ТЕХНОЛОГІЯ ХАРЧОВОЇ ТА ЛЕГКОЇ ПРОМИСЛОВОСТІ

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CONSUMER PROPERTIES AND QUALITY ASSESSMENT OF QUINOA GRAINS

The article presents data on the chemical composition and beneficial properties of quinoa grains. The organoleptic evaluation of this culture was studied, on the basis of which a general profile of the color, smell and appearance of the quinoa grain sample under study was constructed. It is shown. that quinoa seeds are the most important sources of high-grade proteins, plant fiber, polyunsaturated fatty acids, which creates prerequisites for their use in the development of new foods that will be positioned as gluten-free.

Key words: *quinoa, beneficial properties, organoleptic quality indicators, gluten-free products.*

The problem is presented in general terms and its connection with important scientific or practical tasks. Quinoa (lat. Chenopōdium quīnoa) or Cienwa (Quechua kinwa) is a pseudo-cereal crop, an annual plant, a species of the Mar family (Chenopodium) of the Amaranthaceae family growing on the Andes slopes in South America.

Despite the short lifespan, the plant can reach a height of one and a half or even 2 meters. It has a high stem, on which are located round leaves of light green color. Most of the plant is common at high altitude, ranging from 3000 meters above sea level. It prefers difficult climatic conditions and mountain slopes, its homeland is considered to be the shore of Lake Titicaca, the largest of the high mountain lakes. For the inhabitants of this region, quinoa was one of the staple foods, no less in demand than potatoes and corn. Due to its high yield and resistance to adverse conditions, quinoa is a popular crop in the places of its growth, and due to its chemical composition and excellent taste, it was called “golden grain”. In appearance, quinoa seeds are similar to buckwheat, while they differ in a variety of shades and, depending on the variety, can be beige, red or black. [1, p. 78].

The plant has been known for a long time, in particular, it was included in the diet of the Indians of South America. Even the ancient Incas used it in everyday dishes along with potatoes or corn. Quinoa could even replace bread or rice in cases where there were poor yields. Much later, this amazing plant was artificially grown in the mountains. Including with the approval of the Dalai Lama began to cultivate it in Tibet. Also, the plant survives well on the beach or in places where jungle used to be.

The analysis of recent researches and publications, based on which the author considers this problem and approaches to its solution. More than 90% of the plant, which is grown in Peru and Bolivia, is sent to the United States of America, and everything else – mainly to European countries. It is so highly valued, also because of its purity and naturalness: it is forbidden to use genetically modified organisms during cultivation, even to help the plant fight pests or increase the yield.

Quinoa production is growing: it is currently grown in more than 70 countries around the world. The world's leading producers of quinoa are Bolivia, Peru and the USA (Table 1).

Table 1

Quinoa production in the world

Country	Year		
	2009	2011	2016
Peru	39.4	41.2	79.3
Bolivia	34.1	38.3	65.5
Ecuador	0.8	0.8	3.9

Quinoa production has long passed the continental borders: this culture is grown in Canada, France, England, Sweden, Denmark, Holland and Italy.

The uniqueness of quinoa lies in the fact that it is a seed that is eaten like cereal. It is boiled, added to soups, or ground into flour for baking bread, making drinks and cereals.

Specialists at the Harvard School of Public Health believe that if there is a boiled quinoa daily, the risk of premature death from cancer, diabetes, heart disease and the respiratory system will be reduced by 17%. NASA is interested in this culture as a food source for astronauts who have a long stay in space. Scientists are convinced that the widespread distribution of quinoa will increase the food security of mankind [2].

Despite its taste and use, in fact, quinoa is not a cereal. Vegetables are considered to be its closest relatives, in particular, beets we know. From the seeds of this amazing plant make flour, and the leaves and stems are often used instead of vegetables.

There are only 120 kcal per 100 grams of the finished dish, and it also has a low glycemic index. Therefore, nutritionists consider it an ideal dish for those who want to lose weight or maintain a healthy lifestyle. The main advantage of quinoa is that it contains a very large amount of vegetable protein, which is very easily and quickly absorbed. It is for this reason that these grains are readily used by vegetarians in almost all dishes, and it is recommended to be eaten by children, pregnant women and people with intellectual or exercise-related work.

