https://doi.org/10.15414/agrobiodiversity.2020.2585-8246.070-77

AGROBIODIVERSITY 2020
FOR IMPROVING NUTRITION, HEALTH AND LIFE QUALITY

OPEN ACCESS

ANTIOXIDANT POTENTIAL OF SOME ASTERACEAE BERCHT. & J. PRESL. REPRESENTATIVES

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Received: 19. 5. 2020 **Revised: 12. 7. 2020** **Published: 20. 11. 2020**

Asteraceae Bercht. & J. Presl. is a large family of plants with a different direction of use, among which are medicine, decorative, dietary crops that widely have used in human life. Plant raw material of these plants is a source of biologically active compounds with numerous biological activities such as antioxidant, antimicrobial, anti-inflammatory, etc. This study was aimed to evaluate the antioxidant potential of selected plants from Asteraceae: *Bidens ferulifolia* (Jacq.) Sweet, *Echinacea purpurea* (L.) Moench, *Rhaponticum carthamoides* (Willd.) Iljin, *Silphium asteriscus* L., *S. lacinatum* L., *S. perfoliatum* L., *S. trifoliatum* L. Raw collected from the collection of M.M. Gryshko National Botanical Garden of the NAS of Ukraine (NBG) in the stage of budding and flowering. Determination of the antioxidant activity of investigated plants conducted by DPPH free radical scavenging activity. In this case, 1 g of dried and milled plant raw extracted in methanol and water in volume 25 ml and 100 µl of filtrate mixed with 3.9 ml of a radical solution. The optical density of the plant extracts measured using the spectrophotometer Unico 2800 (Russia) at the wavelength of 515 nm. Results expressed in % of inhibition. The DPPH free radical scavenging activity of methanol extracts of *Bidens ferulifolia* was 72.27–86.69%, *E. purpurea* of 31.19–75.92%, *Rh. carthamoides* of 56.31–73.14% and *Silphium* spp. from 34.86 to 92.51%. This parameter in water extracts was for *Bidens ferulifolia* 14.68–62.07%, *E. purpurea* of 45.47–68.90%, *Rh. carthamoides* of 52.61–79.05%, *Silphium* spp. from 14.88 to 93.47%. Thus, a study of the inhibition ability of different extracts of selected Asteraceae plants from NBG demonstrated the antioxidant potential of investigated plants than can be used for further study. Also, raw of these plants can be recommended for farther pharmacological investigations and as useful forage plants.

Keywords: Asteraceae, 2.2-diphenyl-1-picrylhydrazyl, free radical scavenging activity

Introduction

According to some researchers, most plant species (two-thirds) known as medicinal plants and have appropriate biological activities (Krishnaiah et al., 2011). Among known plant's families should be highlighting the Asteraceae Bercht. & J. Presl., which consists of

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approximately 1,000 genera and 25,000 species some of them use in medicine (Bessada et al., 2015). Family of Asteraceae includes different groups of plants that are important in human life such as medicinal (Vijaylakshmi et al., 2009; Patel, 2012), forage (Rakhmetov et al., 2019), food (García-Herrera et al., 2014), etc.

Raw of these plants has exhibited biological activities such as antioxidant (Vergun et al., 2018; Shelepova et al., 2019), antimicrobial (Babotă et al., 2018), and even invasive representatives have a high biological activity (Kozuharova et al., 2019). Plants from Asteraceae demonstrate the antioxidant activity due to the content of different groups of phenolic compounds in particular. Among them chlorogenic acid, luteolin, quercetin, apigenin, rutin (Bakar et al., 2015). Also, an important group of biologically active compounds isolated from Asteraceae is terpenoids that exhibited cancer-preventive effects, analgesic, anti-inflammatory, antimicrobial, antifungal, antiviral, antiparasitic activities (Sülsen et al., 2017). The investigation of raw showed that Asteraceae plants produced the essential oil with rich biochemical content (Raal et al., 2011). The *Bidens pilosa* oil, for example, demonstrated high inhibition of DPPH radical, and the main constituent of it was α-pinene, ε-caryophyllene, ß-ocimene (Goudoum et al., 2016).

