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CONTENT OF MACROELEMENTS IN FRESH SEEDS OF FABA BEAN

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INTRODUCTION

Though bioelements contribute only to ca 4% of the human body weight, they play an important role in proper physiology of an organism. They sustain suitable level of osmotic pressure. The bioelements are coenzymes of many enzymes. Moreover, they affect activity of the enzymes in dependence on their concentration in the milieu (GÓRNICKA 2003).

The seeds of leguminous vegetables are commonly recognized as a rich source of protein, mineral compounds, free amino acids, organic acids and lipids and possess high nutritive value (KORSZIKOW et al. 1991, JASIŃSKA, KOTECKI 1993, BOROWSKA et al. 1995). Faba bean seeds which are grown for processing should be also characterized by appropriate organoleptic features (ZADERNOWSKI et al. 1994). Therefore, small seed cultivars are suitable for food processing industry.

The aim of the study was to estimate the content of macroelements in small (Orlik, Jupiter, Nowo) and large seed (Bachus, Basta, Windsor Biały) cultivars of faba bean.

MATERIAL AND METHODS

The experiment was carried out in 2002 and 2003. The fresh seeds of new Polish faba bean cultivars: Bachus, Basta, Orlik, Jupiter and Nowo were tested. The control cultivar was Windsor Biały. The seeds of faba bean were sown on 9th April in the first year of study and on 15th April 5 in the second year, at a distance of 40 cm between rows and at 20 cm in the row. Cluster sowing was applied - two seeds sown at a depth of 10 cm. The experiment was established in randomized blocks with four replications. The plot area was 2.88 m² (1.8×1.6 m). Crop management was carried out according to the commonly accepted recommendations for this species. Mineral fertilization was quantified according to the results of the chemical analysis of the soil. Faba bean was cultivated on post-bog soil of 3rd class of the soil valuation. Within the cultivation treatments of plants, the weeding, irrigation and spraying (Dithane M-45 and Decis 2.5 ES) to protect the plants against diseases and pests (mainly against faba bean rust and bean aphid) were done. A single harvest of faba bean pods took place at their milk maturity phase, on 9th July in the first year and on 6th July – in the next one. After the harvest, the content of dry matter of the fresh faba bean seeds by means of a drier-weight method was estimated. Furthermore, the content of total nitrogen with Kjeldahl method, phosphorus with colorimetric method, and potassium, sodium, calcium and magnesium with flame photometry was evaluated. The results were subjected to an analysis of variance. The means of two years were separated by Tukey's test at $p=0.05$.

RESULTS AND DISCUSSION

On the basis of the study, it was proved that there were significant differences in the dry matter content between the tested cultivars (Fig. 1). Small seed cultivars Orlik and Jupiter contained the most dry matter, 22.76 and 21.85%, respectively. The least dry matter was found in seeds of cv. Nowo (12.04%). The content of dry matter in large seed cultivars was on average 15.35% for cultivar Bachus, 17.19% for cv. Basta and 17.33% for cv. Windsor Biały. It was proved that these differences were significant. According to LISIEWSKA and KMIECIK (1985) the dry matter content is an important factor which describes maturity of faba bean seeds. For processing maturity the amount of dry matter should be 30-35%. BOROWSKA et al. (1999) observed that dry matter content depended on the term of harvest. Moreover, higher concentration of dry matter was determined by those authors in small seed cultivars of faba bean.

There were significant differences in nitrogen, phosphorus, potassium, calcium and magnesium in the seeds of the tested cultivars (Table 1).

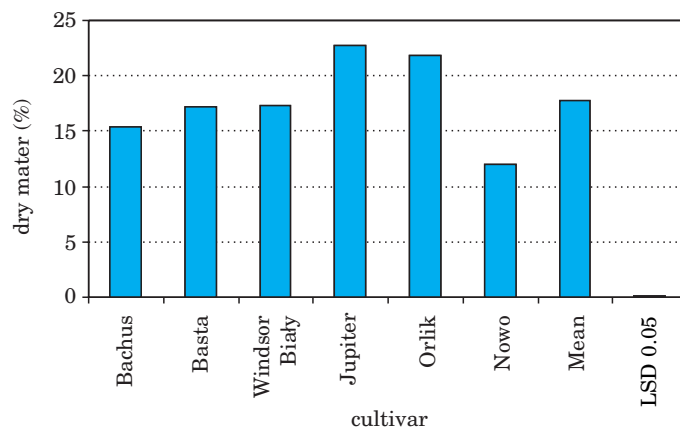


Fig. 1. The content of dry matter in fresh seeds of faba bean (mean in 2002-2003)

The highest content of total nitrogen (mean in 2002–2003) was found in seeds of cultivar Nowo (15.63% d.m.). Seeds of cultivar Bachus contained less of nitrogen (13.12% d.m.) in comparison with cv. Nowo, while seeds of cv. Orlik were characterized by the lowest content of nitrogen (11.65%), in comparison with all the cultivars tested in the experiment. Cultivars Jupiter, Nowo, Bachus and Orlik contained the highest amount of phosphorus. Significantly smaller content of this macroelement was found in seeds of cv. Basta and Windsor Biały (0.76 and 0.75% d.m., respectively). These results are comparable to those given by BOROWSKA et al. (1999). However, those authors observed higher level of phosphorus for large seed cultivars, which was not revealed in the present work.

