

# Use of Area Specific Mineral Mixture to Ameliorate Region Specific Reproductive Problems in Ruminants

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## Abstract

*Reproductive inefficiency in ruminant cows is one of the most important global problems affecting the profitability of the farm. Some trace minerals like Ca, P, Cu, Zn, Co and Mn have important roles to maximise reproductive performances. Even marginal deficiency of these minerals can impair reproduction showing clinical signs of deficiency. Effects of mineral deficiency and metabolic disorders in all categories of dairy animals have been observed due to lower mineral content and poor availability of essential macro and micro minerals from different feed stuffs. Deficiency associated problem have been observed in cattle of different regions and in most of the cases it differs from one region to another due to different soil composition, intensity of cropping, precipitation pattern and soil erosion pattern and so on. The assessment and preventives of mineral deficiency needs thorough understanding of the factors like age of animals, season, soil profile, plant materials and feeding practices. It is, therefore, important to understand the basics of mineral nutrition very clearly as also to meet the requirement of the animals to overcome the problem of deficiencies or excesses, so as to maintain productivity. The concept of area-specific mineral supplement is a new approach of low input and high output for the end users. In this review, the authors discussed the roles of some trace minerals on some productive and reproductive performance of ruminants with special emphasis on bovine species.*

**Keywords:** Trace minerals, ruminants, bovine, growth, reproduction, hormone, metabolites

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## INTRODUCTION

The productivity of dairy cows is dependent on balanced feeding by providing adequate quantities of all necessary nutrients to meet their requirements for a particular physiological function. Reproductive efficiency is one of the most important factor which affects profitability in ruminants. Some trace minerals have important roles to maximise reproductive performances. Even marginal deficiency of these minerals can impair reproduction showing few, clinical signs of deficiency. Effects of mineral deficiency and metabolic disorders in all categories of dairy animals have been observed due to lower mineral content and poor availability of essential macro and micro minerals from different feed staffs. Deficiency associated problem have been observed in cattle of different regions and in most of the cases it differs from one region to another region due to different soil composition, intensity of cropping, precipitation pattern and

soil erosion pattern [1–3]. The assessment and preventives of mineral deficiency needs thorough understanding of the factors like age of animals, season, soil profile, plant materials and feeding practices. It is, therefore, important to understand the basis of mineral nutrition very clearly as also to meet the requirement of the animals to overcome the problem of deficiencies or excesses, so as to maintain productivity. The concept of area-specific mineral supplement is a new approach of low input and high output for the end users.

## Effect of Mineral Mixture on Growth Parameter

Sawant *et al.* reported that supplementation of mineral mixture increases growth rate and body weight with better feed conversion efficiency in heifers deficient with certain minerals [4]. Bone meal supplementation has been reported to increase body weight gain in grazing animals [5]. Similar observation of increased body weight gain on mineral

supplementation has been found in zebu cattle [6] and buffalo calves [7].

### **Effect of Minerals (Ca, P, Cu, Zn, Co and Mn) on Reproductive Performances**

Deficiency of a single or multiple minerals or their imbalances leads to delayed puberty, delayed ovulation, lower conception rate, high embryonic/foetal losses and prolonged postpartum anoestrus [8]. The supplementation of ASMM has been reported to increase reproductive efficiency in buffaloes. Dietary deficiency of macro nutrients is well combated by commercially available feeds and hence optimum supplementation of all the micro minerals results as stimulus for ovarian rebound and initiation of ovarian activity [9].

Mineral supplementation has been reported to improve the reproductive efficiencies in animals [1–3, 10, 11]. Effect of supplementation of deficient minerals (Ca, P, Cu, Zn and Mn) through area specific mineral mixture (ASMM) was studied by a series of experiments [12]. The results revealed increased plasma oestrogen and progesterone concentrations in repeat breeder and anoestrous cows.

Selvaraju *et al.* reported that pubertal process could be initiated in the delayed pubertal heifer through supplementing the area specific mineral mixture [13]. They also found that problem of silent oestrus can also be ameliorated through area specific mineral supplementation. Deficiencies of minerals like P, Cu and Zn have been associated with subnormal fertility and anoestrus conditions. Mineral supplementation decreases days to first service and days open and also improves conception rate in bovines [14].

