UDC: 66.014: [631.53.02:582.929.4]-021.4

NUTRITIONAL PROPERTIES OF CHIA SEEDS AND THEIR SANITARY SAFETY

L. Valevskaya[1]**,** PhD, Associate Professor
A. Iegorova[2]**,** PhD, Associate Professor
L. Ovsiannykova[1], PhD, Associate Professor
O. Sokolovskaya[1]**,** PhD, Senior Lecturer
F. Marchenkov[3]**,** Candidate of Biological Science
A. Shulyanska[4]
[1]Department of grain processing
[2]Department of Biochemistry, Microbiology and Physiology of Nutrition
Odessa National Academy of Food Technologies
112, Kanatna Str., Odessa, Ukraine, 65039
[3]«Kronos-Agro»
[4]LLC «Ukrelevatorprom»

DOI: https://doi.org/10.15673/fst.v14i2.1716

Article history

Received 19.08.2019
Reviewed 15.10.2019
Revised 22.12.2019
Approved 02.06.2020

Correspondence:

L. Valevskaya
E-mail: ludmila_valev@ukr.net

Cite as Vancuver style citation

Valevskaya L, Iegorova A, Ovsiannykova L, Sokolovskaya O, Marchenkov F, Shulyanska A. Nutritional properties of chia seeds and their sanitary safety. Food science and technology. 2020;14(2):96-102. DOI: https://doi.org/10.15673/fst.v14i2.1716

Цитування згідно ДСТУ 8302:2015

Nutritional properties of chia seeds and their sanitary safety / Valevskaya L. et al // Food science and technology. 2020. Vol. 14, Issue 2. P. 96-102. DOI: https://doi.org/10.15673/fst.v14i2.1716

Abstract. Currently, there are more and more requirements not only to the quality of food, but also to the raw materials it is made from. This leads to the search for new, non-traditional products. One of these is chia seeds (*Salvia hispanica*). The article provides data on their useful properties. The high demand for chia seeds is due to their unique chemical composition. The main feature of the seeds of this crop is that they contain many chemical substances of high calorific and biological value, as compared with cereals and oilseeds traditionally grown in Ukraine. In chia seeds, there are 30–35% of fat, 25–41% of carbohydrates, and 20–22% of protein. Chia seeds are a valuable source of vitamin B, calcium, potassium, iron, zinc, and copper. The fatty acid composition of this crop indicates a high content of polyunsaturated fatty acids. 63.3% of them is linolenic fatty acid, which belongs to ω-3 acids and is important for the brain function, growth, and development of a living organism. That is why it is so important to find optimal ways of preparing freshly harvested chia seeds so as to extend their shelf life. These ways must take into account the biological and chemical characteristics of this crop, and make it possible to preserve its consumer properties for further targeted processing. The article presents the results of studying the quality indicators and microbiological condition of chia seeds to establish how long they can be safely stored and to assess the sanitary safety of this crop. It has been shown that within the period of 6 months, the greatest changes in the quality of chia seed oil are observed at 25°C: there is a significant increase in the acid and peroxide values and a decrease in the iodine value (the latter indicates spoilage of chia seeds). Lowering the air temperature to 5°C slows down the enzymatic processes that take place in chia seeds, and inhibits the increase of the acid and peroxide values of fat, which ensures retention of the consumer properties of seeds. It has been established that the seeds of the crop under study can be stored, without any loss of their quality, for 6 months at 5–15°C and the relative humidity 60–70%. All the beneficial properties of chia seeds are due to their unique composition, so they are supposed to be widely used for specialised and functional nutrition.

Key words: chia seeds, microbiota, consumer properties, quality indicators, storage, chemical and fatty acid composition.

Introduction. Formulation of the problem

The safety characteristics of raw materials for food production are of primary importance for consumers. Reduction or loss of other properties can just make food less functional or socially significant, but going beyond the permissible values of the safety indicators makes it dangerous. According to the Law of Ukraine 'On the Basic Principles and Requirements for Food Safety and Quality' [1-2], a product is safe if it has no harmful effect on the human body.

People are becoming more and more demanding not only of the quality of food, but also of the raw materials it is made from. This leads to the search for new, non-traditional raw materials, methods and modes of processing it so as to preserve its useful properties.

