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Research Article

Effect of Selenium Yeast Supplementation Over Vital Characteristics and Growth of Cross Breed Pateri Goat

Nabi Bux Solangi[1]*, Moolchand Malhi[1], Saeed Ahmed Soomro[1], Jamil Ahmed Shaikh[2], Hafiz Ahsan Raza[3], Tahseen Jamil[1], Benazir Kanwal[4], Abdul Wahid Solangi[1], Bushra[1], Sarfaraz Nawaz Sanjrani[1] and Neel Kanth[5]

[1]Department of Physiology and Biochemistry, Sindh Agriculture University, Tando Jam, Pakistan

[2]Directorate General of Animal Husbandry Sindh, Hyderabad, Pakistan

[3]Remount Veterinary and Farms Directorate, Ministry of defence

[4]Sindh Institute of Animal Health, Livestock Department Government of Sindh, Karachi, Pakistan

[5]Department of Veterinary surgery, Sindh Agriculture University Tandojam, Pakistan

***Corresponding Author:** Nabi Bux Solangi, Department of Physiology and Biochemistry, Sindh Agriculture University Tandojam, Sindh, Pakistan.

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Abstract

The present study was conducted on forty cross-bred goats to evaluate the effects of dietary selenium yeast (SY) on hematological, physiological and growth performance indices. Animals were randomly divided into two groups and were given the basal diet consisting of barseem and concentrate (group A) and basal diet supplemented with SY at the dose rate of 0.3 mg/kg feed (group B). The experiment lasted 10 weeks. The results showed that the hematological analysis of blood showed an increase ($P < 0.05$) in red blood cells (RBC) count and hemoglobin concentration in B compared to A, however, no significant effect ($P > 0.05$) of dietary Se was observed on rest of the hematological parameters between the two groups. The physiological parameters including temperature, respiratory rate and heart rate were not different ($P > 0.05$) between the groups. The final body weight significantly increased ($P < 0.05$) group B (22.24 ± 0.64 kg) compared to A (19.84 ± 0.75 kg). Concurrent with increase in final body weight, the average daily gain was significantly higher ($P < 0.05$) in B (95.86 ± 1.9g) compared to A (60.57 ± 0.82g). Improved growth performance in present study demonstrates that the dietary selenium yeast supplementation has no any adverse effects over hematological and physiological parameters hence improved health of the animals.

Keywords: *Growth; Hematology; Selenium Supplementation; Physiological Indices*

Abbreviations

PCV: Packed Cell Volume; MCV: Mean Corpuscular Volume; MCH: Mean Corpuscular Hemoglobin; MCHC: Mean Corpuscular Hemoglobin Concentration; TLC: Total Leukocyte Count; DLC: Differential Leukocyte; BW: Body Weight; ADG: Average Daily Gain; FCR: Feed Conversion Ratio; F:G: Feed Gain Ration; DM: Dry Matter; Se: Selenium; CP: Crude Protein; TDN: Total Digestible Nutrient; SY: Selenium Yeast

Introduction

Selenium (Se) is a trace element essential for biochemical transformation in animal and human body cells [13] maintaining vital functions of body i.e. normal health and growth [17]. The content of Se in the organism is naturally very low due to the Se deficient soil [17], whereas the small ruminant farming mainly depends upon open grazing in Pakistan which ultimately encounters Se deficiency problem. Naturally it exists in four states i.e. Se^{-2}, Se^{0}, Se^{+4}i, Se^{+6} showing both metallic and non-metallic properties [13]. Se is a component of at

least 25 selenoproteins bounded in tissues and blood, perform several basic functions in body like the process of antioxidation, also possess chemoprotective properties with anti-inflammatory response [19]. Se is the part of several enzymes, the most important are related to glutathione peroxidases (GPx) family, thioredoxin reductases (TrxR), iodothyronine deiodinases (ID), selenophosphate synthetase, selenoprotein P and selenoprotein W. It is the part of glutathione peroxidase family, an antioxidant enzyme which destroy free radicals produced during normal metabolic activity by catalyzing reduction of hydrogen per oxide and lipid hydro peroxidase [18]. Se supplementation shows remarkable increase in blood Se concentration which denotes relative improvement in antioxidative status of the cell [31], this increased anti oxidative status by preventing process of peroxidation ultimately increases immunological potential [15] at cellular levels with no any adverse effect [31].

Selenium deficiency causes many neonatal as well as adult health problems. Neonates may suffer from white muscle disease, decreased sucking reflex, show signs of weakness, highly prone infectious diseases due to weakness and less immunity, also the chances of neonatal mortality [5]. Thyroid functions are also Se dependant, due to the Se deficiency disturbances in thyroid homeostasis occur which more likely to be evident in immune disorders and endocrine dysfunctions. [12]. New-born, sucking calves and within womb may also have Se deficiency, saturation of kids during sucking depends on the saturation of the mother [16]. The diet of mother and Se supplementation in diet highly effects concentration of Se in milk [10], Se concentration can be increased by adding organically bound Se in the form of selenomethionine as dietary supplement [21].

