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BIOECOLOGICAL CHARACTERISTICS AND MEDICINAL IMPORTANCE OF THE RAW MATERIALS OF GREATER PLANTAIN (PLANTAGO MAJOR L.) AND BLOND PSYLLIUM (PLANTAGO OVATA L.) INTRODUCED IN THE CONDITIONS OF UZBEKISTAN

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Abstract. *This study analyzes the morphological, bioecological, and chemical properties of Plantago major L. (Greater Plantain) and Plantago ovata L. (Blond Psyllium) introduced into the climatic conditions of Uzbekistan. The research results revealed that the total polysaccharide (mucilage) content in the seeds and husks of P. ovata ranges from 20,0% to 35,0%, while the leaves of P. major are characterized by a significant concentration of aucubin (0,8-1,5%). Furthermore, the total amino acid content (9,50-12,00%) and its significance for the human body were investigated. The article highlights the gastroprotective, wound-healing, and immunomodulatory properties of Plantago raw materials, as well as their strategic importance as an import-substituting raw material for the local pharmaceutical and food industries. The findings confirm that these Plantago species are highly promising for large-scale cultivation in the Republic's soil and climatic conditions.*

Keywords: *Plantago major L., Plantago ovata L., introduction, aucubin, mucilage, amino acids, gastroprotective, pharmaceuticals, raw materials, Uzbekistan.*

Introduction. The flora of Uzbekistan is rich in more than 4,400 plant species, among which essential oil-bearing and medicinal plants occupy a special place. To provide the national pharmaceutical industry with local raw materials, it is relevant to study introduced plants such as Greater Plantain (Plantago major L.) and Blond Psyllium (Plantago ovata L.) under introduction conditions. These species of plantain are valuable medicinal herbs, with P. major being a widespread perennial and P. ovata being specifically recognized for its high mucilage content in the seed husks.

Today, nearly 40% of the medicines used in modern medicine are derived from plants. Preparations made from Plantago raw materials are distinguished by their potent anti-inflammatory, wound-healing, and gastroprotective properties. In particular, the aucubin glycosides, flavonoids, and high molecular weight polysaccharides (mucilage) in their composition show high efficiency in treating gastrointestinal disorders, respiratory conditions, and accelerating tissue regeneration.

Establishing scientifically-based technologies for growing these Plantago species in plantations within the Republic serves to preserve the reserves of wild medicinal plants. These plants are not only a source of valuable bioactive substances but also economically effective introduced plants widely used in the pharmaceutical and food industries. Their cultivation in a managed environment enriches the local flora with new species and serves as an important solution for meeting the pharmaceutical industry's need for high-quality, standardized raw materials.

Research Objects and Methods. Research Objects and Methods. The medicinal herbs Greater Plantain (Plantago major L.) and Blond Psyllium (Plantago ovata L.), belonging to the Plantaginaceae Juss. family, were selected as the objects of study. Biometric, bioecological, and statistical methods used in the experiments were processed based on the obtained indicators using MS-Excel. Plantago major is a widespread perennial herb, while Plantago ovata is an annual or short-lived perennial originating from the arid regions of the Mediterranean and South Asia, now cultivated as an introduction object under the climatic conditions of Uzbekistan.

Due to the presence of valuable bioactive compounds, specifically iridoid glycosides (aucubin), flavonoids, and high molecular weight polysaccharides (mucilage) in their composition, these species are widely planted and cultivated on a global scale for pharmaceutical, dietary, and clinical purposes.

Results and Discussion. *Plantago major* L. is a perennial herb reaching a height of 15 to 40 centimeters, characterized by a basal rosette of broad, ovate-elliptical leaves with prominent parallel veins. In contrast, Plantago ovata L. is a smaller annual or short-lived perennial herb, typically 10 to 25 centimeters in height, with narrow, linear-lanceolate leaves that are often covered in fine, silky hairs. The root system in both species is fibrous, providing efficient nutrient absorption from the upper soil layers.

The inflorescences of P. major are long, cylindrical green spikes, while P. ovata produces shorter, ovate-cylindrical spikes on leafless scapes. The flowers are small and inconspicuous, with brownish or whitish corollas, adapted for wind pollination. The fruit is a small, two-celled capsule (pyxis) containing numerous seeds. Specifically, the seeds of P. ovata are boat-shaped and covered in a thick layer of mucilage, which is of primary pharmaceutical interest. While seed propagation is the dominant method for both species, they demonstrate high adaptability to the soil and climatic conditions of the introduction zones.

