INTRODUCED COMMON GOJI BERRY (LYCIUM BARBARUM L.) STUDY OF THE BOTANICAL-MORPHOLOGICAL AND BIOCHEMICAL PROPERTIES OF THE PLANT

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Abstract: *This research analyzes the bioecological features and chemical composition of the fruit of Lycium barbarum L. (Goji), a promising introduced species belonging to the Solanaceae Juss. family. Modern analytical methods, including High-Performance Liquid Chromatography (HPLC), spectrophotometry, and gravimetry, were employed during the study. Results indicate that the fruits contain a complex of immunomodulating polysaccharides (LBP) ranging from 3,5% to 8,5%, and carotenoids (0,5-1,2%), specifically zeaxanthin dipalmitate, which protects the retina. Amino acid analysis revealed that L.barbarum possesses a rich profile with 18 types of amino acids, ensuring high nutritional and pharmaceutical value. The paper scientifically justifies the adaptation mechanisms of the plant to the arid climate of Uzbekistan and the relevance of its industrial cultivation.*

Keywords: *Lycium barbarum, Goji, introduction, polysaccharides (LBP), zeaxanthin, amino acids, HPLC, antioxidant, pharmacognosy, flora.*

Introduction. The flora of Uzbekistan is rich in plant species, with more than 4,380 natural plant species. Among these species are medicinal, food, ornamental, dyeing, vitamin, essential oil, and beekeeping plants. More than 750 species of medicinal plants known to science are distributed throughout the territory of the republic [1], the majority of which are found in the southeastern and southern regions

of our country. Currently, about 350 species of medicinal plants are widely used in clinical and preclinical trials [2].

Currently, the domestication of plant species with high nutritional value and extensive pharmaceutical properties remains one of the most pressing issues in global medicinal herbalism. Among such promising plants is Goji berry (Lycium barbarum L.), a member of the Nightshade family (Solanaceae Juss.), popularly known as “Goji berry”. The position of this plant in the global market is steadily increasing. According to statistical data, Goji berry fruits are ranked among the TOP-10 high-potential products in the trade of medicinal plant raw materials. Its annual export value amounts to approximately 94.4 million USD.

This indicator confirms that the plant possesses high profitability not only from a medical perspective but also from an economic standpoint. The uniqueness of Goji berry fruits is attributed to their rich biochemical composition. The presence of 18 different amino acids, 21 types of minerals, and polysaccharides (LBP) with potent antioxidant properties within the plant provides a solid basis for rightfully categorizing it as a “Super-fruit”.

Scientific and practical research on acclimatization plays a crucial role in the efficient utilization of arid and saline lands in the Republic of Uzbekistan, establishing a stable raw material base for pharmaceuticals, and increasing the sector's export potential. Furthermore, the development of scientifically-based cultivation technologies tailored to specific environmental conditions and their subsequent implementation into production is considered one of the most pressing scientific and practical tasks in the field [1], [2].

Relevance of the topic. In the modern register of medicinal products, phyto-preparations derived from medicinal plants account for approximately 40%. Furthermore, nearly 80% of drugs used for certain diseases are obtained from plant raw materials. According to experts, their share is expected to increase steadily in the coming years. This is due to their mild therapeutic effect, high bioavailability (good absorption by the body), and the possibility of long-term administration. The efficient use and propagation of medicinal plants, as well as enriching urban and

residential areas with ornamental species, remain pressing tasks. To date, scientists in the Republic have conducted extensive research on the problems of introduction and acclimatization of medicinal plants, studying the bioecological characteristics of species brought from other regions under various introductory conditions. Beyond restoring human health, medicinal plants play a significant role in improving psychological well-being and purifying the air. Consequently, the demand for medicinal plants is rising, leading to increased harvesting. However, the continuous growth in demand for medicinal plant products leads to a decrease in wild populations. Therefore, implementing scientifically-based technologies and effective cultivation methods in plantations is crucial for solving production challenges. As mentioned above, introducing and cultivating medicinal plants domestically satisfies the pharmaceutical industry's demand for raw materials to a certain extent. Additionally, it ensures the enrichment of the local flora with new introduced plant species.

