

QUALITY CHARACTERISTICS AND CONTENT OF MINERAL COMPOUNDS IN FRUIT OF SOME CULTIVARS OF SWEET PEPPER (*CAPSICUM ANNUUM* L.)

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Abstract

The study was carried out in 2005–2007. The aim of the experiment was to estimate the quality and mineral compound content in sweet pepper fruits. The experimental material consisted of seven F₁ hybrids grown in the open field: ISI 56511 F₁, ISI 56503 F₁, Axel F₁, Akron F₁, Roei F₁, Elfo F₁ and Polonez F₁ (control cultivar). The fruits were harvested many times. They were collected when green and fully grown. After the harvest, the fruit quality including its mean weight, length, diameter, pericarp weight and pericarp thickness, was evaluated. In 2006–2007, the content of macro- and microelements, such as nitrogen, phosphorus, potassium, sodium, calcium, magnesium, iron, zinc and nitrates was determined in the dry weight of the yield. The results were statistically evaluated by the analysis of variance. Significance of the differences was tested by Tukey's test at $p = 0.05$.

The biometrical traits of fruits were characteristic for each cultivar. The highest content of dry weight was found for cultivar ISI 56511 F₁ (11.2% higher than the mean amount determined for all of the cultivars and 39.8% higher than the lowest dry matter content assessed in fruits of cultivar Roei F₁).

The sweet pepper cultivars tested in the experiment differed significantly in the content of macro- and microelements. The highest content of nitrogen was determined in fruits of cultivar Polonez F₁. Fruits produced by cultivars Elfo F₁, ISI 56503 F₁ and Roei F₁ in comparison with the other cultivars were characterized by a significantly higher content of iron. The highest content of nitrates was assessed in cultivar ISI 56503 F₁ fruit.

Key words: sweet pepper cultivars, quality characteristics of fruit, macro- and microelements content.

CECHY JAKOŚCIOWE ORAZ ZAWARTOŚĆ SKŁADNIKÓW MINERALNYCH W OWOCACH WYBRANYCH ODMIAN PAPRYKI (*CAPSICUM ANNUUM* L.)

Abstrakt

W latach 2005–2007 badano jakość owoców papryki i zawartość makro- i mikrośladników. Badaniom (uprawa polowa) poddano następujące odmiany papryki: ISI 56511 F₁, ISI 56503 F₁, Axel F₁, Akron F₁, Roei F₁, Elfo F₁ i Polonez F₁ (odmiana kontrolna).

Zbiór owoców papryki wykonywano wielokrotnie, zbierano owoce zielone w pełni wyrosnięte. Po zbiorach owoce poddano ocenie jakościowej, uwzględniając ich masę, długość, średnicę oraz masę i grubość perykarpu. W latach 2006-2007 w suchej masie plonu oznaczono zawartość: makro- i mikrośladników – azotu ogólnego, fosforu, potasu, sodu, wapnia, magnezu, żelaza, cynku oraz azotanów. Wyniki opracowano statystycznie testem Tuckeya, wyliczając półprzedziały ufności na poziomie istotności $\alpha = 0,05$.

Badane cechy biometryczne owoców były charakterystyczne dla poszczególnych odmian papryki. Istotnie największą suchą masę zawierały owoce odmiany ISI 56511 F₁ – o 11,2% więcej od średniej zawartości w owocach wszystkich badanych odmian i o 39,8% więcej w porównaniu z najmniejszą jej zawartością, oznaczoną w owocach odmiany Roei F₁.

Badane odmiany papryki różniły się istotnie zawartością makro- i mikrośladników. Najwięcej azotu ogólnego i potasu zawierały owoce odmiany Polonez F₁. W owocach odmian Elfo F₁, ISI 56503 F₁ i Roei F₁ oznaczono – w porównaniu z pozostałymi badanymi odmianami – istotnie większą zawartość żelaza. Istotnie największą zawartość azotanów zawierały owoce odmiany ISI 56503 F₁.

Słowa kluczowe: odmiany papryki, cechy jakościowe owoców, zawartość składników mineralnych.

INTRODUCTION

Sweet pepper (*Capsicum annuum* L.) is a vegetable of a very high biological value and specific flavour (KORZEŃ, PERUCKA 1978, GAJC-WOLSKA, SKAPSKI 2001). Sweet pepper fruits are a rich source of such compounds as vitamins (especially vitamin C), polyphenols, chlorophylls, carotenoids and sugars (AYHAN, FERAMUZ 2007, JADCZAK, GRZESZCZUK 2009). Many studies have proved that those compounds play an important role in protection against many civilization illnesses like cardiopathies, cancer, etc. (HOWARD et al. 2000, PERUCKA et al. 2004). Moreover, sweet pepper fruits are a rich source of mineral compounds, especially magnesium, calcium, potassium, phosphorus and iron (PERUCKA 1995).

