FarDU. Ilmiy xabarlar – Scientific journal of the Fergana State University

Volume 30 Issue 2, 2024-yil DOI: 10.56292/SJFSU/vol30_iss2/a135

UO‘K:577.1:576.8:591.69

CYNARA SCOLYMUS L. O‘SIMLIGINING MAKRO VA MIKRO ELEMENTLARI VA SUVDA ERIYDIGAN VITAMINLAR TAHLILI

АНАЛИЗ МАКРО- И МИКРОЭЛЕМЕНТОВ И ВОДОРАСТВОРИМЫХ ВИТАМИНОВ РАСТЕНИЙ *CYNARA SCOLYMUS* L.

ANALYSIS OF MACRO AND MICRO ELEMENTS AND WATER-SOLUBLE VITAMINS OF THE PLANT *CYNARA SCOLYMUS* L.

Dolimov Xayotjon Xakimjon o‘g‘li[1]
[1]Farg‘ona davlat universiteti, botanika, biotexnologiya va ekologiya kafedrasi o‘qituvchisi

Jalolov Iqboljon Jamolovich[2]
[2]Farg‘ona davlat universiteti kimyo kafedrasi dotsenti, k.f.n.

Ibragimov Alidjan Aminovich[3]
[3]Farg‘ona davlat universiteti kimyo kafedrasi professori, k.f.d

Annotatsiya

O‘simliklardagi makro va mikro elementlar va vitaminlarning tarkibi ularning foydali xususiyatlarini aniqlaydigan muhim omillardan biri hisoblanadi, ular bir qator muhim ahamiyatga ega. Odamlar hayot faoliyati davomida organizm uchun zarur bo‘lgan makro va mikro elementlarga, shuningdek vitaminlarga bo‘lgan ehtiyojni asosan o‘simlik mahsulotlarini iste'mol qilish orqali qondiradilar. Tabiiyki, bu holda qaysi o‘simliklar ushbu mahsulotlarni o‘z tarkibida ko‘p miqdorda saqlashini bilish juda muhimdir. Shuningdek, biz artishok o‘simlikining makro- va mikro-element va vitamin tarkibini tahlil qildik. O‘zbekiston Respublikasining turli hududlarida o‘sadigan Cynara scolymus L. o‘simligi tarkibidagi elementlar va vitaminlar induktiv bog‘langan plazmali mass - spektrometriya xamda yuqori samarali suyuqliq xromatografiya usuli bilan taxlil qilindi. O‘simlikning turli vegetativ qismlarida vitaminlar, makro va mikroelementlar miqdori bir-biridan farq qilishi aniqlandi.

Abstract

The content of macro and micro elements and vitamins in plants is considered one of the important factors that determine their beneficial properties. Humans satisfy the need for macro and micro elements necessary for the body during their life activities, as well as vitamins, mainly by consuming plant products. Naturally in this case it is very important to know which plants store these products in large quantities in their composition. We also analyzed the macro- and micro-element and vitamin composition of the Cynara scolymus L. plant, which is appreciated for a number of its beneficial properties during our study. Studied the composition of water - soluble vitamins, macro-and microelements in the plasma Cynara scolymus L. plant with high-performance liquid chromatography and inductively coupled mass spectrometry, Grows in different regions of the Republic of Uzbekistan. It was found that the amounts of vitamins, macro and microelements in different vegetative parts of Artichoke differ among themselves.

Аннотация

Содержание макро- и микроэлементов и витаминов в растениях считается одним из важных факторов, определяющих их полезные свойства, Человек удовлетворяет потребность в макро- и микроэлементах, необходимых организму в процессе жизнедеятельности, а также в витаминах, главным образом, потребляя растительные продукты. Естественно, в этом случае очень важно знать, какие растения хранят эти продукты в больших количествах в своем составе. В ходе нашего исследования мы также проанализировали макро-, микроэлементный и витаминный состав Cynara scolymus L., который ценится за ряд его полезных свойств. Изучен состав водорастворимых витаминов, макро- и микроэлементов растения Cynara scolymus L. с помощью высокоэффективной жидкостной хроматографии и масс-спектрометрии с индуктивно связанной плазмой, произрастающего в разных регионах Республики Узбекистан. Было установлено, что количество витаминов, макро- и микроэлементов в разных вегетативных частях растения различается между собой.

