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Mixture of Vegetable Oils with Balanced Fatty Acid Composition

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Abstract

Context: The study considered the issue of creating a mixture of oils with a balanced fatty-acid composition, namely the required ratio of ω-6 and ω-3 acids. To create a mixture of oils with a balanced fatty acid composition, an analysis of various vegetable oils was carried out to study the possibility of their use in providing the human body with polyunsaturated fatty acids by using a mixture with a balanced fatty acid composition.

Sunflower predominates in the Kazakh oilseeds market and in recent years flax has taken more and more stable positions and safflower is successfully cultivated in the southern regions. Safflower oil has a significant content of linoleic acid (over 78%), which is essential and is necessary to ensure the integrity of plasma membranes, growth and reproduction processes, skin and other organs.

The aim of the study is to obtain a mixture of vegetable oils with a balanced fatty acid composition.

As components of a mixture of vegetable oils with a balanced fatty acid composition, it is recommended to use sunflower, linseed and safflower oil, which are successfully produced in Kazakhstan.

The objects of research were sunflower, safflower, linseed oil and their mixtures in a ratio of 70:05:25; 75:05:20; 70:15:15. In vegetable oils and their mixtures, organoleptic parameters, fatty acid composition were determined on the CHROMOS GH-1000 gas chromatograph (Russia) with a flame ionization detector.

Results and conclusions: Studies of the fatty acid composition of the mixtures have found that the use of vegetable oils (sunflower, safflower, linseed) in an amount of 70:05:25 and 75:05:20 allows to obtain a product with an acid ratio of ω-6: ω-3 ≤ 5:1, which is more desirable to reduce the risk of many chronic diseases.

Keywords: Vegetable oil; Mixture of oils; Fatty acid composition

Introduction

Vegetable oils and other fat products used for direct consumption and for food production are generally do not have an optimal fatty acid composition, which according to modern ideas is determined not only by the content of polyunsaturated fatty acids, but also the ratio in it of acids of the omega-6 family and omega-3, primarily linoleic and linolenic, which are functional ingredients of fat products of the healthy nutrition group [1-5].

Among polyunsaturated fatty acids of plant origin, linoleic and linolenic acids are essential [6]. They are not produced in the human body and their absence causes negative health consequences.

The balance between omega-6 and omega-3 fatty acids is an important determinant of brain development and reduced risk of coronary heart disease, hypertension, cancer, diabetes, arthritis and other autoimmune and possibly neurodegenerative diseases [7]. Therefore, it is relevant to obtain fat products with a given composition and properties that meet the requirements of a healthy diet [8]. The aim of the study is to obtain a mixture of vegetable oils with a balanced fatty acid composition. One of

the oils with a high content of polyunsaturated fatty acids and a "record holder" in the number of tocopherols is wheat germ oil, which is included in a number of blends [9]. Due to the high cost, the content of this oil in the blends usually does not exceed 1-5% [10].

There are developments of a number of emulsion fat products that contain pumpkin oil in the blend (source of polyunsaturated fatty acids [11]) and thistle oil (sources of polyunsaturated fatty acids [12-14], as well as fat products that include wheat, barley, sea buckthorn, seedling, nut, apricot oils, forest nut oil and however, such rare for the oil and fat industry and produced in small volumes these types of vegetable oils have a low probability of widespread use for the production of mass consumption products, they can be considered only as biologically active food additives.

Similar developments exist in the Republic of Belarus. Specialists of the Scientific and Practical Center of the National Academy of Sciences of Belarus for Food created a formula of oil "Golden" on the basis of rapeseed and sunflower oil in a ratio 70:30, oil "Lianok" consists of a mixture of sunflower and linseed oil in a ratio 90:10, oil "Belarus" includes sunflower, rapeseed and linseed oils in a ratio of 68:30:2, respectively. Studies of the fatty acid composition of blended oils showed that in the "Golden" the ratio of fatty acids of ω -6: ω -3 - 5:1, "Belarus" - 11:1, "Lyanok" - 8.5: 1 [15].

