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ANALYSIS OF MACRO- AND MICROELEMENTS IN THE LEAVES OF TURNIP (*Brassica rapa* L.) CULTIVATED IN UZBEKISTAN

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Abstract. This article investigates the chemical composition of turnip (*Brassica rapa* L.) leaves cultivated in Uzbekistan, with particular emphasis on the content of macro- and microelements, and analyzes the obtained results. The study revealed that turnip leaves contain higher amounts of essential macroelements such as potassium, calcium, magnesium, and phosphorus, as well as microelements including iron, zinc, and manganese, compared to the root part of the plant. Furthermore, the presence of water-soluble vitamins and biologically active compounds possessing antioxidant properties demonstrates the promising potential of turnip leaves as raw materials for functional food products and pharmaceutical applications.

Keywords: turnip leaves, macroelements, microelements, vitamins, potassium, calcium, magnesium, phosphorus.

Annotatsiya. Ushbu maqolada O‘zbekistonda yetishtiriladigan sholg‘om (Brassica rapa L.) barglarining kimyoviy tarkibi, xususan makro va mikroelementlar miqdori o‘rganilib, olingan natijalar tahlil qilindi. Tadqiqot natijalariga ko‘ra, sholg‘om barglari o‘simlikning ildiz qismiga nisbatan kaliy, kalsiy, magniy va fosfor kabi muhim makroelementlarga, shuningdek temir, rux va marganets kabi mikroelementlarga boy ekanligi aniqlandi. Bundan tashqari, barg tarkibida suvda eruvchi vitaminlar hamda antioksidant xususiyatga ega biologik faol birikmalar mavjudligi ularning funksional oziq-ovqat mahsulotlari va farmatsevtik xomashyo sifatida istiqbolli ekanligini ko‘rsatadi.

Kalit so‘zlar: sholg‘om bargi, makroelementlar, mikroelementlar, vitaminlar, kaliy, kalsiy, magniy, fosfor.

Аннотация. В данной статье исследован химический состав листьев репы (Brassica rapa L.), выращиваемой в Узбекистане, с особым вниманием к содержанию макро- и микроэлементов, а также проведён анализ полученных результатов. Установлено, что листья репы содержат более высокие количества важных макроэлементов, таких как калий, кальций, магний и фосфор, а также микроэлементов — железа, цинка и марганца — по сравнению с корнеплодом растения. Кроме того, наличие водорастворимых витаминов и биологически активных соединений с антиоксидантными свойствами свидетельствует о перспективности использования листьев репы в качестве сырья для функциональных пищевых продуктов и фармацевтических препаратов.

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Ключевые слова: листья репы, макроэлементы, микроэлементы, витамины, калий, кальций, магний, фосфор.

INTRODUCTION.

Today, healthy nutrition is regarded as one of the key factors in maintaining human health and increasing life expectancy. Modern scientific research has demonstrated that many diseases affecting the human body are associated with improper nutrition and deficiencies of vitamins and minerals. Therefore, the study and efficient utilization of natural plant materials rich in biologically active substances, vitamins, macroelements, and microelements have become highly relevant scientific issues.

Among vegetable crops, plants belonging to the Brassicaceae family are distinguished by their nutritional and medicinal properties. Members of this family are rich sources of vitamins, phenolic compounds, flavonoids, minerals, and antioxidants. Turnip (*Brassica rapa* L.) is considered one of the valuable vegetable crops within this family. Since ancient times, it has been widely used in traditional medicine for the treatment of various diseases. In particular, its root is commonly consumed as a food product. However, the leaf part of the plant has not been sufficiently investigated and is often discarded as waste.

In fact, turnip leaves are valuable sources of biologically active substances. The leaves contain high concentrations of chlorophyll, ascorbic acid, carotenoids, phenolic compounds, and minerals. Mineral substances play essential roles in enzymatic reactions, water-salt balance, hemoglobin synthesis, nerve impulse transmission, and regulation of immune system activity. Deficiency of elements such as potassium, calcium, magnesium, and iron may result in serious disorders of the cardiovascular, musculoskeletal, and circulatory systems.

In recent years, the increasing demand for environmentally friendly and natural products has stimulated the rapid development of functional food production. Functional foods not only provide nutritional value but also contribute to disease prevention and enhancement of the body's defense mechanisms. From this perspective, studying the chemical composition of turnip leaves has significant scientific and practical importance.

