

Bioactive Compounds and Antioxidant Capacity from Five Types of Seedlings

Florina COPACIU, Andrea BUNEA*, Loredana BERENGEA, Sanda ANDREI, Dumitrița RUGINĂ, Adela PINTEA

Department of Chemistry and Biochemistry, University of Agricultural Science and Veterinary Medicine, 3-5 Manastur Street, 400372, Cluj-Napoca, Romania

* corresponding author: andrea_bunea@yahoo.com

Bulletin UASVM Animal Science and Biotechnologies 73(2)/ 2016

Print ISSN 1843-5262; Electronic ISSN 1843-536X

DOI:10.15835/buasvmcn-asb: 12285

Abstract

After germination process, the green seedlings accumulate important quantities of bioactive compounds such as: enzymes, vitamins, minerals, chlorophylls and nutrients. The current study presents a comparison between different bioactive compounds and their antioxidant capacity, after the seedling germination and growth of five seeds (arugula, lentil, wheat, beans and mustard) both on soil, in a pot (natural system), and directly on cotton wool soaked, in water (artificial system). In this study the carotenoids content and the antioxidant capacity were analysed. The data of the present study showed that the highest amount of zeaxanthin and β - carotene was found in cultivars of wheat grown in natural system, while the highest antioxidant activity was found in cultivars of wheat, lentils and beans, though in this case with no statistical differences between the systems. The results show statistical differences between the values of bioactive compounds in the five types of seedlings but also in the values obtained for the same seedlings in different systems. The best cultivars for improving the nutritional quality for human consumption are wheat seedlings followed by lentil ones.

Keywords: *antioxidant capacity, bioactive compounds, seedling*

INTRODUCTION

In order to improve the quality of vegetables, germination is considered to be one of the most effective processes (Świeca *et al.*, 2012; Pajak *et al.*, 2014). The effect of germination methods on the nutraceutical value of vegetables like mung beans or lentils has been researched according to the current literature.

The research has shown that germinated seeds contain higher quantity of nutrients, especially amino acids, vitamins, minerals and peptides, (Frias *et al.*, 2002; Kuo *et al.*, 2004) and lower levels of non-nutrients notably trypsin inhibitors, tannins, lectins and galactosides (Ibrahim *et al.*, 2002; Urbano *et al.*, 2005) by comparison with ungerminated seeds. Literature shows that due to germination, the content of polyphenolic

antioxidants in various vegetables has changed (López-Amorós *et al.*, 2006; Oomah *et al.*, 2011).

Wheat sprouts contain lipids which are high in unsaturated fatty acids, vitamin E and also contain numerous minerals, thiamine, with co-factor enzymatic role. Wheat grains have low levels of vitamin A and do not contain vitamins C and D (Bushuk, 2001). Mustard sprouts contain high levels of vitamins (A, B1, B2, B12, C), enzymes, proteins, chlorophyll and minerals while arugula seedlings represent a rich source of fiber and vitamins and have high quantities of iron and potassium and low calories. By comparison to dry seeds, studies have shown that common bean sprouts have a lower content of non-nutrients and higher levels of nutrients (Lopez *et al.*, 2013). In addition, during bean dietary fiber

levels germination and phenolic composition are enhanced (Dueñas *et al.*, 2016).

AIMS AND OBJECTIVES

The current study presents a comparison between different bioactive compounds and their antioxidant capacity, after the seedling germination and growth of five seeds (arugula, lentil, wheat, beans and mustard) both on soil in a pot (natural system) or directly on cotton wool soaked in water (artificial system).

MATERIALS AND METHODS

Carotenoids were extracted from 1 g sprouts with a mixture of methanol/ethyl acetate/petroleum ether (1:1:1, v/v/v). The extracts were partitioned in a separatory funnel with water, diethyl ether and saline solution; the ether phase was evaporated to dryness. The residue obtained

was diluted with TBME/methanol, filtered (PTFE, 0.45 μm) and subjected to high-performance liquid chromatography-photodiode array detector (HPLC-PDA) analysis.

