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EFFECT OF SUPPLEMENTATION OF CHELATED MINERAL MIXTURE ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF DAIRY ANIMALS

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ABSTRACT

Chittoor is the cattle belt area with a population of 9,76,636 animals and mineral deficiencies are widely prevalent in dairy animals. The study was conducted as on farm trails by RASS KVK for three continuous years to assess the effect of supplementing chelated mineral mixture on the Productive and Reproductive Performance of milch cattle. A total of 120 animals were selected through simple random sampling which are in 2nd and 3rd lactation from six adopted villages of Vedurkuppam, Vadamalpeta, Renigunta, Karvetinagaram and KVB Puram mandals of Chittoor district. A group of sixty animals were fed with 50gms of chelated mineral mixture on daily basis for a period of 90 days and another group of sixty animals were not given any additional mineral mixture supplement which was the farmer practice in the study area. The farmers has a practice of not feeding any additional supplement other than green fodder, dry fodder and rice bran. Considering the importance of feeding balanced di*et al*ong with mineral mixture supplementation in improving the milk yield a trail was conducted from 2023-24 to 2025-2026. The data of milk yield, fat percentage was collected from the farmer and for every fortnightly average of milk yield and fat percentage was taken. The reproductive parameters like conception rate and no of AI per conception were noted. On analysis data revealed that there is an increase of 1.31 liters/day (23.4% increase than control group), 0.35 percent increase in fat percentage, Conception rate was also found 80% and no of AI for conception was found to be < 2, gross returns, net returns and B:C ratio were notably higher in trail group animals than control group animals. This suggests that continuous feeding of chelated mineral mixture improves milk production with increased conception rate there by recommending its usage on daily basis.

Keywords **:** Mineral mixture, Milk yield, Milk quality, Solids not fat, Fat percentage, Dairy nutrition, Rumen function.

Introduction

India ranks first in milk production attaining an annual production of 239 million metric tons in the year 2024 with annual growth rate of about 4%. Livestock productivity in India is often constrained by inadequate and imbalanced nutrient supply. Minerals such as calcium, phosphorus, magnesium, zinc, copper, cobalt, selenium, and iodine are essential for growth, reproduction, and lactation. However, conventional feeding practices relying on crop residues and low-quality fodder frequently fail to meet the mineral requirements of dairy animals. Deficiency of minerals adversely affects feed utilization, metabolic functions, and immune response, ultimately reducing milk production and quality. A study had shown that out of all nutrients available in feed, vitamin and minerals play a vital role in metabolism, lactation, reproduction and also in microbial fermentation in rumen (Bindari, Garg *et al*., 2014). Previous studies also described that reproductive performance of cattle can be improved with the help of trace minerals (Kumar *et al*., 2011). Supplementation of chelated mineral mixtures has been recommended as an effective strategy to enhance milk productivity and conception rate. This study focuses on assessing the effect of chelated mineral mixture supplementation on milk yield and conception rate.

Materials and Methods

Present study was conducted by RASS Krishi Vigyan Kendra for three continuous years as on farm trails in Tirupati and Chittoor districts of Andhra Pradesh, India during 2023,2024,2025 to assess the effect of mineral mixture feeding on milk yield and conception rate. The study was conducted in six adopted villages of Vedurkuppam, Vadamalpeta, Renigunta, Karvetinagaram and KVB Puram mandals of Chittoor district. Twenty lactating animals in 2nd and 3rd lactation were selected for the study for each year. To ensure the consistency of study two animals were selected from same farmer one under treatment and the other under control group. The animals in the control group were fed with 20-25kgs of green fodder, 3-4 kgs of dry fodder and 1.5 kg of concentrate feed along with this the animals in the treatment group were fed with 50gms of chelated mineral mixture for a period of 90 days. This mineral mixture contained calcium 25.5%, Phosphorous 12.75%, Magnesium, Iron, Manganese, Iodine, Sodium, Zinc, Sulphur, Copper, Cobalt, Potassium and VitaminA,D3 and E. Daily data on parameters like milk yield and fat % were taken from farmer and fortnightly by the researcher. The animals were checked for estrous signs and no of artificial insemination for conception were noted and confirmed pregnancy by the researcher at 3 months gestation during the study period. Three years data on milk yield, fat percentage, conception rate, no of AI per conception were pooled and subjected to statistical analysis. Data were analysed using descriptive statistics and t-tests were done to evaluate the effect of supplementation of chelated mineral mixture.

