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RESEARCH OF CONSUMER PROPERTIES OF ORGANIC OILS

The object of the work is organic cold-pressed oils: sea buckthorn oil, amaranth oil, sesame oil. In the work, consumer properties of vegetable oils were studied: organoleptic characteristics, peroxide value, fatty acid composition. Among the organoleptic indicators, transparency, smell, color and the presence of sediment were studied. To determine the smell, the oil was applied in a thin layer on a glass plate. In order to study the color, the oil was poured into a glass with a layer of 50 mm and examined in transmitted and reflected light on a white background. Determination of transparency was carried out in the cylinder after settling at a temperature of 20 °C for 24 hours. To detect sediment in the settled oil, the number of divisions in the lower part of the cylinder occupied by oil sediment was noted. All organoleptic characteristics correspond to the limits of the norm. All samples are transparent, do not contain sediment and foreign odors. The color is inherent in each type of oil. In all samples, the peroxide number was studied. The amount of peroxides was determined by the iodometric method. In sea buckthorn oil, the peroxide number is 4.6 1/2O mmol/kg, sesame – 4.8 1/2O mmol/kg, amaranth – 4.3 1/2O mmol/kg. The indicated indicators correspond to the norm. The fatty acid composition of the oil was determined by gas chromatography on an HP 6890 gas chromatograph (Agilent, USA). The content of meristic, palmitic, stearic, oleic, linoleic and linolenic acids was studied in oils. Oleic acid (18:1ω–9) is found in the largest amount in sesame oil (29.29 %). The content of linolenic acid (18:2ω–6) is the highest in amaranth oil (49.29 %). The content of linoleic acid (18:3ω–3) is the highest in sea buckthorn oil (19.28 %). Further research is planned to be devoted to the effect of vegetable organic oils on the lipid fraction of flour products.

Keywords: *organic vegetable oils, sea buckthorn oil, sesame oil, amaranth oil, peroxide number, fatty acid composition.*

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1. Introduction

Vegetable oils are rich in important fat-soluble vitamins A and E, which have a positive effect on the condition of the skin, vision and human immunity. Experimental clinical studies have shown that vegetable oils containing linolenic acid in significant amounts have anti-atherosclerotic, anti-arrhythmic, anti-inflammatory and anti-allergic properties. Oils can be used to prevent cardiovascular diseases, including angina pectoris, thrombosis, and others, as well as in the treatment of acute and chronic inflammation [1]. That is why in recent years vegetable oils have been used in the formulations of confectionery and flour products to improve their consumer properties.

The global growth in the production of vegetable oils of all kinds has been observed during the last four marketing seasons. According to the Foreign Agricultural Service/USDA, in 2021–2022 world production of all types of vegetable oil reached 214.79 million tons, export – 90.83 million tons, import – 86.81 million tons. Palm oil is produced the most in the world – 76.54 million tons, or almost 35.6 %. The second position is occupied by soybean oil – 61.74 million tons. In third place is rapeseed oil – 27.42 million tons and in fourth place is sunflower oil – 21.80 million tons. Indonesia is the largest vegetable oil producer in the world. The second country in terms of production of vegetable oils is China – 28.97 million tons. A very significant supply of vegetable oils on the world market comes from Malaysia – 22 million tons [2]. In 2018, about 1.5 million hectares were used for growing organic oilseeds. This is 0.6 % of the total oilseed area in the world (over 230 million hectares according to FAOSTAT as of 2020). The countries with the largest organic areas of oilseeds were China, India, France, Romania, and the USA [3]. In the structure of vegetable oil production in Ukraine, sunflower oil occupies about 90 % of the total volume. In the diet of the population of countries such as the United States, Canada and the population of Europe, soybean and rapeseed oils occupy the first positions [4].

Recent studies [5] prove the beneficial effects of non-traditional oils on the body, as well as their positive effect on the biological value of finished products. Due to the inclusion of non-traditional types of oils in the formulation, an increase in the proportion of unsaturated and a decrease in the proportion of saturated fatty acids is achieved. Organic products represent a special enthusiasm for consumers in the near future. In the previous works of the author, new formulations of organic confectionery products with improved amino acid composition [6] and fatty acid composition [7] were investigated. However, the range of organic oils is quite wide, which makes it necessary to study the consumer properties of these products. These studies are relevant and can serve as a basis for the development of new types of organic flour and confectionery products with an improved fatty acid composition.