Taking into account previous studies of Asteraceae plants, this work was aimed to evaluate the antioxidant potential of selected species raw as a potential source of antioxidants.

Material and methodology

Biological material

It was investigated some representatives from the Asteraceae Bercht. & J. Presl. such as *Bidens ferulifolia* (Jacq.) Sweet, *Echinacea purpurea* (L.) Moench, *Rhaponticum carthamoides* (Willd.) Iljin, *Silphium asteriscus* L., *S. lacinatum* L., *S. perfoliatum* L., *S. trifoliatum* L. An experiment carried out during 2018 at the laboratory of Cultural Flora Department of M.M. Gryshko National Botanical Garden of the NAS of Ukraine. Plants samples took at the budding and flowering stages and dried at 45 °C for 72 hours. All investigated plants are perennial.

Determination of DPPH scavenging activity

1 g of dried and milled plant raw extracted in the 25 ml of solvent (methanol and water) for 24 hours. After filtration procedure obtained extracts used to determined antiradical activity on a spectrophotometer Unico UV 2800 (Russia). A working solution of 2.2-diphenyl-1-picrylhydrazyl (DPPH) prepared the following way: 25 mg of radical dissolved in 100 ml of methanol. Obtained radical solution dissolved in 10 times till optical density was in the range of 0.700–0.800. The procedure of measuring conducted by Brand-Williams et al. (1995). 3.9 ml of radical solution mixed with 100 µl of plant extract and put for 10 min in the dark. During the procedure of measuring on a spectrophotometer at a wavelength of 515 nm used value of radical solution and value of the radical solution with the sample. Obtained results expressed in percentages.

Statistical analysis

The mean values of three replicates and the standard deviation are given. Data submitted with ANOVA and differences between means compared using the Tukey-Kramer test ($p = 0.05$).

Results and discussion

Use of DPPH scavenging activity method for evaluating the antioxidant potential of plant raw material widespread last decades and helps to find new sources of antioxidants. Plants from Asteraceae, also, not an exception in this relation and wild plants and crops from this plant family are rich in different compounds with antioxidant activity (Jamuna and Paulsamy, 2014; Indradi et al., 2017).

Plants of *Bidens* spp. use in folk medicine and exhibit numerous biological and pharmacological activities such as antioxidant, immunomodulatory, antidiabetic, antimicrobial anti-hypertensive, anti-hyperglycemic, antitumor, immunosuppressive, anti-inflammatory, antimalarial (Bessada et al., 2015). *B. pilosa* also has an essential oil that rich in biologically active compounds and demonstrated high antioxidant activity. In this case, the DPPH scavenging activity showed inhibition of 18.69–77.4% (Goudoum et al., 2016).

DPPH scavenging activity of different organs of *Bidens ferulifolia* was 72.27–86.69% in methanol extracts and 14.68–62.07% in water extracts (Figure 1). The most antiradical activity of extracts noticed for inflorescences and above-ground parts. Also, it should be noted that methanol extracts of *B. ferulifolia* demonstrated higher free radical scavenging activity than water extracts.

