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ANTIOXIDANT POTENTIAL OF SELECTED OIL PLANTS OF BRASSICACEAE BURNETT

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The economically important species of genus *Brassica* L. were investigated in this study. Alcohol and water plant extracts of cultivars and varieties of *Brassica campestris* and *B. rapa* were inspected on antiradical activity by DPPH-method (with 2,2-diphenyl-2-picrylhydrazyl). Obtained extracts were measured on a spectrophotometer at wavelength 515 nm. Antiradical activity of methanol extracts was in the range from 34.29 (*B. rapa* subsp. *rapifera* Metzger (f. *biennis*), f. EOTRFO) to 58.09% (*B. campestris* f. *biennis* D.C., cv. Oriana). Water extracts demonstrated this activity in range from 58.18 (*B. campestris* f. *biennis* D.C., cv. Oriana) to 84.25% (*B. campestris* f. *biennis* D.C. × *B. rapa* L., f. EOTFVS). Antioxidant activity (AA) of extracts of investigated plants was expressed in ascorbic acid equivalent (mg g^{-1} AAE). The highest AA of methanol extracts was found for *B. campestris* f. *biennis* D.C. × *B. rapa* L., cv. Fitopal (86.07 mg g^{-1} AAE), the lowest one – for *B. rapa* subsp. *rapifera* Metzger (f. *biennis*), f. EOTRFO (52.78 mg g^{-1} AAE). Maximal AA of water extracts was registered for *B. campestris* f. *biennis* D.C. × *B. napus* f. *biennis* D.C., cv. Innovacia (121.77 mg g^{-1} AAE), minimal – for *B. campestris* f. *biennis* D.C. × *B. rapa* L., f. EOTFVS (85.18 mg g^{-1} AAE).

Keywords: oil plants, *Brassica*, antioxidant activity

Introduction

The Brassicaceae Burnett one is the most important group of plants in the food industry that includes a wide range of horticultural crops with economic significance. The high content of lipids in the seeds (more than 40%) makes this group of crops very valuable among other plants (Hodur et al., 2012; Chen et al., 2015). The last study concerning of the Brassicaceae has demonstrated results about their human health benefits such as reduced risk for generative diseases. It is a good source of carotenoids (Bjorkman et al., 2011; Kumar and Andy, 2012).

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The genus *Brassica* L. is the most important from Brassicaceae, which includes some crops and species of great worldwide economic importance such as *Brassica oleracea* L., *Brassica napus* L., *Brassica rapa* L. (Cartea et al., 2011). Plants from Brassicaceae such as *Brassica*, *Camelina* species are not only known for their high fat and protein contents for human and animal consumption, but recognized as a rich source of nutrients such as vitamins, minerals, carbohydrates, amino acids, and different groups of phytochemicals: phenolics, glucosinolates, fatty acids etc. (Jensen et al., 1996; Goffman et al., 1999; Jahangir et al., 2009; El-Beltagi et al., 2010; Cartea et al., 2011; Rakhmetov et al., 2014; Vergun et al., 2017b). The main fatty acid composition of *B. campestris* var. *oleifera* during growth was α-linoleic acid, linoleic acid, cis-10-heptadecenoic acid, and palmitic acid. The most abundant was oleic acid content (Peiretti et al., 2012). *B. campestris* seeds, also, rich in lipid composition (Sharma et al., 2003). Some results support the beneficial effects of turnip (*B. rapa*) in the management of metabolic syndrome (An et al., 2010; Abo-youssef, Mohammed, 2013). These plants characterized by different pharmaceutical effects such as antioxidant, anti-inflammatory, antiepileptic, anti-diabetic, immunological, cardiovascular etc. (Al-Snafi, 2015). As reported Rajamurugan et al. (2012), methanol extracts of *B. nigra* leaves demonstrated the protective effect at the hepatic and renal injury because of anti-inflammatory and antioxidant effect.

Plants from genus *Brassica* is a source of antioxidants of different nature such as flavonoids, tannins and other phenolic compounds (Ryu et al., 2012; Gul et al., 2013; Routray et al., 2013). Plant raw material of these plants contains phenolic acids such as caffeic, sinapic, *p*-coumaric, ferulic etc. (Seong et al., 2016). On the basis of the experimental work of Behman and Sani Mohamadi (2017), extracts from leaves and roots of *B. rapa* possess antibacterial properties. It could be used as possible food antimicrobial preservative in the food industry. These plants also demonstrated the quick tolerance to salt stress in some investigations (Jan et al., 2016; Jan et al., 2017).

The aim of this study was to determine an antioxidant potential of some oils plants of Brassicaceae.

Material and methodology

Biological material

The plants were grown in 2017 in the experimental fields of the M.M. Gryshko National Botanical Garden of the NAS of Ukraine in the Kyiv city (50° 24' 55" N, 30° 33' 45" E). Plant material was collected from the experimental collections of oil plants of the Department of the Cultural flora of M.M. Gryshko National Botanical Garden of NAS of Ukraine in the stage of flowering and analyzed in the laboratory of a department.

