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Fatty acids composition of some vegetable oils obtained in the west area of Romania

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Abstract

In this study was investigated the fatty acid composition of some vegetable oils: walnut (*Juglans regia L.*), soybean (*Glycine max*), apple (*Malus domestica*) and pumpkin seed (Cucurbita maxima) in the west area of Romania.

Of unsaturated fatty acids, the oleic acid content of the oils ranged from 13.62 to 28.65% of the total fatty acids, while the linoleic acid content ranged from 44.82 to 56.57 % and the linolenic acid contents from 6.28 to 12.09 %. It was found the palmitic acid was between 9.75 to 14.98% while stearic acid ranged from 2.90 to 9.33%. The fatty acid profile was determinated by GC-MS according to AOAC standards.

Keywords: fatty acids, walnut oil, soybean oil, apple seed oil, pumpkin seed oil, GC-MS

1. Introduction

Oils constitute one of the three major classes of food product, the others being proteins and carbohydrates. However, since the turn of the century, vegetable oils have supplanted lard and beef tallow as the major source of dietary [1]. Recent studies on seed of plants indicate they are potential sources of oils for nutritional, medicinal, and industrial purposes. Fatty acid was the main components of oils.

Pumpkin seed oil is used widely as salad oil in the South of Austria and the adjacent regions in Slovenia and Hungary. Recently, it is also applied to treat minor disorders of the prostate gland and the urinary bladder [1]. Edible oil of pumpkin seed has been used for a long period in Yugoslavia, Austria, Hungary, and the southern part of the USSR where it was highly appreciated and considered very good for health [2].

Pumpkin (*Cucurbita pepo*) seeds were found to be rich in oil (35%), protein (38%), α-tocoferols (3 mg/100 g) and carbohydrate content (37%) [4]. The fatty acid profile of the foods is determined via total lipid extraction, fatty acid derivitisation and GC analysis. Total oil of pumpkin seed is 42.3% and fatty acid composition is the following: C16:0 -14%, C18:0-6.93%, C18:1-35.8%, 18:2-40.70% [3] . The four dominant fatty acids found are: palmitic C16:0 (13.3%), stearic C18:0 (8.0%), oleic C18:1 (29.0%) and linoleic C18:2 (47.0%). The oil contains an appreciable amount of unsaturated fatty acids (78.0%) and found to be a rich source of linoleic acid (47.0%). The total oil content of the pumpkin seed analysed was 42.3% [4].

Composition in Fatty Acid of pumpkin seed oil is: palmitic (11.2%), stearic (5.0-5.3%), oleic (27.1-30.4%) and linoleic (53.4-56.7%) [5,6].

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Soybean oil, or soya bean (*Glycine Max*) is derived from a species of legume native to East Asia. It is usde in the cosmetic and food industry. (Poiană). Fatty Acid Composition: Area % of soybean oil: C 16:0 palmitic (10.1%), C 18:0 stearic (4.3%), C 18:1 oleic (22.3%), C 18:2 linoleic (53.7%) and C 18:3 linolenic (8.1%) [7].

Apple seeds, a common byproduct of apple processing, could be examinated for their overall proximate composition, fatty acid and amino acid composition of the lipid and protein components, respectively, as well as their key mineral constituents. Proximate analysis indicated that apple seeds are rich in oil content and protein ranging from 27.5 to 28% and 33.8 to 34.5% respectively, comparing favorably with oilseeds. GC analysis indicated high levels of linoleic acid (49%) with the other dominant fatty acids being oleic, palmitic and stearic acids, ranging from _39, 7 and 2% respectively. Amino acid analysis indicates that there are substantial amounts of sulfur containing amino acids in the apple seed. The apple seeds also contain significant amounts of phosphorus, potassium, magnesium, calcium and iron, in the order of 720, 650, 510, 210 and 110 mg/100g, respectively. Based on the proximate composition of the apple seeds, if adequate amounts are available as a process byproduct, apple seeds could have value-added potential as a source of edible oil, with the oil cake potentially serving as an animal feed supplement.

The apple tree belongs to the *Malus domestica* species of Rosaceae family and is one of the most widely cultivated fruit trees in the world. In 2005 global production of apples was ~72 million metric tons, with China producing almost 1/3 (~22 million metric tons) of that amount, making it the biggest apple producing country in world. Of Chinese production, ~3.0 million metric tons of apples are used to produce juice resulting in ~0.9 million metric tons of apple pomace and ~12 thousand metric tons of apple seed as a byproduct.

