

ACCUMULATION OF SELENIUM IN KIDNEYS, LIVER AND HEART OF TSIGAI LAMBS

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The retention of selenium (Se) in the heart, liver and kidneys of lambs fed diets with different Se contents was studied for a period of 60 days. The experiment was conducted with three groups each containing 16 Tsigai breed lambs. The diets were composed of concentrates and forage. A concentrate mixture without added Se was provided for control group I. The mixture supplemented with 0.1 and 0.2 mg Se per kg in the form of sodium selenite was offered to experimental groups II and III, respectively. The mean age of the lambs at the beginning of the trial was 52 days. The highest daily gain was recorded in group II (0.239 kg), followed by group III, (0.221 kg) and control group I (0.200 kg.) The highest Se contents were found in the kidneys (0.875, 0.985 and 1.194 mg per kg in groups I, II and III, respectively, followed by the liver (0.146, 0.241 and 0.280 mg per kg in groups I, II and III, respectively.) The lowest Se contents were found in the heart (0.0723, 0.154, and 0.233 mg per kg in groups I, II and III, respectively). The differences between the control and the experimental groups were significant ($P < 0.05$). Selenium concentrations ranked in the order kidneys > liver > heart. The differences between them were significant, as well.

Key words: lambs, selenium content, internal organs.

INTRODUCTION

Since 1957 (Schwarz and Foltz) has been included in the group of essential trace elements (Kirschgessner, 1980; Ullrey, 1980). The importance of selenium in preventing nutritional muscular dystrophy (NMD) in lambs has been clearly demonstrated (Ehlig et al., 1967; Hogue et al., 1962; Oldfield et al., 1963; Hartley and Grant, 1961). Thus, Ullrey et al., (1977) stated that there is little potential human hazard associated with supplementing diets for growing sheep with an amount of selenium (0.1 mg per kg) from sodium selenite adequate to prevent signs of selenium deficiency. Sheep have been provided with supplemental selenium in a variety of ways which have included an oral drench (McLean et al.,

1963; Oldfield et al., 1963), subcutaneous or intramuscular injection (Kuttler et al., 1961; Schubert et al., 1961), addition of selenium to feedstuffs (Slen et al., 1961; Echevarria et al., 1988; Henry et al., 1988; Frosle et al., 1985; Moksnes and Norheim, 1983), application of selenium to the soil (Allaway et al., 1966; Davies and Watkinson, 1966; Grant, 1965; Overnes et al., 1986) or addition of selenium in selenium fortified trace mineral salt (Paulson et al., 1968; Overnes et al., 1985).

Selenium concentrations in animal tissues vary with the tissue and with the amount and chemical form of selenium in the diet. In cattle, sheep and swine, selenium concentrations decrease in the order kidneys > liver > heart > skeletal muscle > adipose tissue (Ullrey, 1987).

The aim of this work was to study the retention of selenium in the heart, liver and kidneys of lambs provided with a hay-concentrate diet of different selenium content for a period of 60 days.

MATERIAL AND METHODS

Fourty eight Tsigai lambs averaging 20.58 kg and 52 days of age were assigned randomly to three equal groups. The duration of the experiment was 60 days. The lambs were weighed at the beginning and at the end of the experiment.

The diet was composed of concentrate mixture and forage (meadow hay). The composition (%) of the concentrate mixture was as follows: maize 70, barley 10, soybean meal 5, sunflower seed meal 5, lucerne meal 8, salt 1, dicalcium phosphate 1. All three groups were fed on the same diet but the concentrate mixtures for groups II and III were supplemented with 0.1 or 0.2 mg of selenium per kg, respectively. Selenium was in form of sodium selenite and its carrier was wheat bran, 2 kg per 1000 kg of feed. The diets were offered once a day (ad libitum) in weighed portions for each group separately in plastic bags. The feed consumption was recorded every day. At the end of the trial the concentration of selenium in whole internal organs (heart, liver, kidneys) was determined.

Selenium was determined by the method of Byrne and Kosta, 1974. All samples were analysed in duplicate. The recovery values were determined for selenium added to the samples at two different levels. The mean recoveries for selenium added to diets, heart, liver and kidneys were 98, 98, 99 and 101% respectively.

All data were statistically analysed by one-way ANOVA using Software Microstat Package Program by Ecosoft Inc. 1985. version.

RESULTS

The mean total gain, as well as the mean daily gain for the entire period of fattening are shown in Table 1. The highest mean total gain (14.37 kg) was

recorded in group II (fed with the diet supplemented with 0.1 mg of selenium per kg), some what lower (13.26 kg) in group III (fed with the diet supplemented with 0.2 mg selenium per kg), and the lowest (12.00 kg) in the control group I (fed with the diet without the supplementation of selenium).

Table 1. Weight gain and feed consumption of Tsigai lambs

Item	Groups		
	I	II	III
No of lambs	16	16	16
Duration of trial, days	60	60	60
Initial mean wt, kg	20.56	20.59	20.59
Final mean wt, kg	32.53	34.96	33.84
Total mean gain, kg	12.00	14.34	13.26
Daily mean gain for the fattening period, kg	0.200	0.239	0.221
Used for 1 kg of gain:			
Feed units of oats, kg	5.338	4.501	4.885
Digestible proteins, kg	0.438	0.393	0.407

The mean daily gain for the whole fattening period was 0.200, 0.239 and 0.221 kg for the group I, II and III, respectively, Table 1. Mean consumption of feed by experimental groups is shown in Table 2. The feed consumption for 1 kg of gain was 4.61 kg in group II, 5.00 kg in group III and the highest (5.50 kg) in the control group. These results indicate that group II of experimental lambs achieved the best feed conversion during the fattening period. The supplemental level of selenite selenium which seems appropriate to add to deficient diets for lambs is 0.1 mg per kg (Ullrey et al., 1977; Morris and Levander, 1970; Thompson et al., 1975; Sakurai and Tsuchiya, 1975; Andrews et al., 1976).

