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High performance liquid chromatographic profiling of carotenoids in sweet corn genotypes

Edward MUNTEAN
University of Agricultural Sciences and Veterinary Medicine Cluj Napoca, Romania
Research & Development Station for Agriculture, Turda, Romania
e-mail: edimuntean@yahoo.com

INTRODUCTION

Sweet corn is one of the most popular vegetables, being consumed all year round both fresh and preserved. It is highly appreciated not only for its particular taste, delicate flavor and sweetness but also for the nutritional properties, being a good source of carbohydrates, proteins, fiber, carotenoids and potassium [4]. Among the biologically-active compounds it contains, carotenoids have multiple beneficial effects for human health (free radical scavengers, antioxidants, positive effects in prevention of certain types of cancer (lung, breast, colon and prostate cancer)/ UV-induced skin damage/ coronary heart disease, cataracts and macular degeneration; besides, carotenoids with β- ring end groups taken from the diet act as precursors for the production of retinoids in animal cells. [1, 2, 5, 6]

Research objective: The major aim of this work is to characterize the carotenoid content from several commercial sweet corn genotypes.

MATERIALS & METHODS

Sampling and sample preparation: Plant material was produced by the Research and Development Station for Agriculture (RDSA) Turda (Romania), six hybrids being tested: Prima, Estival, Deliciul Verii, Dulcin, Delicios and Jubilee. Representative sweet corn kernels in milk stage were extracted with ethanol and acetone, the resulting suspension being filtrated under vacuum, then subjected to liquid-liquid extraction with diethyl ether-water (1 : 4)/evaporation to dryness in a rotary evaporator/ dissolution in ethyl acetate/ membrane filtration (0.47 µm).

Total carotenoids were determined by UV-VIS spectrophotometry using a T80+ instrument (PG Instruments Ltd, UK).

High performance liquid chromatography (HPLC) was accomplished on two systems, on which separations were monitored at 450 nm, using a Nucleosil 5-C_{18} column (Macherey Nagel)

1. for carotenoids' identification: Agilent 1100 (Agilent Technologies Inc., USA), consisting in a solvent degasser, a quaternary pump, an autoinjector, a photodiode array detector, a controller and a computer running Chemstation software.
2. for quantitative analysis: Flexar system (Perkin Elmer, USA), consisting in a solvent degasser, two UHPLC pumps, an autoinjector, an UV-VIS detector, a controller and a computer running Chromera software. The quantitative determinations were accomplished by the external standard method [3].

RESULTS

- The carotenoids identified on sweet corn grains from the studied genotypes were violaxanthin, antheraxanthin, lutein, zeaxanthin, β-cryptoxanthin, α-carotene, β-carotene, β-zeacarotene, δ-carotene; from these, lutein, zeaxanthin, β-cryptoxanthin and β-carotene were quantified, as well as the total carotenoids (Table 1).
- HPLC analysis revealed as major carotenoids lutein, zeaxanthin and β-cryptoxanthin, while β-carotene was a minor carotenoid, the HPLC fingerprints of carotenoids in the studied genotypes showing significant differences.
- Provitamin A carotenoids (β-cryptoxanthin and β-carotene) are present in low quantities, hence the recorded provitamin A values are rather modest; however, certain genotypes proved to contain relatively high amounts of lutein and zeaxanthin.
- HPLC analysis highlighted that lutein is the major carotenoid in most hybrids with concentrations in the range of 2.83-8.55 mg/ kg; the average concentrations of zeaxanthin and β- cryptoxanthin did not differ significantly (3.21 and 3.08 mg / kg respectively), while low concentrations were determined for β-carotene in the range of 0.14-0.70 mg/ kg.
- HPLC analysis revealed three HPLC fingerprint profiles, from which the most prominent ones are those having lutein as major carotenoid (illustrated in fig.1), those with β-cryptoxanthin as major carotenoid (fig.2) and those with both lutein and zeaxanthin as major carotenoids, β-cryptoxanthin being in much smaller amounts (not reported here)

