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# Effects of Area Specific Mineral Mixture (ASMM) Supplementation on Production and Reproductive Parameters of Crossbred and Desi Cows: A Field Study

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**Abstract**

A field study was conducted to evaluate the effects of supplementation of area specific mineral mixture (ASMM) on the production and reproductive performance of cows. 16 animals of both crossbred and desi cows each were evaluated for production and reproduction performances. In all treatment groups (n=8), ASMM was supplemented @ 50 g cow$^{-1}$ day$^{-1}$ and @ 30 g cow$^{-1}$ day$^{-1}$ to crossbred and desi cows respectively. The control groups (n=8) of each experiment were without ASMM supplementation. In case of productive performance, milk production and milk composition parameters were studied for a period of 90 days of lactation where as dissolution of common reproductive disorders were screened for reproductive performance. Average daily milk yield in the crossbred cows supplemented with ASMM on 90$^{th}$ day and 120$^{th}$ day were 7.72 ± 0.19 L cow$^{-1}$ and 7.52 ± 0.12 L cow$^{-1}$ in contrast to 5.96 ± 0.14 L cow$^{-1}$ and 5.63 ± 0.21 L cow$^{-1}$ in the control group. Similarly average daily milk yield in the desi cows supplemented with ASMM on 90$^{th}$ day and 120$^{th}$ day were 4.17 ± 0.09 L cow$^{-1}$ and 3.70 ± 0.08 L cow$^{-1}$ in contrast to 3.06 ± 0.03 L cow$^{-1}$ and 2.92 ± 0.04 L cow$^{-1}$ in the control group. No significant supplemental effects on the milk composition parameters in all the groups were found. First postpartum estrus and number of AI per conception were lesser but conception rates were higher in both crossbred and desi treatment groups compared to respective control groups. It can be concluded that continuous supplementation of area specific mineral mixture enhanced the productive and reproductive efficiency of both crossbred and desi cows.

## 1. Introduction

According to 19$^{th}$ Livestock Census, 2012, India has a total cattle population of 190.9 million, of which West Bengal accounts for about 24.62 million. Crossbred cattle account for about 39.73 million in India and in West Bengal accounts for 3.33 million. Desi cattle account for about 151.1 million in India and in West Bengal accounts for 21.29 million. Despite the enormous number of cattle, the per capita availability of milk is low indicating under developed genetic improvement and production (Nivsarkar *et al.*, 2000). Under-production is mainly result of involuntary culling due to poor body conditioning, low fertility and some health issues; eventually it affects profitability from the animals. Balanced nutrition is very essential for keeping animal body in good condition and renders them to maintain their optimum production. The productive performance of the dairy cows is mainly dependant on the feeding of balanced ration through which the animals fulfill their need of adequate quantities of all necessary nutrients required for a particular physiological function. The profitability of a dairy farm is significantly affected by the reproductive efficiency of the animals. Out of all nutrients, minerals and vitamin play a crucial role in metabolism, lactation, reproduction and even for microbial fermentation in rumen (Bhanderi *et al.,* 2014). The minerals, especially some trace minerals, play pivotal roles to enhance and maximize both production and reproductive performances of the dairy cows. Even marginal deficiency of these minerals can impair production and reproduction showing few, clinical signs of deficiency. Considerable effects of deficiencies of these minerals there by metabolic disorders have been observed in all categories of dairy animals as a result of lower mineral content and poor availability of essential minerals, both macro and micro, from different feed stuffs available to the animals. Different problems associated with the deficiencies of these minerals have been noticed in dairy animals of different regions and in most of the cases it varies from region to region due to

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varied soil composition, cropping intensity, precipitation pattern and spoil erosion pattern (Ghosh *et al.,* 2008; Ghosh *et al.,* 2010; Ghosh *et al.,* 2013). More than 90 percent of mineral deficiencies exist at subclinical level in livestock (Underwood and Suttle, 1999). During the past decades, significant advances have been made in understanding the effects of trace-element supplements on the milk production of dairy cows (Griffiths *et al.,* 2007). Data regarding the role of mineral supplementation affecting milk yield performance in desi cattle is little. Supplementation of all the elements in ration may not be desirable always, because many of them such as Mg, S, K, I, Co, Fe and Mn are present in required concentrations in feeds and fodders of specific areas.

