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THE CONCENTRATIONS OF MINERAL ELEMENTS IN DIFFERENT CONSERVED FEEDS

KONCENTRACIJE MINERALNIH ELEMENATA U RAZLIČITIM KONZERVIRANIM KRMIVIMA

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SUMMARY

The aim of this study was to determine the concentration of some mineral elements in conserved feeds. In the trial maize corn was treated with high moisture in 3 variants: variant UC (control) without additives, variant A (*Lactobacillus rhamnosus, Lact. plantarum, Lact. brevis, Lact. buchneri, Pediococcus pentosaceus,* 2,5x10 11 CFU.g-1) and variant B (*Enterococcus faecium, Lact. plantarum, Lact. casei, Lact. buchneri, Pediococcus pentosaceus, 150x10^3 CFU.g^{-1}*) with biological additives.

After silage fermentation the highest content Ca was found in the control variant UC (0.483 g.kg^{-1} of DM). The lowest P content (2.976 g.kg^{-1} of DM) was detected in inoculated variant A (with lactic acid bacteria addition). In the Mg content was found the same effect as in Ca and P content. After application of silage additives lower concentration of Mg (0.957 g.kg^{-1} of DM in variant A and 0.970 g.kg^{-1} of DM in variant B) was determined. The Na concentrations were between 0.480 g.kg^{-1} of DM (variant B) and 0.711 g.kg^{-1} of DM (untreated control variant UC), significant differences were found between variants UC and B, as well as between A and B ($P<0.05$). The highest K concentration was found in variant A (conserved by biological inoculant), 4.039 g.kg^{-1} of DM. The concentration of K in experimental variant B was the lowest (3.716 g.kg^{-1} of DM). Differences between experimental variants (A, B) were significant ($P<0.01$).

After application of the silage additives to high moisture corn in silages lower Ca, P, Mg and Na content was determined.

Key words: feed, conservation, mineral elements, concentrations, additives

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INTRODUCTION

Livestock need mineral elements for many functions of metabolism. Minerals are essential for skeletal growth, milk production, and the maintenance of body fluids and enzyme systems. The concentration of many minerals in feeds affect a spectrum of factors (Rayburn, 1997). Forages provide an important source of minerals for ruminants (Underwood, 1981), but also for non-ruminants (Capcarová et al., 2008). The concentration of mineral elements in feeds depends on soil, plant species, maturity status and management factors (Green et al., 1987, Haenlein, 1991). The maturity of forages affects the mineral content in them (Buxton, Fales, 1994). Content and utilization of some minerals from feeds in animal nutrition affect metabolism (Bíro et al., 2008). Many references in the world report, that the limiting factors which influence mineral content in feeds are kinds of feed and stage of maturity. In animal nutrition absorption of mineral elements is very important, too. Values of true absorption of minerals are used to establish mineral requirements of livestock because the degree of absorption greatly affects the amount available for metabolism. From this area have been reported in the world many studies (Martz et al., 1999).

MATERIAL AND METHODS

In the experiment high moisture corn obtained from University agricultural farm in Kolíňany (Slovak republic) was conserved. Harvested corn grain (grain hybrid *Latizana*) was immediately mechanically processed by the masher MURSKA 1000 HD with the dry matter content 609.6 – 613.3 $g.kg^{-1}$. The experiment was composed of 3 variants. Variant UC was ensiled without additives. Corn grain in other variants was ensiled with microbial inoculants (variant A and B). All the variants were hermetically closed into silos of the volume of 50 dm^3. Additive used in variant A consisted of homo- and heterofermentative lactic acid bacteria (*Lactobacillus rhamnosus*, *Lactobacillus plantarum*, *Lactobacillus brevis*, *Lactobacillus buchneri* and *Pediococcus pentosaceus*: 2,5 x 10^{11} $CFU.g^{-1}$). In variant B additive compound of 5 lactic acid bacteria species (*Enterococcus faecium*, *Lactobacillus plantarum*, *Lactobacillus casei*, *Lactobacillus buchneri* and *Pediococcus pentosaceus*: 150 x 10^3 $CFU.g^{-1}$) was applied. Inoculants used in variants were in powder form. After stuffing the matter into silos it was sealed and stored in the Laboratory of conserved feeds at temperature 18-20°C. After termination of the fermentation process (6 months of storing) the silos was opened and in average laboratory samples the parameters of nutritive value and fermentation process were determined. For anorganic nutrients analysing standard methods were used according to Regulation of the Ministry of Agriculture of the Slovak Republic no. 2145/ 2004-100 on sampling of feeds and laboratory testing and evaluation of feeds and methods by AOAC (2000). In laboratory conditions the average samples were analyzed on concentration of calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), and potassium (K). Flame atomic absorption spectrometry, by analyzer AVANTA (GBC) was used.

