

THE AMOUNT OF MAJOR ELEMENTS IN HAY

SADRŽAJ MAKROELEMENATA U SIJENU

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Scientific review - Pregledno znanstveni članak
UDC - UDK: 636.12.532.
Received - Primljeno: 18 may - svibnja 1999.

SUMMARY

The results obtained by sixteen authors on the amounts of calcium, phosphorus, magnesium, potassium and sodium in hay, which were published in the last years, were collected. The first cut contained in a kg of dry matter on average 6.94 g Ca (n=723), 2.66 g P (n=724), 2.58g Mg (n=665), 18.64 g K (n=572) and 0.56 g Na (n=801). The second cut contained in a kg of dry matter on average 7.39g Ca (n=246), 3.13 g P (n=246), 3.08 g Mg (n=223), 19.01g K (n=229) and 0.92 g Na (n=261). The samples for which the successive cut was not known contained in a kg of dry matter on average 6.07 g Ca (n=439), 2.64 g P (n=440), 2.08 g Mg (n=132), 17.75 g K (n=166) and 0.80g Na (n=166). The samples ought to be better defined. We think that the samples exchange among laboratories should be obligatory.

1. INTRODUCTION

Hay is the best fodder for as various animals as calves, cows, horses, sheep, goats, deer, roe. Modern technologies of drying and systems for drying under roof enable the production of best quality hay, an important supplement to element supply.

It could be augured that more and more farmers will decide for sustainable farming. The importance of quality hay will increase. Sustainable production means economical supply of elements, which is nature and animal friendly. Hence data on the content of elements in the first and second cut are appreciated.

2. MATERIAL AND METHODS

The results published for the period of the last ten years are presented. The samples are not

described well therefore a sample from the second cut could be found among samples from the first cut. We could not on the basis of a sample when it was produced, we only know when it was brought for analysis. Not to mention detailed data on the sample and place of production.

3. RESULTS AND DISCUSSION

All elements are quoted in g kg⁻¹ of dry matter.

Calcium

Animals need a lot of calcium. Tables 1 and 2 show the calcium content in samples of first and second cut.

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Table 1. Calcium content in the first cut, g kg⁻¹ DM**Tablica 1. Sadržaj kalcija u prvoj kosidbi, g kg⁻¹ ST**

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
401	7.53		37.8 ^{x)} 23.3 ^{xx)}	1971-1981	Stekar et al., 1982
65	5.58		34.63	1984	Pen et al., 1986
101	5.20		21.77	1985	Pen et al., 1986
38	8.25	3.25		1985	Stekar and Golob, 1986
61	5.40		25.28	1986	Pen et al., 1987
31	7.80	2.43		1986	Stekar et al., 1987
35	7.50		44.50	1987	Stekar et al., 1988
18	6.46	1.23	19.07	1988	Stekar et al., 1989
13	5.71	1.20	21.00	1989	Stekar et al., 1990
10	5.56	1.31	23.60	1990	Stekar et al., 1991
1	3.19			1993	Rajčević and Jazbec, 1994
1	4.72			1994	Rajčević et al., 1995a
4	6.36	1.28	20.10	1994 ^{*)}	Rajčević et al., 1995b
9	4.78	1.50		1994	Agricultural Institute of Slovenia
	7.30				Kellner and Becker, 1971

x) inside years – unutar godina

xx) among years – među godinama

*) produced in 1993 – proizvedeno 1993.

Table 2. Calcium content in the second cut, g. kg⁻¹ DM**Tablica 2. Sadržaj kalcija u drugoj kosidbi, g kg⁻¹ ST**

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
83	7.60		5.1 ^{x)} 10.3 ^{xx)}	1971-1981	Stekar et al., 1982
22	7.18		23.33	1984	Pen et al., 1985
60	6.63		27.67	1985	Pen et al., 1986
21	7.76	1.99		1985 [*]	Stekar and Golob, 1986
19	8.47	3.26		1986 [*]	Stekar et al., 1987
29	7.31		24.81	1986	Pen et al., 1987
12	8.60		43.80	1987 [*]	Stekar et al., 1988
9	7.35	1.92	26.16	1988	Stekar et al., 1989
10	6.06	1.45	23.80	1989	Stekar et al., 1990
3	7.55	2.99		1994	Agricultural Institute of Slovenia
	9.90				Kellner and Becker, 1971