Today, chia seeds (*Salvia hispanica*) have become very popular in dietetic and healthy nutrition, being a natural source of omega-3 fatty acids, antioxidants, and dietary fibre.

Chia is used to increase the biological value and expand the range of health-improving products when manufacturing breakfast cereals, confectionery, sausages, dairy products. Besides, it is an ingredient of protein bars, beverages, and food for sportspeople. The use of chia seeds in the baking and confectionery industry allows not only increasing the nutritive value of confectionery and bakery products, improving their fatty acid composition, but also expanding the range of products. Today, on supermarket shelves, you can find mass consumption products made with addition of chia seeds. Such a high demand for chia seeds is due to its unique chemical composition [2-4].

That is why it is so important to find optimal ways of preparing freshly harvested chia seeds so as to extend their shelf life. These ways must take into account this crop's biological and chemical characteristics, the quantitative and species composition of its microbiota, and make it possible to preserve its consumer properties for further targeted processing.

Analysis of recent research and publications

The plant chia (sage, *Salvia hispanica* in Latin) is a food plant. It has a long tradition of being used as food by the Maya Indians and residents of other South American countries (Mexico, Bolivia, Ecuador), who still make food and drinks from seeds and other parts of this plant, in particular, cook its green parts and obtain oil from its seeds. In Europe, this plant has not been widely consumed so far [4].

Chia seeds are amazing for a great many beneficial elements that improve human health. They restore the function of the gastrointestinal tract, regulate the blood sugar level, improve the condition of the skin and hair, and help against depression.

Chia is an annual plant of the family Labiatae. The seeds are tiny, usually white, grey, brown, or black, with a specific relief pattern. Chia has a long shelf life and a very pleasant nutty taste [5]. Its seeds contain some oil (30–35%), with a high percentage of polyunsaturated fatty acids, including alpha-linolenic acid and linoleic acid [5,6].

An important characteristic of the chemical composition of chia seeds (Table 1) is the high content of proteins in them, 20–22%, of which nonessential amino acids make 12–15%, and essential amino acids 7–8%. According to the fat content (30–35%), chia seeds belong to oilseeds. Besides, these seeds are a source of vitamin B, calcium, potassium, zinc, iron, and copper.

Chia seeds contain by 14% more magnesium than broccoli, by 60% more calcium than milk, by 30% more iron than spinach, and by 10% more dietary fibre than wheat bran [5]. If you mix a glass of water with a spoonful of chia and leave for about 30 minutes, it will form almost hard gelatin. The reaction that promotes the conversion into gel occurs due to the presence of soluble fibre [5]. In the stomach, the gel formed creates a physical barrier between carbohydrates and digestive enzymes, dissolving them in such a way that the conversion of carbohydrates into sugar is reduced.

It is known that magnesium contained in chia seeds promotes the formation of bones and teeth, as well as helps the absorption of calcium and potassium. Because calcium stimulates muscles, magnesium is used to achieve muscle relaxation, and the main function of iron is to supply oxygen from the lungs to the muscles and other organs.

Table 1 – Chemical composition of chia seeds [6]

Parameters	Mass fraction, %:
Protein	20–22
Non-essential amino acids	12–15
essential amino acids	7–8
Fat	30–35
Carbohydrates	25–41
of them	
mono- and disaccharides	14–15
non-starch polysaccharides	26–28
insoluble in water	20–23
soluble in water	4–5

The nutritive and biological value of fats are largely determined by the fatty acid composition. Table 2 shows the fatty acid composition of chia seeds.

Table 2 – Fatty acid composition of chia seeds [7]

Fatty acid	Mass fraction, %:
Saturated fatty acids:	8.66
myristic	0.02
pentadecanoic	0.03
palmitic	5.98
margaric	0.05
stearic	2.26
behenic	0.08
tricosanoic	0.03
lignoceric	0.21
Monounsaturated fatty acids:	11.97
myristoleic	0.02
palmitoleic	0.86
oleic	11.02
gadoleic	0.07
Polyunsaturated fatty acids:	79.37
linoleic (ω-6)	16.03
linolenic (ω-3)	63.3
eicosadienoic	0.02
eicosatrienoic	0.02

A feature of the fatty acid composition of chia seeds is its high content of polyunsaturated fatty acids–about 80% of all fats, including 63.3% of linolenic fatty acid, one of ω-3 acids, which play an important role in the brain function, growth, and development of a living organism [7-8].

