CHEMICAL PROFILE AND ANTIOXIDANT ACTIVITY OF *HELIANTHUS TUBEROSUS*

Pavle Maškovića[1], Saša Đurović[2], Marija Radojković[2], Dragutin Đukić[1], Leka Mandić[1], Milica Zelenika[1], Vesna Đurović[1]

Abstract: *Helianthus tuberosus* L., commonly known as the Jerusalem artichoke, belongs to *Helianthus* genus and *Asteraceae* botanical family. Due to its wide range of biological activities, aim of this study was to investigate chemical profile of extracts obtained using different approaches: maceration, percolation, infusion and Soxhlet extraction. Extracts were further investigated regarding heavy metal, saccharides, total phenolics and total flavonoids contents, as well as antioxidant activity using DPPH assay. Obtained results showed presence of all investigated species, as well as significant capability of prepared extract to scavenge DPPH radicals.

Key words: *Helianthus tuberosus* L., heavy metal content, saccharide content, total phenolics and flavonoids contents, antioxidant activity

Introduction

Helianthus tuberosus L., commonly known as the Jerusalem artichoke, belongs to *Helianthus* genus and *Asteraceae* botanical family (Yuan et al, 2012). This sunflower species originates from North America (Ohio and Mississippi river valleys) and while becomes naturalized as economic crop worldwide in temperate areas (Pan et al., 2009). Various studies showed that plant possesses wide range of pharmacological activities such as aperient cholagogue, diuretic, stomachic and tonic effects (Pan et al., 2009; Talipova, 2001), as well as antioxidant, antimicrobial, antifungal, anticancer (Yuan et al., 2012) and many other activities.

Previously conducted studies marked coumarins (Cabello-Hurtado et al., 1998), unsaturated fatty acids (Lin, 1978; Matsuura et al., 1993), polyacetylenic derivatives (Yoshihara et al., 1992; Matsuura et al., 1993) and sesquiterpenes (Baba et al., 2005) as major classes of chemical compounds in this plant. It has been also reported that leaves of *Helianthus tuberosus* L. contain high amounts of phenolic compounds (Yuan et al., 2008). It also represents a source of inulin (Rakhimov et al., 2003) and has been used in food, pharmaceutical, feed, sugar, paper, cosmetic and bioethanol industries, as well as in desert and tideland control (Chen et al., 2013).

Due to significant biological activity and wide application, this study was dealt with the chemical profile of underground parts of *Helianthus tuberosus* L. In order to accomplish aim, several comprehensive analytical techniques were applied. Heavy metals, sugars as well as total phenolics and flavonoids contents were determined, together with the antioxidant activity of obtained extracts.

[1]University of Kragujevac, Faculty of Agronomy, Cara Dušana 34, Čačak, Serbia (pavlem@kg.ac.rs)
[2]University of Novi Sad, Faculty of Technology, Bulevar Cara Lazara 1, Novi Sad, Serbia

Material and methods

Plant material

Underground parts of *Helianthus tuberosus* L. were collected in November 2015. in the area of Čačak, Republic of Serbia. Collected material was dried naturally in the shade on draft for one month. Dried plants were grounded in the blender and kept in the paper bags prior the usage.

Extraction of plant material

Dried plant material was extracted to obtain extracts for analysis. Applied extraction techniques were maceration, percolation, infusion and Soxhlet extraction.

Determination of heavy metals content

Metal content was determined using atomic absorption spectrophotometry, according the previously described method and L KM UP 4-107/2 (Manual for determination of metals' traces with AAS using flame technique) manual.

Determination of saccharides content

Determination of saccharides content was performed using Varian liquid chromatograph coupled with RI detector. Column was Zorbax Carbohydrate (150 mm x 4.6 mm), flow was 1.4 mL/min, mobile phase was mixture of acetonitrile and water (80:20, V/V), column temperature was 40 °C, while injected volume was 5.0 µL.

Determination of total phenolics and flavonoids contents

Total phenolics (TPC) and flavonoids (TFC) contents were determined using previously described methods (Markham, 1989; Sigleton and Rosi, 1965). Results were expressed as mg GAE/mL and mg RU/mL for TPC and TFC, respectively.

Determination of antioxidant activity

Antioxidant activity of obtained extracts was determined using previously described DPPH assay (Espin et al., 2000). Desired amount (0.50 mg/mL) of extracts were tested against DPPH radicals, while the result was expressed as percentage of inhibition.

