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THE REVIEW OF TECHNOLOGIES FOR STORAGE THE LOCAL VARIETIES OF VEGETABLES WITH EXTENDED SHELF LIFE

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Abstract

An analysis of local vegetable variety storage technologies has been conducted. The conducted research resulted in the selection of fruit and vegetable samples for a storage experiment. These samples included “Kukcha” variety carrots, “Uzbekiston 102” variety beets, and “Tuyimli” variety potatoes. This selection was based on the fact that these vegetables demonstrated the most pronounced characteristics of several key quality indicators. Sugars constituted the majority of organic matter in all the selected vegetables. “Kukcha” variety carrots had the highest sugar, vitamin C, and β -carotene content; “Tuyimli” potatoes were characterized by high moisture, starch, and vitamin C content. “Uzbekistan 102” beet roots also had the highest moisture and carbohydrate content.

Keywords: *vegetable products (carrots, beets, potatoes), storage technology, evaluation of methods, ensuring product safety*

Introduction

Ensuring product quality and safety is an important task for agricultural producers in the crop production industry. It should be noted that the seasonality of production and the need for regular consumption of fresh vegetables require infrastructure for long-term storage, which will ensure the population has access to fresh vegetables (Agrarian and biological foundations of production, storage and processing of plant products (2014); Babakina, M. V., 2020).

The need to reduce product losses of fresh vegetables and preserve their nutritional and biological value during the interseason period

determines the relevance of research related to the development of new storage methods, including the use of additional innovative packaging materials that ensure high quality of agricultural products during the long interseason period (Borisov, V.A., 2010).

Purpose of research is to analyze and evaluate reference data on storage technology for local varieties of vegetables with extended shelf lives.

Studies included local varieties of vegetables, carrots, beets, and potatoes, as well as information sources.

Methods of research are modern methods of physicochemical analysis were used

to analyze and evaluate storage technologies (Gorelikova, G. A., 2009; Guzhvin, V. D., 2019).

The methodological basis for the theoretical and experimental studies was based on both classical and new scientific concepts used in commodity science.

Results and discussion

When developing a storage technology for fruit and vegetable products with extended shelf lives, it was necessary to preliminarily substantiate and select the main fruit and vegetable samples (including the variety) for use in a subsequent storage experiment (Kopylov, S. I., 2012).

According to research, it has been shown that the most preferred long-life vegetable products by consumers are tubers and roots such as potatoes, carrots, and others (Matvienko, A. N., 2014). When selecting potential study subjects, we were guided by the fact that these vegetable products, i.e., potatoes, carrots, and beets are included in the list of recommended rational food consumption standards that meet modern healthy eating standards (Nikolaeva, M. A., 1985). Furthermore, potatoes, carrots, and beets are among the most popular in traditional diets, as they are the main vegetable types, according to the list of certain socially significant food products (Plotnikova, T. V., 2001).

Carrot and beet roots, as well as potato tubers, are suitable for long-term storage during the autumn and winter (GOST 28372–93 ISO 2165–74. (2004). However, carrots have a lower shelf life than other vegetables suitable for long-term storage. Carrot roots have very thin and delicate integumentary tissues, which makes them poorly stored, prone to rapid wilting, and susceptible to various diseases (GOST 1725–85).

In order to select a suitable carrot variety for use in a subsequent storage experiment, root samples grown in the Samarkand region of Uzbekistan were examined. The most common carrot varieties studied were “Kukcha”, “Samarkand 6” and “Nurli”, all included in the State Register of Breeding Achievements of the Republic of Uzbekistan and approved for use (Fig. 1, 2, 3) (GOST 28275–94). The main advantages of the presented varieties were stable yields, good ripening and shelf life, and resistance

to microflora. The roots of the table carrot variety “Kukcha” were cylindrical, elongated, blunt-tipped, and semi-long – 10–20 cm. The flesh and core were orange. The skin was smooth, and the core was orange. The roots weighed 90–170 g. The taste was excellent: the fruits were sweet and juicy. This carrot variety is known to tolerate frost well (down to -4°C).

Figure 1. Root crops of table carrots of the commercial and botanical “Kukcha” variety



Figure 2. Root crops of table carrots of the commercial and botanical “Samarkand-6” variety



Figure 3. Root crops of table carrots of the commercial and botanical “Nurli” variety



The table carrot “Samarkand-6” variety was characterized by large orange roots with juicy, sweet flesh. The root crops appeared whole, healthy, clean, unwilted, and uncracked. The root crops were cylindrical, bright orange, averaging 13–15 cm in length, 4.5 cm in diameter, and weighing 69–155 g. The flesh was bright orange. The root crops had good flavor.

