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Effect of dietary selenium levels on growth performance under endotoxin induced stress condition in goats

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Abstract
Goat rearing under intensive and semi-intensive systems for commercial production has been gaining traction in recent years due to its favorable economic prospects. A number of commercial goat farms have been erected around the country. According to 20th livestock census, total goat population in the India is 148.88 million and has increase by 10.1% as compared to the previous census. Selenium (Se) plays a crucial role in production, reproduction, immunity, and metabolism in the animals. Therefore, supplementation of selenium in animal rations is extremely important to protect against problems related to selenium deficiency. The present study is aims to assess the effect of Se in body weight of goats exposed to sub-clinical endotoxin induced stress condition. During the 62-day trial period, the mean body weight gain of kids was 16.61 to 19.23 in the control group, 16.99 to 19.30 in the endotoxin control group, 16.28 to 18.84 in the Se 600 control group, 16.66 to 18.98 in the Se 600 endotoxin, 16.36 to 19.00 in the Se 900 control group, and 16.76 to 19.48 in the Se 900 endotoxin group. Weekly body weight gain did not differ significantly (P>0.05) between treatment groups. However, the numerical average daily gain was greater in the Se 900 endotoxin group, but there was no statistically significant (P>0.05) difference between the treatment groups. As per findings of this study, dietary selenium supplementation in kids under normal and endotoxin-induced stress circumstances seemed to result in neither beneficial nor deleterious endotoxin effects, implying that the negative effect of selenium was compensated by selenium.

Keywords: Selenium, endotoxin, body weight and kids

Introduction
Trace elements are micronutrients that are essential for a variety of crucial biological activities in food animals such as goats, including immunity, oxidative metabolism, nutrition and energy metabolism and reproductive function [1, 2]. Selenium (Se) is a key micronutrient that must be present at lower proportions in animal feed for numerous biological processes to work efficiently. In most parts of India (excluding northern India), soil Se levels are excessively low, resulting in Se-deficient plants, which eventually lead to Se deficiency in animals [3, 4]. Depending on the physiological status of the animals, deficiency of Se causes muscular dystrophy (white muscle disease), poor growth rate, delayed puberty in young animals, reproductive disorders like infertility, abortion, premature birth, early embryonic death, cystic ovarian diseases, retention of fetal membrane, delayed ovulation, mastitis, metritis and production related condition like reduced milk and meat production in adults [5, 6]. Endotoxin is a lipopolysaccharide (LPS), consist of O-antigen, core polysaccharides and lipid A-containing fatty acids and disaccharide phosphates. Toxin released after death or growth of bacteria, inside the cell of host animal. It causes harmful effects by inducing oxidative stress, generation of pro-inflammatory cytokines, increasing stress hormones, influencing liver enzymes in rats and goats [7, 8, 9]. Several studies have inferred those therapeutic levels of Se reduce the risk of diseases such as oxidative stress, muscular dystrophy, cardiovascular disease, cystic fibrosis and arthritis [10]. Because of its direct link with immunity and tumorigenesis, selenium is widely applied in feed [11]. Therefore, supplementation of selenium in animal rations is extremely important to protect against problems related to selenium deficiency. It is a supplement in either organic or inorganic forms for animals. The present study is aims to assess the effect of Se in body weight of goats exposed to sub-clinical endotoxin induced stress condition.

Materials and Methods

Selection and distribution of experimental animals

Total 36 male goats were selected on the basis of their body weight and body condition score from the flock of goats for conducting the experiment. All the animals were physically healthy at the time of selection. These animals were divided into 6 groups, six in each following completely randomized design. Group of animals described in Table 1.

Table 1: Experimental groups and dietary treatment

Group	Endotoxin*	Se supplementation levels (ppb)	Dietary level of selenium (ppb)**
CON (Control)	-	200	300
ET CON	+	200	300
Se 600 CON	-	500	600
Se 600 ET	+	500	600
Se 900 CON	-	800	900
Se 900 ET	+	800	900

*Endotoxin exposure at 0.2µg/kg BW I/V once at weekly interval for about six weeks

** Selenium will be added as inorganic selenium i.e. sodium selenite (Na_2SeO_3)

Feeding trial

Experimental feeding was continued for 9 weeks; all the animals were fed according to NRC [12]. Kids in all the groups were fed diet containing concentrate and roughage (wheat straw + maize hay) at the ratio of 70:30. Experimental feeding was similar in all the groups except for the level of Selenium in the diet. The ingredients used for basal diet were weighed on digital electronic balance and properly mixed manually. The mineral mixture was prepared in the mineral and vitamin laboratory to fulfil the remaining mineral requirements of goats as per NRC [12]. Basal diet contained 100 ppb Selenium, available from the feed ingredients and as sodium selenite is added daily in concentrate mixture as solution form manually according to requirement of animal. Feeds of the goats was having similar nutrient composition for all the six groups, except Se levels.