At present apple seeds are considered a waste product and are discarded, contributing negatively to the local environment. Increasing attention is being paid to such problems and solutions are being sought [8]. The apple seed oil has a nutritionally favorable fatty acid composition with a fairly low level of saturated fatty acids (~9.5%), somewhat higher than Canola oil (6.3 %) but less than soybean oil (16.2%) [8].

The hexane extract of apple seed was analyzed by GC-MS and found to consist mainly of fatty acids (80.9%) in its volatile fraction with linoleic acid as the most dominant one (51.2%), followed by palmitic, linolenic, stearic and oleic acids (10.5, 5.6, 4.3 and 4.1%, respectively) [9].

The literature data confirm that walnuts are a rich source of a number of important nutrients that appear to have a very positive effect on human health. Further experiments on the effects of feeding walnut diets to humans would be of great interest to understand the mechanisms of all the nutrients in walnuts. Despite the need for further research it is clear that prudent consumption of walnuts has played and can continue to play an important role in a healthy diet [10].

Walnuts contain about 10% -linolenic acid which has been associated with reduced risk in several prospective studies possibly due to antithrombotic and antiarrhymic effects of -linolenic acid [10].

Walnuts have a special dietary food value, given their carbohydrate content (11-14%), protein (14-16%) represented the essential amino acids and lipids (62-65%, of which 44-48% are polyunsaturated fatty acids) [11].

Walnuts have generated considerable interest because they are believed to possess plasma cholesterol-lowering properties This property is believed to result from the fatty acid profile present in walnut oil. The major fatty acids (FA) found in walnut oil are oleic (18:1 n-9), linoleic (18:2 n-6) and linolenic (18:3 n-3) acids. The ratios of these FA are considered important for their economic and nutritional value. For example, lower linoleic and linolenic acid contents in the oils may have a longer shelf life while higher levels of polyunsaturated fatty acids are more desirable because of their potential health benefits.

In one study, the supplementation of a background diet with 68 g of walnut/day reduced the total and low-density lipoprotein cholesterol by 5 and 9 % respectively, and it was suggested that these reductions would have some positive effects in reducing the risk of coronary heart disease. This is important as have shown that the fatty acid profile and chemical composition of walnut oil varies among cultivars [12].

The proximate compositions of walnut are as follows. Energy, 630 kcal; protein, 18.10–13.60%; total oil, 62.60-70.30%; dietary fiber, 5.20%; ash, 1.80% [10].

The chemical composition of 12 walnut genotypes as follows: Protein, 20.92 –25.95%; ash, 1.68-2.06%; fat, 66.30-74.95%. 141-146 141 from 62.4 to 68.7%, the oleic acid content of the oils ranged from 14.3 to 26.1% of the total fatty acids, while the linoleic acid content ranged from 49.3 to 62.3% and the linolenic contents from 8.0 to 13.8% [13].

As a result, walnuts are a rich source of n-3 and n-6 polyunsaturated fatty acids. The effects of walnut consumption on hyperlipidemia and systolic blood pressure, triglyceride and cholesterol were determined. In conclusion, the composition of the fatty acids consumed in the human diet appears to be more important than its total content. The benefits of walnuts in the human diet against hypercholesterolemia were studied [10].

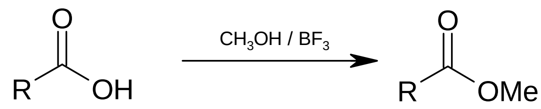
Walnut kernels (*Juglans regia* L.) generally contain about 60% oil, but this can vary from 50 to 70% depending on the cultivars, location, and irrigation rate. The major fatty acids found in walnut oil are oleic (C18:1), linoleic (C18:2, w-6), and linolenic (C18:3, w-3) acids. The good proportion of these fatty acids is important to the walnut nutritional value. Higher levels of these polyunsaturated fatty acids (PUFAs) are more desirable because of their health benefits, although lower linoleic and linolenic content may provide longer shelf life [14].Walnut (*Juglans regia* L.) fruits have been used in human nutrition since ancient times. The walnut seed contains high levels of oil (52–70%). The major constituents of walnut oil (WO) are TG, in which monounsaturated FA (mainly oleic acid) and PUFA (linoleic and a-linolenic acids) are present in high amounts. The proportions of these FA are important to the economic and nutritional value of the nut. Higher linoleic and linolenic acids contents may result in a poorer oxidative stability and a shorter shelf life of the oils. Higher oleic acid levels are desirable because of their potential health benefits [15]. The total oil content of the walnut (*Juglans regia* L.) samples were collected ranged from 62.4 to 68.7%. The oleic acid content of the oils ranged from 14.3 to 26.1% of the total fatty acids, while the linoleic acid content ranged from 49.3 to 62.3% and the linolenic contents from 8.0 to 13.8% [16].

