Analysis of carotenoids in some Hungarian maize landraces

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Abstract

This work was conducted to estimate genetic variation among the different types of corn on the basis of carotenoid content. Fourteen accessions of three types of maize (convar.*mays*, convar. *dentiformis*, convar. *microsperma*) landraces from the germplasm collection at the Institute for Agrobotany were chosen that varied in endosperm color (yellow to orange). High performance liquid chromatography (HPLC) was used to assay carotenoids (polyoxycarotenoids, lutein, zeaxanthin, ß-zeacarotene, zeinoxanthin, cryptoxanthin) and total colour content. This study provides evidence for carotenoids differences among the maize landraces.

Introduction

Carotenoids (provitamin A) are lipid soluble antioxidants associated with decreased risk of several human diseases. Carotenoids occur naturally in corn (*Zea mays* L.) grain. Corn grain is a major component in diets of humans and animals, and improves nutritive value of meals with increased levels of vital carotenoids such as lutein, zeaxanthin (JOHNSON et al., 2000). Corn (maize) consumed on the cob or cut from the cob after cooking is usually considered a vegetable,but when dried, ground, whole, or refined, in cooked or baked foods, it is usually categorized as a cereal grain. There are red, yellow, white, red and mixed varieties. Yellow corn is important for its carotenoid vitamin A precursor value, considerable work has been done to breed yellow corn with high carotenoid content (BLESSIN et al.,1963). Two general classes of carotenoid pigments, carotenes and xanthophylls (or oxycarotenoids), are primarily responsible for the yellow color of maize. Although the content of xanthophylls is considerable higher (10 times) than that of carotene in kernels and leaves, the concentration of both classes of pigments varies appreciably with the genotype. Carotenoid and carotene content are influenced by genetical and environmental factors. Special corn varieties with high carotenoid content can be bred (BRUNSON, 1962).

Materials and methods

In this work 14 accessions of three types of maize (dent corn, flint corn and popcorn) landraces were analysed. These maize germplasms were collected from different sites of Hungary. The maize types, locations and geographical positions from where the maize landraces were collected were given in the *Table 1*.

Carotenoid content and composition was determined using high performance liquid chromatography (HPLC) method BIACS and DAOOD (1994). The extraction procedure started with moistening two grams of ground sample with 2 ml water followed by disintegration in a crucible mortar in presence of quartz sand. Then 20 ml methanol was added to bind the water. The carotenoids were then transfered to less polar solvent by shaking the mixture with 60 ml of 1:6 methanol-dichloroethan for 15 min. The two different phases were separated by adding few drops of water and the lower solvent layer was dried on anhydrous Na_2SO_4. The solvent was then evaporated and the residues were redissolved in 2 ml HPLC eluent. This sample was injected into the HPLC column after final filtration through a 0.45 µm PTFE syringe filter.

The Beckman System Gold (Fullerton, CA) high performance liquid chromatograph consisting of a model 114 solvent

Table 1: **Data for *Zea mays* accessions collected in Hungary**

Accession number	Genus	Species	Subtaxa	Site of collection	Origin	Latitude	Longitude	Altitude a.s.l. (m)
RCAT014697	Zea	mays L.	convar.dentiformis	Böcs	HUN	48° 02'	20° 58'	116
RCAT073209	Zea	mays L.	convar.dentiformis	Zalaszentgyörgy	HUN	46° 52'	16° 43'	226
RCAT014580	Zea	mays L.	convar.dentiformis	Martonvásár	HUN	47° 19'	18° 46'	121
RCAT073089	Zea	mays L.	convar.dentiformis	Zalaszentgyörgy	HUN	46° 52'	16° 43'	226
RCAT014077	Zea	mays L.	convar.dentiformis	Rózsafa	HUN	46° 01'	17° 52'	106
RCAT014411	Zea	mays L.	convar.dentiformis	Szõreg	HUN	46° 15'	20° 10'	75
RCAT014124	Zea	mays L.	convar.dentiformis	Kondoros	HUN	46° 46'	20° 48'	91
RCAT014180	Zea	mays L.	convar.mays	Gyõrzámoly	HUN	47° 43'	17° 34'	111
RCAT014416	Zea	mays L.	convar.mays	Letenye	HUN	46° 25'	16° 43'	141
RCAT014129	Zea	mays L.	convar.mays	Ásványráró	HUN	47° 49'	17° 30'	114
RCAT073067	Zea	mays L.	convar.microsperma	Zalaszentgyörgy	HUN	46° 52'	16° 43'	226
RCAT056699	Zea	mays L.	convar.microsperma	Tápiószecsõ	HUN	47° 27'	19° 36'	131
RCAT056698	Zea	mays L.	convar.microsperma	Tápiószecsõ A	HUN	47° 27'	19° 36'	131
RCAT056700	Zea	mays L.	convar.microsperma	Igal	HUN	46° 31'	17° 56'	178