2. The object of research and its technological audit

The object of research is organic cold-pressed oils: sea buckthorn oil, amaranth oil, sesame oil.

Cold-pressed organic sea buckthorn oil Elit Phito in a glass jar with a capacity of 500 ml is shown in Fig. 1.

Fig. 1. Elit Phito organic sea buckthorn oil (Ukraine) cold pressed in a 500 ml glass jar

This oil is produced from organically grown sea buckthorn on German equipment using German technologies, meets European food safety requirements (GMP) and is constantly monitored in accredited laboratories of the State Standard and leading institutions of Ukraine and laboratories in Germany.

Also, the object of research was organic sesame oil of the first cold pressed barrel Gansedorf with a capacity of 250 ml (Fig. 2).

Information on nutritional value from the manufacturer is given in Table 1.

Fig. 2. Organic sesame oil of the first cold pressing Gansedorf (France) with a capacity of 250 ml

The third sample for the study was Elit Phito organic cold-pressed amaranth oil in a 500 ml glass jar (Fig. 3).

Amaranth seed oil is a vitamin mixture of biologically active substances containing up to 77 % fatty acids, up to 8 % squalene, up to 9 % phospholipids, up to 2 % phytosterols, vitamin E, carotenoids, etc.

Table 1

Nutritional value of Gansedorf sunflower oil

Energy value (energy)	3700 kJ/900 kcal
Fats, including:	100 g
Saturated fatty acids	17 g
Monounsaturated fatty acids	40 g
Polyunsaturated fatty acids	43 g
Carbohydrates, including:	0 g
Sugar	0 g
Proteins	0 g
Salt	0 g

Fig. 3. Elit Phito organic amaranth oil (Ukraine) cold pressed in a 500 ml glass jar

One of the most problematic places is the insufficient amount of data in the scientific literature on the consumer properties of organic oils. There are similar studies on oils made from traditionally grown raw materials. However, organic oils remain little studied.

3. The aim and objectives of research

The aim of research is to study the consumer properties of organic oils. Given this goal, the objectives of the study are:

1. To analyze the organoleptic properties of organic oils.
2. To carry out an analysis of the peroxide value of organic oils.
3. To carry out a fatty acid analysis of organic oils.

4. Research of existing solutions to the problem

Today, there are about four dozen types of vegetable oils used for food purposes. The most common and most commonly used are sunflower, olive, corn, walnut, palm, sesame, coconut, hemp and the like [8].

The fatty acid composition of the oil varies depending on the variety, origin and timing of harvesting the fruit. It has been established that sea buckthorn seed oil is enriched with linoleic (18:2ω–6) and linolenic (18:3ω–3) essential acids. Their content is 30–40 and 20–35 %, respectively. The main fatty acids in seeds are oleic (18:1ω–9, 13–30 %), palmitic (16:0, 15–20 %), stearic (18:0, 2–5 %), vaccenic (18:1ω–7, 2–4 %) acids. Sea buckthorn oil from the soft parts of the fruit has a different fatty acid composition, characterized by a high content of palmitoleic acid (16:1ω–7, 16–54 %) [9]. However, information in the scientific literature on the fatty acid composition of organic oils is rather limited. Organic sea buckthorn oils are presented on the Ukrainian market: «Elit Phito», «Taste of the Ukrainian Carpathians» (Ivano-Frankivsk region, Ukraine).

Sesame oil has better protection against high blood pressure, high blood cholesterol and lipid peroxidation [10]. Sesame seeds contain up to 60 % oil, which in equal proportions contains monounsaturated oleic (35–48 %) and polyunsaturated linoleic (37–48 %) fatty acids. Also, this oil contains 10 % saturated fatty acids – stearic and palmitic [11].

