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Research Paper

Estimate the Serum Trace Minerals of Female Black Bengal Goats at Different Stages

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ABSTRACT

Serum hormone level was estimated to find out FSH, LH and total estrogen for all the animals under three treatment groups from 20 to 55 week. The FSH level (from 0.56 to 1.32 ng/ml; 0.91 to 1.91 ng/ml and 0.46 to 1.36 ng/ml for first, second and third treatment group, respectively) was higher in the second group; and third group had lowest level out of the three groups. The serum LH level (0.46 to 1.40 ng/ml and 0.27 to 1.91 ng/dl in first and second treatment group, respectively) showed similar pattern like FSH. The total estrogen was higher in the first treatment group (1.08 to 4.2 pg/ml) than that of the second group (0.14 to 2.30pg/ml) and third group ((0.04 to 2.37 pg/ml)). The serum biochemical profiles of the animals under three groups were estimated by serum glucose, total protein in blood and serum cholesterol levels. The glucose level varied from 65.66 to 77.11, 50.03 to 63.78 and 55.22 to 68.66 mg/dl for the first, second and third group, respectively, with higher value at the time of service. The total protein level did not vary much among the animals under three treatment groups (64.45 to 78.55 g/l). The serum cholesterol level varied between 50.17 to 110.05 mg/dl among all the animals irrespective of groups. During prepubertal period this value was low, but it was higher during pubertal period, time of several other services and towards pregnancy for all groups of animals. Regarding the serum trace mineral status, serum copper level showed higher value from 7 months onwards; serum zinc and iron level were almost similar in first and second group; and the third group showed lower value for all the trace minerals. All the good effects noticed in the first treatment group were due to the non-hormonal factors applied to them through nutrition and buck. The effects in the second group of animals was due to the nutritional effect, whereas, the third group showed poor performance without any support from nutrition and social interaction through buck.

Keywords: Serum, nutrition, Minerals, treatment, glucose, protein, blood

According to the FAO, India ranked second in goat population (125.7 million) after China (149.3 million) in the world (FAO, 2008). India ranked second in the goat meat production. There is no religious taboo regarding the consumption of goat meat in India. Goat milk is the source of protein and has medicinal value (www.Agricultureinformation.com). The goat population in India is about 17 percent of the world's total goat population. As per the recommendations by Indian Council of Medical Research (ICMR), the daily allowance of meat is 34 g, but the per capita meat consumption is as low as 14 g per day. Regarding the population of goat in India, it was 14 crore according to the 18th Livestock Census, Government of India, which was 12 crore during 2003 (17th Livestock Census, Government of India). The total goat population in West Bengal

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was 1.5 crore in the year 2007 (18th Livestock Census, Government of India). There are 34 descriptive breeds of goats in India (www.nbagr.res.in). Black Bengal Goat is famous for the delicious meat and superior quality skin. More people like chevon (goat meat) over beef. But the production of chevon is only 10 percent of the total meat. Minerals play a vital role in livestock. Minerals should be given as an essential part of the ration, as they contribute to the building of the skeleton, physiological functions and reproduction. The more important of these salts are calcium and phosphorus. The requirements of calcium and phosphorus for maintenance are 6·5 g and 3·5 g, respectively, per 50 kg body weight per day. Goats require slightly larger quantities of calcium than sheep. The mineral mixture may be included in the concentrate ration at the rate of 0·2 per cent. Common salt to the extent of 2 percent may also be mixed with the daily grain ration of goats to maintain regular body function. Goats need particularly vitamins A, D and E. The microbes in the rumen synthesize most of the other needed vitamins. Vitamin A can be supplied by feeding green forage and yellow maize. Inadequate supply of Phosphorus has been most commonly associated with decreased reproductive performance in ruminants. Inactive ovaries, delayed sexual maturity and low conception rates have been reported, when phosphorus intakes are low. Adequate amount of calcium was necessary to maximize production and minimize health problems. Copper, manganese, and cobalt deficiencies have been associated with impaired ovarian function, silent estrus and abortions. Various minerals like, copper, zinc, selenium, manganese can influence reproductive performance of ruminants. Reproductive failure may be induced by deficiency of single or combined trace elements (Hidiroglou, 1979).

