

THE INFLUENCE OF CORN SILAGE IN DAIRY COWS FEEDING ON CALCIUM, PHOSPHORUS AND MAGNESIUM CONTENTS IN THE BLOOD SERUM

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Abstract: The amount of calcium, phosphorus and magnesium in milking cows' blood was tested and it is one of indicators that cows were fed with these substances. The average amount of calcium, phosphorus and magnesium in blood of milking cows was tested and it is one of indicators that cows were fed with these substances. The average amount of calcium in tested cows' blood is 2.82 mmol/l, the average amount of phosphorus is 1.66 and the average amount of magnesium is 1.29 mmol/l. Cows' were fed by corn silage, alfalfa hay, along with concentrate of standard mineral composition.

Key words: cow, corn silage, calcium, phosphorus, magnesium

Introduction

The amount of these mineral substances in high content of fodder has not been sufficiently tested. Last research results of mineral substance in the fodder show the low level of phosphorus that appears more often than calcium does. The manifestation appears more often during the drought and during some periods that occurs very often at Kosovo and Metohija and where the tests were performed. It should be mentioned the fact that the soil Kosovo and Metohija contains a low level of physiologically active phosphorus (P_2O_5), as *Stojkovic* (2006) established and the low of this element in soil has an adverse effect on the level of this element in plants. It should be mentioned *Stojkovic's* (2009) observation that lots of plants from this area contain the low level of phosphorus. Examinations of the level of calcium, phosphorus and magnesium in cow's blood serum which are fed by different fodder as a source of these elements and standard fodder with mineral would certainly contribute to better knowledge of general status and dynamics

circulation of these elements and their relations in cows' blood serum. They assumed that their level in blood serum is one of the indicators that cows fed with these elements. Contribution is certainly greater since the cows with different lactation were examined.

Material and methods

The experiments were carried out on Simmental cows at the farm. It lasted 45 days during which the blood samples were taken for the mineral analyses. There were 20 cows and five of them were at the beginning of the lactation period with average 25 kg of milk per day (four groups). In the second group there were five cows in the middle of lactation period with average 22.5 kg of milk per day. In the third group there were five cows at the end of lactation period with average 12.6 kg of milk per day and in fifth group were pregnant cows.

They were fed with 4.0 kg of alfalfa hay, 25.0 kg of maize silage, while the food mixture for the milking cows was distributed by groups: cows at the beginning of lactation 5 kg, cows in the middle of lactation 4 kg, and those at the end of lactation and pregnant cows 3 kg. Structure and nutrition value of cow servings are showed in the table 1 and chemical composition, nutritious value and mineral composition in table 2.

Table 1. Composition and nutritious value of ration

Group	Food	kg	D.M. (kg)	NEL MJ	Total protein g)	Total Ca (g)	Total P (g)	Total Mg (g)
I	Hay lucerne	4.0	3.64	1.82	337	41.0	13.8	2.90
	Maize silage	25.0	7.50	7.29	520	127.0	45.3	11.80
	Food mixture	5.0	4.55	5.60	587	75.0	51.9	4.60
	Total	34.0	15.69	14.62	1444	243.0	111	19.00
II	Hay lucerne	4.0	3.64	1.82	335	41.0	13.8	2.95
	Maize Silage	25.0	7.50	7.0	495	130.0	45.3	11.89
	Food mixture	4.0	3.50	4.85	470	61.2	37.6	3.80
	Total	33.0	14.64	13.66	1300	232.2	96.7	18.64
III and IV	Hay Lucerne	4.0	3.64	1.82	337	41.0	13.8	2.90
	Maize silage	25.0	7.50	7.0	495	130.0	45.3	11.70
	Food mixture	3.0	2.66	4.10	380	52.2	28.9	3.15
	Total	32.0	13.80	12.92	1212	224.2	88.0	17.75

The level of calcium, phosphorus and magnesium in cows' blood and food they were fed with is tested. Cows' blood was taken *v. jugularis* and the serum was isolated and tested to these metals.

Table 2. Chemical composition and nutritious value of used foodstuff

Nutrient	Hay lucerne	Maize silage	Food mixture
Moisture (% DM)	9.45	69.00	11.30
Crude ash (% DM)	6.30	3.59	6.50
Crude protein (% DM)	16.80	4.22	12.60
Crude cellulose (% DM)	31.00	7.98	5.87
Crude fat (% DM)	0.89	0.34	3.50
NEF (% DM)	35.34	16.87	55.36
Ca (% DM)	2.86	1.20	1.30
P (% DM)	0.56	1.80	0.85
Mg (% DM)	0.95	1.10	1.12
NEL MJ	0.45	0.28	1.10

Calcium in the samples of fodder was tested by permanganate method. Serum samples were tested by atomic – absorbing methods, the hollow cathode HCL at 442,7 nanometer wave length. Phosphorus in the fodder samples was tested by classical gravimetical methods, measured as $M_{g_2}P_2O_7$ and serum samples by colourmertical methods on photocolourmetre. Magnesium in the fodder samples was tested by gravimetical method as M_gO , and serum on atomic absorber.