Growing interest in field cultivation of sweet pepper has led to the creation of new F₁ hybrids, which are characterized by a short vegetation period, resistance to cold and high quantity and quality of marketable yield (BUCZKOWSKA 1997).

The aim of the experiment was to characterize the quality traits of fruit of some sweet pepper cultivars and to estimate the content of mineral compounds of the fruits.

MATERIAL AND METHODS

The experiment was conducted in the years 2005-2007 in the Department of Vegetable Growing and in the Laboratory of Processing and Storage of Plant Raw Material of Agricultural University in Szczecin. The research material consisted of six Israeli F_1 hybrids: ISI 56511 F_1 , ISI 56503 F_1 , Axel F_1 , Akron F_1 , Roei F_1 , Elfo F_1 . A Polish cultivar, Polonez F_1 , was cultivated as a control. The field experiment was set in a randomized block design with four replications. The seedlings of sweet pepper were produced in the greenhouse. Seeds were sown on 23rd March (each year). The seedlings were transplanted into the open field on 31st May in 2005, 2nd June in 2006 and 4th June in 2007. Then, polypropylene non-woven fabric covers were held on plants for a two-week period.

The field was prepared according to agronomic recommendations for sweet pepper cultivation. Mineral fertilization was dosed according to the results of the chemical analysis of the soil. During the growing season, the crop treatment was carried out. It included mainly irrigation, weeding, soil cultivation and plant protection practices.

The fruit harvest was carried out many times. Fruits were collected when they were green and fully grown. After the harvest, the fruit quality including its mean weight, length, diameter, pericarp weight and pericarp thickness was evaluated. In 2006-2007 the content of nitrogen by Kjeldahl's method, phosphorus by the colorimetric method, potassium, sodium and calcium by flame photometry, magnesium, iron and zinc by the method of atomic absorption spectrophotometry (AAS) was determined in the dry weight of the yield. Moreover, the content of nitrates (PN-92/A-75112) in the raw plant was evaluated. The results of nitrate content were counted as mg of NO_3^- per kg of dry matter of fruit.

The results obtained in each year were subjected to analysis of variance. The means of the years were separated by Tukey's test at $p = 0.05$.

RESULTS AND DISCUSSION

The cultivars of sweet pepper tested in the experiment differed significantly in the fruit quality traits of the 1st class marketable yield (Table 1). The highest fruit weight was obtained for the cultivars Axel F_1 , Akron F_1 and ISI 56503 F_1 . However, fruits of Elfo F_1 and Roei F_1 had a significantly lower fruit weight (respectively 168.5 and 165.9 g) only in comparison with the cultivar Axel F_1 . The lowest fruit weight was noted for cv. Polonez F_1 . Similar results were obtained for pericarp weight, which was the lowest for cv. Polonez F_1 fruit. The pericarp weight of this cultivar did not differ sig-

Table 1

Quality traits of fruit of tested sweet pepper cultivars (mean for 2005-2007)

Cultivar	Fruit weight (g)	Pericarp weight (g)	Fruit length (cm)	Fruit diameter (cm)	Pericarp thickness (mm)	Dry matter content (%)
Akron F ₁	195.4	164.4	12.8	8.0	4.7	9.24
Axel F ₁	210.8	173.9	12.1	8.3	4.8	9.25
Elfo F ₁	168.5	141.2	12.2	8.1	4.4	9.25
ISI 56511 F ₁	179.1	148.6	10.2	8.6	4.1	10.29
ISI 56503 F ₁	194.4	166.6	9.8	9.0	6.7	9.79
Polonez F ₁	128.1	108.7	9.2	7.7	4.9	9.57
Roei F ₁	165.9	132.3	8.8	8.0	5.6	7.36
LSD _{α = 0.05}	35.21	34.81	1.92	1.13	0.77	0.496

nificantly from the pericarp weight of cultivars Elfo F₁ and Roei F₁. BUCZKOWSKA (1997) claims F₁ hybrids differ significantly with specified cultivars on the quality traits. The mean fruit weight of F₁ hybrids was 75.3-89.2 g, while the mean weight of the fruit produced by cv. Kujawianka was 56.2 g. In the research by GAJC-WOLSKA and SKAPSKI (2001) the mean weight of F₁ hybrids fruit of sweet pepper was also higher in comparison with the fruit of the cultivars tested in our study, and varied between 82 and 130 g. Our analysis of the fruit length proved that cultivars Akron F₁, Axel F₁ and Elfo F₁ formed significantly longer fruits in comparison with the other cultivars tested in the experiment. Moreover, a significantly larger diameter was noticed for cultivar ISI 56503 F₁, but only in comparison with cultivar Polonez F₁. The largest pericarp thickness was determined for cultivar ISI 56503 F₁ fruits, while the smallest one was recorded for cultivars Axel F₁, Akron F₁, Elfo F₁ and ISI 56511 F₁. GAJC-WOLSKA and SKAPSKI (2001) state that the mean pericarp thickness of sweet pepper is 5–6 mm while BUCZKOWSKA (2004) suggests it ranges from 5.5 to 5.8 mm.

