CHEMICAL SCIENCES

STUDY OF THE CHEMICAL COMPOSITION OF THE PLANT FERULA LIPSKYI KOROVIN USING HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

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Abstract

This article presents the results of a study of the amino acid composition of the roots of Ferula lipskyi, a plant native to the Fergana Valley. Plants of the genus Ferula are a valuable source of natural biologically active substances and are widely used in folk and traditional medicine due to the presence of essential oils, resins, coumarins, flavonoids, terpenoids, amino acids, and mineral compounds. The aim of the study was to qualitatively and quantitatively determine the amino acid composition of Ferula lipskyi roots. The analysis was performed by high-performance liquid chromatography with a fluorescence detector on an Agilent 1260 II Infinity system using standard amino acid samples. Serine, glycine, threonine, arginine, alanine, lysine, valine, methionine, phenylalanine, isoleucine, and proline were identified in the sample. The highest content was found for threonine—0.98 mg/g, glycine—0.79 mg/g, and lysine—0.53 mg/g. Asparagine, glutamine, histidine, glutamate, and tryptophan were not detected in the test sample. The obtained data demonstrate the specificity of the amino acid profile of Ferula lipskyi and confirm the promise of further phytochemical and pharmacological study of this plant as a potential source of natural biologically active compounds for the pharmaceutical and food industries..

Keywords: *Ferula lipskyi,* genus Ferula, amino acid composition, plant roots, biologically active substances, high-performance liquid chromatography, fluorescence detector, threonine, glycine, lysine.

With the development of medicine, the delivery of medications to patients is becoming increasingly important. The majority of drugs used in medical practice are biologically active substances isolated from plant components. Plants of the genus Ferula are a valuable source of natural biologically active substances and are widespread in the arid and mountainous regions of Central Asia. Representatives of this genus contain essential oils, resins, coumarins, flavonoids, terpenoids, amino acids, and minerals. Due to their rich chemical composition, Ferula plants exhibit anti-inflammatory, antimicrobial, antioxidant, antispasmodic, and restorative properties. In folk and traditional medicine, they are used to treat various diseases and are also considered promising raw materials for the pharmaceutical, food, and agricultural industries. The chemical composition of Ferula plants depends on the species, growing conditions, climate, soil composition, and stage of plant development, necessitating their comprehensive phytochemical and pharmacological studies. [1,2]. Objective: To study the amino acid composition of the root parts of Ferula lipskyi, a plant native to the Fergana Valley.

About the plant: Ferula lipskyi is a large perennial plant, typically reaching a height of 1.5–2.5 meters. It is characterized by a strong putrid odor. Rhizome: thick, large, often coarse. It is highly branched underground. It secretes a yellowish milky sap (rich in substances with anti-inflammatory properties). Stem: erect, large, hollow, smooth or slightly inflamed. It reappears annually. Leaves: large, intricately divided into four or five parts. The lobes are small and needle-like. The leaf blades have an expanded, cap-shaped sheath. Flowers: small, yellowish. Arranged in complex umbel-shaped (zonal) inflorescences. The flowers are bisexual. Fruit: A mericarp (split fruit) dividing into two wing-shaped parts. Each part has five distinct marginal lines. The fruit turns yellow-orange when ripe. Distribution and ecology: Distribution: Central Asia, especially the foothills and mountains of Uzbekistan, Tajikistan, and Kazakhstan. Habitat: Dry valleys, rocky and sandy soils, steppes, and slopes. Growing season: Grows in spring; fruits ripen in late summer.

Materials and methods

The root parts of Ferula lipskyi, collected in the Fergana district of the Fergana region in May 2025, were used as the test sample. The plant sample was analyzed for qualitative and quantitative amino acid parameters using standard samples supplied by Sigma Aldrich (Germany). The determination was carried out using a fluorescence detector (FLD) installed on an Agilent 1260 II Infinity liquid chromatography system, manufactured by Agilent Technologies, USA. A Poroshell 120 EC-C18 column (150 mm × 4.6 mm × 4 μm), manufactured in the USA, was used as the

stationary phase. Pre-column derivatization was performed in an automatic programmable mode. For amino acid analysis, the following mobile phases were used: phase A — a solution of sodium dihydrogen phosphate (40 mM), pH 7.8, and phase B — a mixture of acetonitrile, methanol, and water (in a ratio of 45:45:10), using a gradient mode.

