NUTRIENT COMPOSITION OF FRUITS STORED AT COLD TEMPERATURES FOR EXPORT

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Abstract. *This study used the method of atomic absorption spectrometry of apple and apricot fruits grown in Uzbekistan and intended for export, mineral elements, macroelements (Na, K, Ca, Mg), and microelements (Cr, Cu, Mn, Fe, Cd, Pb, Zn, Co and Ni). These fruits were kept in cold storage for some time before being sent for export. It was determined how the mineral substances in the fruits change and how long they can be stored in cold conditions. The main effect in the group is macroelements potassium and sodium, iron, and manganese, while there are microelements. The results were compared with those obtained by other researchers around the world.*

Key words. *Fruits, mineral elements, atomic absorption spectrometry, Frozen fruits.*

INTRODUCTION

The global demand for frozen fruits has witnessed a steady rise due to their convenience, extended shelf life, and nutritional value. [1] Frozen fruits are an excellent source of essential vitamins, minerals, and antioxidants, making them a popular choice among health-conscious consumers worldwide. As the export market for frozen fruits continues to grow, it is crucial to understand their nutritional composition to ensure they meet the highest quality standards.

Frozen fruits are primarily composed of carbohydrates, with varying amounts of dietary fiber depending on the fruit type. [2] The freezing process helps preserve the natural sugars found in fresh fruits, contributing to their sweet taste and energy content. Additionally, frozen fruits contain negligible amounts of protein and fat, making them a low-calorie and nutrient-dense option for a balanced diet.

One of the most significant advantages of frozen fruits is their rich micronutrient content. [3 - 5] Frozen fruits are an excellent source of various vitamins and minerals, including:

Vitamins:

Vitamin C: Frozen fruits like strawberries, raspberries, and blueberries are particularly high in vitamin C, a powerful antioxidant that supports immune function and skin health.

Vitamin A: Fruits like mangoes and papayas are rich in vitamin A, which is essential for maintaining good vision and promoting healthy skin and mucous membranes.

Vitamin E: Frozen fruits like avocados and kiwis are excellent sources of vitamin E, an antioxidant that helps protect cells from oxidative stress.

Minerals:

Potassium: Many frozen fruits, such as bananas and kiwis, are rich in potassium, which plays a crucial role in regulating blood pressure and muscle function.

Magnesium: Frozen fruits like raspberries and blackberries are good sources of magnesium, a mineral that supports bone health and energy production.

Iron: Certain frozen fruits, like prunes and apricots, contain significant amounts of iron, which is essential for the formation of red blood cells and the transportation of oxygen throughout the body.

To ensure the nutritional integrity of frozen fruits for export, strict quality control measures are implemented throughout the production process. Fruits are typically frozen at their peak ripeness, preserving their nutritional value and flavor. Additionally, advanced freezing techniques, such as blast freezing and cryogenic freezing, help maintain the texture and color of the fruits, minimizing nutrient loss during storage and transportation.

In our experiments, we have conducted several studies that give the nutritional value of apples and apricots that have been refrigerated for export.

Apples and apricots are fruits known for their delicious taste, nutritional value, and vibrant colors. However, they are also perishable and require proper storage to maintain their quality and extend their shelf life. Cold rooms provide conditions that help to slow down spoilage processes in these fruits.

Currently, in all countries, refrigeration is a common method used to extend the shelf life of fruits, including apples and apricots. During storage in the refrigerator, several changes occur in the chemical composition of these fruits, which may affect their overall quality and shelf life [6-8].

Apples and Apricots in our country are rich in biologically active substances and have medicinal properties, and the fact that they are grown mainly in natural sunny conditions attracts foreign buyers. Taking this into account, one of the important tasks facing our country today is keeping fruits in good condition and delivering them to customers in good quality. Because these fruits contain a lot of water, the presence of free and weak water bonds causes the fruits to quickly deteriorate, become diseased and unstable for various fruit pathogens, and cannot be stored for a long time. Studying the cooling conditions of apples and apricots, as well as biotechnological research of their composition and quality, is one of the promising and effective methods of fruit export in our country.