Table 2 presents the chemical composition of quinoa grains.

The protein content of quinoa culture has the highest rates, which exceed the data on the protein of corn 4.6 times, rice – 2.1; rye – 1.8; millet and oats – 1.6. Analysis of the data makes it possible to judge the high protein content in quinoa, which allows it to compete with generally accepted high-protein herbal products, such as barley, buckwheat and amaranth (Table 3). Moreover, some varieties of quinoa contain more than 20% protein [3, p. 149].

Unlike wheat and rice containing a small amount of lysine, the amino acid composition of quinoa proteins is very balanced and close to the composition of milk proteins, the number of amino acids is up to 20 types (Table 4).

Table 2

Chemical composition of quinoa grains, g/100 g of product

Name of the indicator	Content per 100 g of product
Proteins, g	14.12
Water, g	13.28
Fat, g	6.07
Ash, g	2.38
Dietary fiber, g	7
Carbohydrates, g	57.16
Energy value, kcal	368
Vitamins, mg/100 g of product	
Vitamin A, mcg	1
Vitamin B1	0.36
Vitamin B2	0.318
Folic acid (Vitamin B9), мкг	184
Choline (B4)	70.2
Pantothenic acid (B5)	0.772
Pyridoxine (B6)	0.487
Vitamin E	2.44
Vitamin PP	1.52
Trace elements, mg/100 g of product	
Potassium	563
Calcium	47
Magnesium	197
Phosphorus	457
Iron	4.57

Table 3

Comparative analysis of the protein content in products

Culture	Protein content, %
Quinoa	16.2
Rice	7.5
Millet	10.0
Wheat	14.0
Corn	3.5
Rye	8.8
Oats	10.1
Barley	15.8

However, when assessing the biological value of the protein component of the product, the quantitative representation of essential amino acids per 100 g of protein is of importance (Table 5). When recalculating, the data of table 4 were used, in particular, the quinoa protein content equal to 16.2 [1, p. 43].

The calculation of the biological value of the protein component of quinoa revealed the presence of 2 limiting essential amino acids, the 1st limiting – leucine. However, this does not reduce the value of quinoa culture as a promising source of protein in the composition of multi-component food formulations.

Table 4

Amino Acid Composition of Quinoa Culture

Amino Acids	The amino acid content, g/100 g quinoa
Valin	0.59
Isoleucine	0.5
Leucine	0.84
Lysine	0.77
Arginine	1.09
Histidine	0.41
Methionine	0.31
Threonine	0.42
Tryptophan	0.17
Phenylalanine	0.59
Aspartic acid	1.13
Alanine	0.59
Glycine	0,69
Glutamic acid	1.87
Proline	0.77
Serine	0.57
Tyrosine	0.27
Cysteine	0.20

Table 5

Comparative analysis of the content of essential amino acids in quinoa

Essential Amino Acids	Mass fraction of essential amino acids, g/100 g protein		Amino acid fast, %
	FAO WHO, 2007	investigated	
Histidine	1.5	2.5	166.6
Isoleucine	3.0	3.1	103.3
Leucine	5.9	5.2	88.0
Lysine	4.5	4.8	106.6
Methionine + Cysteine	2.2	3.2	145.5
Phenylalanine + tyrosine	3.8	5.3	139.5
Threonine	2.3	2.6	113.0
Valin	3.9	3.6	92.0

Due to the high concentration of lysine in the product, the body can better absorb calcium, which approximately at the same time enters the body. In addition, lysine stimulates wound healing and helps bone formation. High fiber content – 2.8 g per 100 g helps in the fight against diabetes or overweight, as well as help those who have heart disease.

Fiber also helps the body get rid of harmful substances and toxins, removes harmful cholesterol from the body and stimulates digestion. In addition, it is believed that daily consumption of fiber seriously reduces the risk of developing cancer. A high percentage of phosphorus can replace many species of fish with this plant.

