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Short communication

Serum selenium concentration and glutathione peroxidase activity and selenium content in testes of Polish Konik horses from selenium--deficient area in North-Western Poland

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Abstract

The aim of this study was to determine serum selenium concentrations in Polish Konik horses residing in the Odra Delta Nature Park (Poland) and to evaluate the activity of glutathione peroxidase and Se content in testes of this horse breed. In over 95% of cases, serum Se concentration was below the optimal range, and none of the horses examined was deficient in this trace element. The lack of Se deficiency in the animals examined suggests however, that the Polish Konik horses have a natural ability to the optimal use of nutrients available in their life area. Testicular content of Se and GSHPx activity in the colts was higher than those found in stallions, and a positive relationship between these antioxidants was demonstrated. The differences in Se contents and GSHPx activities in testes between colts and stallions suggest that selenoenzymes play important roles during the puberty of male horses.

Key words: Polish Konik horses, selenium, glutathione peroxidase, serum, testes

Introduction

The Odra Delta Nature Park is the first model area in Poland to implement the principles of the European Ecological Network Natura 2000 in practice. Located in the north-western part of the West Pomerania, the park is grazed throughout the year by Polish Konik horses, which are classified as being threatened with extinction due to their small population size. These horses are undemanding in terms of feed quality and their diet is based on sedge, reed and other tall grasses growing in meadows and pastures lying above the flood plain. Only in winter Polish Koniks are fed with additional hay. Polish Konik horses living in free-ranging herds may be used as a model to investigate the reproductive processes in wild horses (Opalka et al. 2010). These processes are influenced by trace elements, in particular selenium (Se), which serves structural and enzymatic functions as a component of selenoproteins.

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Table 1. Mean serum selenium (Se) concentrations in Polish Konik horses in relation to sex and age.

Item		Males			Females			Young (n=10)	Adult (n=14)	Total (n=24)
		Colts (n=4)	Stallions (n=5)	Total (n=9)	Fillies (n=6)	Mares (n=9)	Total (n=15)			
Se (μg/ml)	Mean	0.101	0.092	0.096	0.085	0.088	0.087	0.094	0.090	0.090
	SD	0.03	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02
	Median	0.105	0.097	0.098	0.085	0.081	0.085	0.093	0.091	0.090
	Min	0.062	0.073	0.062	0.071	0.059	0.059	0.062	0.059	0.059
	Max	0.131	0.100	0.131	0.094	0.120	0.120	0.131	0.120	0.131

SD standard deviation of the mean; GM – geometric mean

Table 2. Proportion of Polish Konik horses with specific selenium concentration.

	Selenium concentration		
	deficient (≤ 0.053 g/ml)*	marginal (0.054-0.12 μg/ml)*	optimal (≥ 0.13 g/ml)*
Males (n – 9)	–	8	1
Females (n = 15)	–	15	–
Total (n – 24)	–	23	1

* according to Puis 1994

Table 3. Mean Se concentrations and GSHPx activity in testes of Polish Konik horses.

	Item	Colts (n = 7)	Stallions (n = 7)	Total (n= 14)
Se (μg/g w.w.)	mean ± SD	0.314 ± 0.05^{A}	0.132 ± 0.01^{B}	0.223 ±0.10
	median	0.324	0.127	0.188
	range	0.229-0.374	0.119-0.146	0.119-0.374
GSHPx (U/g tissue)	mean ± SD	15.70 ± 4.63^{a}	10.42 ± 0.77^{b}	13.06 ± 4.20
	median	16.07	11.07	11.24
	range	8.64-23.86	9.52-11.40	8.64-23.86

w.w. – wet weight; Means marked with different letters within lines differ significantly: uppercase letters at $p<0.01$, lowercase letters at $p<0.05$.

The aim of this study was to determine serum Se concentrations in Polish Konik mares and stallions from a Se-deficient area and to evaluate the activity of glutathione peroxidase and selenium content in testes of Polish Konik stallions.

Materials and Methods

The herd consisted of Polish Koniks imported in March 2008 from the nature reserve in Delfgauw near Rotterdam, The Netherlands, and domestic Polish Koniks. The herd totals 105 animals in 6 studs. Sex ratio in the herd was 65% mares and 35% stallions. The material used in this study consisted of serum collected from 24 randomly chosen horses grouped according to sex and age. The animals under 2 years of age were classified as young and those over 2 years of age as adult. In addition, testes (one testis per animal) were collected from 14 males. Testes were obtained at the time of castration which was performed under anaesthesia when horses were recumbent.

Se content was determined spectrofluorometrically using 2,3-diaminonaphthalene (Pilarczyk et. al. 2011). Glutathione peroxidase activity was determined by a modified method of Paglia and Valentine (1967).

The activity of glutathione peroxidase was assayed spectrophotometrically at 340 nm using cumene hydroperoxide as the substrate.

Results and Discussion

The mean serum concentration of Se in the animals examined was 0.090 ± 0.02 µg/ml (Table 1). In over 95% of the horses, serum Se concentration was below the optimal range (Puis 1994) (Table 2). This situation may be due to the low levels of Sein plants consumed by Polish Konik horses from the Odra Delta Nature Park and/or the fact that Se is present in a poorly available form. It is interesting, though, that despite the low Se content reported in the West Pomerania in an earlier study (Zablocki 1990), the mean Se concentration in Polish Konik horses was over three times higher than found by Balicka-Ramisz et al. (2002) in farm-raised horses in this area. We also found that serum Se concentration was slightly higher in males than in females (0.096 vs. 0.087 µg/ml respectively), but the lack of significant differences (Mann-Whitney U test) suggests that the concentration of this element is not sex dependent. Similar observations were made by Crisman et al. (1994). Our results also show that serum Se concentration was not affected by the age of the animals. This is consistent with findings of other authors that the age of horses had no significant effect on antioxidant parameters (Gorecka et. al. 2002).

Testicular GSHPx activity (Table 3) was positively correlated to Se concentration ($r_s = 0.70$; $p<0.01$). Statistically significant differences in testicular Se content ($p<0.01$) and GSHPx activity ($p<0.05$) between colts and stallions were observed. It is possible that the differences between colts and stallions were due to processes in the testes before and during puberty which were necessary for the onset and maintenance of spermatogenesis. A study by Behne et al. (1986) with rats confirmed the protective role of selenium and antioxidant enzymes during spermatogenesis. These authors also showed that testicular requirements for Se increase during pubertal maturation are coincident with the beginning of spermatogenesis. The fact that testicular selenium content increases during sexual maturation was also found by Bedwal et al. (1993), who at the same time suggested the contribution of this trace element to testosterone biosynthesis.

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