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TECHNOLOGY FOR PRODUCING SALAD OIL BASED ON COMPOSITE OILS BY COLD PRESSING

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Abstract. The article presents research results on the development of technology for producing salad oil based on sunflower and pumpkin seed oils using the cold pressing method. The studied oils were obtained from locally grown sunflower and pumpkin seeds cultivated in the Republic of Uzbekistan. Physicochemical and organoleptic characteristics of the original oils and their blends at ratios of 95:5, 90:10, 85:15, 80:20, and 70:30 were determined. Experimental data indicate that the addition of pumpkin seed oil to sunflower oil increases the content of tocopherols, polyunsaturated fatty acids and the antioxidant activity of the product. The organoleptic properties of the blend were found to be optimal at a ratio of 80:20–85:15. The developed formulation can be recommended for industrial application in the production of functional salad oils.

Keywords: cold pressing, sunflower oil, pumpkin seed oil, salad oil, tocopherols, polyunsaturated fatty acids, physicochemical parameters, functional products, antioxidant activity.

Аннотация. В статье представлены результаты исследований по разработке технологии производства салатного масла на основе подсолнечного и тыквенного масел методом холодного прессования. Исследуемые масла были получены из местных семян подсолнечника и тыквы, выращенных в Республике Узбекистан. Были определены физико-химические и органолептические характеристики исходных масел и их смесей в соотношениях 95:5, 90:10, 85:15, 80:20 и 70:30. Экспериментальные данные показывают, что добавление тыквенного масла к подсолнечному маслу увеличивает содержание токоферолов, полиненасыщенных жирных кислот и антиоксидантную активность продукта. Органолептические свойства смеси оказались оптимальными при соотношении 80:20–85:15. Разработанная рецептура может быть рекомендована для промышленного применения в производстве функциональных салатных масел.

Ключевые слова: холодный отжим, подсолнечное масло, масло тыквенных семечек, салатное масло, токоферолы, полиненасыщенные жирные

кислоты, физико-химические параметры, функциональные продукты, антиоксидантная активность.

Annotatsiya. Maqolada sovuq presslash usuli yordamida kungaboqar va qovoq moylari asosida salatbop moy ishlab chiqarish texnologiyasini ishlab chiqish bo‘yicha tadqiqot natijalari keltirilgan. Tadqiq etilgan moylar O‘zbekiston Respublikasida yetishtirilgan mahalliy kungaboqar va qovoq urug‘laridan olingan. Dastlabki moylar hamda ularning 95:5, 90:10, 85:15, 80:20 va 70:30 nisbatdagi aralashmalarining fizik-kimyoviy va organoleptik ko‘rsatkichlari aniqlandi. Tajriba natijalari shuni ko‘rsatdiki, qovoq moyining kungaboqar moyiga qo‘shilishi mahsulot tarkibidagi tokoferollar, ko‘p to‘yinmagan yog‘ kislotalari miqdori va antioksidant faolligini oshiradi. Aralashmaning organoleptik xossalari 80:20–85:15 nisbatlarda eng maqbul deb topildi. Ishlab chiqilgan retseptura funksional salatbop moylar ishlab chiqarishda sanoat miqyosida qo‘llash uchun tavsiya etilishi mumkin.

Kalit so‘zlar: sovuq presslash, kungaboqar moyi, qovoq urug‘i moyi, salatbop moy, tokoferollar, ko‘p to‘yinmagan yog‘ kislotalari, fizik-kimyoviy ko‘rsatkichlar, funksional mahsulotlar, antioksidant faollik.

INTRODUCTION.

Nutritional quality and the importance of dietary supplements are key aspects of a healthy lifestyle today. Enriching foods with natural biologically active substances enhances their functional properties [1]. Vegetable oils obtained by cold pressing occupy a special place among functional foods, as they retain the maximum amount of biologically valuable components - vitamins, tocopherols, phospholipids and polyunsaturated fatty acids.

Salad oils are widely used in the food industry, and adding biologically active vegetable oils to them enhances their beneficial effects [2]. Sunflower oil is one of the most common types of vegetable oils used in the food industry due to its light and neutral flavor. It contains significant amounts of mono- and polyunsaturated fatty acids and also provides the body with vitamin E, which has antioxidant properties [3].

At the same time, pumpkin seed oil is characterized by high biological activity and is rich in vitamins A and E, zinc, and other microelements [4]. The antioxidant properties of pumpkin seed oil and its role in strengthening the immune system have been confirmed in a number of scientific studies [5]. From this perspective, enriching sunflower oil with pumpkin seed oil can enhance the biologically active properties of salad oil [6]. The average lipid concentration in pumpkin seeds is 35-45%, and its fatty acids include oleic (23.9%) and linoleic (53.3%) acids [9].

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Pumpkin seed oil is an excellent source of antioxidants such as polyphenols, tocopherols, carotenoids, and PUFAs, which prevent disease and promote health [5]. Numerous clinical studies have shown a link between pumpkin seed oil consumption and reduced total cholesterol levels, which is explained by its high phytosterol content [10]. Research also shows that pumpkin seed oil tocopherols protect the body from DNA damage, high blood pressure, and diabetes [11, 12].