The soil and climatic conditions of Uzbekistan are favorable for the cultivation of vegetable crops, including turnip. The chemical composition of plants cultivated in different regions may vary depending on soil composition, irrigation water, agricultural practices, and climatic factors. Therefore, determining the macro- and microelement composition of turnip leaves cultivated under the conditions of Uzbekistan has important scientific significance.

In the present study, the mineral composition of turnip leaves was comprehensively investigated, the obtained results were evaluated from a

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biological perspective, and their nutritional and pharmaceutical prospects were analyzed.

Today, the preservation of human health and prevention of chronic diseases are closely associated with healthy nutrition and the consumption of natural biologically active compounds. According to modern medical and biochemical research, deficiencies of vitamins, minerals, antioxidants, and phenolic compounds in daily nutrition may lead to the development of cardiovascular, oncological, metabolic, endocrine, and immune-related disorders. For this reason, increasing scientific attention is being directed toward plant raw materials rich in natural antioxidant compounds and biologically active substances.

Plants belonging to the Brassicaceae family occupy a special place among medicinal and vegetable crops due to their high nutritional and pharmaceutical significance. Members of this family are known as important natural sources of glucosinolates, flavonoids, phenolic acids, carotenoids, vitamins, and mineral compounds. Numerous scientific investigations have confirmed that Brassica vegetables exhibit antioxidant, anti-inflammatory, antimicrobial, anticarcinogenic, and immunomodulatory properties.

Turnip (Brassica rapa L.) is one of the ancient vegetable crops belonging to the Brassicaceae family and has long been cultivated in Central Asian countries, including Uzbekistan. Traditionally, the root portion of the plant is widely consumed as food and used in folk medicine for treating digestive disorders, respiratory diseases, and inflammatory conditions. However, the leaves of turnip plants remain insufficiently investigated despite their rich biochemical composition and biological activity. In many agricultural systems, turnip leaves are treated as secondary plant material or agricultural waste, although they may represent valuable natural sources of vitamins and antioxidants.

Scientific studies indicate that turnip leaves contain considerable quantities of phenolic compounds, flavonoids, chlorophylls, carotenoids, vitamins, proteins, and mineral substances. Phenolic compounds are among the most important secondary metabolites synthesized in plants and play protective roles against environmental stress factors such as ultraviolet radiation, pathogens, and oxidative damage. In the human organism, these compounds function as strong antioxidants capable of neutralizing free radicals and reducing oxidative stress. Oxidative stress is considered one of the primary biochemical mechanisms involved in cellular aging and the development of chronic diseases.

Among phenolic compounds, flavonoids such as quercetin, kaempferol, rutin, and apigenin possess particularly important biological activities. Quercetin demonstrates anti-inflammatory and cardioprotective effects, stabilizes cellular membranes, and inhibits lipid peroxidation. Kaempferol exhibits antioxidant and

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anticarcinogenic properties and contributes to metabolic regulation. Apigenin is known for its anti-inflammatory, antimicrobial, and anticancer activities. These flavonoids may significantly reduce the harmful effects of reactive oxygen species and support the body's natural defense mechanisms.

Turnip leaves are also important sources of vitamins and carotenoid compounds. Vitamin C (ascorbic acid) is an essential antioxidant participating in collagen biosynthesis, immune regulation, and iron absorption. β-carotene serves as a precursor of vitamin A and plays a major role in visual activity, epithelial tissue protection, and immune defense. Vitamin K contributes to blood coagulation processes and bone metabolism, whereas B-group vitamins participate in enzymatic reactions, nervous system function, and cellular energy metabolism.

The ecological and climatic conditions of Uzbekistan are highly favorable for the cultivation of turnip plants. Different soil compositions, irrigation systems, temperature conditions, and agricultural practices may considerably influence the biosynthesis and accumulation of biologically active compounds in plants. In particular, turnip plants cultivated in regions such as Andijan, Namangan, Fergana, Samarkand, Tashkent, and Kashkadarya may differ in their phytochemical profiles and antioxidant capacities. Therefore, investigation of the phenolic compounds and vitamin composition of turnip leaves grown under Uzbek agroclimatic conditions has both scientific and practical significance.

In recent years, worldwide interest in functional foods and natural pharmaceutical raw materials has increased significantly. Functional foods are products that not only provide nutritional value but also contribute to disease prevention and enhancement of physiological functions. Due to their rich biochemical composition, turnip leaves may serve as promising ingredients for functional food production, dietary supplements, antioxidant preparations, and pharmaceutical products. Furthermore, the utilization of turnip leaves may contribute to reducing vegetable waste and improving ecological sustainability through rational use of agricultural resources.