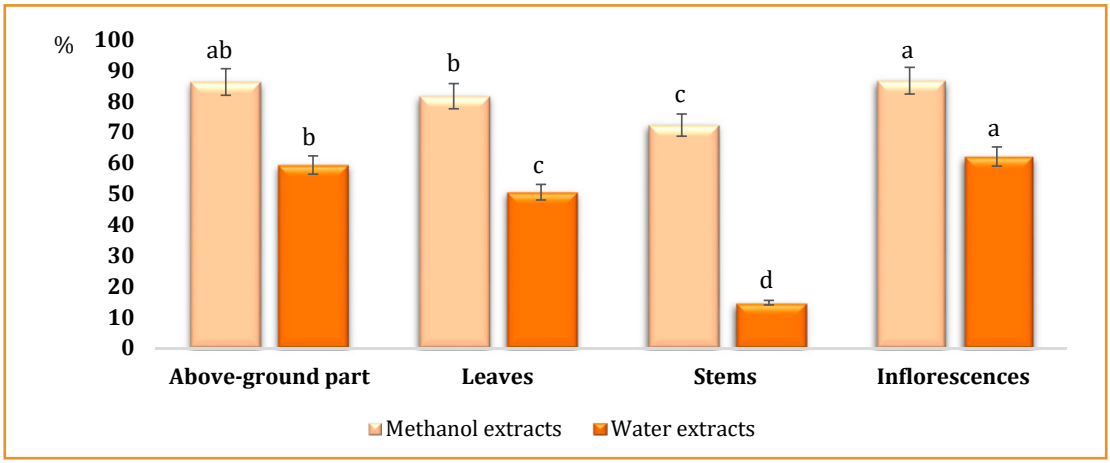

Figure 1 DPPH scavenging activity of *Bidens ferulifolia* (Jacq.) at the stage of flowering (means in columns followed by different letter are different at $p = 0.05$; each value represents the mean of three independent experiments (±SD))

Echinacea purpurea is a well-known medicinal plant with immunomodulatory, anti-inflammatory, antibacterial, antifungal properties and beneficial effects such as antianxiety, antidepression, cytotoxicity, antimutogenicity, etc. Among phenolic compounds, an efficient

effect determined for cichoric acid (Manayi et al., 2015). That is an ethnomedicinal plant that used at cough, respiratory infection, and bronchitis. Leaf and root essential oil of *Echinacea* spp. rich in volatile components (Nyalambisa et al., 2017).

Scavenging activity of radical in methanol and water extracts of *E. purpurea* in our experiment was 31.19–75.92% and 45.47–68.90%, respectively (Figure 2). In this case, most values of this parameter determined for leaves and above-ground parts.

The pharmacological study of *E. purpurea* demonstrated immunomodulatory, anti-inflammatory, antiviral, antifungal, antimicrobial activity, etc. (Barnes et al., 2005). The study of different extracts of *E. purpurea* showed antioxidant activity of 89.2% (Rady et al., 2018). Stanisavljević et al. (2009) found DPPH scavenging activity for ethanol extracts of *E. purpurea* 93.6% and antimicrobial activity.

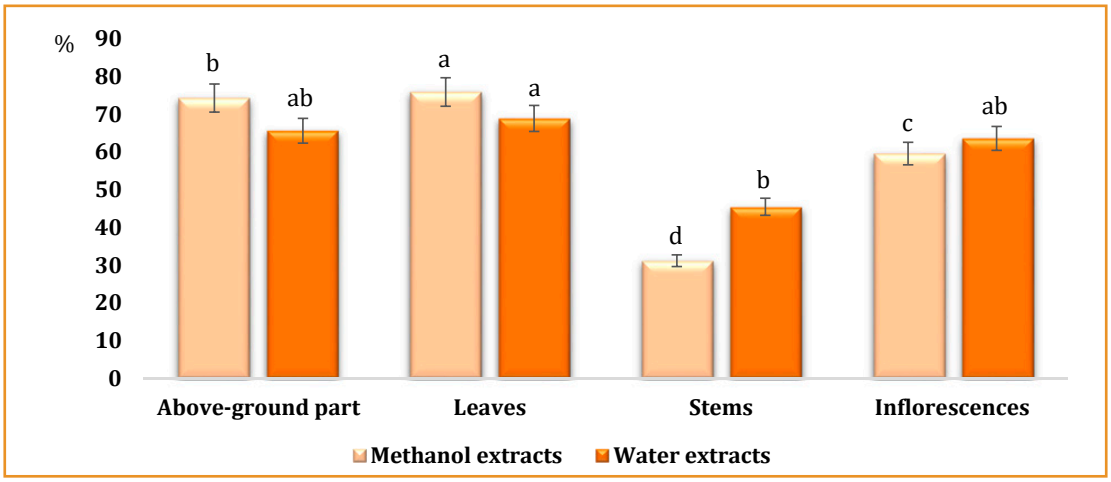

Figure 2 DPPH scavenging activity of *Echinacea purpurea* (L.) Moench. at the stage of flowering (means in columns followed by different letter are different at $p = 0.05$; each value represents the mean of three independent experiments (±SD))