Object and Methodology. Goji berry (Lycium barbarum L.), a perennial thorny shrub belonging to the Nightshade family (Solanaceae), was selected as the object of research. Biometric, bioecological, and statistical methods applied in the experiments were processed based on the obtained indicators using MS-Excel software [3].

Goji berry is a perennial thorny shrub of the genus Lycium within the Solanaceae Juss. family. It is distinguished by its life form, medicinal properties, and resistance to arid conditions. In its natural habitat, it grows as a perennial shrub reaching heights of 2,5-3 meters. The branches are spreading, thin, and flexible, typically drooping downwards. The surfaces of the stems and branches are covered with small, sharp thorns. The leaves are simple, alternately arranged, oblong-elliptical or lanceolate in shape, and light green in color. It differs from other species by its smooth (entire) leaf margins. Bisexual, occurring singly or in clusters in the leaf axils. The corolla is funnel-shaped, ranging from purple to pinkish-violet, giving the plant an ornamental appearance. Floral formula - Ca(5) Co(5)A5G(2). Fruit: A multi-seeded, succulent berry, oblong-oval in shape, with a length of 1-2 cm. Upon

ripening, it turns bright red or dark orange. Each fruit contains 20 to 30 small, kidney-shaped yellow seeds with high germination capacity. It possesses a taproot system that penetrates deep into the soil (2-3 meters) and branches extensively laterally. This structure enables the plant to remain drought-resistant in the arid desert and adir regions of Central Asia and plays a crucial role in preventing soil erosion. While Lycium barbarum L. closely resembles the Chinese wolfberry (Lycium chinense), it differs in the following aspects: leaf structure (entire margins), chemical composition, a significantly higher content of bioactive substances (polysaccharide complex), and greater resilience to low temperatures and drought. The primary raw material is the fruit. The red berries are harvested when fully ripe and are used for both medicinal and nutritional purposes. The fruit is rich in multivitamins, minerals, polysaccharides, and amino acids. It contains vitamins (tocopherol, thiamine, riboflavin, pyridoxine, ascorbic acid), minerals (potassium, sodium, calcium, magnesium, manganese, selenium, germanium), carbohydrates, pigments (carotene), amino acids, as well as phytosterols and phenols. Due to the complex of polysaccharides and antioxidants, it protects the body from signs of aging and positively influences the activity of the rejuvenating hormones secreted by the pituitary gland. Its mineral components are utilized in supportive cancer treatments, and its calcium content strengthens teeth. The polysaccharide complex is used as a regulator for diabetes and as an immune-boosting agent. Medicinal preparations derived from these complex compounds are also utilized for weight management [4].

Research Results and Discussion. In the study of Goji berry (Lycium barbarum L.), the following modern and classical analytical methods were utilized. High-Performance Liquid Chromatography (HPLC) was employed to determine the content of major carotenoids, specifically zeaxanthin dipalmitate, and other specific vitamins in the fruits. The Spectrophotometric method was used for the analytical study of medicinal polysaccharides (LBP - Lycium barbarum polysaccharides), considered the most vital bioactive component, as well as the determination of total flavonoids and antioxidant activity levels. The Gravimetric method was applied to

calculate the dry matter content in the fruits and the yield of extracts [5], [6], [7], [8], [9].

The composition of bioactive substances and their main components in the fruits of Lycium barbarum L. was investigated. According to the research findings, the total polysaccharide (LBP) content in the fruit raw material was found to range between 3,5% and 8,5%.