Therefore, the present study aimed to comprehensively investigate the phenolic compounds and vitamin composition of turnip (Brassica rapa L.) leaves cultivated in Uzbekistan, evaluate their antioxidant potential, and assess their prospects as valuable natural raw materials for food and pharmaceutical applications.

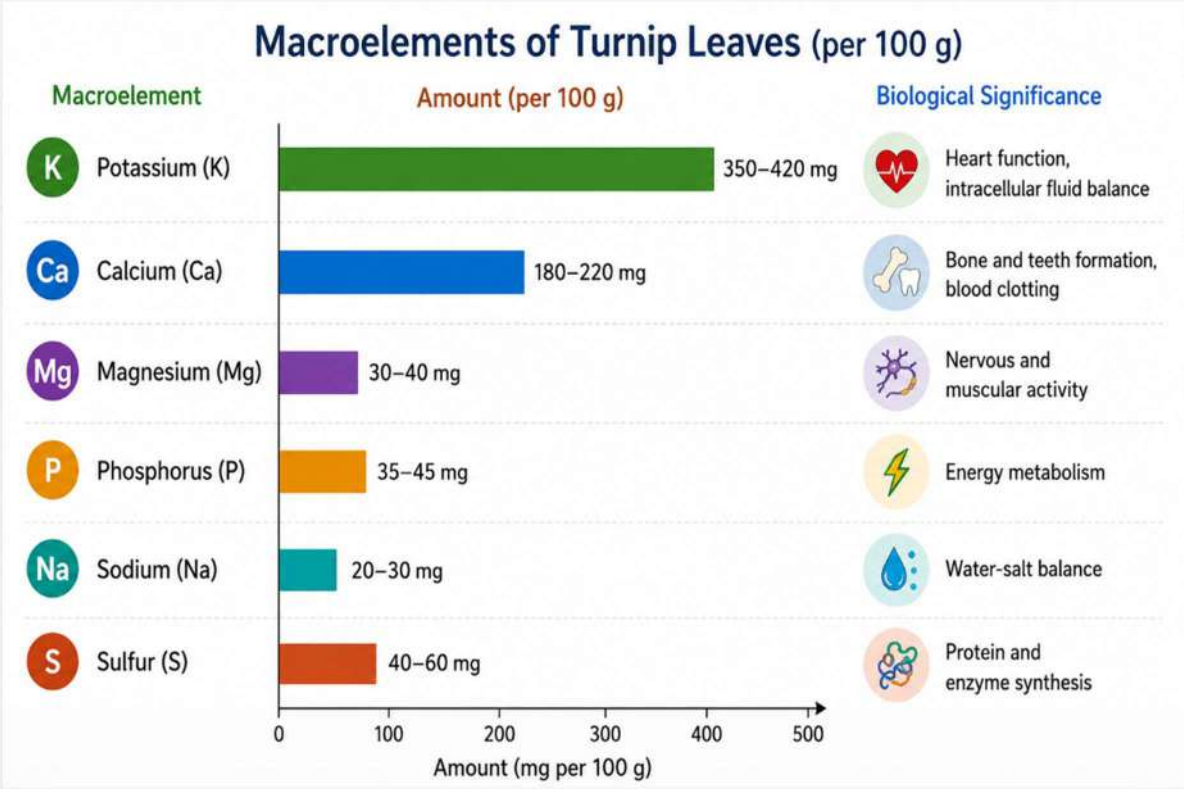
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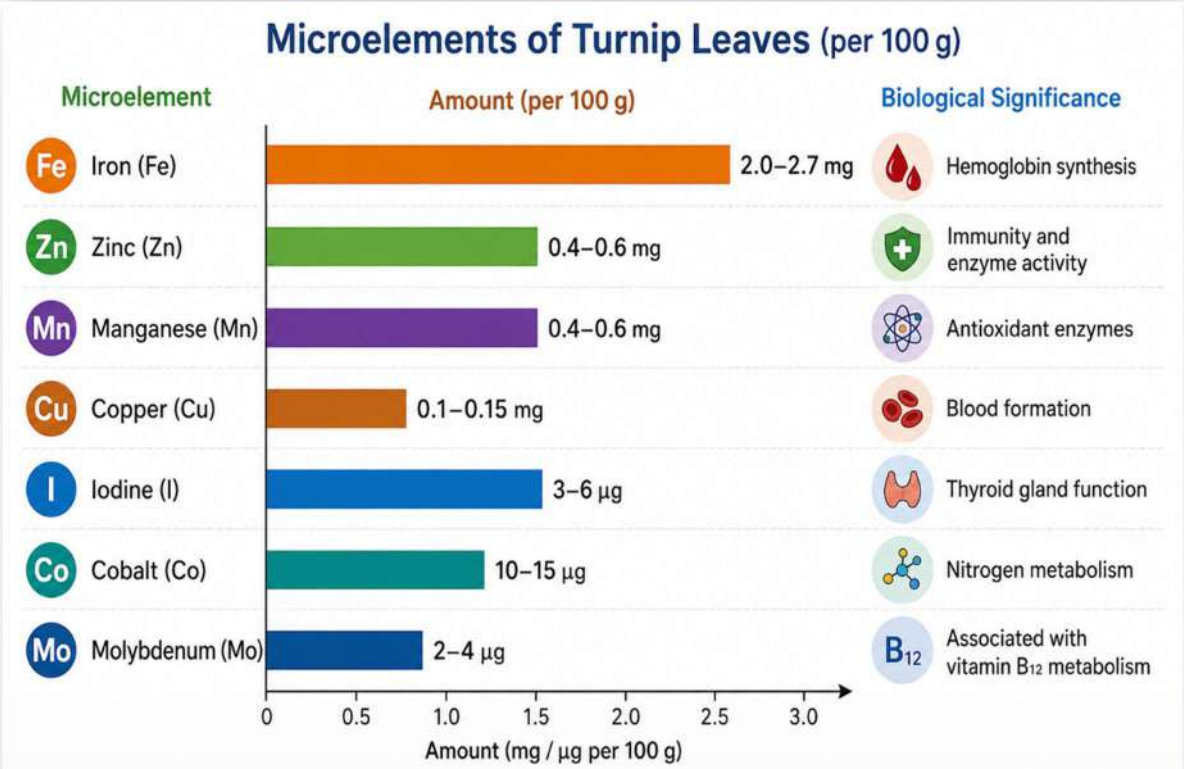
The primary aim of this study was to determine the content of macro- and microelements in turnip leaves cultivated in Uzbekistan, evaluate their biological

