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Mineral Elements Level in Milk of the Cows with Mineral Dietary Supplementation

Poziom elementów mineralnych w mleku krów poddanych dożywianiu mineralnemu

Mineral elements are the typical components supplied to organism. They significantly condition animal growth and development, and so do proteins and energetic componds. Numerous authors (2, 3, 5, 6,) treated the problem of supplementary ingredients use and claimed that appropriate composition of a mixture should suit the habitat previously examined. The objective of the work was to assess the influence of two mineral preparations on the level of mineral components in milk of the cows whose habitation region showed mineral deficiencies.

MATERIAL AND METHODS

The examination was conducted in a farm „A" located in the former Chełm province. Strict examinations covered 60 cows black-white breed selected according to analog method. The cows were aged 4–8 years, their milk efficiency was 2550 kg, of similar breeding and physiological parameters. The animals were fed feedstuff produced in the region. The dietary units were composed of pasture forage, average quality meadow hay, cereal mixture produced at farm, maize silage, fodder straw. The mineral supply state of goats was assessed on the basis of dietary units applied after the Standardsfor Animal Feeding (9). The animals were kept in the same maintenance conditions and microclimate. The examination period lasted for two years. The mean daily supply of each mineral element was calculated at the summer and winter feeding time.

The soil samples were collected twice from the pastures and arable land at 0–15cm depth by means of a sampling stick at the height of the vegetative season (June, September). Determination of total content of Ca, P, Mg, K, Fe, Cu, Zn, Mn and Co was made with spectral emission analysis method on high dispersion spectrograph Higler E-478 type using method of „one additive" and pouring by Gliński and Grajpel cit. (2).

The fodders were sampled regularly as they were introduced into feeding according to sample representativeness rule. The content of mineral components like Ca, Mg, Na, K, Fe, Cu, Zn, Mn and Co in feedstuff was established by atomic absorption spectrophotometry method with flame spectrophotometer ASA-Unicam 939, while the phosphorus level with colorimetric analysis according to Fiske-Subbarow`s method cit. (11). The cows under study were assigned into 3 treatment groups, 20 animals each, after the analog method. Control K group obtained no mineral ingredients, while experimental D_1 group was supplied with fodder ammonium phosphate named POLIPASZ A the in amount 250g/animal daily produced by the Chemical Plants in Police. The mixture composition contained: N-min. 14% m/m, P –min. 23% m/m, P2O5 – min. 54% m/m, F max. 0.2% m/m, Pb – max. 10 ppm, As – max. 5 mg/kg d.m., Cd – max 3 mg/kg d.m., Hg – max 50 μg/kg.d.m. The experimental D_2 group received a mineral-herbal mixture formulated after the present author` recipe named BOVIFOSFOMAG. Its daily unit was 150g/animal. The mixture was constituted by: Ca – 150 g/kg, P – 80g/kg, Mg – 70g/kg, Na – 60 g/kg, Cu – 4 g/kg, Mn – 15 mg/kg, J – 8 mg/kg, Fe – 110 mg/kg, Zn – 120 mg/kg, Co – 5 mg/kg, Se – 4 mg/kg. Vitamins: A-20000 i.u., E-22.00 mg, B1-2.00 mg, B2-2.00 mg, B6-2.40 mg. Acids: nicotinic – 15.00 mg, panthotenic – 6.00 mg, folic – 0.40 mg, Biotin – 0.15 mg, Choline – 4.00 mg and the following herbs being partly the source of vitamins, while technologically used as carriers and improving its palatability: flax grains, nettle, camomile, common horsetail, melissa, oak bark, willow bark. Milk was sampled for three times: in 6–8, 10–12 and 14–18 week of lactation. The cows were hand milked to chemically pure disposable containers, prior to the morning milking. The mammary gland was subjected to clinical examination before the material sampling, while milk with Californian test. The samples in which somatic cell count exceeded 500 th in 1ml milk were eliminated from the examination. A content of Ca, Mg, Na, Fe, Cu and Zn was determined by ASA method, while an inorganic phosphorus level with Fiske-Subbarow`s method (11). An Se concentration in milk was fixed with atomic absorption flameless spectrophotometry with a technique of electrothermal atomization ETAAS.

At the tables the significance of differences between the samplings were noted with small letter and the groups were noted with capital letter symbols; the means differ significantly ($p \leq 0.05$) if they are not noted with the same letter. The letter denotations were made on the basis of results of 5% confidence intervals NIR.