Thus, chia is called a perfect food and the product of the future from the past. Chia seeds have a more pronounced ability to absorb moisture. When they are steeped, their weight increases 10–12 times (whereas, for example, the weight of flax seeds only increases 3–4 times). The moisture holding capacity of chia seeds is due to the formation of a gel-like layer around each seed, which is not destroyed during storage and use [8]. Due to chia's ability to absorb several times more water compared to its own weight, it helps satisfy one's hunger and thus control obesity.

Chia seeds are a promising crop that can be used in the food industry to develop functional products. However, in the publications throughout the world, there are but very few recommendations for, and almost no practical experience of how to store and process chia seeds.

Seeds are a living organism, so they undergo a number of chemical transformations – metabolism, which ensures their viability. Metabolic processes in a living organism are two-directional: anabolic (synthesis) and catabolic (cleavage of synthesised substances). During anabolism, there is energy absorption accompanied by mainly reductive chemical processes, and during catabolism, chemical reactions are oxidative, and energy is released [9].

The composition and more developed microbiota of seeds and products of their processing are significantly affected by different storage modes [10,11]. The level of inoculation of products with microorganisms is on average tens of thousands of bacteria per 1 g [12]. The bacteria that prevail in products are *Erwinia herbicola* (their number makes up 70–90% of all bacteria), and there are 5–15% of spore-forming bacteria and cocci. The content of fungal spores ranges from fractions of 1 percent to 1–5% of the total number of microorganisms [13]. The fungal flora of seeds is represented mainly by the species *Penicillium* [14]. During long-term storage under conditions when the moisture content of the product and the temperature exclude the possibility of microbiota development, there is a gradual decrease in the total number of bacteria as a result of the death of non-spore-bearing forms [15].

Oilseeds, including chia, are high in glycerides of highly unsaturated fatty acids (linoleic and linolenic), which tend to accumulate toxic substances due to peroxidation [5]. It should be emphasised that in the lipid complex of seeds during storage, there are enzymatic processes: phospholipids and glycerides are broken down, and at the same time, free fatty acids accumulate. Under the influence of air oxygen and the enzyme lipoxygenase, they are oxidised to form peroxides, hydroperoxides, and other oxidation products. This is because the seeds of oil crops are high in fat that cannot bind and retain moisture (like protein and starch do), which leads to high moisture saturation of other substances and its uneven distribution. With the generally low moisture content, the concentration of moisture in the parts of the seeds that contain proteins and carbohydrates can be high: the higher the oil content, the higher the moisture content is [4].

Thus, to store chia seeds effectively and preserve their properties, it is necessary to provide an effective system of protection of seeds from adverse factors. This is only possible on the basis of deep knowledge of their chemical composition, of complex biological and chemical processes occurring in seeds (the intensity of these processes depends on the object's specific features and environmental conditions) [16-23].

Analysis of literature sources and patents has shown that storage of chia seeds has never been studied.

The **purpose** of this work is to study the quality and microbiological status of chia seeds to establish safe conditions and time of their storage.

The **objectives** of the study were:

– to determine the changes in the chia seed oil quality during storage, which are characterised by certain indicators or values (acid, iodine, peroxide).

– to study the qualitative and quantitative composition of the grain microbiota to assess the sanitary safety of chia seeds;

– to determine storage conditions of chia seeds without loss of their quality.

Research materials and methods

The object of the study was freshly harvested chia seeds. They were harvested in 2019 and stored at 5–25°C and the relative humidity 60–70%. The temperature and relative humidity varied depending on the season. The microbiological status and quality indicators (AV, IV, PV) of the chia seeds were studied prior to their storage, and after 1, 3, and 6 months of storage.

