Indian J. Anim. Res., 49 (6) 2015:788-792
Print ISSN:0367-6722 / Online ISSN:0976-0555

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com/www.ijaronline.in

Effect of different selenium sources (Selenium yeast and Sodium selenite) on haematology, blood chemistry and thyroid hormones in male goats (*Capra hircus*)

Kamdev Sethy*[1], R.S. Dass, A.K. Garg, S. Sahu and S. Gogoi

Mineral and Vitamin Nutrition Laboratory,
Centre of Advanced Faculty Training in Animal Nutrition,
Indian Veterinary Research Institute, Izatnagar-243 122, India.
Received: 08-06-2014 Accepted: 11-09-2014 DOI: 10.18805/ijar.7040

ABSTRACT

Present study was undertaken to elucidate the effect of selenium yeast and sodium selenite supplementation on haematology, blood biochemical parameters and hormones in goats. 18 male kids (2-3 months of age and 6.63 ± 0.30 kg average BW) were stratified by their body weight and randomly assigned to three different treatments, fed a basal diet consisting of concentrate mixture and oat straw. In addition kids in group II and III were supplemented with 0.3 mg selenium kg^{-1}DM as selenium yeast and sodium selenite respectively. This experimental feeding lasted for 180 days, during which blood samples were collected on day 0, 60,120 and 180 days. Hemoglobin content and packed cell volume were statistically similar ($P>0.05$) among the three groups. Non significant differences were also observed for the serum glucose, total protein, albumin, globulin, A: G ratio, urea, creatinine and total cholesterol ($P>0.05$) among all the groups. But, concentration of triiiodothyronine (T_3) was significantly ($P<0.05$) increased while concentration of thyroxin (T_4) and T_4:T_3 ratio were significantly ($P<0.05$) decreased in all the supplemented groups. It may be concluded that supplementation of sodium selenite and selenium yeast increased serum level of T_3 which is indicative of the better thyroid hormone homeostasis and thus the better metabolic balance to the body without affecting other blood biochemical parameters of goats.

Key words: Blood chemistry, Goats, Sodium selenite, Selenium yeast, Thyroid hormone.

INTRODUCTION

Selenium (Se) is an essential trace element for maintaining normal physiological processes in animals and humans. Se exerts multiple actions on the antioxidant, reproductive, endocrine and immune systems, has been well established. The nutritional essentiality of selenium arose from the work of Patterson *et al.* (1957) in chickens. The main Se supplement that has been used in animal diets is the inorganic form (sodium selenite or selenate). Some studies indicated that organic selenium from selenomethionine (Se-Met) or Se enriched yeast is an ideal additive because animals absorb and retain it more than inorganic selenium (Ortman and Pehrson, 1997). Organic selenium is needed not only for healthy and productive animals but also for the production of meat, milk and other products which are rich in selenium (Surai, 2002). Selenium is also a component of enzyme type I deiodinase that is required for the conversion of thyroxine (T_4) into more active tri-iodothyronine (T_3) (Guyot *et al.*, 2007). Keeping this in view, the study reported herein was conducted to determine the effect of selenium yeast and sodium selenite supplementation on haematology, blood chemistry and thyroid hormones in male goats (*Capra hircus*).

MATERIALS AND METHODS

Present experiment was conducted in the Animal Nutrition Shed of Indian Veterinary Research Institute (IVRI) Izatnagar, by taking 18 male kids (*Capra hircus*; about 2-3 months of age, average live weight 6.63±0.30kg) after prior approval by the "Committee for the Purpose of Control and Supervision of Experiments on Animals" (CPCSEA), India. Prior to the start of experiment Selenium yeast was prepared by growing Saccharomyces cervisiae in broth media followed by addition of aqueous solution of sodium selenite. The experimental kids were adapted on the basal diet comprising of concentrate mixture and oat straw for a period of one month during which they were treated against ecto and endo parasites and subsequently at regular intervals. All the kids

*Corresponding author's e-mail: babuivri@gmail.com, *This research work was carried out by the first author for his Ph.D. programme. [1]C.V.SC & A.H, OUAT, Bhubaneswar (Odisha), India.

