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Influence of balancing mineral nutrition of dairy cows on milk yield and the content of some minerals in blood and milk

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ABSTRACT

The effectiveness of mineral mixtures balancing the mineral nutrition of cows in 8 chosen dairy farms using different winter feeding models, traditional (T) or modern (M), was evaluated. A positive influence of mixture A used in barns with the traditional feeding model was noted on milk yield (8% increase) and also on the level of some deficient minerals (Ca, P, K, Cu ≤ 0.05) in cows' blood serum and on the potassium content in milk. Mixture (B), balancing mineral nutrition of cows from barns where the modern feeding model was used, did not significantly affect either milk yield or mineral level in blood plasma or milk in comparison with the commercial mixture.

KEY WORDS: dairy cows, minerals, diet, blood, milk

INTRODUCTION

The studies of Bujanowicz-Haraś and Matras (2003) determined a deficiency, in relation to standards (INRA, 1988), of the majority of minerals contained in typical basic rations for cows. Rations need supplementation not only in sodium, calcium or phosphorus, but also in potassium, which has been considered a mineral occurring in surplus in typical diets. Zinc and copper are also deficient. Mineral additives can increase animal productivity as well as the mineral content in blood and, to a more limited degree, also in milk (Brzóska et al., 2001).

The aim of the investigations was the evaluation of the effectiveness of two mineral mixtures, prepared according to our formula, in balancing minerals in the winter feeding of dairy cows in selected barns of central eastern Poland.

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MATERIAL AND METHODS

The 3-month-long study was carried out in 8 dairy barns in the Lublin region, following the investigations conducted in these barns by Bujanowicz-Haraś and Matras (2003), dealing with providing these animals with minerals contained in basic diets. Half of the barns were units (nearly 5000 kg milk yield) where a traditional (T) feeding model was used and the other 4 barns (7500 kg milk yield) used a modern (M) model. No mineral additives were used in the barns with the T-feeding model, whereas in the barns where the M-model was used, the diets were supplemented with commercial mineral mixtures. The herds of each barn were divided, by analogues, into two feeding groups: control (C), where feeding was continued as before and an experimental group (M), whose basic diets were supplemented with mineral mixtures prepared according to our formula (mixtures A or B). Mixture A (300 g/head/d) was used in the diets for cows of T-model barns and mixture B (590 g/head/d) was added to the rations of cows in the M-feeding model barns. Feed intake and milk yield were measured once a month when samples were taken for analysis. Blood samples were taken at the end of the experiment. The contents of basic nutrients were determined in the feed and milk samples. In addition to Ca, the contents of Mg, Na, K, Cu and Zn were assayed in these samples and in blood serum (AOAC, 2000).

Ten pairs of analogues in each of investigated feeding model were chosen for statistical analyses. The data were subjected to statistical analyses (ANOVA) using Statistica Software and Student's t-test.

RESULTS AND DISCUSSION

The diets of the traditional feeding model consisted of sugar-beet leaf silage and ensiled sugar beet pulp, meadow hay and concentrate (25, 13, 42 and 20% in diet DM, respectively). The diets of the modern model contained maize silage, haylage, meadow hay and concentrate in proportions of 24, 22, 12 and 42% in diet DM, respectively. The data of Table 1 show that after introducing the mineral mixtures, the experimental diets contained mineral levels complying with standards (INRA, 1988; NRC, 2001).

The mineral mixture added to the diets of the traditional feeding model increased the milk yield of cows by 8% and elevated ($P \leq 0.05$) Ca, P, K and Cu contents in blood serum and K in milk (Table 2). The concentration of potassium in the blood of control group cows was below the reference level, whereas the phosphorus, zinc and copper contents - in the lower reference ranges (Winnicka, 2004).

Providing cows with K significantly elevated its content both in blood serum and in milk. Also the contents of P, Zn and Cu in blood were increased ($P \leq 0.05$)in

this group. These results are similar to those obtained in our investigations on balancing summer mineral feeding of cows (Bujanowicz-Haraś et al., 2004).

No significant differences were found between both groups in the herds fed according to the modern model of feeding, except a somewhat higher level of potassium, magnesium and zinc contents in the experimental cows' milk.

