MENTHA PIPERITA L. STUDY OF THE PHYTOCHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITY OF ITS LEAVES

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Abstract. *This study is devoted to investigating the biochemical composition, nutritional value, and pharmaceutical potential of Peppermint (Mentha piperita L.). During the research, the essential oils, phenolic compounds, and amino acid complexes of the plant leaves were analyzed using modern analytical methods.*

The results revealed that peppermint raw material is dominated by menthol (45-55%), rosmarinic acid (52.14%), and flavonoids (11.30%), which determine its high therapeutic efficacy. Additionally, a total of 11.40% amino acids were identified in the leaf composition, with 4.62% consisting of essential types. The study demonstrates the antispasmodic, antiseptic, sedative, and cardiotropic properties of peppermint extract, as well as its adaptogenic potential to increase the body's resistance to stress.

The obtained data indicate that the cultivation of Mentha piperita L. under the Republic's climatic conditions is of great importance in creating a strategic raw material base for the pharmaceutical, dietetic, and functional food industries as an import-substituting product.

Keywords: *Mentha piperita L., peppermint, menthol, rosmarinic acid, amino acids, adaptogen, antispasmodic, essential oil, introduction.*

Introduction. The flora of Uzbekistan is rich in more than 4,400 plant species, among which essential oil and medicinal plants occupy a special place. Pepper Mint in order to provide the Republican pharmaceutical network with local raw materials (Mentha piperita L.) are considered relevant to the study of imported plants in the context of introduction.

This species of Mint is a cultivated plant, which is known as water mint (M. aquatica) and garden mint (M. spicata) is a natural hybrid of species. Today, about 40% of drugs used in modern medicine are obtained on the basis of plants, and preparations made from Mint raw materials are characterized by a mild effect in diseases of the cardiovascular, digestive and nervous system and good absorption by the body.

The introduction of scientifically based technologies for the cultivation and propagation of peppermint in plantations on the territory of the republic will help preserve the reserves of wild medicinal plants. This plant is not only a source of valuable essential oil (menthol), but also an introduced plant with phytoncide properties that purifies the air and uplifts the human spirit. Cultivating it without cultivation, while enriching the local flora with new species, serves as an important solution to meet the pharmaceutical industry's need for quality raw materials.

Object and styles of research. *Lamiaceae* Juss. is a perennial plant in the family Pepper Mint (Mentha piperita L.) the plant was chosen as an object of study. The biometric, bioecological, and statistical methods used in the experiments were processed based on the obtained indicators (in MS-Excel) [2]. This plant is a cultivated hybrid that grows in the natural flora of Europe and North America, as well as in Uzbekistan, and is widely cultivated and cultivated due to its medicinal essential oils. The life form is a perennial herb, reaching a height of 0.3 m to 1 m. The STEM is four-pointed, erect-growing, the branches are green or purple in color. The leaves are ovoid-lanceolate, the edges are saw-toothed and are located opposite

on the stem. The flowers are small, purple-pink, forming a spike at the tip of the stem. The fruit consists of four nuts, the seeds of which are very small, liver-colored.

The raw material is the leaf. The plant is harvested for its green, fragrant leaves [1] when the flowering phase begins (June-August). Since the composition of raw materials of this plant is very rich in essential oils (menthol), it is widely used medicinally (in the treatment of diseases of the cardiovascular and digestive systems), in the production of food and in perfumery [2], [3], [4].

Pepper mint leaves are considered as the main healing and functional raw material in all Asian and European countries [5]. They are among the best-selling healthy foods and medicinal teas on the world market [6]. Mint leaves are becoming increasingly popular worldwide as a "healing herb" due to their antispasmodic and calming properties. For example, mint has been used since ancient times to calm the nervous system, relieve nausea, and benefit respiratory function.