Copper, zinc, selenium and manganese are actively related to the reproduction. The reproductive efficiency is reduced due to alterations of enzyme systems, caused by low copper levels. Copper deficiency can result in delayed estrus, reduced libido, decreased conception rates, infertility, early embryonic death, necrosis of the placenta and central nervous system abnormalities in offspring. Zinc is well known to be essential for sexual maturity and onset of estrus. Zinc plays vital role for maintaining the lining of the reproductive organs. Adequate zinc levels are vital for repair of the uterine lining following kidding, return to normal estrus cycles and maintenance of the uterine lining necessary for implantation of embryos. Selenium is associated with thyroxine hormone regulated metabolism, reproduction, circulation and muscle function. Manganese is essential for breeding (Fig. 1).

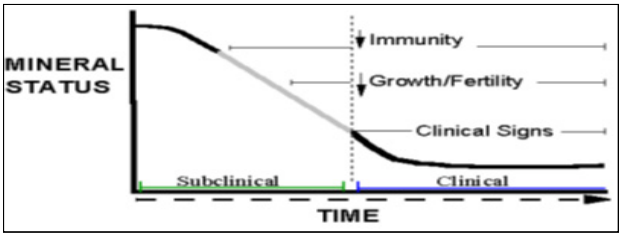

Fig. 1: Relationship between mineral status and onset of subclinical and clinical disease symptoms (Adapted from S. Wikse, 1992. Texas A&M Univ. Beef Cattle Short Course)

REVIEW OF LITERATURE

Haenlein (1980) investigated the deficiency symptoms of Zn in goats. He studied that the most common signs of Zn deficiency was growth retardation and anorexia in all species. Reduction in plasma alkaline phosphates activity and hyperkeratinisation of the epithelial cells were common low zinc concentration symptoms (parakeratosis in swine). Goats, like cattle, show parakeratosis, increased bacteria in the mouth, stiffness of joints with swelling of feet and horn over - growth, excessive salivation, small testicular size and low *libido* on deficient Zn. Apgar (1985) reviewed that adequate concentrations of Zn in the serum and in the diets were vital for uterine involution, tissue repair, after parturition and particularly the return to estrus. Naziroğlu *et al.* (1998) reported the information from 148 aborting ewes and found that the most common cause of abortion had been low levels of micronutrients, and among them, was low Cu concentration. Nix (2002) stated that copper deficiency could result in delayed estrus, reduced *libido*, decreased conception rates, infertility, and early embryo death, necrosis of the placenta and central nervous system abnormalities in offspring. Adequate zinc levels were vital for repair of the uterine lining following kidding, return to normal estrus cycles and maintenance of the uterine lining necessary for implantation of embryos. Inadequate zinc levels in cattle had been associated with abortion, fetal mummification,

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lower birth weights and prolonged labor. Zinc was also vital to sperm quality in males. Moeller and Carol (2003) investigated regarding the effects of copper deficiency on the fertility of ruminant. It was difficult to conclude whether reproductive functions were affected directly by the lack of dietary copper or by some general dysfunction produced by copper deficiency. Hostetler *et al.* (2003) and Robinson *et al.* (2006) reported that Zn played a key role in maintaining the integrity of the epithelia of the reproductive organs, which was necessary for embryo implantation. Boland (2003) reviewed the importance of copper in normal growth, production and reproduction. He also noted that zinc had a vital role in hormone secretion. Hedaoo *et al.* (2008) recorded that the serum copper levels in cyclic and non-cyclic buffaloes were 1.2 ± 0.44 and 0.36 ± 0.06 ppm, respectively. The serum zinc levels and serum iron levels in cyclic and non-cyclic buffaloes were 5.76 ± 1.22 and 4.20 ± 0.51 ppm as well as 2.39 ± 0.64 and 1.01 ± 0.22 ppm, respectively. Al Sobaiyl (2010) investigated that the copper and iron levels in the blood serum of Aradi goats were recorded as 0.13 mg/dl and 0.196 mg/L respectively. Hassabo *et al.* (2011) experimented on Sudanese goats on different management system, and studied that for different rearing systems the results of this study recorded 1.583± 0.616 and 0.367 ± 0.205 ppm for Cu and 0.833± 0.297 and 0.455 ± 0.305 ppm for Zn in intensive and extensive animals, respectively, for the two elements. Vázquez-Armijo *et al.* (2011) reviewed on different trace minerals in sheep and goats. They stated that Cu, Se and Zn directly affected reproductive events on sheep and goats, that directly influenced events, such as, expression of estrus, embryo implantation and reduction in spermatogenesis; indirectly, which affected overall animal health. Bindari *et al.* (2013) reviewed the effect of nutrition on reproduction in ruminants. They stated that zinc was an essential component of over 200 enzyme systems, of which the metabolic action include carbohydrate and protein metabolism, protein synthesis, nucleic acid metabolism, epithelial tissue integrity, cell repair and division, and vitamin A and E transport and utilization. In addition, zinc played a major role in the immune system and certain reproductive hormones.

