Determination of the Fatty Acids profile in edible oils using GC-MS system

Z Moldovan[1] and F Covaciu[1]

[1] National Institute for Research and Development of Isotopic and Molecular Technologies, 67-103 Donat, 400293 Cluj-Napoca, Romania, E-mail: zaharie.moldovan@itim-cj.ro

Abstract

In this work, a simple and sensitive method based on coupled system Gas Chromatograph-Mass Spectrometer (GC-MS) for the simultaneous determination of saturated and unsaturated Fatty Acids (FAs) in edible oils is described. The concentration of the Monounsaturated Fatty Acids (MUFA) in few common commercial edible oils is reported.

I. Introduction

Meat fat is an important structural and functional component of meat and meat-products and its composition in individual fatty acids is the main determinant of meat quality [1-4]. Among the fatty acid classes (saturated, monounsaturated and polyunsaturated), both the content and their profile are relevant from the nutritional point of view [3].

The presence of saturated fatty acids such as palmitic and myristic acids is probably associated to an increased incidence of cardiovascular diseases. Since the main contribution of saturated acids intake to the diet comes from meat and the meat products food group, the quantification of fatty acids content in foods is relevant in the development of strategies for a healthy diet [3]. Free fatty acids (FFAs) in edible oils are one of the most frequently determined quality indices during production, storage, and marketing[5].

In this study, a simple, stable and sensitive method for the simultaneous determination of saturated and unsaturated FFAs from edible oils using Gas Chromatograph-Mass Spectrometer (GC-MS) coupled system has been developed. The common commercial edible oils were characterized based on MUFA concentration measured.

II. Experimental

II.1. Investigated samples. Were investigated 30 sample from common commercial edible oils. The method no involves pre-treatment as derivatization of compounds and therefore is able to accurately determine the individual FAs oils without any interference with other reagents. This principle has shown many advantages compared to the reported method which involves sample pre-treatment [6].

II. 2. Instruments: The analyses were performed on samples diluted in ethanol. The fatty acids present in sample were changed in situ in ethyl esters by dilution in ethanol and by injection in GC inlet system heated at 250 ^{o}C. Analysis was carried out using a Gas Chromatograph – Mass Spectrometer coupled system (Polaris, Thermo-electron Corporation, USA). The chromatographic separation was accomplished by an HP-5MS column (l = 30m, d_i = 0.25 mm) with helium as carrier gas at a flow rate of 1.5 mL/min. The GC oven temperature was programmed from 90 ^{0}C (hold 1 min) to 120 ^{0}C (at 20 ^{0}C/min, then to 300 ^{0}C (hold 10 min) at 4 ^{0}C/min. The injection port temperature was set at 250 ^{0}C. Mass spectrometric analysis was performed by MS that operated in Electron Impact mode at 70 eV and with the ion source temperature set at 250 ^{0}C. The mass spectra were obtained in full scan mode in the range 50-650 Daltons.

III. Results and discussions

No sample pre-treatment techniques were employed such as extraction or derivatization for the analysis of target acids from oil samples, the samples were just diluted in ethanol and then directly injected to the instrument. The fatty acids were detected and measured as ethyl esters.

Health effects

The fatty acids in food can have some effect/7/ as:

Hydrogenated oils (high containing of SFA) cause "double deadly effect", raising the level of LDLs and decreasing the level of HDLs in the blood, increasing the risk of blood clotting inside blood vessels.Foods containing monounsaturated fats (MUFAs) reduce low-density lipoprotein (LDL) cholesterol, while possibly increasing high-density lipoprotein (HDL) cholesterol; A high consumption of omega-6 polyunsaturated fatty acids (PUFAs), may increase the likelihood that postmenopausal women will develop breast cancer. A similar effect was observed on prostate cancer and skin cancer.