Key words: *vitamins, micro- and macro elements, high-efficiency liquid chromatography.*

Ключевые слова: *витамины, микро- и макроэлементы, высоко-эффективная жидкостная хроматография.*

Kalit so'zlar: *vitaminlar, mikro va makro elementlar, yuqori samarali suyuqlik xromatografiyasi*.

INTRODUCTION

Artichoke is a genus of plants in the family *Asteraceae*. Its parts contain a very large volume of plants, which are mainly consumed as various kitchen utensils and medicines[1]. In fact, flower buds that did not bloom during the collection of food artichokes, its diameter reaches 7.5 cm, formed from fleshy scales of a very large size. It is a flat, low-root perennial herb[2]. The leaves are rather wide, have a feather shape, covered with elegant black hairs below, forming a dense protrusion closer to the stem[3]. An adult artichoke looks like an asparagus, because its flowering is accompanied by flowering purple or blue flowers. To better understand the usefulness of artichokes for the body, you must first familiarize yourself with its chemical composition[4,5]. Artichoke varieties grown in France and Spain are considered very low-calorie foods and contain only 47 kcal per 100 g. The fruits of this plant contain a large amount of carbohydrates (about 15%), proteins (3%), fats (0.1%), as well as phosphates and various salts of iron and calcium[6-8]. The composition contains a huge amount of organic acids - chlorogenic, glycolic, glycic, quinic and caffeic. The leaves, arranged in the outer layer, contain a large amount of essential oils, which have a pleasant taste characteristic of the fruit. These fruits have long healing properties[9]. For example, in Russia in the 18th century it was recommended for the treatment of patients with jaundice and gout, since this drug was considered to have choleretic and diuretic properties, which is confirmed by modern research[10,11]. Now it is known that the extract of this plant loses properties associated with the liver, bile ducts and kidneys, which makes them a necessary tool for detoxification[12]. Since ancient times, folk doctors have used this product to treat a large list of various diseases[13-15]. For example, in combination with honey, its juice is actively used to treat various diseases of the oral mucosa: stomatitis, cracks in the tongue and fungus in childhood[16-18]. For the manufacture of medicines, mainly leaves and flowers are used, some traditional healers also recommend collecting the roots of this plant[19-20].

MATERIALS AND METHODS

It is concentrated on the territory of the Yozyavon district Fergana Department of Natural Monuments-Forestry in July 2021, the flowering period of the plant. The harvested plant was a peeled and divided flower, an aboveground stem and an underground stem, as well as a leaf. The technique of neutron activation determination of the concentration of chemical elements of the studied samples is based on the registration of gamma-ray spectra of radioactive isotopes that are formed when irradiating samples with a stream of delayed neutrons. In our case, a unique neutron radiation source was used nuclear physics facility – nuclear reactor type VVR-SM Institute of Nuclear Physics (INP) Academy of Sciences of the Republic of Uzbekistan. Research on neutron activation analysis is currently being conducted in the scientific laboratory "Ecology and Biotechnology" INP AS RUz. Preparation of the sample for analysis. The studied samples are cleaned of foreign pollutants. The plant samples are first washed with tap water, and then distilled water, then mixed to provide an average value for the content of the elements. Vegetation samples are first dried in a drying cabinet to a constant weight at a temperature of 60 degrees (C), then crushed and mixed. For irradiation on a neutron beam of the reactor, an average of 100 mg of the sample is taken. The test sample and the reference sample used are-they are neatly packaged, placed in a special container. The capsule is made of aluminum, and is irradiated with a constant stream of neutrons from a nuclear reactor. When neutrons interact with atomic nuclei of the test sample, nuclear transformations occur, which depend on the individual half-life of the resulting radioactive nucleus. The half-life depends on the specific radioactive isotopes and can vary from fractions of a second to several years. After irradiation with a neutron beam for a certain time, the results of the task and exposure are measured gamma-ray spectra from samples. In this method, the concentration of elements is determined relative to reference samples, where the concentrations of the desired elements are known. The studied samples and etalons are irradiated under the same conditions and at the same time. According to the intensity of the analytical peaks of the elements in the standard and the studied samples, taking into account the weights of the standard and the studied samples, the concentration of the desired elements is calculated according to a well-known formula. The spectrometric complex includes a semi-conductor