The above findings suggested the possibility to increase the reproductive capacity of goat by providing good nutritional support and presence of male goats i.e. 'buck effect'. In eastern India the popular goat breed is Black Bengal goat, which is famous for its delicious meat quality, excellent skin, better disease resistance power and prolificacy resulting in to better production. In India, the meat production is not up to the recommendation of ICMR for daily consumption of meat. Thus the public demand is always high towards the production of good quality meat. Being a prolific breed, if the female goats are given better management facility and some non-hormonal factors, which can improve the reproductive efficiency of the breed with nutrition and male effect; the female Black Bengal can reproduce better in the field condition of the state. Thus, not only the economic condition of the farmers can be improved, but also the meat quality will be organic without any chemical residues. For these reasons, the present investigation was undertaken to find out the possibility of increasing the productivity of Black Bengal goat through combination of some positive effects by offering improved nutrition and male effect to the female goat.

METHODOLOGY

The experiment was conducted in Completely Randomized Design (CRD) with three treatments, viz. (i) Nutritional Effect and buck effect, (ii) Nutritional effect and (iii) Control. There were five female Black Bengal kids of three months of age in each group. The first group of animals was allowed to graze *ad lib* and the only were kept with a buck while the other two groups of animals were stall fed with the similar type of grass *ad lib*. The animals of TG-1 and TG-2 were also provided with concentrate feed supplement (21% CP) @ 10g per kg body weight per day in two divided doses. The animals under control group were neither provided the concentrate feed mixture nor kept with the buck. All the animals were placed in comfortable sheds and were under standard management practices. Different reproductive parameters viz, age, of 1st estrus, number of services per conception, length of gestation, age of 1st kidding, kidding size and post-partum heat were recorded as per standard protocol. The data were analysed statistically by the analysis of variance (ANOVA) method, described by Cochroan and Cox (1967) and Panse and Sukhatme

(1967). Error mean square by Fisher and Snedecor's F-test method was followed to test significance of different sources of variation. The standard error (S_e) and test of significance have been provided in the tables of results to compare the mean values.

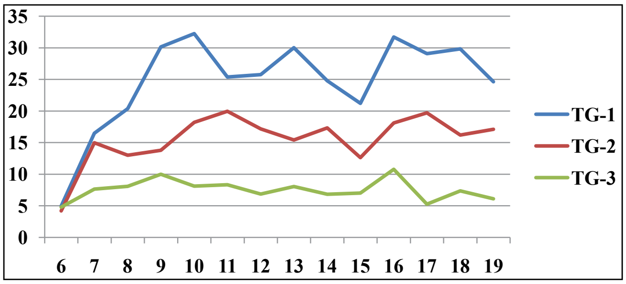
RESULTS AND DISCUSSION

Determination of trace minerals in blood serum

The serum trace minerals namely, copper, zinc and iron of the animals under different treatment groups were determined at monthly interval from six to nineteen months *i.e.* the period of experimentation.

Evaluation of serum copper

Serum copper level of the animals under different treatment groups were estimated through Atomic Absorption Spectrometry. The average serum copper levels, expressed in µg/L, were tabulated in the Fig. 2.



[X-axis represents stage (month) of the animal and Y-axis represents the level of serum copper (µg/L)]

Fig. 2: Average copper level (µg/L) in blood serum of animals under different treatments at different months

It was observed that the average serum copper levels in the animals under three treatment groups at the age of six months were almost similar (from 4.2156 to 4.948 µg/L) and the test result was not significant. The serum copper levels of the animals under three treatment groups from seven months to nineteen months varied significantly among the three treatment groups. It was also noted that the serum copper levels were consistently higher in the animals under the first treatment group than the other groups. The serum copper levels of the animals under the first treatment group increased consistently from six to ten months and after that the higher level remained more or less constant during the rest of the experimental period. The increase in the serum copper levels of the second group of animals was of similar pattern like that of the first group up to seven months. After that it was more or less constant but much lower than that of the first group of animals during the rest of the experimental period. On the contrary, the third group of animals recorded much lower level of serum copper than the other two groups throughout the experimental period (Fig. 2). The serum copper level of the animals under three treatment groups varied significantly at five percent level.