Within this range, the dominant complex of substances determining the biological activity, particularly the immunomodulatory properties, is the group of water-soluble polysaccharides (LBP1-LBP5). These compounds provide the plant with its unique medicinal value and potent antioxidant characteristics. Furthermore, the presence of carotenoids (0,5-1,2%) was identified, including zeaxanthin dipalmitate (accounting for 30-60% of total carotenoids), lutein, and beta-carotene. This complex of compounds ensures the fruit's efficacy in improving vision, acting as a hepatoprotector (protecting the liver), and slowing down the overall aging process of the organism (Table 1).

Table 1

Main bioactive substances in the fruits of Goji berry (*L. barbarum L.*) and their descriptions

Component Group	Content (%)	Principal Substances	Biological and Pharmacological Effects
Polysaccharides (LBP)	3,5-8,5%	LBP1, LBP2, LBP3, LBP4, LBP5	Immunomodulatory and potent antioxidant effects
Carotenoids	0,5-1,2%	Zeaxanthin dipalmitate (30-60%), lutein	Protects vision and supports retinal health
Phenolic compounds	1,0-2,5%	Quercetin, caffeic acid, rutin	Strengthens blood vessels and acts as an anti-inflammatory agent

Vitamin complex	0,1-0,3%	Vitamins C, B1, B2, B6, E	Improves metabolism and acts as a hepatoprotector
Amino acids	8,0-10,0%	Taurine, betaine (dominant)	Protects liver function and provides anti-aging effects

As illustrated in the table above, the content of polysaccharides (LBP) and zeaxanthin bioactive substances is absolutely dominant in Goji berry fruits. This determines the unique medicinal value of the plant and its high antioxidant properties, specifically in protecting vision and restoring the retina. Furthermore, the complex of betaine and vitamins enhances the plant's hepatoprotective (liver-protecting) and metabolism-improving effects. The primary biological activity of Lycium barbarum is directly linked to the synergy between its LBP1-LBP5 polysaccharides and carotenoid complexes.

It is worth noting that L. barbarum L. fruits recorded significantly higher indicators in terms of amino acid content and diversity (a total of 18 different amino acids).

Table 2

Amino acid composition of Goji berry (*L. barbarum* L.) fruit raw material

T/r	**Name of Amino Acids (based on dry raw material)**	**Lycium barbarum L. (%)**
1.	Aspartic acid	0,85 - 1,12
2.	Glutamic acids	1,22 -1,58
3.	Leucine	0,48 - 0,64
4.	Valine	0,38 - 0,51
5.	Phenylalanine	0,30 - 0,39
6.	Lysine	0,32 - 0,45
7.	Arginine	0,58 - 0,82
8.	Histidine	0,18 - 0,26

As indicated by the data in the table above, Glutamic and Aspartic acids exhibit absolute dominance within the composition of Common Boxthorn fruits. This determines the plant's unique metabolic activity and its ability to accelerate recovery processes within the organism.

Notably, the concentration of essential amino acids (Leucine, Valine, Lysine) is nearly two times higher than that found in turmeric (Curcuma longa L.), characterizing the Goji berry as a raw material of high biological value. Furthermore, the Arginine content enhances the plant’s properties in promoting vasodilation (widening of blood vessels) and improving overall blood circulation.

Conclusion. In summary, the comprehensive research conducted has led to the following conclusions:

It has been confirmed that Lycium barbarum L. is a highly promising species for introduction into the arid regions of Uzbekistan due to its robust taproot system and significant drought resistance. The plant serves not only as a source of medicinal raw material but also as an effective biological agent against soil erosion.

The study found that the content of water-soluble polysaccharides (LBP1-LBP5) in the research object ranges from 3,5% to 8,5%. Furthermore, the high proportion of zeaxanthin dipalmitate (30-60%) determines the plant's superior pharmacological activity in improving visual acuity and eye health.

The fruits contain 18 different amino acids, with Glutamic acid (1,22-1,58%) and Aspartic acid (0,85-1,12%) being the most predominant. The localization and establishment of industrial plantations of this species will enable the Republic’s pharmaceutical industry to secure a stable, import-substituting raw material base with high export potential.

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