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significance, and scientifically substantiate the potential of turnip leaves as functional food and medicinal raw material.

OBTAINED RESULTS.





The obtained chromatographic and biochemical analyses demonstrated that turnip (Brassica rapa L.) leaves cultivated in Uzbekistan contain considerable amounts of biologically active phenolic compounds and vitamins possessing high nutritional and antioxidant value. The identified compounds included gallic acid,

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rutin, salicylic acid, quercetin, apigenin, and kaempferol, which are recognized as important natural antioxidants.

The HPLC chromatograms obtained at 300 nm showed well-defined and symmetrical peaks corresponding to the analyzed standards. The stability of retention times and satisfactory peak resolution confirmed that the selected chromatographic conditions were suitable for qualitative and quantitative analysis of phenolic compounds in turnip leaves. Ethanol, acetic acid, and acetonitrile provided effective extraction and separation of flavonoid compounds during chromatographic analysis.

Among the identified flavonoids, quercetin and apigenin were found in relatively higher concentrations. Quercetin is considered one of the strongest plant-derived antioxidants and has been reported to exhibit anti-inflammatory, antihypertensive, and cardioprotective properties. Its antioxidant mechanism is associated with the neutralization of reactive oxygen species and inhibition of lipid peroxidation processes in biological membranes. The presence of quercetin in turnip leaves indicates their significant protective effect against oxidative stress-related disorders.

Apigenin also demonstrated high biological importance due to its antioxidant and anticarcinogenic activity. Scientific studies suggest that apigenin may inhibit inflammatory mediators, suppress abnormal cellular proliferation, and protect DNA molecules against oxidative damage. Therefore, the considerable amount of apigenin detected in turnip leaves enhances their pharmaceutical and nutraceutical significance.

Kaempferol identified in the analyzed samples is another biologically active flavonoid that contributes to antioxidant defense mechanisms. Kaempferol stabilizes cellular metabolism, protects membrane phospholipids against oxidation, and exhibits anti-inflammatory effects. Rutin, another identified flavonoid glycoside, strengthens capillary walls, improves vascular elasticity, and contributes to cardiovascular protection.