Results and discussion

Contents of Cu, Zn, Mn, Pb and Cd are presented in Table 1. It might be noticed that highest contents of Cu and Zn were observed in macerate. Highest amount of Mn was achieved in percolate, while it was not detected in the Soxhlet extract. Highest amount of Pb was also noticed in percolate, while detected amounts of the same element

in the infuse and macerate was very similar. Cadmium was achieved its highest content in Soxhlet extract, while its contents in infuse and macerate were pretty close, like in the case of led. Manganese was not observed in Soxhlet extract, while lowest contents of Cu and Zn and Pb were noticed in Soxhlet extract, while the lowest amount of cadmium was observed in percolate.

Tabela 1. Sadržaj metala u ekstraktima *Helianthus tuberosus* L.
Table 1. Metals contents in Helianthus tuberosus L. extracts

Metal *Metal*	Macerat (mg/l) *Macerate (mg/L)*	Perkolat (mg/l) *Percolate (mg/L)*	Infuz (mg/l) *Infuse (mg/L)*	Soxhlet (mg/l) *Soxhlet (mg/L)*
Cu	26.25	6.00	20.00	3.50
Zn	29.25	5.75	5.12	3.00
Mn	2.50	3.75	1.25	/
Pb	5.82	7.00	5.85	5.70
Cd	4.96	3.86	4.97	6.60

Results for the sugars contents in *Helianthus tuberosus* L. extracts are presented in Table 2.

Tabela 2. Sadržaj šećera u ekstraktima *Helianthus tuberosus* L.
Table 2. Saccharides contents in Helianthus tuberosus L. extracts

Šećer *Saccharide*	Sadržaj (mg/ml) *Content (mg/mL)*			
	Macerat *Macerate*	Perkolat *Percolate*	Infuz *Infuse*	Soxhlet *Soxhlet*
Glukoza *Glucose*	/	60.99	/	63.41
Fruktoza *Fructose*	79.92	210.07	/	185.15
Saharoza *Sucrose*	/	/	/	24.59

Presented results showed significant variety in contents of investigated saccharides. Glucose was determined in percolate and Soxhlet extract, while the highest content of fructose was observed in percolate. Content of fructose was 3.4-fold and 2.9-fold higher than of glucose in percolate and Soxhlet extract, respectively. On the other hand, sucrose was determined only in Soxhlet extract with the lowest amount of all three investigated saccharides.

Beside metals and saccharides, TPC and THC were also determined in all extracts, while results are presented in Table 3. The highest contents of TPC and TFC was observed in percolate, while the lowest results were achieved in macerate. Soxhlet extraction and infusion exhibited similar contents of investigated classes of compounds, especially regarding the TFC results. According to the presented results, it was expected that percolate, which contained the highest amounts of flavonoids and phenolic compounds, expressed the highest antioxidant activity. This assumption was confirmed

using DPPH assay (Table 3). Presented results for DPPH assay showed the same tendency as the results for TPC and TFC. This indicated that phenolic compounds presented in the investigated extracts were responsible for the activity against DPPH radicals.

Tabela 3. TPC, TFC i antioksidativna aktivnost ekstrakata *Helianthus tuberosus* L.
Table 3. TPC, TFC and antioxidant activity of Helianthus tuberosus L. extracts

Klasa jedinjenja *Class of compounds*	Sadržaj *Content*			
	Macerat *Macerate*	Perkolat *Percolate*	Infuz *Infuse*	Soxhlet *Soxhlet*
TPC (mg GAE/ml) *TPC (mg GAE/mL)*	0.25	2.44	1.65	1.46
TFC (mg RU/ml) *TFC (mg RU/mL)*	0.25	1.23	0.38	0.31
% inhibicije *% of inhibition*	25.50	39.90	30.57	27.07

Conclusion

Chemical analysis of different extracts of the *Helianthus tuberosus* L. showed dependence of chemical profile on applied extraction technique. Investigation shoved presence of heavy metals inside the plant which indicate possible contamination of the soil. Saccharide analysis revealed presence of glucose, fructose and sucrose inside the extracts, while fructose reached the highest content. Spectrophotometric analysis also revealed the presence of polyphenolic and flavonoid compounds in the plant material. These compounds are known as antioxidant activity carriers, which is proved by DPPH assay. Obtained results indicated the need for further and dipper analysis of this plant.

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