FATTY ACIDS CONTENT AND NUTRITIONAL VALUE OF SOME VEGETABLE OILS

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Abstract. *Pure vegetal oils are easily digested and they contribute to the absorption of lipo-soluble vitamins (A, D, E, and K). Due to their antioxidants and monounsaturated fatty acids, vegetal oils reduce the risk of cardiovascular disease. Phenol compounds also have anti-inflammatory and anticoagulant properties, and they increase metabolic rate. The ratio between Omega-6 and Omega-3 fatty acids is extremely important. The recommended ratio is between 1:1 and 4:1, but our diet relies on a high supply of Omega-6. This study aims at evaluating the profile of fatty acids in certain vegetal oils available on the domestic market. Based on the results, it was evaluated the nutritional value of the studied material.The analysis of oil samples was done with gas chromatograph coupled with mass spectrometry on a Shimadzu GCMS QP 2010 Plus. The most balanced ratio of fatty acids was in the maize germ oil, which also supplies important amounts of vitamins (A and E). Olive oil has mainly oleic acid, and grape, pumpkin and maize germ oils contain mainly linoleic acid.*

Keywords: *vegetal oil, fatty acids, healthy diet*

INTRODUCTION

Raw matter quality is the most important feature of vegetal oils and of foods, in general. Both technological processing and plant (seed) properties are economically important in the assessment of oil quality.

Oils contain the main active principles of raw matters, beneficial to the human body: this has made them staple foods on the market.

Meeting the increasing consumption demands of the population is one of the main traits of our society. To meet this desideratum, agriculture has intensified vegetal production, higher valorisation of its products and higher quality standards in the resulted products.

There has always been a concern in the food industry worldwide regarding the development of a wide range of products to meet the demands and exigencies of the consumers and to support human health.

Food vegetal oils (as food additives or for cooking) have better taste and higher digestibility (about 90%) than many animal fats. One of their disadvantages is that, during processing, they lose part of the liposoluble vitamins (A, D, E, and K) (TABĂRĂ, 2005).

Vegetal oils are widely use in the tin industry and in bread making. Through hydrogenation, they obtain margarine, used as food or in pastry. Vegetal oils are increasingly highly appreciated in diets.

There are also efforts to develop diet products or products with a wider range of uses.

Nutrition research has determined a new trend in dieting and a revisit of some components neglected or avoided.

This study aims at evaluating the profile of fatty acids of certain vegetal oils on the domestic market. Based on our results, we can evaluate the nutrition value of five vegetal oils available on the market.

Measurements were made in the laboratory of Physical and Chemical Analyses of the Multidisciplinary Research Platform of the Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Romania.

MATERIAL AND METHODS

The profile of fatty acids is of considerable importance in the analysis of food lipids. They contribute not only to the typical, traditional features such as smell and taste, but also to shelf-life studies. Moreover, their profile has been used as authenticity marker in vegetal oils.

Isolating free fatty acids from biological materials is a complex task and we need to take measures to prevent or minimise the effects of hydrolysis enzymes. Purifying free fatty acids can be done through on solid phase micro extraction (SPME) (TOMAINO ET AL., 2001).

For our research, we studied five samples of marketed oils: olive pomace oil, virgin olive oil, grape seed oil, pumpkin seed oil and maize germ oil.

The analysis of oil samples was done through gas chromatography coupled with mass spectrometry on a Shimadzu GCMS QP 2010 Plus after we derivatised as methyl esters. The samples were derivatised with methanol solution of boron trifluoride for 1 h, and methyl esters were extracted in hexane. Injection temperature it has been set at 250 ºC. Separating esters was done on an AT5 column L = 30 m, d = 0.25 mm, and thickness = 0.25 µm.

The temperature programme in the initial column was 140ºC; it increased up to 250ºC at a rate of 7ºC/min; the temperature kept constant for 10 min. Total separation time was 22 min. He was the carrier gas at a column rate of 2 ml/min, total debit 24 ml/min, and linear speed 37.8 cm/s. The pressure was 278 kPa, and the splitting rate was 1/10. The separated compounds were detected through mass spectrometry, at a temperature of the electronic ionisation of the ion source 210ºC, and at an interface temperature of 250ºC. Identification of the separated and detected compounds was done based on the NIST 05 spectrum library of the soft.

RESULTS AND DISCUSSION

Relative content of fatty acids in vegetal oils was determined through area normalisation (Table 1-5).

Table 1.

The relative content of fatty acids in olive pomace oil

№	Compound name (as methylic ester)	Retention time (min)	%
1	Palmitoleic acid C16:1,	10.935	0.70
2	Palmitic acid C16:0	11.460	14.02
3	Linoleic acid C18:2, 9,12	15.035	12.79
4	Oleic acid C18:1, 9	15.260	66.76
5	Oleic acid C18:1, 11	15.346	2.56
6	Stearic acid C18:0	15.840	2.61
7	Docosenoic acid	19.430	0.24
8	Eicosanoic acid	20.040	0.32

The ratio between saturated fatty acids and unsaturated fatty acids in olive oil is 4, i.e. five times more than the optimum 0.8, which points to biochemical pathology (it leads to hyper-cholesterol).

Olive oil contains mainly oleic acid (66.76%, one ω9 acid, the acids ω3 (docosenoic acid + eicosanoic acid) and represent only 0.56, while acid ω6 (linoleic acid) represented 12.79%; thus, no ratio corresponded to the optimal value 4:1 mentioned in literature (Niac, 2004).

