Macro and microelements in persimmon fruits of Uzbekistan

Ruziboy Normakhmatov[1*], *Khaitmurod* Tilavov[2], *Elnara* Devletshayeva[2], and *Rakhmatullo* Tashmanov[2]

[1]Samarkand Institute of Economics and Service, street Amir Temur 9, 140100, Samarkand, Uzbekistan
[2]Samarkand Agroinnovations and Research University, A.Temur street, 7, 141001, Samarkand region, Akdarya district, Dakhbet, Uzbekistan

Abstract. The study's findings on the macro and microelement contents of three pomological persimmon fruit varieties—Hiyakume, Zenju-Maru, and Denaus sugar—grown in the Republic of Uzbekistan's weather-climatic circumstances are presented in this article. The research demonstrated that Uzbekistan's climate favors persimmon cultivation, which is distinguished by a high concentration of macro and microelements. Studies have established that the accumulation of macro and microelements by fruits is significantly influenced by the pomological variety of persimmon fruits and the weather and climatic conditions of cultivation. As a result, compared to persimmon fruits grown in Surkhandarya region's Bandykhan Valley, those grown in Fergana Valley have about three times the magnesium concentration. The salt level of the several persimmon fruit kinds under study varied considerably from one another as well. For instance, Fergana Valley persimmon Hiyakume fruits had 6.30 mg/100 g of this element; Bandykhan Valley persimmons of the same type had 28.70 mg/100 g of this element. The fruits of the persimmon variety Zendji-Maru from Fergana Valley were the richest in iron macronutrient content among the studied varieties. For example, the iron content in fruits of Zendji-Maru variety was 10.64 μg/100 g, i.e., almost two times higher than the iron content in fruits of the same variety grown in Bandykhan zone of Surkhandarya region. However, an inverse dependence on manganese content was observed. Persimmon fruits grown in the weather and climatic conditions of Uzbekistan were also rich in iodine content, which is deficient for the region. Overall, it was shown that persimmon fruits may be effectively employed in preventative nutrition and are a good source of potassium, salt, calcium, and several trace elements, including copper, iron, zinc, manganese, and iodine.

1 Introduction

The majority of people in Uzbekistan, as is well known, reside in rural areas, and the efficient expansion of the nation's industries is essential to the employment and income growth of over half of the population. Thus, the current economic policy places a high priority on the growth

* Corresponding author: normaxmatov49@gmail.com

of agricultural production. Modernizing and intensifying agriculture is one of the main goals of the "Strategy of Actions for Further Development of the Republic of Uzbekistan," which was adopted in the first part of 2017. Ensuring the population's food security was the first of nine strategic priorities covered by the Presidential Decree approved on October 23, 2019, "Strategy for the Development of Agriculture of the Republic of Uzbekistan for 2020-2030" [1].

It is possible to designate the last three years as a priority for the agricultural sector's historically extensive reforms, which include the adoption of cutting-edge technologies, the introduction of market processes, and the shift to a cluster system of production. The growth of agricultural production is now viewed as strategically important [2].

Food production in Uzbekistan has advanced significantly. Significant gains in agricultural production and productivity are among the primary causes of this. Reforms in the agricultural sector have allowed for more diversified output and better rural infrastructure, placing less emphasis on cotton monoculture and more on more varied production.

In Uzbekistan, horticulture is the most significant area of agriculture. Currently, in the Republic, year-round supplies of these vital items to the populace are ensured by the expansion of horticulture and increased fruit production. Today, the republic's cotton monopoly is history thanks to the introduction of a scientifically supported crop allocation plan.

Fruits are well-known for being rich sources of water-soluble sugars, organic acids, fiber, pectin, and protein-containing compounds. They are also major sources of some minerals and vitamins. Many fruits have also been found to have medicinal and antibacterial qualities [3-9]. Fruits should be a staple of any human diet due to their many benefits. The horticultural production of subtropical fruits in Uzbekistan has received a great deal of attention in the last few years.

Persimmon is ranked second among the republic's subtropical fruits, after pomegranate. The districts of Fergana and Surkhandarya have the most ideal climates for farming in Uzbekistan. The Uzbek Scientific Research Institute of Horticulture, Viticulture, and Winemaking, named after Academician M. Mirzaev, along with its branches and field experiment stations, along with seasoned horticulturists, have been conducting noteworthy research in recent years to investigate the biology of subtropical fruits, including persimmons.