x) inside years - unutar godina

xx) among years - među godinama

*) the second and the third cut - druga i treća kosidba

Mean values of calcium in the first cut differed significantly. Kellner and Becker, 1971 reported values between 5.6 g and 10.7 g Ca kg⁻¹ DM. Regarding these values some of our samples contained little calcium. It might be an earlier cutting that contains more grass since the green parts of grass contain less calcium in spring (Golob, 1971). The second cut contains more calcium. Kellner and Becker 1971 reported between 5.6 g and 10.78 g Ca for the first cut and between 7.8 g and 13.3 g Ca for the second cut, hence some of our second cut samples contain little calcium.

Pen and Kapun, 1997 reported that hay contained 6,00 g Ca in samples cut between 1990 and 1996 (n=402), which is not a lot. The Agricultural Institute of Slovenia found in samples, for which data on the cutting were not available, the mean value of 7.07 g Ca (SD = 2.10, n = 25) in 1997, 7.24 g (SD = 2.26, n = 4) in 1995 and 6.15 g (SD = 2.21, n = 8) in 1996.

The calcium content in hay is affected by precipitation (Stekar et al., 1982). It has been known (Henning, 1972, McDonald et al., 1998) that calcium is deposited in plants especially in dry

periods, thus there is less calcium in plants when the soil is wet.

Phosphorus

We know that soil does not contain enough phosphorus in Slovenia. Nevertheless, the analyzed samples contained enough. It is supposed that farmers who had their hay analyzed used enough fertilizers. In spite of that first cut samples contained little phosphorus. Kellner and Becker, 1971 reported that the first cut contained between 2.8 g and 4.4 g P and the second cut between 2.6 g and 4,6 g P. Our hay might contain less legumes and herb that but contain more phosphorus than grass. We should mention that plants contain more phosphorus when there is a lot of rain.

The data on the phosphorus content when the sequence of cuttings is not known are as follows: Pen and Kapun 1997, 1990 - 1996 (n= 403) 2.61 g P, which is not a lot, Agricultural Institute of Slovenia for 1994 3.17 g (SD = 0.79, n = 25), 1995 3.75 g (SD = 0.84, n = 4) and for 1996 2.06 g (SD = 0.70, n = 8).

Table 3. Phosphorus content in the first cut, g kg⁻¹ DM

Tablica 3. Sadržaj fosfora u prvoj kosidbi, g kg⁻¹ ST

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
401	2.60		12.6 ^{x)} 8.0 ^{xx)}	1971-1981	Stekar et al., 1982
65	2.14		23.72	1984	Pen et al., 1985
101	2.44		21.39	1985	Pen et al., 1986
38	2.81	1.05		1985	Stekar and Golob, 1986
61	2.47		28.23	1986	Pen et al., 1988
31	3.27	0.74		1986	Stekar et al., 1987
35	2.90		27.60	1987	Stekar et al., 1988
19	3.25	2.01	61.86	1988	Stekar et al., 1989
13	3.24	0.48	14.70	1989	Stekar et al., 1990
10	2.76	0.70	25.30	1990	Stekar et al., 1991
1	3.59			1993	Rajčević and Jazbec, 1994
1	4.04			1994	Rajčević et al., 1995
4	3.45	0.14	4.04	1994 ^{y)}	Rajčević et al., 1995b
9	2.93	0.66		1994	Agricultural Institute of Slovenia
	3.30				Kellner and Becker, 1971

^{x)} inside years - unutar godina

^{xx)} among years - među godinama

^{y)} produced in 1993 - proizvedeno u 1993.

Table 4. Phosphorus content in the aftergrass, g kg⁻¹ DM**Tablica 4. Sadržaj fosfora u kasnijoj kosidbi, g kg⁻¹ ST**

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
83	3.30		27.4 ^{x)} 12.6 ^{xx)}	1971-1981	Stekar et al., 1982
22	2.62		20.38	1984	Pen et al., 1985
60	2.74		18.42	1985	Pen et al., 1986
21	3.32	0.77		1985*	Stekar and Golob, 1986
19	3.16	0.69		1986*	Stekar et al., 1987
29	2.97		19.65	1986	Pen et al., 1987
12	3.20		31.00	1987*	Stekar et al., 1988
9	3.82	1.34	35.18	1988	Stekar et al., 1989
10	3.26	0.56	17.20	1989	Stekar et al., 1990
3	3.22	0.98		1994	Agricultural Institute of Slovenia
	3.30				Kellner and Becker, 1971

x) inside years - unutar godina

xx) among years - među godinama

*) the second and the third cut - druga i treća kosidba

Table 5. Magnesium content in the first cut, g kg⁻¹ DM**Tablica 5. Sadržaj magnezija u prvoj kosidbi, g kg⁻¹ ST**

