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7 DETERMINATION OF THE AMINO ACID CONTENT IN THE FRUITS OF *SOPHORA JAPONICA* L.

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Introduction: *Sophora japonica* L. (family ***Fabaceae***) is a medicinal plant widely distributed in East Asia, and its flower buds and fruits have long been used in traditional medicine as well as modern pharmaceutical practice. This plant is rich in biologically active compounds, including flavonoids, isoflavones, alkaloids, polysaccharides, and other phytochemicals. Numerous studies have demonstrated that *S. japonica* possesses significant antioxidant, anti-inflammatory, antimicrobial, angioprotective, and cardioprotective properties due to its diverse phytochemical composition.

In recent years, increasing attention has been devoted not only to the investigation of secondary metabolites in medicinal plants but also to their primary metabolites, particularly amino acids. Amino acids are essential components of protein biosynthesis and play crucial roles in nitrogen metabolism, cellular metabolism, maintenance of osmotic balance, and adaptation to various environmental stress factors

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in plants. Furthermore, certain amino acids have been reported to enhance antioxidant defense systems and regulate the biosynthesis of secondary metabolites.

In recent years, increasing attention has been paid not only to the investigation of secondary metabolites in medicinal plants but also to their primary metabolites, particularly amino acids. In addition to serving as the fundamental building blocks of protein biosynthesis, amino acids play essential roles in nitrogen metabolism, cellular metabolism, maintenance of osmotic balance, and adaptation to environmental stress in plants. Furthermore, certain amino acids have been reported to enhance antioxidant defense systems and regulate the biosynthesis of secondary metabolites.

Although the biologically active constituents of *Sophora japonica*, such as rutin, quercetin, genistein, and matrine, have been extensively studied, relatively little information is available regarding the qualitative and quantitative composition of free amino acids in its fruits. In particular, the amino acid profile of *S. japonica* specimens growing in Central Asia has received very limited scientific attention.

The chemical composition of medicinal plants may vary considerably depending on geographical distribution, climatic conditions, soil characteristics, the stage of vegetation, and other environmental factors. Therefore, determining the amino acid composition of *Sophora japonica* fruits growing under the environmental conditions of Uzbekistan is of considerable scientific and practical importance for pharmacognosy, phytochemistry, and the standardization of medicinal plant raw materials.

Results and Discussion

The amino acid composition of the fruits of *Sophora japonica* L. growing in the Surkhandarya region was qualitatively and quantitatively analyzed using **High-Performance Liquid Chromatography (HPLC)** on an **Agilent Technologies 1200 Series** system. The analysis identified **20 amino acids**, with a total amino acid content of **41.967 mg/g** of dry plant material. These findings indicate that the fruits of *Sophora japonica* are a rich source of biologically active primary metabolites and represent a valuable medicinal plant material.

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Among the identified amino acids, cysteine was present at the highest concentration (5.254 mg/g), followed by histidine (5.201 mg/g), asparagine (5.073 mg/g), arginine (4.395 mg/g), leucine (2.894 mg/g), glycine (2.510 mg/g), and tryptophan (2.396 mg/g). The lowest concentrations were observed for glutamine (0.160 mg/g), threonine (0.310 mg/g), methionine (0.464 mg/g), and proline (0.472 mg/g). The remarkably high concentration of **cysteine** identified in this study is of particular scientific significance. Cysteine is a sulfur-containing amino acid and serves as a key precursor in the biosynthesis of **glutathione**, one of the most important intracellular antioxidants. Glutathione plays a crucial role in protecting plant cells against oxidative stress, scavenging free radicals, and maintaining the stability of cellular membranes. Therefore, the high level of cysteine detected in the fruits of *Sophora japonica* may contribute to the plant's antioxidant potential and could be considered one of the factors underlying its biological activity.

The second highest concentration was observed for histidine. Histidine is an important amino acid involved in metal ion chelation, regulation of enzymatic activity, and antioxidant defense mechanisms. It also plays a significant role in maintaining cellular homeostasis and protecting cells from oxidative damage. The high concentration of histidine in the fruits of Sophora japonica further confirms the richness of this plant in biologically active compounds and supports its potential pharmacological value.

The analysis also revealed relatively high concentrations of **asparagine** and **arginine**. Asparagine is one of the principal forms of nitrogen storage and transport in plants, whereas arginine, being the most nitrogen-rich amino acid, serves as a precursor for the biosynthesis of polyamines, nitric oxide, and other biologically active compounds. The elevated levels of these amino acids suggest active nitrogen metabolism in the fruits of *Sophora japonica* and indicate intensified metabolic processes during fruit development and physiological maturation. The quantitative composition of amino acids identified in the fruits of *Sophora japonica* L. growing in the Surkhandarya region is presented in **Table 1**.

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Table 1.

Quantitative Composition of Amino Acids in the Fruits of *Sophora japonica* L. Growing in the Surkhandarya Region

No.	**Amino Acid**	**Concentration (mg/g dry plant material)**	№	Aminokislotalar nomi	*Sophora japonica* L. mevasi Konsentratsiya mg/gr
1	Aspartic acid	1.051	11	Proline	0.472
2	Glutamic acid	1.416	12	Tyrosine	1.736
3	Serine	2.069	13	Valine	1.692
4	Glycine	2.510	14	Methionine	0.464
5	Asparagine	5.073	15	Histidine	5.201
6	Glutamine	0.160	16	Isoleucine	0.822
7	Cysteine	5.254	17	Leucine	2.894

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8	Threonine	0.310	18	Tryptophan	2.396
9	Arginine	4.395	19	Phenylalanine	1.531
10	Alanine	2.201	20	Lysine	0.320
Total					**41.967**

HPLC analysis identified a total of 20 amino acids in the fruits of Sophora japonica L. The highest concentrations were recorded for cysteine (5.254 mg/g), histidine (5.201 mg/g), asparagine (5.073 mg/g), and arginine (4.395 mg/g). These findings indicate that the fruits of Sophora japonica represent an important natural source of biologically active amino acids.

Relatively high concentrations of leucine, glycine, and tryptophan were also detected. Leucine is one of the essential amino acids and plays a crucial role in protein biosynthesis and cell growth. Glycine participates in the biosynthesis of chlorophyll and glutathione, whereas tryptophan serves as the primary precursor for the biosynthesis of the plant hormone auxin.

These results suggest a high level of metabolic activity associated with the biosynthesis of biologically active compounds in the fruits of Sophora japonica. The study also identified several essential amino acids, including valine, leucine, isoleucine, methionine, phenylalanine, lysine, threonine, and tryptophan. The presence of these amino acids enhances both the nutritional and pharmacological value of the plant. Since essential amino acids cannot be synthesized by the human body and must be obtained from external sources, the fruits of Sophora japonica may be considered a promising natural raw material for the development of dietary supplements, phytopharmaceuticals, and functional food products.

Conclusion

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In this study, the amino acid composition of the fruits of Sophora japonica L., collected in September 2025 from the Surkhandarya region, was qualitatively and quantitatively analyzed using High-Performance Liquid Chromatography (HPLC) on an Agilent Technologies 1200 Series system. A total of 20 amino acids were identified, with a total amino acid content of 41.967 mg/g of dry plant material. Among the identified amino acids, cysteine (5.254 mg/g), histidine (5.201 mg/g), asparagine (5.073 mg/g), arginine (4.395 mg/g), leucine (2.894 mg/g), and glycine (2.510 mg/g) were present in the highest concentrations.

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