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Effects of Selenium and Vitamin E Supplementation on Concentrations of Plasma Thyroid Hormones in Lambs

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Abstract: An attempt was made to determine the effects of selenium and vitamin E supplementation on thyroid hormones in lambs. Sixteen Akkaraman lambs were used and divided equally into four groups. One group was used as a control. Second group was fed with selenium (sodium selenite, 0.3 mg kg⁻¹ feed). Third group was fed with vitamin E (DL- α tocopheryl acetate, 250 mg kg⁻¹ feed) and fourth group was fed with selenium (sodium selenite, 0.3 mg/ kg⁻¹ feed) + vitamin E (DL- α tocopheryl acetate, 250 mg kg⁻¹ feed) supplemented diet. Serum selenium, vitamin E and plasma thyroxine (T₄) and tri-iodo-thyronine (T₃) were measured at 1st, 5th, 10th weeks.

Levels of T₃ were slightly increased and both levels of T₄ and ratio of T₄/ T₃ were slightly decreased when vitamin E, selenium and vitamin E plus selenium were supplemented to the diets of lambs. The levels of serum vitamin E were significantly higher (p<0.01) in vitamin E and vitamin E plus selenium supplemented groups than that in the control group. However, the levels of serum selenium were significantly higher (P<0.05, P<0.01) in both vitamin E and selenium supplemented lambs than of that in control.

Results in this study, there was no effects of selenium and vitamin E supplementation on plasma thyroid hormones in lambs. However, vitamin E had an increasing effect on serum selenium level, despite that selenium did not effect serum vitamin E levels.

Key Words: Selenium, vitamin E, thyroxine (T₄), tri-iodo-thyronine (T₃), Lamb.

Kuzularda Rasyona E vitamini ve Selenyum Katılmasının Plazma Tiroid Hormonu Düzeyleri Üzerine Etkileri

Özet: Bu çalışmada kuzuların rasyonuna ilave olarak E vitamini ve selenyum katılmasının plazma tiroid hormonları ile kan serumu E vitamini ve selenyum düzeyleri üzerine etkilerinin araştırılması amaçlandı. Araştırmada onaltı Akkaraman kuzu kullanıldı ve dörder kuzudan oluşmak üzere dört grup oluşturuldu. Birinci grup kontrol grubu olarak kullanıldı. İkinci gruptaki kuzulara selenyum (0.3 mg sodyum selenit/ kg yem), üçüncü gruptakilere E vitamini (250 mg DL- α tokoferil asetat/kg yem), geriye kalan diğer 4 kuzuya ise selenyum ve E vitamini kombinasyonu (0.3 mg sodyum selenit + 250 mg DL- α tokoferil asetat) içeren rasyon verildi. Tüm hayvanların 1., 5. ve 10. haftalarda kanları alınarak plazma ve serumları elde edildi. Alınan plazma örneklerinde toplam T₄ ve T₃ düzeyleri, serum örneklerinde ise E vitamini ve selenyum miktarları belirlendi.

Araştırmada, E vitamini ve selenyum uygulanan gruplarda plazma T₃ düzeylerinin hafif düzeyde arttığı ve yine plazma T₄ düzeyi ile T₄/ T₃ oranının hafif düzeyde azaldığı gözlemlendi. Rasyona E vitamini, E vitamini + selenyum ilave edilen gruptaki kuzularda serum E vitamini diğer gruptakilerine kıyasla istatistiksel anlamda yüksek (P<0.01) bulundu. Bununla birlikte, kontrol grubuna kıyasla, rasyona selenyum ve E vitamini ilave edilen üç grupta da selenyum düzeyi yüksek bulundu (P<0.05, P<0.01).

Araştırmada sonuç olarak; kuzuların rasyonuna ilave olarak E vitamini ve selenyum katılmasının plazma tiroid hormonları düzeyi üzerinde etkisinin olmadığı gözlemlendi. Bununla beraber, rasyona selenyum ilave edilmesinin kan serumu E vitamini düzeyi üzerinde etkisi yok iken, E vitamini katılmasının kan serumu selenyum düzeyi üzerinde artırıcı bir etkisinin olduğu saptandı.

Anahtar Sözcükler: Selenyum, E vitamini, Tiroksin (T₄), Tri-iodo-tronin (T₃), Kuzu.