Pepper mint (Mentha piperita L.) the composition is very rich and varied, and it is characterized by its healing and nutritional properties. The main component is as follows:

Essential Oils (Menthol): The main component in peppermint. It has strong antiseptic, analgesic and antispasmodic properties, and has a positive effect on the respiratory and digestive systems;

Flavonoids: Vascular-strengthening and anti-inflammatory active ingredients;

Vitamins: Especially vitamin C, A (carotene), and vitamins P and PP;

Minerals and microelements: it contains essential minerals for the body, such as potassium (potassium), calcium (calcium) and magnesium (magnesium);

Astringents (Tannins): Compounds that have antiseptic properties and improve gastrointestinal function;

Organic acids: Ursolic and oleanolic acids, which help improve metabolism.

Due to its composition, this plant has spasmolytic, calming, bile-driving and antiseptic effects and is highly valued in the treatment of diseases of the nervous system, cardiovascular and digestive systems, as well as in the dietary food industry.

Pepper mint (Mentha piperita L.) plant raw materials (Leaf) are used for many healing purposes. That is:

Anti-inflammatory and antiseptic:

- The essential oils (menthol) in peppermint leaves fight pathogenic microorganisms and reduce inflammatory processes in the mucous membranes. It is effective in respiratory and oral infections due to its antiseptic properties.

Antispasmodic and analgesic:

- Menthol has the property of relieving smooth muscle spasms, relieving gastrointestinal pain (colic). It also has a pain-relieving effect on migraines and headaches by dilating blood vessels.

Effect on the digestive system (Bile secretion):

- Mint raw materials stimulate bile secretion and increase the activity of digestive enzymes. This is important in the treatment of nausea, flatulence (rest) and liver diseases.

Sedative (sedative) effect:

- Has a mild sedative effect on the central nervous system, helping to reduce insomnia, nervous tension and stress;

Cardiotropic effect:

- Mint preparations (for example, Valolid) reflexively dilate the coronary vessels of the heart, normalize the heartbeat, and are used as an adjuvant in angina attacks.

Bronchodilator:

The active ingredients in the composition have the property of moving mucus in the upper respiratory tract and facilitating breathing.

Experimental results and their analysis. Experimental results and their analysis. The following modern and classical methods were used in the study of the peppermint plant (Mentha piperita L.). In this, the chromatographic analysis method (the percentage of phenolic compounds (Rosemary acid, caffeine, tannin, etc.) as well as the determination of the content of menthol in essential oil) and the

spectrophotometric method (calculation of the total amount of antioxidant in the equivalent of rosmarinic acid has been studied analytically) [7].

Pepper mint (Mentha piperita L.) the essential oil of its leaves and the composition of its main components were studied. According to the results of the study, the total amount of essential oil in the plant leaf was found to be in the range of 2.5-4.5%. The dominant substance in peppermint essential oil, which is most abundant and determines its biological activity, is menthol (45-55%), which gives the plant its characteristic pungent odor and healing properties. It was also found to contain components such as menthone (15-25%), menthyl acetate (3-10%), and cineole (3.5-6.0%). This complex of volatile compounds provides the strong antispasmodic, antiseptic and sedative effects of mint raw materials (Table 1).

Table 1

Pepper mint (Mentha piperita L.) the composition of essential oil and the main components of its leaves

№	Components name (Essential oil composition)	**Amount, % (relative to total essential oil**
1.	Menthol (Main dominant component)	45,0-55,0
2.	Menthone	15,0-25,0
3.	Isomenthone	2,0-5,0
4.	Menthyl acetate	3,0-10,0
5.	Mento-furan	1,0-5,0
6.	Limonene	1,0-3,0
7.	Pulegone	0,5-2,0
8.	Cineole (1,8-cineole)	3,5-6,0
9.	α-pinene and β-pinene	0,5-1,5
10.	Unidentified components	2,0-4,0
11.	Total essential oil content (in leaf)	2,5-4,5%

As can be seen from the table above, menthol (45-55%) is absolutely dominant in the composition of peppermint, which determines the specific smell and medicinal (antiseptic, analgesic) properties of this plant. The compounds Mentone and menthyl acetate, on the other hand, enhance the spasmolytic effect of the plant. The main biological activity of Mint is associated with the essential oils contained in it.