The compared faba bean cultivars showed a varied level of potassium. The highest content of this macroelement was found in cultivar Nowo seeds (2.31% d.m.) and the lowest in Orlik seeds (1.83% d.m.). The present results are similar to those reported by BOROWSKA et al. (1999). Of the investigated cultivars, Windsor Biały had the highest content of calcium. The differences in the magnesium content were statistically proven only in 2003 and for the means in 2002-2003. Small seed cultivars of faba bean: Nowo, Jupiter and Orlik contained significantly higher amounts of magnesium (0.15, 0.12, 0.11% d.m., respectively) in comparison with large seed cultivars: Basta, Bachus and Windsor Biały (0.10% d.m.). Similar results were obtained by BOROWSKA et al. (1999).

The Ca:Mg ratio in seeds of faba bean is shown in Table 2. Proper ion proportions between calcium and magnesium in plant food are very important to sustain a suitable organism metabolism. Too wide ratios of calcium and magnesium ions (>3) might show that there is not enough magnesium content in the food (CZAPLA, NOWAK 1995, WRÓBEL, MARSKA 1998). In the con-

Table 1

The content of macroelements in fresh seeds of faba bean

Macro-elements	Years	Cultivar						LSD $_{\alpha=0.05}$
		Bachus	Basta	Windsor Biały	Orlik	Jupiter	Nowo	
N	2002	7.08	6.01	6.69	5.60	6.41	7.49	0.32
	2003	19.16	19.21	17.94	17.70	18.33	23.77	0.68
	2002-2003	13.12	12.61	12.32	11.65	12.37	15.63	0.31
P	2002	0.88	0.83	0.81	0.87	0.90	0.83	0.01
	2003	0.71	0.69	0.68	0.71	0.74	0.79	0.08
	2002-2003	0.80	0.76	0.75	0.79	0.82	0.81	0.03
K	2002	2.14	2.04	2.02	1.76	2.00	2.16	0.09
	2003	2.06	2.08	1.98	1.90	1.95	2.47	0.17
	2002-2003	2.10	2.06	2.00	1.83	1.98	2.31	0.08
Ca	2002	0.34	0.36	0.46	0.34	0.40	0.40	0.09
	2003	0.14	0.10	0.09	0.14	0.10	0.13	0.07
	2002-2003	0.24	0.23	0.28	0.24	0.25	0.27	0.04
Mg	2002	0.15	0.15	0.14	0.16	0.15	0.15	n.s.
	2003	0.05	0.06	0.06	0.06	0.08	0.16	0.09
	2002-2003	0.10	0.10	0.10	0.11	0.12	0.15	0.04
Na	2002	0.009	0.010	0.085	0.007	0.008	0.007	0.003
	2003	0.004	0.007	0.007	0.006	0.005	0.007	0.001
	2002-2003	0.006	0.009	0.008	0.007	0.006	0.007	n.s.

n.s. – non significant differences

Table 2

Ca:Mg ratio in faba bean seeds

Cultivar	2002	2003	2002-2003
Bachus	2.31	2.80	2.55
Basta	2.47	1.68	2.07
Windsor Biały	3.40	1.75	2.57
Orlik	2.19	2.33	2.26
Jupiter	2.67	1.28	1.97
Nowo	2.86	0.84	1.85
LSD $_{\alpha=0.05}$	r.n.	r.n.	r.n.

Table 3

K:(Ca+Mg) ratio in faba bean seeds

Cultivar	2002	2003	2002-2003
Bachus	4.37	10.94	7.65
Basta	4.05	13.22	8.63
Windsor Biały	3.39	13.27	8.33
Orlik	3.56	9.51	6.53
Jupiter	3.63	10.83	7.23
Nowo	3.85	8.59	6.22
LSD $\alpha=0.05$	0.84	6.18	n.s.

n.s. - non significant differences

ducted experiment the Ca:Mg ratio varied from 1.85 to 2.57. However, no cultivar-specific influence was determined. Except the content of macro- and microelements in food, a proper ion ratio between potassium and divalent cations of calcium and magnesium is another very important characteristic. According to WRÓBEL, MARSKA (1998) this ratio should be about 1.62. KOTOWSKA and WYBIERALSKI (1999) suggest that regular use of NPK fertilizers makes soil pH lower, which makes it more difficult for plants to take up nutrients. In the pre-sent experiment this ratio was much higher – on average varying from 6.22 to 8.63 and there was no effect of a cultivar.

CONCLUSIONS

1. The examined faba bean cultivars differed significantly in dry matter content. Two small seed cultivars: Orlik and Jupiter and a large seed cv. Bachus showed the biggest amount of dry matter.