were vaccinated against foot and mouth disease and *peste des petits of ruminants* (PPR). These animals were distributed into three different groups of six kids in each on the basis of their body weights following randomized block design and were kept in a well ventilated shed with individual feeding and watering arrangements. Kids in all the three groups were fed on concentrate mixture and oat straw to meet their nutrient requirements for 50 g daily weight gain (NRC, 2007). The concentrate mixture consisted of (%) crushed maize grain 30, soyabean meal 37, wheat bran 30, mineral mixture 2 and common salt 1.Treatments were: group I (control) without any supplementation, group II supplemented with 0.3 ppm Se as selenium yeast and group III supplemented with 0.3 ppm Se as sodium selenite through the concentrate mixture. Oat straw was provided to the animals after total consumption of concentrate mixture. All the kids were offered about 100 g of the available green [(oat (*Avena sativa*)/ berseem (*Trifolium alexandrium*)/maize (*Zea mays*)] fodder once a week to meet their vitamin A requirements. Clean and fresh drinking water was provided twice a day to all the animals. This feeding practice lasted for 180 days. About 12 ml blood was collected from each kid through jugular venipuncture in the morning (before watering and feeding) at zero day and subsequently at 60 days interval. Out of 12 ml, 10 ml blood was collected into clean and dry test tube and kept in slanting position for 45 min for the separation of serum for blood chemistry and thyroid hormones estimation and the collected serum were kept at -40°C until further analysis. Remaining 2 ml was taken in another clean and dry ependroph tube (2 ml) containing anticoagulant (heparin) for the haematological studies. Hemoglobin estimation was done by treating with Drabkin's solution and further change in colour was measured by spectrophotometer. Packed cell volume (PCV) was estimated by Wintrobe method and all blood biochemical parameters (serum glucose, total protein, albumin, globulin, A: G ratio, urea, creatinine and total cholesterol) were estimated as per the standard protocol provided by the Span Diagnostic kits. Estimation of triiodothyronine (T_3) and thyroxin (T_4) was done by radioimmunoassay technique.

TABLE 1. Chemical composition of feeds offered to goats (% DM basis)

Particulars	Concentrate mixture	Oat straw
Organic matter	91.9	93.6
Crude protein	20.4	4.3
Ether extract	2.3	1.2
Neutral detergent fiber	34.5	78.3
Acid detergent fiber	11.6	57.1
Hemicelluloses	22.9	21.2
Cellulose	9.5	43.9
Calcium	1.57	0.85
Phosphorus	0.86	0.14
Selenium(ppm)	0.12	0.11
alpha-tocopherol (ppm)	13.75	1.90

Data generated was analysed using SPSS (1996) by one way analysis of variance. Treatment means are presented along with standard errors of the mean (SEM). Individual animal was the experimental unit for analysis of all the parameters. When significant differences were noticed, means were separated by using Duncans test. The P-values compared the differences between different groups.

RESULTS AND DISCUSSION

The chemical composition of concentrate mixture and oat straw is presented in Table 1. The crude protein content of the concentrate mixture and oat straw was 20.4 and 4.3%, respectively, whereas the basal Se concentration in concentrate mixture and oat straw were 0.12 and 0.11 mg kg^{-1}, respectively.

Results of haematological and blood biochemical parameters are presented in Table 2. The mean haemoglobin (Hb) values (8.9 to 9.3 g/dl) and PCV (27.9 to 28.5 %) values were in normal range and were found to be comparable ($P>0.05$) in all the three groups. Similar findings was observed by Shinde *et al.* (2009) in buffalo calves who observed that supplementation of selenium and vitamin E had no effect on the haematological parameters *viz.*, Hb and PCV. Contrary to the above findings, Qureshi *et al.* (2001) reported significantly ($P<0.05$) higher haemoglobin concentration and PCV values in buffaloes supplemented with selenium.

