# WATER-SOLUBLE VITAMINS, FLAVONOIDS OF THE *CYNARA SCOLYMUS* L. PLANT

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**ABSTRACT.**To date, alcohol extracts and capsules derived from the artichoke plant have been widely used in medicine as remedies for liver and biliary tract diseases, reducing blood cholesterol levels, and treating conditions such as chronic hepatitis, chronic intoxication, and renal failure. A pharmaceutical product containing cynarin, a biologically active compound extracted from artichoke, has also been utilized to treat chronic cholecystitis, liver cirrhosis, and chronic nephritis. This article focuses on the study of the chemical composition of *Cynara scolymus* L., specifically its water-soluble vitamins, and flavonoid compounds.

**Keywords:** vitamins, flavonoid, compounds, cholesterol, chronic nephritis.

**ANNOTATSIYA.** Bugungi kunga kelib, artishok o‘simligidan olingan spirtli ekstraktlar va kapsulalar tibbiyotda keng qo‘llanilmoqda. Ular jigar va o‘t yo‘llari kasalliklarini davolashda, qondagi xolesterin miqdorini kamaytirishda hamda surunkali gepatit, surunkali intoksikatsiya va buyrak yetishmovchiligi kabi holatlarni davolashda ishlatiladi. Artishokdan ajratib olingan biologik faol birikma – tsinarin saqlovchi farmatsevtik mahsulot surunkali xolesistit, jigar sirrozi va surunkali nefritni davolashda ham qo‘llaniladi. Ushbu maqolada *Cynara scolymus* L. ning kimyoviy tarkibi, xususan, suvda eriydigan vitaminlari va flavonoid birikmalari o‘rganilgan.

**Kalit so‘zlar:** vitaminlar, flavonoid, birikmalar, xolesterin, surunkali nefrit.

**АННОТАЦИЯ.** На сегодняшний день спиртовые экстракты и капсулы, полученные из растения артишок, широко используются в медицине. Они применяются для лечения заболеваний печени и желчевыводящих путей, снижения уровня холестерина в крови, а также для лечения таких состояний, как хронический гепатит, хроническая интоксикация и почечная недостаточность. Фармацевтический препарат, содержащий биологически активное соединение цинарин, извлеченное из артишока, также используется для лечения хронического холецистита, цирроза печени и хронического нефрита. В данной статье рассматривается химический состав **Cynara scolymus L.**, в частности, его водорастворимые витамины и флавоноидные соединения.

**Ключевые слова:** витамины, флавоноиды, соединения, холестерин, хронический нефрит.

## INTRODUCTION

*Cynara scolymus* L., commonly known as artichoke, is a perennial medicinal



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plant highly valued in both botany and medicine. Below is detailed information about this plant. Botanical description family *Asteraceae* (Composite family). Height reaches 1-2 meters. Leaves large, serrated or lobed, gray-green in color. Flowers blue-purple in color, arranged in capitulum-shaped inflorescences[1]. Fruit hairless achenes with a hard shell. Distribution it predominantly grows in the Mediterranean region cultivated in Southern Europe, North Africa, the USA, and other regions. It does not tolerate cold climates well and thrives in warm, sunny locations. Health benefits liver health Artichoke enhances detoxification processes in the liver and reduces cholesterol levels[2]. Improved digestion promotes better digestion and stimulates appetite. Diuretic properties helps cleanse the kidneys. Antioxidant fights free radicals and slows down aging. Immune support its flavonoids and vitamins boost the immune system. Medicinal applications liver diseases useful in hepatitis and cirrhosis. Digestive disorders relieves dyspepsia and bloating. Cholesterol reduction acts as an adjunct in cardiovascular diseases. Skin care used externally for various skin conditions[3]. Tea or infusions prepared from the leaves and roots. Culinary use young artichoke heads are used in salads, soups, or as a side dish. Extracts and supplements available in pharmacies as tablets or capsules. Artichoke (Cynara scolymus) has been widely used in traditional medicine due to its numerous health benefits[4]. Its significance is particularly evident in the following areas, teas and infusions made from artichoke leaves were traditionally used to protect the liver and enhance detoxification processes. It stimulates bile production, helping to prevent gallstones[5]. It has been used as a restorative remedy for conditions like hepatitis, cirrhosis, and fatty liver disease. In traditional medicine, artichoke was used to stimulate digestion and reduce bloating. It is well-known as a natural appetite stimulant[6]. It has been used as a remedy for lowering blood pressure and managing cholesterol levels. The cynarin compound in artichoke helps reduce “bad” cholesterol (LDL)[7]. Dried leaves are steeped in boiling water and consumed to aid digestion and support liver health. Fresh leaves are juiced to cleanse the body. Alcoholic or aqueous infusions are used for liver and heart conditions. Young artichoke heads are consumed as a delicious dish, aiding digestion and providing nutritional benefits[8].