germanium detector with an energy-with a resolution of 2 keV on the gamma line of the 60Co radio nuclide with an energy of 1333 keV, a multichannel analyzer of the DSA-1000 brand with software. The computer program provides processing of complex gamma-ray spectra and calculated the content of 35 elements in the studied objects from analytical peaks. Units of measurement of the content of micro- and macronutrients, in mcg/g (micrograms per gram).

Part of the underground stem and seeds of the *Cynara scolymus* L. plant were used to study water-soluble vitamins . The analyses were performed using the HPLC method with a diode array detector (DAD). Chromatography conditions: Chromatograph-Agilent 1200 Infinity with autoclave (USA) mobile phase (gradient mode) – aceotonitrile buffer solution pH=2.92 (4% : 96%) 0-6 min., (10% : 90%) 6-9 min., (20% : 80%) 9-15 min., (4% : 96%) 15-20 min. the injection volume is 20 µl. the velocity of the mobile phase is 1,000 ml/min. column – Eclipse XDB – C18. detector – diode-matrix, wavelengths 272 nm, 292 nm, 254 nm, 297nm and 360 nm.

RESULTS AND DISCUSSION

Cynara scolymus L. in the stem part of plant specimens are mainly 7 different macro and 28 different microelements have been identified, including Sr, Ti, B, Fe quantities proved to be relatively more(tab.1).

Table 1

***Cynara scolymus* L. the amount of macro and micro elements (mg/kg)contained in the stem of the plant**

№	Macro elements	Stem	Micro elements	Stem
1	Na	209.981	Ge	0.000
2	Mg	1657.376	Se	0.026
3	Al	9.778	Sr	2.444
4	Si	706.637	Zr	0.006
5	P	2394.210	Mo	0.036
6	K	7856.018	Ag	0.001
7	Ca	1454.261	Rb	0.098
8			In	0.000
9			Cs	0.000
10			Ba	0.248
11			Ta	0.001
12			W	0.000
13			Re	0.000
14			Tl	0.000
15			Ti	21.346
16			V	0.005
17			Sr	2.444
18			Mn	0.505
19			Co	0.009
20			Ni	0.086
21			Cu	0.061
22			Zn	0.731
23			Ga	0.066
24			Li	0.031
25			Be	0.004
26			B	4.998

27			Sn	0.067
28			Cr	0.273
29			Nb	0.000
30			Fe	80.256

In the composition of the plant leaf, mainly 29 different trace elements were identified. Among the trace elements identified, the amount of elements Sr, Ti, B, Zn, Fe has been shown to be higher compared to others (tab. 2).

Table 2.

***Cynara scolymus* L. the amount of macro and micro elements in the composition of the leaves (mg/kg)**

№	Macro elements	Leaf	Micro elements	Leaf
1	Na	248.552	Ge	0.000
2	Mg	3252.808	As	0.333
3	Al	22.521	Se	0.081
4	Si	2017.423	Sn	0.065
5	P	11847.291	Sr	1.944
6	K	18575.198	Zr	0.028
7	Ca	3032.463	Nb	0.000
8			Mo	0.066
9			Ag	0.001
10			Rb	0.198
11			In	0.000
12			Cs	0.000
13			Ba	0.474
14			Ta	0.001
15			W	0.004
16			Re	0.003
17			B	36.458
18			Tl	0.001
20			Li	2.158
21			Ti	41.639
22			V	0.024
23			Ga	0.119
24			Mn	2.583
25			Co	0.037
26			Ni	0.178
27			Cu	0.149
28			Zn	1.171
29			Ga	0.119
30			Fe	178.369

7 macros and 29 different trace elements were also identified in the plant root (tab. 3).

