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*Content of Selected Trace Elements in Milk and Hair Coat of Cows from Central Pomerania Region**

Zawartość wybranych mikroelementów w mleku i sierści krów z regionu Pomorza Środkowego

Mineral deficiency or inbalance results in many health and performance problems. In addition to protein and energy, minerals play an important role in the growth, physiological functions and performance of farm animals (12,13). The various factors which bring about the mentioned problems include environmental irregularities with breeding of animals in the first place. It mainly concerns the unfulfilled mineral requirements, which are very often connected with biogeochemical conditions.

The aim of the present experiment was to determine the trace element content of milk and hair coat of dairy cattle from the Central Pomerania region. The level of particular minerals was shown in relation to the physiological status of the cows.

MATERIAL AND METHODS

Five dairy farms in the region of Central Pomerania were investigated. They were marked as „A", „B", „C", „D" and „E". The cows were of the Black-and-White breed with different Holstein-Friesian inheritance, aged from 2 to 5 years. They had similar breeding parameters and were at different physiological stages. 10 equivalent cows were chosen from each herd, including 5 cows at different but close stages of lactation (group I) and 5 cows that came into lactation after parturition (group II). Samples of milk and hair coat were taken to determine the mean content of trace elements Fe, Zn, Cu and Se. Milk was sampled on four occasions after previously testing the mammary gland with the California mastitis test. Hair coat from cows was taken three times ac-

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cording to the Brochart (4) method, i.e. hair regrown at the height of withers was taken after previous shaving. The content of minerals Fe, Zn and Cu was determined with the ASA–Unicam 939, and selenium level using the fluorometric method (6).

To determine microelements contents at the food chain, soil and feed were sampled. The soil was collected once from 0-15 cm depth at the height of the vegetative period, while feeds were sampled regularly upon their introduction into dietary units. A rule of sample representativeness was observed. Over the research period the analyses on soil mineral availability were conducted as well as on feedstuff fed to cattle. Animal feeding was performed in compliance with the standards required (11).

The numerical data were analyzed statistically. Values of traits were characterized by arithmetic means ($\bar{x}$) and standard deviation (*SD*). Significant differences between herds were checked with multivariate analysis of variance (ANOVA – F test and NIR ranges).

RESULTS AND DISCUSSION

The mineral balance is affected by many factors, but the soil – plant – animal relationship is the most important. Numerous areas in Poland have a reduced content of many minerals. For example, there is a low concentration of selenium in the soils of north-eastern Poland and copper deficiencies all over Poland, especially in sandy, limestone and peaty soils, in river valleys and in the riparian areas of seas and oceans, i.e. in the region under investigation (5, 2, 7, 3). The levels of minerals in soils and feeds are compared in Tables 1 and 2. Polish (3, 9, 13) and foreign researchers (1, 8) have tested the concentration of minerals in hair coat and milk to complement the evaluation of mineral metabolism in blood serum. It was

Table 1. Results of tests on *pH* (in 1M KCL) and mineral composition of grassland soils in farms A, B, C, D, E

Farm	Type of soil	n	*pH*		Fe	Cu	Zn	Se
					in mg/kg d.m.			
A	Alluvial	25	6.0	$\bar{x}$	9.6	5.2	197	0.1
				SD	0.8	0.5	33	0.1
B	Podzolic from clayey sands	25	6.0	$\bar{x}$	9.4	5.5	222	0.1
				SD	1.0	0.6	41	0.1
C	Peat	25	5.8	$\bar{x}$	10.1	5.1	267	0.2
				SD	1.2	0.5	42	0.1
D	Rendzina	25	6.1	$\bar{x}$	11.6	5.4	185	0.2
				SD	2.2	2.0	31	0.2
E	Loams of aqueous origin	25	5.9	$\bar{x}$	11.1	5.2	291	0.1
				SD	2.2	0.5	0.5	0.2

