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Impact of Breeding Region and Season on the Content of Some Trace Elements and Heavy Metals in the Hair of Cows

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The aim of the research was to determine the effect of the season and the breeding region on the content of selected minerals (Zn, Cu, Mn, Fe, Pb, Cd) in the hair of dairy cows. The research material covered 114 Holstein-Friesian breed cows from three breeding centres in Poland, hereafter referred to as A, B and C. Breeding centre A is located in Opolskie province, breeding centre B in Podlaskie province and breeding centre C in Kujawsko-Pomorskie province.The cows were kept in freestanding cowsheds with den boxes. Animal nutrition involved the use of the TMR system, considering division into nutrition groups. Hair was sampled in summer and in the period of winter and spring from the side of the body, directly behind the coastal arch. The Zn, Cu, Mn, Fe analysis was performed with atomic absorption spectrometry. The Pb and Cd content was assayed with the use of the electrothermal atomic absorption spectrometry. The results demonstrated the effect of season and breeding region on the level of the minerals and heavy metals assayed in the hair of cows being in the period of drying-off. The hair sampled in winter from cows from C demonstrated a higher concentration of most elements except for Fe than in material derived in summer. Hair sampled in winter from cows from the B centre showed higher Zn, Cu and Pb concentrations as compared with summer. Higher Cu, Mn, Fe and Pb concentrations were determined in hair sampled during winter from cows from A than in the material obtained in summer. The Cd content in the cow hair did not exceed the admissible norm, however, normal levels were exceeded for Pb in hair sampled in winter from cows from breeding centre C.

Key words: microelements, heavy metals, hair, cows.

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Research performed in recent years showed that the best method of mineral state evaluation in animals is the analysis of minerals from hair (GABRYSZUK *et al*. 2008; PATKOWSKA-SOKOŁA *et al*. 2009). It is a method fully alternative to blood and urine tests due to the regular accumulation in hair of bioelements which are excluded from the metabolic processes of the body (BUDZYŃSKA *et al*. 2006). The level of minerals in body fluids is relatively low and it depends considerably on various homeostasis mechanisms as well as on diet (BLAND 1984). The external hair coat made of keratin ensures the permanence of the chemical composition by preventing the loss of internal nutrients as well as external pollution penetrating inside (DUNNETT & LEES 2003; GRATACÓS-CUBARSÍ *et al*. 2006). Bioelements are built into the hair structure during its growth, thanks to the presence of sulfhydryl group -SH of cysteine capable of chelatation (PATRA *et al*. 2007). Due to this, the concentration of minerals in the hair is higher than in the blood and urine and provides information on their content in the whole body over a longer period (BUDZYŃSKA *et al*. 2006; PATRA *et al*. 2007). Moreover, animal hair can be easily and non-invasively sampled, without hurting, causing pain, transporting or storage (DUNNETT & LEES 2003; GRATACÓS-CUBARSÍ *et al*. 2006). In recent years research was conducted on the level of minerals in the hair of animals, only getting limited to the assays in milk, meat and internal organs (CYGAN-SZCZEGIELNIAK *et al*. 2012b; GABRYSZUK *et al*. 2008; SZKODA & ŻMUDZKI 2001). However, analysis of minerals in cow hair can facilitate the evaluation of reference values for some minerals and can help ensure better animal welfare (GABRYSZUK *et al.* 2008, 2010). The hair of animals can be a good bioindicator of nutrition mistakes as a consequence of inadequate meeting of the mineral requirements of animals as well as soil, water and air pollution (PATKOWSKA-SOKOŁA *et al.* 2009; SZKODA & ŻMUDZKI 2001; TYMCZYNA *et al.* 2000).

The aim of this study was to evaluate the effect of region and season on the content of selected minerals in the hair of cows during drying-off.

Material and Methods

The material consisted of 114 cows of the Holstein-Friesian breed during drying-off. The cows were derived from 3 breeding centres (A,B,C) in Poland. Breeding centre A is located in Opolskie province, breeding centre B in Podlaskie province and breeding centre C in Kujawsko-Pomorskie province. Each experimental group comprised 38 cows aged from 3 to 5 years.

The animals from all three breeding centres were kept in freestanding cowsheds with den boxes. Animal nutrition involved the use of the TMR system, considering division into nutrition groups. The centres were equipped with systems modelling and controlling animal nutrition processes by ensuring adequate animal feed dosage. The animals remained under ongoing care of a veterinarian and did not show any symptoms of disease.