Table 3

***Cynara scolymus* L. the amount of micro elements in the root is mg / kg**

№	Micro elements	root	Macro elements	root
1	Ge	0.001	Na	1583.098
2	Ga	0.122	Mg	1898.458
3	Se	0.014	Al	661.126
4	Sn	0.120	Si	2613.168
5	Sr	2.240	P	3355.262
6	Zr	0.016	K	10806.038
7	Nb	0.002	Ca	1507.026
8	Mo	0.115		
9	Ag	0.014		
10	Rb	0.194		
11	In	0.000		
12	Cs	0.002		
13	Ba	0.423		
14	Ta	0.001		
15	W	0.001		
16	Re	0.000		
17	B	7.463		
18	Tl	0.001		
19	Be	0.007		
20	Li	0.619		
21	Ti	1.847		
22	V	0.329		
23	Tl	0.001		
24	Mn	0.335		
25	Co	0.045		
26	Ni	0.206		
27	Cu	0.508		
28	Zn	1.860		
29	Fe	219.203		
30	Cr	0.496		

It turned out that almost all vegetative parts have a high content of the element K when the samples from the stem, leaf, root of the plant are analyzed (diagram 1).

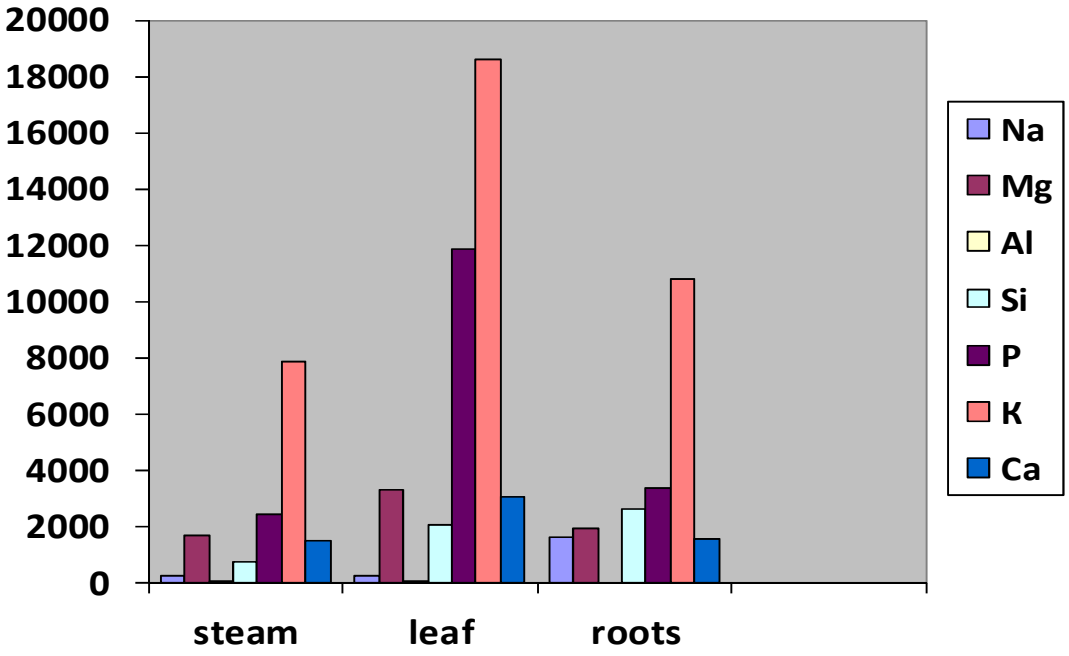

Diagram 1
***Cynara scolymus* L. diagram of macronutrients in the stem, leaf and root of the plant (mg/kg)**

Vitamins to be low molecular mass organic compounds despite having high biological activity, biochemical in the body regulates processes. According to the literature, in fact only 13 are important the vitamin is present, the rest are vitamin-like compounds. Current at the time, vitamins are studied as water-and fat-soluble vitamins, but both groups of them are considered important for the human organism. Since vitamins are considered the main coferments in biochemical processes, *Cynara scolymus* L. vitamins contained in the plant qualitatively and quantitatively studied (tab. 4).

