

EFFECT OF COPPER SUPPLEMENTATION ON THE ONSET OF ESTRUS IN ANESTROUS BUFFALO COWS AND HEIFERS

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ABSTRACT

An experiment was conducted to find serum levels of common trace elements in anestrous buffalo cows and heifers of the government farm to assess the deficiency status if any. Fourteen anestrous buffalo cows and heifers were taken for the purpose, and their blood was collected, and the serum was analyzed for the level of common trace minerals such as copper (Cu), manganese (Mn), zinc (Zn), iron (Fe) and cobalt (Co). After detecting a deficiency of Cu in all the anestrous animals, a supplement with copper sulfate penta hydrate (inorganic salt of copper) was administered once a week. Subsequent estrus were recorded for a period of two months after starting the supplementation. Six out of 14 animals showed the signs of estrus in the first month of supplementation, while another five animals showed signs of estrus in the second month. Hence just two months of copper supplementation brought about a dramatic response: the observation of estrus was recorded in about 80% of the animals, which suggested the influence of the copper requirements on the normal

reproductive performance of the animals. Thus, it may be concluded that Cu plays a very important role in the normal reproductive physiology and its supplementation in a deficient diet is essential to obtain adequate reproductive performance in mature animals.

Keywords: copper, buffalo cows and heifers, anestrous, trace element

INTRODUCTION

Normal productive and reproductive behavior in domestic animals is closely associated with the nutritional status of the animals. In this regard, minerals in particular play very crucial role in exploiting the actual genetic potential of the animals. Animals cannot evidence their genetic potential if their mineral needs are not met even if they receive 100% of their protein and energy needs. Mineral deficiency exists widely in livestock and the severity of the deficiency depends upon the type of feed, physiological status of the animals

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and the agro-climatic conditions of the region. Deficiency of a single or of multiple minerals or their imbalances may cause various reproductive failures, such as infertility, poor conception, anestrus etc. (Hidioglou, 1979). Several trace elements act as cofactors and help in hormone synthesis and hence influence biochemical functions associated with reproduction. Because of their role in the endocrine system and in tissue integrity, minerals have a beneficial role to play in resumption of follicular growth and fertility in dairy cows and buffaloes.

Minerals that affect reproduction in ruminants are generally found within the trace elements group (Cu, Co, Zn, Fe and Mn). Copper and zinc are known to have a significant correlation with reproductive hormones (progesterone and estradiol) (Prasad *et al.*, 1989) as they are specific activators of enzyme systems that assist in maintaining the activity of hormones in blood (Georgievskii, 1982). Dietary deficiency of micronutrients need be combated. Commercially available feeds are usually deficient in trace elements and consequently optimum supplementation of all the micro minerals results in a stimulus for ovarian rebound and initiation of ovarian activity (Markandaya *et al.*, 2002). The most devastating economic loss in dairy industry is caused by suboptimal production and infertility and that is why supplementation of any deficient mineral has dramatically increased the fertility status of the grazing cattle (Mc Donald, 1986). Mn also has a significant role to play in maintaining the optimum fertility in the animals (Underwood, 1981).

This study aimed to determine the trace element status in the serum of anestrus buffaloes, and after detection of copper deficiency, to evaluate the effects of copper supplementation through diet on the onset of estrus.

MATERIALS AND METHODS

The experiment was conducted at a Government Livestock Farm at Jabalpur (state of Madhya Pradesh, India). Blood samples of fourteen anestrus buffalo cows and heifers were collected by jugular venipuncture, observing all aseptic precautions in the morning (before watering and feeding), into clean and dry test tubes and kept in slanting position for 45 minutes, followed by centrifugation at 700×g for 15 minutes to separate the serum. Serum samples were stored in plastic vials at -20°C for further analysis of trace elements.

These serum samples were used for estimation of common trace elements like zinc (Zn), copper (Cu), manganese (Mn), iron (Fe) and cobalt (CO) by an atomic absorption spectrometer (AAS). After assessing the status of different trace minerals, it was established that copper was deficient in most of the buffaloes, and hence a strategy was adopted to supplement copper through the diet using 3 g of copper sulfate pentahydrate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) in the concentrate mixture being offered to the buffalo cows and heifers once a week for a period of about 2 months and monitoring daily its effect on the onset of estrus in the supplemented animals.