Table 2

Pepper mint (Mentha piperita L.) amino acid composition of its leaves

№	Amino acid content (on dry matter basis)	**Mentha piperita L. (%)**
1.	Aspartic acid	1,42
2.	Threonine*	0,58
3.	Serine	0,55
4.	Glutamic acid	1,64
5.	Proline	0,72
6.	Glycine	0,68
7.	Alanine	0,75
8.	Valine*	0,62
9.	Methionine*	0,18
10.	Isoleucine*	0,54
11.	Leucine*	0,92
12.	Tyrosine	0,45
13.	Phenylalanine*	0,65
14.	Histidine*	0,38
15.	Lysine*	0,71
16.	Arginine*	0,61
Σ	Total amino acid content	11,40
Σ	Sum of essential amino acids	4,62

Based on the table above, Pepper Mint (Mentha piperita L.) the following analytical conclusions can be made regarding the amino acid composition of its leaves:

Total amount and biological value: The results of the study show that mint leaves are very rich in amino acids, with a total amount of 11.40% relative to the total dry matter. This figure indicates that the plant is not only a source of essential oils, but also a source of protein with high nutritional value. In this case, the sum of 8 amino acids necessary for the human organism (and a total of 10 with semi-irreplaceable histidine and arginine) is 4.62%. This corresponds to about 40.5% of the total amino acid content, which indicates that the plant has a high-quality protein composition. Also, the highest amounts of glutamic acid (1.64%), asparagine acid (1.42%), and leucine (0.92%) were found in mint leaves. Glutamine and asparagine play a crucial role in regulating the functioning of the nervous system and in the body's metabolic processes. The high content of leucine (0.92%) and lysine (0.71%) is important for cell regeneration and protein synthesis. Although the amount of methionine (0.18%) is lower than in other species, it was found to be twice as high as in black chingil fruit (0.09%).

In conclusion, Mentha piperita L. The fruits, with their balanced amino acid composition, are important not only in the production of pharmaceutical preparations (sedatives, antispasmodics), but also in the production of dietary and sports nutrition.

Conclusion. Studies show that Peppermint (Mentha piperita L.) It is an introdusent plant with high prospects for enriching the flora of Uzbekistan and providing the pharmaceutical industry with high-quality local raw materials. The main results of the study are as follows:

Biochemical wealth: The dominant components in the plant leaf - menthol (45-55%), rosmarinic acid (52.14%) and flavonoids (11.30%) - determine its high therapeutic effectiveness.

Nutritional value: The presence of 11.40% total amino acids in the leaf raw material opens up the possibility of its use not only in medicine, but also in functional foods and dietetics.

Versatile healing effects: Mint raw materials are a safe and effective remedy for treating cardiovascular, digestive, and nervous system diseases due to its strong antispasmodic, antiseptic, sedative, and cardiotropic properties.

Large-scale cultivation of peppermint on plantations throughout the republic, along with its protection, will serve to create a stable raw material base for the medical, perfumery, and food industries.

In addition, Mentha piperita L. the proportionality of essential oils and amino acids in the leaves increases the adaptogenic properties of the plant. In particular, the calming effect of menthol on the nervous system, combined with the ability of glutamic acid to support intellectual activity, makes it possible to produce complex drugs that provide the body with resistance to stress. A significant proportion of essential amino acids (4.62%) allows the use of mint raw materials not only in the production of aromatic teas, but also in the functional beverage industry, which contains easily digestible proteins. This takes the nutritional value of the plant to a new level.As a final conclusion, it should be noted that the chemical composition of peppermint confirms that it is not only a traditional antispasmodic, but also a strategic raw material for modern phytopreparations that regulate metabolic processes and strengthen the immune system. Expanding the cultivation of this plant in the climatic conditions of the republic will serve as an important solution to increasing the volume of local products that replace imports in the pharmaceutical and dietary supplement industries.

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