Given these characteristics, the inclusion of pumpkin seed oil in salad oil formulations is beneficial both for improving nutritional value and for enriching it with biologically active compounds. This work continues and expands on the authors' previous research in the development of functional vegetable oils [12, 17, 18].

The aim of the study is to develop a technology for producing salad oil based on sunflower and pumpkin seed oils using cold pressing and to evaluate its quality based on organoleptic, physicochemical and biological parameters.

Research subjects. Oils obtained from local sunflower and pumpkin seed varieties grown in the Republic of Uzbekistan were selected as the subjects for enriching salad oil. The seeds were pre-cleaned to remove mechanical impurities and tested for spoilage.

RESEARCH METHODS. Analysis of the organoleptic and physicochemical properties of raw materials and finished products was conducted in accordance with GOST 18848-2019 and GOST 18848-2019. Modern instruments that had passed state verification were used to study the raw materials and finished products [16, 17, 18, 19]. Physicochemical properties were determined according to the methods specified in GOST and OzDSt.

The acid value was determined according to GOST 5473-2014 [10], and the peroxide value was determined using AOAC Official Method 965.33 [11]. Organoleptic evaluation was carried out by tasting on a five-point scale with the participation of a trained tasting committee. The tocopherol content was determined spectrophotometrically. The fatty acid composition was determined by gas chromatography in accordance with UzDSt 3220:2017 [20].

Sunflower and pumpkin oils were obtained in the educational and scientific laboratory of the Food Technology Department of Namangan State Technical University by cold pressing of seeds using an NF-100 press (Fig. 1).

The cold pressing process included the following steps: manually cleaning the seeds from their shells, weighing and loading the cleaned kernels into the press's distribution hopper, and then feeding them to the auger shaft. The auger speed was 30-35 rpm, and the operating temperature was 50-60°C. The pressed material was divided into two augers: the first extracted the oil, and the second

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extracted the cake. Upon completion of pressing, the resulting oil was filtered, packaged, and stored in a dark place for further analysis.



Figure 1. NF-100 Press

1 - Auger On/Off Button, 2 - Auger Off Button, 3 - Screen Displaying Auger Temperature and Speed, 4 - Auger Speed Adjustment Button, 5 - Electric Motor, 6 - Gearbox, 7 - Raw Material Hopper, 8 - Raw Material Distribution Auger, 9 - Cake Outlet, 10 - Thermometer, 11 - Oil Outlet, 12 - Device Support

Cold pressing is a low-temperature pressing method. During cold pressing, the oil temperature and acidity remain low. Oil obtained by this method generally does not require refining; after settling and filtration, the finished oil is obtained, preserving the maximum amount of biologically valuable components.

Results and discussion. In the first stage of the study, the physicochemical properties of sunflower and pumpkin seed oils obtained by cold pressing were determined. The results are presented in Table 1.

Table 1

Physicochemical properties of oils included in the salad oil recipe

№	Oil name	Iodine number, g I_2/100g	Acid value, mg KOH/g	Moisture and volatile substances, %	Colour value, mg iodine
1	Sunflower oil	126,1-127,3	0,20-0,21	0,20-0,22	5-7
2	Pumpkin oil	104,2-106,4	0,4-0,6	0,18-0,20	20-24

Table 1 shows that sunflower oil has a higher iodine value (126.1-127.3% I2) than pumpkin seed oil (104.2-106.4% I2), indicating a higher degree of

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unsaturation of its fatty acids. The acid value of pumpkin seed oil (0.4-0.6 mg KOH) is slightly higher than that of sunflower seed oil (0.20-0.21 mg KOH), which is explained by its higher biological activity and the presence of free fatty acids in pumpkin seed oil. Both values are within acceptable limits according to current standards.

The color of pumpkin seed oil (20-24 mg iodine) is significantly higher than that of sunflower seed oil (5-7 mg iodine), due to the high content of carotenoids and chlorophylls in pumpkin seed oil. The moisture and volatile content of both oils is negligible and meets regulatory requirements.

A series of salad oils for experimental studies were prepared using the obtained sunflower and pumpkin seed oil samples by thorough mixing. The ratios of sunflower and pumpkin seed oils in the samples were: 95:5, 90:10, 85:15, 80:20, and 70:30. This concentration range was chosen to evaluate the optimal pumpkin seed oil content, ensuring increased biological value while maintaining acceptable organoleptic properties. The results of the organoleptic evaluation are presented in Table 2.

The results of the organoleptic evaluation showed that adding pumpkin seed oil at levels ranging from 5% to 30% gradually alters the color, flavor, and aroma of the salad oil. When adding 5% pumpkin seed oil (a 95:5 ratio), the organoleptic characteristics of the mixture are virtually indistinguishable from those of pure sunflower oil-it retains its light yellow color and mild, neutral aroma.

