KRMIVA

NUTRITIONAL AND MINERAL MATTERS IN RATIONS AND METABOLIC PROFILE OF COWS

HRANJIVE I MINERALNE TVARI U OBROKU I METABOLIČKI PROFIL KRAVA

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SUMMARY

The supplying of cows (N=20) of Friesian breed with nutritional matters and mineral elements (Ca, P, K, Na, Mg, Zn, Cu, Fe) in winter feeding meals was treated. Cows were in the afterbirth period. The chemical analysis of all used feeding mixtures was performed. Milk was analysed monthly (dry mattter, lactose, proteins, fat, urea). At the autumn and at the spring season the biochemical analysis of blood serum and haematological diagnosis (n=10) were performed. At the autumn were found the anaemia in larger number of dairy cows, deviations from referential values in the serum aP and TSP and the content of ketones. At the spring season there were no anaemic cows, but the deviations in content of aP and TSP in the serum were found.

INTRODUCTION

Nutritive matters and minerals, which cows consume by fodder, significantly influence the health conditions, reproduction processes and milk production capacities. An unbalanced ratio of nutrients to minerals most affects the cows in near-partum period when they produce the greatest quantities of milk.

Standards for minerals differ a lot and they have become the subject of several new studies and corrections.

It is not adequate to know the concentration of minerals in fodder that is fed to cows if a real estimation of supply of minerals in cows is to be known. The results of biochemical analysis and haematological diagnosis represent an effective supplement to nutrition control, metabolic profile and health conditions in cows.

MATERIAL AND METHODS

In the farm with 215 cows we monitored the production and nutrition parameters in the group of 20 Friesian cows in the post-partum period from the beginning of November 1993 till the end of March 1994. In the mentioned period, cows consumed 18 to 21 kg grass silage, 17 to 19 kg maize silage, 1,5 to 2,5 kg hay and 4 to 6 kg feed mixtures a day. DLG standards (1991) were used to analyze the supply of nutrients in cows, and NRC standards (1988) for mineral supply analysis.

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All used fodder was chemically analyzed. The contents of minerals calcium (Ca), phosphorus (P), potassium (K), sodium (Na), magnesium (Mg), zink (Zn), manganese (Mn), copper (Cu) and iron (Fe) in fodder were determined.

Dry matter, lactose, protein, fat, urea and acetate were determined in milk every month. Urea in milk was determined according to Erbersdobler et al. (1979).

In the beginning and in the end of the research, in ten cows from the researched group the biochemical analysis of serum and blood tests were permormed.

Data were statistically processed by t-test.

RESULTS

Chemical composition of fodder

Table 1: Chemical composition of used fodder (g/kg DM)
Tablica 1. Kemijski sastav upotrebljene hrane (g/kg ST)

Minerals Minerali	Silage Silaža		Hay Sijeno	Feed mixtures Krmne smjese		
	grass trava	maize kukuruz		1	2	3
Dry matter Suha tvar,g/kg	236,6	347,2	890,5	891,4	890,1	892,5
Crude protein Sirove bjelančevine	207,5	77,0	176,8	132,6	309,9	220,7
Crude fibre Sirova vlaknina	230,8	220,9	263,7	35,8	61,3	50,5
Ether extract Sirove masti	42,9	30,6	35,5	29,2	20,2	34,9
Crude ash Pepeo	143,3	42,6	98,0	68,2	94,2	67,9
N-free extractives NET	375,0	628,9	569,7	734,2	514,4	625,8

Table 2: Quantity of minerals in the fodder (g/kg DM)
Tablica 2. Količina minerala u hrani (g/kg ST)

Minerals Minerali	Silage Silaža		Hay Sijeno	Feed mixtures Krmne smjese		
	grass trava	maize kukuruz		1	2	3
Calcium Ca	4,40	2,42	4,72	8,68	5,62	10,96
Phosphorus P	3,79	1,78	4,04	4,19	8,83	5,07
Potassium K	12,46	4,73	14,30	3,84	7,92	4,21
Sodium Na	1,56	0,68	1,73	11,39	10,31	1,18
Magnesium Mg	3,16	1,52	3,24	1,25	2,52	2,93
Zink,mg Zn	36,33	20,67	38,55	60,83	141,2	79,92
Manganese,mg Mn	218,5	26,3	129,5	19,48	94,7	70,25
Iron,mg Fe	1200,24	577,53	748,6	66,4	357,3	192,70
Copper,mg Cu	5,00	4,00	10,9	14,89	28,1	22,78

Consumed nutrients, production and composition of milk

Cows were continuously given too much energy and protein. The protein surplus in rations even increased when the feed mixture was changed in December but

Table 3: Average daily milk production and average consumed nutrients by months
Tablica 3. Prosječna dnevna proizvodnja mlijeka i prosječno konzumirane hranjive tvari po mjesecima