## METHOD

**Determination of vitamins in *Cynara scolymus* L.** To analyze the water-soluble vitamin content in **C**ynara scolymus L., 5 grams of plant material from vegetative organs (roots, stems, and leaves) were measured and dissolved in 100 ml of water. Vitamins were extracted using the extraction method. The prepared extracts were filtered and centrifuged at 7000 rpm for 10 minutes. The resulting solutions were analyzed using High-Performance Liquid Chromatography (HPLC). Samples from each region were dried, dissolved in water, extracted, centrifuged, and



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then analyzed via HPLC.

Chromatographic Conditions: Chromatograph: Agilent 1260 Infinity (USA). Mobile Phase: Gradient flow of acetonitrile and buffer with pH=2.92: 0–6 min: 4% acetonitrile : 96% buffer, 6–9 min: 10% acetonitrile : 90% buffer, 9–15 min: 20% acetonitrile : 80% buffer, 15–20 min: 4% acetonitrile : 96% buffer. Injection Volume: 20 µl. Flow Rate: 1.0 ml/min. Column: Agilent Eclipse XDB-C18 (4.6 x 250 mm, 5 µm particle size). Detector: Diode-array detector. Detection Wavelengths: 265 nm and 254 nm.

**Determination of flavonoids in *Cynara scolymus* L.** After initial qualitative tests confirmed the presence of flavonoids in Cynara scolymus L., the types and quantities of flavonoids were determined through extraction of plant samples with chloroform and subsequent analysis using High-Performance Liquid Chromatography (HPLC). The HPLC method employed an isocratic elution mode and a diode array detector (DAD). Acetonitrile and buffer solution were used as the mobile phase. Spectral data were collected in the wavelength range from 200 to 400 nm. Chromatographic Conditions: Chromatograph: Agilent Technologies 1260. Mobile Phase (Isocratic Mode): Acetonitrile – buffer solution (35:75), pH=2.92, for 15-20 minutes. Injection Volume: 5 µl. Flow Rate: 0.75 ml/min. Column: Eclipse XDB-C18 (5.0 µm, 4.6 x 250 mm). Detector: Diode Array Detector (DAD). Detection Wavelengths: 254, 320 nm.

## RESULTS

**Amount of water-soluble vitamins in Cynara scolymus L.** Vitamins are low molecular weight organic compounds with high biological activity, playing a crucial role in regulating biochemical processes in the body. Literature suggests that only 13 essential vitamins exist, while others are vitamin-like compounds. Currently, vitamins are studied as water-soluble and fat-soluble, both of which are essential for human health. Due to their role as primary coenzymes in biochemical processes, the vitamins present in Cynara scolymus L. were studied for both quality and quantity (Table 1). This analysis provides insights into the vitamin content of the plant, highlighting its nutritional value and potential medicinal benefits. Based on the obtained results, it can be stated that the vitamin content in the root and flower of *Cynara scolymus* L. is lower compared to that in the leaf and stem(Figure 2-3-4-5).

**Table 1**

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

| № | Sample | Quantity mg/100 g | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $B_1$ | $B_6$ | $B_9$ | PP | C | $B_2$ | $B_{12}$ |



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 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. stem | 1.21 | 0.02 | 0.014 | - | 0.9 | 3.4 | 0.1 |
| 4 | *Cynara scolymus* L. flower | - | - | 0.03 | - | - | 1.81 | 0.4 |

