ECOLOGICAL CHEMISTRY AND ENGINEERING A

Vol. 17, No. 10 2010

Adam RADKOWSKI[1] and Iwona RADKOWSKA[2]

QUALITY AND NUTRITIONAL VALUE OF SILAGES MADE FROM GRASSES DERIVED FROM THE FARMS LOCATED IN THE REGION OF KRAKOW-CZESTOCHOWA JURA PART II. CONTENT OF MACROELEMENTS

JAKOŚĆ I WARTOŚĆ POKARMOWA KISZONEK SPORZĄDZONYCH Z TRAW POCHODZĄCYCH Z GOSPODARSTW POŁOŻONYCH NA TERENIE JURY KRAKOWSKO-CZĘSTOCHOWSKIEJ CZ. II. ZAWARTOŚĆ MAKROELEMENTÓW

Abstract: This paper presents an estimation of the mineral composition of silages derived from farms specialized in milk production from the region of Krakow-Czestochowa Jura. The samples of silages, four from each farm, were collected for the chemical analysis before grazing. The phosphorus and magnesium content was estimated by the colorimetric, vanadium-molybdenic method, whereas the potassium, sodium and calcium content using flame photometry.

Silages from all investigated farms did not reach the optimal P, Ca and Na content, which indicates too low a level of phosphorous fertilization as well as limited liming of grasslands located in the investigated farms. On the other hand, an excessive amount of potassium results from fertilization with liquid manure, leading to the accumulation of this element, which is calcium and magnesium antagonist.

Proportions between mineral component content in the examined silages were diversified. Only 42 % of samples had Ca:Mg weight ratio and K: (Ca + Mg) ionic ratio at the optimal level and 33 % of silage trials were characterised with the optimal K:Mg ratio. The other proportions, especially K:Ca and K:Na, were unfavourably too high.

Keywords: silages, macroelement content, antagonism of elements

Among all chemical components of silages derived from grasslands not only organic compounds but also macroelements play an important role in animal feeding [1, 2]. 80–85 % of the total phosphorus content of animal organisms occurres in blood and

[1] Department of Grassland, Agricultural University of Krakow, al. A. Mickiewicza 21, 31–120 Kraków, Poland, phone: 012 662 43 61, fax 012 633 62 45, email: rrradkow@cyf-kr.edu.pl

[2] National Research Institute of Animal Production Balice, ul. Krakowska 1, 32–083 Balice, Poland, phone: 666 08 11 49, email: iradkowska@izoo.krakow.pl

bones. Deficiency of this element has a negative effect on the appetite, animal growth, process of ossification, intensity of metabolism and animal reproduction. Potassium can lower the level of magnesium and calcium, what can lead to grass tetany occurrence in animals. Calcium in animal organisms can be found in bones, which contain about 98 % of its whole content. Magnesium deficiency induces response from the nervous system, convulsions and tetany. On the other hand, sodium deficiency affects perturbations of water balance, blood pressure drop, excessive licking behavior, hematuria, muscle tremors and fertility disturbances [3, 4].

The aim of the present paper was an estimation of the mineral composition of silages from farms specialized in milk production in the region of Krakow-Czestochowa Jura, situated in the southern part of Poland.

Material and methods

The research was conducted under production conditions in 12 farms specialized in milk production in the region of Krakow-Czestochowa Jura.

The examined silages were derived mostly from the first swath of grass flora, less frequently from the second and third swath. The material was harvested in two stages, first the green fodder was mown at the turn of stages of heading and flowering of grasses (silages from the first swath) with a rotational mower and then the fodder was shortly dried by single teding. The material was raked 30 minutes before collection. Harvesting was done with a constant chamber baler and the bales formed were transported to the storage place, where they were wrapped using the wrapping machine. Average time from the bale forming to the protection with plastic wrapping never exceeded 4 hours.

Before feeding samples of silages were collected (4 from each farm) for chemical analysis, which comprise: the phosphorus and magnesium content estimated by the colorimetric, vanadium-molybdenic method as well as the potassium, sodium and calcium content using the flame photometry method.

Presentation of the results was limited to the average values from all investigated years. The results obtained were subjected to the analysis of variance and significance of differences was estimated by the Duncan test at the significance level of $\alpha = 0.05$.