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
401	2.60		12.6 ^{x)} 8.0 ^{xx)}	1971-1981	Stekar et al., 1982
65	2.08		27.65	1984	Pen et al., 1985
96	2.22		21.80	1985	Pen et al., 1986
38	2.36	1.17		1985	Stekar and Golob 1986
22	1.03		53.52	1986	Pen et al., 1987
31	3.35	0.96		1986	Stekar et al., 1987
35	3.30		48.60	1987	Stekar et al., 1988
17	3.17	0.82	25.95	1988	Stekar et al., 1989
13	3.07	0.65	21.20	1989	Stekar et al., 1990
10	2.74	0.52	18.80	1990	Stekar et al., 1991
1	2.37			1993	Rajčević and Jazbec, 1994
1	3.24			1994	Rajčević et al., 1995a
	2.00				Kellner and Becker, 1971

x) inside years - unutar godina

xx) among years - među godinama

Table 6. Magnesium content in the second cut, g kg⁻¹ DM

Tablica 6. Sadržaj magnezija u drugoj kosidbi, g kg⁻¹ ST

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
63	2.89		32.4 ^{x)} 12.2 ^{xx)}	1971-1981	Stekar et al., 1982
60	2.79		22.07	1985	Pen et al., 1986
21	3.02	0.60		1985	Stekar and Golob, 1986
19	3.71	0.82		1986 [†]	Stekar et al., 1987
29	2.89		23.30	1986	Pen et al., 1987
12	4.00		34.10	1987 [†]	Stekar et al., 1988
9	4.54	1.63	35.97	1988	Stekar et al., 1989
10	3.15	0.61	19.40	1989	Stekar et al., 1990
	2.70				Kellner and Becker, 1971

^{x)} inside years - unutar godina

^{xx)} among years - među godinama

^{†)} the second and the third cut - druga i treća kosidba

Table 7. Potassium content in the first cut, g kg⁻¹ DM

Tablica 7. Sadržaj kalija u prvoj kosidbi, g kg⁻¹ ST

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
261	17.76		4.7 ^{x)} 21.2 ^{xx)}	1971-1981	Stekar et al., 1982
65	17.43		22.63	1984	Pen et al., 1985
96	16.61		32.32	1985	Pen et al., 1986
38	23.50	9.92		1985	Stekar and Golob, 1986
61	17.85		33.54	1986	Pen et al., 1987
31	25.11	7.80		1986	Stekar et al., 1987
35	21.40		33.40	1987	Stekar et al., 1988
16	19.06	5.02	26.36	1988	Stekar et al., 1989
13	18.25	5.71	31.30	1989	Stekar et al., 1990
10	18.20	3.35	18.50	1990	Stekar et al., 1991
1	24.06			1993 ^{†)}	Rajčević and Jazbec, 1994
1	14.30			1994 ^{†)}	Rajčević et al., 1995a
9	17.97	4.00		1994	Agricultural Institute of Slovenia
	16.70				Kellner and Becker, 1971

^{x)} inside years - unutar godina

^{xx)} among years - među godinama

^{†)} produced in 1993 - proizvedeno u 1993.

Magnesium

The magnesium content in hay has been less investigated than the calcium and phosphorus content. Tables 5 and 6 show that first and second cut contain enough magnesium, only one average value exceeds. It should be mentioned that Stekar et al., 1991 argued that the median showed the whole better than the mean value. We ought to say that Babnik et al., 1996 found out that herb contained more magnesium than legumes and more than grass, which is in accordance with Kirchgessner's report, 1980. Kellner and Becker, 1971 found between 1.2 g and 2.9 g Mg in the first cut and between 1.8 g and 3.9 g mg in the second cut.

Potassium

It is known that animals get enough potassium because plants contain a lot of it. Nevertheless, it is important to determine the potassium due to the ratio of potassium to sodium. Tables 7 and 8 show the values determine by various authors.