The dry matter content of sweet pepper fruits differed significantly between the cultivars. Most dry matter was noted for cultivar ISI 56511 F₁ (10.29%) and the least for cultivar Roei F₁ (7.36%). GAJC-WOLSKA and SKAPSKI (2001) determined lower amounts of dry matter of sweet pepper, i.e. from 4.6 to 8.4%. OLSZEWSKA and NOWACZYK (2004) assessed on average 8.81% of dry matter in fruits of sweet pepper, while BUCZKOWSKA et al. (2001) determined that sweet pepper fruit contained 10.1%.

The sweet pepper cultivars tested in the experiment were characterized by a high content of mineral compounds (Table 2). Significantly higher content of total nitrogen (24.70 g kg⁻¹ d.m.) and potassium (23.22 g kg⁻¹ d.m.) was assessed in fruits of cultivar Polonez F₁. The least nitrogen was in

Table 2

Content of mineral compounds in the yield of tested cultivars of sweet pepper
(mean for 2006-2007)

Cultivar	(g kg ⁻¹ d.m.)						(mg kg ⁻¹ d.m.)		
	N-total	P	K	Ca	Na	Mg	Fe	Zn	NO ₃ ⁻
Akron F ₁	19.88	3.60	20.06	2.62	0.23	1.01	365.0	10.0	50
Axel F ₁	19.51	3.25	21.14	2.59	0.25	1.11	370.0	11.2	27
Elfo F ₁	20.09	3.22	19.24	2.62	0.23	1.02	600.0	12.3	25
ISI 56511 F ₁	18.48	3.02	20.32	2.33	0.17	1.25	350.0	12.0	50
ISI 56503 F ₁	20.49	3.22	20.52	2.62	0.22	1.10	600.0	10.2	115
Polonez F ₁	24.70	3.60	23.22	2.62	0.15	0.75	350.0	15.1	24
Roei F ₁	20.64	3.05	21.34	2.33	0.17	0.87	600.0	15.0	24
Mean	20.54	3.28	20.83	2.53	0.20	1.02	462.1	12.3	45
LSD _{α = 0.05}	0.946	n.s.	0.523	0.121	n.s.	n.s.	46.421	3.486	3.1

n.s. – non-significant differences

fruits of cultivar ISI 56511 F₁ (18.48 g kg⁻¹ d.m.), while the lowest concentration of potassium was found in fruits of cultivar Elfo F₁ (19.24 g kg⁻¹ d.m.). Among the cultivars examined in the experiment, Roei F₁ and ISI 56511 F₁ were characterized by a higher content of calcium than the other cultivars. There were no significant differences found between the tested sweet pepper cultivars in the content of phosphorus, sodium and magnesium. Comparable amounts of magnesium in hot pepper fruit were obtained by PERUCKA et al. (2004). OSUNDE and MUSA MAKAMA (2007) determined 20.4 mg of calcium and 693.0 mg of potassium in 100 g of dry weight of sweet pepper.

A significantly higher content of iron was assessed in fruits of cultivars Elfo F₁, ISI 56503 F₁ and Roei F₁ in comparison with the other cultivars and by 29.8% in comparison with the mean content of iron of all the tested sweet pepper cultivars. A significantly higher content of zinc was determined in fruits of cultivars Polonez F₁ and Roei F₁ (15.1 and 15.0 g kg⁻¹ d.m., respectively) but only in comparison with cultivars Axel F₁, ISI 56503 F₁ and Akron F₁. Fruits of cultivar ISI 56503 F₁ were characterized by the highest content of nitrates (115 g kg⁻¹ d.m.). The content of nitrates in fruits of cultivars Akron F₁ and ISI 56511 F₁ was 50 g kg⁻¹ d.m. A lower content of nitrates, from 24 to 27 g kg⁻¹ d.m., was determined in fruits of the other tested cultivars of sweet pepper.