DISCUSSION

Generally, the soils showed acid reaction (*pH* 6.1) and were poor in P (2.6±0.5 g/kg d.m.), Mg (2.0±0.3 g/kg d.m.) and Cu (5.4±0.4 mg/kg d.m.), whereas very rich in Cu (14.3±2.2 g/kg d.m.). The other elements were contained within the values regarded as mean (2). The analysed feed samples were highly Ca available (3.8–14.8 g/kg d.m.) but clearly P (0.4–4.6 g/kg d.m.) and Mg deficient. The extreme values of magnesium concentrations at most feedstuff ranged from 0.6 to 2.1 g/kg d.m.,i.e. below the minimum standards defined by the other authors as 2.0 g/kg d.m. (4, 9, 10). Phosphorus content concentrations in livestock feed, as it follows from the literature, are differentiated and on average range from 0.1–42 g/kg d.m. in the domestic conditions (4, 9, 10). Na and K quantity in the feeds may be considered optimum. Sodium concentration oscillated within the interval from 1.6–2.7 g/kg d.m. with a slight excess of P, whose values reached 2.5–17.6 g/kg d.m. The levels of Cu and Zn were shown to be low (3, 4, 9, 10). They were contained in the intervals: Cu 1.4–7.1 mg/kg d.m., Zn 15.0–41.0 mg/kg d.m. It was proven that, among others, the regulation of floristic composition of meadows and pastures makes a vital element of mineral supply because feed legumes show a higher copper content than grasses. In the case of copper, its content under 5 mg/kg d.m. leads to deficiency occurance in animals. Nitrogen fertilization and soil liming cause biomass increase but on the other hand, decrease this element content. In the feeds studied the zinc levels were found below the optimum standards (3, 4, 10). The values ranged from 30 to 60 or even 100 mg/kg d/m. It is admitted that levels of iron, manganese and cobalt were contained within low or mean limits regarded as regular (9, 10). The data on mineral element quantities that would meet nutritional and productive requirements of cows vary according to the authors. Comparing the data presented by various authors (1, 2, 6, 7, 8) and the status of cow mineral components supply, an argument of incomplete and unregulated mineral supply at cows has been confirmed. The components shown to occur in excess were calcium 158.0 g in summer and 149.0g in winter and potassium – 228.0 g and 232.0 g, respectively. As to deficient elements, they were: phosphorus – 31.0 g and 33.0 g, magnesium – 22.0 g and 24 g, copper – 58.0 mg and 61.0 mg and zinc – 285.0 mg and 308.0 mg, respectively. A factor proving milk usability for this type of researches is sampling accessibility and ease of analysis performance. Another criterium for this organism liquid usability is a fact that between the mammary gland blood and milk there occurs permanent two-sided interchange of components, in that mineral. Their main source in milk is animal feedstuff as well as elements in soil and water. The levels of mineral elements in milk are presented in Table 1. A Ca concentration in milk from the cows D_2 treatment group was significantly higher at each of three samplings compared to a content in K group. The cows from D_2 group as against D_1 group also showed a significantly higher Ca level at I, II and III sampling. This element level in milk from D_1 and K group did not differ significantly at I and II sampling. Considering all three collectings of samples P content in milk turned out to be highest in D_1 group. As to Mg concentration, in D_2 group it was significantly higher throughout the research period in relation to the element value in K and D_1 group. However, D_1 group compared to the control K did not differ significantly only at I sampling. The comparison of Na content at all three groups did not reveal any significant differences.

Table 1 Levels of Ca, P, Mg, Na, K, Fe, Cu, Zn in milk of cows (mg/100ml), Se [μg/dm^3] (n=20)

