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CHEMICAL COMPOSITION OF THE PURPLE CONEFLOWER (ECHINACEA PURPUREA) PLANT

Asqarov Ibrohim Rakhmonovich
Doctor of Chemical Sciences, Professor, Chairman of the Uzbekistan "TABOBAT" Academy, Honoured Inventor of Uzbekistan
E-mail: tabobat_akademiya@mail.ru

Mo'minjonov Mirjalol Muqimjon ogli
Doctor of Chemical Sciences, Associate Professor,
Deputy Chairman of the Uzbekistan "TABOBAT" Academy
E-mail: mirjalolmominjonov0@gmail.com ;

Mo'minjonova Mukarramkhon Sherzodbek qizi
Master's Degree Student in Chemistry,
Andijan State University, Andijan, Uzbekistan
E-mail: anonimthehuman@gmail.com

Abstract

The Purple Coneflower (*Echinacea purpurea*) is a medicinal plant widely recognised for its immunostimulatory and therapeutic properties. This study aimed to investigate the chemical composition of *Echinacea purpurea* through qualitative and quantitative analyses. The plant samples were collected during the flowering stage and subjected to drying, extraction, and subsequent laboratory analysis. Advanced chromatographic (HPLC) and spectroscopic methods were employed to identify major classes of bioactive compounds, including phenolic acids, flavonoids, and essential oils. The results revealed the presence of chlorogenic acid, cichoric acid, caftaric acid, and rutin in significant concentrations, which contribute to the antioxidant and immunomodulatory

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effects of the plant. The study confirms that *Echinacea purpurea* is a rich source of phytochemicals with potential applications in herbal medicine and pharmaceutical development. These findings provide a scientific basis for the traditional use of this plant and support further pharmacological investigations.

Keywords: Echinacea purpurea, root, leaf, flower, stem, moisture, ash content, chemical composition, chemical elements, proteins, amino acids, polyphenols.

Introduction

The red echinacea (Echinacea purpurea) plant is very rich in its chemical composition, it has many biologically active substances. This chemical composition allows the plant to be widely used as a medicine. The composition of the red echinacea plant has been widely studied, and this article reviews the results of several studies on the chemical composition of the red echinacea plant. The moisture, protein, ash, fibre and other contents of the red echinacea plant are presented in Table 1 below.

Table 1. Ash, moisture, protein, and fat content of red echinacea (Echinacea purpurea), %.

Indicators	Parts of purple coneflower (Echinacea purpurea)				
	Root	Leaf	Flower	Stem	Seed
Humidity	17.55	6.75	5.75	21.65	6
Protein	7.54	7.62	8.20	15.23	25.6
Ash	3.45	4.55	4.63	4.33	4.64
Fiber	1.11	1.22	1.30	1.10	1.72
Oil	2.44	1.42	2.41	2.23	2.12
Carbohydrates	2.54	2.62	3.11	2.44	2.73
Organic content	11.4	12.35	22.25	2.3	3.6

Research into the elemental composition of plants is very interesting, and the results obtained from it are widely used in many areas (folk medicine, pharmacy, medicine, and others) [1;*1365-2672-p.*].

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Conducted extensive research on elemental analysis of medicinal plants. Turner R.B., Ricker D.K. and Gangemi J.D., et al. concluded that 21 of the 24 chemical elements with physiological significance in plants are considered "conditionally" essential elements [2;*1732–1740*-b.]. Depending on the amount in the human body and food, all elements are usually divided into microelements (their amount in living organisms is less than 0.001%) and macroelements (their amount in living organisms is more than 0.001%). The human need for microelements: iron, copper, zinc, and cobalt is very small, it corresponds to one thousandth of a gram [3;*5800–5806*-b.].

Vital elements include macroelements (H, O, N, C, Ca, Cl, F, K, Mg, Na, P, S) and 8 microelements (Cr, Cu, Fe, I, Mn, Mo, Se, Zn) biogenic elements. Of these, the following elements C, O, H, N, S, P, Ca, K, Si are the main elements that play a role in the occurrence of life processes in the biosphere layer [4;*515–523*-b]. These chemical elements are found in different amounts in red echinacea. The table below provides information on the macro- and microelements contained in red echinacea.

Table 2. The number of elements contained in red echinacea (Echinacea purpurea).

Elements	Parts of purple coneflower (*Echinacea purpurea*)				
	Root	Leaf	Flower	Stem	Seed
K (mg/ml)	285.5	175.5	421.5	101.1	70.9
Ca (mg/ml)	125.4	343.1	41.1	2.51	2.46
Mg (mg/ml)	56.0	72.1	37.6	11.9	27.1
Copper (mg/ml)	0.14	0.35	0.49	0.15	0.25
Co (mg/ml)	0.008	0.009	0.006	0.003	0.003
Zinc (mg/ml)	0.18	0.69	0.64	0.67	0.56
Fe (mg/ml)	1	9.69	0.87	0.72	0.74

Purple echinacea (Echinacea purpurea). The protein content of the seeds is 7-30%. It is estimated that the protein content is 0.8 g/kg of human body weight

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[5;*11630–11639*-b]. The quality of plant foods depends not only on the protein content, but also on the ratio of essential amino acids in their content.