To determine the acid, iodine and peroxide values, the classical methods were used in accordance with DSTU (State Standard of Ukraine) EN ISO 660:2019 *Animal and vegetable fats and oils. Determination of the acid value and acidity* (EN ISO 660:2009, IDT; ISO 660:2009, IDT), DSTU EN ISO 3961:2019 *Animal and vegetable fats and oils. Determination of the iodine value* (EN ISO 3961:2018, IDT; ISO 3961:2018, IDT), and DSTU EN ISO 3960:2019 *Animal and vegetable fats and oils. Determination of the peroxide value. Iodometric (visual) endpoint determination* (EN ISO 3960: 2017, IDT; ISO 3960: 2017, IDT). The acid value of fat in the chia seeds was determined by titration of free fatty acids, and the peroxide value by titration with sodium hyposulphate solution.

To determine the quality parameters, the test samples of chia seeds were ground using a laboratory mill LZM-1.

One of the most important indicators of the quality of any food product is its microbiological characteristics.

Microbiological studies of the samples were performed before storage and every three months after the start of storage, using both modern methods of determination (the microbiological analyser BacTrac 4300 based in its operation on recording the changes in the electrical resistance of the growth medium that result from the activity of microorganisms) and classical methods. The samples were taken in sterile containers under aseptic conditions, which excluded contamination of the product with microbes from the environment. The composition of the microbiota of the chia seeds was determined by microbiological and sanitary parameters, which included the quantity of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAnM), myxomycetes (moulds and yeasts), and bacteria of the coliform group (CGB), and the following step was identifying the opportunistic pathogens *Escherichia coli* and *Staphylococcus aureus*.

The total number of bacteria was determined by inoculating wipe samples of different degrees of dilution on meat peptone agar (MPA), and moulds and yeast were quantified by inoculating them on wort agar (WA), where they were then cultivated, respectively, at 30±1°C for 24–48 hours, and at 28±1°C for 5–7 days. Spore forms of bacteria were determined in pasteurised wipe samples that were inoculated on a complex growth medium MPA and WA in the ratio 1:1.

The presence of *Escherichia coli* bacteria was established by the fermentation samples method (applied to a wipe sample from the grain inoculated onto the Kessler medium) and assessed by gas formation and turbidity of the medium [12].

The presence of the opportunistic pathogens *Staphylococci* was established by accumulating them in meat peptone broth with 6% of NaCl followed by inoculating them on milk salt agar. The microorganisms in both inoculations were cultivated for 24 hours at 37±1°C [12].

The chia seeds were also analysed for mycotoxins (aflatoxins B_1, zearalenone, deoxynivalenol) using the Veratox test system [17].

Results of the research and their discussion

At the first stage of the study, it was determined how the acid, peroxide, and iodine values of chia seeds changed during storage.

The acid, iodine, and peroxide values of chia seeds during storage and those of the original sample are given in Table 3.

During 6 months of storage, the acid value of fat in chia seeds increases. The sharpest increase (up to 2.05 mg KOH/g) occurs at the storage temperature 25°C. An increase in the acid value indicates a decrease in the quality.

When seeds are stored, the increase in their acidity is due to the activity of enzymes (phytase, phosphatase) that split phosphoric acid off organic compounds. Under the action of lipase, fat is broken down into glycerol and free fatty acids, which leads to a higher acid value of fat [18-19].

When storing chia seeds, there is a decrease in the iodine value, which indicates their spoilage. The iodine value of the initial sample is 193.42 I_2/100g. After 6 months of storage, the content of this parameter decreased to 190.36, 187.68, and 185.65 at the storage temperatures +25°C, + 15°C, and +5°C, respectively.

There are no peroxides in fresh fat, but they appear quite quickly with an ingress of air, so the peroxide value increases during storage. The highest peroxide value (5.66 mol O_2/kg) was observed when storing chia seeds for 6 months at + 25°C.

Reducing the air temperature to 5°C slows down the enzymatic processes that take place in chia seeds, and inhibits the increase of the acid and peroxide values of fat, thus preserving the consumer properties of seeds.

The results of the microbiological studies of the chia samples under different storage conditions are given in Table 4.

