

ДОСЛІДЖЕННЯ ЯКОСТІ ХАРЧОВИХ ПРОДУКТІВ

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- Svitlana BELINSKA,** Doctor of Technical Sciences, Professor,
Professor at the Department of Commodity Science,
Safety and Quality Management,
Kyiv National University of Trade and Economics
19, Kyoto str., Kyiv, 02156, Ukraine
E-mail: s.belinskas@knute.edu.ua
ORCID: 0000-0001-6029-8804
- Olena MOROZ,** Doctor of Economics, Professor,
Head of the Department of Entrepreneurship,
Logistics and Management,
Vinnytsia National Technical University
95, Khmelnytsky highway, Vinnytsia, 21000, Ukraine
E-mail: moros@vntu.edu.ua
ORCID: 0000 0003 3337 3345
- Larysa SAFIULLINA,** senior lecturer at the Department
of Modern European languages,
Kyiv National University of Trade and Economics,
19, Kyoto str., Kyiv, 02156, Ukraine
E-mail: l.safiullina@knute.edu.ua
ORCID: 0000-0002-9281-3900

CONSUMER PROPERTIES OF FRESH AND FROZEN HIPPOPHAE BERRIES OF THE VELIKAN VARIETY

The consumer properties of hippophae berries of the Velykan variety have been studied. It was found that freezing at a temperature of minus 30 °C is accompanied by minor changes in organoleptic and physicochemical parameters. The most sensitive to freezing is vitamin C, the loss of which during low-temperature processing is 6.1 %. The effect of freezing on the quantitative indicators of the content of β -carotene and mineral elements was not detected.

Keywords: hippophae, ascorbic acid, β -carotene, freezing, mineral elements.

Background. The question of the role of nutrition in the system of formation of the human body resistance to various diseases has become especially relevant in the context of the spread of coronavirus infection. Scientists in Ukraine and around the world continue research that confirms that the consumption of products – carriers of vitamins A, C, E, D, mineral elements, including Magnesium, Selenium, Zinc has a positive effect on the functioning of the immune system. It is known that the value of fresh fruits and vegetables is primarily due to the content of a wide range of vitamins and vitamin-like compounds, enzymes, minerals, dietary fiber. Statistics show small fluctuations in the consumption of fruits and vegetables in recent years (*Table 1*), but confirm the irrationality of consumption: exceeding the consumption of potatoes, which is characterized by a sufficiently high

starch content; exceeding the consumption norms of vegetables, which are mainly used after heat treatment, as a result of which the indicators of its biological value and insufficient consumption of fruits, berries and grapes decrease. [1; 2].

Table 1

**Consumption of potatoes, vegetables, fruits, berries and grapes
by the population of Ukraine (per person per year, kg)**

Type of fruit and vegetable products	Consumption rate	Years		
		2016	2017	2018
Potato	95	139.8	143.4	139.4
Vegetables and melon food crops	110	163.7	159.7	163.9
Fruits, berries and grapes	64	49.7	52.8	57.8

Note: Dried and processed potatoes, vegetables and melons, fruits, berries and grapes are included in the consumption fund in recalculation of fresh.

It should be noted that in 2018 the level of self-sufficiency of Ukraine in potatoes was 101.5 %, vegetables and melons – 103.4 %, fruits, berries and grapes – 91.3 % [1]. These data indicate the ability of Ukraine to provide the population of the country with domestically produced fruits and vegetables. However, the traditional range of fruits and vegetables grown in Ukraine, due to the peculiarities of chemical composition, unsuitability for long-term storage in fresh form does not fully meet the daily human needs for biologically valuable substances, including vitamins and minerals [3].

Therefore, in recent years, much attention is paid to the possibility of using in the diet of such fruit and vegetable products, which when consumed systematically in fresh or processed form have a regulatory effect on the human body as a whole or on individual systems and organs.

Hippophae berries are a natural concentrate of biologically active substances, which have long been called a nutritious berry. They are known as valuable multivitamin and medical and technical raw materials. Compared with other fruit and berry crops, hippophae has a number of advantages in terms of quantitative and qualitative composition of biologically active substances and its impact on the human body. Systematic consumption of berries improves the general state of human health, increases efficiency. It has been established that hippophae berries and hippophae oil reduce pain and inflammatory processes, accelerate granulation and epithelialization of tissues, promote rapid healing of wounds and ulcers. Hippophae berries and oil are also used for hypovitaminosis, infectious diseases, radiation injuries of the skin. Due to the action of linoleic and linolenic acids, fat-soluble vitamins (A, E), phospholipids and sterols, hippophae reduces the amount of total cholesterol and total lipids in the serum and inhibits the development of atherosclerotic processes. Oil, juice, hippophae extract are also used to prevent premature aging, muscle dystrophy, lowering blood pressure, antitumor prophylaxis [4; 5].

Like most fruit and berry products, hippophae berries have a limited shelf life in fresh form. They are mainly consumed after processing into jam, marmalade, jelly, etc. Considering the organoleptic properties, varietal

diversity of hippophae, seasonality of its cultivation, which leads to a limited period of its consumption in fresh form, it is important to establish changes in the quality of hippophae berries when using one of the most economical methods of preservation – freezing.