n – number of bulk samples; A, B, C, D, E – herd symbols

Table 2. Levels of minerals in cattle feeds on farms A, B, C, D, E

Type of studied feeds	n		Fe					Cu					Zn					Se				
			g/kg s.m.															μmol/kg s.m.				
			A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Meadow hay	20	$\bar{x}$	155	157	163	172	144	2.2	3.1	2.1	1.8	1.8	30	57	63	57	36	20	19	18	19	19
		SD	16.1	8.2	18.1	17.5	16.1	0.4	0.5	0.3	0.4	0.3	0.3	3.5	2.5	2.3	3.5	6.2	5.2	4.3	5.2	4.8
Pasture green forage	20	$\bar{x}$	177	182	195	183	192	2.3	2.8	2.1	2.1	1.7	33	30	62	56	41	20	21	20	18	20
		SD	20.1	10.1	17.1	18.1	19.1	0.2	0.5	0.3	0.3	0.3	0.4	2.5	2.7	2.1	2.7	17.6	7.3	8.2	7.2	8.2
Protein food of home production	20	$\bar{x}$	241	202	271	195	204	6.7	7.1	6.5	6.7	7.2	101	104	90	92	94	30	28	26	30	20
		SD	27	28	27	19	20	0.8	1.2	0.9	0.5	0.5	10.2	6.3	2.4	2.5	3.4	7.8	6.1	4.2	11.9	6.8
Barley-oat feed straw	20	$\bar{x}$	19.4	212	18.6	20.6	222	0.2	0.2	0.3	0.2	0.3	8.5	7.3	6.3	5.4	5.3	7	6	4	3	4
		SD	5.3	4.7	5.2	5.2	4.1	0.2	0.2	0.1	0.2	0.1	0.2	0.2	7.1	0.1	0.1	2.0	3.0	2.0	1.2	2.1
Dry beet pulp	20	$\bar{x}$	55	55	40	51	47	1.3	1.0	1.0	0.9	0.9	41	52	51	37	40	52	33	48	48	36
		SD	6.6	4.1	6.6	9.4	5.2	0.3	0.2	0.4	0.2	0.2	3.1	7.1	6.2	6.1	5.1	5.2	3.2	4.8	4.5	0.1
Fodder beet	20	$\bar{x}$	173	196	204	186	200	2.2	2.0	1.8	2.0	1.8	41	51	53	42	42	48	36	52	52	38
		SD	28	20	15	25	33	0.5	0.1	1.0	0.2	0.3	3.1	6.1	7.1	3.6	4.2	5.2	4.1	5.6	5.3	4.2

Table 3. Mean content of trace elements in milk and hair coat of cows

	Element	Sample	Group I-lactation		Group II-early lactation		Comparison of groups		
			$\overline{x}$	*SD*	$\overline{x}$	*SD*	difference in means	t	P_1
Milk mg/100ml	Fe	I	22.90	2.60	25.91	4.28	3.01	3.01	<0.01
		II	21.39	2.67	24.38	4.21	2.99	3.00	<0.01
		III	20.56	2.63	23.39	4.15	2.83	2.88	<0.01
		IV	19.56	2.44	23.47	2.97	3.91	5.08	<0.001
	Zn	I	18.07	1.51	20.14	1.33	2.07	5.14	<0.001
		II	16.95	1.67	19.38	1.45	2.43	5.50	<0.001
		III	16.25	1.26	18.46	1.40	2.21	5.89	<0.001
		IV	15.48	1.24	17.66	1.37	2.18	5.86	<0.001
	Cu	I	22.08	3.19	22.83	4.43	0.75	0.68	>0.49
		II	20.98	3.13	21.70	4.31	0.72	0.67	>0.50
		III	20.08	3.01	20.62	4.03	0.54	0.54	>0.59
		IV	18.93	2.80	19.68	3.69	0.75	0.82	>0.41
µg/100ml	Se	I	92.72	7.99	100.48	6.13	7.76	3.85	<0.001
		II	91.76	7.85	86.04	3.60	-5.72	3.31	<0.002
		III	94.36	9.85	73.16	12.77	-21.20	6.57	<0.001
		IV	131.72	4.75	70.56	3.27	-61.16	53.06	<0.001
Hair coat mg/kg d.m.	Fe	I	103.08	9.67	100.20	10.55	-2.88	3.19	<0.01
		II	114.68	9.34	106.64	7.63	-8.04	5.99	<0.001
		III	138.76	14.90	128.92	20.01	-9.84	6.34	<0.001
	Zn	I	107.12	10.95	106.52	18.04	-0.6	4.14	<0.001
		II	106.48	9.98	98.40	6.44	-8.08	5.09	<0.001
		III	188.72	35.56	161.48	46.22	-27.24	3.34	<0.002
	Cu	I	5.5	0.31	5.45	0.49	-.005	1.85	>0.1
		II	6.04	0.39	5.64	0.32	-0.4	2.78	<0.01
		III	6.84	0.42	6.22	0.49	-0.62	4.50	<0.001

