CAROTENOIDS IN SEVERAL TRANSYLVANIAN MAIZE HYBRIDS



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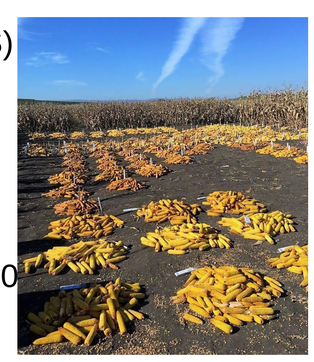
Introduction

The increased interest in the biotechnology of carotenoids has been mainly generated by their health-related antioxidant properties (Dube et al., 2018; Zhu et al, 2018). It is well-established that dietary carotenoids fulfill essential requirements for human nutrition (Conception et al. 2018). Carotenoids with β- ring end groups taken from the diet act as precursors for the production of retinoids in animal cells; vitamin A deficiency leads to xerophthalmia, blindness and premature death. Besides, carotenoids have multiple beneficial effects for human health, such as: the capacity of acting as free radical scavengers and antioxidants, while an inverse relationship exists between the dietary intake of carotenoid-rich foods such as fruit and vegetables and the incidence of cancer (lung, breast, colon and prostate cancer), UV-induced skin damage, coronary heart disease, cataracts and macular degeneration (Cooper, 2004; Demmig-Adams and Adams, 2013). Maize is one of the most important crops due to its high productivity and its multiple uses as a food source for humans, livestock feed and as raw material in various industries; among staple crops, it has a relatively high amount of carotenoids. The major aim of this work is to characterize the carotenoid content from several maize hybrids produced by the Agricultural Research and Development Station Turda.

Materials & methods

Sampling and sample preparation: kernels from 100 maize hybrids originating from the Agricultural Research and Development Station (ARDS) Turda were milled (WZ-1 laboratory mill, Sadkiewicz Instruments, Poland); samples of ~1 g were weighed and extracted with 50 mL ethanol, then with 50 mL acetone, the resulting suspension being filtrated each time under vacuum. A supplementary membrane filtration (0.47 μm) was accomplished before the spectrophotometric and chromatographic determinations.

Instruments: Determination of total carotenoids was accomplished using a T80+ UV-VIS spectrophotometer (PG Instruments Ltd, UK). High performance liquid chromatography (HPLC) was accomplished using a Flexar system (Perkin Elmer, USA), consisting in two UHPLC pumps, a solvent degasser, an autoinjector, an UV-VIS detector, a controller and a computer running Chromera software. Separations were monitored at 450 nm, using a Nucleosil 5-C_{18} column (Macherey Nagel), the quantitative determinations being accomplished by the external standard method (Muntean et al., 2008).



Results

- The carotenoids' content of maize grains from several maize hybrids produced by ARDS Turda revealed significant differences between total carotenoids (Table 1). HPLC analysis revealed that lutein is the major carotenoid in most hybrids with concentrations in the range of 2.75-10.13 mg/ kg; the concentrations of zeaxanthin and β- cryptoxanthin did not differ significantly (1.42 and 1.37 mg / kg respectively). Low concentrations were observed for β-carotene in the range of 0.15-1.93 μg / g.
- HPLC analysis, principal component analysis and cluster analysis revealed five HPLC fingerprint profiles (fig.1-5), from which the most prominent ones are those having lutein as major carotenoid (illustrated in fig.2) and those with b-cryptoxanthin as major carotenoid (fig.4)

Table 1. Carotenoid content recorded in 100 hybrids produced at ARDS Turda [mg/ kg]

Parameter	Lutein	Zeaxanthin	β-cryptoxanthin	β-carotene	Total carotenoids
Mean value	5.43	1.42	1.37	0.54	10,49
Minimum value	2.75	0.48	0.21	0.15	4.13
Maximum value	10.13	4.17	4.07	1.93	24,22
Range	7.38	3.69	3.86	1.78	20.09

