ANALYSIS OF WATER- AND FAT-SOLUBLE VITAMINS IN FERULA TADSHIKORUM RESIN

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Annotatsiya: Maqolada dorivor o‘simliklar turkumiga mansub *Ferula L.* turkumining vakili *Ferula tadshikorum* smolasi tarkibidagi yog‘da va suvda eruvchi vitaminlari yuqori samarali suyuqlik xromatografiya usulida o‘rganilgan, tahlillar jadval va rasmlar bilan izohlangan.

Kalit so‘zlar: *Fersmola, ula tadshikorum*, YuSSX, sifat va miqdor analizi

Abstract: In this article, fat-soluble and water-soluble vitamins contained in the resin of *Ferula tadshikorum*, a representative of the *Ferula L.* genus belonging to the group of medicinal plants, were studied using the high-performance liquid chromatography (HPLC) method. The analysis is illustrated with tables and figures.

Keyvords: *Ferula tadshikorum,* HPLC, resin, quantitative and qualitative analysis.

Аннотация: В данной статье с использованием метода высокоэффективной жидкостной хроматографии (ВЭЖХ) исследованы жирорастворимые и водорастворимые витамины, содержащиеся в смоле *Ferula tadshikorum* — представителя рода *Ferula L.*, относящегося к группе лекарственных растений. Результаты анализа представлены в виде таблиц и изображений.

Ключевые слова: *Ferula tadshikorum* ВЭЖХ, смола, количественной и качественный анализ

Introduction.

Ferula tadshikorum a species included in the Red Book of Uzbekistan, belongs to the genus Ferula L. of the family Apiaceae. It is a perennial monocarpic plant that grows to a height of 1.5–1.8 meters and is characterized by a strong garlic-like odor. The root is thick, with a vertical rhizome and a simple caudex. The stem is solitary, about 5 cm in diameter at the base, dark-colored, and smooth. The leaves are soft and easily wilt; the upper surface is nearly hairless, while the underside is grayish and hairy. They have a circular structure with many vascular bundles. The leaf blade is large, up to 40 cm long and 30 cm wide, elliptic in shape, and tripinnately divided. The first-order segments may be divided two to three times. Upper stem leaves are sessile (without petioles). The inflorescence is a broad panicle with numerous umbels, all of which are fruit-bearing. The central umbels

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have thick peduncles that often form a thick ring and are 3–6 cm long. The secondary umbels (umbellets) contain 10–15 flowers, with no involucres. Flower stalks (pedicels) are short, 0.5–0.8 cm. The calyx teeth are small and three-edged. Petals are yellow, 2–2.5 cm long, elongated-elliptic, blunt, and curved inward at the tip. The stylopodium (the base of the style) is cup-shaped. The fruit is 1.9–2.7 cm long and 0.9–1.2 cm wide, obovate, elongate-obovate, ovate or elliptic, compressed dorsally, flat, and glabrous. Flowering occurs in April–May, and fruiting in June–July [1; 95-b.]; [2; 44-b.]..

Ferula tadshikorum is a perennial monocarpic species with a life cycle lasting 23–27 (up to 30) years.

Additionally, *Ferula tadshikorum* is a plant species from the Ferula genus, commonly found in Central Asia, especially in regions like Tajikistan and Uzbekistan. It is widely used in traditional medicine for its therapeutic properties [3; p.225-229] [4;p.53] [5;p.43] [6; p.75-81.] [7;p.947-954].

Water-Soluble Vitamins (Hydrophilic Vitamins):

1. Vitamin C (Ascorbic Acid)

Acts as a powerful antioxidant.

Strengthens the immune system.

Promotes faster wound healing.

Commonly found in many plants, including various Ferula species.

2. B-Group Vitamins:

B1 (Thiamine): Important for nervous system function.

B2 (Riboflavin): Helps in cellular energy production.

B3 (Niacin): Supports circulation and cholesterol control.

B6 (Pyridoxine), B9 (Folic Acid): Vital for blood formation and nerve health.

Fat-Soluble Vitamins (Lipophilic Vitamins):

1. Vitamin E (Tocopherol)

A strong antioxidant.

Protects cells from oxidative stress.

Often found in the oil or seeds of Ferula species.

2. Vitamin A (Retinol or Beta-Carotene)

Essential for good vision.

