CHEMICAL COMPOSITION AND NUTRITIVE VALUE OF SEEDS OF SELECTED PEA VARIETIES

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Abstract. Chemical composition and the nutritive value of seeds of 10 pea varieties with white and coloured flowers was analysed. In the white-flowering varieties the activity of trypsin inhibitors was 2.93 TIU/mg and the polyphenol content 0.74 mg/g, and in the colour-flowering ones – 4.75 and 2.62, respectively. The proanthocyanidin content of seeds was 0.01 mg/kg in the pea varieties with white flowers and 0.40 - 1.66 mg/kg in those with coloured flowers. Compared with the seeds of colour-flowering pea, the yield of white-flowering ones was higher (32.8 vs. 31.3 dt/ha), and their seeds contained more crude protein (22.03% vs. 20.99%) and less NDF (18.72% vs. 20.54%). Indices of amino acid composition (EAAI and CS index) of seeds were similar. The seeds of the pea varieties with white flowers, compared with those with coloured flowers, were characterised by a considerably lower concentration of ADF and a slightly higher yield and crude protein content.

Keywords: *Pisum sativum*, chemical composition, rats, protein value, ADF.

SELEKCIONUOTŲ ŽIRNIŲ VEISLIŲ SĖKLŲ CHEMINĖ SUDĖTIS IR MAISTINĖ VERTĖ

Santrauka. Buvo analizuota 10 žirnių veislių sėklų su baltais ir spalvotais žiedais cheminė sudėtis bei maistinė vertė. Baltai žydinčiose žirnių veislėse tripsino inhibitoriaus aktyvumas buvo 2,93 TIU/mg ir polifenolių kiekis – 0,74 mg/g, o spalvotai žydinčiuose žirniuose – atitinkamai 4,75 TIU/mg ir 2,62 mg/g. Proantocianidino kiekis sėklose su baltais žiedais buvo 0,01 mg/kg, o su spalvotais žiedais – 0,40–1,66 mg/kg. Lyginant spalvotai žydinčių sėklų žirnių veislių derlių (vid. 31,3 dt/ha) su baltai žydinčių žirnių sėklų derliumi, pastarasis buvo didesnis (vid. 32,8 dt/ha), o sėklos pasižymėjo didesniu baltymingumu – 22,03% (spalvotai žydinčių vid. – 20,99%). Baltai žydinčių žirnių sėklose nustatytas mažesnis neutraliais detergentiniais tirpalais išplauto pluošto (NDF) kiekis – 18,72% (spalvotai žydinčių – vid. – 20,54%). Žirnių rūšių veislės su baltais žiedais buvo charakterizuojamos kaip turinčios žymiai mažesnę ADF ir nedaug didesnį derlių bei baltymų kiekį.

Raktažodžiai: žirniai (*Pisum sativum)*, cheminė sudėtis, žiurkės, baltymų vertė, ADF.

Introduction. One of the ways of increasing the role of pea seeds in feedstuff production is to cultivate its new varieties on light soils. The researches conducted by numerous authors (Gdala et al., 1992; Zduńczyk et al., 1997; Bastianelli et al., 1998) show that progress in pea breeding results not only in higher yields, but also in changes in the chemical composition of seeds. Therefore, in order to make optimum use of pea seeds in animal nutrition, a comprehensive evaluation of their fodder value should be based on such indicators as the quantity and quality of protein, the kind of structural carbohydrates and the ANF content. Such an evaluation was made in the present studies, which compared the chemical composition, yield and nutritive value of protein of 10 pea varieties to be cultivated on light soils. Differences between white-flowering and colour-flowering varietis of pea were searched for.

Material and methods. The nutritive value of pea (*Pisum sativum*) seeds selected at the Plant Breeding Station in Szyldak near Olsztyn in recent years was determined in the studies. Four varieties with white flowers and six with coloured ones were analysed.

The content of total phenolic compounds was determined using the Folin-Ciocalteau test (Naczk and Shahidi, 1989). The proanthocyanidins were determined according to Oszmiański et al. (1988), and trypsin inhibitors activity according to Kakade et al. (1974). The contents of crude fibre (CF), neutral detergent fibre (NDF), acid detergent fibre (ADF) and lignin (ADL) were determined by the Van Soest and Wine method (1967). The amino acid composition of protein was determined with an amino acid analyser AAAT 339M. The quality of protein was determined by means of the essential amino acid index (EAAI) according to Oser and chemical score (CS) according to Block and Mitchel, with the egg protein composition as the standard. Protein efficiency ratio (PER_C) was calculated from the amino acid composition, according to the formula devised by Alsmayer et al. (1974). The net protein ratio (NPR) was determined on Wistar rats (14 days of experimental feeding eight 77.6 g animals in each group).

Results and discussion. The seeds of the pea varieties compared differed in terms of antinutrients (Table 1). In the pea varieties with white flowers, the polyphenol content was 0.74 mg/g, whereas in those with coloured flowers - 2.62 mg/g. High differences were reported for the content of proanthocyanidins. In the seeds of the white-flowering pea varieties, the concentration of these

compounds was as low as 0.01 g/kg, whereas in the other varieties it ranged from 0.40 to 1.66 g/kg d.m. In the seeds of colour-flowering pea, a higher activity of trypsin inhibitors (4.75 vs. 2.93 TIU/mg) was determined. The concentration of antinutrients in the seeds of both types of pea corresponded to the results obtained by other authors (Bastianelli et al., 1998; Smulikowska et al., 2001).

