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SELENIUM CONTENT IN FEEDSTUFFS IN SERBIA

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Samples of grain (134) and hay (24) from different regions in Serbia were taken from local farmers. The average Se concentration in all samples was 30.4 μg/kg dry matter (27.0 μg/kg in grain and 49.4 μg/kg in hay). Among the grains the highest Se concentration was in oats (66.7 μg/kg), followed by soybean (36.0 μg/kg), wheat (27.9 μg/kg), maize (21.7 μg/kg) and barley (16.5 μg/kg) Samples from Vojvodina (grain and hay) Contained about twice as much Se (51.0 μg/kg) as samples from other regions, but far from an adequate level. Feedstuffs grown in the Sjenica-Pešter plateau were extremely poor in Se (8.8 μg/kg).

Key words: Selenium, grain, hay, Serbia

INTRODUCTION

Selenium deficiency in Serbia was first recognized in livestock in the early sixties (Vujić and Čalić, 1961; Vujić and Krdžalić, 1963) when in some flocks 60% of the lambs died with typical signs of nutritional muscular dystrophy (NMD). Since then, in some regions, widespread occurrence of Se/vitamin E responsive diseases was recorded, causing substantial financial loss to animal producers. Up to now, there have been no detailed and systematic investigations of the selenium content in feedstuffs grown in Serbia. We have presumed the existence of Se deficient regions in Serbia only on the basis of the incidence of Se/vitamin E responsive diseases in livestock. This paper presents the results of analyses of the selenium content in feedstuffs from Serbia.

MATERIAL AND METHODS

Samples of cereals (134) and hay (24) from different regions of Serbia were taken from local farmers. The samples were dried to constant weight and analyzed by the fluorometric method (Lindberg, 1968), using ^{75}Se to count the recovery percentage in each sample. The results were expressed as μg/kg on a dry weight basis.

RESULTS

GRAIN. The mean and standard deviation of all grain samples was 27.0± 23.8 μg/kg, ranging from 3.0 - 144.0. The Se concentration slightly exceeded 100 μg/kg in only two samples from Vojvodina. Se content in 84.8% of the samples was lower than 50 μg/kg (Table 1.). The highest selenium concentration was in oats (66.7 μg/kg) followed by soybean (36.0 μg/kg), wheat (27,9 μg/kg) and barley (16.5 μg/kg). The Se content in wheat, maize and barley was significantly lower than in oats ($p<0.001$). Differences between mean selenium concentrations in grain from various regions were small, except for the Sjenica-Pešter plateau (from where grain samples were extremely poor in selenium) and Vojvodina (where grain contained about twice as much selenium as the average).Selenium levels in maize were extremely low in all regions (66.7 - 100% of samples below 25 μg/kg), except for Vojvodina where 66.7% of the samples contained less than 50.0 μg/kg Se. Wheat contained significantly more selenium than maize, except in the regions of Zaječar and Vojvodina where selenium levels in these two cereals were similar.

HAY. Samples of hay included alfalfa, red clover and meadow hay. There was no significant difference in Se content between them. The mean value for all samples of hay was 49.4 ± 37.6 μg/kg Se, which is significantly higher ($p < 0.001$) than for grain. However, 58.3% of the samples of hay contained less than 50 μg/kg Se and only two samples contained above 100 μg/kg. The highest Se level was found in hay from Vojvodina (85.0 ± 51.7 μg/kg) and the lowest in hay from the Sjenica-Pešter plateau (14.4 ± 4.0 μg/kg; all samples below 25.0 μ/kg). One sample of alfalfa collected from a horse farm in the Smederevo region contained 737.9 μg/kg, but the precise origin of this sample could not be traced.