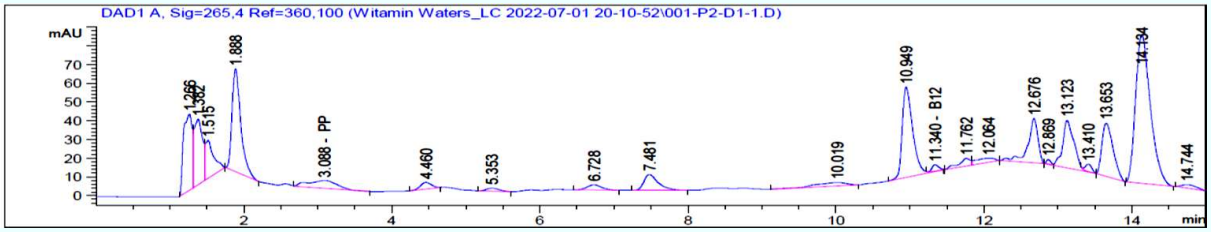



**Figure 2**. ***Chromatogram of water-soluble vitamins identified in the leaf of Cynara scolymus L.***

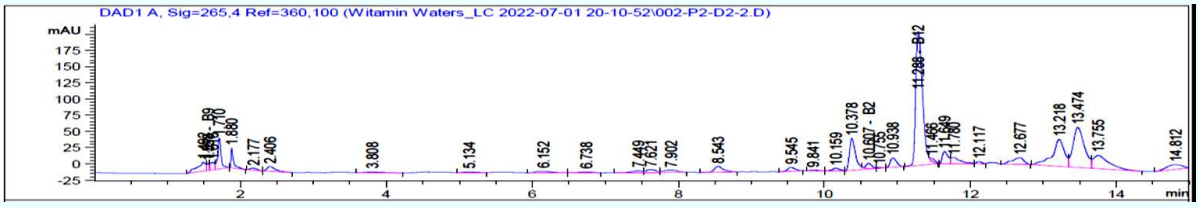



**Figure 3**. ***Chromatogram of water-soluble vitamins identified in the stem of Cynara scolymus L.***

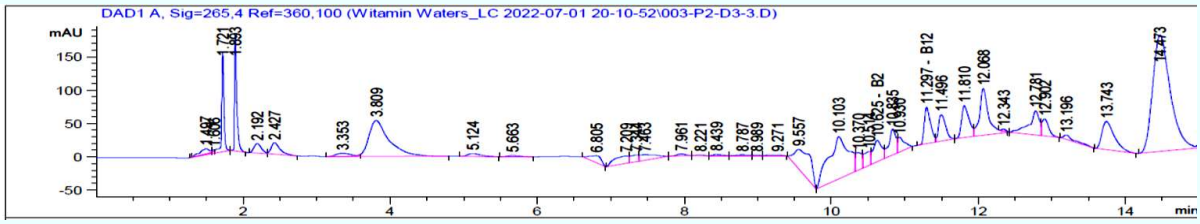



**Figure 4**. ***Chromatogram of water-soluble vitamins identified in the root of Cynara scolymus L.***

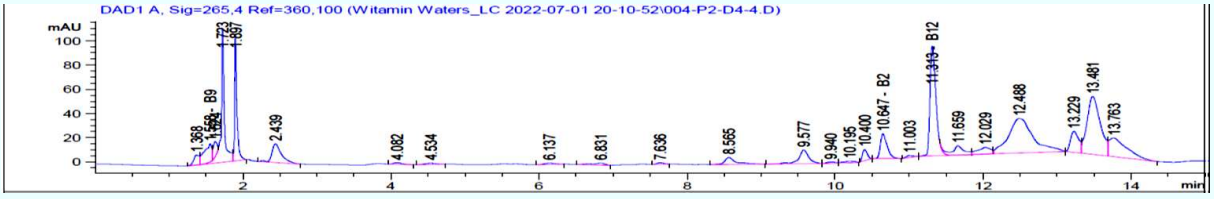



**Figure 5.** ***Chromatogram of water-soluble vitamins identified in the flower of Cynara scolymus L.***



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The results of the analysis revealed that the stem of *Cynara scolymus* L. is rich in vitamin $B_1$, the leaf in vitamin PP, and the flower in vitamin $B_2$.

**The amount of flavonoids identified in the *Cynara scolymus* L. plant.** Among the phenolic compounds found in plants, flavonoids are considered the most important due to their high biological activity. Literature reviews on plants belonging to the *Cynara* genus show that they all contain flavonoids, and these compounds can be used to address various diseases. Therefore, determining the flavonoid content and their quantity in this plant species became one of the key tasks in the scientific research project (Figure6).

