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Blood Serum Concentrations of Selenium and Glutathione Peroxidase Activity in Akkaraman Sheep

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Abstract: Selenium and other essential elements play an important role in animal husbandry. These elements help to minimize infectious diseases, reduce concomitant stresses and bring about optimal productive and reproductive performance.

The mean serum selenium concentration of the sheep sampled in this study was 303.65 ng/ml. Such values are considered to be indicative of adequate dietary supplementation. Serum glutathione peroxidase activity in the sheep sampled in this study was also analysed, and the mean glutathione peroxidase activity was 3.65 nmolNADPH+H⁺/min/mg protein.

It is recommended that producers monitor the selenium in serum in order to maintain adequate nutrition and performance in sheep.

Key Words: Sheep, Selenium, Glutathione Peroxidase, Serum.

Akkaraman Koyunlarda Serum Selenyum Konsantrasyonu ve Glutatyon Peroksidaz Aktivitesi

Özet: Selenyum ve diğer esansiyel elementlerin hayvan yetiştiriciliğinde hastalıkların önlenmesinde önemli rolleri vardır. Mineraller sadece enfeksiyöz hastalıkların ve onlarla beraber görülen stresin azaltılmasında değil aynı zamanda optimal üretim ve verim performansının sağlanmasında da gereklidir.

Bu çalışmadaki koyunların ortalama serum selenyum düzeyleri 303,65 ng/ml olarak bulunmuştur. Bu değerler diyetle yeterli miktarda selenyum alındığını göstermektedir. Aynı hayvanlarda serum glutathion peroksidaz aktivitesi de analiz edilmiş ve ortalama glutathion peroksidaz aktivitesi 3,65 nmol NADPH+H⁺/dak/mg protein bulunmuştur.

Serumda düzenli selenyum analizlerinin yapılması koyunlarda yeterli beslemenin ve performansın oluşturulması açısından önemlidir.

Anahtar Sözcükler: Koyun, selenyum, serum, glutathion peroksidaz.

Introduction

Serum or blood concentrations of nutrients, especially minerals and vitamins, are commonly used to assess the nutritional status of animals. The validity of this practice with respect to each specific nutrient seems to depend on the physiological and environmental factors affecting its serum concentration (1,2). Selenium (Se) is an essential microelement for all animals. Early interest in Se was

related mainly to its toxic effects. Later investigators showed that insufficient selenium intake can result in several disorders, such as reproductive failures, muscle degeneration, and functional and/or physical damage to cell membrane (1,3,4). Selenium is an integral component of the enzyme glutathione peroxidase (GSH-Px, EC. 1.11.1.9), which protects the cells against intracellular radicals and peroxides coming from the

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respiratory chain or other metabolic pathways (1,5,6). The objective of this research was to evaluate serum selenium concentrations in order to establish laboratory reference values for sheep in the Kırıkkale region. The second objective was to determine the relationship between serum selenium and serum glutathione peroxidase activity in sheep.

Materials and Methods

A total of 100 Akkaraman sheep from Kırıkkale slaughterhouse were used in this study. Blood samples were collected by jugular venepuncture. Selenium and glutathione peroxidase tests were conducted on the serum samples. The serum was split into two portions: one was stored at -20°C until the selenium concentration was determined. The other portion was assayed within three hours of collection for glutathione peroxidase activity. Glutathione peroxidase activity was determined by a modified method (7) originally performed by Paglia and Valentine (8), using t-Buthylhydroperoxide as the substrate. The serum samples were analysed for selenium by wet ashing and fluorometric detection of the 2,3-diaminonaphthalene derivative. The procedure was essentially the same as that of Koh and Benson (9). This study was carried out during the summer of 1999.

The correlation between selenium concentration and glutathione peroxidase activity was calculated with an orthogonal regression analysis (10).

Results

The average serum selenium concentration and glutathione peroxidase activity are shown in Table 1. From the 100 blood samples collected, the mean concentration of selenium was 303.65 ng/ml (SE 8.86), with a minimum of 129.2 and maximum of 524.0 ng/ml (Table 1). The mean glutathione peroxidase activity was 3.65 nmol NADPH+H⁺/min/mg protein (Table 1). In

terms of selenium concentration, 30% of the sheep had less than 250 ng/ml. The relationship between serum selenium and glutathione peroxidase activity was calculated with an orthogonal regression analysis, which is shown in Figure 1. No correlation was found between serum selenium and glutathione peroxidase activity (r=0.067, P>0.05).