Table 1. **Total polyphenol (TP) and proanthocyanidin (ProAC) content and of trypsin inhibitor activity (TIA) in seeds of different types of pea**

Type of pea	Varieties	TP g/kg	ProAC g/kg	TIA TIU/mg
White-flowering	Albatros	0.68	0.01	1.78
	Bielik	0.76	0.01	2.96
	Kos	0.60	0.01	3.28
	Mazurek	0.90	0.01	3.67
	$\bar{x}$	0.74	0.01	2.93
Colour-flowering	Bocian	2.00	1.28	4.13
	Kormoran	3.06	1.66	5.03
	Skalik	3.27	1.03	4.31
	Sokolik	2.57	0.69	4.60
	Winerek	2.24	0.40	5.22
	Żuraw	2.60	1.04	5.19
	$\bar{x}$	2.62	1.02	4.75

Table 2. **Yield of seeds (dt/ha) and indices of their chemical composition, (%)**

Type of pea	Varieties	Seed yield	Crude protein	Fibre			
				CF	NDF	ADF	ADL
White-flowering	Albatros	34.0	20.72	6.71	17.20	9.89	0.71
	Bielik	32.4	25.06	5.84	21.34	6.38	0.99
	Kos	31.7	22.87	6.99	18.83	8.73	0.35
	Mazurek	33.1	19.45	6.08	17.50	8.35	0.56
	$\bar{x}$	32.8	22.03	6.41	18.72	8.34	0.65
Colour-flowering	Bocian	30.3	20.99	5.97	22.15	10.40	0.28
	Kormoran	28.9	22.72	6.22	20.21	9.43	0.85
	Skalik	33.8	20.60	6.14	19.71	9.12	0.53
	Sokolik	36.2	21.56	7.51	20.88	8.99	0.53
	Winerek	29.4	22.26	6.31	21.21	9.02	0.94
	Żuraw	29.2	25.76	7.49	19.06	11.40	0.90
	$\bar{x}$	31.3	20.99	6.61	20.54	9.73	0.67

Compared with the seeds of colour-flowering pea, the yield of white-flowering ones was higher and their seeds contained more crude protein and less fibre, especially NDF and ADF (Table 2). The crude protein content of pea seeds varied from below 20% to over 25% d.m. The concentrations of neutral detergent fibre and acid detergent fibre showed even larger differences, ranging from ca. 17% to over 22% d.m. and from 6.4% to 11.4% d.m., respectively. The average lignin content was similar in the white- and colour-flowering varieties (0.65 and 0.67% d.m, respectively).

The protein content observed in the studies was comparable with that reported by other authors for other Polish pea varieties (Gdala et al., 1992; Zduńczyk et al., 1997). The content of particular fibre fractions (NDF, ADF, ADL) was similar to the results obtained by Zduńczyk et al. (1997) and Stanek (1999), but slightly higher than that reported by Gdala et al. (1997). There were significant differences in the fibre fraction content between the pea varieties examined. The varieties with coloured flowers were characterised by higher concentrations of NDF, ADF and lignin.

The amino acid composition of seed protein was similar, which was confirmed by the amino acid index (EAAI) amounting to 75.9 - 77.6. This index was higher only in Skalik variety – 85.1 (Table 3). In seed protein of all varieties, the limiting amino acid was methionine and cystine, and the average CS index was 44.5. The PER index, calculated on the basis of the content of four amino acids, was 1.66 to 2.14. The NPR index determined in rats was similar in all varieties, and ranged from 3.12 to 3.78. Only some indices of protein quality were consistent with

those presented by Igbasan et al. (1997) and Stanek (1999).

An insignificant negative correlation was found between the seed yield and protein content (Table 4). The coefficient of correlation, was however, relatively high, for a small number of samples analysed (r = - 0.43). The coefficient of correlation between the NPR index and EAAI was very low (0.094), and much higher between NPR and CS (0.310). The negative correlation observed between NPR and PER (r = - 0.43) indicates that the formula proposed by Alsmayer et al. (1974), devised for other types of protein, does not correspond to the results of protein biological evaluation in the case of the pea seeds analysed.

Table 3. **Indices of biological value of pea protein**

Type of pea	Varieties	EAAI	CS (met+cys)	PER_C	NPR
White-flowering	Albatros	77.6	44.2	1.85	3.12
	Bielik	75.9	42.7	2.07	3.36
	Kos	75.9	42.3	1.67	3.78
	Mazurek	77.6	45.5	1.81	3.69
	$\bar{x}$	76.8	43.7	1.85	3.49
Colour-flowering	Bocian	75.9	45.8	1.65	3.66
	Kormoran	75.9	44.7	1.50	3.53
	Skalik	85.1	42.8	1.42	3.69
	Sokolik	75.9	43.1	1.53	3.68
	Winerek	75.9	46.8	1.78	3.78
	Żuraw	75.9	44.2	1.68	3.41
	$\bar{x}$	77.4	44.6	1.59	3.63

Table 4. **Coefficients of correlation between seed yield, crude protein content and indices of their biological values**[1]

	Seed yield	EAAI	CS	PER
Crude protein content	-0.43	0.086	0.164	0.89
NPR	-	0.094	0.31	-0.43

[1]Correlation coefficients are significant when higher than 0.632 ($p<0.05$) and 0.765 (0.01)

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