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Assessment of chelated mineral mixture on milk production and economics in lactating buffalo

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Abstract
The current study's goal was to examine how chelated minerals feeding Murrah buffalo affected their ability to produce. For the on-farm trial, which KVK Hanumangarh carried out in 2020, 2021 and 2022, thirty Murrah crossbred buffalo of the third lactation were chosen. The selection process included 30 lactating crossbred Murrah buffalo from 30 distinct farmer herds, with an average milk output of 13.1 lit. Each animal was given 30 days of T1 Balance feed (which included a mineral mixture 50 g bd) before receiving 30 days of Balance feeding plus a chelated mineral mixture 30g bd. Data was collected by farmers daily in the morning and evening and by the researcher every two weeks. Data analysis showed that the treatment group's milk yield increased by 3.6 lit/day (27.5 percent) as a result of the addition of chelated mineral mixture. Under farmer management techniques, chelated mineral mixture supplementation's B:C ratio was reported to be 2.03. These results would indicate that chelated mineral mixture supplementation improved the reproductive and productive performance for a larger return and long-term profit from buffalo farming.

Keywords: Chelated minerals, murrah cross buffalo, milk performance

Introduction
India has the largest population of buffaloes in the world and produced the most milk (187.75 million tonnes) in 2018–19. The country's per-capita milk availability is 394 g/day, which is significantly higher than the global average milk consumption of 302 g/day (BAHS, 2019). However, due to poor genetic make-up and impaired nutritional condition of dairy cows, which cause a variety of metabolic diseases and reproductive inefficiencies such anestrous, repeat breeding, and infertility, the country's per-animal production is relatively low (Bach, 2019) [1]. Therefore, a balanced diet is crucial for maintaining a good body condition score (3 to 3.5), which improves dairy animals' ability to produce and reproduce. Mineral insufficiency in dairy cattle is the primary cause of slow growth, weakened bodily defences, reduced milk production, and different reproductive issues (Bindari *et al*. 2013) [3]. Significant study has been done over the past ten years to determine how macro/micro mineral supplements affect dairy cows' production efficiency (Griffiths *et al*. 2007, Garg *et al*. 2008) [5, 4]. Numerous minerals are gradually being removed from soil and cultivated feed, and this has an impact on dairy animals by causing a deficiency syndrome for that particular mineral (Sharma *et al*. 2009) [12]. Lack of trace minerals in the di*et al*one can cause a 20–30% reduction in animal productivity. Therefore, it has long been a practice to supplement trace elements in animal diets to assure their quick growth, improve reproductive efficiency, and enhance immunological response (Underwood and Suttle, 1999) [18]. When there is insufficient mineral intake, trace mineral deficits can develop as a primary deficiency or as a secondary shortage when other dietary components interfere with absorption and metabolism. Chelated minerals have been added to the diet in recent years to help with the aforementioned issue because they are more bioavailable than their inorganic counterparts (Spears, 1989) [16]. Increased mineral bioavailability for animals to support metabolic processes is the aim of the formation of chelates. The effects of chelated minerals on animal feeding trials, particularly in non-ruminants, are extensively established in a number of literatures. However, there are relatively few references available that discuss how adding chelated minerals affects the performance of dairy animals, notably buffalo. In order to determine how feeding chelated minerals affects the performance of murrah cross buffalo in terms of production, the current experiment was conducted.

Materials and Methods

In order to assess the effects of chelated mineral mixture supplementation on the productivity and economics of lactating buffaloes under farmer management practices, the current study was carried out under an on-farm trial that was laid out during 2020, 2021, and 2022 in District-Hanumangarh, Rajasthan. To conduct this study, 10 buffalo were chosen annually from the district. All of the buffaloes were recently parturated and were healthy physiologically and anatomically. A total of 30 lactating buffaloes from 10 different farmers were chosen, all of which were roughly at the same stage of lactation, milk output, and parity. Two buffaloes from each farmer were chosen; one buffalo was kept as the control (T1), and the other was supplemented with a chelated mineral mixture and was thought of as the treatment group in order to ensure consistency in feeding and management techniques (T2). Thus, a total of 15 buffaloes were kept in treatment group and 15 kept under control group. Prior to the experiment, a training programme was organized for the farmers to instruct them on the proper way to capture data on various criteria. The farmers used the same management techniques for all of the buffaloes. The control group (T1) buffaloes were given 500g concentrate feed / liter of milk production, 5-6 kg of dry feed, and 30–40 kg of green feed each day. Both buffalo groups received concentrates that had a comparable composition. Twice daily, just prior to milking in the morning and evening, the concentrate was given. For the duration of the experiment, a continuous 60-day supplementation programme of more than 30 g of chelated mineral mixture per buffalo was administered to the treatment group (T2). The farmers kept a logbook of their daily milk production, which the researcher also kept at intervals of every two weeks.