Amino acids are divided into essential and non-essential amino acids. 100 grams of Echinacea purpurea fruit contains 583 mg of essential amino acids and 169 mg of non-essential amino acids. Amino acid content of Echinacea purpurea Merali S, Binns S, Paulin Levasseur M, Ficker C, Smith M, Baum B.R., Brovelli E and Arnason J.T. (2013) and their results are shown in Figures 1.5 and 1.6.[6;*171–179*-b].

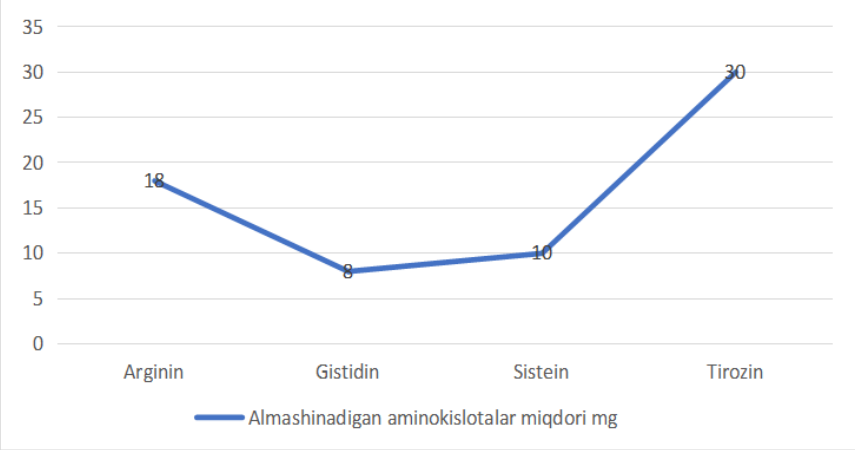

Figure 1. The amount of exchangeable amino acids in 100 g of Echinacea purpurea seeds, mg.

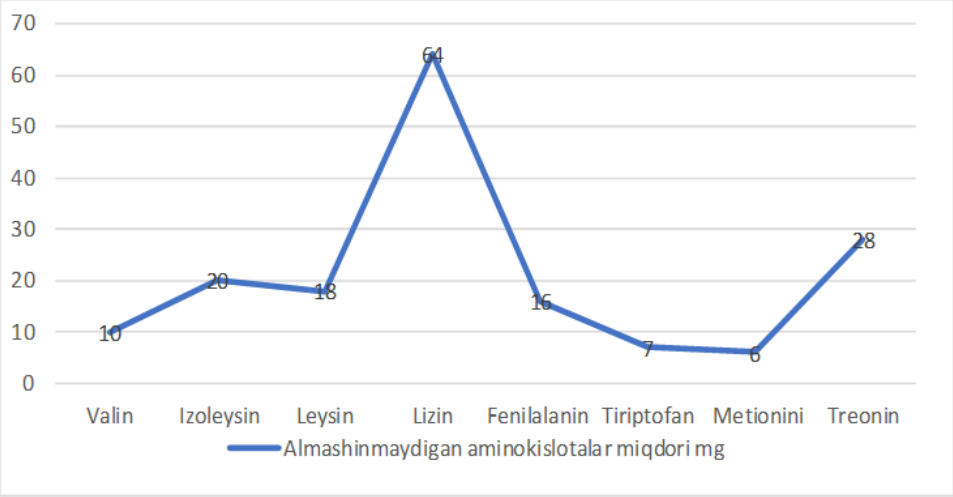

Figure 2. The amount of essential amino acids in 100 g of Echinacea purpurea seeds, mg.

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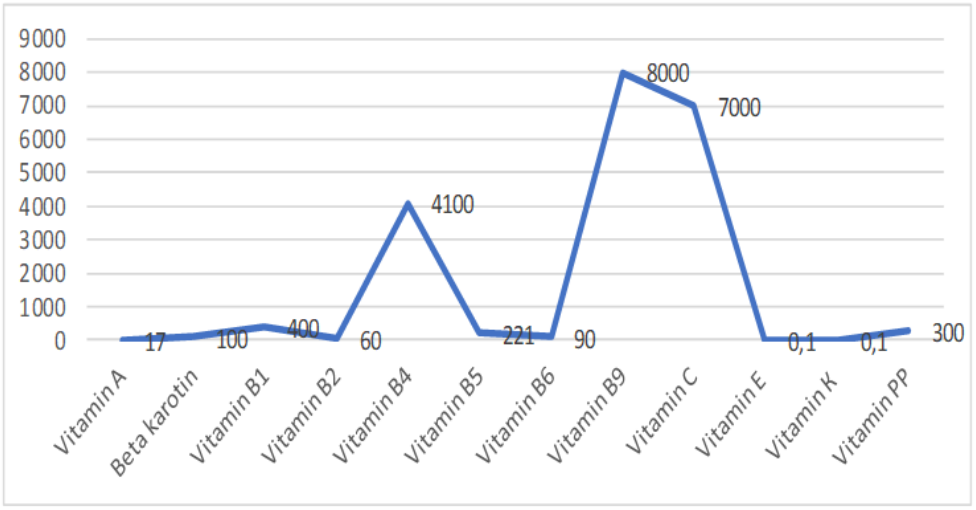

Figure 3. Vitamin content in 100 g of Echinacea purpurea seeds, mcg

Vitamins, even when present in small amounts, exhibit metabolic regulation and antioxidant activity [7;*1494*-b.].100 g of red echinacea (Echinacea purpurea) contains 0.1 g of starch, 5.8 g of mono- and disaccharides, 2.4 g of glucose, 2 g of sucrose, and 4.3 g of fructose [8;*649–656*-p., 9;*929–954*-b.].