The concept of area-specific mineral mixture supplement is a new approach of low input and high output for the end users. Supplementation of area specific mineral mixture and vitamin are not practicing in most of the part of country (Garg *et al.,* 2004). A survey work in various states, conducted by NDDB indicated that Zn, Cu, S, Mn, and Co were deficient in the ration of dairy livestock (Bhanderi *et al.,* 2006). Hence, animal depend for their mineral and vitamins requirement on feed and fodders they are fed. Most of the feed ingredients available for feeding livestock are deficient in one or other mineral. So, the present study was planned to evaluate the effects of supplementation of area specific mineral mixtures on production and reproductive performances of crossbred and desi cows of West Bengal.

## 2. Materials and Methods

### *2.1. Experimental Design*

The present study was conducted in 3 blocks of the North 24 Parganas district of West Bengal. Total 64 cows (32 crossbred and 32 desi) were selected from 6 different villages under Habra – I, Habra – II and Gaighata blocks of the district. 32 cows (16 crossbred and 16 desi) in their late gestation were chosen for production performance study and another 32 cows (16 crossbred and 16 desi) with the history of reproductive problems like anoestrous, repeat breeding etc. were selected for reproductive parameters study. The distribution patterns of the animals and the study design are given in Figure 1. The farmers were trained first regarding feeding of the experimental area specific mineral mixture and for collection of data.

### *2.2. Management and Feeding of Experimental Animals*

All the animals under the study were maintained with the ration as fed by their owners regularly. No alteration in the ration and feeding schedule was done. *Ad libitum* fresh clean drinking water was made available to the animals throughout day. Deworming and vaccination were done according to standard schedule as usual.

The animals (both crossbred and desi cows) in the control groups were without any ASMM supplementation for production as well as reproductive performances studies.

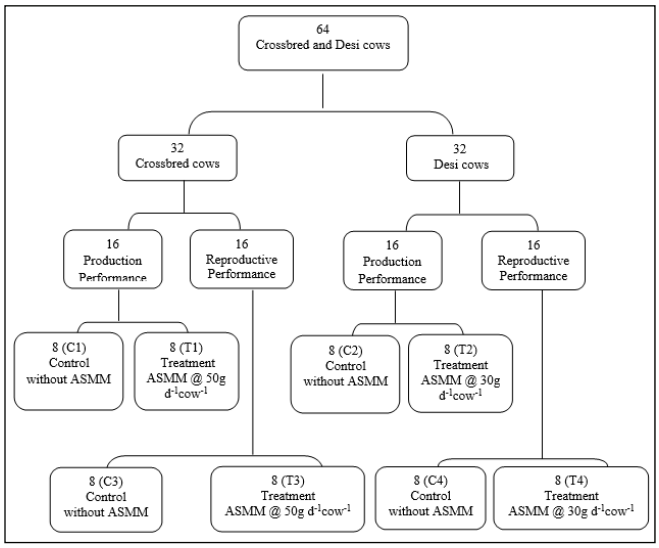


Figure 1: Schematic diagram of experimental design and distribution of animals

ASMM was supplemented in the treatment groups both for production and reproductive performances studies @ 50 g $d^{-1}$ $cow^{-1}$ and @ 30 g $d^{-1}$ $cow^{-1}$ for crossbred and desi cows respectively. Supplementation of ASMM was continued from day one of their calving till 90 days of lactation and milk production and milk composition data were recorded up to 120 days of lactation *i.e.,* 30 days after the cessation of ASMM supplementation. For reproductive parameters supplementation of ASMM continued for 90 days and the parameters like onset of first postpartum estrus (in days), numbers of animals conceived, conception rate, Artificial Insemination (AI) per conception were recorded accordingly. The composition of area specific mineral mixture (ASMM) used for this experiment is presented in Table 1.

