STUDY OF THE PHYTOCHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITY OF LYCIUM RUTHENICUM MURRAY FRUITS

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Abstract: *This study is devoted to the study of the phytochemical composition and biological activity of the plant Lycium ruthenicum Murray (Black goji, goji berry). During the study, the phenolic compounds and amino acid composition of the plant fruits were analyzed using modern chromatographic and spectrophotometric methods. The results showed that gallic acid (57.94%) and polysaccharides (26.64%) were dominant in the fruit, which determined its high antioxidant activity. The plant also contained 11.64% total amino acids, of which 4.69% were essential. The study demonstrated the anticancer (antiproliferative), cardioprotective, anti-inflammatory, and anti-diabetic and anti-obesity (lipase and α-glucosidase inhibition) properties of black goji extract. The data obtained reveal the prospects for the use of Black goji (Lycium ruthenicum) fruits as a strategic raw material and immunomodulatory agent in the pharmaceutical, cosmetology and functional food industries.*

Keywords: *Lycium ruthenicum, black goji, gallic acid, anthocyanins, polysaccharides, amino acids, cardioprotection, antioxidant, antiproliferative activity.*

Introduction. The flora of Uzbekistan is rich in plant species, with more than 4,400 natural plant species growing there. Among these species are medicinal, food, ornamental, dyeing, vitamin, essential oil, and honey plants. On the territory of the Republic, more than 750 species of medicinal plants are distributed, which are clear to science. However, the study of medicinal plants that are not found in the Republic under the conditions of introduction and scientific research on them is being strengthened.

In the modern list of medicines, preparations based on medicinal plants make up 40%. About 80% of the drugs used in certain diseases are obtained from plant raw materials. Experts believe that their use will increase in the coming years. This is due to their mild effects, good absorption by the body, and the possibility of long-term use. One of the urgent tasks is to make effective use of medicinal plants and increase their cultivation, and to enrich cities and other populated areas with ornamental plants.

To date, scientists have conducted extensive research on the problems of introduction and acclimatization of medicinal plants in the republic, and the bioecological characteristics of plants introduced from other regions under various introduction conditions are being studied. Medicinal plants, in addition to restoring human health, also have a significant impact on improving human mood and spirit, and cleaning the air around us. That is why the demand for medicinal plants is increasing and their production is increasing. The increasing demand for medicinal plant products regularly leads to a decrease in the number of wild medicinal plants. This is why the introduction of scientifically based technologies that support effective technologies for growing and propagating medicinal plants in plantations is important in finding the right solution to the problem that arises in production. As noted above, the introduction of medicinal plants and their cultivation in a cultivated form will partially meet the demand of the republic's pharmaceutical industry for

medicinal plant raw materials. It also ensures the enrichment of the local flora with new introduced plant species.

Object and methodology of experience (research). The Black goji (Lycium ruthenicum Murray), a perennial shrub plant in the family Solanaceae, was selected as the object of study. Biometric, bioecological and statistical methods used in the experiments. The statistical processing of the obtained biometric indicators was processed on a computer (MS-Excel program) based on generally accepted criteria [2].

Lycium ruthenicum Murray (Black goji) is native to Central Asia and north-western China, where it grows in a natural flora based on land such as China, Afghanistan, Uzbekistan, Rossia and Pakistan, and is cultivated on a wide scale for its healing reasons. The life form is a perennial thorny shrub, reaching a height of 0.2 m to 2 m (sometimes up to 1.8 m). The stem is branched, with hard spines, and the branches are whitish or light in color. The leaves are linear-lanceolate or oblong in shape and are arranged in groups or in series on the branches. The flowers are funnel-shaped, light purple or dark purple-purple, and are located in the axils of the leaves, 1-2 per flower. The fruit is a berry, juicy fruit, and when ripe, it turns dark purple or very black. The Shape of the fruit is spherical, about 4-9 mm in diameter, inside which many small, kidney-colored brown seeds reach a length of.

The raw material is the fruit. The fruit of the plant is a black berry [1] that is harvested when ripe (in August-October). Due to the high content of anthocyanins in this plant raw material, it is used in medicine (for the treatment of heart and eye diseases), in the production of food products, and in cosmetics [2], [3], [4].

Black goji (goji berry) berries are gradually seen as a functional food in many Asian countries, as well as throughout Europe [5]. They are also sold as healthy foods in Western countries [6]. Goji (wolfberry) berries have recently become increasingly popular in North America and Europe as a "super fruit" due to their health-promoting properties. For example, goji berries have been used since ancient times to increase longevity and benefit the liver, kidneys, and vision.