Analysis of recent research and publications. Problems of peculiarities of hippophae yield formation, research of chemical composition of hippophae of different varieties, possibilities of its use in production of various assortment of foodstuff are covered in a number of works of domestic and foreign scientists [6–19].

Marketing prospects and economic efficiency of growing different varieties of hippophae in the northern forest-steppe of Ukraine are covered in the works [6; 7].

The results of the study of agroecological, biochemical properties and economically valuable characteristics of hippophae varieties grown in Ukraine are reflected in the works [8–13]. In Ukraine such hippophae varieties as *Velykan*, *Prevoskhodna*, *Obilna*, *Vitaminna*, *Zoloty pochatok*, *Oranzheva*, *Maslyнна*, *Samorodok*, *Trofymivska*, *Podarunok sadu*, *Botanichnyi*, *Chuiska*, *Yantarna* and others are grown. Hippophae berries have a sour-sweet taste, sometimes with a bitter savor, a peculiar pleasant aroma reminiscent of pineapple, citrus. The chemical composition of berries is diverse and depends on varietal characteristics. Hippophae contains 10–19 % of dry matter, including 7.3–11.3 % of soluble. They contain almost all water- and fat-soluble vitamins. The pulp contains 5–9 % oil (in the seeds – 13 %), 2.6–6.6 % sugars, 1.1–4.6 % organic acids, up to 0.3 % nitrogenous substances, 50–200 mg/100 g of vitamin C, 50–150 mg/100 g of vitamin K, 28 mg/100 g of vitamin E, up to 8 mg/100 g of carotenoids. Among the organic acids the malic, tartaric, oxalic, succinic acid were found. The latter one is characterized by active physiological action to prevent the toxic effects of medicines and X-rays on the human body. Berries also contain B vitamins, P-active substances. In terms of vitamin E content, hippophae ranks first among fruit plants, and in terms of vitamin K content it differs among such crops as chokeberry, mountain ash, black currant. Mineral elements are represented (mg/100 g) by Potassium – 180–220, Calcium – 9–16, Magnesium – 7–12, Phosphorus – 12–17, Iron – 6–14, and also Manganese, Zinc, Aluminum, Titanium, Silicon. Pectic substances in hippophae berries are from 0.3 to 1.2 %. Upon ripening of berries, the amount of pectin is significantly reduced. The berries also contain the alkaloid serotonin, which has high radioprotective activity and slows the pathological growth of tissues. [8–13].

Antioxidant properties, safety of hippophae berries were studied by G. Zakyntinos and A. Jaroszevska [14; 15].

Possibilities of using hippophae berries to increase the biological value of fish products are proved by Dietrich I.V., fruit sherbet – by V. N. Korzun, I. Yu. Antoniuk, confectionery – by O. Gorobets, whey-based drinks – by R. Yu. Pavliuk [16–19].

In Ukraine, the results of the study of the consumer properties of frozen hippophae are insufficiently covered in scientific publications.

The aim of the work is to investigate the consumer properties of fresh and frozen hippophae berries.

Materials and methods. The object of research is hippophae berries of the *Velykan* variety.

Quality assessment was performed on organoleptic and physico-chemical parameters. Among the organoleptic parameters the appearance, color, taste, smell was determined. Among the physicochemical – soluble dry matter [20], the content of ascorbic acid [21], titrated acids in terms of malic [22], total sugar [23], mineral elements – by the X-ray fluorescence method on the spectrometer "ElvaX" (Ukraine); β -carotene [24].

The study was performed in a medium sample of berries before freezing and fresh-frozen. The berries were frozen in plastic bags with a net weight of 200 g at a temperature of minus 30 °C until achieving the temperature inside the berries minus 18 °C. The calculations were performed in terms of the initial mass, taking into account its losses during freezing. The research results were subjected to mathematical and statistical processing.

Results. Organoleptic properties of the product are one of the important indicators on which the consumer's interest in the product and the speed of its promotion on the market depends. To determine the effect of freezing on the change in organoleptic quality indicators of hippophae, we analyzed the appearance, color, smell and taste. According to the results of research it is established that the organoleptic parameters are not changed during freezing: the shape and integrity of frozen berries are not damaged, the color is even, intense orange. Fresh-frozen hippophae berries had a pleasant taste and smell typical for fresh berries. Outside taste and smell were not detected. The consistency of hippophae berries is an indicator by which the suitability of vegetable raw materials for freezing is determined, after thawing it resembled the consistency of fresh product. The exfoliation of the pulp from peel wasn't detected.

Studies of the chemical composition show slight changes of indicators after freezing. (Table 2).

Table 2

Physico-chemical quality indicators of hippophae berries

Indicator	Unit of measurement	Before freezing	Fresh frozen
Soluble dry matter	%	10.2	10.1
Total sugar		6.4	6.1
Titrated acids		2.1	2.3
Vitamin C	Mg/100 g	146.64	137.72
β -carotene		3.1	3.1
Calcium		15	15
Potassium		18.7	18.7
Iron		0.53	0.53
Magnesium		7.6	7.4
Copper		0.050	0.050

In our opinion, a slight decrease in the amount of soluble dry matter is established due to the rather high rate of moisture crystallization process. This is due to both the small size of the berries and the applied freezing temperature – minus 30 °C.