Table 3 – Changes in the quality characteristics of chia seeds during storage

Duration of storage, months	Acid value, mg KOH/g	Iodine value, I_2/100g	Peroxide value, mol O_2/kg
Storage temperature +5°C			
0	0.70	193.42	1.80
1	0.75	193.0	1.90
3	0.98	192.24	2.44
6	1.66	190.36	3.58
Storage temperature +15°C			
0	0.70	193.42	1.80
1	0.75	193.0	1.90
3	1.10	190.51	3.18
6	1.87	187.68	4.62
Storage temperature +25°C			
0	0.70	193.42	1.80
1	0.75	193.0	1.90
3	1.42	189.93	3.92
6	2.05	185.65	5.66

Table 4 – Group composition of the microbiota of the chia seed samples under study, CFU/g

Storage temperature	Duration of storage, months	Composition of the microbiota, CFU/g	
		QMAFAnM	Micromycetes
+5°C	0	380	40
	1	340	30
	3	270	40
	6	150	50
+15°C	0	380	40
	1	230	30
	3	190	30
	6	200	40
+25°C	0	380	40
	1	350	50
	3	290	50
	6	240	60

Studying the microbiota of the chia seeds has shown that the predominant component of the bacterial microbiota is a non-spore-bearing gram-negative bacillus *Erwinia herbicola*, a representative of the epiphytic microbiota of the seeds. *Erwinia herbicola* makes up 73–79% of the total number of bacteria, which indicates the good quality of the seeds studied.

Of the spore-forming bacteria, the bacterial groups *Bacillus subtilis Licheniformis* have been found. They constitute 8% of all bacteria, and coliform bacteria and micrococci 13–19%.

The field fungi *Cladosporium* and *Alternaria* and a small number of unidentified fungi were the micromycetes detected before storage.

The studies have shown that during storage, regardless of the temperature, the number of bacteria decreased. These data are consistent with the data available in the literature on the storage of different types of natural cereals [18-19]. The most significant decrease was observed at the storage temperature +5°C. Micromycetes practically did not develop, but there was a change in their qualitative composition. The number of field fungi of the genera *Cladosporium*, *Alternaria*, and others decreased significantly. Mould fungi of the genera *Aspergillus* and *Penicillium* permanently represented the fungal microflora. This means that the seeds comply with sanitary and hygienic standards [18].

In all test samples, the content of aflatoxins, zearalenone, and DON (deoxynivalenol) remained within the permissible limits. It should be noted that in all samples under different storage conditions (the temperature 5–25°C and the relative humidity 65–75%) *Escherichia coli*, staphylococcus, salmonella, *Proteus*, and sulphite-reducing clostridia were not detected. The micromycetes were within normal limits. This indicates that the storage conditions of the chia seeds complied with sanitary and hygienic standards [18].

The results obtained allow us to establish that during long-term storage at different temperatures, the number of bacteria decreases, mainly due to the death of the seed epiphyte *Erwinia herbicola*. These data are consistent with the data available in the literature on the storage of different types of oil crops [14,24].

Conclusion

Studies have shown it can be recommended to store chia seeds for up to 6 months at 5–15°C and the relative humidity 60–70%, since under these storage conditions, their microbiological parameters remain within normal limits. When seeds are stored at 25°C, the acid and peroxide values increase significantly, and the iodine value decreases. This indicates spoilage of chia seeds and deterioration in their consumer properties. All the beneficial properties of chia seeds are due to their unique composition, so they are supposed to be widely used in specialised and functional nutrition.

References:

1. Turchinov DV, Vilyams EA, Boyarskaya LA. Vozdeustvie pitaniya i obraza zhizni na zdorovie naseleniya. Pushevaya promushlenost. 2015;1:8-11.
2. Butenko LM, Slobodyanuk NM, Androshuk OS. Vpluv nauki pro harchuvannya na texnologiu yakisnuh ta bezpechnuh productive. Hlebopekarskoe I konditerskoe delo. 2013;5:24-25.
3. Osmanyan RG. Krupyanue productu bustrogo prigotovleniya. Pushevaya i pererabatuvaushaya promushlennost. 2007;3:874.
4. Klumova EV. Vliyanie protsesa extruzii na pishevyu tsennost produktov pitaniya. Pushevaya i pererabatuvaushaya promushlennost. 2009;3:779.
5. Valevskaya L. Comparative assessment of chemical composition and physical and technological indicators of land seed and land chia. Vcheni zapiski Tavriiskogo nationalnogo universitety. 2018;6:97-101.
6. Skurihin IM. Himicheskiy sostav pushevuh productov. Moskva: Agropromizdat; 1987.
7. Vershinina OL, Mihailov VA, Lobanova AV. Ispolzovanie arahisovoi masu pri proizvodstve hlebobulochnuh izdeliy povushennoi pishevoi tsennosti. Tehnica i tehnologiya pishevuh proizvodstv. 2009;3:23-26.
8. The Community summary report on antimicrobial resistance in zoonotic and indicator bacteria from animals and food in the European Union in 2010. The EFSA Journal. 2011;8(7):1658. https://doi.org/10.2903/j.efsa.2012.2598.
9. Kliva V. Mikrobiologicheskaya porcha pusshevuh productov. Profesiya; 2008.
10. Ilyashenko NG. Mikrobiologiya pishevuh proizvodstv. Moskva: Kolos; 2008.

