

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.905.064>

Effect of Supplementing Area Specific Mineral Mixture on Reproductive Performance of Peripartum Black Bengal Goats

G.M. Kedare^{1*}, Vipin², R.S. Mantri¹, A. Mandal¹, M. Karunakaran¹ and M.K. Ghosh¹

¹ICAR-National Dairy Research Institute, Eastern Regional Station,
Kalyani-741 235, West Bengal, India

²Division of Animal Nutrition-Indian Veterinary Research Institute,
Bareilly, Uttar Pradesh, India

*Corresponding author

ABSTRACT

The deficiency of each mineral in animal results in various health disorders that can be removed by supplementation of suitable specific mineral. This study was conducted to find out the influence of area-specific mineral mixture supplementation on reproductive performances during peripartum period in Black Bengal does with a birth weight of the kid, first postpartum heat, conception rate, hormones (Progesterone and Estradiol-17 β). For this purpose, two groups of 20 pregnant Black Bengal does were made into according to the body weights viz., Control- T₀ (N=10) and Treatment- T₁ (N=10) supplemented with 0 and 6 g ASMM/animal/day, respectively starting from 3 months before the expected date of parturition to till the onset of first post-partum estrus. Overall mean birth weight of kid born and mean average placental weight in control (T₀) and treatment (T₁) group were statistically non-significant (P>0.05) between the groups. The onset of first postpartum heat and conception rate after first postpartum heat in control (T₀) and treatment (T₁) groups were non-significant (P>0.05) between the groups. Overall mean plasma estradiol-17 β (22.34 \pm 0.26 vs. 23.13 \pm 0.30 pg/ml) and progesterone (5.96 \pm 0.17 vs. 7.22 \pm 0.17 ng/ml) were significant (P< 0.05) between groups. So, the supplementation of the area-specific mineral mixture improved the reproductive performances of Black Bengal does.

Keywords

Area specific mineral mixture, Reproduction, Peripartum, Black Bengal does

Article Info

Accepted:
05 April 2020
Available Online:
10 May 2020

Introduction

The goat breed Black Bengal goat (*Capra hircusbengalensis*) is mostly found in the Eastern and North-Eastern region of India. It is a small size, highly prolific and meat-type breed of goat and it has many desirable traits like sexual maturity at an early age (6-8

months). There are important twenty-two mineral elements which are very much essential for animals. Animal health and production are influenced by these minerals within the body (Sharma *et al.*, 2009). Trace elements are often correlated with reproductive efficiency in animals. Trace elements affect the several enzymatic

activities in the body so they can reduce reproductive efficiency including cessation of cyclic activity. Many nutritional factors can affect reproduction. Reports indicated that micronutrient deficient can alter the serum progesterone and oestrogen level of animals (Kumar *et al.*, 2005). Lower concentration of micronutrients causes conception failure and embryonic death one of the most important reason for repeat breeding in cattle. Reproductive failure accounts for nearly 50 per cent of all losses resulting from disease, mostly due to mineral deficiency. In this manner, there is an abundant opportunity for exploiting the idea of area-specific mineral mixture for adjusting the deficiency/excess of minerals for extract the ideal production potential of animals to improve the economy of farmers. Ghosh *et al.*, (2013) reported six minerals are deficient in lower Gangetic part of West Bengal namely Ca, P, Zn, Cu Co and Mn but till now, the impacts of the area-specific mineral mixture have not been studied on reproductive performance of Black Bengal goat.

Materials and Methods

This study was approved by the Institutional Ethics Committee of the National Dairy Research Institute, India.

Site, selection and feeding trial of experimental animals

All experimental animals were 20 Black Bengal does of 1st parity maintained at E.R.S-I.V.R.I. Kalyani farm. Animals were divided randomly based on their body weight into two groups control (T₀) and treatment (T₁) based on initial body weight so that the average body weights of the two groups were similar. In the morning time, measured quantity (300 g per animal per day) of concentrate feed was given to each animal individually. In control (T₀) group, no area-specific mineral mixtures

were fed, whereas in treatment group experimental animal was fed with area-specific mineral mixture @ 6g per animal per day starting from three months before parturition to till first post-partum estrus shown by the animals. The area-specific mineral mixture (KALMIN-ERS) used to fed the experimental goat has the following composition.