Discussion

Monitoring the selenium status of domestic livestock is an appropriate clinical practice. Evaluation of the selenium results requires knowledge of differences according to species, age, sample type and experience with the analytical technique (2).

The assay for Se-dependent GSH-Px enzyme is an indirect measure of the Se status of livestock (5,8). In a study by Allen et al. (11), a highly significant correlation was found between red blood cell GSH-Px activity and the concentration of blood selenium. In the present study, no correlation between serum Se and GSH-Px activity was observed (Fig. 1). Serum Se concentrations are directly related to dietary Se intake in many animal species (2,12,13). Whole-blood Se levels also correlate well with Se intake, because whole blood contains both serum Se and Se in GSH-Px in the red blood cells. When Se is taken, changes in the Se level in whole blood are slower than those in the Se level in serum. This is because the majority of the glutathione peroxidase in whole blood is incorporated into the red blood cell at the time of erythropoiesis. A complete response of the whole-blood Se levels to Se intake will, therefore, require a time span equal to the average life span of the red blood cell, which is approximately 90 to 120 days (1,2,14,15,16). The ratio of whole blood Se to serum Se is approximately 4 to 1 in sheep. When oral intake of Se increases, the ratio becomes lower initially, and when intake decreases, the ratio becomes higher (2).

	N	X	SE	Min	Max
Selenium (ng/ml)	100	303.65	8.86	129.20	524.0
Glutathione Peroxidase (nmol NADPH+H ⁺ /min/mg prot)	81	3.65	0.299	0.50	15.21

Table 1. Serum Selenium and Glutathione Peroxidase Activity in Akkaraman Sheep.

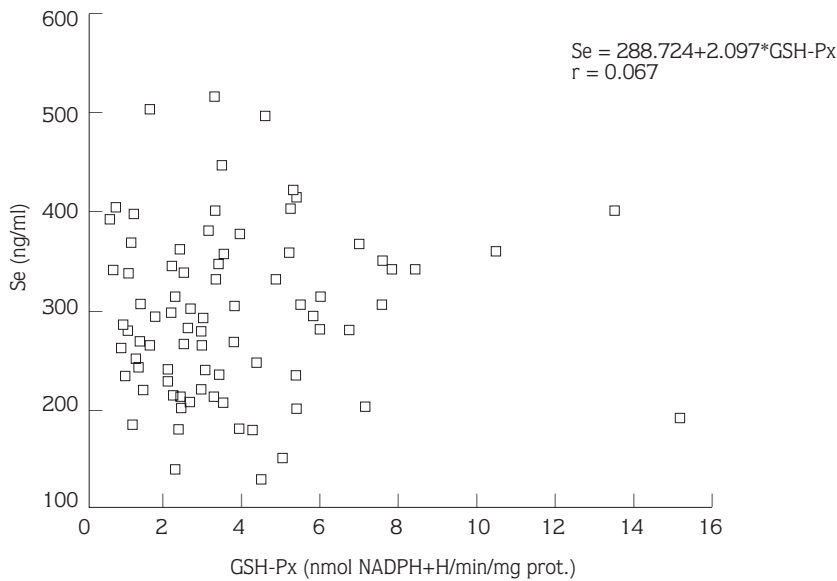


Figure 1. Relation Between Glutathione Peroxidase Activity and Selenium Concentration in serum.

The serum Se concentrations in sheep were highly variable (Table 1), with many samples having higher-than-adequate values (2). This finding was particularly true for the summer months, in which the availability of fresh forages is likely to increase (1).

Atroshi et al. (17) showed that the age of the animal has an effect on the GSH-Px activity, which decreases slightly with age. There is an apparent gradual increase in serum Se concentrations with age in all species, and considerable difference in the ranges among species, particularly in adults (2,18).

Continued monitoring of selenium in serum is also important, because it is necessary for producers to maintain adequate nutrition and performance in sheep.

Conclusions

The results of this study provide regional reference values of Se for the region of Kırıkkale. Serum Se levels vary according to the feed consumed. Hence, the validity of trace element reference ranges should not be based solely on data derived from overseas publications.

Limit values for serum Se and GSH-Px activity in Akkaraman sheep are reported in this paper. This is a basis for further studies in this field with similar research projects.

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