

# The capsaicin and dihydrocapsaicin contents in soft-flesh fruit of *Capsicum frutescens* L. and *Capsicum annuum* L. hybrids

P. NOWACZYK<sup>1</sup>, L. NOWACZYK<sup>1</sup>, M. BANACH<sup>2</sup>, A. WOŹNA<sup>1</sup>

<sup>1</sup>Department of Genetic and Plant Breeding

<sup>2</sup>Department of Environmental Chemistry

University of Technology and Agriculture

Bernardyńska 6, 85-029 Bydgoszcz, Poland

e-mail:warz@atr.bydgoszcz.pl (P. Nowaczyk)

## S u m m a r y

Soft-flesh fruit can be used to produce juices or pastes obtained by mechanical separation of the soft tissue of pericarp from inedible parts. Genotypes selected from interspecific hybrids of *Capsicum frutescens* L. and *Capsicum annuum* L. were used as the research material. A general assessment of technological usefulness of the fruit was carried out, and as a result it was noted that there was some diversity in the sizes of the ripe fruit, their mean weight and wall thickness. Significant differences were observed in biotechnological performance – understood as the amount of pericarp separated from inedible parts, namely the placenta with seeds, the remnants of internal partitions and the peel. An HPLC analysis was carried out in order to determine the capsaicin and dihydrocapsaicin contents. The genotypes under examination differed in terms of the contents of capsaicinoids, as well as their ratios. The average values for genotype groups were comparable, and capsaicin and dihydrocapsaicin participation was similar. Considering the amounts of capsaicinoids, the genotypes with the highest content of them can be classified as mildly piquant.

*Key words: biotechnological performance, capsaicin, dihydrocapsaicin, HPLC*

## INTRODUCTION

Obtaining material sources for the production of original nutritional articles can take place by means of inducing new plant species or genetic improvement of species that are currently used. There is also a solution combining the two options, namely creating interspecific hybrids. In the case of the genus *Capsicum*, this can relate to *C. annuum* L., a species of high production performance, and *C. frutescens* L., characterised by presence of soft-flesh forms and diverse content of capsaicinoids [1].

Soft-flesh fruit can be a very interesting material for the production of juices or pastes. The technology employed consists in mechanical separation of the soft tissue of pericarp from inedible or ballast parts of the fruit (placenta, seeds and peel). The product is homogenous, and eliminating heat treatment from the production process enables retaining the heat-sensitive ingredients. Depending on the content of capsaicinoids, one can create mixtures with a specific degree of piquancy. Moreover, standardisation of the product becomes easier, which is vital from the point of view of active food quality and nutraceuticals. Undoubtedly, articles produced from pepper fruit can be of such character, as they are rich in antioxidants [2, 3]. It is also worth noting that according to the latest research work, capsaicin reduces obesity [4].

The above-mentioned standardisation of the product as regards capsaicinoids is related to their presence in fruit, and provides a good analysis method for them. The compounds may be limited to capsaicin and dihydrocapsaicin. According to the research results published by Zewdie and Bosland [5], in the major species they constitute over 90% of the total content of capsaicinoids. Currently, the best method of qualitative and quantitative determination is the high performance liquid chromatography [6].

The prime aim of the research was to assess the materials selected from inter-specific hybrids of soft-flesh *Capsicum frutescens* L. and *C. annuum* L., as to their contents of the above-mentioned capsaicinoids, and at the same time to state the general functional characteristics of the material under examination.

## MATERIAL AND METHODS

Fruit picked from F<sub>5</sub> generation of the fruit of the inter-specific hybrids of *Capsicum frutescens* L. and *C. annuum* L. was the analysed material. Two lines, revealing high phenotype uniformity, were chosen from the selected hybrids. Out of 50 plants of each line, marked with the symbols of 33/1 and 33/3 and grown in a foil tent, four – most typical of the phenotypes under observation – were chosen for each line. The yield of ripe fruit was established, as well as the average weight and wall thickness of the fruit. After separating the soft tissue of the pericarp from inedible parts of the fruit, on a sieve with 1-mm meshes, biotechnological performance was established, which is the percentage of the obtained paste in the technological weight of the fruit. This in turn signifies the fruit deprived of pedicles and calyx sepal.

The analysis of capsaicin and dihydrocapsaicin content was carried out by means of HPLC with a Perkin Elmer S 200 device, carefully following the method described by Collins et al. [7]. A few ripe fruit of each plant were chosen at random. Having had their placentas with seeds removed, they were put to dry at the temperature of 58-60 °C for three days. The dried fruit were ground directly before analysis, and 1.5-g samples were prepared. Each sample was analysed in

four replications. The content of capsaicinoids under examination in ppmH was established after performing the analysis, using the formula given in the above-mentioned publication. Multiplying the results by the index of 15 enabled presenting them in Scoville Units (SU), which are universally understood and used in the assessment of taste piquancy. The volume of the lowest significant difference was determined by means of Tukey's test with  $P = 95\%$ . In tables, the data that were statistically different are identified by different letters.

## RESULTS AND DISCUSSION

A key issue in the production of nutraceuticals is maintaining full biological and taste qualities of the plant material. Eliminating or reducing heat treatment may be one of the factors contributing to achieving this goal. The soft flesh of the examined genotypes of pepper enables mechanical separation of edible and inedible parts of fruit. Soft-flesh materials selected from interspecific hybrids of *Capsicum frutescens* L. and *C. annuum* L. revealed morphological diversity. Consequently, the yield quantities of ripe fruit were also different (Table 1). The average fruit weight, as far as the selected lines are concerned, was not diverse, with fluctuations between individual fruit within the limits of 20 g and 45 g. The observed values were several times higher than those noted by Sreelathakumary and Rajamony [8] for the genotypes of *C. frutescens* L. The average fruit weight is a consequence of the fruit size and wall thickness. The value of the latter ranged from approximately 2.5 mm to almost 4.5 mm.