Chemical analysis

Chemical analysis of the following parameters was done as per AOAC (2005) and fractions of cell wall constituents such as NDF, ADF, cellulose, hemicellulose and lignin were estimated as per Van Soest *et al.*, (1991).

Estimation of blood hormones

Blood samples were collected from all the animals at fortnightly interval started from three months before parturition till up to first post-partum estrus for estimation of plasma progesterone and oestrogen.

Blood was collected from the jugular vein and collected in the heparin-coated vial after that plasma was collected from each sample by centrifuge machine. Oestrogen and progesterone were estimated by using a commercially available ELISA Kit. For estrogen bovine ELISA Kit Catalog number E0004Bo and for bovine progesterone ELISA Kit Catalog number E0018 Bowas Used.

Statistical analysis

Suitable statistical procedures were followed to the analysis of data recorded under various experiments in this study. Different statistical designs were considered to the analysis of data as per Snedecor and Cochran (1994) and analysis through SPSS programme.

Results and Discussion

The area-specific mineral mixture (KALMINERS) was fed to pregnant Black Bengal does to study its effects on reproductive performance of pregnant Black Bengal doe.

Chemical composition of experimental ration

The same experimental ration except ASMM for the treatment group was fed to pregnant Black Bengal does. Chemical composition of concentrate mixtures and green fodder is presented in Table 2.

Influence of ASMM on birth weight of kid

The present study revealed that kids weight did not differ significantly ($P>0.05$; Table 4) in between the groups. Several authors (Husain, 1999; Amin *et al.*, 2001) reported that male kids have more birth weight than female kids. The average birth weight of crossbred goat and black Bengal goats were 1.90 ± 0.75 and 1.60 ± 0.50 respectively and differences were statistically ($P<0.05$) significant Under the traditional farming system of sub-continent, the birth weights of kids were 1.5 kg & 2.0 kg respectively (Banerjee, 2004).

Influence of ASMM on placental weight

The present study revealed that placental weight did not differ significantly ($P>0.05$; Table 4) in between the groups. Harrison and Hancock (1984) reported that Se supplementation (as oral or injected) reduced the incidence of RFM in about 80 per cent of studies. Placental weight of Black Bengal does was found to be 175.0 ± 12.3 , 187.5 ± 15.6 , 230.0 ± 11.5 , 197.5 ± 13.7 on supplementation

of different level of concentrate mixture viz. 150, 200, 250 and 300g/day respectively by Sultana *et al.* (2012). Placental weight is mainly influenced by the litter size (Hafez, 1962).

Influence of ASMM on first post-partum heat

In our present study, it is being observed that in treatment (T_1) group most of the animal have come on first post-partum heat in early days, whereas in control groups first post-partum heat come in late but did not differ significantly ($P>0.05$; Table 4) between the groups. Estrus signs were observed in the groups by observing some visual signs like oedema of the vulva, congestion of mucous membrane and presence of mucus discharge. Verma *et al.*, (2015) reported that age at first estrus significantly ($P<0.05$) lower in ASMM fed heifers. In copper-deficient animals, low fertility related to suppressed estrus. (Smith and Akinbamijo, 2000; Underwood and Suttle, 2003). Kreplin and Yaremco (1992) observed that low fertility in animals related to delayed or suppressed estrus that grazed on Cu deficient pastures.

Influence of ASMM on conception rate at first post-partum estrus

It is one important parameter to measure reproductive efficiency. It is also called the conception rate. The overall mean of conception rate in the first post-partum heat was 60 % in the control group and 80 % in the treatment group, respectively (Table 4).

Ballantine *et al.*, (2002) reported the same improvements with the organic form to replaced inorganic sulphate salts of Copper, Manganese, Zinc and Cobalt.