Results and discussion

The content of mineral components in the examined silages was diversified. The weighted mean macroelement content fluctuated in the range of: 1.39–2.68 g P; 24.84–68.38 g K; 3.03–6.26 g Ca, 1.42–3.16 g Mg; 0.35–0.88 g Na · kg^{-1} d.m. (Table 1). However, forage of high quality should contain at least 3.0 g P; 17–20 g K; 7.0 g Ca; 2.0 g Mg i 1.5–2.5 g Na · kg^{-1} d.m. [1, 5]. In the conducted study the potassium content in silages from all farms reached desired values, whereas the magnesium content was at the satisfactory level in 58 % of all samples. On the other hand, phosphorus, calcium and sodium amounts were below the optimal level.

Table 1

Weighted mean of macroelement content and ionic proportions in silages

Item	Investigated farm											
	1	2	3	4	5	6	7	8	9	10	11	12
	[g · kg^{-1} d.m.]											
P content [g · kg^{-1} d.m.]	1.39 a*	2.24 b	2.68 c	2.53 c	1.87 ab	2.16 b	2.57 c	2.21 b	2.37 bc	1.79 ab	1.47 a	2.14 b
K content [g · kg^{-1} d.m.]	39.99 ab	25.93 a	68.38 c	28.28 a	46.68 b	24.84 a	51.73 bc	29.14 a	34.34 ab	30.92 a	44.82 b	30.83 a
Ca content [g · kg^{-1} d.m.]	4.32 b	3.25 a	6.26 c	3.03 a	3.35 a	3.66 ab	3.57 ab	3.18 a	3.89 ab	3.70 ab	4.89 b	3.50 ab
Mg content [g · kg^{-1} d.m.]	1.64 a	1.70 a	2.96 b	1.42 a	1.64 a	2.36 ab	2.14 ab	1.86 a	2.29 ab	3.16 b	2.97 b	2.22 ab
Na content [g · kg^{-1} d.m.]	0.44 a	0.46 a	0.88 b	0.46 a	0.35 a	0.80 b	0.42 a	0.40 a	0.58 ab	0.79 b	0.58 ab	0.47 a
Ca:Mg	2.63 c	1.91 bc	2.11 c	2.13 c	2.04 c	1.55 b	1.67 b	1.71 b	1.70 b	1.17 a	1.65 b	1.58 b
K:Mg	7.63 b	4.77 a	7.23 b	6.23 ab	8.91 c	3.29 a	7.57 b	4.90 a	4.69 a	3.06 a	4.72 a	4.35 a
K:Ca	4.74 ab	4.09 a	5.60 b	4.78 ab	7.14 c	3.48 a	7.43 c	4.70 ab	4.52 a	4.28 a	4.70 ab	4.51 a
K:(Ca + Mg)	2.92 b	2.19 a	3.14 b	2.70 b	3.95 c	1.68 a	3.73 c	2.39 a	2.29 a	1.78 a	2.35 a	2.21 a
K:Na	53.44 bc	33.14 ab	45.69 b	36.15 ab	78.42 c	18.26 a	72.42 c	42.83 b	34.81 ab	23.01 a	45.44 b	38.57 ab

* Means marked with the same letter are not statistically different following verification with Duncan test ($p = 0.05$).

Quantitative weight or ionic ratios between elements are crucial to the estimation of forage quality [6]. The Ca:Mg weight ratio, which should amount to 2–3:1, was on an appriopriate level only in the case of 42 % of samples. About 33 % of silage samples had optimal K:Mg weight proportions (close to 6–8:1) as opposed to other trials, which were characterised by its unproper range. The 2:1 K:Ca weight ratio is assumed as optimal, in our research it was always very high. The K:(Ca + Mg) ionic proportions in good forage derived from grasslands should range between 1.6–2.2:1 [7]. It was stated that 42 % of samples fulfilled these requirements. The K:Na weight ratio in high quality fodder should amount to 5–7:1 [7]. In the examined forage its range was too wide, from 4 to 11 times higher than the optimal value. Serious sodium deficiency in silages was the major reason of poor forage quality.

The fact of a low content of mineral components in analysed silages can be due to unproper fertilization of the grassslands in examined farms. Low phosphorus and calcium fertilization was determined, which indicates application of liquid manure, which is an excessive product in such farms. Under high treatment with this fertilizer higher yield is achieved but on the other hand the effect of component dilution ocurres. This phenomenon is accompanied by the changes in nutrient availability due to strong acidification of soil and is manifested by the lower level of basic cations, especially Ca and Mg in plants [5]. As a result most of the investigated silages were characterised with unfavourable weight and ionic proportions.