Two mean values exceed in Table 7 and in Table 8. It is not a mistake as both laboratories (Agricultural Institute of Slovenia and Chemical Laboratory of Institute for Nutrition, BF) are included

in the international exchange of samples and their results of analyses are within the limits. For the last few years samples have been exchanged among laboratories in Slovenia on voluntary basis. We are of the opinion that samples should be exchanged among laboratories and if a laboratory fails to determine a certain sample should settle it. It is still more important not to have a data than to have a wrong one. Today laboratories cover the exchange expenses themselves even though they are considerable.

Kellner and Becker, 1971 reported that the first cut contained between 11.1 and the second cut between 10.1 g and 26.5 g.

Slovene non-defined samples contained the following amounts of potassium: Pen and Kapun, 1997 reported 17.6 g (n = 146) for the period between 1990 and 1996, AIS 18.45 g (SD = 6.41, n = 15) for 1994, 23.06 g (SD = 8.07, n = 3) for 1995 and 15.32 g (n = 2) for 1996.

Sodium

Plants contain little sodium. Tables 9 and 10 show the values that were determined in Slovene samples of the first and second cut.

Table 8. Potassium content in the second cut, g. kg⁻¹ DM

Tablica 8. Sadržaj kalija u drugoj kosidbi, g kg⁻¹ ST

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
66	18.52		18.31 ^{x)} 14.6 ^{xx)}	1971-1981	Stekar et al., 1982
22	16.61		38.02	1984	Pen et al., 1985
60	16.74		33.51	1985	Pen et al., 1986
21	21.32	6.63		1985 [†]	Stekar and Golob, 1986
19	24.91	4.75		1986 [†]	Stekar et al., 1987
29	17.32		37.78	1986	Pen et al., 1987
12	18.80		38.80	1987 [†]	Stekar et al., 1988
9	18.55	5.71	30.79	1988	Stekar et al., 1989
10	21.53	6.82	31.70	1989	Stekar et al., 1990
3	31.47	4.58		1994	Agricultural Institute of Slovenia
	17.10				Kellner and Becker, 1971

^{x)} inside years - unutar godina

^{xx)} among years - među godinama

^{†)} the second and the third cut - druga i treća kosidba

Table 9. Sodium content in the first cut, g kg⁻¹ DM
Tablica 9. Sadržaj natrija u prvoj kosidbi, g kg⁻¹ ST

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
135	0.64			1972-1977	Stekar and Pen, 1980
35	0.36		80.7 ^{x)} 20.59 ^{xx)}	1971-1981	Stekar et al., 1982
65	0.83		198.24	1984	Pen et al., 1985
96	0.62		175.20	1985	Pen et al., 1986
38	0.57	0.65		1985	Stekar and Golob, 1986
61	0.94		214.56	1986	Pen et al., 1987
31	0.72	0.47		1986	Stekar et al., 1987
35	0.88		73.30	1987	Stekar et al., 1988
16	0.56	0.56	99.78	1988	Stekar et al., 1989
13	0.98	0.62	62.80	1989	Stekar et al., 1990
10	0.84	0.31	36.40	1990	Stekar et al., 1991
1	1.13			1993*)	Rajčević and Jazbec, 1994
1	1.73			1994	Rajčević et al., 1995a
4	0.96	0.35	36.66	1994*)	Rajčević et al., 1995b
3	1.24	1.08		1994	Agricultural Institute of Slovenia
	1.90				Kellner and Becker, 1971

^{x)} inside years - unutar godina

^{xx)} among years - među godinama

^{*)} produced in 1993 - proizvedeno u 1993.

