

Effect of zinc supplementation on reproductive performance of Teresa goat

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Abstract

Aim: The present study evaluates the effect of dietary zinc supplementation on reproductive and productive performance of Teresa goat, an indigenous species of Andaman and Nicobar Islands.

Materials and Methods: Eighteen female goats were randomly divided into 3 groups of 6 animals each; (A) control with basal ration without any zinc supplementation (B) Treatment 1 with basal ration supplemented with 50 ppm zinc oxide (C) Treatment 2 with basal ration supplemented with 100 ppm zinc oxide. Different reproductive parameters, e.g. numbers of days to oestrus, the incidence of oestrus, pregnancy rate, kidding rates and weight of kids were recorded.

Results: Data indicated that the supplementation of different levels of inorganic zinc oxide significantly increased the incidence of oestrus (33%), pregnancy rate (12%), kidding rate (5%) and resulted in shorter onset (8 days) of oestrus as compared to the control. The mean body weight and daily weight gain of kids born to supplemented does were significantly ($p < 0.05$) higher than the kids born to control.

Conclusion: The supplementation of 50 to 100 ppm zinc oxide to the basal diet of Teresa goat significantly improved different productive and reproductive parameters.

Keywords: Andaman and Nicobar islands, fertility, reproduction, Teresa goat, zinc.

Introduction

Trace elements are needed for vitamin synthesis, hormone production, enzyme activity, energy production and other physiological processes related to growth, reproduction and health [1]. Deficiency of trace elements affects almost all physiological processes like growth, reproduction, immunity, milk production and other processes of animals. Histological sections of organs also showed their ultrastructural changes due to the elemental deficiencies [2]. Zinc is a very important trace element that is involved in a wide range of metabolic activities and productive performances like growth [3], reproduction [4] and humoral immune system [5]. Maternal Zinc deficiency may compromise infant development and lead to poor birth outcomes [6]. The trace elements status in general and Zinc in particular of new-born depends on maternal transfer via the placenta, the colostrums or the milk [5, 7]. Forages are the main source of Zinc for the goats but its contents in forages are very variable; so that when the mineral supplementation is insufficient, animals suffer from several deficiencies. Under field conditions, the bioavailability of Zn is influenced by interactions with other trace elements like Ca, Cd, Ni, and phytic acid, which can induce a secondary Zn-deficiency even if their intake is high [2].

Teresa goat is an indigenous species of Andaman and Nicobar Islands. The name 'Teresa' have been coined from the Island Teresa, a unique Island among Nicobar group of Islands. The Island is unique in the sense that it has plenty of grasslands whereas other Islands of Nicobar group are covered by tropical rain forest and coconut plantation. This unique topography makes this Island very much feasible for goat rearing. From the original breeding tract of Teresa Island, the breed has scattered to adjoining small Islands like Hut bay, Little Andaman etc. The breed is tall and sturdy; colour varies from brownish to dark tan with white and black patches. The most prominent feature of the breed is the presence of a white patch or line starting from inner canthus of both eyes or from eye brows and extending up to nostrils or mouth [8]. The adult weight ranges from 55 to 70 kg. At present the population of goat in the Nicobar district is only 8357 [8]. Teresa goats are reared mainly for meat purpose.

Reproductive problems are common among the dairy animals of Andaman and Nicobar Islands [9]. Lower levels of macro and micro minerals were reported in blood serum of dairy animals which might be the major cause of reproductive problems [10]. Moreover, the soil, grass and water of Andaman and Nicobar Islands are reported to be deficient in micro and macro minerals particularly Zn and P [11]. The Teresa goats are reared mostly under free range system and their feed consists of grass, coconut leaves, tree fodders, dried coconut and oil extracted coconut as

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Table-1: Effect of zinc supplementation on the reproductive performance of Teresa goat.