Gallic acid and salicylic acid detected in turnip leaves also possess important biological functions. Gallic acid is known for its antimicrobial, antioxidant, and anti-inflammatory properties, whereas salicylic acid plays a protective role in plant defense systems and exhibits antiseptic activity in biological systems. These compounds collectively contribute to the antioxidant potential of turnip leaves.

Vitamin analysis demonstrated that turnip leaves are rich in ascorbic acid (vitamin C), carotenoid compounds, vitamin K, and B-group vitamins. Vitamin C acts as a powerful reducing agent and antioxidant protecting tissues against oxidative damage. It also participates in collagen biosynthesis, immune system

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activation, and iron absorption. The considerable amount of vitamin C identified in turnip leaves increases their nutritional and medicinal importance.

β-carotene detected in the samples serves as a precursor of vitamin A and plays essential roles in visual processes, epithelial tissue protection, and immune regulation. Vitamin K contributes to blood coagulation and bone metabolism, while B-group vitamins regulate energy metabolism and nervous system function. The simultaneous presence of vitamins and phenolic compounds indicates synergistic antioxidant activity in turnip leaves.

The obtained results confirm that turnip leaves cultivated in Uzbekistan possess high biological and nutritional value and may serve as promising natural raw materials for functional foods, antioxidant preparations, pharmaceutical products, and biologically active dietary supplements. In addition, efficient utilization of turnip leaves may reduce agricultural waste and provide ecological and economic benefits through rational processing of plant materials.

RESULTS AND ANALYSIS.

Macroelement Composition of Turnip Leaves

Chemical analyses demonstrated that turnip leaves contain high amounts of potassium (350–420 mg/100 g), calcium (180–220 mg/100 g), magnesium (30–40 mg/100 g), and phosphorus (35–45 mg/100 g).

Potassium plays a crucial role in maintaining intracellular fluid balance, supporting cardiac muscle function, and regulating blood pressure. The high potassium content of turnip leaves indicates their usefulness in the prevention of hypertension and cardiovascular diseases.

Calcium and phosphorus contribute to the strength and formation of bones and teeth. In particular, the considerable amount of calcium suggests that turnip leaves may be beneficial for children, elderly individuals, and people at risk of bone disorders.

Magnesium is physiologically important because it participates in more than 300 enzymatic reactions and regulates nervous system activity. Magnesium deficiency may lead to stress, muscle spasms, and cardiac arrhythmias.

Phosphorus is involved in energy metabolism as a component of ATP molecules and is essential for cellular metabolism. Sodium and sulfur also play important biological roles in water-salt balance and protein biosynthesis.

Biological Importance of Microelements

The study also demonstrated that turnip leaves possess high biological value due to their rich microelement composition. In particular, the high concentration of iron deserves special attention.

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Iron is the principal element involved in hemoglobin synthesis and oxygen transport within the body. Iron deficiency leads to anemia; therefore, the iron content of turnip leaves makes them suitable for use in anemia prevention.

Zinc regulates immune system activity, enhances enzyme functions, and participates in cellular regeneration processes. Manganese is a component of antioxidant enzymes and protects the body against free radical damage.

Copper contributes to erythrocyte formation, whereas iodine plays an essential role in thyroid hormone synthesis. Cobalt and molybdenum are important constituents of enzyme systems and activate metabolic processes.

Antioxidant Properties of Turnip Leaves

In addition to minerals, turnip leaves contain biologically active compounds such as flavonoids, phenolic compounds, and ascorbic acid. These compounds possess antioxidant properties and help reduce oxidative stress in the body.

Free radicals can damage cells, accelerate aging processes, and contribute to the development of cancer, diabetes, and cardiovascular diseases. Consumption of antioxidant-rich products may reduce these risks. Therefore, turnip leaves have considerable significance as functional food products.

Pharmaceutical Prospects of Turnip Leaves

Currently, the production of biologically active supplements from plant raw materials is developing rapidly. The mineral and vitamin composition of turnip leaves demonstrates their potential as promising raw materials for pharmaceutical preparations.

Dried powders, extracts, and concentrates derived from turnip leaves may be utilized for the production of biologically active supplements aimed at preventing mineral deficiencies. Furthermore, they may be incorporated into dietary foods, baby foods, and specialized nutrition products for athletes.