Statistic significance of determined differences was tested by single-factor analysis of variance (ANOVA).

RESULTS AND DISCUSSION

The contents of minerals in fresh high moisture corn are showed in table 1. The content of dry matter in corn grain with high moisture was from 609.6 $g.kg^{-1}$ to 613.3 $g.kg^{-1}$. The highest Ca content was detected in variant UC (0.421 $g.kg^{-1}$ of dry matter), which was conserved without additives. Rayburn (1997) found a different Ca content in his study, due his work on dry matter of corn grain averaging 0,2-0.3 % of Ca. Animals need P for skeletal growth and for energy metabolism. The P content is similar in different forage types. The P content was settled before conservation, it ranged from 3.124 (variant B) to 3.417 $g.kg^{-1}$ of dry matter (variant A). By the detected P content the results of Rayburn (1997), partially also Petrikovič et al. (2000) were confirmed. In contents of other minerals we several differences (table 2) are determined.

Table 1. Mineral elements content in high moisture corn before ensiling
Tablica 1. Mineralni sastav u vlažmom kukuruzu prije siliranja

Variant	DM	Ca	P	Mg	Na	K
	g.kg^{-1}	g.kg^{-1} of DM				
UC	613.3	0.421	3.166	1.484	0.669	4.460
A	609.6	0.411	3.417	1.571	0.444	4.438
B	610.7	0.350	3.124	1.398	0.446	3.793

* DM: dry matter, Ca: calcium, P: phosphorus, Mg: magnesium, Na: natrium, K: potassium

Mineral nutrients content in ensiled high moisture corn is showed in table 2. After termination of the fermentation process the highest concentration of Ca was found in variant UC, which was conserved without additives. This confirmed the results of Mohamadou et al. (2008), who detected lower Ca content due to effect of bacteria species *Bacillus* and lactic acid. In P content the same effect of conservation additives as in Ca content was determined. P content lower in comparison with the control variant were in variants with added inoculants. Detected differences were not statisticaly significant (P>0.05). Determined concentrations of P (as well as Ca) partially correspond with results published by Petrikovič et al. (2000). The highest Mg content was found again in the cotnrol variant. In variants conserved by biological inoculants (A, B), lower content of Mg (0.957 g.kg^{-1} of dry matter in variant A, 0.970 g.kg^{-1} of dry matter in variant B) was determined. Almost identical concentrations of Mg in conserved corn grain were also detected by Rayburn (1997). Na content in feeds and feed rations limits tenability of acido-base balance. Animals need Na for glucose and amino acid transport, for maintaining body fluids, and acido-base balance (Rayburn, 1997). Na contents were in variants with applied inoculants higher in variant A (0.699 g.kg^{-1} of dry matter), while the differences were statisticaly significant (P<0.05) in comparison with variant B. But both variants conserved by biological additives were characterized by lower Mg content in comparison with the control variant. Many reports on the importance of K in animal nutrition, its content in feeds and possible correlation between its content and crude protein content have been in the world published (e.g. Kume et al., 2001, Kume et al. 2004). The K content ranged in conserved high moisture corn grain from 3.716 (variant B) to 4.039 g.kg^{-1} (variant A) of dry matter. Conserved high moisture corn grain of variant A was characterized by higher K content. We confirmed the results of Oboh and Elusiyan (2007) only partially, while we also detected increase of K due to bacterial fermentation, but without statistical significance. We detected significant differences only between variants conserved by biological inoculants.