As the proportion of pumpkin seed oil increases, a characteristic color change occurs: from yellow (90:10) to golden yellow (85:15), golden amber (80:20), and dark golden (70:30). The most harmonious organoleptic properties are noted with the addition of 15-20% pumpkin seed oil, at which point the product acquires a golden amber hue, a moderate characteristic aroma, and a balanced nutty flavor. At 30% pumpkin seed oil, the intensity of the specific odor becomes dominant, which may limit consumer acceptance.

Table 2

Organoleptic properties of salad oil obtained from sunflower and pumpkin seed oils

Ratio of sunflower and pumpkin oils, %	Colour	Smell	Flavour
95:5	Light yellow, homogeneous	Characteristic of sunflower oil, with a slight nutty shade	Mild, neutral

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Ratio of sunflower and pumpkin oils, %	Colour	Smell	Flavour
90:10	Yellow, slightly rich	Light pumpkin aroma	Light nutty flavour
85:15	Golden-yellow	Pronounced nutty-pumpkin aroma	Moderately pronounced flavour
80:20	Golden-amber	Moderately intense pumpkin aroma	Harmonious, balanced flavour
70:30	Dark golden	Intensive pumpkin smell	Strongly pronounced flavour

The physicochemical parameters of all the studied blend samples are given in Table 3.

Table 3

Physicochemical properties of salad oil obtained from sunflower and pumpkin seed oils

Ratio of sunflower to pumpkin oil, %	Acid number, mg KOH/g	Peroxide value (mmol O_2/kg)	Density at 20°C, g/cm³	Tocopherols (mg/kg)	Colour (Lovibond Y, units)	PUFA (total), % of total fatty acid
95:5	0,12	1,5	0,915	600	2,0	65,0
90:10	0,14	1,8	0,917	620	2,5	63,0
85:15	0,16	2,2	0,919	640	4,0	60,0
80:20	0,18	2,6	0,921	670	5,0	57,0
70:30	0,22	3,5	0,924	720	7,0	52,0

An analysis of the physicochemical parameters revealed a consistent increase in the acid and peroxide values, which increased with the proportion of pumpkin seed oil. The acid value increased from 0.12 mg KOH/g at a ratio of 95:5 to 0.22 mg KOH/g at a ratio of 70:30, reflecting the higher unsaturation of pumpkin seed oil. The peroxide value ranged from 1.5-3.5 mmol O_2/kg, with all values remaining within acceptable regulatory limits.

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At the same time, an increase in the concentration of tocopherols-natural antioxidants-was observed, as was an increase in the color and density of the mixture. The tocopherol content increased from 600 mg/kg (95:5) to 720 mg/kg (70:30), indicating a significant enrichment of the product with biologically active substances. This fact has important practical significance, as tocopherols act as natural antioxidants and contribute to an increased shelf life of the oil.

The polyunsaturated fatty acid (PUFA) content varied depending on the oil ratio: from 65.0% (95:5) to 52.0% (70:30), confirming the possibility of targeted regulation of the product's fatty acid composition. The decrease in the PUFA content with increasing pumpkin seed oil content is explained by the different fatty acid profile of pumpkin seed oil compared to sunflower seed oil.

The density of the mixtures increases from 0.915 g/cm³ (95:5) to 0.924 g/cm³ (70:30), which corresponds to the higher density of pumpkin seed oil. All tested samples meet the requirements of current quality standards for vegetable oils based on a combination of parameters.

Based on a comprehensive analysis of organoleptic and physicochemical properties, it was determined that the optimal ratio of sunflower and pumpkin seed oils is in the range of 80:20-85:15. At these ratios, the mixture has an increased content of biologically active substances (tocopherols up to 640-670 mg/kg), improved organoleptic properties (golden-amber color, harmonious aroma, balanced flavor), and meets food standards.

The choice of this ratio ensures a reasonable compromise between the product's biological value and its consumer properties. At these ratios, the acid and peroxide values remain within the specified limits, guaranteeing the product's safety and stability during storage.

CONCLUSION. The conducted studies confirmed that adding pumpkin seed oil to sunflower salad oil is an effective way to enhance its biological value and functional properties. Oils obtained by cold pressing from local sunflower and pumpkin seed varieties of the Republic of Uzbekistan demonstrated high quality characteristics across all studied parameters.

The optimal component ratio has been found to be in the range of 80:20-85:15, resulting in a mixture with increased levels of biologically active substances, improved organoleptic properties, and compliance with food standards. At this ratio, the tocopherol content reaches 640-670 mg/kg, significantly exceeding that of pure sunflower oil.

The cold-pressing method has proven effective in producing blended oils, ensuring minimal thermal impact on the biologically active components. The results obtained can be used in developing formulas for functional vegetable oils

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and are recommended for further research and industrial application in the production of functional salad oils.

Further research should be directed towards studying the stability of the developed blend under various storage conditions, determining the product's shelf life, and assessing its bioavailability in vivo.

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