The overall mean values of serum glucose (43.4 to 46.5 mg/dl) were found to be similar ($P>0.05$) in the three groups and were within the normal range, indicating that the supplementation of Se-yeast or sodium selenite had no effect on the serum glucose level. Similarly sodium selenite supplementation by Mudgal *et al.* (2012) in buffalo calves had no effect on plasma glucose ($P>0.05$) concentration. Contrary to above, Ebrahimi et al. (2009) observed decreased plasma glucose concentration in Holstein calves fed with 0.3 ppm of selenium as Sel-plex for 120 days. The mean total protein (TP) (6.7 to 7.2 g/dl), albumin (3.3 to 3.4 g/dl), globulin (3.4 to 3.8 g/dl) and A:G (0.89 to 1.0) values in groups I, II and III were found to be statistically ($P>0.05$) non significant. Similarly Arthur *et al.* (1988) did not observe any effect of supplementation of Se on the serum total protein and albumin levels of Friesian steers. Similarly Shinde *et al.* (2009) observed that supplementation of either Se (0.3 ppm) or vitamin E (300 IU) or both (300 IU vitamin E and 0.3 ppm Se) in the diet had no effect on serum albumin, globulin

TABLE 2: Effect of selenium yeast and sodium selenite on the blood biochemical parameters of goats

Parameters	Group	Days				Mean	SEM	G	P	GXP
		0	60	120	180					
Haemoglobin (g/dl)	I	9.9	9.5	8.6	8.6	9.2	0.19	0.12	0.18	0.88
	II	9.2	9.0	8.7	8.9	8.9	0.16			
	III	9.7	9.6	8.6	9.4	9.3	0.22			
PCV (%)	I	29.1	26.5	28.2	30.5	28.5	0.59	0.18	0.87	0.94
	II	29.1	26.1	28.2	29.2	28.1	0.52			
	III	28.5	27.0	27.4	28.9	27.9	0.44			
Glucose (mg/dl)	I	42.9	43.2	44.0	43.6	43.4	1.38	0.47	0.05	0.569
	II	43.4	47.9	46.8	47.8	46.5	0.72			
	III	42.1	46.0	45.5	48.2	45.4	0.91			
Total Protein (g/dl)	I	6.5	6.9	6.9	6.6	6.7	0.16	0.09	0.12	0.697
	II	6.7	7.5	7.3	7.3	7.2	0.16			
	III	6.5	6.5	7.0	7.2	6.8	0.19			
Albumin (g/dl)	I	3.3	3.4	3.2	3.3	3.3	0.10	0.47	0.14	0.88
	II	3.4	3.4	3.5	3.3	3.4	0.06			
	III	3.4	3.3	3.5	3.5	3.4	0.10			
Globulin (g/dl)	I	3.2	3.5	3.7	3.3	3.4	0.17	0.13	0.14	0.63
	II	3.3	4.1	3.8	4.0	3.8	0.18			
	III	3.1	3.0	3.5	3.6	3.4	0.15			
A:G	I	1.0	0.97	0.86	1.0	0.96	0.08	0.34	0.78	0.59
	II	1.0	0.83	0.92	0.82	0.89	0.07			
	III	1.2	1.1	1.0	0.98	1.0	0.05			
Urea (mg/dl)	I	29.9	32.8	31.7	31.4	31.4	0.47	0.22	0.04	0.62
	II	31.7	31.7	30.8	29.1	30.8	0.46			
	III	30.0	29.4	32.5	30.3	30.6	0.49			
Creatinine (mg/dl)	I	0.85	0.84	1.14	0.85	0.92	0.05	0.52	0.41	0.90
	II	0.87	0.92	0.79	1.05	0.90	0.03			
	III	0.85	0.85	0.94	1.06	0.92	0.06			
Total Cholesterol (mg/dl)	I	108.2	100.2	102.8	102.3	103.4	3.13	0.69	0.92	0.80
	II	112.5	103.4	108.2	109.4	108.4	2.42			
	III	106.9	106.9	103.9	116.1	108.4	1.59			

TABLE 3. Effect of selenium yeast and sodium selenite on Thyroid metabolism of goats

Parameters	Group	Days				Mean	SEM	G	P	GXP
		0	60	120	180					
T_3 (nmol /L)	I	1.5	1.4	1.6	1.5	1.5 [a]	0.05	0.02	0.05	0.19
	II	1.6	1.9	1.9	2.1	1.9 [c]	0.08			
	III	1.6	1.6	1.6	1.8	1.7 [b]	0.06			
T_4 (nmol /L)	I	42.4	45.1	50.3	50.8	47.1 [b]	0.93	0.01	0.07	0.15
	II	42.3	42.5	44.5	45.2	43.6 [a]	0.81			
	III	39.7	41.8	49.0	51.5	45.5 [a]	0.94			
T4: T3	I	28.2	32.2	31.4	33.8	31.4 [c]	1.56	0.02	0.04	0.21
	II	26.4	22.3	23.4	21.5	23.4 [a]	2.10			
	III	24.8	26.1	30.6	28.6	27.5 [b]	1.87			