CONCLUSIONS

1. The cultivars of sweet pepper tested in the experiment differed significantly in the quality traits of fruits.
2. The highest dry matter content was found in fruits of cultivar ISI 56511 F₁ while the lowest one – in fruits of cultivar Roei F₁, in comparison with the control.
3. There were significant differences found in the macro- and microelements content between the tested cultivars of sweet pepper. The highest amounts of nitrogen and potassium were noted in fruits of cultivar Polonez F₁. Cultivars Elfo F₁, ISI 56503 F₁ and Roei F₁ were characterized by a significantly higher content of iron in comparison with the other cultivars.
4. Among the cultivars tested in the experiment, the highest content of nitrates was determined in fruits of cultivar ISI 56503 F₁.

REFERENCES

- AYHAN T., FERAMUZ O. 2007. *Assessment of carotenoids, capsaicinoids and ascorbic acid composition of some selected pepper cultivars (Capsicum annum L.) grown in Turkey*. J. Food Comp. Anal., 20 (7): 596-602.
- BUCZKOWSKA H. 1997. *Ocena plonowania nowych, polskich mieszańców F₁ papryki słodkiej w uprawie polowej na Lubelszczyźnie. [Evaluation of yields produced by new Polish F₁ hybrids of sweet pepper in Fidel cultivation in the region of Lubelszczyzna]*. Mat. VII Ogólnopolskiego Zjazdu Hodowców Roślin Ogrodniczych, Szczecin, 377-380 ss. (in Polish)
- BUCZKOWSKA H. 2004. *Wpływ zagęszczenia roślin na wzrost i plonowanie papryki słodkiej odmiany 'Mino'. [Effect of increasing plant stand density on growth and yield of cv. Mino sweet pepper]*. Fol. Univ. Agric. Stetin., Agric., 239 (95): 27-32. (in Polish)
- BUCZKOWSKA H., KUZUYK K., NAJDA A. 2001. *Wpływ cięcia ogławiającego roślin na zawartość niektórych składników w owocach papryki słodkiej. [Effect of head cut of plants on the content of some nutrients in sweet pepper fruits]*. Zesz. Nauk. ATR w Bydgoszczy, 234, Rolnictwo, 46: 33-37. (in Polish)
- GAJC-WOLSKA J., SKAPSKI H. 2001. *Ocena nowych polskich odmian papryki słodkiej uprawie polowej. [Evaluation of new Polish cultivars of sweet pepper in Fidel cultivation]*. Fol. Hort. Ann., 13 (1A): 257-266. (in Polish)
- HOWARD L.R., TALCOTT S.T., BRENES C.H., VILLALON B. 2000. *Changes in phytochemical and antioxidant activity of selected pepper cultivars (Capsicum species) as influenced by maturity*. J. Agric. Food. Chem., 48: 1713-1720.
- JADCZAK D., GRZESZCZUK M. 2009. *The estimation of yielding and biological value of some cultivars of sweet pepper grown in the climatic conditions of Western Pomeranian region of Poland*. Acta Hort. (in print).
- KORZEŃ A., PERUCKA I. 1978. *Zawartość witaminy C, sumy chlorofili a i b, karotenów oraz suchej masy kilku odmian papryki słodkiej. [Content of C vitamin, sum of chlorophyll a and b, carotens and dry master in some sweet pepper cultivars]*. Roczn. Nauk Rol., Ser. A 103 (3): 19-34. (in Polish)
- OLSZEWSKA D., NOWACZYK P. 2004. *Charakterystyka użytkowania wybranych gatunków z rodzaju Capsicum. [Characteristics of some species of the genus Capsicum]*. Fol. Univ. Agric., Stetin., Agric., 239 (95): 275-278. (in Polish)

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- OSUNDE Z.D., MUSA MAKAMA A.L. 2007. *Assessment of changes in nutritional values of locally sun-dried vegetables*. AUJT, 10(4): 248-253.
- PERUCKA I. 1995. *Wpływ nawożenia potasowego na zawartość mikroelementów i potasu w owocach wybranych odmian papryki (Capsicum annuum L.). [Effect of potassium fertilization on content of micronutrients and potassium in fruits of some pepper (Capsicum annuum L.) cultivars]*. Ann. UMCS, Sect. E, 50: 169-174. (in Polish)
- PERUCKA I., MATERSKA M., SENCZYNA B. 2004. *Zawartość potasu, magnezu i wapnia w owocach wybranych odmian papryki ostrej poddanych działaniu jonów Ca^{2+} . [Content of potassium, magnesium and calcium of some hot pepper cultivars affected by Ca^{2+} ions]*. J. Elementol., 9(4): 667-673. (in Polish)
- PN-92/A-75112. *Owoce, warzywa i ich przetwory. Oznaczenie zawartości azotynów i azotanów [Fruits, vegetables and fruit and vegetable products. Determination of the content of nitrites and nitrates]*. (in Polish)