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Table 2: **Carotenoid content and composition of different accessions of corn**

Site of collection	Carotenoids (µg/g) Polyoxy-carotenoids	Lutein & Zeaxanthin	β–zeacarotene	Zeino-xanthin	Crypto-xanthin	Other carotenoids	Total colour content
Böcs	2,72	6,43	0,51	0,54	0,56	0,27	11,51
Zalaszentgyörgy	2,54	7,53	0,54	0,63	0,73	0,21	11,49
Martonvásár	2,81	11,30	0,67	0,87	1,50	0,59	18,10
Zalaszentgyörgy	2,45	9,95	0,81	0,82	1,79	0,47	16,70
Rózsafa	10,17	5,51	0,36	0,06	1,64	3,66	24,94
Szõreg	4,40	4,17	0,56	0,06	1,15	0,98	12,46
Kondoros	2,85	2,13	0,17	0,05	0,73	0,79	7,54
Gyõrzámoly	3,37	2,85	0,52	0,09	0,72	1,07	9,44
Letenye	3,46	6,35	0,61	0,13	1,24	1,67	14,71
Ásványráró	3,41	4,33	0,60	0,08	0,89	1,08	11,18
Zalaszentgyörgy	2,27	10,05	0,31	0,92	2,05	0,12	16,04
Tápiószecsõ	1,16	4,94	0,12	0,44	0,71	0,83	8,74
Tápiószecsõ A	1,19	5,21	0,16	0,57	1,04	1,01	9,68
Igal	0,95	4,59	0,11	0,33	0,42	1,04	8,05

delivery pump and a model 166 variable wavelength ultraviolet-visible detector. Separation was carried out on a column (25 cm x 4,6 mm i.d.) packed with a Chromsil C-18 (5µm) using acetonitrile-methanol-isopropanol (200-210-100) as the mobile phase at a flow rate of 0.9 ml/min. The separated carotenoids were monitored at 450 nm. Peak identification and quantification were based on comparison of retention time and spectral characteristics of sample carotenoids with those of standard (lutein and β-carotene) and prepared authentic materials.

Results and discussion

In this study we compared different maize accessions for their carotenoids content and composition. Of the detected carotenoid components, lutein, zeaxanthin, zeinoxanthin cryptoxanthin, ß-zeacarotene could be identified. Lutein and zeaxanthin were the dominant carotenoids followed by the unidentified polyoxygenated compounds. As shown in *Table 2* the highest level of total carotenoids and colour content was recorded for the accession collected in Rózsafa location (RCAT014077). However, the content of the biologically active lutein, zeaxanthin and cryptoxanthin was not the highest in this accession. Accessions collected in Martonvásár (RCAT 014580) and Zalaszentgyörgy (RCAT 073067) had the highest concentration of lutein and zeaxanthin among the tested samples. In addition, these accessions contained the highest level of cryptoxanthin (precursor of vitamin A). Therefore, such accessions are of special interest from nutritional and biological points of view.

The data obtained from this work are useful to select the convenient types or accessions for further breeding and other applications in the field of human and animal nutrition.

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