Statistical analysis of data is done by Statistica program version 6, StatSoft. Inc. (2003).

Research results and Discussion

The amounts of calcium, phosphorus and magnesium, measured in the experiments, are in table 3 and 4.

The average amount of calcium in cows' blood serum in the experiment is 2.82 mmol/l serum (table 4). That amount was within the normal limits. The amount of calcium in food mixture was sufficient to provide enough calcium in the blood serum (224-242 g).

The average amount of phosphorus for all groups in the experiment is 1.66 mmol/l serum. This result is on the lower level within the normal scale amount on literature data (1.45-2.09 mmol/l). Observing apart the amounts of the content it can be seen that 9 out of 20 cows had amount of phosphorus under the lower limit of normal content. So it can be concluded that there was not enough phosphorus in the foodstuff. Since it was established that there was enough amount of phosphorus in the food mixture, it is possible that other factors influenced to the low amount in

the blood serum among which it should be mentioned first of all the level of usage out of some kind of food mixture.

Based on the mineral elements' analysis, it is concluded that amount of calcium and phosphorus are directly connected to cows' lactation. The group of cows with average daily lactation of 25.0 kg had the lowest amount of calcium and the pregnant cows had the highest amount. The proportion was 2.62 : 3.10 mmol/l serum (table 3).

Table 3. Content of calcium, phosphorus and magnesium in blood serum of investigated cows (mmol/l)

Group	Mineral matters	X	SD	CV, (%)	IV
I	Ca	2.62	0.26	9.10	2.32-3.26
	P	1.32	0.34	13.40	1.20-2.21
	Mg	1.31	0.25	8.20	0.85-1.46
II	Ca	2.91	0.79	10.80	2.41-3.81
	P	1.55	0.60	12.10	1.19-2.60
	Mg	1.30	0.58	9.40	0.80-1.30
III	Ca	2.64	0.35	10.90	2.61-3.90
	P	1.81	0.34	12.70	1.10-2.65
	Mg	1.28	0.40	9.10	0.80-1.35
IV	Ca	3.10	0.30	11.30	2.60-3.50
	P	1.97	0.67	10.20	1.23-2.41
	Mg	1.27	0.54	8.90	0.78-2.54

The amount of magnesium was within the normal limits (1.29 mmol/l) and there were slight changes among groups and among cows. There were no individual changes in the amount of magnesium or changes within the group of cows with different lactation. But groups' average amounts indicated that magnesium is not in the same relations to lactation as calcium and phosphorus are. It means that the cows with the highest lactation had the highest amount of magnesium and vice versa. The difference between the lowest and the highest amount was 9%, in the favor of the highest amount.

Judging by data from the book (*Radovanovic et al., 2000*), *Stojković (2009)*, this amount was 8.66% lower from the average amount of calcium in the previous experiments *Stojković (2001, 2007)*. Based on same data the amount of calcium in the blood serum milking cows can be considerably higher, *Jovanović (2007)* which was the case when high amounts of calcium were added to their servings. There are also cases with extremely low amounts of calcium. As (*Zebeli et al., 2006*) mentioned in his experiments the amount of calcium was just 1.11 mmol/l with the very high amount of phosphorus (5.05 mmol/l) at the same time.

Table 4. The content of calcium, phosphorus and magnesium in the cows' blood serum, average amount for all groups

Element	X	SD	CV, (%)	IV
Ca	2.82	0.42	10.52	2.48-3.61
P	1.66	0.48	12.10	1.18-2.47
Mg	1.29	0.44	8.90	0.80-1.66

The amount of phosphorus changed in the relation to cows' lactation. The group of cows with average daily lactation of 25.00 kg had the lowest amount of phosphorus in the blood serum which was 1.31mmol/l serum (table 3). These amounts were under the lower limits of normal amounts and also insufficient amount for the organism. The amount of phosphorus was increasing in the group of cows with lower lactation. In the group of cows with average daily lactation of 22.50 kg the amount of phosphorus was 1.81mmol/l and that was above lower level of the normal amounts. This amount was even more increased (5.60 mg in 100 ml) with the group of cows with average daily lactation of 12.60 kg and even more (1.97 mmol/l table 3) with the group of pregnant cows.

In the experiment with milking cows (*Adamović et al.*, 2005) established that the of phosphorus in the blood serum in is correlation with lactation which *Stojković* (2001, 2007) results confirmed. The amount of phosphorus in *Stojković's* previous testing was 5% lower than in this. The fact that amount of phosphorus in the blood serum can be above the average (1.45 – 2.09 mmol/l) confirms the experiments of (*Zebeli et al.* 2006) and (*Yang et al.* 2007) where the pregnant heifers had from 2.23 to 2.51 mmol/l phosphorus. The amount of phosphorus was even greater (3.20 – 3.35 mmol/l) in the experiments of *Šefer et al.* (2008).