L. ruthenicum Murray [7] commonly known as black goji berry or black wolf Berry, is a nutrient-rich fruit known for its high concentration of bioactive compounds responsible for its dark purple color, specifically anthocyanins. Its composition includes rich phytochemicals that contribute to its medicinal and nutritional value.

The composition of L. ruthenicum Murray (black goji berry or black goji berry) is very rich and diverse, and it is distinguished by its medicinal and nutritional properties. The main components include:

- Anthocyanins: One of the most important components in black goji berry. They have strong antioxidant properties, protecting cells from free radicals and slowing down aging;

- Polysaccharides: Active ingredients that strengthen the immune system and increase the body's overall resistance;

- Vitamins: Especially vitamin C, but also vitamins B1 and B2;

- Minerals and microelements: it contains minerals necessary for human health, such as iron (iron), zinc (zinc) and Selenium (selenium);

- Carotenoids: Substances that support eye health and reduce visual fatigue;

- Betaine (Betaine): An alkaloid that helps improve liver and kidney function.

This fruit is highly valued as a dietary supplement in the prevention of chronic metabolic diseases due to its antioxidant, anti-inflammatory, anti-radiation, immunomodulatory and anti-tumor effects.

The raw material of the Black goji (goji berry) *plant is used for many healing purposes.*

That is:

Anti-inflammatory:

- Inflammation is a sign of many diseases, associated with infection and the immune system, and has anti-inflammatory effects along with inflammatory cytokines such as inflammation, tumor necrosis factor-α (TNF-α), interleukin (IL)-1β, and IL-6 [5];

Prevents signs of aging (Anti-aging effect):

- with this indicator, goji berry is of great importance, as it meets the criteria of the International Classification of Diseases (ICD) for a global problem - aging [37];

- In a thermal stress assay, high-dose LRM extract of black goji berry extract significantly reduces mortality (compared to control (56.9%)) by 34.0% ($p < 0.05$);

- L. it is thought that a large dose of *L. ruthenicum* Murray fruit extract (above 90%) can prolong human life expectancy by limiting calories in the body (high doses of goji fruit extract (daf-16, sod-2, sod-3, hsp-16.2, sir-2.1, daf-12, and jnk-1) controls genes that regulate life expectancy at a high level [6];

Anti-cancer effects:

-According to Zhang et al, *L. ruthenicum*-derived polysaccharide LRP3-S1 shows antiproliferative activity and invasive attenuation effects in pancreatic cancer cells (AsPC-1, BxPC-3, PANC-1) depending on concentration [21]. This compound is also characterized by low cytotoxicity for normal cells (HPDE6-C7 and LO2) [7];

Cardioprotective effect:

- *L. ruthenicum* Murray plant fruit extract has cardioprotective effects against acute myocardial ischemia by lowering CK-MB and LDH enzyme levels in myocardial disease and reducing signs of inflammatory cell infiltration, edema and necrosis. Black goji (goji berry) extract can protect the myocardium by reducing inflammation and tissue damage [8];

Anti-obesity effect:

Excess weight is caused by an imbalance between energy intake and expenditure. This is a significant public health problem worldwide, as it is associated with metabolic conditions such as type 2 diabetes, hypertension, dyslipidemia, and cardiovascular disease. Obesity is usually controlled by diet, physical activity, and pharmaceuticals. However, some pharmaceuticals can have serious side effects; therefore, the need for natural products that are considered relatively safe increases. There is a report on the anti-obesity effect of LRM extract [11].

Anti-diabetic effect:

- *L. ruthenicum* Murray (LRM) seed oil acts against diabetes by inhibiting a-glucosidase through phenylpropanoid derivatives by blocking the absorption of pancreatic lipase and cholesterol esterase, fat and sugar [12].

Results of the experiment (study) and their discussion. The following modern and classical methods were used in the study of the plant *L. ruthenicum* Murray (Black goji). In this, the chromatographic analysis method (the percentage of phenolic compounds (gallic acid, caffeine, tannin, etc.) useful in detection), cell invasion analysis method (the study of the dispersal capacity of cancer cells analyzed), biochemical and enzymatic analysis method (determination of the ability to block pancreatic lipase, cholesterol esterase, and-glucosidase enzymes analytically wrapped), and spectrophotometric method (calculation of the total antioxidant content in gallic acid equivalent analytically studied). The composition of phenolic compounds in the fruits of *L. ruthenicum* was studied. It was found that the most abundant biologically active substances in the fruit of this plant are gallic acid (57.94%), a complex of polysaccharides (26.64%), and tannins (12.16%) (Table 1).

