SOME DATA ON THE SELENIUM STATUS OF DAIRY CATTLE IN ESTONIA

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SUMMARY. *Twelve randomly selected herds were used for charting the selenium status of Estonian cattle. In seven herds no extra selenium was given, while five fed a selenium supplemented mineral feed. The selenium supplementation was, however, very moderate.*

Blood samples were taken for determination of glutathione peroxidase (GSH–Px) in erythrocytes from 7–15 lactating cows, 1–5 dry cows and 4–5 heifers per herd. Milk samples were taken from the lactating animals for determination of selenium and GSH–Px activity.

All animals in the unsupplemented herds had GSH–Px values indicating severe selenium deficiency. When transformed to selenium concentration in whole blood the herd means corresponded to 15–25 μg/l. With one exception the herd means of the supplemented herds were also too low. The herd with a reasonably normal blood selenium status fed more selenium supplemented mineral feed than the others.

The selenium concentration in milk was very low irrespective of whether there had been a selenium supplementation or not (4.5 and 5.1 μg/l, respectively). This was partly supposed to be caused by a low degree of supplementation, and partly by the fact that selenite – at least in comparison to organic selenium compounds – has been found to be relatively inefficient for increasing the selenium concentration of milk.

There was a significant correlation between the selenium concentration and the GSH–Px activity in milk, but the activity of the enzyme was extremely low.

The investigation shows that Estonia should be included among the countries which are highly selenium deficient.

Key words: *antioxidants, glutathione peroxidase, milk, trace elements, selenium deficiency*

Introduction

The geographical distribution of selenium varies highly in different parts of the world. In many countries the selenium status is still unknown, but ongoing research work reveals that selenium deficient crops seem to exist in all continents. Finland (Oksanen, Sandholm, 1970), Norway (Mikkelsen, Aas Hansen, 1967), Denmark (Gissel-Nielsen, 1975) and Sweden (Lindberg, Bingefors, 1970) were among the first countries to be charted and were all found to be extremely deficient. As a consequence, selenium was permitted as a supplement to animal feed in Finland from 1969, in Denmark from 1975, and in Norway and Sweden from 1980. The selenium status of farm animals in these countries has since then been much improved, although some animals with suboptimal selenium concentrations in the blood and tissues can still be found (Pherson, unpublished).

The selenium situation in the Baltic countries has so far been almost unknown. In 1993 we analysed a few blood and milk samples from Estonian cows and found them to be very low in selenium. In the same year Suoranta *et al*.(1993) found low selenium levels in feedstuffs, milk and tissues from one Estonian dairy farm. Data published by T. Kevvai (1994) reveal the Se content of some Estonian soil to be even somewhat lower than that in Scandinavian countries. Quite recently in 1995 Malbe *et al*. reported that the research farm of the Estonian Agricultural University had an extremely low selenium status. The aim of the

present study was to increase the knowledge of the selenium status in Estonia by analysing samples from farms situated in different parts of the country.

Material and methods

Twelve herds from different parts of Estonia were used. The number of dairy cows per herd varied from 20 to 650. The herds were randomly selected from the central, northern and eastern parts of the country. Nothing was known in advance about the feeding routines used at the farms; information about such routines were obtained by interviews of the herdsmen at each individual farm. The information about the amounts of the different feedstuffs fed, and of their nutritional quality, was in most cases very vague. However, it was possible to obtain reliable information from all farms about the brand of the commercial mineral feed used at the farm. Seven herds fed minerals without selenium, and five offered a selenium supplemented mineral feed (10 mg selenium as selenite per kg). After detailed interviews the daily amount of minerals given to each cow was in four out of the five herds that used a selenium supplemented commercial mineral feed estimated to be less than 50 g, indicating very moderate selenium supplementation. In the fifth herd at least 100 g was said to be given. All herds used home-produced hay, silage and oats, barley or wheat as grain. Four herds also fed fodder beets, two fed potatoes and one brewer's grains. Moreover, all herds without selenium supplementation and three of the herds with selenium supplementation fed meal from sunflower, cotton or rape. All this protein feeds were imported from Russia. The maximal amounts given were 1 kg or less in seven of the herds, up to 2 kg in two and up to 2.5 kg in one. The selenium content of these protein feeds was analysed according to Sari *et al.*(1975), and found to be from 0.07 to 0.30 mg/kg (x=0,22 mg/kg; n=10).

Blood samples were taken from 7–15 lactating cows, from 2–5 dry cows and from 4–5 heifers per herd. They were analysed for the activity of glutathione peroxidase (GSH–Px) in the erythrocytes according to Paglia & Valentine (1967). Since the GSH–Px values for the lactating and dry cows were fairly equal, they are presented as one group.

Milk samples were taken from the lactating cows and analysed for selenium (Sari *et al.*, 1975) and GSH–Px (Paglia, Valentine, 1967).

Results and Discussion

The results are presented in Table 1. The range of the herd means of the GSH–Px activity in erythrocytes was 20–108 μkat/l for cows in the herds without selenium supplementation and 44–627 μkat/l for cows in the herds with selenium supplementation. With the correlation equation found in our laboratory (Carlström *et al.*, 1979) these values are equivalent to whole blood selenium concentrations of 18–25 μg/l and 20–69 μg/l, respectively. The corresponding range figures for heifers were 15–73 μkat/l in the herds without supplementation and 14–815 μkat/l in the herds with supplementation, corresponding to whole blood selenium values of 17–22 and 17–85 μg/l, respectively. Most researches seem to agree that at least 50 μg/l should be looked upon as a normal whole blood selenium concentration, so it is quite clear that all the mean values in the unsupplemented herds were below normal. Only the animals in one of the supplemented herds had GSH–Px activities (x=627 μkat/l for cows and 815 for heifers), corresponding to higher whole blood selenium values than 50 μg/l; in that herd as much as at least 100 g of the mineral feed was constantly fed. The values in all the unsupplemented herds were equal to those earlier found to be typical for cattle predisposed to nutritional muscular degeneration (Pehrson *et al.*, 1986).