For the first time the healing properties of this plant were discovered by people who consumed it daily. Then it became noticeable beneficial effect of this culture on the cardiovascular system, including as an effective fight against migraine. This is due to the fact that the magnesium contained in plants, helps to relieve the tension of blood vessels.

In addition, quinoa is great for supporting health at any age: it is useful for children, as it stimulates bone formation, for older people it helps to get rid of arthritis. But for this it is important to use it regularly. In addition, regular use of this plant in food maintains a stable blood sugar level, which is very useful in diabetes. It prevents the development of cardiovascular diseases, and also supports the body in the fight against anemia.

Doctors recommend eating this plant as food for those who need support from the body, in particular, people after surgery or those who are struggling with a complex disease, such as cancer. Quinoa will be no less useful for those who give a lot of strength and energy every day in physically hard or intense intellectual work.

Quinoa is also very useful for those who have high blood pressure or other diseases of the cardiovascular system. This plant contains a large amount of a substance called tryptophan, which stimulates the production of the hormone of joy. So, this plant is really able to lift the mood. The absence of gluten in the croup allows you to add it to the diet, even for people suffering from allergies.

Quinoa is considered one of the most useful cereals in the world.

The main advantage of this plant is that it has much more nutrients, minerals and vitamins than in most other cereals. This means that it is healthier than rice, wheat, or any other cereal. Nutritionists often compare quinoa with mother's milk, since this cereal is also absorbed almost completely.

Quinoa contains saponins, substances that, when used regularly, help the pancreas work normally and also keep cholesterol levels under control. When entering through the blood, these substances are poisonous, however, they are normally absorbed in the digestive tract and even have a benefit.

Quinoa taste reminds unpolished rice, has a creamy-nutty notes, soft taste. This product is similar to the finished rice and the consistency, which makes them feel even more. Despite the exotic origin, do not be afraid of specific flavors and tastes. Quinoa is a neutral base for many dishes, which is well soaked with herbs and spices, organically dilutes meat-based sauces.

Polyunsaturated fatty acids (3.3 g per 100 g) and monounsaturated (1.6 g per 100 g) constitute the largest share of quinoa fats. Linoleic, oleic and palmitic acids have a large mass fraction.

Fatty acids in the seed composition are relatively low – 14.5%, of which 70–89% are unsaturated, including up to 50% linoleic acid, about a quarter of oleic acid and 5% alpha-linolenic acid. Consumption of unsaturated fatty acids instead of saturated reduces the risk of developing type 2 diabetes, obesity, cardiovascular and inflammatory diseases. However, to achieve this effect, it is important not only the total content of unsaturated fatty acids in the human diet, but also the correct ratio of omega-3 and omega-6 fatty acids. In omega-3 acids, one of the double bonds in the hydrocarbon chain lies between the third and fourth carbon atoms, and in the omega-6 molecule, between the sixth and seventh atoms. The optimal ratio of omega-6/omega-3 is from 5: 1 to 10: 1, in quinoa it is about six.

Useful action:

– due to the presence of lysine in the composition enhances calcium absorption and accelerates the healing of tissues.

– improves the digestive system.

– stabilizes the nervous system: mitigates the effect of stress-forming factors, strengthens sleep, removes distraction and irritability.

– due to the presence of phytic acid in the composition increases the anti-cancer functions of the immune system and reduces cholesterol.

– helps to quickly restore physical and emotional tone after operations, diseases.

– prevents the development of arthritis, arthrosis and other joint diseases.

– serves as a source of easily digestible vegetable protein, it is necessary for the growth of muscle mass, the development of a child's body and the nutritional status of pregnant women.

– reduces the risk of atherosclerosis, cardiovascular diseases and arterial hypertension.

Possible negative effect:

– a negative reaction of the body in case of intolerance of the product or its components.

– Complication of the condition with gout or urolithiasis.

– deterioration of the inflammatory or diseased digestive tract organs.