DISCUSSION

The mean for all samples examined (158) was 30.4± 27.6 μg/kg Se and 80.5% of them contained below 50 μg/kg Se. Only 2.5% of samples had an adequate Se concentration (slightly above 100 μg/kg). These results indicate that feedstuffs of Serbian origin are very low in Se. According to Kubota et al. (1967) areas of very low Se concentration are those where more than 80% of plant samples contain less than 50 νg/kg Se. Grain was especially poor in Se. Since Serbian pig and poultry production is mainly based on home-grown maize (60-65% in concentrates) of low Se concentration (mean 21,7 μg/kg), these animals are poorly supplied with Se. In Yugoslavia, supplementation of commercial feeds and feed ingredients was approved in 1989 (Službeni list SFRJ). Maize from Western, Eastern, Southern and Central parts of Serbia are extremely poor in Se (78.6 - 100% of samples below 25 μg/kg). Maize from Vojvodina (the granary of Serbia) containd about twice as much Se as maize from other parts of Serbia, but a far from adequate level. Although the Se concentration in hay is nearly twice as high as in grain it is still far from the minimal requirement. Hay from Vojvodina contains about twice as much Se as the average.

Table 1. Selenium concentration (µg/kg) in Serbian feedstuffs

a - number of samples
b - range

Table 1. Selenium concentration (µg/kg) in Serbian feedstuffs

Region	Maize	Wheat	Oats	Barley	Soybean	All grain	Hay	Grain + Hay
Šabac (western part)	14.2 ± 14.4 (14)[a] (3.2 - 54.3)[b] 92.9% < 50 µg/kg 78.6% < 25 µg/kg	42.4 ± 18.7 (10) (20.2 - 55.7) 70% < 50 µg/kg	-	-	-	25.95±21.4 (24) (3.2 - 55.7) 83.3% < 50 µg/kg		25.95±21.4 (24) (3.2 - 55.7) 83.3% < 50 µg/kg
Kraljevo (southern part)	19.8 ± 6.8 (4) (8.1 - 25.0) 100% < 50 µg/kg 100% < 25 µg/kg	29.95 ± 15.3 (4) (5.0 - 43.4) 100% < 50 µg/kg	-	-	-	24.9 ± 12.9 (8) (5.0 - 43.4) 100% < 50 µg/kg		24.9 ± 12.9 (8) (5.0 - 43.4) 100% < 50 µg/kg
Smederevo (central part)	15.3 ± 15.6 (23) (3.6 - 58.0) 96.4% < 50 µg/kg 81.8% < 25 µg/kg	19.5 ± 9.2 (28) (10.1 - 66.0) 96.1% < 50 µg/kg	40.5 ± 3.9 (3) (37.6 - 46.0) 100% < 50 µg/kg	-	-	18.9 ± 13.4 (54) (3.6 - 66.0) 96.4% < 50 µg/kg	45.9 ± 21.6 (8) (9.0 - 86.0) 42.9% < 50 µg/kg	22.4 ± 17.3 (62) (3.6 - 86.0) 90.3% < 50 µg/kg
Sjenica - Pešter plateau (western part)	-	6.1 (1)	3.9 (1)	3.9 ± 0.7 (3) (3.0 - 4.6) 100% < 50 µg/kg	-	4.3 ± 1.0 (5) (3.0 - 6.1) 100% < 50 µg/kg	14.4 ± 4.0 (4) (9.5 - 20.0) 100% < 50 µg/kg	8.8 ± 5.7 (9) (3.0 - 20.0) 100% < 50 µg/kg
Zaječar (eastern part)	25.3 ± 18.9 (3) (10.0 - 52.0) 66.7% < 50 µg/kg 66.7% < 25 µg/kg	28.8 ± 19.2 (5) (14.0 - 66.0) 80% < 50 µg/kg	-	12.0 (1)	-	25.8 ± 18.7 (9) (10.0 - 66.0) 77.8% < 50 µg/kg	42.0 ± 13.3 (6) (18.0 - 62.0) 83.3% < 50 µg/kg	32.3 ± 18.6 (15) (10.0 - 66.0) 80% < 50 µg/kg
Vojvodina (northern part)	38.3 ± 23.6 (12) (16.0 - 68.0) 66.7% < 50 µg/kg 16.7% < 25 µg/kg	37.9 ± 25.1 (12) (16.0 - 62.0) 58.3% < 50 µg/kg	95.0 ± 34.5 (5) (46.9 - 144) 20% < 50 µg/kg	30.6 ± 6.6 (3) (22 - 38) 100% < 50 µg/kg	36.0 ± 4.0 (2) (32 - 40) 100% < 50 µg/kg	45.0 ± 32.1 (34) (16 - 144) 61.8% < 50 µg/kg	85.0 ± 51.7 (6) (16.0 - 178.0) 33.3% < 50 µg/kg	51.0 ± 38.5 (40) (16.0 - 178.0) 57.5% < 50 µg/kg
All Regions	21.7 ± 20.4 (56) (3.2 - 68.8) 90.4% < 50 µg/kg	27.9 ± 18.9 (60) (5.0 - 66.0) 81.2% < 50 µg/kg	66.7 ± 42.2 (9) (3.9 - 144.0) 55.6% < 50 µg/kg	16.5 ± 13.3 (15) (3.0 - 38) 100% < 50 µg/kg	36.0 ± 4.0 (2) (32 - 40) 100% < 50 µg/kg	27.0 ± 23.8 (134) (3.0 - 144.0) 84.8% < 50 µg/kg	49.4 ± 37.6 (24) (9.0 - 178) 58.3% < 50 µg/kg	30.4 ± 27.6 (158) (3.0 - 178.0) 80.5% < 50 µg/kg