Table 1. Descriptive statistics on carotenoids' content recorded in seven sweet corn genotypes produced at ARDS Turda [mg/ kg]

Parameter	Lutein	Zeaxanthin	β-cryptoxanthin	β-carotene	Total carotenoids
Mean value	4.73	2.23	1.59	0.33	9.37
Minimum value	2.83	1.47	1.03	0.14	6.25
Maximum value	8.55	3.21	3.08	0.70	14.01

Figure 1. HPLC chromatographic fingerprint of sweet corn kernels having lutein as major carotenoid

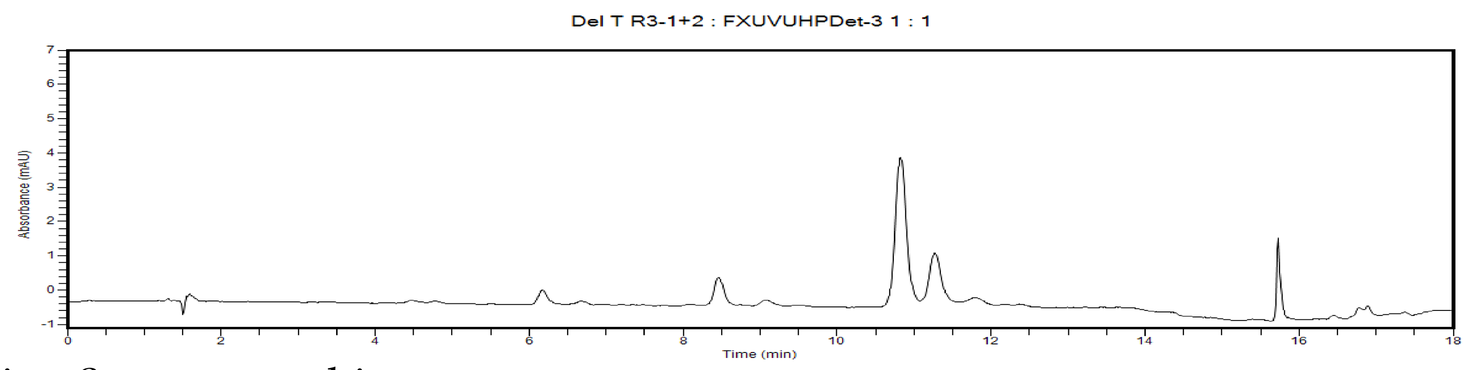
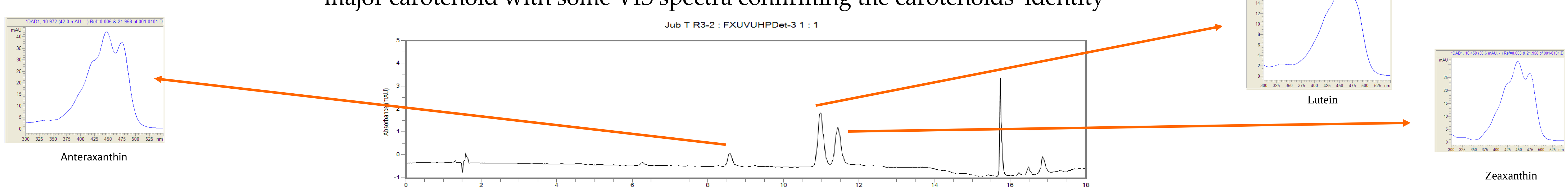


Figure 2. HPLC chromatographic fingerprint of sweet corn kernels having β-cryptoxanthin as major carotenoid with some VIS spectra confirming the carotenoids' identity



CONCLUSIONS

- Besides being a helpful tool for future nutrition studies, this work is in the meantime a valuable tool in assisting the research activity for improving the nutritional quality of sweet corn.
- Because provitamin A carotenoids (β-cryptoxanthin and β-carotene) are present in small quantities, the provitamin A value of the investigated hybrids is rather modest; however, certain hybrids proved to contain significant amounts of lutein and zeaxanthin, which are important in many physiological processes.

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