The root crops of the table carrot “Nurli” variety appeared whole, healthy, clean, unwilted, and uncracked. The surface, flesh, and core of the root crops were orange. The root

crops were described as conical, with a blunt tip, 15 cm long, 5.8–6 cm in diameter, and an average weight of 74–252 g. The taste of root crops was rated as satisfactory to good.

The consumer properties, shelf life, commercial, and technological characteristics of carrot root crops are determined primarily by their chemical composition. A study of the physicochemical properties of different carrot varieties revealed that the content of dry matter, sugars, pectin, β -carotene, ascorbic acid, and organic acids varied significantly across varieties (Table 1).

Table 1. Key physicochemical properties of carrot root crops of the “Samarkand-6”, “Kukcha” and “Nurli” varieties

Carrots, variety	Dry matter, %	Carbohydrates, %		Pectin matter, %	Mass fraction		
		Total sugars	including reducing		β -carotene, mg/100 g	Vitamin C, mg/100 g	Organic acids, %
“Samarkand-6”	17.0±1.2	6.7±0.5	1.40±0.13	2.0	5.9±0.4	6.5±0.5	0.17
“Kukcha”	13.5±0.9	6.9±0.6	1.82±0.16	2.1	7.3±0.5	9.1±0.3*	0.23
“Nurli”	15.0±1.4	6.5±0.5	1.70±0.15	1.8	9.3±0.7	7.8±0.2	0.19

* The difference is significant in terms of vitamin C for the Kukcha carrot variety compared to other varieties

The bulk of organic matter was represented by sugars. The highest vitamin C and sugar content was observed in the commercial carrot variety “Kukcha”. β -Carotene content was predominant in the “Kukcha” and “Nurli” carrot varieties.

Based on the studied parameters, as well as data on the prevalence of Kukcha carrot roots (crops and harvests) in the Samarkand region of Uzbekistan, it was decided to use this carrot variety as the primary target for developing a technology for storing fruit and vegetable products with extended shelf lives.

Beets are also among the socially significant vegetables, which, along with carrots, potatoes, and cabbage, form the basis of the vegetable diet, part of the so-called “borscht set”. This vegetable is becoming increasingly popular due to its high fiber and anthocyanin (vitamin-like antioxidant substances) content (Khujakulov U. K., Sultanova Sh. A., Safarov J. E., 2021). The beet roots “Samarkand 1”, “Kizil Lavlagi” and “Uzbekiston 102” were

studied (Fig. 4, 5, 6). All roots were characterized by good keeping capacity.

The economic and botanical table beet variety “Samarkand 1” is included in the State Register for the region. It is recommended for culinary use and winter storage. The roots appeared fresh, whole, healthy, clean, not wilted, free from pest damage, and free from excess external moisture. The roots were round, with only slight corking of the head. The flesh was red. The roots weighed 220–370 g and had good taste. The roots of the “Kizil Lavlagi” table beet variety were flat-round, dark red, 6–8 cm long, 10–12 cm in diameter, and weighed 146–220 g. The surface was smooth. The flesh was dark red, juicy, and tender with excellent taste. The beetroot roots of the “Uzbekistan 102” variety appeared fresh, healthy, clean, and not wilted. They were round, up to 90 mm in diameter, and dark red in color. The flesh was dense, juicy, high in sugar content, and an intense red-burgundy color. When cut, it was uniform or had faintly defined “rings”.

Figure 4. Root crops of table beet of the commercial and botanical “Samarkand 1” variety



Figure 5. Root crops of table beet of the commercial and botanical “Kizil lavlagi” variety



Figure 6. Root crops of table beet of the commercial and botanical “Uzbekiston 102” variety



When studying the physicochemical properties of the beet varieties “Samarkand 1”, “Kizil Lavlagi”, and “Uzbekiston 102”, no significant differences were observed in the content of dry matter, carbohydrates, pectin, vitamin C, and organic acids (Table 2).

It should be noted that the “Uzbekiston 102” beet variety is a rather popular variety. Among its advantages are high yield and resistance to harsh conditions. The moisture content of the “Uzbekiston 102” root crops was found to be slightly higher than that of other varieties. Furthermore, increased carbohydrate (including reducing) and organic acid content was noted.