Mineral element	Sampling	K			D_1			D_2		
		$\bar{x}$	SD	p	$\bar{x}$	SD	p	$\bar{x}$	SD	p
Ca	I	151.5	5.16	A b	150.6	5.43	A b	157.2	5.13	B b
	II	142.0	3.38	A a	143.0	5.12	A a	152.2	3.55	B a
	III	139.9	3.65	A a	144.2	7.12	AB a	149.2	4.22	B a
P	I	32.6	2.78	A b	40.9	1.62	C a	36.7	2.81	B c
	II	31.2	1.86	A b	41.4	1.88	C a	33.3	2.77	B b
	III	29.4	1.08	A a	40.2	3.96	C a	30.8	1.22	B a
Mg	I	24.4	1.08	A c	25.7	2.02	A a	32.2	2.73	B a
	II	21.1	2.07	A b	25.7	1.78	B a	30.9	2.64	C a
	III	19.4	1.08	A a	25.7	1.92	B a	30.8	1.80	C a
Na	I	34.3	2.35	A b	33.8	2.25	A b	32.9	1.68	A a
	II	31.8	2.25	A a	32.1	1.83	A a	32.8	1.76	A a
	III	32.0	2.83	A a	31.4	1.38	A a	31.8	1.48	A a
K	I	182.4	7.95	B c	174.2	5.01	A b	176.3	3.77	A b
	II	175.0	3.62	A b	178.2	6.37	A b	175.2	2.89	A b
	III	170.2	3.46	A a	169.2	4.88	A a	171.5	3.94	A a
Fe	I	0.251	0.0215	A b	0.251	0.0188	A b	0.247	0.0219	A b
	II	0.204	0.0188	A a	0.242	0.0267	B b	0.251	0.0223	B b
	III	0.203	0.0150	A a	0.219	0.0168	B a	0.217	0.0210	AB a
Cu	I	0.357	0.0188	A c	0.355	0.0211	A c	0.402	0.0166	B a
	II	0.326	0.0303	A b	0.325	0.0300	A b	0.404	0.0370	B a
	III	0.303	0.0137	A a	0.306	0.0151	A a	0.403	0.0436	B a
Zn	I	0.918	0.0531	B c	0.777	0.0405	A b	1.023	0.0812	C a
	II	0.758	0.0386	A b	0.752	0.0333	A b	0.965	0.0540	B a
	III	0.687	0.0314	A a	0.711	0.0446	A a	0.982	0.0827	B a
Se	I	8.302	0.0382	A a	8.482	0.0472	A b	10.086	0.0627	B a
	II	8.316	0.0281	A a	8.364	0.0444	A b	10.852	0.0306	B b
	III	8.132	0.0306	A a	7.956	0.0462	A a	10.880	0.0485	B b

K – control group, D_1, D_2 – experimental groups, x- – mean value, SD – standard deviation. At the tables the significance of differences between the samplings were noted with small letter and the groups were noted with capital letter symbols; the means differ significantly ($p \leq 0.05$) if they are not noted with the same letter

A potassium level was higher only at I sampling in K group in relation to to D_1 and D_2. At II and III sampling there was shown a lack of significant differences between the treatment groups. Over the whole research period Fe content in D_1 and D_2 group did not differ significantly. Only at II sampling Fe content in D_1 and D_2 group was sigificantly higher as against the control K. Cu concentration in D_2 group was higher as compared to D_1 and K group over entire feeding period. According to Greg, quoted after Karleszko (5), a level of such elements like, Ca, Mg, Na, K, Cl, Fe, Cu, Co and Mn in milk does not change significantly under the influence of feed. A level of Zn, Mo, and Fe is reflected in milk composition. Hurly, quoting Karleszko (5), claims that mineral element content in milk is directly conditioned by buffer volume, milk reaction, osmotic pressure and ion strength. The author believes that concentration, among others, of Cu in milk should not vary regardless of these elements content in feed. At all three samplings D_2 group exhibited a significantly higher Zn value as compared to D_1 and K groups. On II and II samplings Zn level in milk of cows from D_1 and K groups did not reveal any significant differences. A similar trend was reported in the case of Se concentration. No significant differences were noted between K and D_1 groups at all three samplings, while in D_2 group Se level proved to be higher in relation to the other groups throughout the experimental period. Fluctuation of a selenium level in milk at the successive samplings can also manifest enhanced elimination of the element together with milk sucked by calves staying with the dams on the first lactation days. Colostrum in particular contains many times more selenium than milk (4) that accounts for the above statements. Analysing the enclosed data there was reported substantial randomness at the stated differences in levels between the groups, a fact unlikely to be explained explicitly in the light of the material gathered. The opinions prevail that only combined determination of the mineral components in serum, hairs and milk provides a fuller picture of mineral supply at ruminants.

CONCLUSION

1. In milk of the cows from group receiving BOVIFOSFOMAG there were found statistically significant higher levels of Ca, Mg, Cu, Zn and Se at all three samplings compared to other groups.

2. At group of cows fed POLIPASZ A a phosphorus concentration in milk was statistically significantly higher as against groups.

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STRESZCZENIE

Celem pracy była ocena wpływu dwóch preperatów mineralnych na poziom wybranych pierwiastków w mleku krów bytujących w fermie A, w województwie chełmskim. Objęte doświadczeniem zwierzęta podzielono na trzy grupy, po 20 sztuk. Grupa K nie otrzymywała dodatków mineralnych, grupa D_1 otrzymywała paszowy fosforan amonowy o nazwie POLIPASZ A, grupa D_2 mieszankę mineralno-ziołową BOVIFOSFOMAG. Po zastosowaniu dożywiania mineralnego w mleku krów otrzymujących mieszankę stwierdzono we wszystkich trzech pobraniach statystycznie istotnie wyższe poziomy Ca, Mg, Cu, Zn i Se w porównaniu z pozostałymi grupami. W grupie otrzymującej POLIPASZ A stężenie fosforu w mleku było statystycznie istotnie wyższe niż w grupach K i D_2.