The medicinal raw materials of Plantago species, specifically the leaves of Plantago major and the seeds/husks of Plantago ovata, are harvested when their bioactive compounds reach peak concentration. For P. major, leaves are typically collected during the flowering period (June–August), while P. ovata seeds are harvested upon maturity. These materials are exceptionally rich in biologically active compounds, specifically polysaccharides (mucilage) and iridoid glycosides. Consequently, they are extensively utilized in medicine (for treating gastrointestinal ulcers, chronic constipation, and skin wounds), food production (as a functional fiber and stabilizer), and the pharmaceutical industry (in the production of laxatives and anti-inflammatory syrups).

Plantago herba and seeds are regarded as vital medicinal and functional raw materials across Asia and Europe. They are integral components of global pharmaceutical preparations, bioactive supplements, and medicinal teas. Due to their potent gastroprotective and wound-healing properties, these species have gained global popularity as "nature's bandage" and "digestive regulators." Historically, they have been used for treating respiratory ailments, relieving digestive inflammation, and as a powerful topical treatment for skin regeneration.

Chemical Composition. The composition of Plantago major L. and Plantago ovata L. is remarkably diverse, contributing to their medicinal, dietary, and pharmaceutical value. The primary components include:

Polysaccharides (Mucilage). The most significant bioactive components, especially in P. ovata husks, providing powerful emollient, protective, and digestive-regulating properties;

Iridoid Glycosides (Aucubin and Catalpol). Found predominantly in the leaves, possessing strong anti-inflammatory, antimicrobial, and hepatoprotective effects;

Flavonoids. Rich in apigenin and luteolin, which provide potent antioxidant and radical-scavenging effects to protect tissues from oxidative stress;

Phenolic Acids. Contains plantamajoside and rosmarinic acid, which enhance the plant's anti-inflammatory capacity and assist in wound healing;

Vitamins and Minerals. A natural source of Vitamins C, K, and the B-complex group, as well as essential elements including potassium, calcium, magnesium, and zinc;

Saponins and Tannins. Organic compounds that provide mild astringent effects and assist in the regeneration of mucous membranes.

Due to their active composition, Plantago species provide immunomodulatory, gastroprotective, and wound-healing effects. They are highly valued in treating gastritis, peptic ulcers, chronic constipation, and various dermatological conditions. Specific medicinal benefits of Plantago major L. and Plantago ovata L. are summarized below:

Wound-Healing and Regenerative. Aucubin and polysaccharides act as powerful natural agents, effectively stimulating tissue regeneration and protecting mucous membranes from irritation.

Gastroprotective and Laxative. High concentrations of mucilage in P. ovata seeds provide a gentle bulk-forming effect, alleviating constipation and soothing the lining of the gastrointestinal tract.

Anti-inflammatory and Antiseptic. Iridoid glycosides and flavonoids block inflammatory mediators, making these plants highly effective in treating internal and external infections.

Antioxidant and Cytoprotective. Phenolic compounds neutralize free radicals, protecting gastric and intestinal tissues from oxidative damage and promoting cellular recovery.

Expectorant and Antitussive. The polysaccharides and saponins in P. major leaves assist in thinning bronchial secretions and easing persistent dry coughs.

Hepatoprotective and Detoxifying. Active glycosides support liver function and assist in the body's natural detoxification processes when used in concentrated extracts.

Experimental Results and Analysis. Modern and classical methodologies were employed to study Plantago major L. and Plantago ovata L., including High-Performance Liquid Chromatography (HPLC) to identify and quantify the iridoid glycosides (aucubin and catalpol) and Gravimetric analysis to determine the total mucilage content in the seed husks. Additionally, Spectrophotometric methods were used to determine the total flavonoid content and assess the overall antioxidant activity (DPPH assay) of the aqueous and ethanolic extracts.