Table 1: Composition of area specific mineral mixture (ASMM)

| Sl. No. | Item (s) | Quantity (in each 100 g) |
|---|---|---|
| 1 | Calcium (Ca) | 19.88 g |
| 2 | Phosphorus (P) | 16.24 g |
| 3 | Zinc (Zn) | 1.36 g |
| 4 | Manganese (Mn) | 1.24 g |
| 5 | Copper (Cu) | 375 mg |
| 6 | Cobalt (Co) | 24 mg |
| 7 | Iodine (I) | 4.56 mg |

### *2.3. Sampling, Data Recording and Tests*

Fresh and clean milk samples were collected in clean sterilized containers from each experimental animal on day 0 and day 90 of feeding and day 120 *i.e.,* one month after the withdrawal of area specific mineral mixture supplementation. All collected

samples were processed and analyzed in triplicate for milk compositions using Lactoscan automatic milk anlyzer. Daily milk yield data and the reproductive parameters data were recorded on the basis of owner's observation and history.

*2.4. Statistical Analysis*

Data generated in this way were tabulated and analyzed statistically. Mean, standard error of mean and range of various parameters were estimated and test of significance (one way analysis of variance and Duncan's test) between different groups were performed using SPSS (1997) for Windows (version 16.0; Microsoft).

## 3. Results and Discussion

*3.1. Effect on Milk Production Parameters*

In the treatment groups both in case of crossbred and desi cows, significant ($P \leq 0.05$) increase was observed in daily milk production on the 90$^{th}$ day and 120$^{th}$ day of the trial than the control; whereas, after the cessation of ASMM feeding from 90$^{th}$ to 120$^{th}$ day non-significant fall was recorded in the daily milk yield (Table 2 and Table 3). Similar findings i.e., increase in milk production at 14 week supplementation of organic trace minerals to cattle were observed by Hackbart *et al.* (2010). Beside this the treated animals produced significantly higher total milk yield upto 120 days than control groups. Noeek *et al.* (2006) has also found higher milk yield in mineral supplemented group of dairy animals. Average total milk yield were found higher in treatment groups over control groups by 20% in both crossbred and desi cows. Same result of improved milk production in mineral fed dairy animals was also reported by Singh *et al.* (2016). Recorded peak milk yield in treatment groups were also found significantly ($P \leq 0.05$) higher than control groups both in cases of crossbred and desi cows. Khare and Bhagel (2010) reported increase in milk yield of mineral mixture supplemented dairy animals by 0.29 L day$^{-1}$ and decrease in non-supplemented animals by 0.43 L day$^{-1}$ during the course of trial. Also Boland (2003) observed significant increase in milk yield in treatment group supplemented with trace minerals as compared to control group of animals. The cows in the treatment groups were able to hold their peak yield for longer duration than the control groups. Result indicating that feeding of mineral mixture could improve milk production potential of crossbred cows due to having impact on the milk productive cells in the udder. Their micro and macro element contribute in the working of mammary cell to enhance their production (Gupta *et al.,* 2017). These finding is in full agreement with the observations of Rohilla *et al.* (2007). Minerals serve as components of hormones of the endocrine system (Suttle, 2010; Costa *et al.,* 2016). In the study conducted by Sahoo *et al.* (2017), they have mentioned that bioavailability of critical minerals was found to be more which might be the reason for improved productive performance in lactating cows.

Table 2: Effects of ASMM supplementation on milk production in crossbred cows

| Group (s) | Milk production (L day$^{-1}$) | | | Peak Milk Yield (L) | Total Milk Yield (120 days) (L) |
|---|---|---|---|---|---|
| | Day 0 | Day 90 | Day 120 | | |
| Control (C1) | 6.63 ± 0.16 | 5.96 ± 0.14$^{a}$ | 5.63 ± 0.21$^{a}$ | 7.31 ± 0.06$^{a}$ | 728.75 ± 6.37$^{a}$ |
| Treatment (T1) | 6.72 ± 0.15 | 7.72 ± 0.19$^{b}$ | 7.52 ± 0.12$^{b}$ | 8.88 ± 0.10$^{b}$ | 878.25 ± 8.55$^{b}$ |
| SEM | 0.157 | 0.171 | 0.173 | 0.081 | 7.543 |
| P Value | 0.703 | 0.000 | 0.000 | 0.000 | 0.000 |

Note: Values followed by different letters (a, b) in a column differ significantly ($P < 0.05$)