Both organic and inorganic forms of Se are used in diet as food supplement, as well as used for medicinal purpose. Most of the animal diets are supplemented mainly either with inorganic form (Sodium Selenite or selenate) or with synthetic organic form (selenomethionine or selenocystein) available as Se yeast (SY) [7,26]. The optimal level of Se supplementation used by previous researchers is for better health and growth performance was 300 mg/kg of ration DM [17]. Hence from previous studies it is evident that Se supplementation promotes health leading to better growth [17], fat percentage throughout the lactation period [8], reproduction of animal with active biosynthesis of selenoproteins [11]. Researches also reveal that the overall milk yield, milk fat, protein and lactose are highly influenced by SY supplementation [28]. Feeding practices effect health, gain and production traits of economic importance like ADI, TBG, ADG and FG ratio, while feeding practices depend upon season and nature of feeding [17]. Goats are commonly grazing dependant animals by feeding practice, hence economically important production traits affected due to natural Se deficient soil leading to significant economic losses. Various trends of supplementation have been introduced, more recently organically bound Se have been synthesized to improve Se intake. Therefore, this study was designed to evaluate the effects of SY (organic Se) supplementation on vital characteristics and growth of goat.

Materials and Methods

Forty crossbreed young female goats of four months old with average weight 14.70 ± 0.88 kg (Mean ± SEM) were kept at Ruminant Research Unit, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tando Jam (25˚ N and 28˚ E) Pakistan, and all the experimental procedures, including animal care, management, sampling and processing were performed according to the guidelines. Study conducted from Nov 2019 to Feb 2020. Throughout the feeding trial, goats were kept in individual pens (1 × 1m) and were randomly divided into two groups: A group (control) fed with high concentrate supplementation; and B group (treatment) fed with Se supplementation along with high concentrate. Animals were kept for 30 days adaptation period before data collection. Both groups fed Barseem grass ad libitum, and high concentrate ration at 2.0% of BW. Table 1 shows fodder chemical composition, Se group supplemented with organic Se using SY (Fubon Selenium Yeast, Angle Yeast Co. LTD. China) @ 0.3 mg Se/KG diet, the optimum dose was 150 mg SY per kg diet (150 mg SY contains 0.3 mg Se) [17]. Fubon SY is produced by submerged fermenting *Saccharomyces cerevisiae* in a Se rich media, same trend of feeding was followed throughout experimental period.

Feeding amount offered and refusals were recorded for individual goat on daily basis to calculate feed intake. To monitor BW change, goats were weighed every week, before feeding in the morning. Difference of FBW was got from IBW and FBW, than divided by total days

Ingredients	%	g/Kg	Nutrient content	g/Kg
Corn	54.56	545.4	Dry mater	855.92
Wheat bran	30.2	307.8	Crude protein	13.59
Soybean meal	12.62	120.6	Total digestible nutrient	70.6
Lime stone	0.60	6	Crude fiber	22.32
DCP	1.08	10.8	Total ash	6.67
Salt	0.32	3.2	Calcium	1.59
Vitamin/ Mineral Premix[b]	0.62	6.2	Phosphorus	1.12
			Selenium	0.06

Table 1: *Ingredients and nutrient contents of the basal diet[a] composition of high concentrate diet (%, g/kg as-fed bases).*

a: Experimental diet was supplemented with selenium at 0.3 mg/kg diet.

b: The vitamin/ mineral supplementation provided per kg of diet: Vitamin A: 1200 IU; Vitamin D3 1500 IU; Vitamin E 44.1 IU; Vitamin K3 4.0 mg; Vitamin B1 1.4 mg; Vitamin B2 5.22; Vitamin B5 20.0 mg; Vitamin B12 0.01 mg; niacin 26.o mg; pantothenic acid 14 mg; folic acid 0.8 mg; biotin 44 µg; Fe 100.0 mg; Cu 16.50 mg, Zn 90 mg; Mn 35 mg; I 0.30 mg.

of trail to have ADG. DM was determined after oven drying at 70°C for 48 hours from feed and refusals, dried feeds were milled to pass through a 1 mm sieve using a Wiley mill, and bottled for analysis [17].

Blood samples (4ml) were collected on weekly basis early in the morning before feeding, samples were collected via jugular vein, with the help of sterile syringe, samples shifted to EDTA tube. Blood samples were taken to the post graduate laboratory, department of Physiology and Biochemistry Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tando jam, Pakistan for complete blood count (CBC). Hematology analyzer (MEK-6510.K.), Japan was used to analyze blood samples. Physical parameters were recorded on weekly bases. Data was analyzed under statistical program by one way ANOVA and if found significant than means were compared by Tukey's HSD method using (Statstix10, USA, © statstix.com) statistical software package. Data is presented as Mean ± SEM and difference is considered significant at $P < 0.05$.