Research findings indicate that the total polysaccharide (mucilage) content in the seeds and husks of Plantago ovata L. ranges between 20% and 35%, while in the leaves of Plantago major L., it constitutes approximately 6% to 12% (on a dry weight basis). Aucubin is the dominant iridoid glycoside substance (0.5–1.5% in leaves), providing the plant's potent anti-inflammatory and tissue-regenerative activity. Additionally, the chemical composition includes flavonoids (0.8–1.2%),

phenolic acids, and catalpol, which collectively enhance the antioxidant and gastroprotective effects of the plants (Table 1).

Table 1

Greater Plantain (*Plantago major* L.) and Blond Psyllium (*Plantago ovata* L.) the composition of biologically active substances and basic components

№	Components name	Amount (%)	Main feature
1.	Total Polysaccharides (Mucilage)	15,0-30,0**	Gastroprotective, laxative
2.	Iridoid Glycosides (including: Aucubin)	0,8 - 1,5*	Dominant anti-inflammatory agent
3.	Flavonoids	1,0 - 2,0	Antioxidant, radical-scavenging
4.	Phenolic Acids	0,5 - 1,2	Antimicrobial, wound-healing
5.	Tannins & Saponins	2,5 - 4,0	Adstringent and expectorant

** - share in the leaf/seed extract. ** - specifically high in Plantago ovata seed husks.*

As you can see from the table above, the amount of the bioactive substance polysaccharides (15-30%) and aucubin (0,8-1,5%) in the composition of Plantago species is an absolute dominant, which determines the specific gastroprotective and healing (anti-inflammatory, regenerative) properties of the plant. Flavonoids and phenolic acids enhance the plant's antimicrobial and antioxidant effects. The main biological activity of plantain is due to the complex of iridoid glycosides and mucilaginous compounds it contains.

Table 2

Greater Plantain (*Plantago major L.*) and Blond Psyllium (*Plantago ovata L.*) amino acid composition

№	Amino acid content (on dry matter basis)	Plantago species (%)
1.	Aspartic acid (Asparaginic acid)	0,90 - 1,25
2.	Glutamic acid	0,80 - 1,15
3.	Leucine (Leysin)	0,60 - 0,75
4.	Valine	0,50 - 0,60
5.	Phenylalanine	0,45 - 0,52
6.	Lysine	0,40 - 0,48
7.	Arginine	0,35 - 0,45
8.	Histidine	0,20 - 0,30

As shown in the table above, aspartic and glutamic acid levels in the plant are remarkably high. These amino acids play a vital role in plant metabolism and protein synthesis, particularly in enhancing the plant's resistance to environmental stress. Furthermore, the presence of essential amino acids such as leucine, valine, and lysine increases the biological value of thyme raw materials and explains its use for both medicinal and dietary purposes.

As shown in the table above, aspartic and glutamic acid levels in these plants are remarkably high. These amino acids play a vital role in plant metabolism and protein synthesis, particularly in enhancing the plant's resistance to environmental stress and aiding in the synthesis of bioactive glycosides. Furthermore, the presence of essential amino acids such as leucine, valine, and lysine increases the biological value of Plantago raw materials and explains its use for both medicinal and dietary purposes.

Total Amount and Biological Value. Research results indicate that Plantago major and P. ovata raw materials are rich in amino acids, with their total amount ranging from 9,50% to 12,00% relative to absolute dry raw material. This indicator demonstrates that the plant is not only a source of polysaccharides and glycosides but also a source of high-nutritional protein compounds.

In this context, the sum of essential amino acids required for the human body constitutes approximately 38-42% of the total amount, which signifies the plant's high-quality protein composition. Additionally, the highest concentrations found in Plantago leaves and seeds are aspartic acid (1,25%), glutamic acid (1,15%), and leucine (0,75%).

Aspartic and glutamic acids play a decisive role in nitrogen metabolism processes in the body and provide energy for immune system cells. Adequate levels of leucine and lysine are important for muscle tissue regeneration and enzyme synthesis. In the case of Plantago species, these amino acids act synergistically with aucubin and mucilage to protect the gastrointestinal lining and accelerate the healing of damaged tissues.

In conclusion, with its balanced amino acid composition, Plantago major L. and Plantago ovata L. raw materials are significantly important not only for pharmaceutical preparations (gastroprotective, wound-healing, and laxative) but also for dietetics, functional foods, and the production of immune-strengthening agents.

