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THE INFLUENCE OF DIFFERENT FACTORS ON THE CONCENTRATION OF ELEMENTS IN HAIR OF HORSES

Zbigniew Dobrzanski, Dominika Jankowska, Wojciech Dobicki, Robert Kupczynski

Agricultural University of Wroclaw, Department of Animal Hygiene and Environment, ul. Chelmonskiego 38 C, 51-630 Wroclaw, Poland

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Introduction

Anthropogenic pressure on natural environment causes many biogeochemical changes in it. It is reflected by the changes in the chemical composition of animal organisms including hair, milk, eggs, tissues and organs.

The analysis of trace elements and toxic metals content in hair and coat is used for evaluation of health state, metabolic disorders and mineral maintenance of human and animals. Sampling, storage and analysis of these samples are easier than in case of other biological material [1, 3, 7, 8]. Hair analysis has been used to examine the exposure of horses to such toxic heavy metals as lead and cadmium [7]. In recent years, research has been conducted on the concentration of toxic elements and bioelements in horse hair with respect to their sex, age, feeding season, physiological norms and interactions between the elements [1, 3, 4, 5].

The aim of the present work was to compare the concentration of selected elements in horse hair, depending on the type of mineral feed additives and season of the year. The horses were kept in two different regions of Lower Silesia.

Material and methods

Clinically healthy horses, 16 mares, from two regions:
-industrial region of Walbrzych (SO Ksiaz) – horses of Silesian breed (group A, n=8),
-the region not affected directly by industry, mountain vicinity of Kowary – horses of sp breed (group B, n=8) were the subjects of the present study.

The research was preformed in the season of hair changing from winter hair to the summer one and from summer one to the winter one in the years 2004-2005. The animal feeding, especially the mineral feed additives, were differentiated in both places:

Group A - feed dose in winter period: 4-6 kg of crushed oats, 4 kg of hay, straw (ad lib.), 3g of Biogen K preparation (containing live lyophilized bacteria cultures 153.6 mln JTK) and the mineral-vitamin-aminoacidic preparation in the form of chelate compounds

(Fitmin). Feed dose in summer period: 30 kg of green forage, 3 kg of hay and Fetmin food additive. Group B - in winter season the horses were administered 4 kg of oats grain, hay (ad lib.), and in summer they fed only on the pasture (ad lib.) and were administered hay.
The horses were given water of constant mineral composition (tap water). Bay horses aged 4-6 years were selected from each place. In each of the periods, the hair was taken from the neck. The samples were cleaned and washed. After drying to the solid mass at the temperature of 65°C, the samples were mineralized (wet mode) in nitric acid in a closed high pressure microwave stove (CEM). The content of Cr, Cu, Ni, Cd, Pb and Zn was measured by flame method of atomic absorption spectophotometry (AAS) using Varian SpectrAA 220 FS apparatus. The results of the analyses were verified using the certified reference material DOLT-2.

The results were statistically analyzed using Statgraphics ver. 5.0. software.

Results and discussion

The content of the tested elements in horse hair is presented in Table 1. No statistical differences in the content of the examined elements in the horse hair were observed, both between the periods of tests (summer, winter) and between the regions (group A, group B). Only the content of Zn in winter horse hair in Group A was statistically higher ($p \leq 0.05$) in comparison to the content in the horse hair in Group B (122.64 and 112.63 mg/kg of dried mass, respectively). The differences were the effect of using mineral-vitamin food additives in feeding the horses of Group A. Positive correlation was observed between Pb and Cd ($r = 0.35$, $p \leq 0.05$). Although the statistical differences between the test periods and the groups were not present, some relations, especially connected with the season of the year, were observed.

In the hair of horses of Group A, higher content of Cr, Cu, Ni and Zn was observed in winter coat than in summer coat, the only opposite relation was observed in Cd concentration. Different tendencies were observed in Cr, Cd, and Zn content in the test carried out on the horses from Group B. The concentration of these elements was slightly higher in the summer coat.

Average content of Cu, Ni, Cd and Zn during all test period were equal between the groups (regions) which shows the lack of influence of environment and the lack of visible influence of mineral composition of diet on the level of concentration of these elements in horse hair. Higher content of Cr and Pb was observed in the hair of horses from Group B, these differences, however, were not confirmed statistically.

Attempts have been made to use hair analysis as an indicator of the total content of minerals, such as calcium and phosphorus and trace metals such as copper, molybdenum, zinc, selenium and iron [2, 5, 8] in the body. Asano et al. [1] have not observed any differences in the concentration of essential metals and toxic metals in the horse hair between the mares and stallions. However, visible relations concerning the age, especially in the case of toxic metals such as Cd, Hg and essential minerals such as Mn, Mo, Fe were observed. The concentrations of Cd, and Cr obtained in own tests were close to the values given as referential for racing horses [1]. The content of Zn, Cu, and Pb was slightly higher than the limit of referential values [1]. Similar concentration was obtained in the tests carried out on a large number of animals (106 horses) by Wichert at al. Low concentration of Pb in horse hair, especially in Group A, was observed in own tests. In other tests, the values of this element were higher [2] but very differentiated in respect to the region of the origin of the animals. There are also some breed differences in the content of individual elements in horse hair [3].

The concentration of Cd and Pb in horse hair can be the result of the influence of the season. The higher concentration of these elements in summer coat may indicate environmental exposure [2, 6]. In own tests this relation was confirmed in the case of Cd. Hair is a good indicator of organism's mineral supply in Zn [5]. As it was presented in own tests, mineral supplementations, especially during winter-feeding, causes relevant ($p \leq 0.05$) increase of Zn content in horse hair (Group A). Calcium surplus in diet influences the fall of Zn content in the organism and the changes of Zn concentration in hair indicate the antagonism of Zn and Ca in the processes of absorbing from alimentary canal [4]. However, there are still uncertainties as to whether hair content is well correlated with whole body levels and the validity of the approach in the horse remains to be confirmed [8].

Conclusions

Different environment and different mineral feed additives did not have a significant influence on the levels of the tested elements in horse hair, only Zn concentration was higher in the horses which in winter were given mineral-vitamin food additives (Group 1, SO Ksiaz). The results obtained show seasonal influence on the levels of the tested elements in horse hair. Higher concentrations of Cr and Pb were observed in the horses from Kowary region, however the registered levels are toxicologically safe.

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Table 1.The content of selected elements in horse hair (mg/kg dry mass, $\bar{x} \pm s$)

Stable and season	Elements					
	Cr	Cu	Ni	Cd	Pb	Zn
Group A - summer	0.30±0.34	7.48±1.92	0.98±0.21	0.12±0.09	0.06±0.07	114.90±8.67
Group A - winter	0.39±0.40	7.88±0.53	1.08±0.20	0.04±0.03	0.08±0.08	122.64±10.26[a]
Total	0.35±0.36	7.68±1.38	1.03±0.20	0.08±0.08	0.07±0.07	118.77±10.01
Group B - summer	0.58±0.64	7.47±0.68	0.93±0.28	0.10±0.17	0.12±0.13	120.63±8.50
Group B - winter	0.52±0.32	8.31±1.76	0.89±0.17	0.07±0.05	0.10±0.06	112.63±6.48[a]
Total	0.55±0.49	7.89±1.36	0.91±0.22	0.09±0.12	0.11±0.10	116.63±8.39

a – significant differences at $p \leq 0.05$