Table 1.

Black goji (Lycium ruthenicum Murray composition of phenol compounds

1.	**Phenolic compounds/amount, % (internal lization method)**	***Lycium ruthenicum*** **ıy**
2.	Gallic acid (Gallic acid)	57,94
3.	Hyperoside	-
4.	Isoferulic acid	-
5.	Catechin	0,15
6.	Caffeine	-
7.	Luteolin-7-glycoside	1,06
8.	Tannin	12,16
9.	Ferulic acid	0,58

10.	Chlorogenic acids	0,31
11.	Cicoric acid (Cicoric acid)	1,09
12.	Epicatechin	0,07
13.	Unidentified components (Complex of ccharides)	26,64
14.	Total amount of antioxidants (gallic acid), mg/g	2,00 ±0,01

As can be seen from the table above, Lycium ruthenicum Murray (black goji) fruits are dominated by gallic acid (57.94%) and polysaccharides (26.64%), which determine high antioxidant activity (2.00 mg/g) and pharmaceutical potential. Together with tannins (12.16%) and other phenolic acids, this plant is a rich source of biologically active components.

Table 2

Amino acid composition of black goji (Lycium ruthenicum) fruits

№	**Amino acids / amino acid content (calculated on a dry basis)**	**Lycium ruthenicum %**
1.	Asparagine acid	1,99
2.	Threonine*	0,46
3.	Serine	0,50
4.	Glutamic acid	1,76
5.	Proline	1,31
6.	Glycine	0,56
7.	Alanine	0,54
8.	Valine*	0,45
9.	Methionine*	0,09
10.	Isoleucine*	0,39
11.	Leucine*	0,69
12.	Tyrosine	0,29
13.	Phenylalanine*	0,49

14.	Histidine*	0,50
15.	Lysine*	0,53
16.	Arginine*	1,09
Total amino acid content		11,64
Sum of essential amino acids		4,69

Based on the data in Table 2, the following analytical conclusions can be drawn regarding the amino acid composition of the Black goji (Lycium ruthenicum Murray) fruit.

The fruits of this plant are very rich in amino acids, and their total amount (relative to absolutely dry raw materials) shows a high result:

- Irreducible amino acids: the sum of 8 amino acids (and a total of 10 together with half irreducible histidine and arginine), essential for the human body and only accepted through food, is 4.69%. This represents about 40.3% of the total amino acids, confirming that the fruit is a good source of protein.

- Common compounds: The fruit contains the highest amounts of asparagine (1.99%), glutamic acid (1.76%), proline (1.31%), and arginine (1.09%). Asparagine and glutamine acids are important for the functioning of the nervous system and metabolism.

Their biological significance lies in the fact that the high content of arginine (1.09%) and leucine (0.69%) is beneficial for the circulatory system and muscle regeneration. Although methionine (0.09%) was the least abundant, the presence of almost all other essential amino acids increases the pharmaceutical value of the plant.

In conclusion, according to Table 2, *L. ruthenicum* fruits have high potential in dietetics and medicinal preparations due to their balanced amino acid composition.

Conclusion. Research has shown that the plant *L. ruthenicum* (Black goji) has a high biological value with its rich phytochemical composition, especially dominant phenol compounds such as anthocyanins, polysaccharides (26.64%) and gallic acid (57.94%).

The main healing properties of the fruits and extract of the plant are manifested in the following. Especially:

-Antioxidant and Anti-Aging: Neutralize free radicals and regulate the activity of genes that regulate lifespan;

-Therapeutic efficacy: Strong antiproliferative, cardioprotective, and anti-inflammatory effects against pancreatic cancer cells, myocardial ischemia;

-Metabolic correction: An effective remedy for obesity and diabetes by blocking the enzymes lipase and a-glucosidase.

L. ruthenicum (Black goji) is not only a traditional medicine, but also a safe and promising raw material for modern pharmaceutical, cosmetology and functional food industries, with the status of a "super fruit".

In addition, such a rich complex of amino acids in the fruits of *L. ruthenicum* (Black goji) determines the immunomodulatory properties of the plant. In particular, the high concentration of asparagine and glutamic acid improves energy metabolism in the body and increases intellectual activity. The significant proportion of essential amino acids (4.69%) in the total composition makes it possible to use this raw material as a natural protein supplement for sports nutrition and patients in the rehabilitation period. The amino acid composition of the plant's fruits confirms its not only nutritional value, but also its strategic raw material for pharmaceutical preparations used to treat metabolic diseases. This indicates the need for industrial-scale cultivation of the plant and the widespread introduction of its extracts into modern medicine.

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