In 1996, quinoa was classified by FAO as one of the most promising cultures of mankind, not only because of its beneficial properties and many applications, but also as an alternative to solving the serious problems of human nutrition. According to foreign researchers, quinoa has a unique chemical composition. Quinoa leaves are used for medical purposes and have healing properties – as anti-inflammatory, analgesic and disinfectant. It is also used in case of fractures and internal hemorrhages, for healing wounds and as a remedy for insect bites. Quinoa is used as a green forage. Remains of the crop are suitable for feeding cattle, sheep, pigs, horses and poultry.

In the food industry, quinoa grains are used in various processing. Almost all flour confectionery, bakery and pasta can be made from flour and whole grains of quinoa. Quinoa seed embryos can be separated from the rest of the seed and used in a concentrated form in infant, sports, gerontological nutrition, nutrition of pregnant and lactating women. In order to improve the quality of diet food, quinoa is used to prepare breakfast cereals, beverages, special dishes for patients with intolerance to wheat protein (gluten).

At the Department of Grain Storage Technology of the Odessa National Academy of Food Technologies, an organoleptic assessment of the quality of samples of quinoa grains was carried out (harvest 2017). To study such significant composite consumer properties of quinoa grains as "smell", "color" and "taste", they used the profiling method, the essence of which is that the complex concept of one of the organoleptic indicators is represented as a set of simple components that are evaluated quality, intensity and order of manifestation [4; 5]. In fig. 1 shows a general profile of the appearance, color and smell of quinoa grain samples.

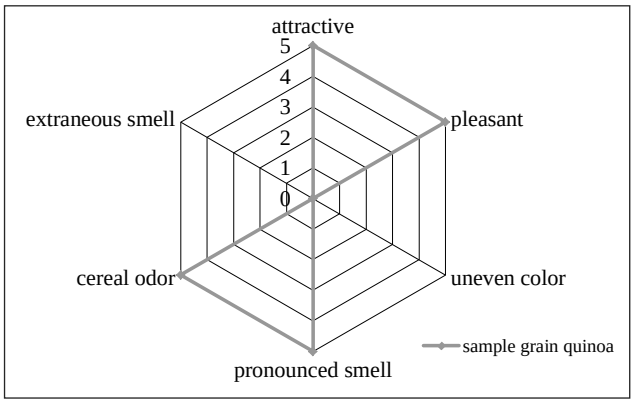

Fig. 1. General profilogram of the appearance, color and smell of quinoa grains.

As can be seen from fig. 1 The test sample of quinoa grain has an attractive appearance, a pleasant color and is characterized by a pronounced grain odor.

Conclusions from this study and further perspectives in this direction. Thus, quinoa seeds are the most important sources of high-grade proteins, plant fiber, and polyunsaturated fatty acids, which creates prerequisites for their use in the development of new foods that will be positioned as gluten-free.

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СПОЖИВНІ ВЛАСТИВОСТІ Й ОЦІНЮВАННЯ ЯКОСТІ ЗЕРЕН КІНОА

У статті подано дані хімічного складу й корисних властивостей зерен кіноа. Досліджена органолептична оцінка цієї культури, за результатами якої побудована загальна профілограма кольору, запаху та зовнішнього вигляду досліджуваного зразка зерен кіноа. Показано, що насіння кіноа є найважливішими джерелами повноцінних білків, рослинної клітковини, поліненасичених жирних кислот, що створює передумови використання їх у розробленні нових продуктів харчування, які будуть позиціонуватися як безглютенові.

Ключові слова: *кіноа, корисні властивості, органолептичні показники якості, безглютенові продукти.*

ПОТРЕБИТЕЛЬСКИЕ СВОЙСТВА И ОЦЕНКА КАЧЕСТВА ЗЕРЕН КИНОА

В статье представлены данные химического состава и полезных свойств зерен киноа. Исследована органолептическая оценка данной культуры, по результатам которой построена общая профилограмма цвета, запаха и внешнего вида исследуемого образца зерен киноа. Показано, что семена киноа являются важнейшими источниками полноценных белков, растительной клетчатки, полиненасыщенных жирных кислот, что создает предпосылки использования их в разработке новых продуктов питания, которые будут позиционироваться как безглютеновые.

Ключевые слова: *киноа, полезные свойства, органолептические показатели качества, безглютеновые продукты.*