2. Materials and methods

Soxhlet extraction. Plant material (soybean, walnut kernels, pumpkin seeds and apple seeds) was collected from the west of Romania, cleaned of impurities, crushing, drying, grinding and Soxhlet extracted with petroleum ether, achieving crude extract.

Materials. Reagents: Petroleum ether (p.f. = 40-60 °C); Soxhlet extraction; Reflux condenser; Nest electric thermostat; Boiling indicator (porous porcelain).

*Determination of fatty acids by GC-MS chromatographic technique in oils. Fatty acid derivatization. General Procedure:*For GC-MS analysis of fatty acid derivatization was necessary to obtain their corresponding methyl esters, more volatile. Derivatization was performed in round-bottomed flask 100 ml, fitted with reflux condenser, which were weighed 100 mg of oleic acid or linolenic • 5 ml methanolic BF_3 (20% BF_3, Lewis acid) to reflux on a water bath for 2 minutes, were introduced 2 ml hexane and continued refluxarea another minute. After cooling esterified mass was treated with 15 ml of saturated NaCl, shake vigorously for 15 seconds, then the flask was filled with the same salt solution to separate the organic layer in the neck of the flask, where it was separated and dried on anhydrous $CaCl_2$.



oleic acid R=$(CH_2)_7$**CH=CH**$(CH_2)_7CH_3$
linoleic acid R=$(CH_2)_7$(**CH=CH**$CH_2)_2(CH_2)_3CH_3$
linolenic acid R=($CH_2)_7$(**CH=CH**$CH_2)_3CH_3$

Figure 1. Fatty acid derivatization (linolenic, linoleic and oleic acid) the system methanol·BF_3.

GC-MS analysis. For fatty acid analysis of samples degraded esterified or using a gas chromatographic analysis system coupled with a mass spectrometric detection. We used a Hewlett Packard HP 6890 Series GC coupled with mass spectrometer Hewlett Packard 5973 Mass Selective Detector. For the quantitative determination using a calibration factor of 1.0 (external standard Dodecanese) and the injection was performed using a HP Autosampler GC-MS system attached.

GC analysis conditions were: Column: HP-5 MS 30m length, inner diameter 0.25mm, 0.25mm film thickness; Temperature program: 50°C to 250°C at a rate of 4°C/min; injector temperature 280°C; detector temperature: 280°C; Injection volume: 2 mL; carrier gas: He.

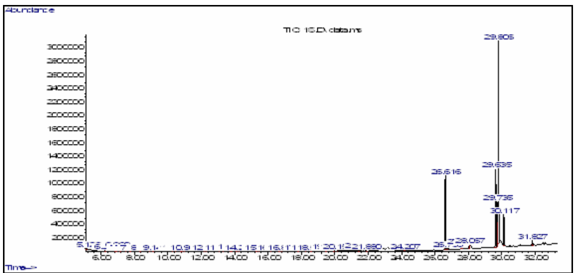
For MS detector has worked with its energy of 70eV, source temperature at 150° C, scan range 50-300 AMU, scanning speed 1 s-1 for mass spectrometry and the spectra obtained were compared with database NIST / EPA / NIH Mass Spectral Library 2.0 (2002). Data acquisition was performed using the software package G1701BA Hewlett Packard Enhanced ChemStation ver. B.01.00/1998 and processing of gas chromatography and mass spectrometry was performed using Hewlett Packard Enhanced Data Analysis program of the software package above.

3.Results and Discussions

The experimental results obtained by GC-MS analysis performed not differ significantly from literature data and highlighted the major saturated and unsaturated fatty acids contained in oils namely (palmitic, stearic, oleic, linoleic and linolenic).