Fig.1 Cluster analysis using Ward's method & Mahalanobis distance

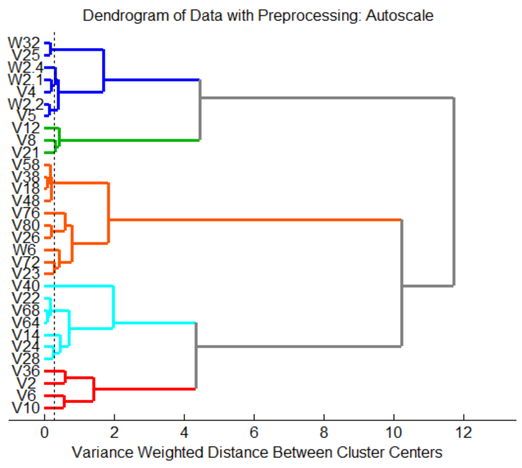


Fig.2 Biplot for experimental data

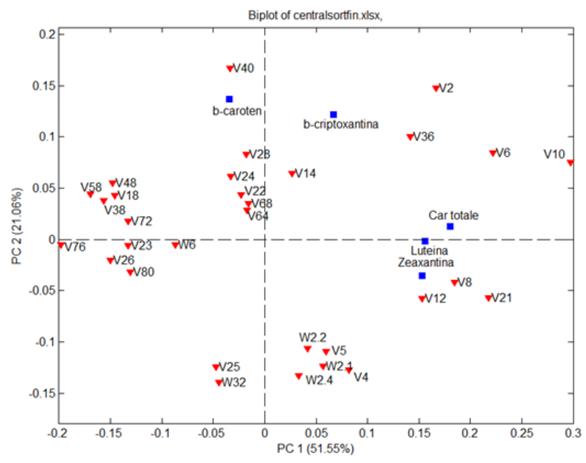


Figure 3. HPLC chromatographic fingerprint of maize kernels having lutein as major carotenoid (cluster 2 – samples V8, V12,

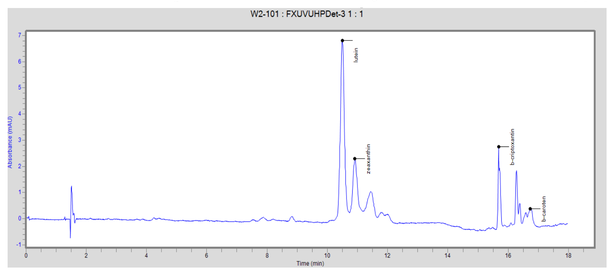


Figure 4. HPLC chromatographic fingerprint of maize kernels having β-cryptoxanthin as major carotenoid (cluster 5 - samples V2, V6, V10, V36)

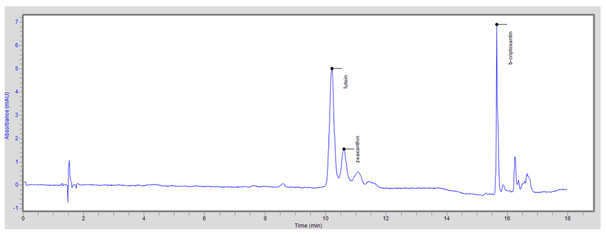
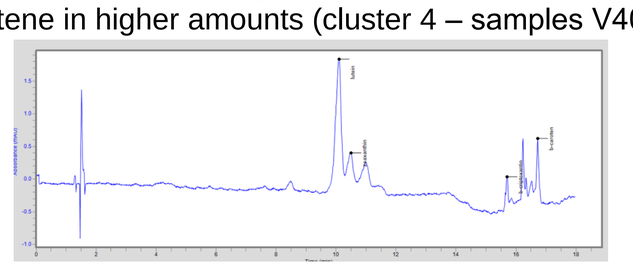


Figure 5. HPLC chromatographic fingerprint of maize kernels having β-carotene in higher amounts (cluster 4 – samples V40… V28)



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 improvement the nutritional quality of maize. 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 – important in in many physiological processes.

Acknowledgements

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