–20 in village-Bhakhrana, Block- Kotputli, District- Jaipur, Rajasthan to evaluate the impact of chelated mineral mixture supplementation on the productive, reproductive performance and economics of lactating buffaloes under farmer management practices. Every year, 20 buffalo were selected from Bhakhrana village to carry out this study. All the buffaloes were free from physiologicaland anatomical disorder and recently parturated. A total of 40 lactating buffaloes of nearly at the same lactation stage, milk yield and parity were selected belonging to 20 farmers. To maintain similarity in feeding and management practices, two buffaloes of each farmer were selected and one buffalo was kept as control (T_1) and another was supplemented with chelated mineral mixture and considered as treatment group (T_2). Thus, a total of 20 buffaloes were kept in treatment group and 20 kept under control group. All the buffaloes were managed under farmer's management practices. The feeding of buffaloes in control group (T1) 5–6 kg dry fodder, 30–40 kg green fodder and 6–7 kg concentrate per day per buffalo. The composition of the concentrate for both buffalo groups was similar. The concentrate was offered two times a day just before milking in morning and evening. In treatment group (T_2), in addition to above 40 g chelated mineral mixture per buffalo was supplemented continuously from the day one after calving for 90 days of experiment. A training programme was conducted for the farmers before starting the experiment to educate them for correct method of data recording on different parameters. The daily milk yield was recorded in morning and evening by the farmers in a diary and at fortnightly interval by the researcher. The data on onset of first post – partum estrus and no. of inseminations required for conception were recorded on the basis of dairy buffalo owner's response. The trail was conducted for a period of 90 days. The data were analyzed through GLM procedure. The liner model was used for all variables using least square analysis of variance. In the present fixed factors were treatments (T_1 –Control group and T_2-Treated group). The statistical analysis was carried out using SPSS software program, version 14.0. The level of statistical significance was set at $P<0.05$.

RESULTS AND DISCUSSION

Milk production parameter: Milk production parameters of lactating buffalo in the treated group (T_2) and control group (T_1) are presented in Table 1. The pooled average milk yield during the trial period was observed 11.35±0.36 and 9.80±0.36 lit./day/buffalo in treated and control group, respectively. It indicates that the average milk yield of buffalo in treated group was significantly higher ($P<0.01$) as compared to control group. Similar findings were also observed by Riad *et al.*(2018) and Somkuwar *et al.* (2011), an increase in milk production in dairy animals during the supplementation of chelated minerals. Kumar *et al.* (2020), Singh *et al.* (2020) and Gupta *et al.* (2017) showed that the after supplementation of area specific mineral mixture and trace minerals to dairy animals, which were associated with increased milk yield. Beside this, among the two groups, treated buffaloes were also produced significantly ($P<0.01$) higher mean pooled total milk yield (1021.50 litre) for 90 days than the control group (882.00 litre). Pal *et al.* (2020), Gupta *et al.* (2017) and Noeek *et al.* (2006) has also found higher milk yield in mineral supplementation group of dairy animals. Average daily milk yield and total milk yield was found higher in treatment group over control group by 15.82%. Gupta *et al.* (2017) and Singh *et al.* (2016) also observed same result of increases milk production in mineral supplemented dairy animals. The present results indicating that supplementing of chelated mineral mixture could increase milk yield of buffaloes due to having impact on the milk production cells in the udder. Their micro and macroelement contribute in the working of memory cell to enhance their production (Pal *et al.* 2020). These finding is in full agreement with the observations of Gupta *et al.*(2017) and Rohilla *et al.* (2007).

Table 1. Effect of chelated mineral mixture supplementation on milk production parameters in lactating buffalo

Treatment	Average milk yield (litres/day/buffalo)			90 day total milk yield (litres)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
T_1 (control group)	9.600	10.000	9.800	864.000	900.000	882.000
T_2 (treated group)	11.050	11.650	11.350	994.500	1048.500	1021.500
SEM	0.600	0.420	0.360	53.510	37.060	32.110
P value	0.102	0.011	0.004	0.102	0.011	0.004
Level of significance	NS	*	*	NS	*	*

*P<0.01, NS, Non significant.

Table 2. Effect of chelated mineral mixture supplementation on reproductive parameters in lactating buffalo

Treatment	Onset of first estrus after calving (days)			No. of AI/service required for conception			Service period (days)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
T_1 (Control group)	114.60	117.00	115.80	2.700	2.50	2.60	171.30	169.500	170.40
T_2 (Treated group)	87.40	95.20	91.30	1.700	1.60	1.65	123.10	130.900	127.00
SEM	3.47	3.57	2.51	0.210	0.22	0.15	7.27	6.680	4.85
P value	0	0	0	0.004	0.01	0	0	0.001	0
Level of significance	*	*	*	*	*	*	*	*	*

* P<0.01.