Breeding centre A is located in Opolskie province which, in terms of dust pollution comes 12th and in terms of gas pollution comes 7th in Poland. The content of toxic metals in soil does not exceed admissible values (REPORT WIOS, 2007-2010). Breeding Centre B is located in Podlaskie province; in an agricultural region with little industry. Podlaskie province is one of the least polluted in the country and it contains four national parks and three landscape parks. Land protected by law accounts for 32% of the area of the province (REPORT WIOS, 2004-2006). Over 2000-2007 the concentration of gas pollution in this area remained at a low level, not exceeding admissible norms. Breeding centre C is located in average-industrialised Kujawsko-pomorskie province, with chemical, electromechanical, foodstuffs, cellulose and printing industries. The analysis of the air over 2000-2007 demonstrated a decreasing tendency in concentration of SO_2, NO_2 and particulates in the province (REPORT WIOS, 2000-2007).

Hair was sampled over two periods: summer from July 5, 2005 to September 6, 2005 and winter-spring covering the period from January 4 to March 9, 2006 from the side of the body, right behind the coastal arch, with specialist scissors. The hair sample was cut out just next to the skin from an area about 10 cm^2 in size. The samples of hair were collected from dry cows from other experimental groups, i.e. 38 samples from individuals in winter season and 38 samples from individuals in summer season.

Until further analysis, the sample was stored in a hermetically closed polyethylene bag in a dry and shaded place. To remove the pollution and to defatten, the hair samples were washed in acetone and additionally placed in an ultrasound bath for 15 minutes. Then the samples were stored for 12 hours. After removal of acetone through decantation, the hair was rinsed twice with distilled water and dried in a lab drier at a temperature not exceeding 50^{o}C.

Hair prepared in this way was wet-mineralized using the microwave Ethos Plus mineralizer Milestone according to Polish Norm PN-EN 13805. To do so, 0.20 g was weighed and treated with 6.25 cm^3 of a mixture of HNO_3 65% and H_2O_2 30% at the volumetric ratio 4:1 v:v. The time of mineralization was 20 minutes. For the first 10 min. the temperature was increased up to 190^{o}C, and then it was kept at the level of 190^{o}C±5^{o}C. Mineralized samples were transferred quantitatively into volumetric flasks 25 ml in volume and filled up with distilled water. The content of minerals in the hair was expressed in g/kg and mg/kg of dry matter.

The analysis of zinc (Zn), copper (Cu), manganese (Mn) and iron (Fe) was performed by atomic absorption spectrometry (AAS) with the use of capillaries 25 cm long and inner diameter of 0.5 cm. The content of lead (Pb) and cadmium (Cd) were assayed using electrothermal atomic absorption spectrometry (ASS-ET). The assays were made in a certified laboratory compliant with the methods provided by Chatt & Katz (1979) as well as with Polish Norm PN-EN-14084.

The results of the measurements of some parameters did not meet the assumption of the distribution of normality shown using the Shapiro-Wilk test and the assumption of homogeneity of variance required when applying parametric statistical tests; therefore to investigate significant differences across the groups, a non-parametric Kruskal-Wallis test was used. Parametric analysis of variance was used for parameters meeting the assumptions of normality and homogeneity of variance. The results were statistically verified using the STATISTICA 2008 software.

Results

Tables 1 presents the results of analysis of content of microelements and heavy metals in cow

Table 1

Content of essential trace elements and heavy metals in hair of cows from different breeding centres dependent on the season and region of breeding (mg/kg)

Microelements mg/kg		Research groups					
		A		B		C	
		Summer(1) (n=19)	Winter(2) (n=19)	Summer(3) (n=19)	Winter(4) (n=19)	Summer(5) (n=19)	Winter(6) (n=19)
Zn	$(\bar{x})$	166.09[a]	151.6[a.b]	125.66[a.b]	140.87[a]	247.35[b]	427.38[b]
	SD	22.16	18.27	19.28	32.64	41.37	54.24
Cu	$(\bar{x})$	15.87[a]	30.90[a]	10.16[b]	22.30[b]	11.94[b]	32.04[b]
	SD	2.66	3.17	5.65	2.61	1.44	3.29
Mn	$(\bar{x})$	6.07[a]	6.83[a]	4.52[b]	3.75[b]	4.55[b]	20.02[c]
	SD	1.47	1.52	2.02	0.92	1.58	4.74
Fe	$(\bar{x})$	58.25[a]	79.14[a]	134.61[b]	78.50[a]	237.45[b]	204.50[b]
	SD	10.73	16.26	23.43	15.58	46.07	49.62
Pb	$(\bar{x})$	0.56[a]	1.56[a]	0.35[b]	2.08[a]	0.74[a]	2.34[a]
	SD	0.23	0.82	0.12	0.79	0.28	0.57
Cd	$(\bar{x})$	0.07[a]	0.03[a]	0.03[a]	0.03[a.b]	0.04[a]	0.04[b]
	SD	0.001	0.014	0.006	0.008	0.006	0.008