Table.1 Composition of Area Specific mineral mixture (ASMM) fed to Goats during the study (in each 100 gram)

Minerals	Quantity (gram)
Calcium	25.96
Phosphorus	20.08
Zinc	0.529
Copper	0.258
Cobalt	0.027
Manganese	0.011

Table.2 Chemical composition of concentrate and green fodder feed to the experimental animals in % DM basis

Parameter	Concentrate	Green fodder
Dry Matter (DM)	93.9±0.12	17.13±2.33
Organic Matter (OM)	93.72±0.07	86.81±0.63
Crude Protein (CP)	18.94±0.60	12.82±1.73
Ether Extract (EE)	4.51±0.10	2.66±0.27
Total Ash (TA)	6.28±0.07	12.92±0.62
Acid Insoluble Ash (AIA)	1.77±0.06	3.36±0.28
Neutral Detergent Fiber (NDF)	32.54±1.67	57.6±5.65
Acid Detergent Fiber(ADF)	11.20±1.98	35.91±4.08

Table.4 Influence of ASMM on reproductive performance of Black Bengal does

Groups	No. of animal conceive	The onset of first post-partum heat (days)	Conception rate first post-partum heat	Birth weight (kg) of kid	Placental weight (gm.)
Control (T ₀)	6	36.6±4.59	60%	1.05±0.05	224.89±4.19
Treatment (T ₁)	8	30.9±3.38	80%	1.07±0.04	232.6±6.02

Table.5 Plasma estradiol-17β (pg/ml) profile of black Bengal does

Group	Days interval													Mean ± SEM
	-90	-75	-60	45	-30	-15	0	15	30	45	60	75	90	
Control (T ₀)	21.87±0.24	22.11±0.31	20.22±0.44	21.42±0.29 ^b	22.87±0.18 ^b	23.62±0.15 ^b	25.0±0.22 ^b	22.9±0.22	22.6±0.27	21.7±0.22	22.1±0.25	21.9±0.29	21.88±0.30	22.34±0.26 ^b
Treatment (T ₁)	20.7±0.57	21.9±0.44	21.0±0.48	22.56±0.34 ^a	25.13±0.25 ^a	25.95±0.13 ^a	29.30±0.47 ^a	23.14±0.27	23.20±0.25	22.45±0.18	22.15±0.22	21.77±0.11	21.56±0.19	23.13±0.30 ^a

*Values bearing different superscripts in column differ significantly (P<0.05) from each other

Table.6 Plasma progesterone (ng/ml) Profile of black Bengal does

Group	Days interval													Mean ± SEM
	-90	-75	-60	45	-30	-15	0	15	30	45	60	75	90	
Control (T₀)	11.27± 0.37 ^b	12.11± 0.32 ^b	13.06± 0.39 ^b	13.22± 0.83	10.37± 0.21 ^b	10.71± 0.13 ^b	1.76± 0.04	1.29± 0.05	0.79± 0.10 ^b	0.91± 0.04	0.72± 0.04 ^b	0.67± 0.02	0.46± 0.02	5.96± 0.17 ^b
Treatm ent(T₁)	14.52± 0.14 ^a	14.51± 0.11 ^a	14.03± 0.20 ^a	14.16± 0.28	14.64± 0.28 ^a	14.23± 0.26 ^a	1.55± 0.17	1.43± 0.07	1.23± 0.06 ^a	1.06± 0.06	0.82± 0.02 ^a	0.72± 0.02	1.01± 0.52	7.22± 0.17 ^a

*Values bearing different superscripts in column differ significantly (P<0.05) from each other

Fig.1 Plasma estradiol-17β (pg/ml) in control (T₀) and treatment (T₁) at different intervals