The mean selenium concentration in milk from cows in the unsupplemented herds was 5.1 μg/l. Before there was any selenium supplementation of commercial feedstuffs in Sweden, our cows had on average slightly higher selenium concentrations in milk (7.2 μg/l; Norrman, 1984), and also slightly higher GSH–Px activities in erythrocytes (x=163 μkat/l; Pehrson, unpublished) than those found in the unsupplemented cows in the present investigation (x=57 μkat/l). This might have been due to higher levels of imported protein feeds fed to Swedish cows at that time than those fed to Estonian cows of today. Therefore, the selenium status in Estonia seems basically to be quite similar to that in Sweden, Norway and Finland. This conclusion is strengthened by recent reports from two other Estonian farms;

Table 1. GSH–Px activity in erythrocytes and selenium concentration in milk from cows as herd means in twelve Estonian herds; seven without dietary selenium supplementation and five with dietary selenium supplementation. n = number of herds.

Herds		GSH–Px; μkat/l						Se in milk, μg/l		
		COWS			HEIFERS					
Se suppl	n	x	sd	range	x	sd	range	x	sd	range
NO	7	57	29	20–108	36	18	15–73	5.1	1.2	3.7–7.1
YES	5	189	221	44–627	265	293	14–815	4.5	1.5	2.2–6.2

Suoranta *et al*. (1993) measured milk selenium concentration of 8 μg/l from one unsupplemented farm and Malbe *et al*. (1995) 3.3 μg/l from another. Estonia should thus be included among the highly selenium deficient countries of the world.

It is interesting to note that the mean selenium concentration in milk was equally low in the supplemented as in unsupplemented herds. This might be due to low supplementation levels, and to the fact that selenite – in comparison to organic selenium compounds – has been found to be inefficient for increasing the selenium content of milk (Pehrson, Ortman, 1995).

Based on the total material, there was significant simple correlation (proc Corr, SAS, 1987) between the GSH–Px activity in erythrocytes and the selenium concentration in milk ($R=0.56$; $p<0.05$), and between the GSH–Px activity in milk and the selenium concentration in milk ($R=0.70$, $p<0.0001$). These relationships still held when analysed in a mixed linear model (proc GLM, SAS, 1987), where the variation among farms was accounted for. However, differences between farms were definitely the main source of variation (Table 2).

Table 2. The significance of relationships revealed by general linear models of the data, considering erythrocyte–GSH–Px, milk–GSH–Px (or milk–Se), respectively, as the dependent variable. * = $p<0.05$, ** = $p<0.01$, *** = $p<0.001$.

Variables	Erythrocyte–GSH–Px		Milk–GSH–Px		Milk–Se	
	sign.	R^2	sign.	R^2	sign.	R^2
Farm	***	0,79	***	0,63	***	0,54
Milk–Se	*	0,80	***	0,70		
Farm	***		***			

The activity of GSH–Px in milk was very low (x=0,06 μkat/l; range 0.01–0.21). The reason to the low activity might be that the enzyme is only passively transformed to the milk from the blood plasma; it has thus been reported that less than 1% of the total GSH–Px activity in whole blood is located in extracellular fluid (Carlström, 1979). The relationship between GSH–Px activity and selenium concentration in milk indicates that it may be possible to use the enzyme to chart the selenium status of a population of dairy cattle, although the relationship is too variable to be used on an individual level.

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KOKKUVÕTE: Mõningaid andmeid Eesti lehmade seleeniga varustatuse kohta. *Eesti veiste seleeniga varustatuse uurimiseks valiti 12 juhuslikku karja. Neist seitsmes ei lisatud söödale seleeni, viies farmis kasutati väheses koguses seleeni sisaldavat mineraalsööta. Iga karja 4…5 mullikalt, 2…5 kinnislehmalt ja 7…15 lüpsvalt lehmalt võeti vereproovid glutatiooni peroksüüdaasi (GSH–Px) aktiivsuse määramiseks erütrotsüütides. Lüpsvatelt lehmadelt võeti piimaproovid seleenisisalduse ja GSH–Px aktiivsuse määramiseks. Kõikide seleeni lisasöötmist mittekasutavate farmide lehmade GSH–Px väärtused viitasid tõsisele seleeni defitsiidile. Täisvere seleenisisaldusele ümberarvestatuna olid need keskmiselt 15…25 μg/l. Välja arvatud üks erand, olid ka lisasööta saavate loomade täisvere seleeni-sisaldused madalad.*

Piima seleenisisaldus oli madal nii seleeni saavates kui ka mittesaavates karjades (vastavalt 4,5 ja 5,1 μg/l). See võib olla põhjustatud lisasöötmise madalast tasemest ja osaliselt asjaolust, et seleniid on – vähemalt võrreldes orgaaniliste seleeniühenditega, suhteliselt ebaefektiivne piima seleenisisalduse tõstmisel.

Piima seleenisisalduse ja GSH–Px aktiivsuse vahel täheldati olulist korrelatsiooni, kuid ensüümi aktiivsus oli väga madal.

Käesolev uurimus näitab, et Eesti kuulub tõsise seleenivaeguse all kannatavate maade hulka.