In Ukraine, the company "Delfa" created a series of functional salad oils "Bogatyrskoye" "Healing," "Pickant." The compositions include such vegetable oils as linseed, red, sunflower, mustard, corn, grape, sesame, pumpkin, watermelon [16].

Given that soybean oil can cause allergies, research has not used it in studies and preference has been given to the most affordable types of oil produced at domestic oil processing plants. The Kazakh oilseeds market, as noted earlier, is dominated by sunflower. In the last year takes positions flax more and more steadily and in the southern regions safflower is successfully cultivated [8]. The richest vegetable source of ω-3 fatty acids is linseed oil [9].

In linseed oil, there is no polyunsaturated fatty acids ω-3 with a longer carbon chain, characteristic of fish fat, but -linolenic acid is present in large quantities. It serves as a starting point for the metabolism of ω-3 fatty acids, during which more unsaturated and longer chain fatty acids are formed by desaturation (introduction of a double bond) and elongation (extension of the chain). In the human body, the efficiency of converting-linolenic acid to eicosapentaenoic acid, and then to docosahexaenoic acid is small: 2-15 and 2-5%. However, experimental clinical studies have demonstrated that linseed oil, like fish oil, has antiatherosclerotic, antiarrhythmic, antithrombotic, anti-inflammatory and antiallergic properties and can be used to prevent cardiovascular diseases, including atherosclerosis, angina, arrhythmia, thrombosis, etc., as well as in the therapy of acute and chronic inflammation [5].

Among the new plant-based nutritional resources used by mankind, safflower takes a special place, due to its high productivity and promising production in agriculture and due to the unique chemical composition of seeds, it begins to play a large role in its use for food purposes and the extraction of biologically active components.

Interest in safflower from an agro-technical point of view is mainly due to the predicted aridization of the climate and the possibility of diversification of oilseeds in order to reduce the share of sunflower in field crop rotation. At the same time, in foreign pharmacopoeias (US pharmacopoeia, British Herbal Pharmacopoeia, Chinese Pharmacopoeia) there are articles on the use of safflower oil.

Safflower oil is rich in unsaturated fatty acids; the oil impregnates the skin faster and is absorbed almost instantly. It has softening and moistening effects. Provides barrier (protective) skin function. These properties have contributed to widespread use in various creams and ointments for the skin.

Safflower oil stimulates the release of gastric juice, pancreatic enzymes characterized by bile, anti-sclerotic action, removes sand from the gallbladder, relieves gut spasm and meteorism and normalizes blood glucose, hormonal balance in mastopathy, provides analgesic action, is an expectorant and sweating agent. Peculiarity of this oil is significant content of linoleic acid (more than 78%), which belongs to essential and is necessary for ensuring integrity of plasma membranes, processes of growth and reproduction, functioning of skin and other organs.

Methods and Materials

The materials for the study were vegetable oils of Kazakhstan origin: sunflower, safflower and linseed oil and their mixtures.

Organoleptic indicators: taste was determined by tasting oil at room temperature. To determine the odor, several drops of oil were applied in a thin layer to a glass plate at a temperature of 20°C. The color and transparency of the oils was determined visually against the background of a sheet of white paper (**Table 1**).

Indicator name	Safflower oil content in the mixture,%		
	5	10	15
Transparency	transparent	transparent	transparent
Smell	flavourless	flavourless	flavourless
Taste	no taste	no taste	no taste

Table 1: Effect of safflower oil mass fraction on organoleptic indices of mixture with sunflower oil.

Sample preparation and determination of fatty acid composition by gas chromatography of mass fraction of methyl esters of individual fatty acids to their sum, "based on conversion of fatty acid triglycerides to their methyl esters and gas-chromatographic analysis of the latter. Methyl ethers have a lower boiling point than the parent acids, which greatly facilitates chromatography.