11. Velichko TA. Mikroflora novuh vidov extrudirovannuh suhuh zavtrakov i ee izmenenie pri hranenii. Hraneniu i pererabotka zerna. 2009;8:42-49.
12. Smirnova TA. Kostrova EI. Mikrobiologiya zerna i productov ego pererabotki. Moskva: Agropromizdat; 1989.
13. Davidovich EA. Suhiu zernovie zavtraki dlya detei doshkolnogo i shkolnogo vozrasta. Pishevaya i pererabatuvaushaya promushlennost. 2006;4:1222.
14. Zharikova GG. Mikrobiologiya prodovolstvennuh tovarov. Sanitariya i gigiena. M: Academa; 2005.
15. Fayet-Moore F. Breakfast and Breakfast Cereal Choice and Its Impact on Nutrient and Sugar Intakes and Anthropometric Measures among a Nationally Representative Sample of Australian Children and Adolescents. Nutrients. 2017;9:1045. https://doi.org/10.3390/nu9101045.
16. Peter G. Williams The Benefits of Breakfast Cereal Consumption: A Systematic Review of the Evidence Base. Advances in Nutrition. 2014;5(5):636-673. https://doi.org/10.3945/an.114.006247.
17. Soctrade. Test system for determining mycotoxins [Internet]. OOO "SokTreyd Ko": Moskva; 2008-2020. Available from: http//www.soctrade.com/laboratornoe_oborudovanie/test-sistemy-dlya-opredeleniya-mikotoksinov.phtml.
18. Salun IP, Smirnova AN, editiors. Krupi i ih hranenie. Moskva; 1967.
19. Tutelyan V. Himicheskiu sostav i kaloriinost rosiiskih productov pitaniya. Moskva: Deli Plus; 2012.
20. Falk M. Functional foods - Safety and efficacy - The impact of regulation on informing consumers about the health promoting properties of functional foods in the USA. Journal of Food Science. 2004;5:38-40. https://doi.org/10.1111/j.1365-2621.2004.tb10726.x.
21. Sidorenko TA. Extruzionnaya tehnologiya pishevuh texturatov. Texturirovannue rastitelnue belki. Pishevaya i pererabatuvaushaya promushlennost. 2007;3:874.
22. Liu S, Lee IM, Ajam U. Intake of vegetables rich in carotenoids and risk and risk of coronary heart disease in men. Hth Physicians' Health Study. Int. J. Epidemiol. 2001;30(1):130-135. https://doi.org/10.1093/ije/30.1.130.
23. Slavnov EV, Pepelyaeva EV, Trutnev MA. Extrusionnaya pererabotka svezheubrannogo zerna estestvennou vlazhnosti. Agrarnui vesnik Urala. 2012;8:49-50.
24. Bunyak O. Change of microbiotas of maize-based extruded products with vegetable additives during storage. Food science and technology. 2018;4:79-85. https://doi.org/10.15673/fst.v12i4.1204.