Reproductive parameters	Control (n=6)	Treatment 1 (n=6) (50 ppm ZnO)	Treatment 2(n=6) (100 ppm ZnO)
% Oestrus response (number)	66.66 (4) ^b	83.30(5) ^{ab}	100.00 (6) ^a
% Onset of oestrus in days	25.30±0.42 ^a	20.40± 0.37 ^{ab}	17.70±0.34 ^b
Pregnancy rate (number)	50.00 (3) ^b	66.66 (4) ^{ab}	100.00(6) ^a
Kidding rate (number)	87.50(3) ^b	90.90 (4) ^{ab}	91.70(5) ^a
Fecundity	1.66	2.00	2.40

Values are presented as mean±SEM, Values in the same row with different superscripts (a, b) vary significantly (P<0.05).

Table-2: Effect of zinc supplementation on the production performance of kids up to two months of age

Production parameters	Control (n=6)	Treatment 1 (n=6) (50 ppm ZnO)	Treatment 2(n=6) (100 ppm ZnO)
No. of kids born	4 (66.66) ^b	5 (83.3) ^{ab}	6 (100.0) ^a
Weight (kg) at birth	1.68 ± 0.05 ^b	1.79±0.04 ^a	1.78 ± 0.06 ^a
Weight (kg) at two months of age	5.10 ± 0.30 ^b	5.91± 0.29 ^a	5.87± 0.09 ^a
Body weight gain (kg)	3.43 ± 0.26 ^b	4.11 ± 0.27 ^a	4.09± 0.08 ^a
Body weight gain at 1 st month (g/day)	59.17 ± 5.16	73.13 ± 4.39	68.06 ± 1.82
Body weight gain at 2 nd month (g/day)	55.00 ±12.66	63.96 ± 11.15	68.20 ± 2.15

Values are presented as mean±SEM, Values in the same row with different superscripts (a, b) vary significantly (P<0.05).

per the availability in the area. No supplemental feeding is given to explore the potentiality of the unique indigenous species.

Due to limited information on factors relating to reproductive performance of goats under range conditions, the present study was undertaken to investigate how zinc supplementation affected reproductive events and kidding rate of goats kept under extensive conditions. The findings of this study will be helpful to design measures to increase the reproductive efficiency of this breed which in turn will enable the indigenous tribal population to effectively harness the potential of this goat breed.

Materials and Methods

Ethical approval: The present experiment complies with all relevant institutional and national animal welfare guidelines and policies. Approval from the Institutional Animal Ethical Committee was taken prior to the experiment.

Animals and experimental design: Eighteen Teresa goats of first and second lactation and aged 3 - 4 years, weighting about 25 kg were used in the present study. All does (She goat) were found healthy with no external and internal parasites. Does were provided with night / rain shelter with open paddock. Animals were maintained on grazing and fed with looped fodder. The basal diet in this experiment contained natural grass pasture and lopped fodder available in the area normally grazed by the goat. The proximate composition of the natural grasses was 87.54% OM, 12.46% Ash, 10.70% CP, 1.98% EE, 24.55% CF and 49.69% NFE, besides containing 12.3 ppm Zn. The pregnant animals were offered one coconut (average weight of each coconut is 200g) during the last month of the pregnancy. The treated groups were supplemented with a standard mineral mixture consisting of: Dicalcium phosphate (60%), Sodium chloride (17.5%), Chalk Powder (20%) and Zinc Oxide (2.5%). The basal

diet contained 22.1 mg Zn/Kg whereas mineral mixture contained 20 mg Zn/gm. The animals were randomly divided into three groups of 6 does each. Group 1(Control) was kept as a control and was fed the basal diet. Group 2 (Treatment 1) received basal diet supplemented with 50 ppm zinc oxide (50 ppm ZnO) whereas Groups 3 (Treatment 2) was fed the basal diet supplemented with 100 ppm ZnO. The does were orally supplemented with 2 gm and 4.5 gm prepared mineral mixture /head /day respectively for the treated groups. The experiment was continued for 6 months.

Reproductive performance: The animals were observed for oestrus symptoms every day between 9 AM–12 AM and 2 AM–5 PM using castrated buck. Standing condition of does was considered to be in oestrous when mounted by a buck. Oestrus does were naturally bred. Reproductive traits like oestrus response, the time interval to onset of oestrus, pregnancy, kidding rates and fecundity were recorded.