a, b, c– means marked with different letters in the same row within the same breeding centre (A,B and C) between seasons (1/2; 3/4; 5/6) and between centres (A,B and C) in the same season (1/3/5 and 2/4/6) differ significantly $P \leq 0.05$.

hair sampled in summer and winter from the breeding centres in A, B and C. Hair sampled in winter from C cows showed a higher concentration of most elements except for Fe than in material derived from summer. Hair sampled in winter from B cows contained higher concentrations of Zn, Cu and Pb, as compared with summer. Higher concentrations of Cu, Mn, Fe and Pb were reported in hair sampled in winter from A cows than in material collected in summer. Table 1 provides the results of the analysis of minerals in the hair sampled in summer from cows derived from three centres. The highest mean content of Zn, Pb and Fe was recorded in C cow hair. The lowest contents of most minerals analysed except for Fe were assayed in hair collected from B cows. No significant differences were found only in the Cd content in hair collected in summer from three breeding centres. Table 1 also presents the results of the analysis of minerals in hair collected in winter from A, B and C cows. The analysis showed no significant differences only in the Pb content among the hair samples from three different centres. The hair samples collected from C cows showed a higher concentration of all the minerals analysed as compared with the material collected from the other centres. The hair samples derived from B contained the lowest mean concentrations of Zn, Cu, Mn as well as Fe, as compared with the samples collected from the other breeding centres.

Tables 2 and 3 present the results of the correlation of selected minerals and heavy metals.

Table 2

Values of Spearman's rank correlation coefficient for selected mineral elements assayed in the cow hair collected in summer

Cu	**0.2707**				
Mn	**0.4873**	**0.5599**			
Fe	**0.3697**	-0.2518	0.0374		
Pb	0.1722	**0.7767**	**0.4794**	-0.1954	
Cd	**0.5302**	-0.1385	0.2592	-0.0991	-0.2562
	Zn	Cu	Mn	Fe	Pb

Correlations marked in **bold** are significant at $P \leq 0.05$.

Table 3

Values of Spearman's rank correlation coefficient for selected mineral elements assayed in the cow hair collected in winter

Cu	**0.2907**				
Mn	**0.4973**	**0.5699**			
Fe	**0.3597**	-0.3018	0.0363		
Pb	0.1822	**0.8067**	**0.4697**	-0.1864	
Cd	**0.5402**	-0.2385	0.2563	-0.0881	-0.2572
	Zn	Cu	Mn	Fe	Pb