$\overline{x}$ – mean value, *SD* – standard deviation, P_1 – significance of differences, t – coefficient of variation

therefore necessary to validate these observations to the Pomerania region. The trace element contents of hair coat and milk are given in Table 3. The research proved that level of most microelements Zn and Se in milk surpassed the physiological standards given by the authors in their papers on mineral supply of dairy cows (3, 2). The content of selenium was higher in the first sample taken from cows group II than in lactating cows. However, the concentration of selenium in milk increased in the last sample (IV). Fluctuations in selenium level in the successive samples could reflect the more intense elimination of selenium through milk during the first days of dams' lactation and be proof of the deficiency. During the entire experimental period, small differences were shown in the concentrations of zinc and iron in groups I and II. Each of the successive samples showed a downward trend. Zinc level was lower than the standards accepted (33-39 mg/100ml). Copper groups were similar (20.62 mg/100ml on average).

It is believed that changes in hair coat minerals reflect mineral changes in the body, although there are also opinions to the contrary (10). Data in Table 3 indicate that the concentration of copper was below the physiological level (3,12). Iron content in both groups in sample I did not differ significantly but was significantly lower than in sample III. Copper level did not differ much in the two groups of lactating cows and those coming into lactation, and in the next samples, where it averaged 5.5 mg/kg d.m. Zinc concentration in cows from the lactating group was higher in successive samples in relation to its level in the group of cows which came into lactation postpartum.

The analysis of trace elements data lead us to conclude that milk, just as hair coat, may serve as a complementary test when studying the mineral supply of cows. It is assumed that the clinical symptoms and some mineral deficiencies recorded at the examined animals brought about insufficient microelement supply, which in turn unfavourably affected the animal health state and performance.

CONCLUSIONS

1.Selenium deficiency in soil and feed was manifested in the content of this element in milk of the cows from the region studied.

2.The level of iron, zinc and copper in milk of the cows entering the lactation decreased gradually.

3.Mineral metabolism of the animals at the region studied is supposed to be supplemented by mineral mixture adjusted to the biogeochemical conditions of the region examined.

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STRESZCZENIE

Celem pracy było określenie zawartości mikroelementów w mleku i sierści bydła mlecznego pochodzącego z Pomorza Środkowego. Badaniami objęto pięć ferm bydła mlecznego w rejonie Pomorza Środkowego. Oznaczono je symbolami „A", „B", „C", „D" i „E". Obsadę stanowiły krowy rasy c.b. z różnym dolewem krwi rasy holsztyńsko-fryzyjskiej w wieku od 2 do 5 lat, o wyrównanych parametrach hodowlanych i zróżnicowanych stanach fizjologicznych. W każdym stadzie wytypowano metodą analogów 10 krów, w tym 5 krów w różnym, choć zbliżonym okresie laktacji (grupa I) i 5 krów, które po porodzie weszły w stadium laktacji (grupa II). Do badań pobierano próbki mleka oraz sierści w celu określenia średnich wartości mikroelementów: Fe, Zn, Cu, Se. W przeprowadzonym badaniu wykazano, że analiza mleka odzwierciedla stany niedoborowe Zn i Se oraz niedobór Cu w sierści u krów mlecznych bytujących w badanym rejonie, co wiąże się bezpośrednio z warunkami biochemicznymi i składem podawanej paszy. Stan fizjologiczny krów miał wpływ na poziom badanych pierwiastków.