Rhaponticum carthamoides commonly known as maral root or Russian leuzea uses in the folk medicine of some countries because of medicinal properties. The main groups of isolated compounds of this plant are steroids, flavonoids, phenolics (phenolic acids and flavonoids), triterpenoid glycosides, terpenes, etc. (Kokoska and Janovska, 2009). At the stage of flowering, we determined that methanol extracts of *Rh. carthamoides* were 56.31–73.14% and water extracts 52.61–79.05% (Figure 3). Methanol extracts of whole above-ground parts, leaves, and inflorescences had higher values of inhibition than water and stem extracts opposite. The previous study of the leaf ethanol extracts of this species showed that Trolox equivalent capacity by DPPH method was 9 mg TE/g and molybdenum reducing power of extracts was 77.87 mg TE/g DW (Vergun et al., 2019). Roots of *Rh. carthamoides* well-known source of biologically active compounds and exhibited antioxidant activity (Biskup and Lojkowska, 2009; Biskup et al., 2013).

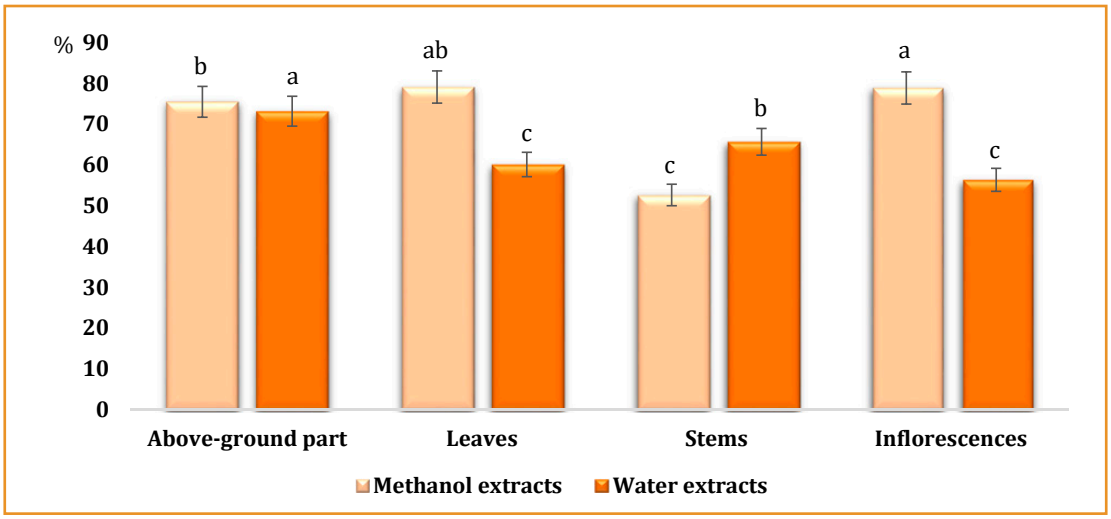

Figure 3 DPPH scavenging activity of *Rhaponticum carthamoides* (Willd.) at the stage of flowering (means in columns followed by different letter are different at $p = 0.05$; each value represents the mean of three independent experiments (±SD))

Different species of *Silphium* genus are a good source of nutrients for forage usage (Rakhmetov et al., 2019).

Plants from genus *Silphium* L. studied primarily at the stage of budding and one species at the stage of flowering (Figure 4). Methanol extracts exhibited results in a range of 34.86–92.51% and water extracts in the range of 14.88–93.47%. If compare generative organs of *S. asteriscus* that values of antiradical activity of both methanol and ethanol extracts increased from budding to flowering period. The study of *S. lacinatum* showed approximately the same values in methanol extracts as well as in water extracts. According to Shang et al. (2017), the scavenging activity of *S. perfoliatum* extracts was 75.71%.