RESULTS AND DISCUSSION

Trace mineral serum levels in the blood of buffalo cows and heifers are shown in the table.

When we compared the values obtained in anestrus buffaloes with the standard values (Georgievskii, 1982; Mc Donald, 1986) of adult ruminants, we found that the serum levels of zinc (Zn), manganese (Mn), iron (Fe) and cobalt (CO) were in the normal range of healthy adult ruminants;

while a wide variation among the values in different animals was observed, overall the levels were found to be on higher side of the normal values reported for these trace minerals, which indicated the good status of the animals raised under standard conditions in an organized manner.

The level of copper was found below the threshold of 0.5 mg/L in all the buffalo cows and heifers, which was a sign of hypocupremia because in general the normal serum copper concentrations studied under different physiological conditions were found to be in the range of 0.6 to 1 mg/L under farm conditions (Geogievskii, 1982). Deficiency of copper is generally accompanied by anemia, debility and lack of appetite but also results in failure of estrus and delayed onset of puberty (Underwood, 1981). It indicates that the reproductive problems may be associated with the reduced copper level and hence on the basis of the above preliminary trial,

further study was continued to observe the effect of copper supplementation on these copper deficient animals on their reproductive performance.

After detection of copper deficiency a feeding trial for a period of two months was conducted in which copper was supplemented through an inorganic source (copper sulfate penta hydrate) at 3 g / week / head properly mixed in the concentrate mixture usually taken by animals within about 15-20 minutes of its being offered. Except for the copper supplementation the diets of these animals remained the same in all other respects as previously and the effect was daily observed on the onset of estrus in the buffalo cows and heifers for a period of two months.

Out of the total fourteen Murrah buffaloes, which were provided with copper, six showed signs of estrus in the first month of supplementation, while another five showed signs of estrus in the second

Table. Trace element serum levels (ppm) in Murrah buffalo cows and heifers.

Animal	Fe	Cu	Zn	Mn	Co
1	3.1	0.275	1.125	0.2	0.35
2	2.95	0.35	1.475	0.175	0.5
3	1.2	0.3	2.375	0.25	0.6
4	3.8	0.225	1.8	0.325	0.25
5	2.275	0.225	4	0.25	0.325
6	3.1	0.625	2.375	0.15	0.3
7	2.275	0.45	3.15	0.325	0.675
8	2.025	0.4	2.15	0.25	0.15
9	2.2	0.575	3.25	0.25	0.2
10	3.375	0.45	6.5	0.1	0.5
11	3.7	0.3	5.425	0.325	0.275
12	2.7	0.825	1.175	0.25	0.9
13	3.5	0.925	1.2	0.175	0.95
14	3.325	0.775	1.125	0.325	0.925
Average	2.82 ± 0.65	0.48 ± 0.20	2.65 ± 1.46	0.24 ± 0.06	0.49 ± 0.24

month of the supplementation. Three buffaloes did not show any signs after the end of two months, and when we observed the level of copper in their sera after two months of the treatment, it was above the level of 0.6 mg/L which indicated that they had the normal range of copper in their blood. The reason these three buffaloes that did not show improvement in spite of reaching normal serum copper level is not known, but it may be assumed that there may have been some other complication involved in these buffaloes in addition to serum copper level, and thus they remained unable to respond after their copper levels returned to the normal range.

Anestrus was also reported in animals having lower blood copper level (Munro, 1957). Similarly, Phillippo *et al.* (1987) also found that the copper deficient heifers (due to high Mo levels) had a decreased pregnancy rate. Muehlenbein *et al.* (2001) also observed a positive effect of copper supplementation on the 30th day conception rate in cows which were very much Cu deficient before and during the breeding season. Ramana *et al.* (2000) also reported a correlation of reduced level of serum copper (0.31 ppm) with the reproductive problems of dairy animals. Similar to the present findings, Lall *et al.* (2000) found that when the diet of adult buffaloes and heifers was supplemented with mineral mixture, the animals came into heat and conceived within a period of 2-4 weeks after starting the supplementation. Koley and Biswas (2004) observed the onset of estrus in six anestrus heifers within 14-21 days, four animals within 28-35 days and four animals within 35-42 days of mineral mixture supplementation which also agreed with the present findings; in their study, 70% of the animals exhibited estrus during the experimental period. Identical findings were also observed by Tiwari *et al.* (1999) and Kumar *et al.*

(2002). Similar to the present findings, Koley and Biswas (2004) also observed an improvement in plasma levels of trace elements (Cu, Zn and Mn) in anestrus heifers after their supplementation. Olson *et al.* (1999) and Kumar *et al.* (2002) also observed that feeding of mineral mixture increased the plasma mineral concentrations.