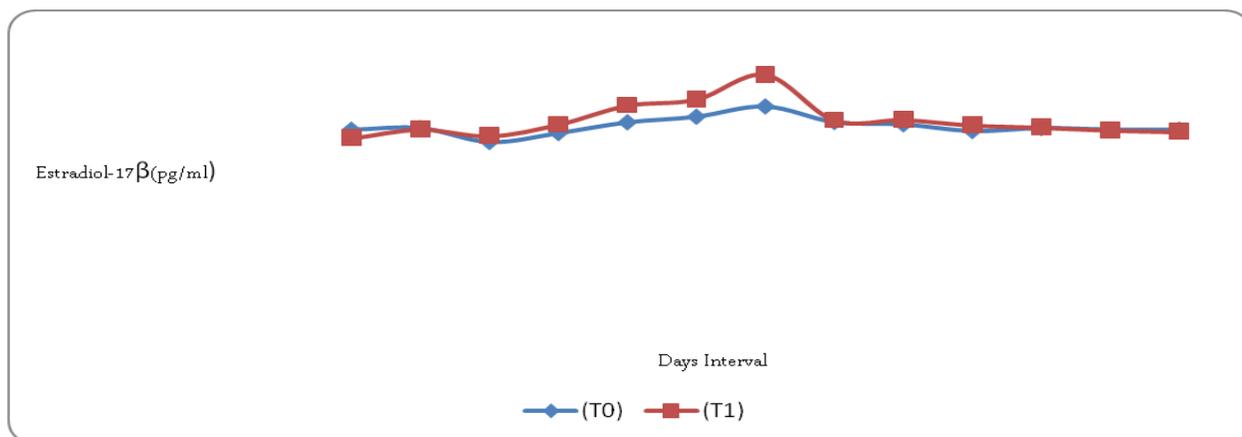
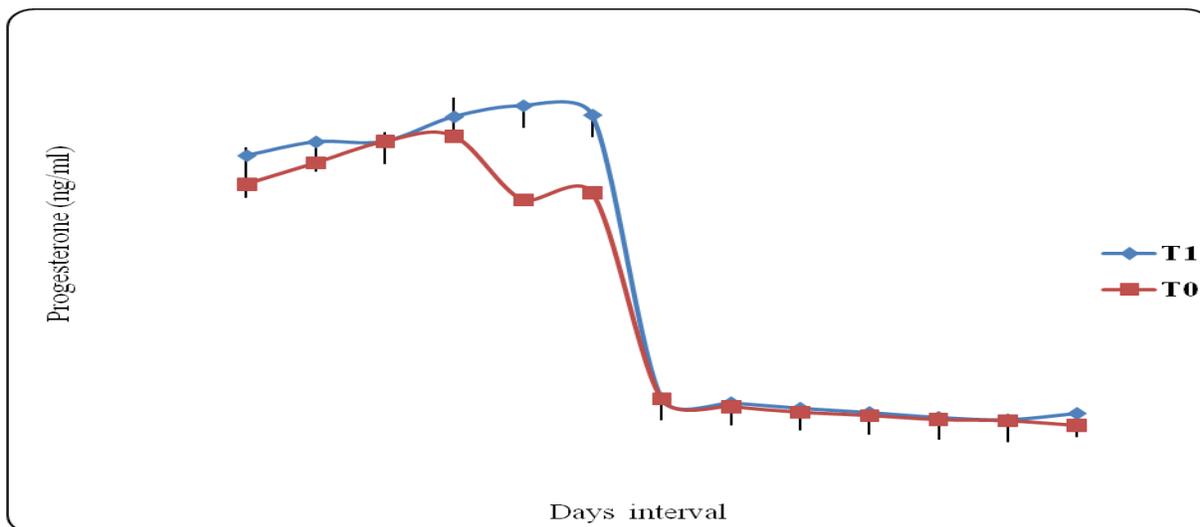


Fig.2 Plasma progesterone (ng/ml) in control (T₀) and treatment (T₁) at different intervals



Influence of ASMM on Estradiol-17β level

Plasma Estradiol-17β level was higher in the

ASMM supplemented group during prepartum than in the control group after that it decreased gradually and maintained at basal

level after 15 days of parturition. It differed significantly ($P < 0.05$; Table 5; Figure 1) before parturition, but after parturition did not show any effect. The overall mean of Estradiol-17 β level differed significantly ($P < 0.05$; Table 5) between the groups. Verma (2015) reported that Estradiol-17 β level was non-significantly ($P > 0.05$) between the groups after the feeding of ASMM (Ca, P, Mn, Zn, Cu and Co) on a crossbred heifer. Copper has been a significant role in maintaining optimum fertility as it behaves in a regular way to be used as an indicator for estrogen activity (Desai *et al.*, 1982). The role of Zn in enzymatic action (superoxide dismutase) involving reproductive functions has also been reported (Olson *et al.*, 1999). Some evidence suggests that Mn plays an important role in the activity of certain endocrine organs. It is involved as a cofactor in cholesterol synthesis which is necessary for the synthesis of steroids like progesterone, estrogen and testosterone (Keen and Zidenburg-Cherr, 1990; Kapil and Zidenberg, 1999). Deficiency of steroid hormone production causes low circulating levels of these hormones causing sperm abnormality in males and abnormal estrus cycles in females. Decrease zinc level was correlated with a decrease in steroid hormone concentrations which showed some correlation between plasma zinc concentration and estrogen-progesterone levels for proper reproductive processes (Dutta *et al.*, 2001). Bearden *et al.*, (2004) reported that minerals have an important role in the activity of enzymes and hormones at the cellular level so its deficiency ultimately affects the reproductive efficiency of females.