However, the issues of macro and micro-element composition of persimmon fruits have been poorly studied until now. In this regard, we set the task to study the content of macro and micro-element composition of released pomological varieties of persimmon in Uzbekistan.

2 Object and methods of research

Research on persimmon fruit was conducted using the most promising varieties—Hiyakume, Zenju-Maru, and Denaus sugar—from the gardens of Bandykhan horticultural and viticultural experimental farm of the Uzbek Scientific Research Institute of Horticulture, Viticulture, and Winemaking, which is named after academician M. Mirzaev. The introduced variety, known as hiyakume, is foreign in origin. It is common in various Fergana Valley regions, including Surkhandarya region of Uzbekistan. Fruits have a circular body with a slightly extended top. Fruits weigh between 150 and 200 g on average; however, some can weigh up to 400 g. The skin has a little waxy patina and is thick and light orange in color. Fibrous, pale orange flesh that loses its tartness as it ripens fully. Ripe fruits have a jelly-like, juicy, and flavorful pulp.[9]

In Uzbekistan, Zenju-Maru is a foreign-origin variety that has been introduced and is found in Surkhandarya area and certain regions of the Fergana valley. Fruits range in size from small to medium. Fruit typically weighs between 100 and 130 g and has a spherical or

somewhat rectangular form. The fruit is orange-brown in hue, with medium-thick skin and a bluish patina on the seeds. The flesh is tasty and dark brown. The pulp of seedless cultivars is acidic and orange until it softens.

A kind of rounded-square sugar with four longitudinal grooves is called Denaus sugar. The fruit measures 3.5–5 cm in height and 7-8 cm in diameter. A 150–170 g weight range is typical. When the fruit is fully ripe, its skin turns a pale orange color and becomes dense. The flesh of the fruit is yellow, floury, and jelly-like. The issue laboratory of macro and microelements at Samarkand State University, named after A. Navoi, uses the atomic adsorption method on the spectrophotometer "Satur" in threefold repetitions to determine the concentration of macro and microelements.

The samples were ash-dissolved in 0.1 nm hydrochloric acid after being ash-soaked both wet [in concentrated nitric acid] and dry at 350–400 °C. The light sources were PLBL-2 source-powered VSV-2 high-frequency electrodeless lamps and LEIC-type bare cathode spectrum lamps. Using a self-describing potentiometer [KSP-4], absorption was measured. An atomizer was created by burning a combination of acetylene and air.

3 Results of the study and their discussion

It is well recognized that a person needs mineral components, which are crucial to metabolic processes, in order to be healthy and efficient. The treatment and prevention of disorders pertaining to the neurological, digestive, and cardiovascular systems, as well as the avoidance of immunodeficiency, depend on both macro and microelements. Table 1 displays our findings about the macroelemental makeup of persimmon fruits in Uzbekistan.

Table 1. Content of macronutrients in Uzbek persimmon fruits.

Persimmon varieties	Place of growth	Mass concentration of macronutrients, mg/100g				
		K	Na	Ca	Mg	Cu
Hiyakume	Bandykhan	265	26,70	3,60	14,9	37
	Fergana	173	6,30	2,70	34,0	37
Zenju-Maru	Bandykhan	197	13,50	4,40	69,7	41
	Fergana	193	7,40	2,30	193,0	34
Denaus sugar	Bandykhan	245	18,20	3,20	6,69	77

It is evident from Table 1's data that pomological types and fruit-growing locations have a major impact on the presence of mineral elements in persimmon fruits. The content of potassium, calcium, copper, and zinc in persimmon fruits is more stable than the content of other elements. For example, the fruits of persimmon Zendji-Maru grown in Bandykhan, Surkhandarya region, and Fergana valley are almost the same in potassium content: 197 mg/100 g and 193 mg/100 g, respectively.