The study of other species from Asteraceae *Tragopogon porrifolius* L. showed DPPH free radical scavenging activity of water and ethanol extracts as 77.3 and 83.2%, respectively (Al-Rimawi et al., 2016). Tandon and Gupta (2020), determined for *Sphaeranthus indicus* Linn. this parameter of whole plant extracts from 27.55 to 87.25%. Mosquera et al. (2009) evaluated 10 species from the Asteraceae family and determined the DPPH scavenging activity of methanol extracts from 4.0 (*Montonoa* spp.) to 33 (*Mikania leiostachya* Benth.) %.

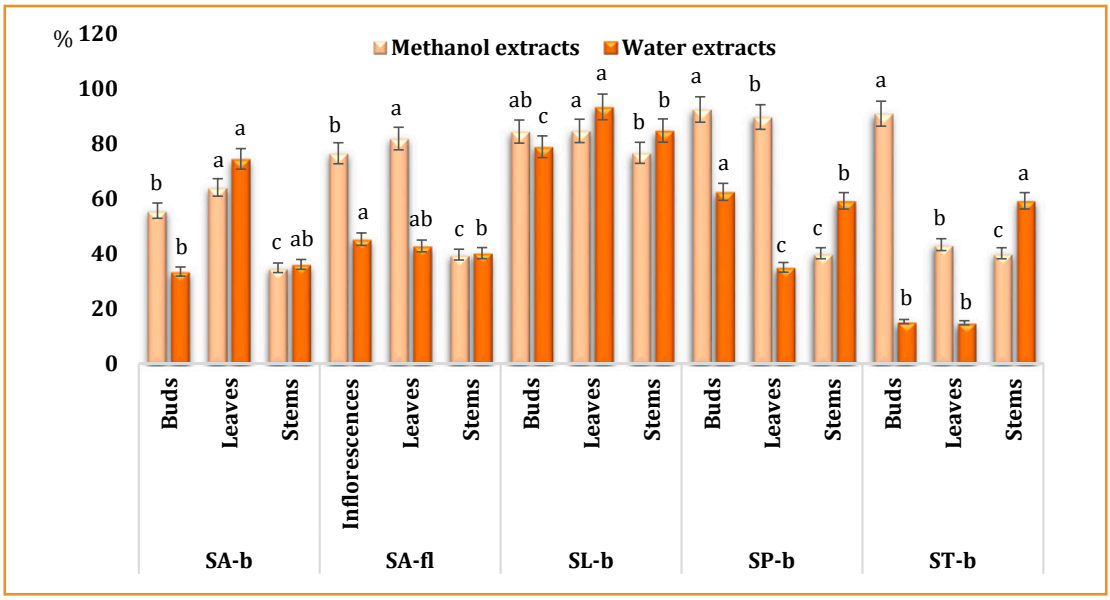

Figure 4 DPPH scavenging activity of *Silphium* spp. at the stage of budding and flowering
SA-b – *Silphium asteriscus* (budding stage), SA-fl – *S. asteriscus* (flowering stage), SL-b – *S. lacinatum* (budding stage), SP-b – *S. perfoliatum* (budding stage), ST-b – *S. trifoliatum* (means in columns followed by different letter are different at $p = 0.05$; each value represents the mean of three independent experiments (±SD))

Conclusions

Thus, all investigated representatives from the Asteraceae family exhibited antioxidant potential through free radical scavenging activity. The plant raw material of *Silphium* spp. showed maximal values of inhibition in methanol as well as in water extracts. It wasn't found strong regularity in peculiarities of inhibition in different organs of plants but in some cases, leaves and generative organs had higher values of scavenging activity than stems. Thereby, obtained data showed that the accumulation of compounds that possess antioxidant activity of plant extracts depends on species, stage of growth, and organ. The screening of new resources of antioxidant compounds among plant species is an important direction of modern science and allows to use of results for deep pharmacological investigations and others.

Acknowledgements

The publication was prepared with the active participation of researchers in International Network AgroBio*Net*.

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