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REVIEW ARTICLE

The Potential of Walnut Cultivation in Uzbekistan and Properties of Walnut Jam

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ABSTRACT

This article reviews the present condition and future possibilities of walnut growing in the Republic of Uzbekistan. It is stated that the recent decrees and resolutions of the President of the Republic of Uzbekistan and the Government have led to the expansion of the area dedicated to fruit crops, particularly walnuts. The establishment of the "Association of Producers and Exporters of Walnuts" has enabled the creation of modern plantations in Uzbekistan consisting of high-yielding walnut varieties that are well-suited to the local natural and climatic conditions. The association also aims to promote the adoption of science-based methods and resource-saving technologies for walnut growing. Furthermore, it aims to increase walnut production in different regions of the Republic, conduct market research to expand the sales market, develop strategies to boost walnut exports and carry out research to implement innovative technologies in walnut production processes. Since one of the products of walnuts in Uzbekistan is walnut jam, the paper also presents the results of experimental studies on the chemical composition of jam made from unripe walnuts. The studies show that the primary macronutrients in unripe walnut jam are sodium, potassium, magnesium, calcium, and iron. Additionally, it contains trace elements such as iodine, zinc, cadmium, nickel, and cobalt. Due to the diverse macro- and micro-elemental composition of unripe walnut jam, this product can be used as both a food item and a preventive material against various diseases, particularly iodine deficiency in the human body.

Introduction

Uzbekistan occupies a central position in Central Asia and serves as a natural and economic hub with a developing infrastructure.

Climatic factors inherent in the Republic contribute to achieving the highest yields of fruits with the best quality at the lowest cost. The hot weather and climate conditions of Uzbekistan make it possible to grow a wide range of fruit species. With proper management of artificial irrigation, stable fruit yields can be achieved, depending on the amount of precipitation (Mirzaev, 1993). A long, dry, and cloudless summer contributes to the optimal ripening of fruits and the significant accumulation of sugar in them.

Horticulture is the oldest branch of agriculture in sunny Uzbekistan. Its origin dates back centuries; it was created through a prolonged period of diligent work by the people. The horticulture industry in

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Uzbekistan has achieved significant results in increasing production. Additionally, the expansion of planting areas of horticultural corps has been done without a negative impact on the other branches of agriculture. Moving forward, the development of horticulture in the republic will require further intensification of agricultural practices (Gharaghani, 2018).

Based on these provisions, the horticulture industry in Uzbekistan will need to address four important tasks simultaneously.

1. Ensuring an adequate supply of fruits to meet the needs of the population in the rapidly developing urban and industrial centers of the republic.
2. In order to ensure the export of fruits outside the republic, a sufficient volume is needed.
3. Create a solid and high-quality raw material foundation for the processing industry.
4. To increase fruit production, particularly nuts.

At present, the Uzbek Research Institute for Horticulture and Viticulture is named after it, Academician M. Mirzaev and other scientific institutions have developed the fundamentals of an agrotechnical complex for orchard care and varietal zoning in all natural zones of the republic.

Walnut Industry in Uzbekistan

It should be noted that walnut plays a significant role in the composition of fruit plantations. In recent years, there has been a significant focus on increasing walnut production in the Republic, particularly the production of walnuts. This is evidenced by the adopted Decree of the President of the Republic of Uzbekistan dated June 1, 2017, "On the establishment and organization of the activities of the Association of Producers and Exporters of Walnuts" (Decree of the President, 2017). Similar developments are underway in other countries as well. The Kazakhstan government has several projects in cooperation with Russia, the USA, Bulgaria, the Czech Republic, and Poland for plant breeding purposes (Akça *et al*., 2020).

According to this resolution, there are plans to establish modern walnut plantations in the Republic of Uzbekistan. These plantations will consist of high-yielding walnut varieties that are adapted to the local natural and climatic conditions. New walnut rootstocks will also be used in these orchards (Vahdati *et al.*, 2021). The aim is to widely introduce science-based methods of growing walnuts and modern resource-saving technologies. Additionally, there is a goal to increase walnut production in the regions of the Republic. This will involve conducting marketing research to expand the sales market and developing proposals to increase the volume of walnut exports. Furthermore, research and development will be conducted to further implement innovative technologies in walnut production.

Walnut is grown in almost all regions of Uzbekistan. At present, there are 337.3 thousand hectares of orchards in the republic, of which 18.7 thousand hectares are dedicated to walnut plantations. Walnut producers plan to collect about 65.1 thousand tons of nuts from their orchards.

In 2021, Uzbekistan exported 2.8 thousand tons of walnuts valued at $10.8 million to 36 countries. Additionally, 1.3 thousand tons of walnuts were exported, with a value of 4.4 million U.S. dollars.

As a result of centuries-old experience from the local population and the research conducted by institutions in Central Asia, particularly in Uzbekistan, a wide range of valuable walnut varieties have been developed. These varieties are of high quality and are comparable, if not superior, to the best varieties found in other countries.