Influence of ASMM on progesterone level

The overall mean value progesterone in control (T_0) and treatment (T_1) groups was 5.96 ± 0.17 and 7.22 ± 0.17 , respectively and values differed significantly ($P < 0.05$; Table 6;

Figure 2) between the groups. The present study showed that blood progesterone level was higher in treatment (T_1) group compare to control (T_0) group till the day of parturition and interestingly after 45 days of parturition level of progesterone increased in the treatment group than the control group. This may be due to increased Cu, Zn containing enzyme metalloproteinase -2 which is responsible for the synthesis of progesterone and estradiol. In the present study blood, Cu and Zn level was also observed higher. Some research found that Mn has an important role in the activity of certain organs. It is involved as a cofactor in cholesterol synthesis which is necessary for the synthesis of steroids like progesterone, estrogen and testosterone (Keen and Zidenburg-Cherr, 1990; Kapilet *et al.*, 1999). The corpus luteum has high Mn concentration and it may be influenced by the dose of Mn supplementation. Dutta *et al.*, (2001) also reported that anestrus heifers are in deficient in zinc level. Decrease zinc level was correlated with a decrease in steroid hormone concentrations which showed some correlation between plasma zinc concentration and estrogen-progesterone levels for proper reproductive processes (Dutta *et al.*, 2001). Bearden *et al.*, (2004) reported that minerals have an important role in the activity of enzymes and hormones at the cellular level so its deficiency ultimately affects the reproductive efficiency of females.

From this study, it is concluded that area-specific mineral mixture supplementation with concentrate has a beneficial effect on the reproductive performance of Black Bengal does. ASMM supplemented animals showed significant higher progesterone and estrogen concentration with an improvement of conception rate. Thus, ASMM supplementation showed overall improvement in reproductive performance of Black Bengal does.

Funding

This study was sponsored by a research grant from ICAR-NDRI (Deemed University) India.

Acknowledgements

The authors thank ICAR-NDRI (Deemed University) India funding this research and especially for providing suitable experimental conditions.