Correlations marked in **bold** are significant at $P \leq 0.05$

Discussion

The Cu content in the hair ranged from 10.16 to 32.04 mg/kg depending on the season and the breeding region (Table 1). A high discrepancy between the results may not only be due to the sampling season and the location but also from a different share of dark hair in the whole sample. Dark hair shows a greater Cu content, which is related to the synthesis of melanin (CHATT & KATZ 1988). ANKE & RICH (1979) demonstrated that the highest Cu concentration was found in black hair (8.6 mg/kg), while the lowest in grey hair (5.6 mg/kg). The Cu content assayed in the samples collected in summer from the cows from all centres differed significantly ($P \leq 0.05$) from the amount sampled in winter (Table 1). In summer the concentrations were approximately two-fold lower as compared to winter. A similar Cu concentration and decreasing tendencies in its content in summer were recorded by CYGAN-SZCZEGIELNIAK *et al*. (2012a) for the hair of heifers, which could have been due to a greater share of light hair in the sample as a result of its partial highlighting due to exposure to sunshine. In the present research the Cu concentration assayed in the hair collected in winter and summer from the cows from the A centre differed significantly ($P \leq 0.05$) from the mean content of that bioelement in the hair from the other breeding centres. A slightly lower range of Cu concentration from 2.26 to 8.0 mg/kg was reported by other authors (BUDZYŃSKA *et al*. 2006; GABRYSZUK *et al*. 2008, 2010; KRUPA & BUDZYŃSKA 2011; SABA *et al*. 1991). ODÓJ *et al*. (2003) demonstrated some deficits of Cu in the hair of cows from the region of Central Pomerania; the mean concentration ranged from 5.5 to 6.84 mg/kg, which provided values almost half as low as the lowest value recorded in the present research. This discrepancy may suggest high variation in this bioelement depending on many factors such as environmental conditions, the condition of the animal (KABATA-PENDIAS & PENDIAS 1999), its physiological state, the lactation period or the type of food (ODÓJ *et al*. 2003). Similarly, the supplementation of this nutrient together with feed is also important (BIS-WENCEL 1999). The impact of location on the Cu content was also noted by FILISTOWICZ *et al*. (2012). A lower content of this element was found in hair of foxes from a breeding centre near Leszno, i.e. 2.51 mg/kg, in comparison to 3.43 mg/kg in hair of individuals from Wielichowo. A similar concentration of Cu in hair of silver foxes and wild foxes, ranging from 2.97 to 3.32, was reported by FILISTOWICZ *et al*. (2011), and the differences between the species were not statistically significant.

In summer the A and C cow hair contained a lower Mn content as compared with the hair sampled in winter, however, significant differences ($P \leq 0.05$) were only confirmed for C (Table 1). Similarly GEHRKE *et al*. (1994) during winter feeding recorded a higher Mn concentration (3.4 mg/kg), as compared with summer (1.5 mg/kg). Similar decreasing tendencies in summer were recorded by CYGAN-SZCZEGIELNIAK *et al*. (2012a) in the hair of heifers, and the Mn concentration ranged from 2.8 to 9.56 mg/kg. Much lower values (from 0.32 to 0.37 mg/kg) were assayed in cow hair by other authors (BUDZYŃSKA *et al*. 2006; KRUPA & BUDZYŃSKA 2011). According to BOMBIK *et al*. (2001), the Mn content depended on the kind of mineral-and-herbal supplement administered as well as the month of age of the calf.

The highest amount of Fe was reported for hair collected in summer from cows from the C breeding centre (Table 1). This result points to considerably high variation in the concentration of that element depending on the factors considered. For all centres except A, a higher Fe concentration was noted in summer. Similar relationships were reported by CYGAN-SZCZEGIELNIAK *et al*. (2012a) for the hair of heifers. Fe content comparable with the present results was assayed in the hair of bison (KOŚLA *et al*. 2011). Research reported by other authors (BUDZYŃSKA *et al*. 2006; GABRYSZUK *et al*. 2008, 2010; KRUPA & BUDZYŃSKA 2011) showed a slightly lower Fe content in the cow hair. According to SABA *et al*. (1992), important factors affecting the Fe level in the tissues and organs of animals include the location of the herd, the lactation period and, as in the case of most microelements, the kind of feed consumed.

The element which showed the highest concentration was Zn (Table 1). Similar results for dairy cow hair were also reported by other authors (BUDZYŃSKA *et al*. 2006; KRUPA & BUDZYŃSKA 2011). In winter the amount of Zn in hair was higher in cows from the B and C breeding centres than in the samples collected in summer (Table 1). A slightly lower Zn content ranging from 124 to 215 mg/kg was determined in the hair of heifers from the A, B and C breeding centres (CYGAN-SZCZEGIELNIAK *et al*. 2012a). The analyses of the effect of season on the content of that element in the hair of heifers showed the opposite tendency; higher Zn concentrations were assayed in samples collected in summer than in winter. The Zn content in the animal body depends mostly on the food chain: soil – plant – animal. Its content is also significantly affected by the age of the individual. Reports by ANKE & RISCH (1979) showed that zinc concentration decreases rapidly from birth to the age of 25, after which it increases slowly. Similarly the effect of the biotope on the content of that mineral is essential, which was evident from various Zn concentrations in hair of wild animals, obtained from various hunting districts. The highest concentration of Zu in the hair of roe deer, namely 93.32 mg/kg, was determined in the vicinity of Wrocław and 98.17 mg/kg in the Legnicko-Głogowski district. In the hair of wild boars investigated in the same areas the zinc concentration was 44.57 mg/kg in the vicinity of Wrocław and 137.24 mg/kg in the vicinity of Grębocice (KUCHARCZAK 2003). Similarly the present research confirms that the location of the farm affects the level of that microelement in the body.