The determination of total antioxidant capacity was performed by using the free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) method. The DPPH radical scavenging activity is generally quantified in terms of inhibition percentage of the pre-formed free radical by antioxidants, and the EC₅₀ (concentration required to obtain a 50% antioxidant effect) is a typically employed parameter to express the antioxidant capacity and to compare the activity of different compounds.

RESULTS AND DISCUSSION

Table 1 shows data regarding the lutein, zeaxanthin, β -carotene and total carotenoids content in the five seedlings grown in two systems

Tab. 1. Carotenoid composition of sprouts determined by HPLC-PDA.

Sprouts	Germination conditions	Carotenoid content mg/100g			
		Lutein	Zeaxanthin	β -Carotene	Total carotenoids
Arugula	natural system	20.13±1.02 c	4.36±0.14 e	68.00±3.31 ab	92.21±4.11 b
	artificial system	19.12±1.24 d	3.33±0.24 d	50.00±2.00 c	72.00±2.95 c
Lentil	natural system	22.32±1.07 c	5.63±0.31 d	73.00±5.13 a	100.32±4.23 b
	artificial system	20.89±1.00 d	4.23±0.26 d	61.00±1.99 a	85.00±5.67 b
Wheat	natural system	41.00±2.22 a	10.12±0.27 a	69.00±3.82 ab	120.32±5.24 a
	artificial system	34.12±2.15 a	9.12±0.55 a	57.00±1.62 ab	100.30±3.85 a
Bean	natural system	31.00±1.32 b	8.91±0.27 b	62.00±1.71 bc	102.36±4.56 b
	artificial system	28.32±1.90 b	7.13±0.34 b	51.00±2.25 bc	86.00±5.64 b
Mustard	natural system	29.00±1.03 b	5.21±0.16 c	56.00±3.22 d	91.23±6.09 b
	artificial system	25.00±1.31 bc	6.32±0.21 c	51.00±3.05 bc	81.69±4.85 bc

Note: The values are mean of three samples, analysed individually in triplicates. Different letters within a column denote significant differences (Tukey's test, $P < 0.05$).

Tab. 2. Antioxidant activity of the tested sprouts.

Sprouts	Germination conditions	Antioxidant activity IC ₅₀ ($\mu\text{g/ml}$)
Arugula	natural system	1.65±0.11 c
	artificial system	1.32±0.55 c
Lentil	natural system	2.65±0.07 a
	artificial system	2.31±0.12 a
Wheat	natural system	2.64±0.07 a
	artificial system	2.42±0.09 a
Bean	natural system	2.21±0.09 b
	artificial system	1.96±0.06 b
Mustard	natural system	1.80±0.07 c
	artificial system	1.40±0.10 c

Note: The values are mean of three samples, analysed individually in triplicates. Different letters within a column denote significant differences (Tukey's test, $P < 0.05$).

(natural and artificial systems). The highest amount of zeaxanthin, lutein, β - carotene and total carotenoids respectively, was found in cultivars of wheat and beans grown in natural system. Similar results regarding the amount of lutein in beans and mustard cultivars were performed by Guo *et al.* (2012) and obtained a quantity of lutein between 22-30 mg/100g.

Table 2 presents the experimental results obtained by assessing the antioxidant activity of seedlings studied in two types of systems by DPPH method. The highest antioxidant activity was found in cultivars of lentils and wheat, even if in this case were not statistical differences between the systems. The growth conditions did not change statistically antioxidant activity, and the results achieved are in accordance with the literature data (Ndolo and Beta, 2013).

CONCLUSIONS

The highest amount of carotenoid compounds was found in cultivars of wheat grown in natural system and the highest antioxidant activity was found in cultivars of lentils. The best cultivars for improving the nutritional quality for human consumption are wheat cultivars followed by lentil ones.

Acknowledgments. This work was supported by grants from the Romanian National Authority for Scientific Research CNCS-UEFISCDI, project number PN-II-ID-PCE-2011-3-0721.

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