Complementation of macroelement deficiency, especially P, Ca and Na, with mineral formulas in the diet of ruminents is highly recommended in examined farms [8].

Conclusions

1. Silages from all of the investigated farms did not reach the optimal P, Ca, Na content, which indicates too low a level of phosphorous fertilization as well as limited liming of the grasslands located in the investigated farms.

2. An excessive level of potassium indicates that grasslands were fertilized with liquid manure. As a result there occurred accumulation of this element which is calcium and magnesium antagonist.

3. The Ca:Mg weight ratio and the K:(Ca + Mg) ionic ratio in 42 % of samples as well as the K:Mg weight proportion in 33 % of samples reached the optimal level. Other proportions between elements were characterised by unfavourable values.

References

[1] Falkowski M., Kukułka I. and Kozłowski S.: *Właściwości chemiczne roślin łąkowych.* Wyd. AR Poznań, Poznań 2000, 132 p.
[2] Underwood S.J.: *Żywienie mineralne zwierząt*. PWRiL, Warszawa 1971, 319 p.
[3] Korzeniowski A.: *Intensyfikacja użytków zielonych a zaburzenia przemiany mineralnej u bydła*. Biul. Inform. Inst. Zoot. 1969, **5**, 54, 15–32.
[4] Ewy Z.: *Zarys fizjologii zwierząt*. PWN, Warszawa 1983, 384–388.
[5] Czuba R. and Mazur T.: *Wpływ nawożenia na jakość plonów*. PWN, Warszawa 1988, 360 p.

[6] Antonkiewicz J.: *Ocena składu mineralnego pasz z runi łąkowej i pastwiskowej pozyskiwanych w przeciętnych warunkach gospodarowania*. XV Szkoła Zimowa nt. Produkcja mleka i wołowiny a zdrowie człowieka. Kraków–Zakopane 2007, 271–282.
[7] Gorlach E., Curyło T. and Grzywnowicz I.: *Zmiany składu mineralnego runi łąkowej w warunkach wieloletniego zróżnicowanego nawożenia mineralnego*. Roczn. Glebozn. 1985, **36**(2), 85–99.
[8] Gabryszuk M.: *Niedobory wapnia i magnezu w żywieniu przeżuwaczy oraz możliwość ich uzupełnienia przez stosowanie dolomitu*. Przegl. Hodowl. 1988, **17–18**, 19–20.

JAKOŚĆ I WARTOŚĆ POKARMOWA KISZONEK SPORZĄDZONYCH Z TRAW POCHODZĄCYCH Z GOSPODARSTW POŁOŻONYCH NA TERENIE JURY KRAKOWSKO-CZĘSTOCHOWSKIEJ CZ. II. ZAWARTOŚĆ MAKROELEMENTÓW

[1] Katedra Łąkarstwa
Uniwersytet Rolniczy im. Hugona Kołłątaja w Krakowie
[2] Instytut Zootechniki – Państwowy Instytut Badawczy w Balicach

Abstrakt: Praca prezentuje ocenę składu mineralnego kiszonek z gospodarstw specjalizujących się w produkcji mleka z terenu Jury Krakowsko-Częstochowskiej. Przed skarmianiem z kiszonek pobrano próbki (po 4 z każdego gospodarstwa) do analizy chemicznej. Zawartość fosforu i magnezu oznaczono kolorymetrycznie metodą wanadowo-molibdenową, potasu, sodu i wapnia metodą fotometrii płomieniowej.

Kiszonki ze wszystkich gospodarstw nie miały optymalnej zawartości P, Ca, Na, wskazuje to na zbyt niskie nawożenie fosforem i ograniczenie wapnowania użytków zielonych w badanych gospodarstwach. Z kolei zbyt wysoka zawartość potasu wskazuje na nawożenie użytków zielonych gnojowicą. W wyniku tego nawożenia następuje kumulacja potasu, który jest antagonistą wapnia i magnezu.

Wartość stosunków ilościowych między pierwiastkami w kiszonkach była zróżnicowana. Jedynie stosunek masowy Ca:Mg i jonowy K:(Ca + Mg) w 42 % próbek oraz stosunek masowy K:Mg w 33 % próbek kiszonek miał wartość optymalną. Pozostałe stosunki, szczególnie K:Ca i K:Na odznaczały się niekorzystnymi wartościami – zbyt wysokimi.

Słowa kluczowe: kiszonki, zawartość makroelementów, antagonizm pierwiastków