International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 5 ǁ 2022 ǁ PP. 06-09

Study of the Composition of Fatty Acids in Vegetable Oils by Gas Chromatographic Method

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Abstract
As a result of this work, the oils ixtracted from some gourds were converted to methyl esters and identified by gas chromatography, and then evaluated quantitatively. The possibility of using the gas chromatography method to assess the composition and authenticity of vegetable oils was shown. The oils obtained from watermelon, melon and pumpkin were used as vegetable oils. This approach can be used in the standardization of the quality of oils, in the development of regulatory documents related to oils.
Key words: *fatty acids, gas chromatography, extraction, esterification, identification, phase*

Date of Submission: 02-05-2022 Date of acceptance: 15-05-2022

I. Introduction

The fats and oils industry is one of the leading sectors of the food industry of the Republic of Uzbekistan and provides the population and the national economy with vegetable oils, fats, as well as the products prepared from them. There are saturated and unsaturated fatty acids, which have one or two double bonds in vegetable oils. In the analysis of vegetable oils the oleic and linoleic acids should meet the requirements regulated by the standard of Codex Alimentarius on their quantitative composition. When producing and using vegetable oils, it is required to constantly monitor the content of their fatty acids.

This article focuses on the results of chromatographic research of fatty acid composition of vegetable oils of gourds grown in the regions of the Republic of Uzbekistan, as well as the evaluation of quality indicators of food products using modern methods of analysis.

Substances belonging to the group of lipids, the most common in nature, are oils and fats. Despite the complexity of their structure, the main part of its composition is triacylglycerides, which are complex esters of glycerin and fatty acids of high molecular mass. Plant oils are extracted from oily raw materials, that is, from plants by pressing and extraction methods using various solvents [1]. 95-97% of the content of vegetable oils is triglycerides [2].

Recently, as a result of the development of the fats and oils industry, the new products also began to be prepared. The methods of preparation of high-grade refined and packaged oils, a new kind of margarine and mayonnaise are the examples. At present, some small-power oil and fat enterprises have been established, in which oil is produced from the seeds of gourds.

The gourds belong to a group of cultural crops, which are cultivated for food, forage and technical purposes, and which grow spreading the lashes. The most common and significant of them are watermelon, melon and pumpkin plants. The fruit of gourds is a valuable food product, which has a dietary property, and is also given to livestock as a feed. Oil is eaxtracted from their seeds by pressing.

Fats are one of the main products that make up a large part of the diet of food for the population. When properly selected and consumed, oils play an important role in maintaining a healthy diet. According to the recommendations of the World Health Organization, the consumption of fats and oils requires the provision of 15-30% of the caloric content of the diet, while saturated fatty acids do not exceed 10% of the total caloric content of the diet. As well as trans-fatty acids should not exceed 1% of the total calorie. The presence and proportion of many unsaturated fatty acids omega –6 and omega-3 in the fat-oil product is also very important.

The requirements for nutrition of the population in the Republic are harmonized with the international principles of healthy eating and determined by sanitary norms and rules "Requirements for nutrition of the population: norms of physiological need for energy and nutrients for different groups". At the same time, one of the ways to solve the problem of the production of oil and oil products, which is responsible for modern views on food hygiene, is the production of oil products, in which, in addition to animal fats, vegetable oils of different types are widely produced [3,4].

Very strict requirements are imposed on the methods of production of fat-oil products, of control of their component composition. Traditional physico-chemical indicators, determined by simple methods of chemical analysis, for example, the number of acid, the number of iodine, the number of peroxide, the number of hydroxide, the number of saponification, the degree of refraction, the density, the viscosity, the group composition of oils and a number of other indicators, will not be enough to assess the quality of fat-oil products. At present, chromatographic methods are widely used for in-depth and thorough study of the composition of these products. Chromatographic methods, in particular gas-liquid chromatography, are the main methods of analyzing the content of fatty acids in oils [3,4]. Chromatographic methods are distinguished by their accuracy, expressiveness, versatility, the presence of the possibility of automation of the separation process, simplicity, as well as the availability of remote control capabilities.

It is desirable to transfer vegetable oils investigated to the state of methyl esters in order to study them by gas chromatographic method. Because the boiling temperatures of methyl esters of fatty acids are much lower than those of the corresponding acids, the process of chromatographic separation is much lighter.

Proceeding from the foregoing, the purpose of this work is to examine the fatty acid composition of the oils derived from melons grown in local conditions using chromatographic methods, as well as identification and quantitative evaluation based on modern methods.

II. Experimental part

To carry out the research, an analysis of the oils of watermelon, melon, pumpkin grown in the regions of the Republic was carried out. For this purpose, an oil was separated from the samples of the plant oils studied by extraction method according to a certain method [1]. The amount of oil extracted from the samples was 40-55%.

Preparation of methyl esters of the vegetable oils was carried out on the basis of the appropriate method [5]. Thus, the methyl esters of the oils investigated were made ready for gas chromatographic analysis.

The chromatographic analysis of the methyl esters of these oils was carried out using gas chromatograph "Chromatec Crystal 9000" with a capillary column of the inner diameter of 0,25 mm and the length of 30 m, packed with stationary liquid SE-30 - phase [6]. For the complete separation of fatty acids of the methyl esters, a temperature-programmed separation mode (isothermal mode at 140°C for 4 minutes, then the temperature was raised to 180°C at 3°C/min) was selected [7]. This temperature was kept for 10 minutes, then the programmed temperature was raised to 240°C with the speed of 3°C/min and the last temperature has been kept for 25 minutes; the temperature of the vaporizer - 300°C, the sample volume to be sent - 0,1 mkl, the temperature of the flame ionization detector-FID - 300°C, the mobile phase - nitrogen flow rate - 70 ml/min, hydrogen flow rate - 25 ml/min, air flow rate - 250 ml/min. Gas chromatographic analysis of the methyl esters of the oils investigated was carried out under these selected optimal conditions. The chromatogram taken in the analysis of pumpkin oil in the experiment is shown in Figure 1.