Table 2. Mean consumption of feed by experimental groups

Item	Groups		
	I	II	III
Mean consumption of feed in kg:			
Per head	65.94	66.18	66.18
For 1 kg of gain	5.50	4.61	5.00
Per feeding day	1.099	1.103	1.103

The mean values of selenium in the internal organs (kidneys, liver, heart) of the experimental lambs are shown in Table 3.

The amounts of Se retained in the examined organs were affected by Se content in the diets. The highest Se contents (kidneys, 1.194, liver, 0.280 and heart, 0.233 mg per kg) were found in the internal organs of group III. A lower

selenium level was found in the kidneys, (0.985), liver, (0.241) and heart, (0.154) of group II and the lowest selenium content was recorded in group I (kidneys, 0.688, liver, 0.146 and heart 0.073 mg per kg).

Table 3. Selenium content (mg per kg) in lamb internal organs

Group	Heart		Liver		Kidneys	
	Mean ¹	SD ²	Mean ¹	SD ²	Mean ¹	SD ²
I	0.0725 ^{αα}	0.0277	0.1463 ^{αβ}	0.0245	0.6875 ^{αγ}	0.1450
II	0.1537 ^b	0.0277	0.2413 ^b	0.0541	0.9850 ^b	0.1227
III	0.2325 ^c	0.0377	0.2800 ^c	0.0251	1.1937 ^c	0.0756

1 - Each mean is from 16 cases

2 - Standard deviations

a,b,c - Means in the same column followed by different superscript letters differ significantly (P < 0.05)

α,β,γ - Means in the same row followed by different superscript letters differ significantly (P < 0.05)

The differences between the control and the experimental groups were significant (P < 0.05) for heart, liver and kidneys, (Table 3). The Se content of kidneys, liver and heart in the control and experimental groups differed significantly (P < 0.05) and ranked in the order kidneys > liver > heart, (Table 3). These results are in good agreement with those of Morrow (1969), Cantor et al. (1975) and Ulrey et al. (1977).

DISCUSSION

The protective effect of selenium against white muscle disease in sheep and cattle is well established (Hague et al., 1967; Oldfield, et al., 1963). Selenium effectively prevents this disease in sheep and cattle at dietary levels of 0.06 to 0.1 mg per kg (Oldfield, 1963; Ulrey et al., 1977).

When the increase of selenium concentration of tissues used for human consumption resulting from dietary supplements of 0.1 mg per kg selenium is compared with selenium provided by foods (60 to 220 µg per day) consumed in the USA (Morris and Levader, 1970) or in Canada (Thompson et. al., 1975), it is obvious that the contribution to the human daily intake of selenium would be minimal and would have no significant effect o maximum daily intake of 500 µg recommended by Japanese authors (Sakurai and Tsuchiya, 1975). It can therefore be concluded that there is little potential human health hazard associated with supplementing diets for growing lambs with an amount of supplemental selenium (0,1 mg per kg) from sodium selenite adequate to prevent signs of selenium deficiency.

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AKUMULACIJA SELENA U BUBREZIMA, JETRI I SRCU JAGNJADI RASE CIGAJA

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SADRŽAJ

Cilj ovog rada je bio da se putem egzaktnih ogleda utvrdi stepen akumulacije selena u unutrašnjim organima mlade jagnjadi, rase Cigaja, hranjene sa obrocima koji su bili snabdeveni sa određenim dozama selena. Ogled je izveden sa tri grupe jagnjadi (od po 16 grla). Prosečna starost jagnjadi na početku ogleda bila je 52 dana, a ogled je trajao 60 dana. Sve tri grupe životinja su imale iste uslove smeštaja, koji se ni po čemu nisu razlikovali od uobičajenih u redovnoj ovčarskoj proizvodnji. Obrok se sastojao iz kabastog i koncentrovanog dela. Koncentrat korišćen za ishranu prve (kontrolne) grupe jagnjadi je bio bez dodatka selena, dok je koncentrat za drugu grupu bio obogaćen sa 0.1 mg selena/ kg. a za treću grupu sa 0.2 mg selena/kg, u obliku Na_2SeO_3 .

Najviši dnevni porast konstatovan je kod jagnjadi II grupe (0.239 kg), zatim u III grupi (0.221 kg) pa u I (kontrolnoj) grupi jagnjadi (0.200 kg).

Najveći sadržaj selena je ustanovljen u bubrezima (0.875; 0.985 i 1.194 mg/kg) za I, II i III grupu jagnjadi. Najniži sadržaj selena je utvrđen u srcu (0.0723; 0.154 i 0.233 mg/kg) za I, II i III grupu jagnjadi.

Konstatovane razlike u sadržaju selena u analiziranim unutrašnjim organima jagnjadi, između kontrolne i eksperimentalnih grupa su statistički signifikantne ($p < 0.05$).

Koncentracija selena opada sledećim redosledom BUBREZI > JETRA > SRCE. Razlike između njih su takođe signifikantne.