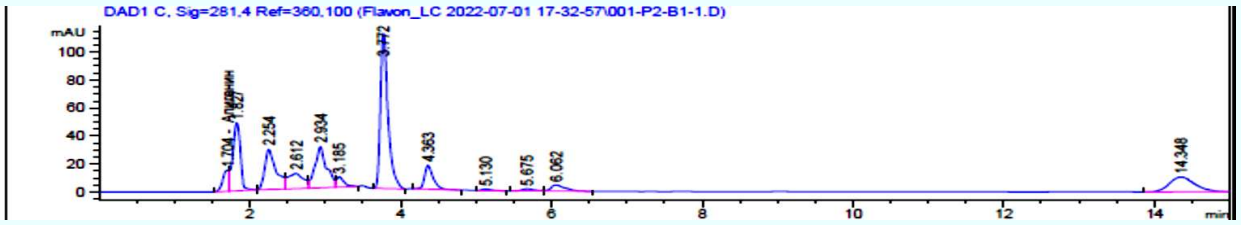



**Figure 6.** ***Chromatogram of flavonoids identified in the leaf of Cynara scolymus L.***

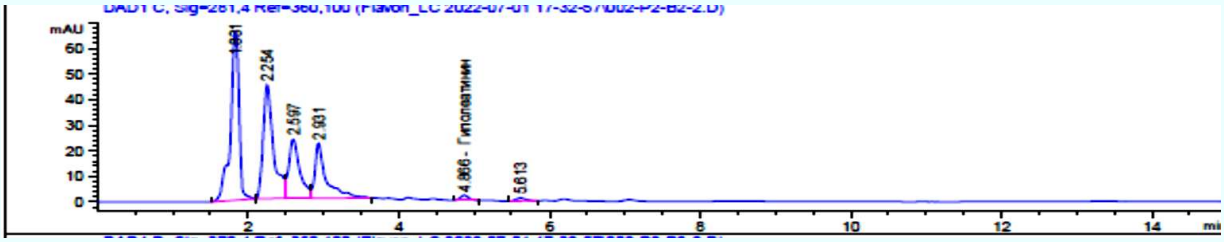



**Figure 7.** ***Chromatogram of the flavonoids identified in the stem of*** *Cynara scolymus L.*

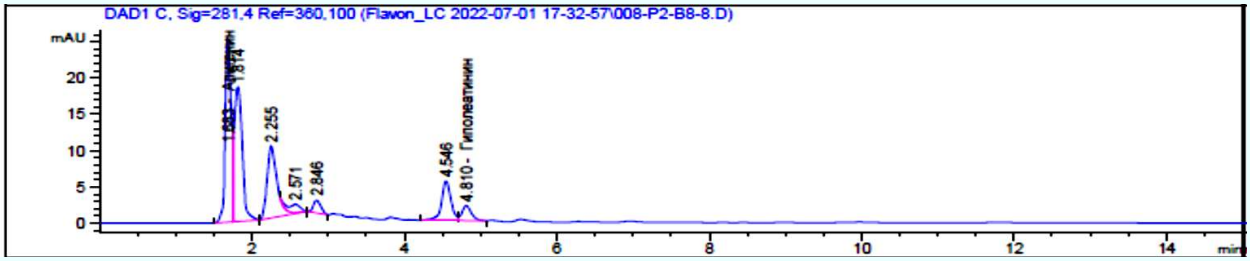



**Figure 8.** ***Chromatogram of the flavonoids identified in the root of*** *Cynara scolymus L.*

It was found that the leaf of *Cynara scolymus* L. primarily contains flavonoids such as apigenin, hyperoside, and hypolaetin apigenin and hyperoside (Table 2). Among them, apigenin, rutin, and gallic acid were present in the highest amounts, and it was determined that the flavonoid robinin was absent from the composition. It can be seen from the table (Table 2) that three main flavonoid representatives — apigenin, hyperoside, and hypolaetin — were identified in the stem of *Cynara scolymus* L. (Figure 7). The compounds robinin, rutin, gallic acid, and quercetin were not present.



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**Table 2**

**The amount of flavonoids identified in the leaves of *Cynara scolymus* L. (mg/100)**

| № | Flavonoids | Amount of flavonoids leaves | Amount of flavonoids stem | Amount of flavonoids root |
|---|---|---|---|---|
| 1 | Robinine | - | - | - |
| 2 | Rutin | 2.7 | - | - |
| 3 | Apigenin | 3.02 | 1.22 | 2.41 |
| 4 | Hyperoside | 0.35 | 0.78 | 0.04 |
| 5 | Gallic acid | 1.9 | - | - |
| 6 | Hypolaetin | 0.11 | 0.21 | 0.12 |
| 7 | Quercetin | 1.55 | - | - |

The amounts of flavonoids identified in the root slightly differ from each other (Table 2). In the root, as in the stem and leaf, the three main flavonoids — apigenin, hyperoside, and hypolaetinin — were identified (Figure 8).

**DISCUSSION**

Based on the results obtained from our studies, it can be concluded that *Cynara scolymus L.* is considered a healthy and beneficial food source due to its nutritional and phytochemical composition. It contains vitamins, minerals, and a high amount of phenolic compounds. The main vitamins and phenolic compounds in the plant support the immune system, regulate protein production, restore skin cell health, protect the brain from premature aging, and folic acid (B9) supports the function of the circulatory system and the bone marrow where blood cells are formed. Ascorbic acid (vitamin C) ensures the body's strong defense against infections and harmful environmental factors.

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