The oil content in light amaranth seeds is 7.53–9.71 %, and in dark ones it is 5.81–6.81 % [12]. Amaranth oil is used in the formulations of many products. More often, oil obtained by cold pressing or extraction from light-colored amaranth seeds is used. Amaranth oil contains up to 50 % polyunsaturated fatty acids, 120–150 mg/100 g of tocopherols, 5–7 % squalene, 3 % phytosterol, and 8 % phospholipids [13].

To summarize, the nutritional value and biological properties of vegetable oils are not limited to fatty acid composition only [14]. Of great importance is the content of related substances in the oil, among which a special role belongs to antioxidants – tocopherols, carotenoids and phytosterols [15]. Antioxidants slow down the spoilage of fatty raw materials, so they can positively affect the shelf life of flour products. In this regard, promising sources of non-traditional raw materials are flax seeds, red seeds, hemp, walnuts, wheat germ, and amaranth [16]. It has been established that due to the inclusion of non-traditional types of oils in the formulation, there is an increase in the proportion of unsaturated and a decrease in the particle of saturated fatty acids in the liver, and the processes of primary oxidation slow down [17]. It has been proven that non-traditional oils are superior to margarine, which is a traditional raw material for the confectionery industry, in terms of the content of polyunsaturated fatty acids [18].

In modern scientific literature, a sufficient number of studies are devoted to the study of consumer properties of vegetable oils and their prospects for use in the confectionery and flour industries. However, a limited number of works are devoted to the study of organic oils, which leads to the scientific novelty of this study.

5. Methods of research

Among the organoleptic indicators in vegetable oils, odor, color, transparency and the presence of sediment were determined. In order to determine the smell, the oil is applied in a thin layer on a glass plate or rubbed on the back of the hand. To determine the color, it is poured into a glass with a layer of at least 50 mm and examined in transmitted and reflected light on a white background. The study establishes the color and shade of vegetable oil. Determination of transparency is carried out in 100 cm^3 of oil. The oil is poured into the cylinder and settled at 20 °C for 24 hours. The distilled oil is viewed in reflected light against a white background. Oil is considered clear if it does not have turbidity or flakes. To detect sediment take 100 cm^3 of oil. After mixing, the oil is poured into a graduated cylinder. The oil is settled for 24 hours at a temperature of +15–20 °C. After settling in vegetable oil, the number of divisions is noted in the lower part of the cylinder, where there is sediment [19]. The amount of peroxides was determined by the iodometric method. The fatty acid composition of the oil was determined by gas chromatography on an HP 6890 gas chromatograph (Agilent, USA) (Fig. 4). An HP-5ms capillary column (30 m×0.25 mm×0.25 μm, Agilent Technologies, USA) was used.

Fig. 4. Gas chromatograph HP 6890 (Agilent, USA)

The evaporator temperature is 250 °C, the interface temperature is 280 °C. The separation was carried out in the temperature programming mode: the initial temperature of 60 °C was maintained for 4 min, raised to 250 °C with a gradient of 4 °C/min, held for 6 min, raised to 300 °C with a gradient of 20 °C, held for 5 min [20].

6. Research results

Analysis of the organoleptic characteristics of organic oils is given in Table 2.

From the data in Table 2, it is possible to conclude that all organoleptic indicators correspond to the limits of the norm. All samples are transparent, do not contain sediment and foreign smells. The color is inherent in each type of oil.

Table 2

The results of organoleptic studies of organic oil samples

Sample name	Indicators			
	Transparency	Color	Smell	Sediment
Elit Phito organic sea buckthorn oil cold pressed	Transparent	Yellow with an orange tint	Corresponds to the norm, does not contain foreign smells	Without sediment
Gansedorf organic sesame oil first cold pressed barrel	Transparent	Dark yellow	Corresponds to the norm, does not contain foreign smells	Without sediment
Elit Phito amaranth oil organic cold pressed	Transparent	Light brown	Corresponds to the norm, does not contain foreign smells	Without sediment

An important indicator for assessing the quality of fats and vegetable oils is the determination of the peroxide number. This indicator characterizes the degree of oxidation of fats in the process of their interaction with the reactive form of oxygen. The degree of oxidation of oils, as well as the quality of oils in general, depends on many factors, in particular: temperature, humidity, oxygen access, and shelf life, the presence of substances that promote or, conversely, prevent oxidation [21]. The study of the peroxide number of oils is presented in Table 3.

