Roczniki Akademii Rolniczej w Poznaniu – CCCLX (2004)

ANNA GOLCZ, PAWEŁ KUJAWSKI

EVALUATION OF THE BIOLOGICAL VALUE OF THE FRUIT OF SEVERAL HOT PEPPER (*CAPSICUM ANNUUM* L.) CULTIVARS

From Department of Horticultural Plants Nutrition
The August Cieszkowski Agricultural University of Poznań

ABSTRACT. The biological value of the fruit of hot pepper five cultivars: 'Cyklon', 'Orkan', 'Wulkan', 'Chillina' and 'Devilla' was compared. It was found that the quality parameters depend on the cultivar. The highest content of dry mass was identified in cv. 'Wulkan' and the lowest one in cv. 'Chillina'. On the other hand, the highest yield of dry mass, capsaicinoids and carotenoids was found in cultivars 'Devilla' and 'Chillina'. A significant positive correlation between the content of dry mass and capsaicinoids was found in Polish cultivars: 'Cyklon', 'Orkan' and 'Wulkan'. Independently of the cultivar the fruit of hot pepper accumulated the greatest amounts of potassium and nitrogen.

Key words: hot pepper, cultivar, the biological value of fruit

Introduction

The fruit of hot pepper (*Capsicum annuum* L.) contain great amounts of capsaicinoids, C vitamin, carotenoids and flavonoids pigments (**Buczkowska** et **al.** 2001 a), sugars and mineral components (**Bubicz** et **al.** 1999, **Perucka** 1995).

Capsaicinoids and their derivatives give a sharp acrid taste (**Buczkowska** et **al.** 2001 a) and show a high biological activity. They are known for their pharmacological, neurological and dietetic actions (**Perucka** 1995).

The aim of the presented studies was to compare the biological value and the content of mineral components in the fruit of three indigenous cultivars ('Cyklon', 'Orkan', 'Wulkan') and two foreign cultivars ('Chillina' and 'Devilla') of hot pepper.

Rocz. AR Pozn. CCCLX, Ogrodn. 38: 37-42

PL ISSN 0137-1738

Material and methods

The studied cultivars of hot pepper were grown in the identical conditions with the application of the same agrotechnical treatments. The fruit were harvested once in the phase of their physiological maturity in the third decade of August.

The chemical composition of the fruit was analysed in the laboratories of the Horticultural Plant Nutrition and Plant Physiology Departments.

Bulk sample of fruit were taken from every combination.

The plant material was dried at ±35°C and homogenized. Subsequently, it was extracted in 2% CH_3COOH (**Nowosielski** 1988).

The following determinations were carried out: P by colorimetric method with ammonium vanadic-molybdate; K, Ca, Na – photometrically; Mg – by atomic spectrometry absorption method; S-SO_4, Cl – by nephelometric method.

After wet mineralization of plant material in concentrated sulphosalicilic acid, total nitrogen was determined by Kjeldahl's method.

Dry mass was determined by the drying and weighing method. Capsaicinoids were identified colorometrically with ammonium vanadate according to Polish pharmacopea IV (1970) and carotenoids were determined colorometrically (**Buczek** 1996).

Statistical analyses were calculated using Duncan's test at the significance level of $\alpha = 0.05$.

Results and discussion

On the basis of an analysis of the obtained results, it was shown that dry mass of fruits differed significantly depending on the cultivar (Table 1).

The greatest content of dry mass in fruit was found in cv. 'Wulkan' (22.81%) and the least content was shown by cv. 'Chillina' (11.64%). Data contained in the literature report that the dry mass content was from ±11% (**Bubicz** et **al.** 1981, **Orłowski** et **al.** 2003) to ±13% (**Buczkowska** and **Najda** 2002)while in our studies, the average content of dry mass was higher amounting to 15.76%.

Polish cultivars: 'Cyklon', 'Orkan' and 'Wulkan' contained more dry mass than foreign cultivars: 'Chillina' and 'Devilla'. An opposite regularity was recorded in the yield of dry mass.