СПОЖИВЧІ ВЛАСТИВОСТІ НАСІННЯ CHÍA ТА ЇХНЯ САНІТАРНА БЕЗПЕКА

Л.О. Валевська[1]**,** кандидат технічних наук, доцент, *E-mail*: ludmila_valev@ukr.net
А.В. Єгорова[2]**,** кандидат технічних наук, доцент, *E-mail*: antoninaegorova59@gmail.com
Л.К. Овсянникова[1], кандидат технічних наук, доцент, *E-mail*: ovsiannikova-ludmila@ukr.net
О.Г. Соколовська[1]**,** кандидат технічних наук, старший викладач, *E-mail*: sokolovskaya_alena@meta.ua
Ф.С. Марченков[3]**,** кандидат біологічних наук, *E-mail*: marchenkov150@gmail.com
А.О. Шулянська[4]**,** начальник ВТЛ, *E-mail*: antonina.shulyanska@adm.com
[1]Кафедра технології зберігання зерна
[2]Кафедра біохімії, мікробіології та фізіології харчування
Одеська національна академія харчових технологій, вул. Канатна, 112, м. Одеса, Україна, 65039
[3]«Кронос-Агро»
[4]ТОВ «Укрелеваторпром»

Анотація. На даний час все більше вимог висувається не тільки до якості продукції харчової промисловості, а й до сировини, з якої вона виробляється, що зумовлює пошук нових нетрадиційних видів продукції, до яких відноситься насіння Чіа (лат. Chia). У статті наведено дані про корисні властивості насіння. Високий попит на насіння Чіа пояснюється його унікальним хімічним складом. Головною особливістю насіння цієї культури є те, що до її хімічного складу входить велика кількість, енергетично і біологічно цінних речовин, у порівнянні з традиційно вирощуваними в Україні зерновими та олійними культурами. Так, в насіння Чіа міститься 30–35% жирів, 25–41% вуглеводів, кількість білка становить 20–22%. Насіння Чіа є цінним джерелом вітаміну В, кальцію, калію, заліза, цинку і міді. Жирнокислотний склад даної культури свідчить про високий вміст поліненасичених жирних кислот, з яких 63.3% складає ліноленова жирна кислота, що відноситься до кислот ω-3 і грає важливу роль у функції мозку, росту і розвитку живого організму. У зв'язку з цим стає актуальним пошук оптимальних шляхів підготовки свіжозібраного насіння Чіа до подовження терміну зберігання, які б враховували біологічні та хімічні особливості цієї культури, і дозволяли зберегти його споживчі властивості до подальшої цільової переробки. У статті наведено результати дослідження показників якості та мікробіологічного стану насіння Чіа для встановлення безпечних термінів його зберігання, а також оцінки санітарної безпеки дослідної культури. Показано, що найбільші зміни якості олії насіння Чіа протягом 6 місяців спостерігаються при температурі +25°С, при яких відбувається значне збільшення кислотного та перексидного чисел, зниження йодного числа свідчить про псування насіння Чіа. Зниження температури повітря до +5°С сповільнює ферментативні процеси, які протікають у насінні Чіа, гальмує зростання кислотного і перекисного чисел жиру, що гарантує збереження споживчих властивостей насіння. Встановлено, що насіння дослідної культури можна зберігати без погіршення його якості впродовж 6 місяців при температурі +(5–15)°С і відносній вологості 60–70%. Всі корисні властивості насіння Чіа обумовлені їх унікальним складом, тому їх планується широко використовувати для спеціалізованого і функціонального харчування.

Ключові слова: насіння Чіа, мікробіота, споживчі властивості, показники якості, зберігання, хімічний та жирнокислотний склад.

Список літератури:

1. Турчанинов Д.В., Вильмс Е.А., Боярская Л.А. Воздействие питания и образа жизни на здоровье населения // Пищевая промышленность. 2015. № 1. С.8-11.
2. Бутенко Л.М., Слободянюк Н.М., Андрощук О.С. Вплив науки про харчування на технологію якісних та безпечних продуктів // Хлебопекарское и кондитерское дело. 2013. № 5. С. 24-25.