The lowest Pb concentration in the hair of B cows (Table 1) may be due to the breeding centre location in a non-industrialised area of Poland. Increased Pb content in C cow hair (Table 1) may be due to the location of that breeding centre in the close vicinity of a national road with considerable traffic (GOULD 2009) and the nitrogen plant in Włocławek as well as the Elana plant in Toruń. Moreover, increased Pb content in cow hair in winter in all the breeding centres may be caused by cows licking metal parts which can be a potential source of this toxic element (NEATHERY & MILLER 1975). Other studies (FARMER & FARMER 2000; PARTA *et al*. 2007) confirm the results reported in the present research on the effect of environmental pollution on the accumulation of toxic metals in cow hair. A slightly different relation was found by FILISTOWICZ *et al*. (2012) for hair of foxes from breeding centres located in environmentally different regions (agricultural or industrial areas). The content of Pb in hair of foxes was similar in both groups independent of the location and reached approximately 0.64 mg/kg. Comparable content of Pb in hair of silver foxes and wild foxes was reported by FILISTOWICZ *et al*. (2011), ranging from 0.42 to 0.63 mg/kg and the difference between the species in question was not statistically important in this case.

Hair constitutes good material for research since it allows for monitoring the content of respective elements accumulating over time (CIEŚLA & JANISZEWSKA 2000; KRUPA 2006). Good bioindicators of environmental pollution include, next to farm animals, also animals living in the wild; Cervidae can serve as an example since throughout their lives they are in close contact with nature and thus show a tendency to accumulate potential pollution in tissues. The highest Pb concentration in red deer hair was noted in Mazowieckie province 10.16 mg/kg, which could have been, to a large extent, connected with city traffic since the air pollution in that province was higher than the admissible values and it ranged from 0.25 to 0.35 μgm^{-3}. A high Pb concentration in the hair of red deer may have also been due to point emissions from power-generation and technological sources. A similar situation was reported in the Małopolskie province where the mean lead concentration in the hair of red deer was 9.46 mg/kg, while in the Kujawsko-pomorskie province it was 7.54 mg/kg which could have been due to the greater forestation of the region and a very low lead concentration in the air; 0.2 μgm^{-3} (ACHREM *et al*. 2004).

In the hair of other animals the lead content varied and it depended on the gender of the animal (BODAK *et al*. 1996; BUDZYŃSKI & TRUCHLIŃSKI 2004) but also on its environment, and in the case of farm animals – on the nutrition system and the period of time spent on pasture land (CIEŚLA & JANISZEWSKA 2000). An increased value of Pb was noted in the hair of horses from the stable at Michałowo. The lead content in mare hair was 0.94 mg/kg and it exceeded the admissible norm of 0.5 mg/kg BUDZYŃSKI & TRUCHLIŃSKI 2004. Similar research was also performed on stallions of Holstein, Polish Half-Breed Horse and Ardennes breed. All the horses were derived from the herd of stallions in Łobzie and were kept in homogenous conditions. No differences were found in the concentration of lead in horse hair depending on the breed and its mean value was 0.136 mg/kg. It was, however, evaluated that in summer the level of Pb was higher, which must have been due to a longer stay of the animals in the paddock (CIEŚLA & JANISZEWSKA 2000).

KUCHARCZAK *et al*. (2003) investigated the hair of roe deer and wild boars from large, different in terms of the degree of environmental pollution, regions of Poland: the vicinity of Wrocław and Legnicko-Głogowski Copper District (LGOM). The lead content in the hair of roe deer from the vicinity of Wrocław and Legnica was 2.18 mg/kg and 1.92 mg/kg, respectively. However, in wild boars the lead content in the hair was 3.09 mg/kg in the vicinity of Głogowski and 4.70 mg/kg in LOGM. Both in roe deer and in wild boars the lead content in the hair was much higher than in the other organs and tissues. This study showed that game animals can be a good bioindicator to evaluate the degree of pollution of a given environment.