Time | Phase A % (sodium dihydrogen phosphate solution, 40 mM, pH 7.8) | Phase B% (acetonitrile: methanol: water = 45:45:10).

The flow rate was 1 ml/min, the thermostat temperature was 40°C, the injected sample volume was 5 µl, the analysis was carried out for 30 minutes, and the following chromatograms were obtained

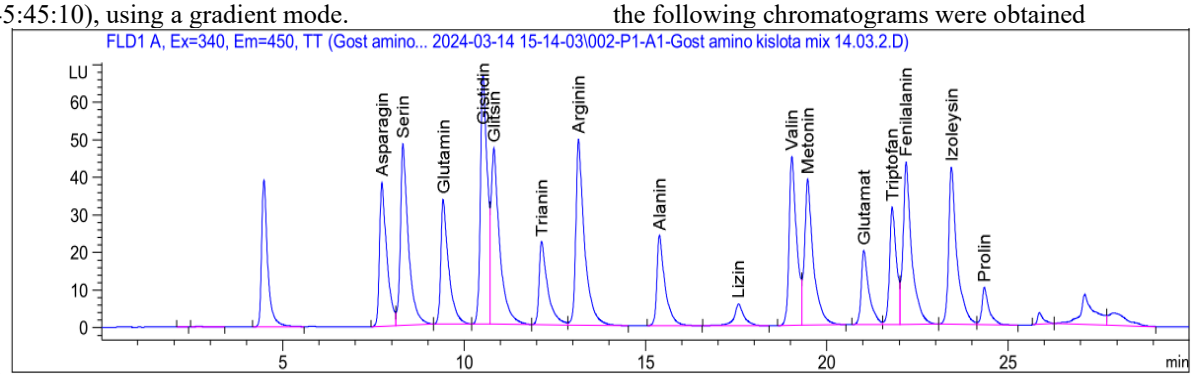


Figure 1. *Chromatogram obtained from standard samples of 16 different amino acids*

Hydrolysis of the amino acids contained in the sample was carried out as follows:First, all samples were ground to a size of 1 mm. A 5.0 g sample was ground and weighed to the nearest 0.001 mg using an analytical balance (FA220 4N). Next, the sample was placed in a 200 ml flask with a reflux condenser, 50 ml of hydrochloric acid (6 N) was added, and the flask was placed in a thermostat at 110°C. Hydrolysis was carried out for 24 hours with magnetic stirring. After hydrolysis was complete, the solution was cooled to room temperature, 10 ml was removed, and centrifuged for 10 minutes at 12,000 rpm. Then, 5 ml of the centrifugate was removed and neutralized with 6 N sodium hydroxide.After this, 1 ml of the solution was filtered through a filter with a pore size of 0.45 µm, placed in a vial and the following results were obtained [4,5,6,7].

Results and Discussion: The results obtained are presented in Table 1.

Table 1

Composition and quantity of amino acids of the root parts of the plant Ferula lipskyi, growing in the Fergana Valley

№	Name of indicators	Ferula lipskyi root parts (mg/g)	№	Name of indicators	Ferula lipskyi root parts (mg/g)
1.	Asparagin	0.00	9.	Lizin	0.53
2.	Serin	0.15	10.	Valin	0.08
3.	Glutamin	0.00	11.	Metonin	0.07
4.	Gistidin	0.00	12.	Glutamat	0.00
5.	Glitsin	0.79	13.	Triptofan	0.00
6.	Trianin	0.98	14.	Fenilalanin	0.01
7.	Arginin	0.20	15.	Izoleysin	0.17
8.	Alanin	0.02	16.	Prolin	0.21