3. Османьян Р.Г. Крупяные продукты быстрого приготовления // Пищевая и перерабатывающая промышленность. Реферативный журнал. 2007. № 3. С. 874.
4. Климова Е.В. Влияние процесса экструзии на пищевую ценность продуктов питания // Пищевая и перерабатывающая промышленность. Реферативный журнал. 2009. №3. С. 779.
5. Comparative assessment of chemical composition and physical and technological indicators of land seed and land chia / Valevskaya L. A. Et al // Вчені записки Таврійського національного університету ім. В.І. Вернадського. Серія: Технічні науки. 2018. Т. 29(68), № 6. Ч.2. С. 97-101.
6. Химический состав пищевых продуктов: Справочные таблицы содержания основных пищевых веществ и энергетической ценности пищевых продуктов / под ред. Скурихин И.М. Москва: ВО «Агропромиздат», 1987. 224 с.
7. Вершинина О.Л., Михайлов В.А., Лобанова А.В. Использование арахисовой массы при производстве хлебобулочных изделий повышенной пищевой ценности // Техника и технология пищевых производств. 2009. № 3. с. 23-26.
8. The Community summary report on antimicrobial resistance in zoonotic and indicator bacteria from animals and food in the European Union in 2010 // The EFSA Journal. 2011. № 8 (7). P.1658. https://doi.org/10.2903/j.efsa.2012.2598.
9. Микробиологическая порча пищевых продуктов / под ред. Клива де В. Блэкберна. СПб.: Профессия, 2008. 784 с.
10. Микробиология пищевых производств: учебник / Ильяшенко Н. Г. и др. Москва: КолосС. 2008. 412 с.
11. Микрофлора новых видов экструдированных сухих завтраков и ее изменение при хранении / Величко Т.А. и др. // Хранение и переработка зерна. 2009. № 8. С. 42-49.
12. Смирнова Т.А., Кострова Е.И. Микробиология зерна и продуктов его переработки: учеб. пособие для вузов. Москва: Агропромищдат, 1989. 159 с.
13. Давидович Е.А. Сухие зерновые завтраки для детей дошкольного и школьного возраста // Пищевая и перерабатывающая промышленность. Реферативный журнал. 2006. №4. С. 1222.
14. Жарикова Г.Г. Микробиология продовольственных товаров. Санитария и гигиена: Учебник. М.: Academa, 2005. 297 с.
15. Fayet-Moore F. Breakfast and Breakfast Cereal Choice and Its Impact on Nutrient and Sugar Intakes and Anthropometric Measures among a Nationally Representative Sample of Australian Children and Adolescents // Nutrients. 2017. № 9. P. 1045. https://doi.org/10.3390/nu9101045.
16. Peter G. Williams The Benefits of Breakfast Cereal Consumption: A Systematic Review of the Evidence Base // Advances in Nutrition. 2014. № 5 (5). P. 636-673.https://doi.org/10.3945/an.114.006247.
17. Test system for determining mycotoxins. веб-сайт. URL: http//www.soctrade.com/laboratornoe_oborudovanie/test-sistemy-dlya-opredeleniya-mikotoksinov.phtml (дата звернення 20.08.19).
18. Салун И. П., Смирнова А. Н., Мудрецова-Висс К. А. Крупы и их хранение. Москва. 1967.
19. Тутельян В. Химический состав и калорийность российских продуктов питания. Каталог. Москва: Дели Плюс, 2012.
20. Falk. M. Functional foods – Safety and efficacy – The impact of regulation on informing consumers about the health promoting properties of functional foods in the USA // Journal of Food Science. 2004. Vol. 69, № 5. P. 38-40. https://doi.org/10.1111/j.1365-2621.2004.tb10726.x.
21. Сидоренко Т.А. Экструзионная технология пищевых текстуратов. текстурированные растительные белки // Пищевая и перерабатывающая промышленность. Реферативный журнал. 2007. №3. С. 874.
22. Liu S., Lee I.M., Ajam U. Intake of vegetables rich in carotenoids and risk and risk of coronary heart disease in men. Hth Physicians' Health Study // Int. J. Epidemiol. 2001. V. 30(1). P. 130-135. https://doi.org/10.1093/ije/30.1.130.
23. Славнов Е. В., Пепеляева Е. В., Трутнев М. А. Экструзионная переработка свежеубранного зерна естественной влажности // Аграрный вестник Урала. 2012. № 8. С.49-50.
24. Change of microbiotas of maize-based extruded products with vegetable additives during storage / Bunyak. O. et al. // Food science and technology. 2018. Vol.12, Issue 4. P. 79-85. https://doi.org/10.15673/fst.v12i4.1204.