Results and Discussion

Milk production parameters of Lactating buffaloes in the treated group (T2) and the control group (T1) are shown in Table 1. In the treatment and control groups, respectively, there were 13.1 and 16.7 litres of milk produced per day per buffalo on average over the trial period. According to this, the treated group's buffalo had a greater average milk output than the control group. Similarly findings of an increase in milk production in dairy animals under the addition of chelated minerals were also noted by Riad *et al*. (2018) [10] and Somkuwar *et al*. (2011) [15]. Researchers Kumar *et al*. (2020) [7], Singh *et al*. (2020) [13], and Gupta *et al*. (2017) [6] demonstrated that dairy animals produced more milk after receiving supplemental area-specific mineral mixtures and trace minerals. In addition, treated buffaloes produced considerably ($P< 0.01$) more mean pooled total milk yield (1021.50 litres) throughout the course of 90 days between the two groups than the control group (882.00 litre). The milk yield of dairy animals receiving mineral supplements was also reported to be higher by Pal *et al*. (2020) [9], Gupta *et al*. (2017) [6], and Noeek *et al*. (2006) [8]. Average daily milk yield and total milk yield were found to be 15.82 percent greater in the treatment group than in the control group. Both Gupta *et al*. (2017) [6] and Singh *et al*. (2016) [14] noted an increase in milk output in dairy cows receiving mineral supplements. The current findings suggest that adding chelated mineral supplements may boost buffaloes' milk output by influencing the udder's milk-producing cells. Their micro and macro components help memory cells function and increase their creation (Pal *et al*. 2020) [9]. These results are completely consistent with what Gupta *et al*. (2017) [6] and Rohilla *et al*. (2007) [11] observed.

Economics of chelated mineral mixture supplementation. In order to measure those components of expenditure and revenue, a partial budget analysis was performed. The price of fodder, concentrate feed, and chelated mineral mixture have thus been taken into account. Because family members were used in the care of the animals in both groups, the cost of labour was not taken into account when calculating the results. Table 1 details the economics of the treated group (T2) and control group (T1) of lactating buffaloes that received chelated mineral supplements. Economic analysis of the data revealed that the treatment group's pooled mean milk yield increased by 27.5 percent per day with the addition of chelated mineral mixture. The mean rearing cost per litre of milk was much lower (13.63) in the treated group than in the control group (16.7), demonstrating that chelated mineral dietary supplementation under field conditions significantly decreased the cost of milk production. Average net profit per day was larger in the treatment group (233.5/day/buffalo) than the control group (143.2/day/buffalo), with average gross return (/day/buffalo) of 461.2 and 361.66 for the treated and control groups, respectively. Additionally, the treated group's mean benefit-cost ratio (2.03) was shown to be higher than in the control group (1.66). By supplementing chelated mineral mixture, buffalo rearing farmers were found to receive an average milk yield of 3.6 litres and 99.5 more each day. Similar results to the current finding were found in dairy cows by Singh *et al*. (2020) [13] and Tanwar *et al*. (2019) [17].

Table 1: Performance of technology in terms of milk production and economics (pooled)

Parameters	T1 (Balance feeding with Mineral Mixture @50 gm/ animal/day)	T2 (Balance feeding with Chelated Mineral mixture @ 30g/Animal/day)
Avg. Milk Prod.(lit.)	13.1	16.7
Average increase in milk prod.	27.5	
Avg. Cost of feeding (Rs./Ani./day)	218.5	227.65
Avg. rearing cost per litre of milk	16.7	13.63
Avg. Gross cost of Milk (Rs./Ani./day)	361.66	461.2
Avg. Net profit (Rs.)	143.16	233.55
Avg. B:C Ratio	1.66	2.03

Conclusion

The results of the current study suggest that providing chelated mineral supplements to lactating buffaloes in the wild not only boosts milk production but also improves socioeconomic situations. Therefore, it is necessary to raise awareness among dairy farmers about the necessity to give their animals chelated mineral supplements in order to increase the profitability of dairy farming.

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