The walnut is a beautiful ornamental tree too. It has been used with a great success in landscaping. It is also used in forest protection edges, the creation of forest areas, walnut orchards, and as the wind break to protect farms, orchards, and vineyards. Additionally, for foresters, walnut trees in mountainous conditions are valuable for soil reinforcement and water regulation. For improving distribution of walnut in different regions, researchers have conducted studies to analyze the cooling and warming requirements of various walnut varieties and genotypes (Aslamarz *et al*., 2009, 2010; Aslani Aslamarz, 2011).

Aslamarz (2010) research is focused on assessing the cold resistance in walnuts, which will aid in the identification of appropriate genotypes for cold regions.

The fruits are false drupes with an external rather fleshy, green, bare pericarp; when ripe, they crack incorrectly on the tree or when they fall. Reach 5–6 centimeters in diameter and are spherical, ovoid, elliptical, leathery, and dense on the outside. Ripens in the second half of September or early October.

Seeds, or drupes, of a nut, consist of a shell and an embryo enclosed in it with two wrinkled cotyledons.

Nut weight, kernel percentage, kernel weight, and shell thickness vary between 6.75 and 16.33 grams, 40.15 and 67.22%, 3.30 and 8.15 grams, and 0.58 and 2.30 millimeters (Yuldasheva, 2017).

Some researchers note that spraying with kaolin helped improve the weight of nuts and kernels, as well as the percentage of fat in the kernels. (Gharaghani *et al*., 2018)

Uses of walnut

Walnuts are used in the cuisines of many nations and carry an immense cultural value (Thapa *et al*., 2021; Vahdati, 2014). The range of uses for walnuts is very wide; it is added to desserts, salads, meat, fish, and first courses. Green walnuts, shells, kernels, barks, green walnut husks, and leaves are largely consumed and the nutritional value of the walnut kernel is very high (Hassankhah *et al*., 2017). The study of literature shows that they are rich in fats, proteins, vitamins, minerals, and other biologically active components (Jahanbani *et al*., 2018). The content of total fats, proteins, moisture, and ash varies between 57–70%, 13.22%, 3.5–5.0%, and 1.90–2.9%, respectively (Sarikhani *et al*., 2021; Askarov *et al*., 2022; Sadullaeva, 2013; Arrow, 1990). The content of dietary fiber and reducing sugars were found in the range of 5.4–10.4% and 0.18–1.7% (Sarikhani *et al*., 2021; Zhursunbek kyzy B, 2019). Walnut kernels are very rich in vitamins. The following vitamins (mg) were found in them: A-0.05, B1-0.4, B2-0.13, C-3.0, B3-1.0, E-23, and folic acid (Sadullaeva, 2013). The main macronutrients contained in the walnut kernel are potassium, phosphorus, magnesium, calcium, and sodium. Also, trace elements such as iron, manganese, iodine, fluorine, cobalt, and others were found in the walnut kernel. Unripe walnut fruits contain up to 2500 mg of vitamin C (Karomatov, 2012). Some authors note that tocopherols (vitamin E) in walnut kernels are 1.0–1.5 mg% (Karomatov, 2012).

Chatrabnous *et al*. (2018) has found that due to the long-lasting content of natural antioxidants, fresh walnuts can be successfully used for the production of functional foods.

Other components of walnut fruits are also widely used. For example, green walnut husks have antioxidant, antimicrobial, and anticancer properties. The total content of phenolic compounds varies between varieties and ranges from 35.50±9 to 58.00±0 mg g^{-1}, equivalent to gallic acid (Habibi *et al*., 2023). Crushed walnut shell is a universal, environmentally friendly raw material with unique physical characteristics and chemical composition that finds a wide range of applications in various industries (Ospanov, 2019).

In addition, the walnut shell is an organic, biodegradable raw material. Processed shells are, firstly, raw materials for the space, pharmaceutical, food, and fuel industries, and secondly, bridging agents, abrasives, fillers, granulates, and sorbents. The walnut shell is safe for human health and the environment. Ground walnut shell is a homogeneous natural powder that does not cause allergies, does not absorb moisture, and therefore does not contribute to the development of mold and bacteria. This is an ideal raw material for the production of body care products, such as washing pastes and scrubs of various sizes (Shalpykov, 2017).

It should be noted that knowledge of biochemical characteristics such as oil, protein, fatty acids, and phenolic compounds is very important to create an excellent genotype with high grain quality (Sarikhani *et al*., 2021).

In this regard, we made jam from unripe walnut fruits grown in the weather and soil-climatic conditions of Uzbekistan to determine the qualitative and quantitative content of macro- and microelements. Summarizing the above, we can conclude that jam from unripe walnut fruits can be successfully used as a prophylactic for a deficiency of trace elements such as aluminum, silicon, iodine, cobalt, chromium, iron, boron, copper, zinc, and others in human body. It can also be used in the confectionery industry as an additive and filling for sweets.

Conflict of interest

There are no conflicts of interest.

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