[abc]Means bearing different superscripts in a row differ significantly (P<0.05)

and albumin: globulin ratio (P>0.05) in buffalo calves. The mean values of total cholesterol, although numerically higher in Se supplemented groups (108.4 mg/dl) as compared to control (103.4 mg/dl), but did not reveal any statistical (P>0.05) differences. Similar to this observation, Arthur et al. (1988) in Friesian steers and Singh *et al.* (2002) in buffalo calves reported that Se supplementation at a level of 0.1 and 8.54 ppm, respectively, had no effect on the blood cholesterol levels. Non-significant (P>0.05) variation in serum urea (30.6 to 31.4 mg/dl) and creatinine (0.90 to 0.92 mg/dl) in 3 groups of goats were similar to the findings of Mudgal *et al.* (2012) who reported that supplementation of Se in the diet of buffalo calves had no effect on their serum urea and creatinine level. Similarly, Shinde *et al.* (2009) observed supplementation of Se (0.3 ppm) or vitamin E (300 IU) or both in the diet of buffalo calves had no effect on their serum urea and creatinine

level and concluded about its no effect on nitrogen metabolism of goats.

The levels of triiodothyronin (T_3), thyroxine (T_4) and T_4: T_3 in different groups as well as at different periods has been presented in Table 3. Results indicated that kids that were supplemented with Se, both as organic (Selenium yeast) and inorganic (Sodium selenite) form had significantly ($P<0.05$) higher levels of T_3 (1.9 nmol/L in Gr. II and 1.7 nmol/L in Gr. III) and decreased T_4 (43.6 nmol/L in Gr. II and 45.5 nmol/L in Gr. III) and T_4:T_3 ratio (23.4 in Gr. II and 26.5 in Gr. III) as compared to control (1.5 nmol/L for T_3, 47.1 nmol/L for T_4 and 31.4 for T_4:T_3). This may be due to the fact that type I iodothyronine-5´-deiodinase is a Se dependent enzyme, which is responsible for the deiodination of T_4 to T_3. Similarly, Nayyar *et al.* (2003) also reported that buffalo heifers that were supplemented with Se had significantly ($P<0.05$) higher levels of T_3 as compared to un-supplemented control animals. Arthur *et al.* (1988) also reported that the peripheral concentration of T_3 was reduced and that of T_4 was increased in calves that were fed a synthetic diet that was deficient in Se as compared to the calves that were fed the same diet supplemented with Se. Similarly, Shinde *et al.* (2009) observed higher level of triiodothyronine in the serum of buffalo calves supplemented with 0.3 ppm of Se and 300 IU of DL- α- tocopheryl acetate for 180 days. Dominguez-vara *et al.* (2009) observed increased plasma T_3 concentration in Rambouillet sheep supplemented with 0.3 ppm organic Se for 95 days. Contrary to this, Kumar *et al.* (2009) observed that supplementation of 0.15 ppm Se both as organic and inorganic form to lambs for 90 days had no effect on serum concentration of T_3, T_4 and T_4: T_3 ratio. Increased T_3 in the blood due to nutritional factor is indicative of the better metabolic balance (Blum *et al.*, 1980) and better enzyme activity thus to regulate the thyroid hormone homeostasis efficiently (Chadio *et al.*, 2006).

From the present study it is concluded that supplementation of selenium yeast and sodium selenite is required in the diet of goats for beneficial effect on thyroid homeostasis and better metabolic balance due to increased triiodothyronin (T_3) concentration without affecting the other blood biochemical profiles in goats.

ACKNOWLEDGMENTS

First author is thankful to Indian Council of Agricultural Research, Krishi Bhawan, New Delhi, India for providing financial assistance in the form of Senior Research Fellowship. Authors are thankful to the Director, Indian Veterinary Research Institute, Izatnagar, India for providing the necessary facilities to carry out this work.