The highest content of Cd was identified in hair sampled in summer from the A breeding centre cows (Table 1). In the reports by ANKE and RICH (1979) the Cd content in the hair of dairy cows was comparable (0.04 mg/kg) with the present research. Similar results (0.04-0.42 mg/kg) of the concentration of that element in cow hair were reported by FARMER & FARMER (2000). The lowest Cd concentration in the hair of cows from B can be due to the breeding centre location in a non-industrialised area of Poland. An increased Cd content in cow hair collected in summer can be due to the accidental penetration of pollution from soil during animal grazing and an increased exposure to the effect of Cd (DOBRZAŃSKI *et al*. 2009). For the purpose of comparison, the mean content of cadmium in the hair of red deer was highest in Małopolskie province and it amounted to 0.18 mg/kg, which could have been due to industrial pollution since 24 plants considered a special environmental nuisance can be found in the province, e.g. Polskie Huty Stali S.A. The cadmium content in the hair of various animals reflects the health status of a given individual and environmental pollution perfectly, which is seen from the research on the Cd content in horse hair (KRUPA *et al.* 2006). The Shierife mare hair showed the Cd content, on average, 0.026 mg/kg, while Ibrahim mares contained, on average, 0.005 mg/kg in the hair. Interestingly, despite different cadmium contents, all the mares were in good physical condition (KRUPA *et al*. 2006). Based on research into the cadmium content in the hair and in the organs of wild living animals from the Legnica and Wrocław regions, it was found that in roe deer the cadmium concentration was highest in kidneys from 0.35 to 0.46 mg/kg, similarly as in wild boar kidneys where the value ranged from 1.33 to 2.22 mg/kg and in hair from 0.07 to 0.12 mg/kg (KUCHARCZAK *et al*. 2003).

Correlation analysis showed positive and significant interactions between Zn-Cu, Zn-Mn, Zn-Fe, Zn-Cd, Cu-Mn, Cu Pb as well as Mn-Pb (Table 2 and 3). Heifers from Kietrz, Knyszyn and Osięciny (CYGAN-SZCZEGIELNIAK *et al*. 2010a) also demonstrated positive and significant correlations for Zn-Cu, Zn-Mn, Cu-Mn. The reports by KABATA-PENDIAS & PENDIAS (1999) showed that between Zn and Cu there is an essential, in terms of metabolism, antagonism and competition occurs for their absorption from the alimentary canal. Similar relationships between elements in the hair of dairy cows were reported by BUDZYŃSKA *et al*. (2006). The Cu content has a direct effect on the Zn level in the body and affects its transformations. Antagonism occurs most often between Cu and Zn ions, synergism – between Cu-Fe, which has a favourable effect on the pattern of various enzymatic processes, especially during the synthesis of haemoglobin. The reports by KABATA-PENDIAS & PENDIAS (1999) showed that antisynergism occurs between Mn and Zn and antagonism occurs between Mn and Fe. A high amount of manganese most often triggers Cu, P and Fe deficit. The interaction of Fe with other elements, including heavy metals, affects its absorption and its metabolism. An especially antagonistic effect towards Fe is triggered by Cd and Pb. The interactions between Pb and other elements significantly disturb the metabolism of the elements indispensable for health. The antagonistic effect of lead on other metals is connected with their affinity to form permanent bonds with proteins. An increase in the lead content accelerates Fe and Cu excretion. Pb inhibits the formation of ceruloplasmin which participates in Cu metabolism. An increase in the Cu level in the diet decreases Pb sorption. The Cd-Fe antagonism is coupled with Cd-Cu antagonism and it decreases the absorption of Fe in the body and the Cd-Ca interaction triggers an increased excretion of Ca caused by Cd.

The present research showed the effect of the season and the breeding region on the content of the mineral nutrients Zn, Cu, Mn, Fe and heavy metals Pb, Cd assayed in the hair of the cows during drying-off. It was demonstrated that the season has a significant effect on the content of respective metals in the hair, except for Mn and Cd. The hair over winter showed a higher mean concentration of Zn, Cu, Mn, Fe and Pb, while in summer the Cd concentration was higher (Table 1). The Cd and Pb content in the cow hair did not exceed the admissible norm.

Including mineral substances and heavy metals to the metabolic pool in organisms occurs at a varied intensity. The content of elements in the animal body depends on the environment it stays in and heavy metals accumulating in respective food chain links pose a threat for its successive elements. For that reason a very important role is played by research monitoring the concentrations of heavy metals in respective animal tissues and organs. The research confirms that the hair can be useful for the evaluation of the mineral profile of the cow body, the level of environmental pollution as well as for determining the reference values of some elements.

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