	November Studeni	December Prosinac	January Siječanj	February Veljača	March Ožujak
Milk production,kg Proizvodnja mlijeka,kg	26,22	26,61	23,27	19,72	18,9
SD	3,10	3,90	0,43	4,86	2,8
Consumed: Konzumirano:					
Dry matter Suha tvar	18,0	18,39	19,1	16,7	15,5
Crude fibre Sirova vlaknina	3204	3326	3489	3223	2952
Crude protein Sirove bjelančevine	2714	3057	3205	2717	2585
NEL,MJ	125,2	126,3	130,6	111,8	104,6

Table 4: Average milk composition by months (n=20)
Tablica 4. Prosječni sastav mlijeka po mjesecima (n=20)

Milk parameters Sastojine mlijeka		November Studeni		December Prosinac		January Siječanj		February Veljača		March Ožujak	
Dry matter Suha tvar (%)	$\bar{X}$ ±SD	12,07	0,80	12,27	1,03	12,06	0,60	12,63	0,82	12,34	0,95
Lactose Laktoza (%)	$\bar{X}$ ±SD	4,86	0,22	4,77	0,34	4,76	0,30	4,68	0,24	4,52	0,44
Protein Bjelančevine (%)	$\bar{X}$ ±SD	3,03	0,22	3,11	0,28	3,15	0,33	3,11	0,21	3,31	0,23
Fat Mast (%)	$\bar{X}$ ±SD	3,46	0,63	3,67	0,99	3,36	0,43	3,85	1,02	3,33	1,09
Urea Ureja %)	$\bar{X}$ ±SD	3,90	1,00	6,47	1,25	5,19	1,20	4,71	0,90	4,71	0,91

the new one contained too much protein, and was fed till the end of March. In those months the concentration of urea in milk increased from 3,90 mmol/l in November to 6,47 mmol/l in December, 5,19 mmol/l in January and 4,71 mmol/l in February and March (Table 4). High protein surplus is not economic and it represents a danger for animal's liver, destablishes the balance in carbon hydrate metabolism and magnesium metabolism (Merall, 1983) as well.

Minerals in rations

Table 5 shows that which gave 17 to 25 kg FCM a day consumed from 4,48 g to 5,48 g Ca in a kg of dry

Table 5: Mineral supply with rations (g/kg DM)
Tablica 5. Sadržaj minerala s njihovim omjerima (g/kg ST)

Month Mjesec	November Studeni	December Prosinac	January Siječanj	February Veljača	March Ožujak
Calcium Ca	5,48	5,1	4,48	4,57	
Phosphorus P	3,46	3,9	3,9	3,7	3,8
Ca : P ratio odnos Ca : P	1,58	1,32	1,3	1,2	1,2
Potassium K	7,6	7,9	8,0	8,2	8,2
Sodium Na	2,3	2,0	2,0	2,1	2,2
K: Na ratio Odnos K : Na	3,28	3,86	4,0	3,9	3,7
Mg	2,4	2,5	2,5	2,4	2,4
Mn,mg	92,7	98	102	103	107
Zn,mg	43	49,6	49	46	47,5
Cu,mg	8,8	11	10,8	9,6	9,8
Fe,mg	621	647	667	708	713

matter. NCR standards recommend 5,1 g to 5,8 g Ca/kg DM for the production of 20 and 30 kg FCM. It is difficult to determine Ca needs in dairy cows due to complicated homeostatic mechanisms. It is known that the near-partum period, in which the cows in our research were, is the most sensitive one regarding the metabolism of Ca.

Cows consumed from 3,5 to 3,9 g/kg DM of phosphorus which matches the NRC standards (3,3 to 3,7 g) for such production. The ratio of Ca to P in a ration was too close in all months except November, which might have caused fertility disorders (Morrow, 1980).

Cows consumed very small amounts of potassium: 7,6 g and the highest 8,2 g/kg DM, which is less than NRC standards suggest (9 g/kg DM). Rations contained enough sodium. Cows consumed from 2,0 to 2,3 g/kg DM of sodium, which is a bit more than NRC standards advise (1,8 g). A ratio of K to Na is a bit too close.

Cows consumed from 2,4 g to 2,5 g/kg DM of magnesium with rations while NRC standards recommend 2 g/kg DM.

The rations contained too much manganese. The lowest consumed amount was 92,7 mg/kg DM, and the highest 107 mg/kg DM, while NRC standards advise 40 mg/kg DM. Such amounts of manganese might be due to the grass silage on one hand and feed mixtures on the other. The use of manganese does not depend on its concentration in rations (Underwood, 1977) and is nearly equal.

NRC standards suggest that cows need 40 mg/kg DM of zink a day. In our research cows consumed 43 to 50 mg zink with rations. Lamand (1983) recommends that cows ought to consume 75 mg/kg DM with rations, which diminishes the absorbtion of Zn. Cooper and iron have an antagonistic effect on resorption of zink (Underwood, 1977).

Cows consumed 8,8 to 11 mg/kg DM of copper with rations but they should consume 10 mg according to NRC standards. Copper shortage could be the consequence of low content of copper in feed mixtures, antagonistic effects of molybdenum and sulphates and some other alimentary effects in fodder (Mn, Zn). In the present research, cows consumed too much manganese. The shortage of Cu causes some basic metabolic disorders in cells and in haemoglobin synthesis (Table 7).