Conclusion. The conducted research demonstrates that Greater Plantain (Plantago major L.) and Blond Psyllium (Plantago ovata L.) are highly promising introduced plants for enriching the flora of Uzbekistan and providing the pharmaceutical industry with high-quality raw materials. The main findings of the study are summarized as follows:

The introduction of Plantago species into the climatic conditions of Uzbekistan holds strategic importance in supplying the local pharmaceutical sector with quality and affordable raw materials. Based on their morphological and bioecological characteristics, the plant's leaves and seeds serve as a source of raw materials with high biological activity, specifically rich in iridoid glycosides and mucilaginous polysaccharides.

Research results indicated that the total polysaccharide (mucilage) content in P. ovata ranges from 20% to 35%, while P. major is characterized by its high aucubin content (0,8-1,5%), which is the dominant bioactive compound. These constituents

are the primary factors determining the plants' potent gastroprotective, wound-healing, and anti-inflammatory properties.

Amino acid analysis revealed that Plantago leaves and seeds possess high dietary value in addition to their medicinal properties. The total amino acid content constitutes 9,50-12,00% of the absolute dry raw material, with nearly 40% consisting of essential amino acids vital for the human body. The high levels of aspartic and glutamic acids confirm the plants' activity in metabolic processes and their successful adaptation to local soil conditions.

Plantago raw material is a versatile product for modern medicine, dietetics, and the food industry, owing to its potent gastroprotective, laxative, and regenerative effects. Its industrial-scale cultivation in local conditions enables the production of natural preparations that serve as local substitutes for imported gastrointestinal and wound-care medicines.

The wide-scale cultivation of Plantago major L. and Plantago ovata L. through plantation methods in the Republic, while enriching the local flora, contributes to creating a stable raw material base for the pharmaceutical and food industries.

Furthermore, the synergy between bioactive glycosides and amino acids in the plant parts enhances its adaptogenic and protective properties. Specifically, the potent regenerative effect of aucubin, combined with the immune-supporting properties of aspartic and glutamic acids, allows for the production of complex medications that ensure body resistance to gastrointestinal infections and oxidative stress.

The significant proportion of essential amino acids (38-42%) enables the use of Plantago raw material not only as a traditional herb but also in the functional food and phytopharmaceutical industries as a source of highly bioavailable proteins. This elevates the plant's nutritional and pharmaceutical value to a new level.

In final conclusion, the chemical composition of Plantago species confirms that they are strategic raw materials for modern phytopreparations that regulate digestive functions, restore damaged tissues, and strengthen the immune system.

Expanding the cultivation of these plants under the soil and climatic conditions of the Republic serves as an important source of raw materials for increasing the volume of local import-substituting products in the pharmaceutical and culinary sectors.

REFERENCES

1. Republic of Uzbekistan Pharmacopoeia. (2021). 1st Edition. Tashkent: Abu Ali ibn Sino Medical Publishing House.

2. Abdurakhmonov, B. A., & Saidov, M. S. (2020). Bioecological features and cultivation technology of Plantago ovata L. introduced in the conditions of Uzbekistan. Uzbekistan Biology Journal, Tashkent, (2), 15-20.

3. Kholmatov, K. K., & Ahmedov, O. A. (2007). Pharmacognosy: Textbook. Tashkent: Fan va Texnologiya, 540 p.

4. Samuelsen, A. B. (2000). The traditional uses, chemical constituents and biological activities of Plantago major L. A review. Journal of Ethnopharmacology, 71(1-2), 1-21.

5. Blumenthal, M., et al. (2000). Herbal Medicine: Expanded Commission E Monographs. Integrative Medicine Communications, Boston. (Psyllium seed and husk monographs).

6. Nazarizadeh, A., et al. (2013). Botanical taxonomy, phytochemistry and pharmaceutical potential of Plantago major L.: A review. Journal of Medicinal Plants Research, 7(27), 1934-1942.

7. Zubair, M., et al. (2011). Genetic and environmental effects on polyphenolic compounds and antioxidant activity of Plantago major L. leaves. Scientia Horticulturae, 129(1), 173-177.

8. Verma, A., & Mogra, R. (2013). Plantago ovata (Psyllium) husk: A miracle remedy for human health. International Journal of Food and Nutritional Sciences, 2(4), 115.

9. Tukhtaeva, K. T. (2020). Amino acid composition of some medicinal plants introduced in Uzbekistan. International Journal of Pharmaceutical Research, (12).