Biochemical analysis

Biochemical analyze of antioxidant activity detection was conducted according to Brand-Williams et al. (1995). Plant extracts were prepared in two solvents – methanol and distilled water. 1 g of dry plant raw material was mixed with 25 ml of each solvent. Extraction was carried out during 12 hours at continuous stirring. Preparing of the radical solution was following: 25 mg of DPPH-radical (2,2-diphenyl-2-picrylhydrazyl) was solved in methanol (in 100 ml volumetric flask) and used for following dilution (1 : 10). 0.1 ml of investigated plant extract was added to 3.9 ml of radical solution. The optical density of the radical solution was measured immediately and after 10 min of incubation in the dark after adding a sample. The measurement was conducted at 515 nm on the spectrophotometer (Unico 2800 UV/VIS). Obtained data calculated using a formula:

$$\% Inh = \frac{A_0 - A_1}{A_0} \times 100$$

Statistical analysis

Obtained data were expressed in mg g^{-1} AAE (ascorbic acid equivalent). The statistically treated data are given in the table as the arithmetical mean values and their standard errors.

Results and discussion

According to our previous data concerning to biochemical properties of Brassicaceae, seeds of these plants are the rich source of lipids (17.72–37.61%). Also, plant raw material characterized by an energetic value of 5,039.33–6,108.00 KcaL.kg^{-1} (Vergun et al., 2017a). Results obtained by Fernandes et al. (2007) indicated that turnip is an easily accessible dietary source of biologically active compounds. The antioxidant potential exhibited by the different turnip edible parts is obviously determined by their composition.

Antioxidant activity has been assessed in many ways (Antolovich et al., 2002). The DPPH (2,2-diphenyl-1-picrylhydrazyl-hydrate) free radical method has been widely applied for estimating antioxidant activity in recent years (Molyneux, 2004). It is an antioxidant assay based on electron-transfer that produces a violet solution in an alcohol solvent. This free radical, stable at room temperature, is reduced in the presence of an antioxidant molecule, giving rise to a colorless ethanol solution (Brand-Williams et al., 1995).

It was studied methanol and water extracts to evaluate the antioxidant potential of investigated plants (Table 1). As shown on the table, methanol extracts exhibited antiradical activity from 34.29 (*B. rapa* subsp. *rapifera* Metzger (f. *biennis*), f. EOTRFO) to 58.09% (*B. campestris* f. *biennis* D.C., cv. Oriana). Antiradical activity of water extracts was from 58.18 (*B. campestris* f. *biennis* D.C., cv. Oriana) to 84.25% (*B. campestris* f. *biennis* D.C.× *B. rapa* L., f. EOTFVS).

According to Fernandes et al. (2007), the antioxidant capacity of different extracts of *B. rapa* correlated with both total phenolic and organic acids amounts. Differences in antioxidant activity of *Brassica* crops were related to differences in total phenolic content but also to differences in phenolic composition for most samples (Soengas et al., 2012). Our previous data showed that *B. campestris* f. *biennis* D.C.× *B. napus* f. *biennis* D.C., cv. Innovacia had an antiradical activity of methanol extracts 21.54 and water extracts – 50.62% that was less than in current research (Vergun and Rakhmetov, 2018). Also, methanol extracts of *B. rapa* and *B. rapa* subsp. *rapifera* Metzger demonstrated 19.86 and 42.42% of inhibition and water extracts – 62.96 and 63.57% respectively. Data obtained for *B. rapa* subsp. *rapifera* Metzger was similar. Also, Sun et al. (2009) reported that the antioxidant activity of methanol extracts was higher than in acetone and water extracts by DPPH-method in some Brassicaceae. This is consistent with our obtained data where only *B. campestris* f. *biennis* D.C., cv. Oriana had the same results in both methanol and water extracts.

Table 1 The antiradical activity of plant extracts of selected oil crops (%)

Name of sample	Methanol extracts	Water extracts
B. campestris **f.** ***biennis*** **D.C., cv. Horlytsia-FHO**	47.70 ±0.91	58.26 ±0.81
B. campestris **f.** ***biennis*** **D.C., cv. Oriana**	58.09 ±0.52	58.18 ±1.78
B. campestris **f.** ***biennis*** **D.C., f. EOSOF-2**	36.39 ±0.20	67.04 ±0.49
B. campestris **f.** ***biennis*** **D.C.×** *B. napus* **f.** ***biennis*** **D.C., cv. Innovacia**	39.09 ±0.72	78.60 ±0.93
B. campestris **f.** ***biennis*** **D.C.×** ***B.*** *rapa* **L., cv. Fitopal**	41.29 ±1.83	83.55 ±2.59
B. campestris **f.** ***biennis*** **D.C.×** ***B.*** *rapa* **L., cv. Obrii**	35.38 ±1.16	61.18 ±0.47
B. campestris **f.** ***biennis*** **D.C.×** ***B.*** *rapa* **L., f. EOTFVS**	50.45 ±1.65	84.25 ±0.76
B. campestris **f.** ***biennis*** **D.C.× B.***rapa* **L.×B.***napus* **f.** ***biennis*** **D.C., f. EOHBFTRO-2**	41.67 ±0.67	77.67 ±0.48
B. *rapa* **subsp.** *rapifera* **Metzger**	42.43 ±0.81	63.57 ±1.25
B. *rapa* **subsp.** *rapifera* **Metzger (f.** ***biennis*****), f. EOTRFO**	34.29 ±0.99	65.67 ±0.38