Detecting low amounts of ω3 acids is because we used a mass spectrometer detector to detect separated compounds: in more concentrated samples, it saturates as major component. Sample dilution prevents this, but sensitivity decreases.

Table 2.

The relative content of fatty acids in virgin olive oil

№	Compound name (as methylic ester)	Retention time (min)	%
1	Palmitoleic acid C16:1,	10.935	1.41
2	Palmitic acid C16:0	11.460	15.54
3	Linoleic acid C18:2, 9,12	15.035	12.13
4	Oleic acid C18:1, 9	15.260	65.02
5	Oleic acid C18:1, 11	15.346	2.62
6	Stearic acid C18:0	15.840	2.77
7	Docosenoic acid	19.430	0.24
8	Eicosanoic acid	20.040	0.27

In virgin olive oil, results are similar to the previous ones: the ratio saturated fatty acids: unsaturated fatty acids are 4.38, higher than the optimal one of 0.8. Virgin olive oil contains mainly oleic acid (ω9 acid), while ω3 acids are detected in smaller amounts (0.51), much below the optimal one.

Table 3.

The relative content of fatty acids in grape seed oil

№	Compound name (as methylic ester)	Retention time (min)	%
1	Palmitoleic acid C16:1,	10.935	0.31
2	Palmitic acid C16:0	11.460	11.30
3	Linoleic acid C18:2, 9,12	15.035	64.45
4	Oleic acid C18:1, 9	15.260	18.02
5	Olec acid C18:1, 11	15.346	1.88
6	Stearic acid C18:0	15.840	3.77
7	Docosenoic acid	19.430	0.14
8	Eicosanoic acid	20.040	0.13

In grape seed oil, the main component is linoleic acid, an essential fatty acid 64.45%, and the ω9 acid represents 20.21%. It ensures the necessary essential fatty acids, but it is susceptible of oxidation.

Table 4.

The relative content of fatty acids in pumpkin seed oil

№	Compound name (as methylic ester)	Retention time (min)	%
1	Palmitoleic acid C16:1,	10.935	1.21
2	Palmitic acid C16:0	11.460	12.80
3	Linoleic acid C18:2, 9,12	15.035	52.45
4	Oleic acid C18:1, 9	15.260	22.96
5	Oleic acid C18:1, 11	15.346	4.88
6	Stearic acid C18:0	15.840	5.67
7	Docosenoic acid	19.430	0.09
8	Eicosanoic acid	20.040	0.08

The pumpkin seed oil also ensures the necessary essential fatty acids, but the ratio ω6: ω3 is also high.

Table 5.

The relative content of fatty acids in maize germ oil

№	Compound name (as methylic ester)	Retention time (min)	%
1	Palmitoleic acid C16:1,	10.935	-
2	Palmitic acid C16:0	11.460	10.82
3	Linoleic acid C18:2, 9,12	15.035	44.35
4	Oleic acid C18:1, 9	15.260	41.06
5	Oleic acid C18:1, 11	15.346	1.03
6	Stearic acid C18:0	15.840	2.44
7	Docosenoic acid	19.430	0.13
8	Eicosanoic acid	20.040	0.16

In the maize germ oil, the ratio between ω6: ω9 is rather balanced, 1:1, but the detection of the ω3 acid was low.

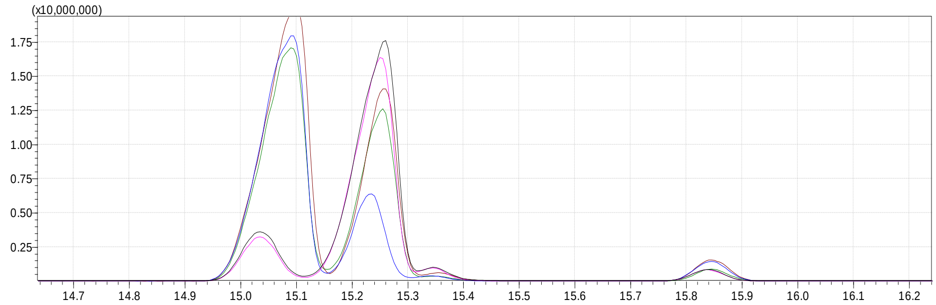

Figure 1. Overlapping chromatograms of the 5 types of oil analysis

Black – olive pomace oil
Pink – virgin olive oil
Blue – grape seed oil
Brown – pumpkin seed oil
Green – maize germ oil

Figure 1 emphasises the change of the ratio between linoleic acid (the first peak) and the oleic acid (the next peak) in the studied oils.

CONCLUSIONS

- Ensuring the necessary essential fatty acids is done through exogenous supply. Unrefined food oils are preferred to refined ones due to their supply of vitamins and antioxidants, but they have a shorter shelf life because of the hydrolytic enzymes.
- Though vegetal oils supply important amounts of essential fatty acids, the ratio of ω6: ω3 acids is not optimal from the perspective of hypercholesterolemia, ω3 acids contributing more intensely to the antiaterogenous action by reducing the seric level of cholesterol, triacylglycerols and LDL.
- Olive oil has mainly oleic acid, while grape seed, pumpkin seed and maize germ oils have mainly linoleic acid.
- The most balanced ratio of fatty acids was in the maize germ oil that also supplies important amounts of vitamins (A and E).
- We recommend unprocessed vegetal oils because processing changes the content of fatty acids and the ratio of the CIS-TRANS isomers. The TRANS form of the unsaturated fatty acids is considered toxic.

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