Results and Discussion

Milk parameters

The inclusion of chelated mineral mixture in the ration of dairy animals produced a marked improvement in milk performance over the three-year study period. Overall, milk yield increased by 23.7%, and in every year, animals receiving supplementation consistently outperformed those in the control group (Table 1). During 2023, the supplemented animals yielded 6.95 ± 0.69 L/day, whereas the control animals produced 5.62 ± 0.58 L/day; the difference was highly significant ($p < 0.001$, Table 2). A similar pattern continued in 2024, with the trial group producing 7.28 ± 0.75 L/day compared to 6.15 ± 1.00 L/day in the controls ($p < 0.001$). In 2025, yield further increased in the supplemented group (7.65 ± 0.63 L/day) while the control group averaged 6.17 ± 0.75 L/day, again with a highly significant difference ($p < 0.001$). The progressive rise in milk yield across the three years clearly demonstrates the long-term benefits of mineral mixture supplementation. Comparable improvements have been reported by Srivara (2019), Meher *et al.* (2017), Gupta *et al.* (2017), Pandey *et al.* (2017), and Nocek *et al.* (2006). Field reports by Mohsina *et al.* (2017) and Tiwari *et al.* (2013) also recorded substantial increases in milk production following the use of area-specific mineral mixtures. The enhancement in yield may be attributed to improved rumen fermentation efficiency, better energy metabolism, and more balanced endocrine activity, all of which are supported by adequate mineral intake. Mineral mixtures also help mitigate subclinical deficiencies, improve immune competence, and support udder health, ultimately contributing to higher productivity. The steady rise in milk yield from 6.95 L in 2023 to 7.65 L in 2025 in the trial group indicates that the animals responded well to the nutritional intervention. The highly significant p-values ($p < 0.001$) confirms that this improvement is not due to chance but is directly associated with mineral supplementation.

Milk fat percentage also improved significantly in all three years. The supplemented animals recorded fat levels of 3.77 ± 0.13 (2023), 3.65 ± 0.16 (2024), and 3.68 ± 0.12 (2025), while the control animals had lower values of 3.35 ± 0.23, 3.37 ± 0.19, and 3.34 ± 0.14, respectively. The differences were highly significant ($p < 0.001$, Table 2). These findings are in agreement with observations by J. Sai Kiran *et al.* (2024)

Table 1: Milk production and reproductive parameters of trail and control animals

Parameter	2023		2024		2025	
	Trail	Control	Trail	Control	Trail	Control
Milk yield	6.95±0.69	5.62±0.58	7.28±0.75	6.15±1.00	7.65±0.63	6.17±0.75
Fat percentage	3.77±0.13	3.35±0.23	3.65±0.16	3.37±0.19	3.68±0.12	3.34±0.14
Conception rate	0.75±0.44	0.30±0.47	0.80±0.41	0.50±0.50	0.85±0.36	0.65±0.51
No. of AI per conception	1.65±0.49	2.10±0.45	1.45±0.51	2.20±0.41	1.65±0.59	2.30±0.47

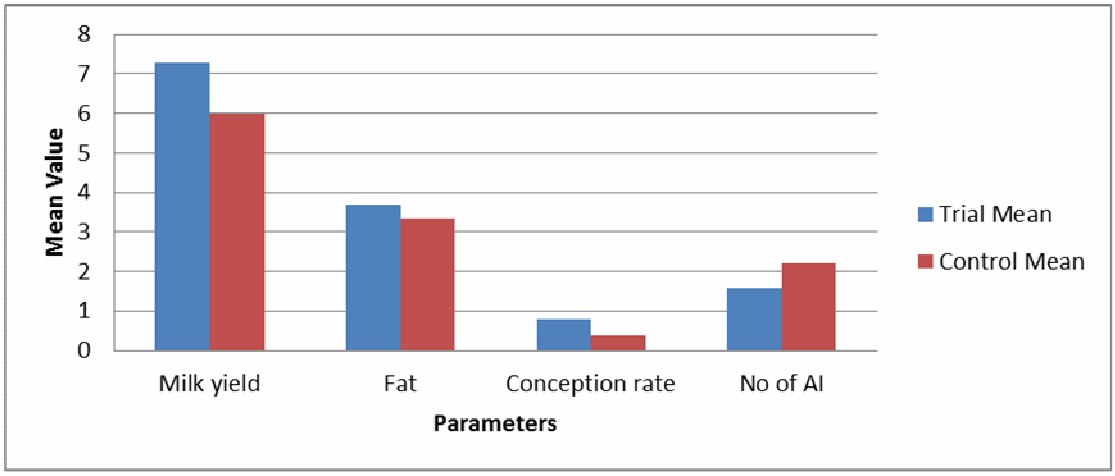

Fig. 1: Milk production and reproductive parameters of Trial Animals vs Control animals-All Parameters