However, no such regularity was found for magnesium content. Fruits of persimmon, Zendji-Maru, grown in Fergana Valley are almost three times higher in magnesium content than fruits grown in Bandykhan Valley of Surkhandarya region. The amounts of sodium in the several persimmon fruit kinds under study also varied considerably from one another. Thus, for example, if the fruit of Hiyakume persimmon grown in Fergana Valley contained 6.30 mg/100 g of sodium, the content of this element in Hiyakume persimmon grown in Bandykhan Valley is 28.70 mg/100 g.

Generally speaking, the macro-elemental value of persimmon can be determined by examining its potassium, sodium, calcium, and magnesium contents. Fruits include calcium in water-soluble, acid-soluble, and adsorbed forms, as well as potassium, sodium, and magnesium as inorganic acid salts. The activities involved in water-soluble metabolism are directly impacted by salt and potassium. The production of bones is the primary function of calcium, but it is also involved in blood clotting, muscle contraction, and mental excitability [6,9].

It is well known that plant-based goods are high in magnesium and frequently supply a portion of the mineral through meals. Magnesium cofactors with several key enzymes involved in energy, phosphorus, and carbohydrate metabolism. Our research revealed significant differences in the magnesium concentration of the various kinds of persimmon fruits.

For instance, if the magnesium concentration of persimmon fruits cultivated in Fergana Valley [the Zenju-Maru variety] was 193.0 mg/100g, this indication is only 6.64 mg/100g in fruits grown in Surkhandarya region [the Bandykhan zone] of Denaus sugar variety. With the exception of Zendji-Maru type grown in Fergana Valley, it is certain that the amount of this macronutrient is lower than that of other fruit-growing zones [7.8]. Additionally, we ascertained the microelement content of Uzbekistan's persimmon fruits; the outcomes are displayed in Table 2.

Table 2. The micronutrient composition of Uzbek persimmon fruits.

Persimmon varieties	Place of growth	Mass concentration of trace elements, mg/100g				
		Zn	Fe	Mn	Ni	I
Hiyakume	Bandykhan	88	656	135	36	23.9
	Fergana	93	266	37	traces	-
Zenju-Maru	Bandykhan	97	618	156	18	20,8
	Fergana	80	1064	31	19	-
Denaus sugar	Bandykhan	70	600	122	traces	-

The highest iron level was found in the fruits of the Fergana Valley persimmon variety Zenju-Maru. For instance, fruits of Zendji-Maru variety, had an iron level of 1064 mcg/100 g, which is about twice as much as fruits of the same variety cultivated in Surkhandarya region's Bandykhan zone. On the other hand, the manganese content has an opposite relationship. Manganese content in fruits from Bandykhan zone was 3.4 times higher in Hiyakume and Zendji-Maru types than in fruits from the Fergana valley. In our view, the districts' soil-climatic characteristics and the agrotechnical practices implemented throughout the fruit-growing season account for this dependence in the first place. The location of the persimmon fruit's growing and pomological types did not significantly affect the trace element zinc accumulation.

According to published research, persimmon fruits are the fruit that accumulates the most iodine trace element when compared to other fruits, with the exception of feijoa fruits [7, 8]. Thyroxine synthesis and metabolism regulation both depend on iodine. There is no information available about the concentration of many trace elements in Uzbek-grown persimmons. Iodine, rubidium, antimony, chromium, and cobalt were among the trace elements found in the laboratory of activation analysis at the Institute of Nuclear Physics of

the Academy of Sciences of Uzbekistan. This was determined using the neutral activation method.

It is well known that most fruits, vegetables, and grain products have a concentration of 5-8 mcg of iodine, a deficient microelement, per 100 g of raw material. Furthermore, iodine content in persimmon fruits ranges from 20.8 to 37.8 mcg per 100 g of product, depending on the variety, according to our research. We believe that eating foods high in iodine is a good way to maximize the availability of this element.

Even though the chromium concentration of persimmon varies greatly, we discovered noteworthy levels of cobalt in it as well. Zenju-Maru fruit varieties have the highest concentration of it. Persimmon fruits are also a source of rare elements including antimony and rubidium.

4 Conclusion

Based on the study's findings, persimmon fruits can be a useful dietary supplement for preventive nutrition as they are high in potassium, salt, calcium, and several trace elements [copper, iron, zinc, manganese, and iodine].

References

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