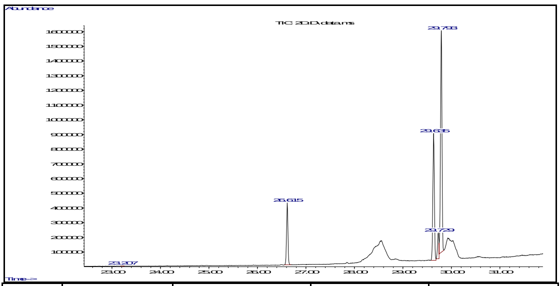
Advanced degree of unsaturation was observed (68.60-78.37%), linolenic acid accounted for (0.85-12.09%), oleic acid (13.62-25.51%) and linoleic acid (44.82-56.57%).

It is noted that in all oil samples, the majority are unsaturated fatty acids (linolenic, oleic linoleic them) as confirmed by the literature and observed a small proportion of saturated fatty acids present, represented by palmitic acid (9.75% -14.98 %) and stearic acid (2.9-9.33%).



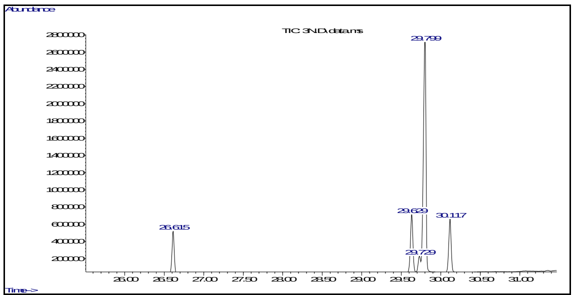
No. crt.	Fatty acids	Abreviation	Retention time (min.)	Percentage
1.	Palmitic	C 16:0	26.616	14.98
2.	Oleic	C 18:1	29.635	17.50
3.	Stearic	C 18:0	29.735	9.33
4.	Linoleic	C 18:2	29.806	44.82
5.	Linolenic	C 18:3	30.117	6.28

Figure 2. The GC chromatogram of fatty acids for soybean seed oil



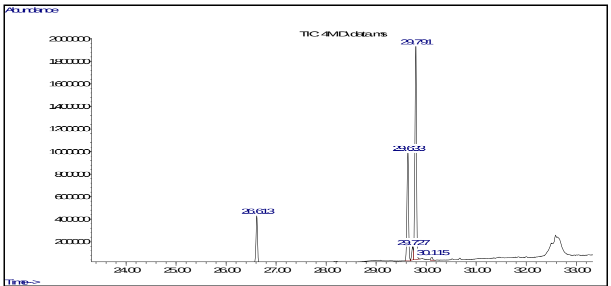
No. crt.	Fatty acids	Abreviation	Retention time (min.)	Percentage
1.	Palmitic	C 16:0	26.62	13.16
2.	Oleic	C 18:1	29.64	28.65
3.	Stearic	C 18:0	29.73	5.66
4.	Linoleic	C 18:2	29.79	49.62
5.	Linolenic	C 18:3	-	-

Figure 3. The GC chromatogram of fatty acids for pumpkin seed oil



No. crt.	Fatty acids	Abreviation	Retention time (min.)	Percentage
1.	Palmitic	C 16:0	26.62	9.75
2.	Oleic	C 18:1	29.63	13.62
3.	Stearic	C 18:0	29.73	3.48
4.	Linoleic	C 18:2	29.80	56.57
5.	Linolenic	C 18:3	30.12	12.09

Figure 4..The GC chromatogram of fatty acids for walnut core oil



No. crt.	Fatty acids	Abreviation	Retention time (min.)	Percentage
1.	Palmitic	C 16:0	26.61	10.57
2.	Oleic	C 18:1	29.63	25.51
3.	Stearic	C 18:0	29.73	2.90
4.	Linoleic	C 18:2	29.79	51.54
5.	Linolenic	C 18:3	30.12	0.85

Figure 5. The GC chromatogram of fatty acids for apple seed oil

Predominant fatty acid composition is linoleic acid, so that its minimum value was recorded in soybean oil (44.82%) and maximum value recorded in walnut oil (56.57%). (Figures 2 and 4).

Conclusions

This study highlights the considerable both conventional sources (soya bean and pumpkin) and nontraditional (walnut and apple seeds) with a high content of potentially edible oil rich in unsaturated fatty acids (oleic acid and linoleic acid).

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