Table 3: Effects of ASMM supplementation on milk production in desi cows

| Group (s) | Milk production (L day$^{-1}$) | | | Peak Milk Yield (L) | Total Milk Yield (120 days) (L) |
|---|---|---|---|---|---|
| | Day 0 | Day 90 | Day 120 | | |
| Control (C2) | 3.44 ± 0.05 | 3.06 ± 0.03$^{a}$ | 2.92 ± 0.04$^{a}$ | 3.67 ± 0.11$^{a}$ | 376.50 ± 11.15$^{a}$ |
| Treatment (T2) | 3.50 ± 0.05 | 4.17 ± 0.09$^{b}$ | 3.70 ± 0.08$^{b}$ | 4.53 ± 0.95$^{b}$ | 453.75 ± 9.17$^{b}$ |
| SEM | 0.052 | 0.070 | 0.063 | 0.104 | 10.218 |
| P Value | 0.399 | 0.000 | 0.000 | 0.000 | 0.000 |

Note: Values followed by different letters (a, b) in a column differ significantly ($P < 0.05$)

*3.2. Effect on Milk Composition Parameters*

No significant differences in milk compositions like milk fat (%) and milk SNF (%) were found in between the treatment groups and the control groups both in case of crossbred and desi cows. Milk protein (%) and lactose (%) were also followed the same trend as these parameters were found non-significantly higher in ASMM supplemented groups than the control groups in crossbred as well as desi cows (Tables 4 and 5). These findings are corroborated with the results obtained by Verma *et al.* (2009). Some other researchers like

Table 4: Effects of ASMM supplementation on milk composition of crossbred cows

| Group (s) | Milk Fat (%) | | | Milk SNF (%) | | | Milk Protein (%) | | | Milk Lactose (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day 0 | Day 90 | Day 120 | Day 0 | Day 90 | Day 120 | Day 0 | Day 90 | Day 120 | Day 0 | Day 90 | Day 120 |
| Control (C1) | 3.67 ± 0.04 | 3.53 ± 0.04 | 3.51 ± 0.05 | 8.66 ± 0.08 | 8.65 ± 0.10 | 8.75 ± 0.11 | 3.12 ± 0.04 | 3.16 ± 0.04 | 3.14 ± 0.04 | 5.02 ± 0.10 | 5.03 ± 0.08 | 5.07 ± 0.07 |
| Treatment (T1) | 3.65 ± 0.04 | 3.58 ± 0.11 | 3.58 ± 0.09 | 8.65 ± 0.08 | 8.73 ± 0.09 | 8.63 ± 0.08 | 3.20 ± 0.05 | 3.21 ± 0.04 | 3.22 ± 0.05 | 5.04 ± 0.11 | 5.15 ± 0.12 | 5.12 ± 0.12 |
| SEM | 0.038 | 0.083 | 0.075 | 0.080 | 0.088 | 0.094 | 0.048 | 0.042 | 0.044 | 0.107 | 0.102 | 0.096 |
| P Value | 0.784 | 0.633 | 0.534 | 0.931 | 0.544 | 0.384 | 0.254 | 0.427 | 0.214 | 0.897 | 0.385 | 0.752 |

Table 5: Effects of ASMM supplementation on milk composition of desi cows

| Group (s) | Milk Fat (%) | | | Milk SNF (%) | | | Milk Protein (%) | | | Milk Lactose (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day 0 | Day 90 | Day 120 | Day 0 | Day 90 | Day 120 | Day 0 | Day 90 | Day 120 | Day 0 | Day 90 | Day 120 |
| Control (C2) | 4.15 ± 0.06 | 4.18 ± 0.09 | 4.21 ± 0.10 | 8.87 ± 0.07 | 8.80 ± 0.06 | 8.85 ± 0.10 | 3.31 ± 0.05 | 3.30 ± 0.04 | 3.32 ± 0.05 | 5.19 ± 0.10 | 5.15 ± 0.08 | 5.20 ± 0.08 |
| Treatment (T2) | 4.21 ± 0.09 | 4.24 ± 0.06 | 4.28 ± 0.07 | 8.79 ± 0.10 | 8.87 ± 0.08 | 8.84 ± 0.09 | 3.35 ± 0.03 | 3.34 ± 0.02 | 3.32 ± 0.05 | 5.24 ± 0.08 | 5.26 ± 0.09 | 5.27 ± 0.04 |
| SEM | 0.073 | 0.056 | 0.086 | 0.089 | 0.070 | 0.096 | 0.042 | 0.032 | 0.050 | 0.086 | 0.084 | 0.067 |
| P Value | 0.612 | 0.615 | 0.573 | 0.540 | 0.594 | 0.964 | 0.550 | 0.335 | 0.986 | 0.694 | 0.371 | 0.518 |