At the same time, it should be noted that even a short freezing process causes a decrease in the total sugar content (by 4.7 %), which is accompanied by an increase in the amount of titrated acids – by 9.5 %. However, these changes did not affect the taste sensations during tasting. The confirmation of the above is the calculation of the sugar-acid coefficient, which is 3.04 in berries before freezing and 2.65 in fresh-frozen.

Ascorbic acid is one of the most labile biologically active substances, which, depending on the type of vegetable raw materials, the method of its preparation for freezing, freezing technology undergoes significant changes. In the berries of hippophae of the *Velykan* variety we found its rather high content – 146.64 mg/100 g, which fully provides the daily requirement of ascorbic acid when consuming 50 g of berries. In frozen hippophae berries, the loss of ascorbic acid was insignificant and amounted to only 6.1 %.

β -carotene, which is a provitamin of vitamin A, contained in hippophae berries in an amount, is insensitive to low temperatures. A similar trend is established for certain mineral elements: Calcium, Potassium, Iron, Magnesium, Copper. The results of our research are accordant with the data presented in the scientific literature on the resistance of carotenoids to low temperatures.

The stability of the mineral content in frozen berries may be due to the peculiarities of the structure of hippophae berries, a dense skin with a waxy coating, which protects the product from leakage of cellular juice during thawing.

Conclusion. Hippophae berries have been proven to be a source of important natural ingredients, so it is advisable to consume them to provide the body with substances that can increase resistance to various diseases for a long time. Freezing of hippophae berries at a temperature of minus 30 °C contributes to the preservation of its original sensory properties and indicators of chemical composition.

At the same time, the prospects for further research are to determine the storage parameters at which changes in quality during low-temperature refrigerated storage would be minimized.

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Белінська С., Мороз О., Сафіулліна Л. Споживні властивості свіжих та заморожених ягід обліпихи сорту Великан.

Постановка проблеми. Питання щодо ролі харчування у системі формування резистентності організму людини до різноманітних захворювань набуло особливої актуальності в умовах поширення коронавірусної інфекції. Науковцями України та світу продовжуються дослідження, які підтверджують, що споживання продуктів, багатих на вітаміни А, С, Е, D, мінеральні елементи, зокрема Магній, Селен, Цинк, позитивно впливає на функціонування імунної системи. Ягоди обліпихи – це природний концентрат біологічно активних речовин, цінна полівітамінна сировина, яка за кількісним і якісним складом біологічно активних речовин, як порівняти з іншими плодово-ягідними культурами, має низку переваг.

Метою роботи є дослідження споживних властивостей ягід обліпихи до заморожування та свіжозаморожених.

Матеріали та методи. Об'єкт дослідження – ягоди обліпихи сорту *Великан*. Оцінку якості проведено за органолептичними та фізико-хімічними показниками. Серед органолептичних показників визначали зовнішній вигляд, колір, смак, запах. Серед фізико-хімічних – вміст сухих розчинних речовин, аскорбінової кислоти, титрованих кислот у перерахунку на яблучну, загального цукру, мінеральних елементів та β -каротину.

Дослідження проведено в середній пробі ягід до заморожування та свіжозаморожених. Заморожували ягоди у поліетиленових пакетах масою нетто 200 г за температури $-30\text{ }^{\circ}\text{C}$ до досягнення температури всередині ягід $-18\text{ }^{\circ}\text{C}$. Розрахунки виконано в перерахунку на вихідну масу з урахуванням її втрат під час заморожування. Результати досліджень піддано математико-статистичній обробці.

Результати дослідження. Свіжозаморожені ягоди обліпихи мали приємний смак та запах, властиві свіжим ягодам. Сторонні смак та запах не виявлені. Консистенція ягід після розморожування нагадувала консистенцію свіжої продукції. Відшарування м'якоті від шкірки не виявлено.

Встановлено незначне зниження кількості розчинних сухих речовин, цукрів (на 4.7 %), аскорбінової кислоти (на 6.1 %), зростання кількості титрованих кислот – на 9.5 %. β -каротин, який міститься в ягодах у кількості 3.1 мг/100 г, виявляє стійкість до заморожування. Аналогічну тенденцію виявлено і для визначених мінеральних елементів: Кальцію, Калію, Феруму, Магнію, Купруму.

Висновки. Доведено, що ягоди обліпихи є джерелом важливих природних інгредієнтів, тому їх доцільно споживати для забезпечення організму речовинами, здатними підвищувати резистентність до різноманітних захворювань упродовж тривалого часу. Заморожування ягід обліпихи за температури не вище ніж $-30\text{ }^{\circ}\text{C}$ забезпечує збереженість вихідних сенсорних властивостей та показників хімічного складу.

Ключові слова: обліпиха, аскорбінова кислота, β -каротин, заморожування, мінеральні елементи.