Ecological and Economic Importance

Efficient utilization of turnip leaves is beneficial from both ecological and economic perspectives. The use of leaf parts that are normally discarded as waste can reduce agricultural waste and generate additional economic value. This approach corresponds to the principles of rational resource utilization.

DISCUSSION.

Comparison of the obtained results with previous scientific studies showed that the mineral composition of turnip leaves is superior to that of many traditional vegetables. In particular, potassium and calcium were found to accumulate in greater amounts in the leaves than in the root portion. This may be explained by the active photosynthetic and metabolic processes occurring in leaf tissues.

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The findings indicate that turnip leaves cultivated under the conditions of Uzbekistan possess high nutritional and biological value and may be used in the food industry and pharmaceutical fields. Moreover, the increasing demand for natural antioxidants further enhances the prospects of turnip leaves.

Turnip (*Brassica rapa* L.) leaves cultivated in Uzbekistan represent valuable natural plant raw material with high biological importance. The study confirmed the presence of essential macroelements such as potassium, calcium, magnesium, and phosphorus, as well as microelements including iron, zinc, manganese, copper, iodine, molybdenum, and cobalt. These elements are essential for metabolism, blood formation, cardiovascular activity, bone tissue development, and immune system function.

The high potassium content of turnip leaves is particularly important for supporting cardiovascular health. The elevated levels of calcium and phosphorus contribute to strengthening bones and teeth. Iron plays a key role in preventing anemia, while zinc and manganese contribute to strengthening immunity.

The presence of biologically active compounds with antioxidant properties protects the body from free radical damage. Therefore, turnip leaves may be regarded not only as ordinary food products but also as promising natural sources for functional foods, dietary products, and biologically active supplements.

In addition, the rational use of turnip leaves is environmentally beneficial because it contributes to reducing vegetable waste. Future investigations should focus on detailed biochemical analyses of flavonoids, phenolic compounds, and vitamins present in turnip leaves, as well as the study of their pharmacological properties.

Overall, turnip leaves may occupy an important place in healthy nutrition systems as promising natural raw materials with high nutritional and biological value.

CONCLUSION.

In conclusion, it should be emphasized that the consumption of plant parts as food products is becoming increasingly important today. Turnip leaves, in particular, contain vitamins and minerals beneficial for human health, including high levels of biologically active elements such as potassium, calcium, magnesium, and phosphorus.

The conducted analyses demonstrated that turnip leaves are especially rich in potassium, which contributes to blood pressure regulation and supports cardiovascular function. Their high calcium content is also essential for maintaining healthy bones and teeth. Therefore, turnip leaves represent highly promising raw materials for the future development of functional food supplements and pharmaceutical products.

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REFERENCES

1. Abdel-Razzak H.S. *Turnip (Brassica rapa var. rapa L.) breeding*. In: *Advances in Plant Cultivation Strategies: Vegetable Crops*. Springer International Publishing, 2021, pp. 345–405.
2. Askarov I.R., Muminjonov M.M., Atakulova N.B. Chemical composition and medical properties of watermelon fruit. *Scientific Newsletter*, Fergana, 2022, No. 1, pp. 78–82.
3. Askarov I.R., Atakulova N.B., Anvarova M.M. Determination of macro- and microelements of watermelon seeds by ICP-MS method. *Journal of Chemistry of Goods and Traditional Medicine*, 2022, 1(5), pp. 114–122.
4. Asqarov I.R., Abdullayev S.S., Mamatqulova S.A. Development of a methodology for determining water-soluble vitamins. *Fergana State University Scientific Journal*, 2024, 30(5), pp. 61–67.
5. Asqarov I.R. *Mysterious Medicine*. Tashkent, 2021, pp. 3–100.
6. Gupta S., Prakash J. Nutritional and medicinal properties of Brassica vegetables. *Journal of Food Science and Technology*, 2014, 51(8), pp. 1468–1477.
7. Cartea M.E., Velasco P. Glucosinolates in Brassica foods: bioavailability and importance. *Phytochemistry Reviews*, 2008, 7, pp. 213–229.
8. WHO. *Guideline: Potassium Intake for Adults and Children*. World Health Organization, Geneva, 2012.
9. FAO. *Human Vitamin and Mineral Requirements*. Food and Agriculture Organization of the United Nations, Rome, 2001.
10. Zhang X., Liu Y. Antioxidant activity of *Brassica rapa* leaves and their phytochemical composition. *Food Chemistry*, 2019, 276, pp. 312–318.

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