Performance of kids: New born kids were numbered and weighed just after birth and colostrums were fed to the kids. Fortnightly body weights were taken up to 2 months of age to determine the body weight gain.

Statistical analysis: The differences between treatments were analyzed using a one way analysis of variance (ANOVA). Differences with a confidence level of 0.05 or less were considered to be significant. All the data collected were analyzed [12].

Results

The different reproductive performance parameters like oestrus response, onset of oestrus, pregnancy and kidding rates, for control and supplemented groups are presented in Table-1. Both the supplemented groups showed significantly (P<0.05) higher incidence of oestrous than the control groups. Does that received 100 ppm ZnO showed early oestrous symptoms (17.7 ± 0.34 days) than control (25.3±0.42 days) and 50 ppm

group (20.4 ± 0.37 days). Similarly supplemental effects have been recorded with regard to pregnancy rate and kidding rates. Does that received 100 ppm ZnO showed significantly ($P < 0.05$) higher pregnancy (100%) rate followed by 50 ppm group (66.66%) and the control group (50.00%). Significant higher kidding rates were recorded in supplemented groups than the control group.

The number of kids born and their weight at birth were significantly ($P < 0.05$) higher in does supplemented with 50 ppm and 100 ppm ZnO than the control group (Table-2). The total body weight gain of kids at two months age was significantly ($P < 0.05$) improved in the group supplemented with 50 ppm ZnO (5.91 ± 0.29 kg) and 100 ppm ZnO (4.09 ± 0.08) as compared to control.

Discussion

Small ruminants including goat play an important role in the livelihood of small and marginal farmers and maintenance of subsistence agriculture. Normally goat is considered as poor man's cow. The farmers keep goat for sale, consumption and personal use. Teresa goat is generally reared by the tribal farmers of Nicobar group of islands and it is an integral part of their tradition and culture. The farmers do not rear goats for commercial purposes and slaughter them for domestic consumption during different festivals, sports or community functions. Sale of goat meat among the tribes is considered as sin. The productivity especially reproduction of goats in subsistence agriculture can be affected by nutrients availability and especially by the mineral content of the forage resources on the rangeland [13]. Inadequacy of year-round feed resources is also another cause of low animal production in arid and semi-arid regions [14]. So, dietary deficiencies of copper (Cu), selenium (Se) and zinc (Zn) are commonly seen in ruminants [4].

The results of the present study showed that the Zn supplementation had beneficial effects on the reproductive performance of the Teresa goat as indicated by higher incidence of oestrous and early oestrous symptoms (Table-1) which is in agreement with reports in cattle where Zn supplementation (0.8g/day/animal) improved onset of oestrus [15] and improved reproductive performance [16]. Ewes receiving zinc supplementation had a higher fertility rate and were more prolific (89% vs. 40%) [17]. On the other hand, goats fed on diets of low Zn had low conception rates and prolificacy [18].

Significantly higher body weight at birth as well as number of kids born from dams receiving supplementation with 50-100 ppm Zn as compared to those of control has been recorded in our result (Table- 2). The result of the study is consistent with the findings in ewes where supplementation of 100 ppm Zn improved the litter size of does, body weight of lambs at birth (4.0 vs. 2.9 kg) and at weaning (17.7 vs. 14.2 kg) as compared to ewes that were fed control diet containing 23–25

ppm Zn [17]. Average daily gain and feed efficiency improved significantly with Zn supplementation in lambs as compared to controls [19, 20]. Feeding a high concentration of Zn to the ewes helps to increase zinc concentration in the whole milk [21]. The lambs that consumed milk containing high level of Zinc also showed higher body weight gain at weaning [22]. In the present study, similar findings were observed. Therefore, in order to improve the reproductive performance of Teresa goat, dietary supplementation of Zn at 50 or 100 ppm is highly recommended.

Conclusion

From the results presented above, it could be concluded that supplementing 50 to 100 ppm zinc oxide to the basal diet of Teresa goat significantly improved the reproductive and productive performance.

Authors' contributions

MSK, JS, SJ and AK were involved in design of the study. The experiments were done by MSK, TS and JS. AK and AKD revised the final draft of manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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