Supports immune function

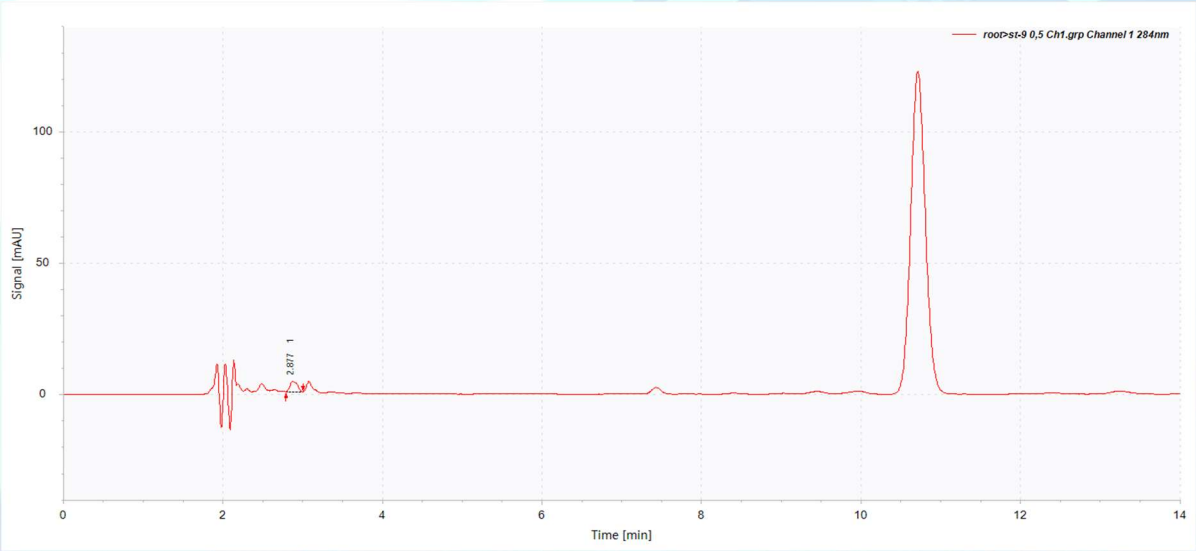
Literature review. According to the literature, there is no unified approach for the detection and sample preparation methods of fat-soluble vitamins, including vitamin E. In pharmaceutical analyses, high-performance liquid chromatography (HPLC) has been widely used in recent years for the quantitative determination of

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vitamin E, employing various detectors [8; p-9]. In developed countries, the HPLC method is primarily used to detect vitamin E in plant samples.

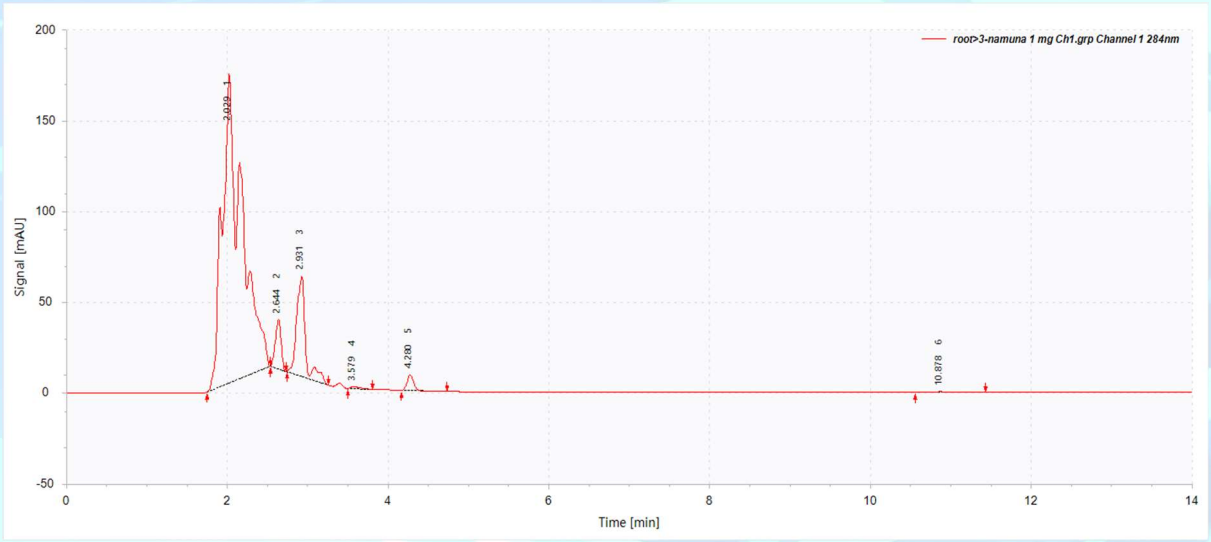
The main challenge in developing methods for determining fat-soluble vitamins lies in the difficulty of extracting them from samples. One of the most common methods for detecting vitamin E using HPLC involves first saponifying the sample with an alkaline solution, followed by extraction with a non-polar solvent such as isooctane or hexane [9; p. 220;] [10; p. 62–69;]. In this study, acetonitrile was used as the non-polar solvent to extract vitamin E from the resin of Ferula tadshikorum.