2. The cultivars tested in the experiment were characterized by a high amount of macroelements. The biggest content of nitrogen, potassium and magnesium was found in Nowo seeds, phosphorus in Jupiter seeds and calcium in Windsor Biały.

3. There were no significant differences found between the compared cultivars in the sodium content.

4. The seeds of faba bean of all the cultivars had a very favourable Ca:Mg ratio.

REFERENCES

- BOROWSKA J., ZADERNOWSKI R., MARKIEWICZ K., PIERZYNOWSKA-KORNIAN G., KOZIKOWSKI W., ŚWIĘCICKI W. 1995. *Nowe odmiany grochu – ich wartość technologiczna i odżywcza. Cz.1. Wartość odżywcza nasion odmian uprawnych i form kolekcjonerskich grochu.* Acta Acad. Agricult. Tech. Olst. Technol. Aliment., 28: 225-238.
- BOROWSKA J., ZADERNOWSKI R., MARKIEWICZ K., WIERZBICKA B. 1999. *Zmiany zawartości składników mineralnych podczas dojrzewania nasion bobu.* Biul. Magnezol., 4(1):27-31.
- CZAPLA J., NOWAK A.G. 1995. *Plonowanie i jakość roślin w warunkach zróżnicowanego żywienia potasem, sodem, wapniem i magnezem.* Acta Acad. Agricult. Tech. Olst. Agricult., 61: 101-107.
- GÓRNICKA J. 2003. *Apteka natury.* Agencja Wyd. Jerzy Mostowski, Raszyn.
- JASIŃSKA Z., KOTECKI A. 1993. *Rośliny strączkowe.* PWN, Warszawa.
- KORSZIKOW B.M., MAKAROWA G.W., NALETKO N.L., PAWLIJ A.I. 1991. *Lecznicze właściwości roślin uprawnych.* PWRiL, Warszawa.
- KOTOWSKA J., WYBIERALSKI J. 1999. *Kształtowanie się stosunków ilościowych między K, Ca i Mg w glebie oraz roślinach.* Biul. Magnezol., 4(1): 104-110.
- LISIEWSKA Z., KMIECIK W. 1985. *Wpływ stopnia dojrzałości nasion bobu na ich przydatność do produkcji konserw apertyzowanych i mrożonych.* Biul. Warz., 278: 225-238.
- WRÓBEL J., MARSKA E. 1998. *Wpływ nawozu dolomitowego na koncentrację wapnia, magnezu i potasu w liściach oraz strąkach dwóch odmian fasoli szparagowej jako wskaźnik jej wartości biologicznej.* Biul. Magnezol. 3(4): 199-205.
- ZADERNOWSKI R., BOROWSKA J., MARKIEWICZ K., KAWECKI Z. 1994. *Nowe odmiany bobu - ich trwałość technologiczna i odżywcza. Cz. II. Wartość odżywcza nasion bobu w stadium przydatności technologicznej.* Acta Acad. Agricult. Tech. Olst., Agricult., 26: 81-88.

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Key words: faba bean, cultivars, content of macroelements.

Abstract

The experiment was carried out in 2002 and 2003. The fresh seeds of new Polish faba bean cultivars: Bachus, Basta, Orlik, Jupiter and Nowo were tested. The control cultivar was Windsor Biały. The examined faba bean cultivars differed significantly in dry matter content. Two small seed cultivars: Orlik and Jupiter and one large seed cultivar Bachus showed the highest amount of dry matter. The cultivars tested in the experiment were characterized by a high amount of macroelements. The biggest content of nitrogen, potassium and magnesium was found in Nowo seeds, phosphorus in Jupiter seeds and calcium in Windsor Biały. There were no significant differences found between the compared cultivars in the sodium content. The seeds of faba bean of all the cultivars had a very favourable Ca:Mg ratio.

ZAWARTOŚĆ MAKROELEMENTÓW W ŚWIEŻYCH NASIONACH BOBU

Słowa kluczowe: bób, odmiany, zawartość makroelementów.

Abstrakt

Doświadczenie przeprowadzono w latach 2002-2003. Materiał badawczy stanowiły świeże nasiona najnowszych polskich odmian bobu: Bachus, Basta, Orlik, Jupiter i Nowo. Odmianą kontrolną był Windsor Biały.

Spośród badanych w doświadczeniu odmian bobu największą zawartość suchej masy miały 2 odmiany drobnonasienne Orlik i Jupiter oraz odmiana grubonasienna Bachus.

W badanych odmianach bobu wykazano dużą zawartość makroelementów. Odmiana Nowo odznaczała się największą zawartością azotu ogólnego, potasu i magnezu. Najwięcej fosforu zawierały nasiona odmiany Jupiter, a wapnia – nasiona odmiany Windsor Biały. Nie stwierdzono istotnej różnicy w zawartości sodu w zależności od odmiany bobu. W nasionach bobu były korzystne proporcje Ca:Mg, niezależnie od odmiany.