Capsaicine and its derivatives are synthesized in the early developmental phases of fruit (**Węglarz** 1994). On the other hand, there are contradicting opinions regarding the period when the content of these compounds reaches the maximum. Some researchers argue (**Bubicz** et **al.** 1981) that the amount of capsaicine in developed fruit is maintained on an equal level. **Blaim** (1965), **Michna** (1968) reported that the highest value of capsaicine is reached in the full colour phase and in the physiological maturity of fruit.

The content of capsaicine oscillates between 0.12 and 1.69% (**Nowiński** 1983). The Polish standard requires not less than 0.18% of this alkaloid (Polish pharmacopea IV 1970).

Table 1

Selected parameters of fruit quality of five hot pepper cultivars
Wybrane parametry jakości owoców pięciu odmian papryki ostrej

Items Cecha		Cultivar – Odmiana					Mean Średnia	NIR $\alpha_{0.05}$
		Cyklon	Orkan	Wulkan	Chillina	Devilla		
Dry matter Sucha masa	content zawartość (%)	16.56 b*	14.24 c	22.81 a	11.64 e	13.55 d	15.76	0.488
	yield ($g \cdot plant^{-1}$) plon ($g \cdot rośl.^{-1}$)	61.7 d	63.7 bc	62.7 cd	65.2 b	69.8 a	64.6	1.879
Capsaicinoids Kapsaicynoidy	content (% d.m.) zawartość (% s.m.)	0.203 ab	0.173 b	0.220 a	0.235 a	0.205 ab	0.207	0.041
	yield ($mg \cdot plant^{-1}$) plon ($mg \cdot rośl.^{-1}$)	125.0 cb	110.4 c	137.7 ab	153.2 a	143.2 ab	133.9	25.64
Carotenoids Karotenoidy	content zawartość (mg %)	3.568 a	1.789 b	2.191 b	1.590 b	3.210 a	2.470	0.920
	yield ($mg \cdot plant^{-1}$) plon ($mg \cdot rośl.^{-1}$)	13.29 a	8.01 b	6.02 b	8.90 b	16.53 a	10.55	3.843

*Means followed by the same letters are insignificantly different.
*Średnie oznaczone tymi samymi literami nie różnią się istotnie.

The content of capsaicine depends mainly on the cultivar. It is also modified by such factors as climate, cultivation conditions, agrotechnical treatments, drying are storage of fruit (**Bubicz** et **al.** 1981, **Lewandowski** 1992, **Buczkowska** et **al.** 2001 b).

In the studies, the mean value of capsaicinoids was 0.207% d.m. The highest statistically significant contents and yield of capsaicinoids were obtained in cultivars Chillina and Wulkan, and slightly lower contents, not significantly differing between each other, were found in cv. 'Devilla' and cv. 'Chillina'. The lowest content of this alkaloid was shown by cv. 'Orkan'.

Bubicz et **al.** (1981) showed a close correlation between the content of capsaicine and dry mass. In our studies, this regularity was confirmed in the Polish cultivars 'Wulkan', 'Cyklon' and 'Orkan' (Fig. 1). In case of heterotic cultivars 'Devilla' and 'Chillina', such correlation did not occur, which corresponds with literature data (**Michna** 1968).