a - number of samples
b - range

Feedstuffs from the Sjenica-Pešter region were extremely poor in Se and may be compared to those from Finland (Oksanen and Sandholm, 1970) and Norway (Froslie et al., 1980). The Sjenica-Pešter plateau is the largest mountain-pasture area in Serbia, situated about 1000 m above sea level. Pasture and meadows comprise 2/3 of its total area, where mostly sheep are bred.

Serbia comprises three main geochemical areas. A Pb-Tertiary area is on the West with large deposits of lead, zinc and antimony (Karamata, 1974). A Cu-geochemical area on the East is the largest copper sulfide deposit in Europe. The copper sulfide deposits in Bor and Majdanpek, in Eastern Serbia contain high concentrations of Se. The anodic slime from electrolytic copper refining represents a commercial source of this element (Mudrinić et al., 1975; Maksimović et al., 1978). However, selenium is more or less uniformly distributed in river sediments and the means between different regions show only small variations (Maksimović, et al., 1985). Our investigations showed as well that Se concentrations in plants grown in the two mentioned geochemical regions were not significantly different. The exception is the Sjenica-Pešter area where Se level in feedstuffs was extremely low. Quaternary sediments were much more important than Tertiary sediments. For the genesis and development of agricultural soil in Vojvodina (northern part of Serbia) Loess is the most wide spread parental substrate of agricultural soil of Vojvodina which provides the basis for the most important soil type in this region - chernozems. Loess in Vojvodina contains 20 - 30% of $CaCO_3$, which gives considerable advantages over the loess in Eastern Europe (Živković, 1971). We found that the feedstuffs grown in Vojvodina contained about twice as much Se as the other geochemical areas.

From the present investigation it can be concluded that the feedstuffs of domestic origin are very poor in selenium (in some regions extremely poor). This indicates a need for selenium supplementation of Serbian feedstuffs.

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KONCENTRACIJA SELENA U HRANIVIMA UZGAJANIM U REPUBLICI SRBIJI

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SADRŽAJ

Određivana je koncentracija selena u hranivima (zrnastim i kabastim) sakupljenim iz različitih regiona R. Srbije. Uzorci su uzimani u selima od seljaka i potiču od roda sakupljenog 1990 i 1992. godine. Prosečna koncentracija selena u svim uzorcima (158) iznosila je 30,4 μg/kg suve materije (27,0 μg/kg u kabastim). Od zrnastih hraniva najviši sadržaj selena imao je ovas (66,7 μg/kg), a zatim soja (36,0 μg/kg), kukuruz (21,7 μg/kg) i ječam (16,5 μg/kg). Uzorci iz Vojvodine (zrnasta i kabasta hraniva) imali su oko dva puta više selena (51,0 μg/kg) nego uzorci iz drugih područja, ali ipak daleko ispod potrebne količine. Hraniva poreklom iz Sjeničko-Pešterske visoravni imala su izuzetno nisku koncentraciju selena (8,8 μg/kg). Na osnovu dobijenih rezultata može se zaključiti da su hraniva uzgajana u R. Srbiji vrlo siromašna selenom, a hraniva iz Sjeničko-Pešterske visoravni su ekstremno siromašna selenom.