Table 1

The general characteristic of genotypes.

genotype	yield per plant [kg]	mean fruit weight [g]	wall thickness [mm]	biotechnological performance (in per cent)
33/1/2	0.74	32	4.42	74
33/1 /4	0.67	45	4.45	39
33/1/43	0.65	27	3.62	65
33/1/50	0.55	30	3.69	59
<b>mean</b>	<b>0.62</b>	<b>34</b>	<b>4.05</b>	<b>59</b>
33/3 /3	0.61	28	3.67	56
33/3 /31	0.47	20	2.40	43
33/3 /33	0.39	33	3.00	53
33/3 /44	0.51	43	3.59	59
<b>mean</b>	<b>0.50</b>	<b>31</b>	<b>3.16</b>	<b>53</b>

Soft-flesh fruit used for producing juices and pastes should have high biotechnological performance, or with a high percentage of the final product in the mass of the raw material. Inedible ballast constituents are the placenta with seeds, peel, as well as remnants of the internal partitions. Their participation obviously influences the discussed fruit performance. The top level of this fruit characteri-

stic was found in 33/1/2 genotype. The obtained paste constituted nearly three fourths of the fruit mass. Only such genotypes can be used as initial material for further genetic improvement of plants.

The prime aim of the research was to assess the contents of capsaicin and dihydrocapsaicin. The results of experiments by Zewdie and Bosland [5] indicate that for the 'Thick cayenne' cultivar (*C. annuum* L.), the content of the mentioned capsaicinoids was 55% and 28%, respectively, while in the case of the 'Tabasco' cultivar (*C. frutescens* L.) the figures were 65% and 31%. The data obtained during our research work (Table 2) reveals how diversified the content of capsaicinoids is among the genotypes, while the average values show that their levels are similar. Lack of consistency in the presented results makes it impossible to formulate any conclusions. At the same time, this fact corroborates what the above-mentioned authors said, namely that the so-called capsaicinoid profiles cannot be considered to be good 'chemotaxonomic indicators'. The range of the absolute capsaicinoid content in our research material ranged from a few dozens to several hundred ppmH. Their total amount reached the maximal level in the 33/1/2 genotype. A very similar value was observed for the 33/3/33 genotype. Represented in Scoville Units, the capsaicinoid level was around 13,000. The analysed fruit can be therefore classified as slightly piquant. Unless it exceeds 200-300 ppmH (3,000-4,500 SU), the amount of capsaicinoids is virtually indiscernible in terms of pungent properties of these compounds.

Table 2

Capsaicinoids in ppmH and pungency in Scoville Units (SU 1000).

genotype	capsaicin	percentage	dihydrocapsaicin	percentage	SU (1000)
33/1/2	393 e	45	487 d	55	13.2 d
33/1/4	27 a	62	53 a	38	2.1 a
33/1/43	240 c	40	360 c	60	9.0 c
33/1/50	146 b	50	146 b	50	4.4 b
mean	217	45	261	55	7.1
33/3/3	100 b	65	53 a	35	2.3 ab
33/3/31	320 d	69	147 b	31	7.0 c
33/3/33	287 cd	34	553 e	66	12.6 d
33/3/44	133 b	87	20 a	13	2.3 ab
mean	210	52	194	48	6.1

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## ZAWARTOŚĆ KAPSAICYNY I DIHYDROKAPSAICYNY W OWOCACH TYPU *SOFT-FLESH* MIESZAŃCÓW *CAPSICUM FRUTESCENS* L. ORAZ *CAPSICUM ANNUUM* L.

P. NOWACZYK<sup>1</sup>, L. NOWACZYK<sup>1</sup>, M. BANACH<sup>2</sup>, A. WOŹNA<sup>1</sup>

<sup>1</sup>Katedra Genetyki i Hodowli Roślin

<sup>2</sup>Katedra Chemii Środowiska

Akademia Techniczno-Rolnicza

ul. Bernardyńska 6, 85-029 Bydgoszcz

e-mail:warz@atr.bydgoszcz.pl

### Streszczenie

Owoce typu *soft-flesh* mogą być surowcem do produkcji soków lub przecierów uzyskiwanych w wyniku mechanicznej separacji miękkiej tkanki perykarpu od części niejadalnych. Materiałem badawczym były genotypy wyselekcjonowane z mieszańców międzygatunkowych *Capsicum frutescens* L. oraz *Capsicum annuum* L. Dokonano ogólnej oceny przydatności technologicznej owoców, stwierdzając zróżnicowanie wielkości plonu owoców dojrzałych, ich średniej masy oraz grubości ścian. Zaobserwowano duże różnice wydajności biotechnologicznej, wyrażonej jako udział oddzielonej tkanki perykarpu od części niejadalnych, czyli łożyska z nasionami, resztek przegród wewnętrznych i skórki. Analiza HPLC pozwoliła określić zawartość kapsaicyny i dihydrokapsaicyny. Badane genotypy różniły się zarówno pod względem ilości kapsaicynoidów, jak i ich proporcji. Wartości średnie dla grup genotypów były zbliżone, a udział kapsaicyny i dihydrokapsaicyny podobny. Zaobserwowany poziom kapsaicynoidów pozwolił uznać genotypy o największej ich zawartości za lekko pikantne.

*Słowa kluczowe:* dihydrokapsaicyna, HPLC, kapsaicyna, wydajność biotechnologiczna