Table 4
***Cynara scolymus* L. the amount of vitamins in the root, flower, leaf and stem of the plant**

№	Sample name	Quantity mg/100 g						
		B_1	B_6	B_9	PP	C	B_2	B_{12}
1	*Cynara scolymus* L. leaf	0.01	0.012	0.001	1.91	0.12	-	0.02
2	*Cynara scolymus* L. root	-	-	-	-	0.015	-	-
3	*Cynara scolymus* L. steam	1.21	0.02	0.014	-	0.9	3.4	0.1
4	*Cynara scolymus* L. flower	-	-	0.03	-	-	1.81	0.4

Based on the results obtained, it can be said that *Cynara scolymus* L. it was found that the content of vitamins in the root and flower of the plant is low in comparison with those in the leaf and stem(figure 1-2-3-4).

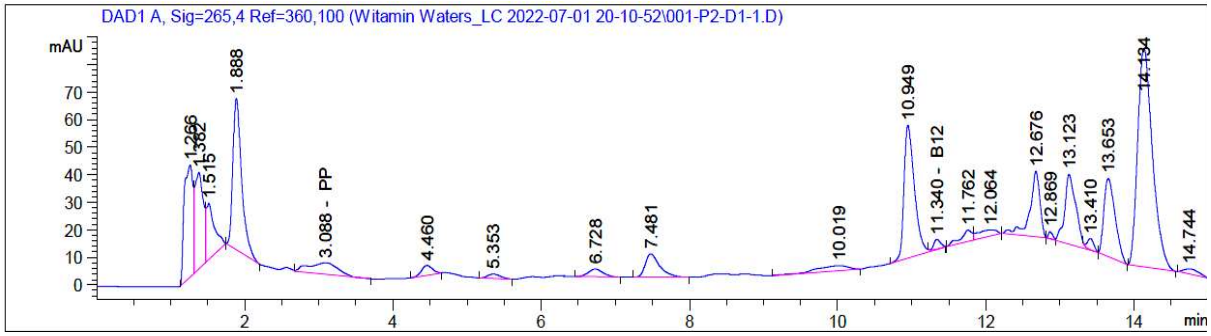

Figure 1. *Cynara scolymus* L. chromatogram of water-soluble vitamins detected on plant leaf

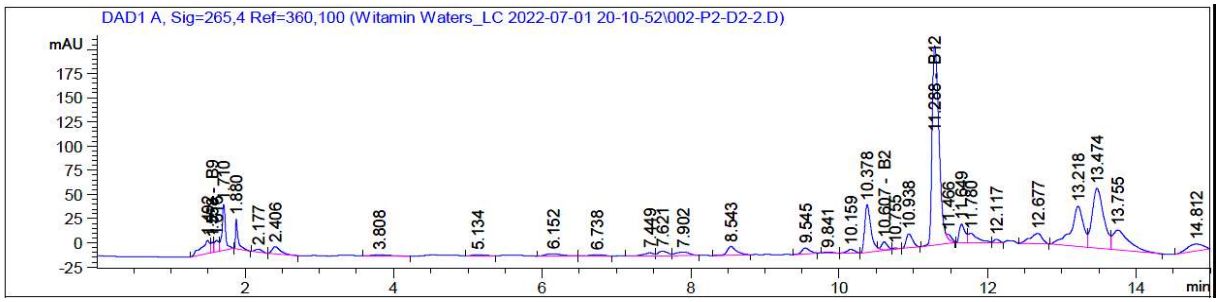

Figure 2. *Cynara scolymus* L. chromatogram of water-soluble vitamins detected at the stem of the plant