It is known that vitamins and minerals are more concentrated in the peel, seeds, and roots of a fruit than in its juicy interior [10;*67–77*-p.]. Seeds have a complex composition. Their main chemical composition consists of pectin, water-soluble vitamins, minerals (iron, zinc, magnesium, potassium), fatty acids, linolenic, linoleic and palmitic acids [11; p. 112-124].

Pectin helps with diseases of the pancreas, stomach and liver, prevents the development of kidney stones and obesity. Another component of the composition of the seeds of red echinacea (Echinacea purpurea) is hemicellulose, which performs a cleansing function in the body [12;*1–16* p.].

*Purple echinacea (Echinacea purpurea)*The seeds contain up to 35% oil, which includes linoleic, linolenic, and palmitic acids. These oils prevent and treat many diseases, and are even used in the treatment and prevention of cancer [13;*102–108*-p., 14; 1298-1308-p].

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Table 3. Vitamin and nutrient content of the leaves and stems of purple coneflower (Echinacea purpurea)

Naming	*Purple echinacea (Echinacea purpurea)*of the leaf, mg/100 g	*Purple echinacea (Echinacea purpurea)*stem, mg/100 g
Proteins	900	1500
Oils	100	300
Carbohydrates	3000	16,000
Organic acids	5700	1500
Dietary fiber	500	4 600
Sucrose	3500	4600
Omega-3 fatty acids	26	2.6
Omega-6 fatty acids	63	6.3
Naming	*Purple echinacea (Echinacea purpurea)*of the leaf, mg/100 g	*Purple echinacea (Echinacea purpurea)*stem, mg/100 g
Vitamin A, retinol	0.002	0.003
Vitamin B4, choline	5.1	6.8
Vitamin B5, pantothenic acid	0.2	0.3
Vitamin B6, pyridoxine	0.06	0.2
Vitamin B9, folate	0.009	0.013
Vitamin C, ascorbic acid	40-80	129
Vitamin E, alpha tocopherol (TE)	0.2	0.3

Gamma-linolenic acid is formed in the body from linolenic acid, a member of the omega-6 fatty acid family. It is found in small amounts in green leafy vegetables and nuts. It has properties such as anti-inflammatory, anti-neuropathic, anti-oedema, and antioxidant activity [11; pp. 112-124].

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Table 4. Purple coneflower (Echinacea purpurea) *leaves* and the number of elements in its stem

Naming	*Purple echinacea (Echinacea purpurea)*of the leaf, mg/100 g	*Purple echinacea (Echinacea purpurea)*stem, mg/100 g
Aluminum	44.6 mcg	51 mcg
Yes	175 mcg	175 mcg
Vanadium	4 mcg	4 mcg
Iron	0.6 mg	0.8-1 mg
Iodine	0.1 mcg	0.1-0.6 mcg
Cobalt	1 mcg	1 mcg
Lithium	10.3 mg	10.3 mg
Naming	*Purple echinacea (Echinacea purpurea)*of the leaf, mg/100 g	*Purple echinacea (Echinacea purpurea)*stem, mg/100 g
Manganese	0.04 mg	30-40 mcg
Copper	0.24 mg	90 mcg
Molybdenum	1 mcg	1 mcg
Nickel	0.9 mcg	0.9-23.9 mcg
Rubidium	5.1 mcg	5.1 mcg
Selenium	0.4 mcg	0.7 mcg
Fluorine	10 mcg	15 mcg
Chrome	0.2 mcg	0.2 mcg
Zinc	125 mcg	250 mcg

The human body is made from linolenic acid, a class of four-bond omega-6 acids. arachidonicsynthesizes fatty acid. Linolenic acid is found in the form of triglycerides in the amount of 40-60% in the seeds of Echinacea purpurea, soybean, corn, cottonseed, and sunflower oils [12;*1–16*-p.].

The above substances determine the healing properties of Echinacea purpurea. Echinacea purpurea reduces blood cholesterol levels and prevents hair loss. Helps the liver and gallbladder function properly. Promotes the formation of healthy leukocytes in the fight against viral and infectious diseases [15;*63–72*-p., 16;*233–241*-p.].

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In conclusion, the red echinacea (Echinacea purpurea) plant is valued as a valuable raw material due to its rich chemical composition and the presence of natural compounds necessary for human health. Therefore, it is currently used in the pharmaceutical, food and other industries. However, scientific research on the development of natural medicinal food supplements based on the rich chemical composition of red echinacea for the treatment and prevention of various diseases has not been completed.

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