Reproductive parameter: Reproductive traits, i.e. onset of first estrus after calving, number of artificial insemination (AI)/ Natural service required for conception and service period were also recorded during the trial period as shown in Table 2. These reproductive traits significantly (P<0.01) differed in the treated group of dairy animals with the control group. The pooled average onset of first estrus after calving was lower (91.30 days) in treated group as compared to control group (115.80 days), which shows significant difference (P<0.01). These findings are in accordance to Singh *et al.* (2020), Kumar *et al.* (2020), Tanwar *et al.* (2019) and Gupta *et al.* (2017) also observed lower post-partum estrous in mineral mixture supplemented group than control. On average onset of first postpartum estrus was observed to occur 24.50 days earlier in the treated group as compared to control. Similar findings were also reported by Tanwar *et al.* (2019) in buffaloes.

The number of pooled mean insemination required for conception was lower in treated group (1.65) as compared to control group (2.60). The number of AI/Natural service required per conception was also significantly (P<0.05) lower in treated group as compared to control group. Service per conception was significantly lower in chelated mineral supplemented group than control. Similar findings were also reported by Tanwar *et al.* (2019), Bhuvaneswari (2019) and Gupta *et al.* (2017), there was a significant difference of a number of AI/ service per conception between mineral mixture supplemented and non-supplemented group in dairy animals.

The pooled average service period was observed 127.0±4.85 days in treated group and 170.4±4.85 days in control group. It was also found significantly (P<0.05) lower in buffaloes supplemented with chelated mineral mixture as compare to control group buffaloes. Similar findings were also reported by Singh *et al.* (2020), Kumar *et al.* (2020), Tanwar *et al.* (2019) and Gupta *et al.* (2017), there was a significant difference of service period between mineral mixture supplemented and non supplemented group in dairy animals. One and half month higher service period in control group reduces the profit of farmer from buffalo rearing. The improvement in reproductive performance of buffaloes due to chelared mineral supplementation as compared to the performance of non supplemented group was very clear.

Economics of chelated mineral mixture supplementation

A partial budget analysis measures was used in those items of expenditure and income. Therefore, the cost of fodder, concentrate feed and chelated mineral mixture have been considered. The cost of labour was not considered for calculation because it was same in both groups as family members were used in management of livestock. Economics of supplemented chelated mineral mixture of lactating buffaloes in the treated group (T_2) and control group (T_1) have been presented in Table 3. Economic analysis of the

Table 3. Economics of supplemented chelated mineral mixture in lactating buffaloes

Parameter	T_1 (Control group)			T_2 (Treated group)		
	2018–19	2019–20	Pooled	2018–19	2019–20	Pooled
Average milk yield (litres/day/buffalo)	9.60	10.00	9.80	11.05	11.65	11.35
Rearing cost (₹/day/buffalo)	180.00	180.00	180.00	188.00	188.00	188.00
Average rearing cost per litre of milk production (₹)	18.75	18.00	18.37	17.01	16.14	16.56
Gross return (₹/day/buffalo)	384.00	400.00	392.00	442.00	466.00	454.00
Net return (₹/day/buffalo)	204.00	220.00	212.00	254.00	278.00	266.00
B:C	2.13	2.22	2.18	2.35	2.48	2.42
Additional milk yield by supplementing chelated mineral mixture (litres/day)	–	–	–	1.45	1.65	1.55
Milk yield increase over control (%)	–	–	–	15.10	16.50	15.82
Value of additional milk (₹)	–	–	–	58.00	66.00	62.00
Cost of chelated mineral mixture supplementation (₹/day/buffalo)	–	–	–	8.00	8.00	8.00
B:C ratio for supplementing chelated mineral mixture	–	–	–	7.25	8.25	7.75

data showed that supplementation of chelated mineral mixture enhances the pooled mean milk yield by 15.82% per day in treated group. The mean rearing cost of per litre of milk was lower (₹16.56) in treated group as compared to control group (₹ 18.37) which showed that dietary supplementation of chelated mineral mixture under field condition reduced the cost of milk production sizably. Average gross return (₹/day/buffalo) was 454 and 392 treated and control group, respectively and mean net profit per day was found higher in treatment group (₹266/day/buffalo) than control group (₹212/day/buffalo). The mean benefit-cost ratio was also found higher in treated group (2.42) as compared to control (2.18). It was observed that buffalo rear farmer getting mean milk yield 1.55 litre and ₹62 additional per day by supplementing chelated mineral mixture and mean benefit-cost ratio of supplementing chelated mineral mixture was 1:7.75. Similar result to the present finding was in accordance with Singh *et al.* (2020) and Tanwar *et al.* (2019) in dairy animals.

It can be concluded from the present study that supplementation of chelated mineral mixture to the lactating buffaloes under field conditions not only increases the milk yield, but also reduce post-partum estrus period, number of AI/service per conception, service period, cost of per litre of milk production and consequently improving socio-economic conditions. Hence, it is needed to awareness created among the dairy farmers to supplement the chelated mineral mixture to their animals to get more profit from dairy animal farming.

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