Table 3

The results of the study of the peroxide value of organic oil (1/2O mmol/kg)

Sample name	Peroxide number (1/2O mmol/kg)
Elit Phito organic sea buckthorn oil cold pressed	4.6
Gansedorf organic sesame oil first cold pressed barrel	4.8
Elit Phito amaranth oil organic cold pressed	4.3

Fats always contain a certain amount of hydroperoxides (being already in the composition of oilseeds), which are susceptible to decomposition into secondary oxidation products, including at the stage of extracting oil from seeds [22, 23]. According to DSTU 4570:2006, the maximum allowable indicator of the peroxide number of vegetable oils is 10 1/2O mmol/kg. According to the data in Table 2, all oils meet the norms.

One of the most important indicators of the nutritional value of vegetable oils is the fatty acid composition. Fatty acids should be supplied to the human body daily in an amount of 65 to 150 g per day, depending on age and gender. Of this amount, 30 % should be vegetable fats. Table 4 shows the results of a study of the fatty acid composition of oils.

Table 4

Fatty acid composition of organic oils

Name of the fatty acid	Elit Phito organic sea buckthorn oil cold pressed	Gansedorf organic sesame oil first cold pressed barrel	Elit Phito amaranth oil organic cold pressed
	Mass part, %		
Myristic (14:0)	16.05	0.4	0.21
Palmitic (16:0)	3.57	6.3	24.93
Stearic (18:0)	0.37	1.1	3.44
Oleic (18:1ω–9)	29.48	49.29	22.8
Linoleic (18:2ω–6)	31.7	39.6	47.9
Linolenic (18:3ω–3)	19.28	0.31	0.69

As can be seen from Table 4, the content of meristic, palmitic, stearic, oleic, linoleic and linolenic acids was studied in oils. Oleic acid (18:1ω–9) is found in the largest amount in sesame oil (29.29 %). The content of linolenic acid (18:2ω–6) is the highest in amaranth oil (49.29 %). The content of linoleic acid (18:3ω–3) is the highest in sea buckthorn oil (19.28 %). Further research is planned to be devoted to the effect of vegetable organic oils on the lipid fraction of flour products.

7. SWOT analysis of research results

Strengths. The study of organic oils showed that they meet the requirements of regulatory documentation for organoleptic indicators and peroxide number. According to the content of oleic acid, sesame oil is preferable. The content of linoleic acid is the highest in amaranth oil, and linolenic acid is highest in sea buckthorn oil. Sea buckthorn oil is also rich in myristic acid, the content of which is 16.05 %. The content of stearic acid is the highest in amaranth oil (3.44 %). The data obtained correlate with preliminary studies of the fatty acid composition of inorganic oils.

Weaknesses. The weakness of the study is that these figures have not been tested and are comparable to conventional oils. Another weakness is that samples from individual manufacturers are tested, rather than a wide range of organic oils.

Opportunities. Prospects for further research on the development of new formulations of organic flour products with an enriched fatty acid composition.

Threats. The market for organic products is still limited due to the high cost of raw materials. Another threat to the organic market is the threat of a global food crisis associated with the war in Ukraine.

8. Conclusions

1. It has been established that, according to organoleptic indicators, organic oils correspond to the limits of the norm. All samples are transparent; do not contain sediment and foreign odors. The color is inherent in each type of oil.

2. A study of the peroxide value showed that sea buckthorn oil has a peroxide value of 4.6 1/2O mmol/kg, sesame oil – 4.8 1/2O mmol/kg, amaranth oil – 4.3 1/2O mmol/kg. The indicated indicators correspond to the norm.

3. The content of meristic, palmitic, stearic, oleic, linoleic and linolenic acids was studied in oils. Oleic acid (18:1ω–9) is found in the largest amount in sesame oil (29.29 %). The content of linolenic acid (18:2ω–6) is the highest in amaranth oil (49.29 %). The content of linoleic acid (18:3ω–3) is the highest in sea buckthorn oil (19.28 %). The content of stearic acid is the highest in amaranth oil (3.44 %), and myristic acid in sea buckthorn oil (16.05 %).

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