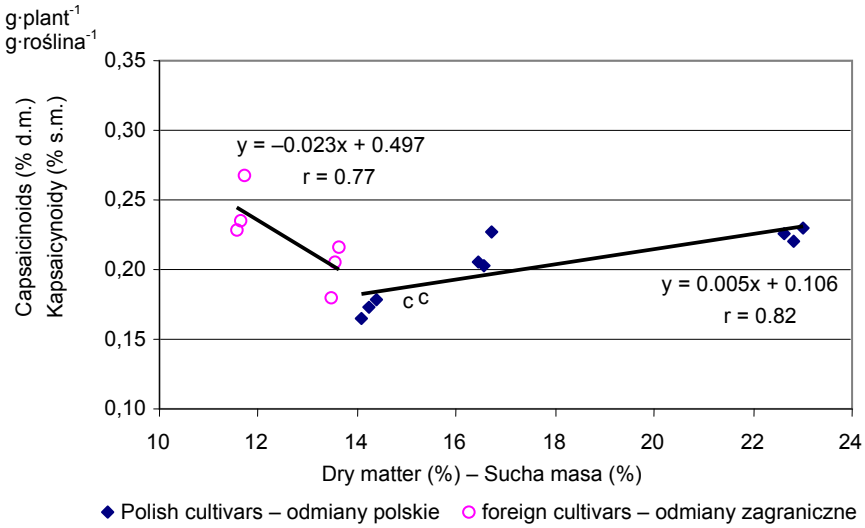

Fig. 1. Correlation between the content of dry matter and capsaicinoids in the fruit of several hot pepper cultivars
Ryc. 1. Korelacja między zawartością suchej masy i kapsaicynoidów w owocach wybranych odmian papryki ostrej

The colour of fruit depends on the presence of carotenoidal and flavonoidal pigments. The content of carotenoids in the physiologically mature fruit oscillates between 2.82 and 3.10 mg % (**Michna** 1966). In our studies, the mean content of carotenoids was 2.47 mg %. The greatest content of carotenoids was found in cv. 'Cyklon' 3.57 mg % and in cv. 'Devilla' 3.21mg %, while the least content was shown by cv. 'Chillina' 1.59 mg %.

Table 2

Chemical composition of fruits of five hot pepper cultivars
Skład chemiczny owoców pięciu odmian papryki ostrej

Nutrient content Zawartość składnika	Cultivar – Odmiana					Mean Średnia
	Cyklon	Orkan	Wulkan	Chillina	Devilla	
N-total N-ogółem	1.95	2.20	2.66	1.92	2.24	2.19
P	0.23	0.26	0.19	0.28	0.31	0.25
K	2.59	2.66	2.85	2.59	2.94	2.73
Ca	0.18	0.19	0.16	0.23	0.22	0.20
Mg	0.20	0.25	0.27	0.23	0.23	0.24
Na	0.18	0.16	0.19	0.19	0.18	0.18
Cl	0.65	0.19	0.65	0.71	0.20	0.48
$S\text{-}SO_4$	0.228	0.210	0.200	0.233	0.269	0.228

The fruit of hot pepper were characterized by high amount of mineral components (**Rumińska** 1981). Independently of the cultivar fruit, contained the greatest amounts of potassium and nitrogen, significantly less chlorine and mineral amount of phosphorus, magnesium, calcium, sulphate and sodium (Table 2). There occurred great differences between the cultivars in the chemical composition. In comparison to the others studied cultivars the fruit of cv. 'Wulkan' contained the greatest amount of total N, magnesium and sodium. The fruit of 'Chillina' accumulated significant amounts of chlorine, calcium and sodium, while the fruit of Devilla accumulated potassium, phosphorus and sulphates. The least amounts of magnesium were recorded in 'Cyklon' and the least amount of chlorine and sulphates were shown by cv. 'Orkan'.

Conclusions

1. In the fruit of hot pepper, the content of dry mass, capsaicinoids, carotenoids and mineral components was diversified depending on the cultivar.
2. Cultivar 'Wulkan' was distinguished by the greatest (22.8%) amount of dry mass, while 'Chillina' showed the least content (11.6%) of it.
3. In cultivars 'Devilla' and 'Chillina', the greatest yields of dry mass, capsaicinoids and carotenoids were obtained as compared to 'Cyklon', 'Orkan' and 'Wulkan' cultivars.
4. A significant positive correlation was found between the content of dry mass and capsaicinoids in Polish cultivars, while a negative correlation was shown between the foreign cultivars.
5. The fruit of hot pepper, independent of the cultivar, accumulate the greatest amounts of total N, while the amounts of Cl, P, Mg, S-SO_4, Ca and Na are accumulated in a significantly lesser degree.

References

Blaim K. (1965): Swoiste substancje roślin uprawnych. PWRiL, Warszawa.

Bubicz M., Korzeń A., Perucka I. (1981): Wpływ nawożenia potasowego na zawartość kwasu α-askorbinowego, β-karotenu i kapsaicyny w owocach papryki. Rocz. Nauk Roln. 104: 43-52.