The explanation behind the result might be explained by the treatment plan among the animals. The first and second group of animals were received sufficient nutritional support through concentrate feed mixture, where trace minerals were also present. For that reason, they had higher level of serum copper than that of the third group. The first and second group of animals became pregnant and gave birth to kids successfully; whereas, all the animals under third group could not become pregnant. Copper might played a vital role regarding this phenomenon. The first group of animals showed higher value of serum copper level than that of the second group, which might be due to the fact that, the first group could graze according to their choice; whereas the second group were stall fed to restrict the buck effect. As per their browsing nature, the first group had better quality pasture rich in copper.

It was known from the earlier works that, when goats fed with Cu deficient diet, it was observed to have low conception rates and 50 percent of the gestating goats with Cu deficiencies aborted. Copper deficiency affected both reproductive behavior and performance (Hidiroglou (1979). Low level of serum copper level might be a cause of abortion in sheep (Naziroğlu *et al.* (1998). Copper deficiency could result in delayed estrus, reduced *libido*, decreased conception rates, infertility and early embryonic death (Nix, J. (2002). Copper level in cyclic and non-cyclic buffalo was recorded as 1.2 ± 0.44 and 0.36 ± 0.06 ppm (Hedaoo *et al.* 2008). In the blood serum of Aradi goats, the Cu level was 0.13 mg/dl (Al Sobaiyl, K.A. 2010). On Sudanese goats it was recorded as 1.583 ± 0.616 and 0.367 ± 0.205 ppm (Hassabo *et al.* (2011).

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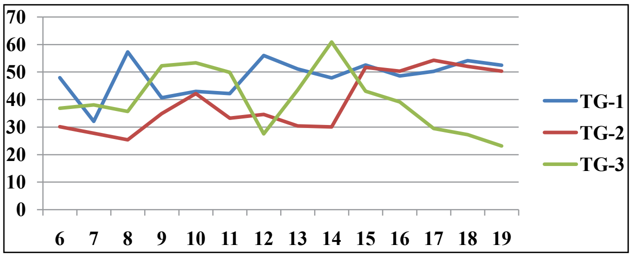
Evaluation of serum zinc

Serum zinc level of the animals under different treatment groups were also estimated through Atomic Absorption Spectrometry. The average serum zinc levels, expressed in µg/L, were presented in the (Fig. 3). The graphical presentation also depicted the trends in changes of serum zinc levels in all the groups (Fig. 3). It was observed that the average zinc levels in the animals under three treatment groups at six months of age were significantly different at one percent level (Fig. 3). The variation in serum zinc levels of the animals under three treatment groups from seven months to sixteen months were not significant during most of the time. It was also noted that the serum zinc levels varied significantly among the animals of the three treatment groups at one percent level from seventeenth to nineteenth months. The animals under third treatment group showed lower level of serum zinc level than the first and second treatment group from fifteen to rest of the experimental period. The serum zinc levels of the first and second group of animals showed similar trends from fifteen months to rest of the experimental period (Fig. 3). The animals of the three treatment groups had serum zinc level within the normal physiological range and no deficiency symptoms were noted.



[X-axis represents stage (month) of the animal and Y-axis represents the level of serum zinc (µg/L)]

Fig. 3: Average zinc level (µg/L) in blood serum of animals under different treatments at different months

Our observation could be explained by the treatment plan followed during the experimental period. The first and second group of animals were provided with nutritional supplementation, which was good source of minerals also. The third group did not receive minerals from concentrate feed. Consequently, they had lower level of zinc which was evident from fifteenth month onwards. Lack of the trace minerals among the animals under third group might be one of the causes of not being pregnant for all animals successfully throughout the experimental period.

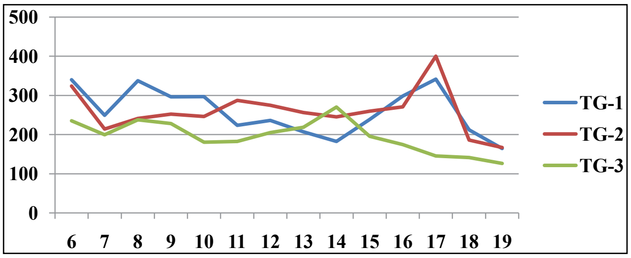
Zinc deficiency might be the cause of reproductive failure in both male and female (Hidiroglou, 1979). It was studied that the most common signs of Zn deficiency was growth retardation and anorexia (Haenlein, 1980). Serum zinc level was 5.76 ± 1.22 and 4.20 ± 0.51 ppm in cyclic and non-cyclic buffalo (Hedaoo *et al.* 2008). The serum Zn level of Sudanese goats was 0.833 ± 0.297 and 0.455 ± 0.305 ppm (Hassabo *et al.* (2011).