Analysis and results. A standard working solution of vitamin E at a concentration of 0.5 mg/ml was prepared. Chromatographic conditions: a Supelco C18 column, 150 mm × 4.6 mm in size, with 5 µm particle size was used; the analysis was carried out at room temperature with a detection wavelength of 284 nm. The mobile phase was acetonitrile-ethyl acetate in an 80:20 ratio, the flow rate was 1 ml/min, and the injection volume was 20 µl (see Figure 1).



a)

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b)

Figure 1. a) Chromatogram of Standard Vitamin E
b) Chromatogram of root resin extract of Ferula tadshikorum in acetonitrile

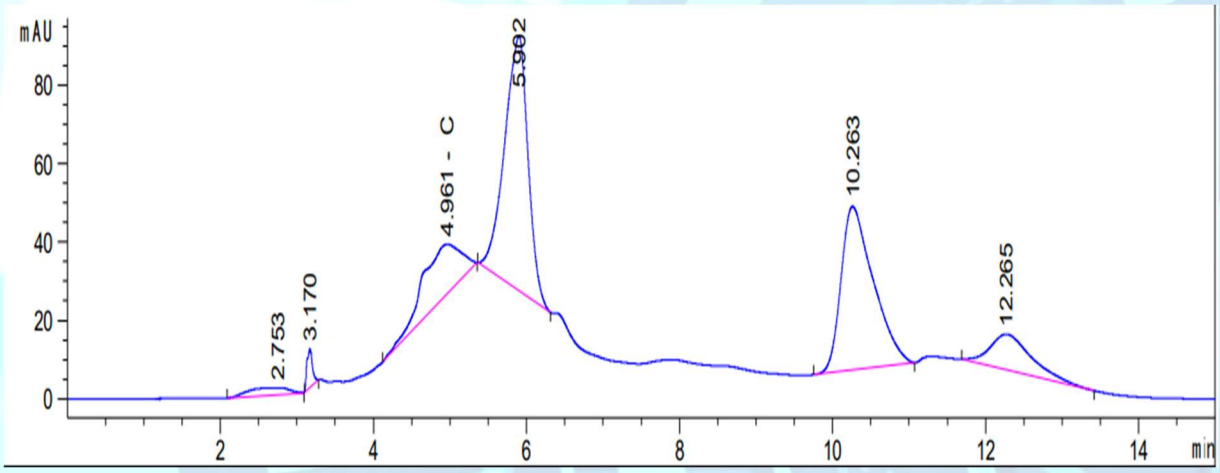


Fig3. HPLC chromatogram of vitamin C

Table.1

The content of water-soluble vitamins in the resin of *Ferula tadshikorum*

№	Sample name	Quantity, mg/100 g						
		B_1	B_6	B_9	PP	C	B_2	B_{12}
1	Resin	-	-	-	-	1,522	-	-

Macro- and Microelemental Composition Important for Humans Analyzed Qualitatively and Quantitatively Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) in the Resin.

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Table.2

Content of Macro- and Microelements in the Resin of *Ferula tadshikorum*

Chemical Element Content (mg/L								
Li	**Na**	**Mg**	**Al**	**Si**	**P**	**K**	**Ca**	**Ti**
0,27	428.46	843.269	75.089	170.383	300.794	143.764	24196.216	238.78
V	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**
0,142	2.933	10.705	484.702	0.102	2.590	6.000	10.507	0.672
Ge	**As**	**Se**	**Rb**	**Sr**	**Zr**	**Nb**	**Mo**	**Ag**
0,004	0.051	0.456	0.251	145.207	0.256	0.005	0.222	0.33
Cd	**Sn**	**Sb**	**Cs**	**Ba**	**Ta**	**W**	**Hg**	**Pb**
0,005	2.571	0.037	0.03	10.714	0.001	0.020	0.095	0.316

Based on the above results, it was found that the resin contains a high concentration of macro- and microelements beneficial for living organisms (such as K, Ca, Mg, Zn, Fe, Ag) (table 2). The most abundant microelements in the resin were calcium (24,196.216 mg/L), iron (484.702 mg/L), and magnesium (843.269 mg/L). It was also noted that essential and vital microelements for living organisms were present, and the levels of heavy metals (As, Hg, Pb), which are considered hazardous if exceeding the permitted limit (PEL), were within safe norms [11; 900-905-b.].

Conclusion. According to the analysis results, the resin of *Ferula tadshikorum* was found to contain 0.16% vitamin E. Additionally, the content of water-soluble vitamins in the resin of *Ferula tadshikorum* was studied using the HPLC method with a DAD detector at a wavelength of 292 nm (Table 1).

The resin obtained from the root of *Ferula tadshikorum* is completely harmless, safe, and beneficial for living organisms.

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