CONCLUSION

From the results, it may be concluded that copper is an essential trace element for normal reproduction performance of the buffaloes and supplementation of copper in buffaloes having deficient level of copper in the blood and thus were showing anestrus may be corrected by proper supplementation of copper through their diet.

REFERENCES

- Georgievskii, V.I. 1982. Mineral composition of bodies and tissue of animals, p. 67-77. In Georgievskii V.I., B.N. Annenkov and V. T. Samokhin (eds.) *Mineral Nutrition of Animals*. Butterworths, London, England.
- Hidiroglou, M. 1979. Trace element deficiencies and infertility in ruminants: a review. *Indian Journal of Dairy Sciences*, **62**: 1195-1206.
- Koley, S. and P. Biswas. 2004. Effect of mineral supplementation on the performance of anestrus cows. *Indian Journal of Animal Nutrition*, 21 (4) 268-270.
- Kumar, A., C. Singh and A.P. Singh. 2002. Effect of feeding mineral mixture on plasma manganese concentration in cattle. *Indian J. Anim. Sci.*, **72**: 510-12.
- Lall, D., V.B. Dixit, U.K. Arora., B. Kumar

- and T.R. Chauhan. 2000. Effect of mineral supplementation on reproductive performance of anestrus buffalo under field conditions. *Indian Journal of Animal Nutrition*, **17**: 74-79.
- Mc Donald, J.T. 1986. Vitamin and mineral supplement use in the United States. *Clin. Nutr.*, **5**(1): 27-33.
- Markandaya, N.M., A.U. Bhikane and G.P. Bharkad. 2002. Clinical response to micro-minerals with vitamin E supplementation in anestrus Deoni cows. *Indian Journal of Animal Reproduction*, **23**: 78-82.
- Muehlenbein, E.L., D.R. Brink, G.H. Deutscher, M.P. Carlson and A.B. Johnson. 2001. Effects of inorganic and organic copper supplemented to first-calf cows on cow reproduction and calf health and performance. *J. Anim. Sci.*, **79**: 1650-1659.
- Munro, I.B. 1957. Infections and non-infectious herd in infertility in Anglia. *Vet. Rec.*, **69**: 125.
- Olson, P.A., D.R. Brink, D.T. Hickok, M.P. Carlson, N.R. Schneider, G.H. Dentscher, D.C. Adams, D.J. Colburn and A.B. Johnson. 1999. Effect of supplementation of organic and inorganic combination of copper, cobalt, manganese and zinc about nutrient requirement levels on post partum two year old cows. *J. Anim. Sci.*, **77**: 522-532.
- Phillippo, M., W.R. Humphries and T. Atkinson. 1987. The effect of dietary molybdenum and iron on copper status, puberty, fertility, and estrous cycles in cattle. *Journal of Agricultural Sciences*, **109**: 321-336.
- Prasad, C.S., P.V. Sharma, A. Obireddy and G. P. Chinnaiya. 1989. Trace elements and ovarian hormonal levels during different reproductive conditions in crossbred cattle. *Indian Journal of Dairy Sciences*, **42**: 489-92.
- Ramana, J.V., C.S. Prasad and S.K. Gowda. 2000. Mineral profile of soil, feeds, fodders and blood plasma in southern transitional zone of Karnataka. *Indian Journal of Animal Nutrition*, **17**: 179-183.
- Tiwari, S.P., U.K. Mishra, R.K. Jain, O.P. Mishra and S. Rajagopal. 1999. Effect of supplementation of micronutrients (mineral capsule) on super ovulation and embryo transfer in Sahiwal cows (*Bos indicus*). *Indian Journal of Animal Sciences*, **69**: 634-636.
- Underwood, E.J. 1981. *The Mineral Nutrition of Livestock*, 2nd ed. Commonwealth Agricultural Bureaux, U.K.