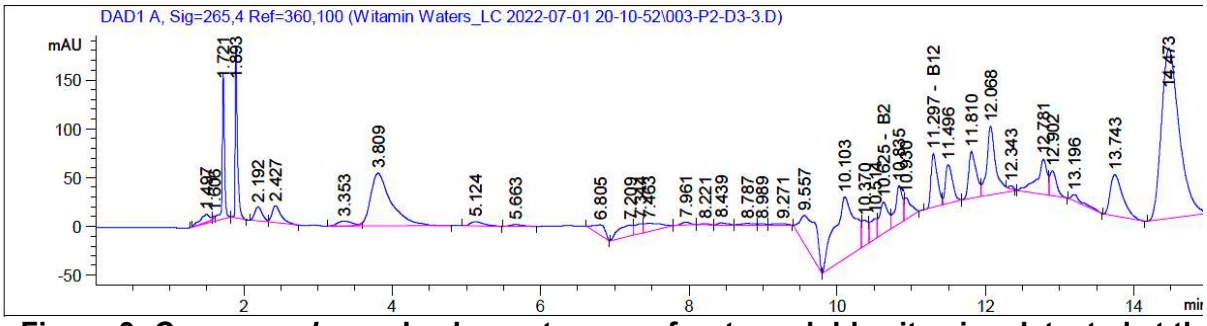

Figure 3. *Cynara scolymus* L. chromatogram of water-soluble vitamins detected at the root of the plant

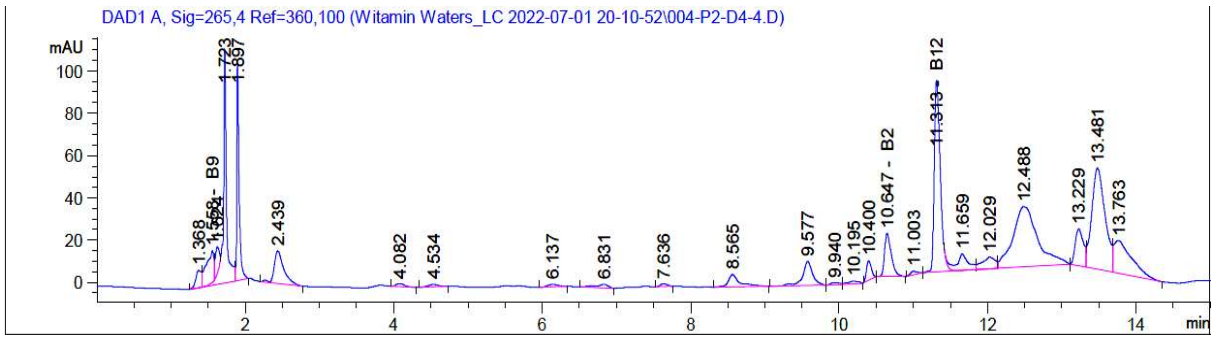

Figure 4. *Cynara scolymus* L. chromatogram of water-soluble vitamins detected in plant flower

CONCLUSION

The investigations resulted in *Cynara scolymus* L. the stem of the plant was found to be rich in vitamin B1, leaf PP, flower B2. The plant has been found to be rich in water-soluble vitamins as well as mainly vitamin B9 and B12. *Cynara scolymus*.The L plant has been found to store primarily

macro elements such as Na, Mg, K, P, Ca in relatively large quantities of micronutrients Sr, Ti, B, and Fe.

REFERENCE

1. Speroni E, Cervellati R, Govoni P, Guizzardi S, Renzulli C, Guerra MC. Efficacy of different Cynara scolymus preparations on liver complaints. Journal of ethnopharmacology. 2003 Jun 1;86(2-3):203-11.

2. Wang M, Simon JE, Aviles IF, He K, Zheng QY, Tadmor Y. Analysis of antioxidative phenolic compounds in artichoke (Cynara scolymus L.). Journal of agricultural and Food Chemistry. 2003 Jan 29;51(3):601-8.

3. Nateghi R, Samadi F, Ganji F, Zerehdaran S. Hepatoprotective effects of Cynara scolymus L. extract on CCl4 induced liver injury in broiler chickens. International Journal of AgriScience. 2013;3(9):678-88.

4. Llorach R, Espin JC, Tomas-Barberan FA, Ferreres F. Artichoke (Cynara scolymus L.) byproducts as a potential source of health-promoting antioxidant phenolics. Journal of agricultural and food chemistry. 2002 Jun 5;50(12):3458.

5. Lattanzio V, Kroon PA, Linsalata V, Cardinali A. Globe artichoke: A functional food and source of nutraceutical ingredients. Journal of functional foods. 2009 Apr 1;1(2):131-44.