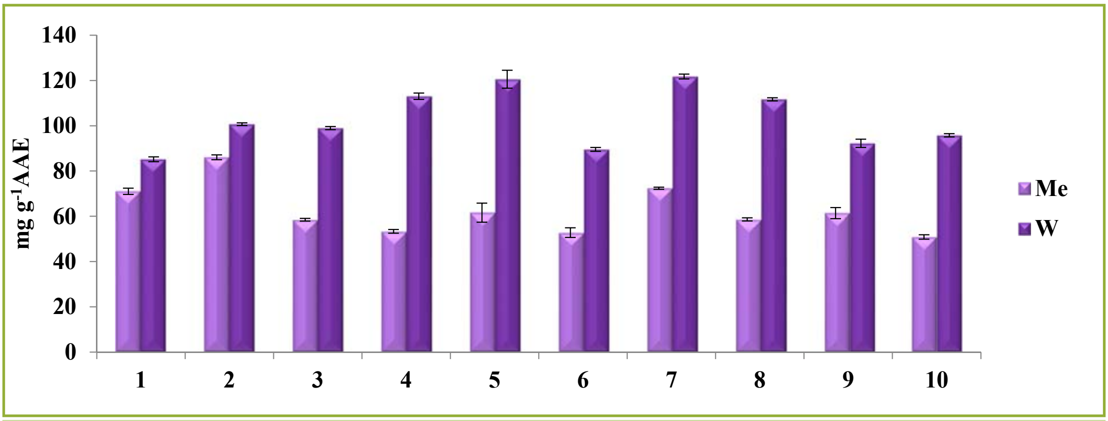

Figure 1 Antioxidant activity of plant extracts of selected oil plants (mg g^{-1} AAE): 1 – *B. campestris* f. *biennis* D.C.× *B. rapa* L., f. EOTFVS; 2 – *B. campestris* f. *biennis* D.C.× *B. rapa* L., cv. Fitopal; 3 – *B. rapa* subsp. *rapifera* Metzger; 4 – *B. campestris* f. *biennis* D.C. × *B. rapa* L. × *B. napus* f. *biennis* D.C., f. EOHBFTRO-2; 5 – *B. campestris* f. *biennis* D.C. × *B. rapa* L., cv. Obrii; 6 – *B. rapa* subsp. *rapifera* Metzger (f. *biennis*), f. EOTRFO; 7 – *B. campestris* f. *biennis* D.C.× *B. napus* f. *biennis* D.C., cv. Innovacia; 8 – *B. campestris* f. *biennis* D.C., cv. Horlytsia-FHO; 9 – *B. campestris* f. *biennis* D.C., cv. Oriana; 10 – *B. campestris* f. *biennis* D.C. × *B. rapa* L. × B. *napus* f. *biennis* D.C., f. EOHBFTRO-2

Antioxidant activity expressed in ascorbic acid equivalent represented in Figure 1. Methanol extracts showed activity from 50.87 (*B. campestris* f. *biennis* D.C. × *B. rapa* L. × *B. napus* f. *biennis* D.C., f. EOHBFTRO-2) to 86.07 mg g^{-1} AAE (*B. campestris* f. *biennis* D.C. × *B. rapa* L., cv. Fitopal). Water extracts exhibited antioxidant activity from 85.18 (*B. campestris* f. *biennis* D.C. × *B. rapa* L., f. EOTFVS) to 121.77 mg g^{-1} AAE (*B. campestris* f. *biennis* D.C. × *B. napus* f. *biennis* D.C., cv. Innovacia).

Conclusions

The cultivars and varieties of *Brassica campestris*, *B. rapa* have the high antioxidant potential in the conditions of M.M. Gryshko National Botanical Garden of the NAS of Ukraine. Study of methanol extracts showed that minimal antiradical activity was found for *B. rapa* subsp. *rapifera* Metzger (f. *biennis*), f. EOTRFO and maximal – for *B. campestris* f. *biennis* D.C., cv. Oriana. The most investigated plants had an antiradical activity of water extracts more than 60%. Antioxidant activity of water extracts of investigated plants was more than in methanol extracts.

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