Evaluation of serum iron

Serum iron level of the animals under different treatment groups were also estimated through Atomic Absorption Spectrometry. The average serum iron levels were expressed in µg/L. The average values of serum iron levels of all the animals under three treatment groups with the test of significance were presented in the Fig. 4. From the result it was clear that the trend in changes of the serum iron level was to some extent similar among the animals under three treatment groups. But the levels of serum iron were almost similar in the first and second groups and that was higher than that of the third group. Most of the time from six to nineteenth month the changes in serum iron level among animals of the three treatment groups were not significant. The serum iron level declined from fourteen months onwards in case of animals under third treatment group. Although the serum copper levels were to some extent different among the three groups, but that was not too low to cause any deficiency symptoms *i.e.* the serum iron level was within normal physiological range.

The serum iron levels of the animals under first and second treatment group were almost similar because these animals had the same concentrate feed throughout the experimental period. On the contrary the third group was not given the concentrate feed and that is why they showed lower level of serum iron throughout the experimentation.

From the previous works it is known that low availability of iron might affect ruminant reproduction adversely (Hidiroglou, 1979). The serum iron level was recorded as 2.39 ± 0.64 and 1.01 ± 0.22 ppm in cyclic and non-cyclic buffalo (Hedaoo *et al.* 2008). In the blood serum of Aradi goats the iron level was 0.196 mg/L (Al Sobaiyl, K.A. (2010).



[X-axis represents stage (month) of the animal and Y-axis represents the level of serum iron (µg/L)]

Fig. 4: Average iron level (µg/L) in blood serum of animals under different treatments at different stages

CONCLUSION

Serum hormone level was estimated to find out FSH, LH and total estrogen for all the animals fewer than three treatment groups from 20 to 55 week, when all of them experienced various phases of reproductive cycle. It is known that all these hormones are responsible for ovulation. The serum FSH level (expressed in ng/ml) was noted to be higher during the time of estrous in all the treatment groups. There were several fluctuations in FSH level (from 0.56 to 1.32 ng/ml; 0.91 to 1.91 ng/ml and 0.46 to 1.36 ng/ml for first, second and third treatment group, respectively) for all over the period of experimentation. Animals of the third treatment group showed lower FSH value than that of the other groups. The general trend showed that second treatment group had higher FSH value than that of the first group. The LH level (expressed in ng/ml) of the first and second treatment groups showed almost similar pattern like FSH level. The LH value ranged from 0.46 to 1.40 ng/ml and 0.27 to 1.91 ng/dl in first and second treatment group, respectively. It was also noted that the values did not vary significantly before reaching the time before puberty. The total estrogen level (expressed in pg/ml) also fluctuated throughout the time of experimentation, because they passed through various phases of reproductive cycle. The interesting thing was that, the total estrogen was higher in the first treatment group (1.08 to 4.2 pg/ml) than that of the second group (0.14 to 2.30pg/ml). The third group showed lowest total estrogen level among the three treatment groups (0.04 to 2.37 pg/ml). Regarding study of hormones on a single animal under first treatment group, it was noticed that, the FSH, LH and total estrogen showed peak during the time of estrous, suggesting that theses hormones were needed for ovulation.

The serum trace mineral status of all the animals under three treatment groups was estimated, from 6 to 19 months at monthly interval, to study the effect of copper, zinc and iron at monthly interval during various phases of reproductive cycle. At the beginning of the experiment at six month, all animals had similar value of copper indicating the prepubertal period. It was also noticed that the serum copper level of the animals of the first group increased significantly from 7 months onwards and all showed higher value than the other two groups. The third group showed lowest level of copper among the three groups. From 7 months onwards, the variation in zinc level among the animals fewer than three treatment groups were significant in most of the times. The animals under third group showed lower value of serum zinc level than the other two groups from 15 months to the rest of the experimental period. The serum iron level of the animals under three treatment groups showed almost similar pattern throughout the experimental period, with to some extent lower level for the third group of animal than the rest of the groups. The first and second group of animals had to some extent similar level of iron throughout the period of experimentation.

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