Table 10. Sodium content in the aftergrass, g kg⁻¹ DM
Tablica 10. Sadržaj natrija u kasnijoj kosidbi, g kg⁻¹ ST

No. of analyzed samples - Broj analiziranih uzoraka	Mean Prosjek	SD	KV	Year of analysis Godina analiza	Authors - Autori
29	0.84			1972-1977	Stekar and Pen, 1980
66	0.95		62.8 ^{x)} 59.8 ^{xx)}	1971-1981	Stekar et al., 1982
22	1.39		183.67	1984	Pen et al., 1985
60	0.71		125.33	1985	Pen et al., 1986
21	1.14	0.92		1985 [†]	Stekar and Golob, 1986
19	1.16	0.67		1986 [†]	Stekar et al., 1987
12	1.30		49.80	1987 [†]	Stekar et al., 1988
9	0.87	0.42	48.57	1988	Stekar et al., 1989
10	0.62	0.24	39.20	1989	Stekar et al., 1990
6	0.72	0.39		1994	Agricultural Institute of Slovenia
	0.92				Kellner and Becker, 1971

^{x)} inside years - unutar godina

^{xx)} among years - među godinama

^{†)} the second and the third cut - druga i treća kosidba

It can be noticed that one determination in the sample of the first cut exceeds in the sodium content. We also see that the second cut contains more sodium than the first cut. Stekar and Pen, 1980 and Stekar et al., 1982 established significant differences in the sodium content among years and a large excess of it among determinations within years. In comparison with the foreign reports, of which we quote Kellner and Becker, 1971 only, our first and second cut contain little sodium. Kellner and Becker, 1971 reported between 0.5 g and 4.0 g Na for the first cut and between 0.9 g and 3.6 g Na for the second cut. Mean value for the period 1990 - 1996 was low (Pen and Kapun, 1997, e.g. 0.81 g (n=157). The determination of Agricultural Institute of Slovenia for 1994 was 0.42 g (SD = 0.06, n = 4), 0.85 g (SD = 0.45, n = 3) for 1995 and 0.34 g (n=2) for 1996.

4. CONCLUSION

- Samples were not defined.
- Second cut contains more calcium, phosphorus, magnesium, potassium and sodium than first cut.
- First cut contains on average a bit less calcium and phosphorus and a bit more magnesium and potassium and four times less sodium in comparison with Kellner and Becker's tables.
- Second cut contains on average less calcium, a bit less phosphorus, more magnesium and potassium and half less sodium in comparison with Kellner and Becker's data.
- Voluntary exchange of samples should become obligatory.

ACKNOWLEDGMENT

We would like to thank Dr. Drago Babnik, the head of the Institute for Animal Production at Agricultural Institute of Slovenia, who collected data and allowed to publish the results of samples analyzed at the Agricultural Institute.

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Sažetak

Sakupljeni su rezultati objavljeni zadnjih godina koje je dobilo 16 autora o sadržaju kalcija, fosfora, magnezija, kalija i natrija u sijenu. Prva kosidba sadržavala je u 1 kg suhe tvari prosječno 6,94 g Ca (n=723), 2,66 g P (n=724), 2,58g Mg (n=665), 18,64 g K (n=572) i 0,56 g Na (n=801). Druga kosidba sadržavala je u kg suhe tvari prosječno 7,39g Ca (n=246), 3,13 g P (n=246), 3,08 g Mg (n=223), 19,01g K (n=229) i 0,92g Na (n=261). Uzorci za-koje nije poznata odnosna kosidba sadržavali su u 1 kg suhe tvari prosječno 6,07 g Ca (n=439), 2,64 g P (n=440), 2,08 g Mg (n=132), 17,75 g K (n=166) i 0,80 g Na (n=166). Uzorke bi trebalo bolje definirati. Smatra se da bi razmjena uzoraka između laboratorija morala biti obvezatna.

EKOLOŠKO ČIST UTOVAR KAMIONSKIH CISTERNI I OTVORENIH KAMIONA

MODUFLEX

TELESKOPSKA CIJEV I FLEKSIBILNI UTOVARNI MIJEH
REDUCIRAJU PRAŠINU, SMANJUJU RASIPANJE
MATERIJALA I POBOLJŠAVAJU RADNU OKOLINU.

**MODULNA KONSTRUKCIJA I ŠIROK IZBOR
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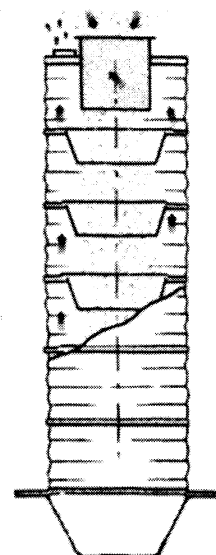
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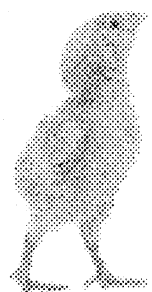


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