Swenson supplemented Cu, Zn, Co and Mn to heifers and found that the cows exhibiting oestrus by day 45 earlier in mineral supplemented group and the percentage of cows bred by artificial insemination was improved [15]. Molybdenum supplementation is found to cause delayed puberty, decreased conception rate and anoestrus in cattle without accompanying changes in Cu status or in live weight gain [16]. Therefore, it was proposed that the effects of Mo were associated with a

decreased release of luteinizing hormone that might be due to an altered ovarian steroid secretion [16].

Supplementation of regional specific mineral mixture i.e. RSMM (Ca, P, Cu, Zn and Mn) and iodized salt through concentrate mixture for a period of 30 days in anoestrous crossbred heifer exhibited oestrus in 92.16 per cent heifers and 97.38 per cent heifer conceived with one to four inseminations [17].

Mohapatra *et al.* observed that anoestrus heifer, anoestrus cow and repeat breeding cows fed with area specific mineral mixture (Ca, P, Zn, Cu, Mn, Co and I) exhibited oestrus in higher percent (45, 70 and 60 per cent, respectively) compared to untreated cattle (10 per cent) [18].

Weiss has extensively reviewed the importance of micro minerals for productive and reproductive performances of dairy cows [19]. Dutta *et al.* reported higher productive and reproductive performances in dairy cows supplemented with mineral mixture enriched with some important micro minerals [20]. Organic iron supplementation during late gestation and early lactation has been found to increase productive and reproductive performances in cows [21].

Zinc plays important roles in reproductive function of dairy cows, particularly by decreasing the incidence of abortion and abnormal oestrus and reducing days to first oestrus [22]. Moreover, other researchers found that Cu improved reproductive performances of Holstein cows and Mn improved bovine sperm activity [23]. Therefore, feeding dairy cows with organic sources of these trace minerals might result in improved fertility. In particular, beneficial effects on fertility have been reported in cows fed organic trace minerals during late gestation [23]. Trace elements deficiencies are expressed in the animals by diverse forms, since these elements form molecule complexes of the metabolism of proteins, lipids and carbohydrates, where they play key roles as components and enzyme cofactors or transcription factors [24]. The mineral status of the animal has effects on every phase of the reproductive cycle [25].

### Effects of Mineral Mixture Supplementation on Blood Metabolites, Enzymes and Hormones during Pubertal Process

Blood metabolite profiles indicate the health status of the animal. Effect of mineral block on blood glucose levels was observed in Boer goat who reported that blood glucose level in treatment group was higher than control group [26]. The NEFA are energy metabolites that can be used as markers of excessive negative energy balance in dairy cow during the transition period. The principle circulating blood metabolites used to assess the energy status are plasma glucose and NEFA. However, blood  $\alpha$ -amino nitrogen is an indicator of protein synthesis status of the animal [27].

Dutta *et al.* also reported low Zn level in anoestrus heifers. Fall in Zn level was associated with fall in steroid hormone concentrations which indicated that there was some correlation between plasma Zn levels and progesterone-oestrogen levels for proper reproductive processes [20]. It is well established that minerals play an intermediate role in the action of hormones and enzymes at cellular level and their deficiency ultimately affects the reproductive performance of females [25]. Effect of minerals (Ca, Cu, and Mn) on SGOT, SGPT and glucose level in crossbred heifer is reported [28]. Humann-Ziehan *et al.* reported that in growing lambs value of SGPT and SGOT was higher in lambs supplemented with mineral mixture than mineral deficient lambs [29].

### CONCLUSIONS

Though number of minerals are important in maximizing productive and reproductive performances in ruminants but in most of eastern region face problems with calcium, phosphorus, zinc, copper, cobalt and manganese. These deficiencies can affect the occurrence of estrus, conception rate and foetal development in females. Even in males, deficiencies of some trace mineral can reduce testicular development, sperm production and viability. Therefore, suitable area specific mineral mixture should be supplied though the ration for better productive and reproductive performance of the animals.

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