Endotoxin exposures

Endotoxin (*E. coli* O55:B5) was injected in treatment groups (ET CON, Se 600 ET, Se 900 ET) at the dose rate of 0.2µg/kg BW I/V once at weekly interval for about six weeks of experimental feeding.

Recording of body weight

Body weights (BW) of each animal were recorded at weekly intervals in the morning before feeding and watering on two consecutive days by using electric weighing balance.

Result and Discussion

Effect of dietary se levels under induced endotoxin stress condition on weekly body weight change (kg) in kids observed in different groups is presented in Table 2. The mean body weight gain of kids during the 62-day trial period was 16.61 to 19.23 in the control (CON) group, 16.99 to 19.30 in the endotoxin control (ET CON) group, 16.28 to 18.84 in the Se 600 control (Se 600 ET CON) group, 16.66 to 18.98 in the Se 600 endotoxin (Se 600 ET), 16.36 to 19.00 in the Se 900 control (Se 900 CON) group, and 16.76 to 19.48 in the Se 900 endotoxin group (Se 900 ET). The difference in weekly body weight gain between treatment groups was not significant (P>0.05). The Se 900 ET group had a higher numerical average daily gain, but there was no statistically significant (P>0.05) difference between the treatment groups. During whole experiment period, weekly body change was recorded to know the efficacy of feed, growth and production efficiency of animals. Effect of dietary se levels under induced endotoxin stress condition on weekly body weight change (kg) and average daily gain (ADG) in kids was similar in all group, did not show any significant (P>0.05) difference among the group. In agreement with our findings Aderao [13] reported that sodium selenite supplementation @ 300, 600, and 900 ppb in the diet of goats had no significant difference (P>0.05) in body weight change and ADG of goats during normal and abiotic stress condition. In the present study there was no adverse effect of endotoxin on body weight change and ADG as it was observed that Se shows beneficial effect in preventing the adverse effect of endotoxin on BW change and ADG of kids. Crude protein of total diet was 15.4% which support the ADG of kid around 41g. Amsath kumar *et al.* [14] and Chaudhary [15] produce endotoxin challenge in goats and rats respectively and found no significant (p>0.05) difference among the groups. Contrary Dhari and Kassim [16] and Kumar *et al.* [17] reported significant increase (p<0.05) in body weight change and ADG in lamb.

Table 2: Effect of dietary selenium levels on weekly body weight changes (kg) of goats under endotoxin stress and normal physiological state.

Period	Groups*						SEM	P value
	CON	ET CON	Se 600 CON	Se 600 ET	Se 900 CON	Se 900 ET		
0 d	**16.61**	**16.99**	**16.28**	**16.66**	**16.36**	**16.76**	**0.26**	**0.979**
Weeks								
1st	16.85	17.21	16.49	16.74	16.78	16.87	0.25	0.983
2nd	17.03	17.28	16.59	17.12	17.01	17.21	0.24	0.980
3rd	17.29	17.72	16.90	17.69	17.12	17.51	0.24	0.921
4th	18.09	18.09	17.38	17.80	17.55	17.78	0.24	0.956
5th	18.47	18.38	17.68	18.32	18.07	18.51	0 .24	0.932
6th	18.47	18.60	18.26	18.57	18.31	18.63	0 .23	0.997
7th	18.75	18.72	18.33	19.01	18.70	18.95	0 .24	0.981
8th	18.99	19.01	18.50	18.98	18.83	19.22	0 .26	0.985
9th	19.23	19.30	18.84	18.96	19.00	19.48	0.28	0.987
ADG (g)	41.65	39.42	40.64	39.09	41.90	43.14	2.78	0.999

*CON, Se 600 CON and Se 900 CON: Goats were fed basal diet containing 285, 585 and 885 ppb Se (Na_2SeO_3), respectively; ET CON, Se 600 ET and Se 900 ET: Goats were fed basal diet containing 285, 585 and 885 ppb Se (Na_2SeO_3), respectively and were exposed to endotoxin at 0.2 µg/kg BW intravenously at weekly interval for the last six weeks of the trial period

Based on the findings of this study, it was concluded that supplementation of dietary selenium levels in kids under normal and endotoxin-induced stress circumstances showed neither positive or negative effects of endotoxin, showing that selenium is helpful. It is possible to infer that selenium supplementation averted physiological alterations while minimizing the harmful effects of endotoxins.

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