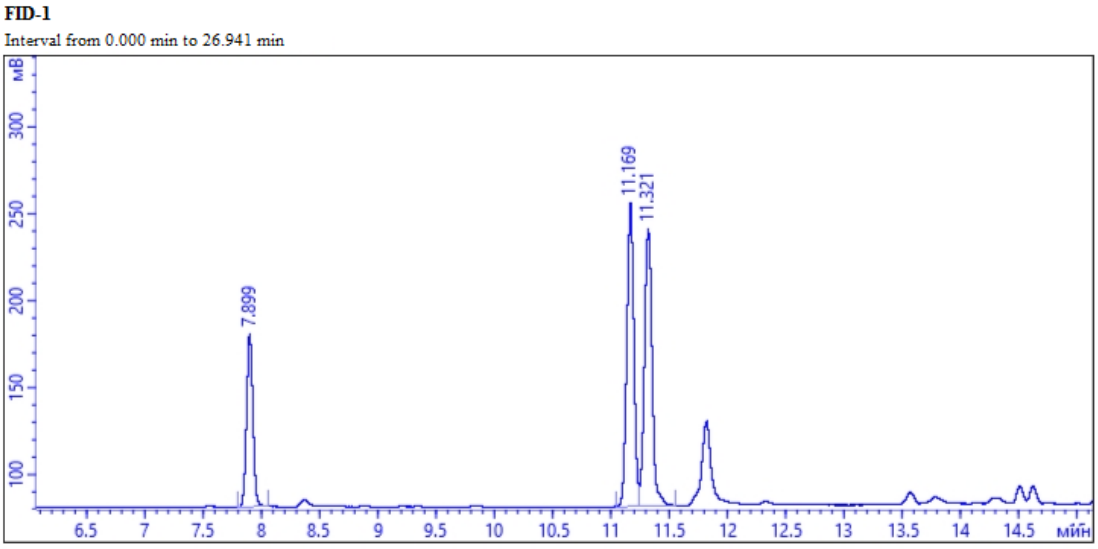

Figure 1: Chromatogram for the methyl ether of pumkin oil taken by GC method.

The qualitative analysis of the fatty acids methyl esters of the oils studied was carried out on the basis of the obtained retention parameters as follows:

1. Using a set of individual components estimated by the method of "Witnesses";

2. Using the data presented in scientific literature, tables and the results obtained on the basis of previous scientific researches for the proposed substances in the absence of standard, purified substances;
3. With the use of different deependences between the physical and chemical characteristics of sorbates and sorbents and retention parameters in cases where the above conditions do not allow;
4. Using the structure-group contributions method.
In the last three cases, the coincidence of the mean square deviation value between the retention indeces calculated and found by experiment of the proposed component as the criteria for identification with the identification error confirms that the identification was carried out correctly. Identification is completed by drawing up a list of the components of the mixture under analysis.
The quantitative composition of the methyl esters of the fatty acids is carried out in the method of internal normalization [8]. The percentage content of the fatty acids of the oils extracted from melons on the results obtained is given in Table 1.

Table 1: The content of the fatty acids of the melons oils

№	Fatty acids name	Watermelon, %	Melon, %	Pumpkin, %
1	Myristic ($C_{14:0}$)	0,06	0,06	0,08
2	Palmitic ($C_{16:0}$)	10,43	11,43	10.72
3	Palmetoleic ($C_{16:1}$)	0,21	0,07	0,24
4	Stearic ($C_{18:0}$)	5,63	6.82	5,40
5	Oleic ($C_{18:1}$)	24,82	20,53	37.73
6	Linoleic ($C_{18:2}$) (vitamin F)	57.49	60,31	44.74
7	Linolenic ($C_{18:3}$)	0.46	0,19	0,33
8	Arachidic ($C_{20:0}$)	0,35	0,16	0,37
9	Gondoic ($C_{20.1}$)	0,24	0.14	0.11
10	Behenic ($C_{22:0}$)	0,31	0.29	0.28

The results of the table above showed that in the composition of the melon plant oil, the amount of linoleic acid of unsaturated fatty acids is much higher than the amount in other plant oils.

When paying attention to the amount of oleic acid in gourds, it seems that its amount in pumpkin oil is twice as much as that of melon oil, much higher than that of watermelon oil, that is, it is almost twice less than that.

If the unsaturated acids in these oils are compared to the total amount of them, their amount in pumpkin oil was 88.50%, in watermelon oil - 88.53% and in melon oil - 81.75%.

In general, the higher amount of unsaturated fatty acids in watermelon oil can be considered as the main property of this oil, which causes it to be widely used for consumption purposes, in pharmaceuticals, in medicine, in cosmetics and other fields.

On the basis of the qualitative and quantitative composition of the plant oils, it is possible to assess their nutritional value, biological activity and their use for various purposes. The use of melon and pumpkin oils helps to manage many physiological processes. They are used as a medicinal remedy in the diseases of kidney, stomach, liver, atherosclerosis, bronchitis, tuberculosis, rheumatism and anemia.

III. Conclusion

Thus, it was found that it is necessary to constantly monitor the content, quality, authenticity of fatty acids in the production and use of vegetable oils and especially their mixtures. It was shown that a detailed information can be obtained by analyzing the content of fatty acids in the oils of melons by chromatographic methods, in particular the method of gas–liquid chromatography [8]. On the basis of the study of the quality and quantitative composition of vegetable oils, its nutritional value was assessed and the opportunities for its use for therapeutic purposes were confirmed.

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