Results and Discussion

In the present study during 70 days of experiment the overall mean RBC, absolute values and WBC does not changed ($P > 0.05$) in goats of group B as compared to those of control group A. However, hemoglobin have significant changes when compared to the control group ($P < 0.05$; Table 2). Weekly analysis of blood samples showed no significant effect of dietary selenium yeast supplementation between groups for 10 weeks, moreover, all the values were within normal reference range. The effect of dietary SY supplementation over physiological indices is shown in the overall mean for rectal temperature and respiratory rate, the values for goats in group B was significantly different ($P > 0.05$) from that of group A ($P < 0.05$; Table 3). Whereas the pulse rate for both groups was same with no any significant difference. However, all the values lie within normal reference range.

Growth performance is shown by apparent increase in digestibility of DM and CP, TDMI increased significantly in B group as compare to A group ($P < 0.05$; Table 4). Similarly, Daily live weight was calculated by ADG has also significant increase in group B when compared to the A group ($P < 0.05$; Table 4). F: G show relation between daily DMI and ADG, increased value of A group indicates less gain when compared to the B group with lower F:G ($P < 0.05$; Table 4).

The red blood cell (RBC) count of an organism determines the carrying capacity of dissolved oxygen by hemoglobin. RBC is a major and reliable indicator of various sources of stress [22]. In the present study, the RBC count was higher in goats fed SY supplemented diet

Item[1]	Treatment		P-Value	SEM[2] (±)
	A	B		
RBC (m/cu mm)	13.73	13.84	0.86	0.42
Hemoglobin (mg/dl)	13.73[a]	8.97[b]	0.004	0.59
Absolute Values				
PCV	24.46	25.33	0.33	0.78
MCV (CU µ)	14.31	14.90	0.50	0.81
MCH (pg)	7.46	8.03	0.15	0.32
MCHC (%)	30.18	31.42	0.29	1.02
TLC (×10^3)	10.68	11.30	0.18	0.39
DLC				
Neutrophils (%)	37.23	38.10	0.61	1.57
Eosinophil (%)	3.53	4.03	0.82	0.48
Basophil (%)	< 1	< 1		
Lymphocytes (%)	51.26	53.13	0.17	1.12
Monocytes (%)	4.33	4.60	0.48	0.34

Table 2: *Erythrocyte count, Hb and TLC of goats fed dietary selenium yeast supplementation.*

Means followed by different letters within same row are significantly different (p < 0.05).

[1]: PCV: Packed Cell Volume, MCV: Mean Corpuscular Volume, MCH: Mean Corpuscular Hemoglobin, MCHC: Mean Corpuscular Hemoglobin Concentration, TLC: Total Leukocyte Count, DLC: Differential Leukocyte

[2]: SEM: Standard error of mean, where n = 10 per treatment.

Item	Treatment		P-Value	SEM[1] (±)
	A	B		
Rectal Temperature	101.52[a]	101.17[b]	0.001	0.09
Pulse rate	71.10	70.10	0.06	0.51
Respiratory rate	21.69[b]	22.16[a]	0.01	0.18

Table 3: *The effect of dietary selenium supplementation on physiological indices of goats.*
Means followed by different letters within same row are significantly different (p < 0.05).
[1]: SEM: Standard error of mean, where n = 10 per treatment.

compared with goats fed diet without supplementation. However, the increase in RBC count was within normal limits. In agreement, Faixova., *et al*. reported greater RBC count in lambs fed basal diet supplemented with SY at the dose rate of 0.3 mg/kg diet DM for 90 days compared to those fed diet without any supplementation [6]. In contrast, SY supplementation at the dose rates of 0.2 or 0.4 mg/kg diet DM, respectively for 70 days did not affect RBC count in lambs [2]. Moreover, increasing dose of SY at the rate of 0.6 mg/kg diet DM for over 60 days did not influence RBC count or any of the erythrocytes indices in beef cattle [11]. The reason of elevation in RBC concentration in the blood of SY fed goats is not clear. Weather Se increases RBC number by stimulating erythropoiesis (RBC production) or by increasing

Items[1]	Treatment			
	HC	SY	P-Value	SEM[2] (±)
Live weight kg				
IBW	15.6	15.53	0.95	0.72
FBW	19.84	22.24	0.7	0.47
TBG	4.24[b]	6.71[a]	0.03	0.10
ADG, g/day	60.57[b]	95.86[a]	0.03	1.46
TDMI, g/day	779.70[b]	904.77[a]	0.03	29.17
F:G (g DMI/ g ADG)	12.87[a]	09.43[b]	0.02	1.55

Table 4: *Mean values for live weight, live weight change, feed DM intake, DM feed conversion and feed cost of goats fed a basal diet of high concentrate (HC) and selenium yeast (SY) supplementation.*

Means followed by different letters within same row are significantly different ($p < 0.05$).