6. Pandino G, Lombardo S, Mauromicale G, Williamson G. Profile of polyphenols and phenolic acids in bracts and receptacles of globe artichoke (Cynara cardunculus var. scolymus) germplasm. Journal of food composition and analysis. 2011 Mar 1;24(2):148-53.

7. Clifford M, Brown JE. Dietary flavonoids and health-broadening the perspective. Flavonoids: Chemistry, biochemistry and applications. 2006:319.

8. Brown JE, Rice-Evans CA. Luteolin-rich artichoke extract protects low density lipoprotein from oxidation in vitro. Free radical research. 1998 Jan 1;29(3):247-55.

9. El Sayed AM, Hussein R, Motaal AA, Fouad MA, Aziz MA, El- Sayed A. Artichoke edible parts are hepatoprotective as commercial leaf preparation. Revista Brasileira de Farmacognosia. 2018 Apr; 28:165-78.

10. Farag MA, El-Ahmady SH, Elian FS, Wessjohann LA. Metabolomics driven analysis of artichoke leaf and its commercial products via UHPLC–q-TOF-MS and chemometrics. Phytochemistry. 2013 Nov 1;95:177-87.

11. Khedr AI, Farrag AF, Nasr AM, Swidan SA, Nafie MS, Abdel- Kader MS, Goda MS, Badr JM, Abdelhameed RF. Comparative Estimation of the Cytotoxic Activity of Different Parts of Cynara scolymus L.: Crude Extracts versus Green Synthesized Silver Nanoparticles with Apoptotic Investigation. Pharmaceutics. 2022 Oct 13;14(10):2185.

12. Sánchez-Rabaneda F, Jauregui O, Lamuela-Raventos RM, Bastida J, Viladomat F, Codina C. Identification of phenolic compounds in artichoke waste by high-performance liquid chromatography–tandem mass spectrometry. Journal of Chromatography A. 2003 Aug 1;1008(1):57-72.

13. Lattanzio V, van Sumere CF. Changes in phenolic compounds during the development and cold storage of artichoke (Cynara scolymus L.) heads. Food Chemistry. 1987 Jan 1;24(1):37-50.

14. Shimoda H, Ninomiya K, Nishida N, Yoshino T, Morikawa T, Matsuda H, Yoshikawa M. Anti-hyperlipidemic sesquiterpenes and new sesquiterpene glycosides from the leaves of artichoke (Cynara scolymus L.): structure requirement and mode of action. Bioorganic & medicinal chemistry letters. 2003 Jan 20;13(2):223-8.

15. Zhu X, Zhang H, Lo R. Phenolic compounds from the leaf extract of artichoke (Cynara scolymus L.) and their antimicrobial activities. Journal of agricultural and food chemistry. 2004 Dec 1;52(24):7272-8.

16. Shen Q, Dai Z, Lu Y. Rapid determination of caffeoylquinic acid derivatives in Cynara scolymus L. by ultra-fast liquid chromatography/tandem mass spectrometry based on a fused core C18 column. Journal of separation science. 2010 Oct;33(20):3152-8.

17. Mejri F, Baati T, Martins A, Selmi S, Serralheiro ML, Falé PL, Rauter A, Casabianca H, Hosni K. Phytochemical analysis and in vitro and in vivo evaluation of biological activities of artichoke (Cynara scolymus L.) floral stems: Towards the valorization of food by-products. Food Chemistry. 2020 Dec 15;333:127506.

18. Schütz K, Persike M, Carle R, Schieber A. Characterization and quantification of anthocyanins in selected artichoke (Cynara scolymus L.) cultivars by HPLC–DAD–ESI–MS n. Analytical and bioanalytical chemistry. 2006 Apr;384:1511-7.

19. Romani A, Pinelli P, Cantini C, Cimato A, Heimler D. Characterization of Violetto di Toscana, a typical Italian variety of artichoke (Cynara scolymus L.). Food Chemistry. 2006 Mar 1;95(2):221-5.

20. Hinou J, Harvala C, Philianos S. Polyphenolic substances of Cynara scolymus L. leaves. InAnnales Pharmaceutiques Francaises 1989 Jan 1 (Vol. 47, No.2, 95-98).