Introduction

Thyroid hormones are necessary for maintenance of normal metabolic states in animals. Both under production and over production of thyroxine (T_4) and 3, 5, 3' tri-iodothyronine (T_3) can be deleterious to health and thus it is essential to exert strict physiological control on thyroid hormone production (1).

Selenium and vitamin E are essential nutrients, closely and mutually involved in a variety of metabolic processes (2). The metabolic and clinical effects of selenium and vitamin E in ruminants reflect their similar but independent roles in protecting tissue membranes against damage arising from the end products of some oxidative processes. Selenium is required for the formation of the enzyme glutathione peroxidase, which destroys potentially toxic peroxides, while vitamin E is believed to act as a "scavenger" of any peroxidase that escapes destruction (2, 3)

A vitamin E and selenium deficiency will cause nutritional muscular dystrophy or white muscle disease in young ruminants (2), from which lambs and calves are most frequently affected, and in the congenital form death occurs before birth (3, 4).

A large number of factors effect thyroid hormone production, for example, vitamin A deficiency in rats has been reported to increase plasma T_3 , T_4 and free thyroxine index (5) and when goats were fed with cobalt and vitamin B_{12} deficient diets for 23 weeks, serum T_4 concentrations and free T_4 concentration were found to increase (6). Selenium deficiency in chicks decreased circulating T_4 and T_3 concentrations (7). In rats fed with low tocopherol containing diets for a long period of time, functioning of the pituitary-thyroid system has been shown to be slowed down (8).

Kauf *et al.* (9) have identified Type I-iodothyronine-5'-deiodinase as a selenoenzyme containing one atom of selenium per molecule. This deiodinase is present in the thyroid, liver and kidneys, and there it plays a role in conversion of T_4 into the active thyroid hormone T_3 . About 85% of T_3 are produced in this way in the organism. Only 15% originate directly in the thyroid.

A large number of studies have been carried out concerning the effects of selenium and vitamin E deficiency on plasma T_4 and T_3 concentrations in mammals. However, there has not been any comprehensive work performed that relates to the effects of supplementation selenium and vitamin E to lambs diet on plasma T_4 and T_3 . It was therefore decided to determine the effects of selenium and vitamin E

supplementation on the levels of plasma thyroid hormones in lambs.

Table 1. Diet composition (%)

Ingredients	Percent
Pelleted white beet pulp	65.0
Clover, dried	16.2
Hay, wheat	16.1
Starch	1.0
Urea	1.0
Mineral mix*	0.1
Vitamin mix**	0.5
Sodium sulphate	0.1

* = in 5 kg mix: Ca_2 0.0161 gr., ZnO 1.492 gr., CuO 0.625 gr., $CoCO_3$ 0.0217 gr., $MnCO_3$ 2.272 gr., $FeSO_4$ 3.225 gr

** = in 5 kg mix: 5 gr. AD_3 , 0.416 gr. B_1 , 1.25 gr. B_2 , 0.625 gr. B_6 , 1.5 gr. Calpan, 2 gr. Niacin, 0.2 gr. B_{12} , 0.25 gr. Biotin, 40 gr. Cholin Clorid

Materials and Methods

Sixteen Akkaraman lambs were used for the experimentation, which weighed about 30-34 kg and were aged 8-9 months at the beginning of the experiment. The lambs were equally divided into four group, as following; the first group, as control group, was fed with the diet given in Table 1.; the second group was fed as in group one but supplemented with selenium (sodium selenite, 0.3 mg kg^{-1} feed); the third group was fed as in group one but supplemented with vitamin E (DL- α tocopheryl acetate, 250 mg kg^{-1} feed) and the fourth group was fed as in group one but supplemented with selenium (sodium selenite, 0.3 mg kg^{-1} feed) and vitamin E (DL- α tocopheryl acetate, 250 mg kg^{-1} feed) supplemented diet.

Blood samples were obtained from *vena jugularis* by using vacuoner tubes with or without anticoagulantly at 1st, 5th, 10th weeks. Plasma and serum samples were obtained from blood samples and plasma were used for the thyroid hormones determination and serum samples were used for the determination of vitamin E and selenium.

Total thyroid hormones, T_3 and T_4 were measured with radio-immunoassay; levels of vitamin E in feed and

serum samples were determined according to Kayden *et al.* (10) and Konning *et al.* (11); feed and serum selenium levels were determined with atomic absorption spectrophotometer according to Stacchini *et al.* (12) and Wilson *et al.* (13).