Table 1. Average daily intake of minerals and their content in 1 kg of diet DM

Feeding model	Item	Ca	P	Mg	K	Na	Cu	Zn
		g					mg	
Traditional	Basic diet	119.9	34.9	56.0	114.4	23.3	140.0	601.0
	Mineral mixture A[1]	30.9	23.4	-	36.4	23.8	57.3	344.0
	In 1 kg of diet DM:							
	Group T-K	6.9	2.0	3.2	6.5	1.3	8.0	34.3
	Group T-M	8.5	3.3	3.1	8.5	2.7	11.1	53.1
Modern	Group M-K							
	Basic diet	76.1	69.5	45.3	107.4	8.5	103.6	606.01
	Commercial mineral mixture	61.8	20.7	11.0	-	27.0	172.5	1425.0
	In 1 kg of diet DM, including commercial mineral mixture	6.30	4.1	2.6	4.9	1.6	12.6	92.7
	Group M-M							
	Basic diet	76.1	69.5	45.3	107.4	8.5	103.6	606.0
	Mineral mixture B[2]	79.1	18.9	20.6	69.9	40.0	90.7	477.3
	In 1 kg of diet DM, including mineral mixture B	7.2	4.1	3.0	8.2	2.2	9.0	49.9
	Norm[3] in 1 kg of diet DM	6.5-7.3	3.7-4.0	1.5-2.0	10	1.5-1.7	10	50

[1] Ca - 103.1g, P - 78.1g, K - 121.4 g, Na - 79.3 g, Zn - 1147 mg, Cu - 191 mg, Co - 5.6 mg, J - 11.2 mg, Se - 2.8 mg in 1 kg

[2] Ca - 134 g, P - 32 g, Mg - 34.9 g, K - 118.4 g, Na - 67.8 g, Zn - 809 mg, Cu - 153.7 mg, Co - 3.7 mg, J - 7.4 mg, Se - 2.0 mg in 1 kg

[3] according to INRA (1989) and NRC (2001) requirements

Table 2. Content of minerals in blood serum and milk of cows fed according to the traditional model

Group	Ca	P	Mg	K	Na	Zn	Cu
	Blood serum, mmol/L					Blood serum, µmol/L	
T-K	2.88^{b}	1.50^{b}	0.98	3.67^{b}	127.69	15.79	13.30^{b}
T-M	3.28^{a}	1.64^{a}	1.00	4.04^{a}	131.60	17.81	13.80^{a}
SEM	0.10	0.03	0.05	0.09	2.08	0.74	0.36
			Milk, g/L			Milk, mg/L	
T-K	1.32	0.87	0.17	1.10^{b}	0.48	6.62	0.49
T-M	1.30	0.91	0.17	1.56^{a}	0.51	6.76	0.52
SEM	0.05	0.03	0.01	0.13	0.03	0.35	0.02

^{A,b} - $P \leq 0.05$, SEM - standard error of mean

CONCLUSIONS

A positive influence on milk yield and on the content of some deficit minerals in blood plasma of cows fed with traditional diets proves the usefulness of the mineral mixture prepared according to our formula. Providing a mineral mixture of our formulation to the cows from the barns using a modern feeding model did not change the cows' yield or mineral contents in blood plasma and milk, but it did balance mineral nutrition, diminishing the excessive expenditure of some minerals (especially zinc and copper), which is noted when the commercial mixtures are used.

REFERENCES

AOAC, 2000. Association of Official Analytical Chemists, Official Methods of Analysis. 17th Edition. Gaithersburg, MD

Brzóska F., Łojewska A., Brzóska B., Zyzak W., 2001. Effect of salt licks with micronutrients on microelement content in milk and blood serum of dairy cows (in Polish). Rocz. Nauk. Zoot. 28 (1), 83-92

Bujanowicz-Haraś B., Matras J., 2003. Providing dairy cows with minerals contained in basic winter diets fed in chosen barns of central-east Poland. Ann. Anim. Sci. 2, Suppl., 13-16

Bujanowicz-Haras B., Matras J., Wojtasik J., 2004. Influence of balancing mineral nutrition of dairy cows on milk yield and content of some minerals in blood and milk (in Polish). Rocz. Nauk. Zoot. 31, 251-264

INRA, 1989. Ruminant Nutrition. Recommended Allowances and Feed Tables. R. Jarrige (Editor). Paris

NRC, 2001. Nutrient Requirements of Dairy Cattle. 6th revised Edition. Natl. Acad. Sci. Washington, DC

Winnicka A., 2004. Reference Values of Basic Laboratory Indices in Veterinary (in Polish). Warsaw Agricultural University (Editor)

STRESZCZENIE

Wpływ bilansowania mineralnego żywienia krów mlecznych w okresie zimowym na wydajność oraz wybrane składniki mineralne w krwi i mleku

Oceniano efektywność mieszanek mineralnych, bilansujących żywienie mineralne krów w wybranych 8 oborach, w których stosowano dwa różne modele żywienia zimowego - tradycyjny (T) lub nowoczesny (M). Mieszanka mineralna A, stosowana w oborach z tradycyjnym modelem żywienia, zwiększyła wydajność mleka (wzrost o 8%) oraz podwyższyła poziom deficytowych składników mineralnych (Ca, P, K, Cu $\leq$0,05) w surowicy krwi. Mieszanka mineralna B, bilansująca żywienie mineralne krów z obór, w których stosowano nowoczesny model żywienia, nie wpłynęła na wydajność ani też na zawartość badanych składników mineralnych w surowicy krwi i mleku krów w porównaniu z krowami otrzymującymi komercyjne mieszanki mineralne.