[1]: IBW: Initial Body Weight, FBW: Final Body Weight, ADG: Average Daily Gain, TDM: Total Matter, F: G: Feed Gain Ratio.

[2]: SEM = Standard error of mean, where n = 10 per treatment.

its life-span through protection. The exact mechanism is yet to be discovered. Faixova., *et al*. observed that SY increases osmotic resistance and hence reduces the membrane fragility of erythrocytes [6]. This suggests that SY protects and maintains life-span of RBCs. The protection of membranes of cell or cell-organelles may be associated with antioxidant effects of Se in blood cells [29].

White blood cell (WBC) count is a vital index of non-specific immunity and mainly involved in phagocytic and immune responses to bacterial, viral and other challenges [3]. The current study observed no influence of dietary SY on WBC count or differential leucocytes count (DLC) in blood of goats. Consisting with our findings Alimohamady., *et al*. found no change in leucocyte counts in lambs fed SY supplemented diet [2]. On contrary, Faixova., *et al*. observed significantly lower WBC count in SY treated lambs [6]. On the other hand, extra physiological dose of SY at the rate of 0.6 mg/kg diet DM for over 60 days elevated the proportion of lymphocytes and lowered that of monocytes in beef cattle [11]. In the same study, the proportion of eosinophils was higher in SY treated calves and the platelets count was higher in SY treated lambs [11]. Moreover, SY produced dose-dependent effects in fish, at dose rates of 0.1, 0.2 and 0.4 g/kg SY supplementation lowered the WBC while no change in WBC count was observed at dose rate of 0.3 g/kg [24]. Furthermore, it has been suggested that the Se supplementation in normal and apparently healthy animal does not have any influence on leucocytes. However, in the immune-comprised animals, the Se supplementation has been shown to induce changes in leucocyte count [14]. The subcutaneous Se administration elevated eosinophils proportion in sheep exposed to heat stress [1]. Eosinophils, being important immune agent provide defense against parasitic infection, are reported to be reduced under heat stress [27] and thus Se treatment counteracts the effects of heat stress by enhancing eosinophils proportion in sheep.

Current studies reveal physiological and hematological values lying within normal reference range which shows counter effect of Se supplementation against Se deficiency and environmental stress. Significant difference in feed gain ratio as compare to the controlled diet show significant improvement in growth performance of B group. Further, improved health of the animals is apparently showed in other significant correlation values among DMI, CPI, ADI, ADG, F:G (Table 4), these findings agrees with findings of Jiang., *et al.* he concluded that selenomethionine could improve growth performance in broilers [9]. In agreement to our study Zhan., *et al.* compared maternal selenomethionine and sodium selenite using same dose rate, he found significantly higher growth rate from birth to weaning in selenomethionine fed piglets as compare to sodium selenite [33].

However, some research studies figure out contrary no any effect of Se supplementation on growth performance [31], these inconsistent conclusions may be caused due to certain differences type of Se used, species, Breeds and stages of experimental animals [17]. The present study was carried out during the months of November to February. In present study the values for temperature and humidity from 0700 to 1800 hours were 17 - 26°C and 38%, and from 1800 to 0700 hours were 10 - 17°C 28%. During experimental period the weather conditions were normal. In the present study, weekly comparisons of rectal temperature, respiratory rate showed significant difference, heart rate did not show significant difference between the groups, however all the values were within normal reference range. Heat stress causes an increase in the rectal temperature, respiration rate and heart rate and the dietary SY supplementation decreased heat stress by exerting opposite effects and produced preventive effect by maintaining antioxidant system in sheep and cow [1]. On the other hand, dietary SY supplementation increased rectal temperature in calves under cold stress [4]. In current study, animals were not under environmental stress, which could be a possible explanation of no significant effect of Se on rectal temperature, respiratory rate and heart rate. Hence the environmental stress adversely affects the physiological parameters and the Se treatment has been shown to alter the environmental stress.

Conclusion

The hematological and physiological values presented in this study suggests that SY supplementation has no any adverse effect over health of goats, on the other hand the supporting results also demonstrates that SY can improve F:G leading to increased growth performance. This study suggests optimum level of SY as dietary supplementation as 0.3 mg/kg diet. Since the feed intake and growth performance of goats is affected by Se supplementation with normal physiological and hematological status, further research is required on other aspects like immune response and role of environment in maintaining hematological and physiological values under prevailing natural and ecological conditions in Sindh so for.

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Conflict of Interest

The All authors read and approved final manuscript.

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