Equipment: gas chromatograph "CHROMOS GH-1000" (Russia) with flame ionization detector, equipped with a software package for controlling the gas chromatograph "CHROMOS"; capillary column "DB-23" (Agilent Technologies: Inc, USA) 60 m long, 0.32 mm inner diameter with 50% -cyanopropyl-50% supported

phase methyl polysiloxane (0.25 mcm fixed phase film thickness). The following standard samples were used to calibrate the chromatographic system and control the quality of the studies carried out: the composition of the mixture of 37 fatty acid methyl esters (F. A.M.E.) Supelco (Supelco TM 37 Component FAME Mix, Catalog № 47885-U).

Reagents: methanol, 99.5%, Panreac; hexane, 99.5%, Panreac; heptane, 99.5%, Panreac; sodium methoxide, Sigma.

Sample preparation of vegetable oil: 2-3 drops of the analysed vegetable oil sample were dissolved in 1 ml of hexane. 50 mcl of a solution of 2 M sodium methoxide in methanol was added to the dissolved sample, and the prepared sample was stirred for 1 minute.

Chromatography was carried out on a capillary column DB-23 at an evaporator temperature of 200 ° C, a detector temperature of 240 ° C. Carrier gas (mobile phase)-nitrogen, flow rate 80 ml/min. 1 mcl of a sample without flow division was introduced into the chromatograph.

Calibration was performed using a standard sample of a mixture of 37 fatty acid methyl esters. To calculate the eluting time confidence interval, the standard mixture was chromatographed in three repeats (N=3). All precautions were taken to prevent contamination of the sample.

Results and Discussion

In assessing the quality of a mixture of vegetable oils, it is important to change organoleptic values depending on the percentage of components. On the recommendation of some authors [2], linseed oil should be consumed only in cold form, without subjecting it to heat treatment. Thus, the linseed oil was used to prepare the mixture by cold squeezing.

Since safflower oil has a specific odor, which can negatively affect the organoleptic characteristics of the obtained mixtures of vegetable oils, a series of experiments have been presented to determine its mass fraction in mixtures of vegetable oils. The organoleptic properties of the safflower oil mixture are shown in **Table 1**.

It was found that the use of safflower oil in an amount of up to 15 percent does not affect the organoleptic characteristics of the mixture. The qualitative characteristics of the safflower oil, namely the physicochemical parameters of the test sample had the following value: acid number AN = 1,0±0,10 mg KOH/g, peroxide number PN = 7,9±0,02 mmol/kg active oxygen, humidity 0.03%. The data obtained indicate the possibility of using this oil directly for food, as well as for the production of fat and oil products.

In vegetable oils, the most significant are two representatives of the families of polyunsaturated fatty acids - linoleic and linolenic acids. Both acids are products of biosynthesis of plant organisms, where they are formed from oleic acid. The fatty acid composition of sunflower, safflower and linseed oil.

In laboratory studies, sunflower, safflower and linseed oil were used in a ratio of 70:05:25; 75:05:20; 70:15:15. The resulting mixtures were examined by fatty acid composition. Importance of a ratio ω-6: ω-3 in a food allowance of the personit is studied and it is considered healthy when the ratio makes ≤ 5: 1 [16]. A lower fatty acid ratio of ω-6: ω-3 is more desirable toreduce the risk of many chronic diseases with high prevalence in Western countries as well as developing countries.

Studies of the fatty acid composition of mixtures of vegetable oils (sunflower, safflower, linseed) in a ratio of 70:05:25 and 75:05:20 allows to obtain a product with an acid ratio of [omega]-6: [omega]-3 ≤ 5:1.

Conclusion

Analysis of various vegetable oils showed the possibility of providing the human body with polyunsaturated fatty acids by using a mixture with a balanced fatty acid composition, namely the required ratio ω-6 and ω-3 acids.

As components of a mixture of vegetable oils with a balanced fatty acid composition, it is recommended to use sunflower, linseed and safflower oil, which are successfully produced in Kazakhstan.

It was found that in a ratio of 70:05:25 and 75:05:20 it is possible to obtain a product with an acid ratio of ω-6: ω-3 ≤ 5:1, which is more desirable to reduce the risk of many chronic diseases.

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