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INSTITUTUM AGRONOMICUM "DR. PETRU GROZA" CLUJ-NAPOCA (ROMANIA)
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CHEMOTAXONOMICAL RESEARCH IN HIGHER PLANTS (XVI) CAROTENOID PIGMENTS IN THE FRUITS OF SOME LOCAL VARIETIES OF CUCURBITA

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Abstract:

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The pigments of seven local Cucurbita varieties were determined. In the fruits only carotenoids with α- and β-ionone structure were identified: hydrocarbon carotenoids (α- and β-carotene), xanthophylls (cryptoxanthin, lutein, zeaxanthin) and xanthophyll epoxides (flavoxanthin, aloxanthin, mutatoxanthin, auroxanthin, violaxanthin, neoxanthin). Quantitatively, the main carotenoid pigments are β-caroten and zeaxanthin, flavoxanthin and violaxanthin. There are differences among the varieties of C. maxima, both quantitatively and qualitatively, due to genetic and/or environmental influences.

Key words: Carotenoids, local varieties, Cucurbita maxima

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The chemotaxonomic research of higher plants (1-3) we are now engaged in, have taken us to identify carotenoid pigments in the fruits of some local provenances and populations of Cucurbita maxima and one population of Cucurbita ficifolia harvested at various localities in Transylvania.

Plants belonging to the genus Cucurbita, besides their fairly important dietary and feeding value, host noteworthy quantities of carotenoids both in their flowers and in fruits (4). Flower and fruit colour is dictated by the nature and quantity of the carotenoid pigment. Thus, it is of utmost importance to know the carotene pigments in the fruits of some. C. maxima varieties, grown in several countries as food plants in order that they be used rationally in the food of both man and animal.

Material and method

The fruits were collected and described botanically by Doctor Attila T. Szabó (Germplasm Resource Laboratory, Botany Department of the Agronomy Institute at Cluj-Napoca). The samples represent local varieties from Transylvania (Tab. 1). Fruits were harvested in late September, 1983. The analyses were performed in December same year, with fresh fruit well kept for as long as two months after harvest.

Carotene pigments were extracted by means of a petroleum ether - acetone - methanol mixture, 6:3:1. For the separation and a mixture of magnesium oxide and fine sand for adsorbent, in 2:1 weight proportion. The development of the chromatographic column was performed by using a mixture of solvents, i.e., petroleum ether and acetone; the latter had been added gradually till it reached 2o % of the whole mixture.

The extraction, identification and dosing of carotene pigments had been undertaken as in previous investigations (1-4).

Results and discussion

In the fruits under investigation, there were identified only bicyclic carotenoids having α- and β-ioninic structure, often encountered in nature. There were not identified carotenoids possessing acyclic or monocyclic structure; neither were there met with ketocarotenoids or carotenoids which, besides the poligenic system, possess acetylene link, allene link or aromatic ring.

Of the hydrocarbon carotenoids under investigation, there were identified only α- and β-carotene. β-Carotene is in higher quantity, a very important fact, for one molecule of β-carotene two molecules of vitamin A can be formed within the animal organism. The presence of β-carotene and of the other provitamine carotenoids (α-carotene, cryptoxanthine), enhances the biological and feeding value of C.maxima fruits.

Table 1

Taxonomy and fruit morphology of the examined local varieties of Cucurbita (A.T. SZABÓ)

Nr. crt.	Germplasm registr. nr.	Genus, species	convar.	Locality of collection	Fruit length (mm)	Fruit width (mm)	Mezocarp colour	Mezocarp width (mm)	Exocarp colour	Exocarp width (mm)
1.	4o7-83	Cucurbita ficifolia	-	Vlaha	19o	16o	white	25	green-white striped	5
2.	492-83	Cucurbita maxima	maxima	Vlaha	16o	175	yellow	24	grey-green	2
3.	568-83	Cucurbita maxima	turbaneiformis	Turea	1oo	19o	yellow	6o	grey-green	,1
4.	74o-83	Cucurbita maxima	maxima	Mera	17o	14o	orange-yellow	32	white-grey	2
5.	743-83	Cucurbita maxima	maxima	Macău	11o	16o	"	28	"	1,5
6.	747-83	Cucurbita maxima	maxima	Macău	25o	14o	orange	35	green-white	1,5
7.	731-83	Cucurbita maxima	hollandrae	Suceag	7o	19o	"	4o	green, grey striped	

Of the free xanthophylls, cryproxanthin, lutein and zeaxanthin were identified in fruits. The later two xanthophylls, together with β-carotene, make up the main pigments.

Characteristic is the superunitary relationship between the zeaxanthin content and that of lutein, with the exception of sample 2-4o2. C.ficifolia Bouche (1-4o7) is very poor in xanthophylls; of these, only lutein was found but in meager quantity. Xantophylls are to be found freely in fruits, in contrast with petals where xanthophylls are esterified (1,4).

The fruits of several varieties of C. maxima contain rather large numbers of xanthophyll epoxides, but to a much lesser extent than that of the main pigments. Of the xanthophyll epoxides, a somewhat larger quantity is displayed by flavoxanthin, eloxanthin and neoxanthin, identified with all the investigated varieties. The other epoxides (mutatoxanthin, auroxanthin and neoxanthin) are present in very small quantities and had not been found in the fruits of all varieties investigated.

The colour range of the identified carotenoids is between orange, with β-carotene, cryptoxanthin and zeaxanthin and, rusty in violaxanthin and anteraxanthin. The rest of carotenoids, i.e. α-carotene, lutein, flavoxanthin, eloxanthin, mutatoxanthin and auroxanthin posses several shades of yellow. Due to the higher contents of orange carotenoids, they will dictate the colour of ripe fruits: orange-yellowish.