Wu *et al.* (2000), Begum *et al.* (2010) and Rabiee *et al.* (2010) also observed similar results *i.e.,* no significant difference in milk protein, milk lactose, milk fat and milk SNF between the supplemented and non-supplemented groups of animals.

*3.3. Effect on Reproductive Parameters*

The reproductive parameters like time taken to come in first heat after calving *i.e.,* first postpartum estrus, number of AI per conception, number of animals conceived and conception rate were recorded in present experiment to check reproductive efficiency in dairy animals. Data for reproductive parameters are presented in Table 6 and Table 7. In case of crossbred cows ASMM fed animals showed sign of first heat 10.38 days earlier than the control group similarly in desi cows it was 8.88 days earlier than the control group. Mudgal *et al*. (2014) and Gupta *et al.* (2017) also observed reduction in days to achieve first post partum estrous in Cu supplemented and mineral mixture supplemented dairy animals. Treatment groups also had slightly lesser number of AI per conception than the control

Table 6: Effects of ASMM supplementation on reproductive parameters of crossbred cows

| Parameter(s) | Control (C3) | Treatment (T3) | SEM | P Value |
|---|---|---|---|---|
| First postpartum estrus (days) | 68.63 ± 1.55[a] | 58.25 ± 1.72[b] | 1.635 | 0.001 |
| AI* per conception (numbers) | 1.88 ± 0.29 | 1.50 ± 0.28 | 0.281 | 0.362 |
| Cow conceived (numbers) | 4 | 6 | - | - |
| Conception rate (%) | 50 | 75 | - | - |

*AI – Artificial Insemination; Values followed by different letters (a, b) in a row differ significantly (P < 0.05)

Table 7: Effects of ASMM supplementation on reproductive parameters of desi cows

| Parameter(s) | Control (C3) | Treatment (T3) | SEM | P Value |
|---|---|---|---|---|
| First postpartum estrus (days) | 97.38 ± 2.51[a] | 88.50 ± 1.68[b] | 2.138 | 0.011 |
| AI* per conception (numbers) | 2.00 ± 0.27 | 1.63 ± 0.18 | 0.229 | 0.266 |
| Cow conceived (numbers) | 3 | 6 | - | - |
| Conception rate (%) | 37.5 | 75 | - | - |

*AI – Artificial Insemination; Values followed by different letters (a, b) in a row differ significantly (P < 0.05)

groups in both types of cows. The results are opposite to the findings of Gupta *et al.* (2017) where they found increased number of AI per conception in mineral mixture fed cows than the control animals. Feeding of ASMM to dairy cattle in their early lactation was able to reduced service period, which favours the findings of Sahoo *et al.* (2017) and Puvarajan and Vijayarajan (2013).

In given period of time the conception rates in the animals within ASMM supplemented groups were higher than the non supplemented groups. In case of crossbred cows these were 75% and 50% in treatment and control groups respectively and in case of desi cows these were 75% and 37.50% in treatment and control groups respectively. The results were in support of the findings observed by Gupta *et al.* (2017). In another study Behera *et al.* (2012) also found comparable result as they improved conception rate in mineral supplemented heifers. In his report Sathish Kumar (2003) suggested that reduced fertility and reduced or delayed conceptions are the prime signs of phosphorus deficiency and this can be overcome with proper phosphorus supplementation whereas, moderate deficiency may lead to repeat breeding condition and poor conception rate.

## 4. Conclusion

Findings of this field study suggest that continuous supplementation of area specific mineral mixture (ASMM) bettered the performances of both crossbred and desi cows in respect to their production and reproductive performances thereby making dairy farming profitable and sustainable especially in West Bengal where mineral deficient feedstuffs are being offered to the animals as a general practice.

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