In this article, we researched the composition of macro and microelements and the amount of vitamins in apples and apricots that can be exported after being stored in a refrigerator for a certain period.

Materials and methods

Chemicals. **HCl (Merk), HNO_3 (Merk), C_2H_2 (Linde)**

Fruits. **Apple and Apricot**

Absorption/flame atomic emission spectrometer. **Atomic Absorption Spectrometer – Varian 280 FS SpectrAA. Flame type: air/acetylene. The sodium, potassium, calcium, magnesium, chromium, copper, manganese, iron, cadmium, lead, zinc, elements determination by atomic adsorption spectrometry was performed with the atomic emission method.**

In analysis of fruits, particularly importance has taken her test and training environments for analysis because the results should reflect as accurately as the chemical composition of fruit product sample was taken for analysis. In most cases the plant material is not homogeneous.

Conditioning of samples analyzed immediately after harvesting was carried out to remove impurities (ground or vegetation debris, etc.), by washing, followed by removal of adherent water with filter paper to full drying.

The primary samples thus obtained were mixed together and from the material obtained medium samples were formed after the quartering method. To determine the dry matter, macro and trace elements content of each variety, 100 ±0.001 g edible parts were selected.

The fruits were divided by cutting into small pieces and removing stones or shells with the use of plastic utensils. Divided fruits were placed in an oven at 100 °C until a constant weight was attained, i.e. when the loss of mass was the same one hour after the last weighing)

The porcelain capsules were cleaned and brought to constant weight by drying at 100°C, weighing approximately 100 g (with an accuracy of ± 0.001 g) plant product). They were then placed in oven-proof capsules at 55–65 °C where they remained for 4 hours. The temperature was then raised to 100 °C and maintained another for 6 hours. After this time, the samples were removed from the oven capsules and allowed to cool in a desiccator provided with the desiccant agent. After cooling, the capsules were weighed and replaced in the oven. This was repeated until the differences between two successive weighings does not exceed ± 0.001 g.

Dry mineralization. Fruit organic matter was oxidized by oxygen in the air in a calcination furnace, heated gradually to 500-550 °C, which was maintained for 7–8 hours. The method used was that described in STAS 5954/1–86, adapted to the specific analysis of plant products.

4 g of plant products obtained after drying were placed in a cold roasting oven. The temperature was gradually raised to 220–250 °C and maintained until complete charring

was achieved. The oven temperature was then raised to 500-550 °C and maintained for 7–8 hours, until a white ash remained.

Wet mineralization. The volume of acid depends on the amount of ash sample. Mineralization of samples was performed as follows: 1–2 g sample with 10 ml HCl and 5 mL HNO_3, or 3–4 g sample with 21 ml HCl and 7 mL HNO_3.

This was boiled until an almost dry sample was obtained, then filtered and the filtrate washed so as to not exceed the volume of 100 mL (volume of the filter flask). The operation was repeated for all samples analyzed. Filtrates obtained were collected in glass bottles (100 mL) for analysis by atomic absorption of macro- and micro-elements.

RESULTS AND DISCUSSION

Numerous studies have shown that fruits and vegetables are rich sources of nutrients as well as non-nutrient molecules with antioxidant or other physiological effects, and it seems likely that given sufficient bioavailability, these compounds may be important constituents of a healthy diet. The healthpromoting properties of plant-based foods have largely been attributed to their wide range of phytochemicals, many present at relatively high levels [9].

Of special interest are food sources rich in Calcium (Ca), Magnesium (Mg), and Potassium (K). Most of these nutrient requirements can be met by increasing the consumption of fruits and vegetables to 5–13 servings/day In addition to meeting nutrient intake levels, a greater consumption of fruits and vegetables is associated with reduced risk of cardiovascular disease, stroke, and cancers of the mouth, pharynx, esophagus, lungs, stomach, and colon [10].