Table 2. Main physicochemical parameters of “Samarkand 1”, “Kizil Lavlagi” and “Uzbekiston 102” beet varieties

Beetroot, variety	Dry matter, %	Mass fraction			Vitamin C, mg/100 g	Organic acids, %
		carbohydrates, % sugars	including reducing	Pectin matter, %		
“Samarkand 1”	16.6±1.3	8.3±0.6	0.1±0.01	0.40	10.9±0.9	0.17
“Kizil lavlagi”	14.9±1.0	9.1±0.8	0.2±0.01	0.65	10.0±0.8	0.21
“Uzbekiston 102”	13.7±0.9	10.8±0.8	0.4±0.03	0.90	9.7±0.5	0.35

Based on the studied parameters, as well as data on the prevalence of the “Uzbekiston 102” beet variety in the Samarkand region of Uzbekistan, it was decided to use this variety of vegetable produce as a research subject in developing a long-term storage technology.

Potatoes are an important fruit and vegetable crop for the population of Uzbekistan. This type of vegetable produce plays a significant role in the country’s nutrition (Khujakulov U. K., Ait-Kaddour A., Safarov J. E. Saydullaev A. B., 2020). Based on this, we

studied several potato varieties grown in the Samarkand region of Uzbekistan. The most common potato varieties currently grown were studied: “Akrab”, “Tuyimli”, and “Umid (Fig 7, 8, 9). All potato varieties demonstrated excellent flavor and keeping capacity.

The tuber crops of the “Akrab” commercial and botanical variety were assessed for appearance as whole, healthy, clean, unwilted, uncracked, free from pest damage, and free from excess external moisture. The tuber crops were round-oval, sometimes elongated,

white, and weighed 90–120 g. The eyes were small and concentrated near the apex. The flesh was white. The flavor after boiling was good. The main advantages were their low maintenance and increased resistance to common diseases and pests.

Figure 7. Tuber crops of the “Akrab” potato commercial and botanical variety



Figure 7. Tuber crops of the “Tuyimli” potato commercial and botanical variety



The tuber crops of the “Tuyimli” variety were described as whole, healthy, clean, unwilted, uncracked, free from pest damage, and free from excess external moisture. The tuber crops were round-oval, weighing 102–154 g, with a yellow skin. The flesh was

light yellow (sometimes yellow). The eyes are small. Key advantages: good yield, large tubers, long shelf life, and disease resistance.

Figure 7. Tuber crops of the “Umid” potato commercial and botanical variety



The tubers of the “Umid” variety appeared whole, dry, uncontaminated, healthy, not sprouted, not wilted, not cracked, free from pest damage, and free from excess external moisture. The tubers were uniform, large, oval, yellow, weighing 110–180 g. The eyes were few and small. The skin was smooth.

In order to select the most suitable potato variety for use in the subsequent storage experiment, we analyzed a range of physicochemical parameters for various potato varieties: dry matter content, carbohydrates (sugars, starch), pectin, ascorbic acid, and organic acids (Table 3).

Carbohydrates accounted for the majority of organic matter. The highest starch content was observed in the “Tuyimli” potato commercial variety. It should also be noted that the vitamin C content of this variety was significantly higher than that of other varieties.

Table 3. Key physicochemical parameters of various potato varieties: “Akrab”, “Tuyimli”, and “Umid”

Potato, variety	Dry matter, %	Mass fraction				Organic acids, %
		Carbohydrates, % Sugars (including reducing)	Starch	Pectin substances, %	Vitamin C, mg %	
“Akrab”	22.0±2.0	1.34±0.08	14.7±0.7	0.19	12.6±0.5	0.01
“Tuyimli”	18.5±1.8	1.0±0.01	16.1±0.9*	0.22	17.8±0.3*	0.03
“Umid”	23.3±1.6	1.9±0.04	11.4±0.4	0.18	16.4±0.2	0.01

* – the difference is significant for the “Tuyimli” potato variety for starch and vitamin C content

Based on the studied parameters, as well as data on the prevalence of “Tuyimli” potato tuber crops in the Samarkand region of the Republic of Uzbekistan, the use of this vegetable variety as a research subject in the development of a long-term storage technology was justified.

Conclusions

As a result of the conducted research, fruit and vegetable products were selected for the storage experiment. The subjects were: “Kukcha” carrots, “Uzbekistan 102” beets, and

“Tuyimli” potatoes. This choice was based on the fact that these vegetables demonstrated the most pronounced characteristics of several of the most important quality indicators. Thereby, the majority of organic matter in all the selected vegetables was represented by sugars. The highest content of sugars, vitamin C, and β -carotene was observed in the “Kukcha” carrot variety. The “Tuyimli” potato variety was characterized by high moisture, starch, and vitamin C content. The beet root crops of the “Uzbekistan 102” variety also had the highest moisture and carbohydrate content.

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