Reproductive parameters

Reproductive performance results were depicted in the table 1. The study revealed that the conception rate is significantly higher in trail group animals which were fed with mineral mixture than control group animals.

Reproductive attributes showed clear improvement in animals receiving mineral supplementation (Table 1). The overall conception rate was notably higher in the trial animals (average 80%) compared to the control group (average 50%). Statistical analysis confirmed that conception rate remained significantly higher in the supplemented animals throughout the study ($p < 0.01$, Table 2). These results are consistent with earlier studies by Gupta *et al.* (2017), Behera *et al.* (2012), and Pranay Bharti *et al.* (2025). The number of inseminations required per conception was also lower in the supplemented group, indicating better estrus expression and reproductive efficiency. Trial animals required 1.65 ± 0.49 (2023), 1.45 ± 0.51 (2024), and 1.65 ± 0.59 (2025) inseminations, whereas the control group needed 2.10 ± 0.45, 2.20 ± 0.41, and 2.30 ± 0.47 in the respective years. This reduction in number of inseminations contributes to improved reproductive economics. The consistent statistical significance ($p < 0.01$) further supports the beneficial impact of mineral supplementation on reproductive physiology. Enhanced mineral balance may have contributed to improved hormonal regulation, ovarian activity, and overall reproductive health.

Table 2: Comparison of trail and control groups using t test statistics

Parameter	2023		2024		2025	
	T value	P value	T value	P value	T value	P value
Milk yield	***6.584513	1.02E-07	***4.018161	0.000294	***6.742133	6.32E-08
Fat percentage	***7.202941	4.78E-08	***5.039613	1.25E-05	***8.392272	4.18E-10
Conception rate	**3.111149	0.003534	**2.8568	0.00892	**2.847	0.00708

***Significant at 1 percent level of significance

Economic parameters

The economic assessment clearly highlights the financial benefits of mineral mixture supplementation (Table 3). In 2023, the supplemented animals generated a net return of Rs. 15,242 and a B:C ratio of 2.69, outperforming the control animals, which recorded Rs. 10,000 net returns and a B:C ratio of 2.00.

In 2024, the profitability gap widened further, with the trial group achieving Rs. 19,140/- net returns and a B:C ratio of 2.88, while the control group obtained Rs. 14,020/- and B:C 2.23. A similar trend was noted in 2025, where the supplemented animals recorded Rs. 21,610/- net income with a B:C ratio of 2.97, compared to Rs. 15,150/- and B:C 2.28 in control group

Table 3: Pooled Data of 3 years of Economics Analysis on supplementing chelated mineral mixture in dairy animals

Particular	2023		2024		2025	
	Trail	Control	Trail	Control	Trail	Control
Gross cost(Rs.)	9000	10000	10200	11400	10950	11800
Gross returns(Rs.)	24242	20000	29340	25420	32560	26950
Net returns(Rs.)	15242	10000	19140	14020	21610	15150
B:C ratio	2.69	2.0	2.88	2.23	2.97	2.28

Conclusion

The findings from the three-year study confirm that regular supplementation of area-specific mineral mixture significantly enhances the production, reproduction, and economic performance of dairy animals. Animals receiving the mineral mixture consistently produced more milk (23.4% increase) with better fat content (0.35% increase), exhibited higher conception rates(80%) with fewer inseminations (<2), and generated greater economic returns(B:C ratio 2.97) than animals without supplementation. The steady improvement recorded each year emphasizes the long-term benefits of correcting mineral deficiencies through dietary supplementation.

Thus, incorporating a mineral mixture into the feeding regimen of dairy animals is a practical and cost-effective strategy to improve herd productivity and profitability. Adoption of this practice can play an important role in strengthening dairy farming outcomes, especially in regions where imbalanced or deficient feed resources are common

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