(*Radovanović et al.* 2000) and *Stojić* (2007) explained that there were slight changes in the amount of magnesium because magnesium doesn't decrease in the soft tissues even when skeleton lost 30% of magnesium. The results of experiments showed certain correlation between the amount of calcium and phosphorus and lactation. The cows with high lactation had lower amounts of these elements and vice versa. This fact was established even when these elements were not examined or showed a deficit. This manifestation was evident in the variations in the amount of phosphorus and little less evident in the amount of calcium while the amount of magnesium behaved differently.

Conclusion

The levels of calcium, magnesium and phosphorus in the blood serum were tested, as one of the indicators that the cows are fed with these elements.

The results of the experiments are:

1. The average amount of calcium in the blood serum is 2.82 mmol/l of serum, of phosphorus is 1.66 mmol/l and magnesium 1.29 mmol/l. The amounts of calcium were on the upper level of normal amounts gotten from books while the amount of phosphorus was almost deficient.

2. The amounts of calcium and phosphorus were decreasing during the period of high lactation while the cows with low lactation had these amounts increased. Calcium varies from 2.64 to 3.10 and phosphorus varies from 1.32 to 1.97 mmol/l of serum.

3. The amounts of magnesium didn't change much in relations to cows' lactation but magnesium behaved differently from calcium and phosphorus.

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Uticaj kukuruzne silaže u obroku krava muzara na sadržaj kalcijuma, fosfora i magnezijuma u krvnom serumu

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Rezime

Ispitivan je sadržaj kalcijuma, fosfora i magnezijuma u krvnom serumu krava, kao jednog od indikatora obezbeđenosti životinja ovim elementima. Prosečan sadržaj kalcijuma u krvnom serumu ispitivanih krava iznosio je 2.82 mmol/l, fosfora 1.66 mmol/l i magnezijuma 1.29 mmol/l seruma. Krave su hranjene kukuruznom silažom, senom lucerke i krmnom smešom za krave muzare.

References

ADAMOVIĆ M., ŠAMANC H., STOJIĆ V., VUJANAC I., GRUIĆ G. (2005): Mineral matter – regulators of rumen contents' electrochemical reactions in dairy cows. *Agricultural News*, no. 3 -4, p. 81-96.

- DAMELLO J. (2000): Farm Animal Metabolism and Nutrition. Critical Reviews. Oxford University Press.
- ČUPIĆ Ž., MIHALJEV Ž., VESELINOVIĆ S., IVANČEV A., (2006): Mineral content in alfalfa samples in Vojvodina. *Modern Agriculture*, vol. 55, no. 3-4, p. 71-74.
- JOVANOVIĆ R. (2007): Domestic animal feed physiology. Megatrend University, Belgrade.
- YANG W.Z., BEAUCHEMIN K.A. (2007): Altering physically effective fiber intake through forage proportion and particle length: digestion and milk production. *J. Dairy Sci.*, 90, 3410/3421.
- MCDONALD P., EDWARDS R.A., GREENHALGH J.F.D. (2002): Animal Nutrition. Person & Prentice Hall, Harlow, England.
- RADOVANOVIĆ T., GUTIĆ M., RAJIČIĆ V., DOSKOVIĆ V. (2000): Wet corn silage feeding systems of dairy cows. *Acta agriculture Serbica*, vol. 5, br. 9, str. 71-79.
- SINOVEC Z., ŠEFER D., JOKIĆ Ž. (2005): The role of minerals in animal health disorders. *Veterinary Bulletin*, vol. 59, no. 1-2, p. 155-165.
- STOJKOVIĆ J., (2001): The content of calcium and phosphorus in blood serum of cows fed on green forage sorghum. *Biotechnology in Animal Husbandry*, Vol 47. (3-4), 113-120.
- SOJKOVIĆ J. (2006): , vol. 22, 651-658.
- STOJKOVIĆ J. (2006): Mineral substances in domestic animal feed. Monograph. Niš.
- STOJKOVIĆ J., JAŠOVIĆ B., RANĐELOVIĆ D. (2007): The amount of some mineral substances in cow blood serum fed with corn silage. *Biotechnology in Animal husbandry* 23 (5-6), p 59-66.
- STOJKOVIĆ J. (2009): The content calcium, phosphorus and magnesium in the blood serum of cows of different milk yield. *Faculty of Agriculture*, vol. 58, no. 1-2, p. 80-85.
- STOJANOVIĆ B., GRUBIĆ G., ĐORĐEVIĆ N., BOŽIČKOVIĆ A., IVEIĆ A. (2008): The alfalfa haylage particle size in complete rations for lactating cows. *Biotechnology in Animal Husbandry*, 24, spec. Issue, 423-433.
- STOJIC V. (2007): *Veterinary Physiology*, Scientific KMD, Beograd.
- STATISTICA, verzion 6, StotSoft. Inc (2003). www.statsoft.com.
- ŠEFER D., SINOVEC Z. (2008): General nutrition. Faculty of Veterinary medicine, Beograd.
- ZEBELI Q., TAJAJ M., STEINGASS H., METZLER B., DROCHNER W. (2006): Effects of physically effective fiber on digestive processes and milk fat content in early lactating dairy cows fed total mixed rations. *J. Dairy Sci.*, 98, 651/668.