Tablica 2. Mineralni sastav u siliranom vlažnom kukuruzu konzerviranom različitim aditivima
Table 2. Mineral elements content in ensiled high moisture crimped corn conserved by different additives

	Ca			P			Mg			Na			K		
	g.kg^{-1} of dry matter														
	$\bar{x}$	s	v	$\bar{x}$	s	v	$\bar{x}$	s	v	$\bar{x}$	s	v	$\bar{x}$	s	v
UC	0.483	0.076	15.802	3.033	0.252	8.297	1.011	0.042	4.116	0.711^{a}	0.055	7.752	3.874	0.126	3.250
A	0.417	0.015	3.666	2.967	0.208	7.017	0.957	0.047	4.940	0.699^{b}	0.050	7.078	4.039^{a}	0.066	1.627
B	0.36	0.046	12.729	2.973	0.208	7.009	0.970	0.083	8.523	0.480^{ab}	0.070	14.469	3.716^{a}	0.081	2.180

*Ca: calcium, P: phosphorus, Mg: magnesium, Na: natrium, K: potassium, $\bar{x}$ **:** arithmetic mean, s: standard error, v: variance

The values with identical superscript are significant at the level α= 0.05

CONCLUSIONS

In the experiment were some minerla contents determined in moisture corn grain conserved by different bacterial additives. Following the estimations done it was found that moisture corn grain was characterized by different minerals content before and after the conservation. Application of additives did not affect significantly several minerals content. Significant effect was detected only in the Na content and partially in the K content.

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SAŽETAK

Cilj ovog rada bio je odrediti koncentraciju nekih mineralnih elemenata u konzerviranim krmivima. U pokusu smo konzervirali kukuruz visokog sadržaja vlage u 3 varijante: varijanta UC (kontrola) bez aditiva, varijanta A (*Lactobacillus rhamnosus, Lact. plantarum, Lact. brevis, Lact. buchneri,*

Pediococcus pentosaceus, 2,5x10 11 CFU.g^{-1}) i varijanta B (*Enterococcus faecium, Lact. plantarum, Lact. casei, Lact. buchneri, Pediococcus pentosaceus*, 150x103 CFU.g^{-1}) s dodatkom bioloških aditiva.

Nakon fermentacije silaže otkrili smo najviši saržaj Ca u kontrolnoj varijanti UC (0.483 g.kg^{-1} DM). Najniži sadržaj P (2.976 g.kg^{-1} DM) otkrili smo u cijepljenoj varijanti A (s dodatkom bakterija mliječne kiseline).

U sadržaju Mg našli smo isto djelovanje kao i u sadržaju Ca i P. Nakon primjene aditiva u silaži ustanovili smo nižu koncentraciju Mg (0.957 g.kg^{-1} DM u varijanti A i 0.970 g.kg.1 DM u varijanti B) Koncentracije Na bile su između 0.480 g.kg-1 DM (varijanta B) i 0.711 g.kg^{-1} DM (netretirana kontrolna varijanta UC), a značajne smo razlike našli između varijanata UC i B kao i između A i B ($P<0.05$). Najvišu koncentraciju sadržaja K našli smo u varijanti A (konzervirana biološkim cjepivom), 4.039 g.kg^{-1} DM. Koncentracija K u drugoj pokusnoj varijanti B bila je najniža (3.716g.kg^{-1} DM). Razlike između pokusnih varijanata (A, B) bile su značajne ($P<0.01$). Nakon primjene aditiva u silaži kukuruza velike vlažnosti utvrdili smo niži sadržaj Ca, P, Mg i Na.

Ključne riječi: krmivo, konzerviranje, mineralni elementi koncentracije, aditivi

narudžbenica

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