Statistical analysis: The collected values as mean \pm SE. Statistical analysis was performed SPSS 6.0 software as described before (14). The variance analysis (ANOVA) and LSD test were used comparison between groups.

Results

Table 2 shows measurements of selenium, vitamin E, T₄, T₃ and T₄ / T₃ ratio in control, vitamin E and selenium groups. Plasma T₄ concentration and T₄ / T₃ ratio were slightly reduced and plasma T₃ concentrations slightly increased when supplemented vitamin E and selenium. Serum vitamin E levels were significantly (P<0.01) higher in vitamin E and vitamin E plus selenium supplemented groups than control and selenium groups.

Serum selenium levels in vitamin E, selenium and vitamin E plus selenium supplemented groups were significantly increased (P<0.05, P<0.01 respectively) compared to the control group. In addition, vitamin E level was significantly (P<0.05) lower in selenium group than vitamin E and vitamin E plus selenium supplemented groups. However, serum selenium level was significantly (P<0.05) higher in selenium plus vitamin E supplemented groups.

Levels of vitamin E and selenium in basal feed measured as 15.16 and 0.04 mg/ kg, respectively.

Discussion

Arthur *et al.* (15) informed that selenium deficiency in calves in contrast to selenium supplementation had increased plasma T₄ concentration and decreased plasma T₃ concentration compared to selenium supplemented calves. Donald *et al.* (16) reported that selenium supplementation of the dam reduced plasma T₄

concentration and increased T₃ concentration and T₄/T₃ ratio decreased from 39 to 21 in plasma of lambs.

In this study, plasma T₄ concentration and T₄ / T₃ ratio were slightly decreased and T₃ concentration was slightly increased in selenium and vitamin E supplemented groups compare to control which is not in agreement with the reports by Arthur *et al.* (15) and Donald *et al.* (16).

However, Jensen *et al.* (7) reported that plasma T₄ and T₃ concentration has significantly increased when a semipurified diet is supplemented with either selenium or vitamin E in chicks. On the other hand, no significant increase in this hormones has been observed in birds feed with a corn-soybean diet, which is consistent with the result presented here. Similarly it has been reported that in terms of serum T₄ and T₃, there has not been a significant difference between the patients with various thyroid disorders and control group (17). Accordingly, Chanoine *et al.* (18) reported that restricting of selenium intake in rats had no effect on circulating T₃ concentrations. Similarly, Arthur *et al.* (19) informed that 10 mg selenium/ kg body weight intraperitoneally given to rats had no effects on thyroid hormone metabolism. These reports (7, 17-19) are consistent with our results (Table 2).

It has suggested that vitamin E could decrease selenium acquisition from diet, because vitamin E has an increasing effect on plasma selenium levels (3, 4, 20). In this study, selenium levels were significantly (P<0.05, P<0.01) higher in selenium and vitamin E supplemented groups than in only that of selenium supplemented group (Table 2). On the other hand, selenium did not have any significant effect on serum vitamin E level, which is in agreement with the reports (21, 22).

In conclusion, there was not a significant effect of selenium and vitamin E supplementation on plasma thyroid hormones in lambs. However, Vitamin E had an increasing effect on selenium levels, whereas, selenium did not increase serum vitamin E levels.

	Control	Vitamin E	Selenium	Selen.and Vitamin.E
T ₄ (ng/ml)	30.35 \pm 3.20	27.03 \pm 3.10	24.93 \pm 2.38	26.16 \pm 3.14
T ₃ (ng/ml)	3.51 \pm 0.09	3.68 \pm 0.26	3.67 \pm 0.19	3.55 \pm 0.15
T ₄ /T ₃ (ng/ml)	8.18 \pm 0.29	8.06 \pm 0.89	6.33 \pm 1.50	8.64 \pm 1.62
Vitamin E (μ g/ml)	0.95 \pm 0.13	2.82 \pm 0.27 ^b	0.97 \pm 0.11 ^c	2.85 \pm 0.25 ^{b,d}
Selenium (ng/ml)	46.57 \pm 9.51	69.51 \pm 7.15 ^a	108.25 \pm 17.25 ^b	126.22 \pm 21.90 ^{b,c}

Table 2. Levels of T₄, T₃, T₄ / T₃, vitamin E and selenium in control and supplemented groups.

^aP<0.05, ^bP<0.01 Compared control group and statistically significant.

^cP<0.05 Compared vitamin E group and statistically significant.

^dP<0.05 Compared selenium group and statistically significant.

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