References

- Amin, M. R., Husain, S. S. and Islam, A. B. M. M. 2001. Reproductive peculiarities and Litter weight in genetic groups of Black Bengal does. *Asian-Australian Journal Animal Science*.14: 297-301.
- AOAC. 2005. Association of Official Analytical Chemists, Official Methods of Analysis. 18th Edition., Maryland, USA.
- Ballantine, H. T., Socha, M. T., Tomlinson, D. A. D., Johnson, A. B., Fielding, A. S., Shearer, J. K. and Van Amstel, S. R. 2002. Effects of feeding complexed zinc, manganese, copper, and cobalt to late gestation and lactating dairy cows on claw integrity, reproduction, and lactation performance. *The Professional Animal Scientist*.18 (3): 211-218.
- Banerjee, G.C. 2004. A text book of Animal Husbandry. *Oxford & IBH Publishing Co. Pvt. Ltd.* New Delhi. 8th edition: 933-961.
- Bearden, H. J., Fuquay. J. W. and Willard, S. T. 2004. Applied Animal Reproduction, Sixth Edition. Pearson Prentice Hall, Upper Saddle River, New Jersey, NY, U.S.A.
- Bearden, H. J., Fuquay. J. W. and Willard, S. T. 2004. *Applied Animal Reproduction, Sixth Edition. Pearson Prentice Hall, Upper Saddle River, New Jersey, NY, U.S.A.*
- Desai, M. C., Thakkar, T. P., Dharshana, R. A. and Janakiraman, K. 1982. Serum copper and iron in Surti buffalo in relation to reproduction and gonadotropins [Indian breed]. *Indian Journal of Animal Sciences*. 102(1): 62-76.
- Dutta, A., Sarmah, B. C. and Baruah, K. K. 2001. Concentrations of serum trace element in cyclic and anoestrus heifers in lower Brahmaputra valley of Assam. *Indian Veterinary Journal (India)*. 78: 300-302.
- Ghosh, M.K., Chatterjee, A., Mondal, A., Das, S.K. and Dutta, T.K. 2013. Area specific mineral mixture (CALMIN-ERS) for livestock in lower Gangetic region of West Bengal.
- Hafez, E. J. H. 1962. Reproduction in Farm Animals. 5th Edition., Lea and Febiger, Philadelphia, USA pp: 410-412.
- Harrison J.P., Hancock D.D., and Conrad H.R. 1984. Vitamin E and selenium for reproduction in the dairy cow. *Journal Dairy Sciences*.67: 123-32.
- Husain, S. S. 1999. Sustainable genetic improvement of economic traits of Black Bengal goats through selective and crossbreeding. *Bangladesh Agricultural University Research Progress*. 10: 72-80.
- Kapil, L.C. and Zidenberg, S. 1999. Manganese: Present Knowledge in nutrition, In: Brown ML (Ed.), *International Life Sciences Institute Nutrition Foundation, Washington*, Pp 308.
- Keen, C. L. and Zidenberg-Cheer, S. 1990. Manganese. Pp: 279-268 In present knowledge in nutrition. M.L. Brown Ed. 32. *International Life science Institute Nutrition Foundation Washington, D.C.*
- Kreplin, C., and Yaremci, B. 1992. Effects of nutrition on beef cow reproduction. *Agdex*, 420: 51-1.

- Kumar, P., Sharma, M.C. and Joshi, C. 2005. Status of microminerals, hormone and vitamin profile in buffaloes (*Bubalus bubalis*) of Agra region of Uttar Pradesh. *Indian Journal of Animal Research*. 75(8): 909-914.
- Olson, P. A., Brink, D. R., Hickok, D. T., Carlson, M. P., Schneider, N. R., Dentscher, G. H., Adams, D. C., Colbum, D. J. and Johnson, A.B. 1999. Effect of supplementation of organic and inorganic combination of copper, cobalt, manganese and zinc about nutrient requirement levels on postpartum two years old cows. *Journal of Animal Sciences*, 77: 522-532.
- Sharma, M. C., Joshi, C. and Das, G. 2009. Soil, fodder and serum mineral (cattle) and haematobiochemical profile in some districts of Central Uttar Pradesh. *Indian Journal of Animal Sciences*.79(4): 411-415.
- Smith, O. B. and Akinbamijo, O. O. 2000. Micronutrients and reproduction in farm animals. *Animal Reproduction Science*, 60: 549 -560.
- Sultana, S., Khan, M., Hassan, M., and Khondoker, M. 2012. Effects of concentrate supplementation on growth, reproduction and milk yield of Black Bengal goats (*Capra hircus*). *Bangladesh Veterinarian*.29(1):
- Underwood, E. J. and Suttle, N. F. 2003. Minerals in livestock nutrition. *Third Edition. University Of Florida, Gainesville*.
- Van Soest, P.J., Robertson, J.B. and Lewis, B.A. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal DairySciences*. 74: 3583–3597.
- Verma, R.K. 2015. Effects of Supplementation of Area-Specific Mineral Mixture on Onset of Pubertal Process in Growing Crossbred Heifers. *M V Sc thesis Animal nutrition, ICAR-National Dairy Research Institute, Karnal*.

How to cite this article:

Kedare, G.M., Vipin, R.S. Mantri, A. Mandal, M. Karunakaran and Ghosh, M.K. 2020. Effect of Supplementing Area Specific Mineral Mixture on Reproductive Performance of Peripartum Black Bengal Goats. *Int.J.Curr.Microbiol.App.Sci*. 9(05): 569-576.

doi: <https://doi.org/10.20546/ijcmas.2020.905.064>