Rations contained too much iron. Cows consumed from 621 to 713 mg/kg DM of iron, which is 14 times more than NRC standards advise (50 mg/kg DM). Silages conainted a lot of iron, especially the grass one. An animal accepts as much iron as it needs.

Biochemical analysis of serum and haematological diagnosis

Biochemical analysis showed too much a. phosphorus in the autumn (2,07 mmol/l) and spring (2,22 mmol/l) tests in comparison with avarage values (1,74 mmol/l). Other parameters (Ca, K, Na, Mg) were normal, CSB contents were below the average (75 g/l) in autumn (74,2 g/l) and in spring (71,70 g/l). In autumn there were 5,75 mmol/l of urea, and 4,98 mmol/l in spring. In the autumn test 4 cows (40 %) had acetone in traces in blood.

Table 6: Biochemical analysis of serum at autumn and spring test in cows (mmol/l)
Tablica 6. Biokemijske analize seruma u jesen i proljeće testiranih krava (mmol/l)

	Autumn test Jesenji test			Spring test Proljetni test			Difference Razlike		
Serum parameters Sastojci u serumu	n	$\bar{x}$	±SD	n	$\bar{x}$	±SD	$\bar{x}$	±SD	
Ca - Calcium	10	2,52	0,10	10	2,52	0,10	0		
P - Phosphorus	10	2,07	0,45	10	2,22	0,25	-0,15	0,57	NS
K - Potassium	10	4,76	0,30	10	4,97	0,38	-0,21	0,56	NS
Na - Sodium	10	146,70	2,58	10	147,20	1,99	-0,50	2,84	NS
Mg - Magnesium	10	1,09	0,06	10	0,99	0,07	0,10	0,03	p=0,01
Cu,µmol/l	-	-	-	10	15,40	5,70	-	-	-
Fe,µmol/l	-	-	-	10	28,70	6,29	-	-	-
CSB,g/l	10	74,20	7,04	10	71,70	4,64	2,50	7,76	NS
Urea	10	5,75	1,33	10	4,98	1,21	0,77	1,99	NS
Acetone	4	+-	-	-	-	-	-	-	-
	6 neg.	-	-	-	-	-	-	-	

Because of anaemy (table 7), which was diagnosed in the autumn test, we determined Cu and Fe in serum in the spring test. The determined Cu and Fe in serum in the spring test. The determined values were below the average but still normal.

Table 7: Haematological test (n=10)
Tablica 7. Hematološki test (n=10)

Blood parameters Sastojci u krvi	Autumn test Jesenji test		Spring test Proljetni test		Difference Razlike		
	$\bar{x}$	±SD	$\bar{x}$	±SD	$\bar{x}$	±SD	
E,10^{12}/l	6,41	0,92	6,71	0,53	0,30	0,61	NS
Hb,g/l	92,2	8,82	111,20	8,73	19,00	12,3	P = 0,01
Ht,l/l	0,27	0,03	0,32	0,03	0,05	0,03	P = 0,01
MCV,fl	45,20	2,78	48,20	3,82	3,00	5,37	NS
L,10^9/l	7,34	2,41	6,41	1,20	-0,93	3,17	NS

The studied haemotological parameters were below the referred values in the autumn test (Jazbec, 1990). Especially deviated Hb and Ht values. Cows were in the early lactation period when Hb values were the lowest (Treatcher et al., 1976; Susmel et al., 1987). Cows were anaemic.

In the spring test the average content Hb amounted to 111,2 g/l and exceeded the referred values (110 g/l) while other parameters approached the referred ones.

In table 7 values for individual parameters neared the values which were determined for more than 10.000 blood samples of beef cattle in Slovenia by Klinkon-Ogrinc (1992). She established that values for erythrocytes (E), especially for E number, inclined to lower parts of standard values referred to in literature.

CONCLUSION

In our research cows were sufficiently supplied by nutrients, even abundantly. Rations of minerals were not always favourable (Ca : P and K : Na).

Cows were unsufficiently supplied by copper in the autumn but the supply improved later on, which might influence the spring blood test results.

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SAŽETAK

Obrađena je opskrba krava (n = 20) Frizijske pasmine s hranjivim tvarima i mineralima (Ca, P, K, Na, Mg, Zn, Cu, Fe) u zimskoj hranidbi. Izvršena je kemijska analiza svih upotrebljenih krmnih smjesa. Mlijeko je bilo analizirano mjesečno (suha tvar, laktoza, bjelančevine, mast, urea). Na jesen i na proljeće izvršena je analiza krvnog seruma i hematološka dijagnoza (n = 10). Utvrđena je anemija u velikom broju mliječnih krava, odstupanja od referentnih vrijednosti aP i TSP u krvnom serumu i sadržaj ketonskih tijela. Na proljeće nisu ustnaovljene anemične krave, ali odstupanja u sadržaju aP i TSP u krvnom serumu bila su utvrđena.