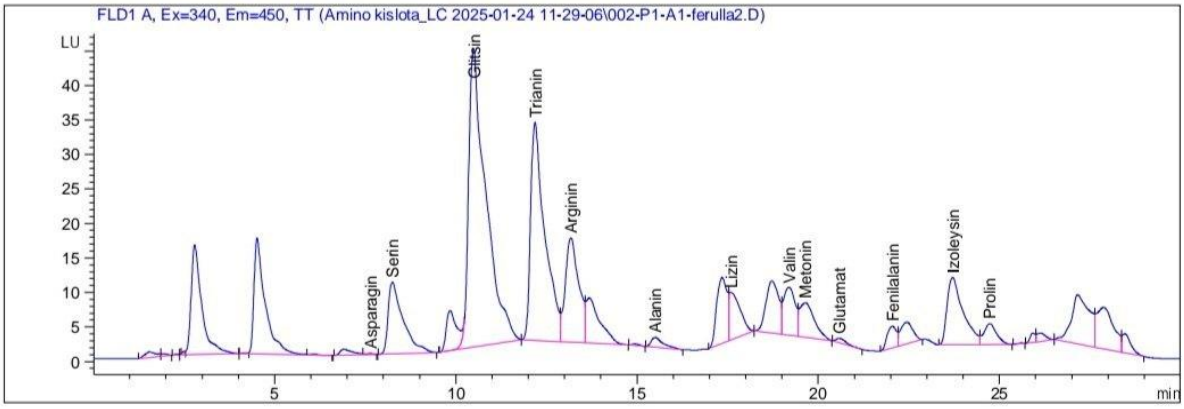


Figure 2. Chromatograms of amino acids obtained from samples of the root part of the plant Ferula lipskyi

Conclusion: Thus, the study of the amino acid composition of the roots of Ferula lipskyi, a plant grown in the Fergana Valley, revealed the presence of a number of physiologically important amino acids.

High-performance liquid chromatography (HPLC) identified and quantified serine, glycine, threonine, arginine, alanine, lysine, valine, methionine, phenylalanine, isoleucine, and proline in the sample. However, asparagine, glutamine, histidine, glutamate, and tryptophan were not detected in the sample. Among the identified amino acids, the highest concentrations were found for threonine (0.98 mg/g), glycine (0.79 mg/g), and lysine (0.53 mg/g). The relatively high content of these amino acids indicates the biochemical value of Ferula lipskyi roots. Threonine is an essential amino acid and plays a key role in protein metabolism, immune system function, and maintaining metabolic processes in the body. Glycine is involved in the synthesis of biologically active compounds, and lysine is an important component of protein metabolism and tissue growth. A comparative analysis with representatives of the genus Ferula shows that the amino acid profile of Ferula lipskyi has its own distinctive features. Like other species of this genus, the plant contains a complex of biologically active substances, but the quantitative distribution of amino acids depends on the species, environmental conditions, soil composition, climatic factors, vegetation phase, and the plant part used. The predominance of threonine, glycine, and lysine in the roots of Ferula lipskyi distinguishes this species from several other representatives of the genus Ferula, for which variable accumulation of amino acids and other nitrogen-containing compounds is more often noted in the literature. The obtained results confirm that Ferula lipskyi is a promising plant material for further phytochemical and pharmacological study. The presence of essential and nonessential amino acids in the root parts of the plant allows this species to be considered a potential source of natural biologically active compounds that can be used in the pharmaceutical, food, and biotechnology industries.[8] However, the absence of asparagine, glutamine, histidine, glutamate, and tryptophan in the studied sample indicates the specificity of the amino acid composition of Ferula lipskyi and the need for further research using samples collected at different stages of the growing season and from different growing regions. This will allow for a more complete assessment of the chemical composition of the plant, the establishment of patterns of amino acid accumulation, and the determination of its practical significance among other species of the genus Ferula.

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