REFERENCES

Arthur, J.R.; Morrice, P.C. and Beckett, G.J. (1988) Thyroid hormone concentrations in selenium deficient and selenium sufficient cattle. *Res. Vet. Sci.* **4** : 122–123.

Blum, J.W.; Gingins, M.; Vitins, P. and Bickel, H. (1980). Thyroid hormone levels related to energy and nitrogen balance during weight loss and regain in adult sheep. *Acta Endocrinol.* **93**: 440–447.

Chadio, S.E.; Kotsampasi, B.M.; Menegatos, J.G.; Zervas, G.P. and Kalogiannis, D.G. (2006). Effect of selenium supplementation on thyroid hormone levels and selenoenzyme activities in growing lambs. *Biol. Trace. Elem. Res.* **109**: 145–154.

Dominguez-Vara, I.A.; Gonzalez-Munoz, S.S.; Pinos-Rodriguez, J.M.; Borquez-Gastelum, J.L.; Barcena-Gama, R.; Mendoza- Martinez, G.; Zapata, L.E. and Landois- Palencia, L.L. (2009). Effects of feeding selenium-yeast and chromium-yeast to finishing lambs on growth, carcass characteristics, and blood hormones and metabolites. *Anim. Feed Sci. Technol.* **152**: 42–49.

Ebrahimi, M.; Towhidi, A. and Nikkhah, A. (2009). Effect of organic selenium on thermometbolism, blood chemical composition and weight gain in Holstein suckling calves. Asian-Aust. *J. Anim. Sci.* **7**: 984-992.

Guyot, H.; Spring, P.; Andrieu, S. and Rollin, F. (2007) Comparative responses to sodium selenite and organic selenium supplements in Belgium Blue cows and calves. *Livest. Sci.* **111**: 259–263.

Kumar, N.; Garg, A.K.; Dass, R.S.; Chaturvedi, V.K.; Mudgal, V. and Varshney, V.P. (2009). Selenium supplementation influences growth performance, antioxidant status and immune response in lambs. *Anim. Feed Sci. Technol.* **153**: 77–87.

Mudgal,V.; Garg, A.K.; Dass, R.S. and Varshney, V.P. (2012). Effect of selenium, zinc and copper supplementation on blood metabolic profile in male buffalo (Bubalus bubalis) calves. *Bio. Trace Elem. Res.* **145**: 304-311.

NRC (2007). Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids and New World Camelids. National Academy Press,Washington, DC.

Ortman, K. and Pehrson. B. (1997). Selenite and selenium yeast as feed supplements for dairy cows. *J. Vet. Med.* **4**:373- 380.

Nayyar, S.; Gill, V.K.; Malik, V.S.; Roy, K.S. and Singh, R. (2003). Vitamin E and selenium improve the blood biochemical composition of anoestrous buffalo heifers. Indian *J. Anim. Sci.* **73** (6): 654-656.

Patterson, E.L.; Milstrey, R. and Stokstad, E.L.R. (1957). Effect of Se in preventing exudative diathesis in chicks. *Proc. Soc. Exp. Biol. Med.* **95**: 617-620.

Qureshi, Z.I.; Lodhi, L.A.; Samad, H.A.; Naz, N.A. and Nawaz, M. (2001). Haematological profile following immunomodulation during late gestation in buffaloes. *Pakistan Vet. J.* **21**: 148-151.

Shinde, P.L.; Dass, R.S. and Garg, A.K. (2009). Effect of vitamin E and selenium supplementation on haematology, blood chemistry and thyroid hormones in male buffalo (Bubalus bubalis) calves. *J. Anim. Feed Sci.* **18**: 241–256.

Singh, R.; Randhawa, S.S. and Dhillon, K.S. (2002). Changes in blood biochemical and enzyme profile in experimental chronic selenosis in buffalo calves (Bubalus bubalis). Indian *J. Anim. Sci.* **72**: 230-232.

SPSS (1996). Statistical Packages for Social Sciences, Ver. 7.5, SPSS Inc. Illinois (USA).

Surai, P.F. (2002). Selenium in poultry nutrition: a new look at an old element. Reproduction, egg and meat quality and practical applications. *World Poul sci. J.* **58:** 431-450.