The colour range in fruits entirely depends on the colour of carotenoids contained. Of the identified carotenoids the α-iononic structure is to be found in α-carotene, lutein, flavoxanthin and in eloxanthin; the rest of carotenoids are of β-iononic structure.

The primary-extract content is higher than the sum of carotene pigments separated on column chromatography because, on one hand, during separation, purification, identification and dosing, a small quantity of carotenoids is lost and, on the other, the primary extracts contain, besides carotenoids, some other compounds too (chlorophylls, sterols, chinones, glycosides etc.); these enhance the extraction of the primary extract, thus rendering the exact determination of carotenoid content difficult.

Highest carotenoid content is to be found in the fruits of variant 5-743 followed by, in decreasing order, 3-568, 6-74o, 2-492, 6-747, 7-7-31 and 1-4o7. The last has an etremely low content in carotenoids.

Based on the present research, it is recommendable to utilize the fruits of 5-743, 6-74o, 3-568, 6-747 and 7-731 provenances.

Table 2

CAROTENOID-PIGMENTS CONTENT IN THE FRUIT OF CERTAIN LOCAL VARIETIES OF CUCURBITA (in µg/g) FRESH MATERIAL

Carotenoids	Samples (Varieties)						
	6-747	7-74o	3-568	5-743	7-731	2-492	1-4o7
a. HYDROCARBON CAROTENOIDS							
α-Carotene	1,32	1,65	1,78	1,21	1,96	1,41	-
β- Carotene	14,24	15,15	13,7o	8,91	5,11	7,97	o,64
b. XANTHOPHYLLS							
Cryptoxanthin	2,97	2,18	2,12	3,19	2,o3	2,51	-
Lutein	5,58	7,66	1o,28	7,78	4,62	7,38	o,48
Zeaxanthin	1o,36	19,64	12,56	8,24	6,o5	4,65	-
c. XANTHOPHYLL EPOXIDES							
Flavoxanthin	1,24	2,1o	o,87	1,96	o,85	o,43	o,1o
Eloxanthin	2,16	2,88	1,5o	2,33	1,83	o,78	o,24
Mutatoxanthin	o,28	o,48	o,36	o,24	-	-	-
Auroxanthin	o,76	o,83	o,63	o,39	-	-	-
Violaxanthin	1,77	1,82	1,96	1,74	o,86	1,46	o,18
Neoxanthin	o,58	o,64	o,83	o,68	-	-	-
Total	41,16	55,47	46,59	36,67	23,31	26,58	1,64
Total carotenoids (primary extract)	58,o8	83,84	11o,59	156,8o	36,9o	69,31	1,46

Finally, the first four populations of C.maxima contains many and various carotenoid pigments. These can be utilized as supplement in animal feeds, mostly in those meant for fowl, in order to intensify the colour of carcass, eggyolk, skin and fat, as well as for provitamin-A source for any diet.

Rezumat

NEAMȚU G., A.T. SZABÓ, DAN V., LUNG C., BLAJ O., 1984, Cercetări chemotaxonomice la plante superioare (XVI). Pigmenți carotenoidici în fructele unor soiuri locale de Cucurbita (în engleză). Not. bot. hort. agrobot. Cluj, XIV. 43-48

S-a determinat conținutul în pigmenți carotenoidici la șapte soiuri locale de Cucurbita. In fructe s-a putut identifica numai pigmenți carotenoidici cu structuri iononice α- și β ; carotenoide hidrocarburice (α - și β-carotine),xantofile (criptoxantină, luteină, zeaxantină), respectiv epoxizi xantofilici (flavoxantină, eloxantină, mutatoxantină, auroxantină, violaxantină, neoxantină). S-au găsit diferențe semnificative între soiurile locale examinate, diferențe determinate de cauze genetice sau de mediu.

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INSTITUTUM AGRONOMICUM "DR. PETRU GROZA" CLUJ-NAPOCA (ROMANIA)
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GREGOR MENDEL AND THE FOUNDATION OF GENETICAL RESEARCH IN AGROBOTANY

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Abstract:

OREL V., 1984, Gregor Mendel and the foundation of genetical research in agrobotany. Not. bot. hort. agrobot., Cluj, XIV.49-52

The accepted principles in research on plant germplasm were first formulated by G. MENDEL (1822-1884), as a result of carefully planned hybridisation experiments carried out on Pisum. Research perfomed by the staff of the Mendelianum (Moravian Museum) demonstrates, that the discovery was not a "bolt from the blue" as commonly supposed, but deeply rooted in the Central European plant breeding traditions. It is proved, that the "Pisum Project" was elaborated for solving the basic problems regarding the formation and development of hybrids, fundamental for the advancement of agrobotany and applied biology. It is demonstrated, that the interaction of the experimental-inductive work of MENDEL, the plant breeder and the hypotetical-deductive method of MENDEL, the mathematician, was fundamental for the discovery.

Key words: G. Mendel, germplasm research, Pisum.

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Mendel's scientific achievements were commemorated on different occasions in the past, and the relevant state of science was always the starting point for the evaluation. The fact is, that after 1900, Mendel's experimental approach in the research of heredity had a decisive role in the development of the new science - the genetics - which had the most poverfull influence in applied botany and in biology as a whole.

In the history of genetics Mendel was sometimes leonised as a scientist who, in the seclusion of the monastery, alone elaborated