Bubicz M., Perucka I., Materacka M. (1999): Zawartość biopierwiastków w owocach wybranych odmian papryki słodkiej i ostrej (*Capsicum annuum* L.). Biul. Magnezol. 4, 2: 289-292.

Buczek J. (1996): Ćwiczenia z fizjologii roślin. Wyd. Uniw. Wroc., Wrocław.

Buczkowska H., Dyduch J., Najda A. (2001 a): Kształtowanie się zawartości niektórych składników chemicznych w owocach papryki ostrej w zależności od odmiany i wielokrotności zbioru. Zesz. Nauk. AT-R Bydg. 234, Roln. 46: 27-32.

Buczkowska H., Dyduch J., Najda A. (2001 b): Wpływ odmiany oraz warunków pogodowych na plon suchej masy i ilość kapsaicynoidów z owoców papryki ostrej. Ann. Univ. Mariae Curie-Sklodowska Sect. EEE 9: 151-158.

Buczkowska H., Najda A. (2002): A comparison of some chemical compounds in the fruit of sweet and hot pepper (*Capsicum annuum* L.). Folia Hortic. 14, 2: 59-67.

Lewandowski A. (1992): Nowe odmiany pieprzowca rocznego i ostropestu plamistego. Wiad. Zielar. 6: 22-23.

Michna M. (1966): Kształtowanie się niektórych składników chemicznych w zależności od stopnia dojrzałości owoców u kilku odmian papryki pochodzenia zagranicznego. Rocz. Nauk Roln. Ser. A. 91, 2: 421-429.

Michna M. (1968): Zawartość kapsaicyny i plon suchej masy w owocach pierwszego pokolenia mieszańców różnych odmian papryki. Hod. Rośl. Aklim. Nasienn. 3: 37-46.

Nowiński M. (1983): Dzieje upraw i roślin leczniczych. PWRiL, Warszawa.

Nowosielski O. (1988): Zasady opracowywania zaleceń nawozowych w ogrodnictwie. PWRiL, Warszawa.

Orłowski M., Grzeszczuk M., Jadczak D. (2003): Ocena plonowania i wartości odżywczej wybranych odmian papryki ostrej (*Capsicum annuum* L.). Folia Hortic. Supl. 2: 325-327.

Perucka I. (1995): Efekt działania etefonu na wzrost roślin oraz akumulację karotenoidów i kapsaicynoidów w owocach papryki ostrej *Capsicum annuum* L. Rozpr. Nauk. AR Lubl. 189.

Polish pharmacopea IV. T. 2. (1970). PZWL, Warszawa.

Rumińska A. (1981): Rośliny lecznicze. PWN, Warszawa.

Węglarz Z. (1994): Badania nad rozwojem i plonowaniem papryki rocznej (*Capsicum annuum* L.) odmiany Bronowicka ostra w warunkach częściowego zniesienia dominacji wierzchołkowej roślin. Rozpr. Nauk. Monogr. SGGW 175: 1-47.

OCENA WARTOŚCI BIOLOGICZNEJ OWOCÓW KILKU ODMIAN PIEPRZOWCA ROCZNEGO (*CAPSICUM ANNUUM* L.)

S t r e s z c z e n i e

Porównywano wartość biologiczną owoców pięciu odmian pieprzowca rocznego: ‘Cyklon’, ‘Orkan’, ‘Wulkan’, ‘Chillina’ i ‘Devilla’. Stwierdzono zależność analizowanych parametrów jakościowych od odmiany. Największą zawartość suchej masy oznaczono u odmiany ‘Wulkan’, a najmniejszą u odmiany ‘Chillina’, natomiast największy plon suchej masy, kapsaicynoidów i karotenoidów uzyskano u odmian ‘Devilla’ i ‘Chillina’. Wykazano istotną dodatnią korelację między zawartością suchej masy i kapsaicynoidów u polskich odmian – ‘Cyklon’, ‘Orkan’ i ‘Wulkan’. Niezależnie od odmiany owoce pieprzowca rocznego gromadziły najwięcej potasu i azotu.