In our research, we determined the amount of macro-microelements in Apple and Apricot fruits.

The amount of macro and micronutrients in the studied fruit samples, mg/100 g of the edible part of the product.

Fruit	K	Mg	Ca	P	Na	Fe	Cu	Mn	Zn
Fresh apple fruit	162	4.15	9,6	11	2.2	0.28	0.04	0.03	0.04
Chilled apple fruit	158	4.12	9,75	10,86	2.2	0,277	0,04	0,031	0,04
Fresh apricot fruit	290	10	13	26	3.75	0,4	0,1	0,07	0,2
Chilled apricot fruit	278	9,8	12,76	24,3	3.75	0,395	0,11	0,069	0,2

* Na - sodium, K - potassium, Ca - calcium, Mg - magnesium, Fe - iron, Cu - med, Zn - zinc, P - phosphate, Mn - Manganese.

In our experiments, the amount of total macro and microelements in 100 g of fruits was determined before and after cooling.

Continuing our research, we determined the amount of proteins, carbohydrates, sugar and ascorbic acid in fruits.

Research of the chemical composition of selected fruits under different conditions (100g)

Fruits	Ascorbic acid, mg, %	Kletchatka, gr	Protein, gr	Starch, gr	Sugar, gr	Total carbohydrate, mg, %
Fresh apple fruit	8,38 ±0,20	2,1±0,02	0,33±0,03	2±0,4	9±1,20	12±2
Fresh apricot fruit	9,6±0,14	0.8±0,07	0,48±0,02	0,03 ±0,01	3,15 ±0,2	3.8±1
Chilled apple fruit	8,28 ±0,20	2,1±0,02	0,32±0,03	2,1±0,4	8,86 ±1,20	11,89±2
Chilled apricot fruit	9,26 ±0,14	0.8±0,07	0,46±0,02	0,033±0,01	3,13 ±0,2	3.76±1

Based on the obtained results, no significant changes were observed in fruits during storage of fruits in low-temperature chambers. This confirms that exporting the relevant fruits through cold storage is an effective method.

The results of macro- and micro-element fruit measurements were compared with results obtained by other researchers at home and abroad, as well as some standards in force on the fruit content of heavy metals.

Research on the sodium content of apples has been made in which Nour et al. 2010 [10] obtained values of this element in the range, 0.26–8.92 mg/100g. In the presented research, the values of sodium content obtained were in the range mentioned above. Nour et al. 2010 [10] analyzed several samples of different apple varieties in which the concentration of calcium in the apple samples ranged between 1.75–8.74 mg/100g. Magnesium is an active component of several enzyme systems in which thymine pyrophosphate is a co-factor. Oxidative phosphorylation is greatly reduced in the absence of magnesium. Magnesium is also an essential activator for the phosphate-transferring enzymes myokinase, diphophopyridinenucleotide kinase, and creatine kinase. It also activates pyruvic acid carboxylase, pyruvic acid oxidase, and the condensing enzyme for the reactions in the citric acid cycle. It is also a constituent of bones, teeth, enzyme co-factor, (kinases, etc). The health status of the digestive system and the kidneys significantly influence magnesium status. Magnesium is absorbed in the intestines and then transported through the blood to cells and tissues. Approximately one-third to one-half of dietary magnesium is absorbed into the body. Nour et al. [10] have determined from analyzed Apple samples, magnesium concentrations in the range 5.02– 11.83 mg/100g. Nour et al. 2010 [10] conducted many experiments aimed at determining the amount of other macro and microelements in apple and apricot fruits.

CONCLUSION

The results of macro- and micro-element fruit measurements were compared with results obtained by other researchers at home and abroad, as well as some standards in force on the fruit content of heavy metals. The results obtained in terms of content in micro samples of fruit have resulted in the following conclusions. Fruit samples analyzed showed higher assimilation for micro-elements, copper, manganese, iron and zinc.

In addition, the amount of other types of chemicals in fruits was also determined. These obtained results can serve as necessary information for proper storage of fruits and consumption at the right time.

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