The mass spectrum of stearic-, linoleic- and linolenic acid as ethyl esters are shown in the Fig 1-3 respectively. The GC-MS chromatogram for olive-, sunflower- and cock- oil is presented in Fig 4-6. The relative concentration of fatty acids groups (SFA, MUFA and PUFA) was determined for a number of 30 of commercial edible oils. The MUFA concentration seems to be an indicator of product quality and is presented in Table 1.

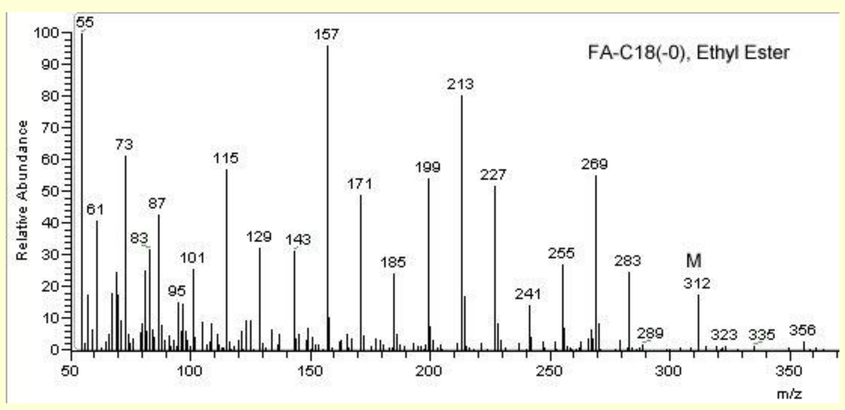

Fig. 1. Mass spectrum of Stearic acid ethyl ester (saturated FA)

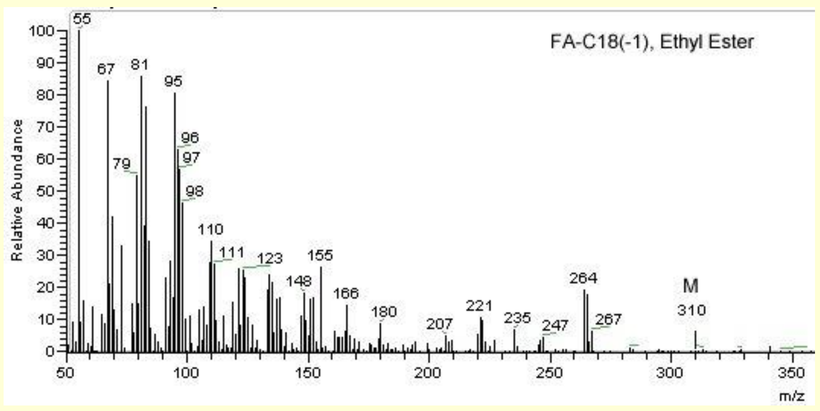

Fig. 2. Mass spectrum of Oleic acid ethyl ester (monounsaturated FA)

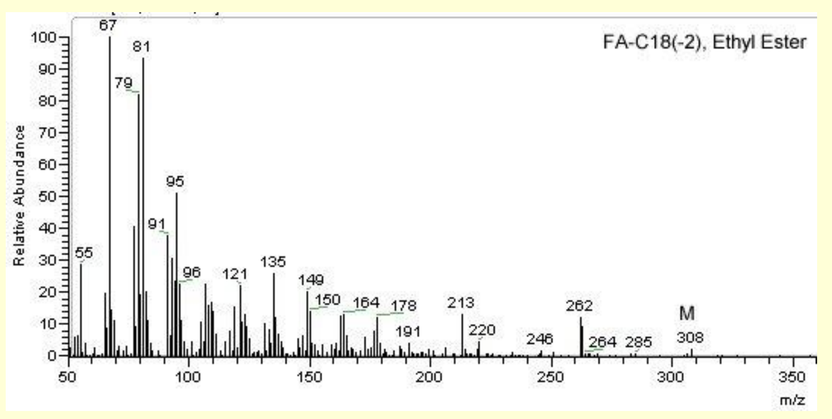

Fig. 3. Mass spectrum of Linoleic acid ethyl ester (polyunsaturated FA)

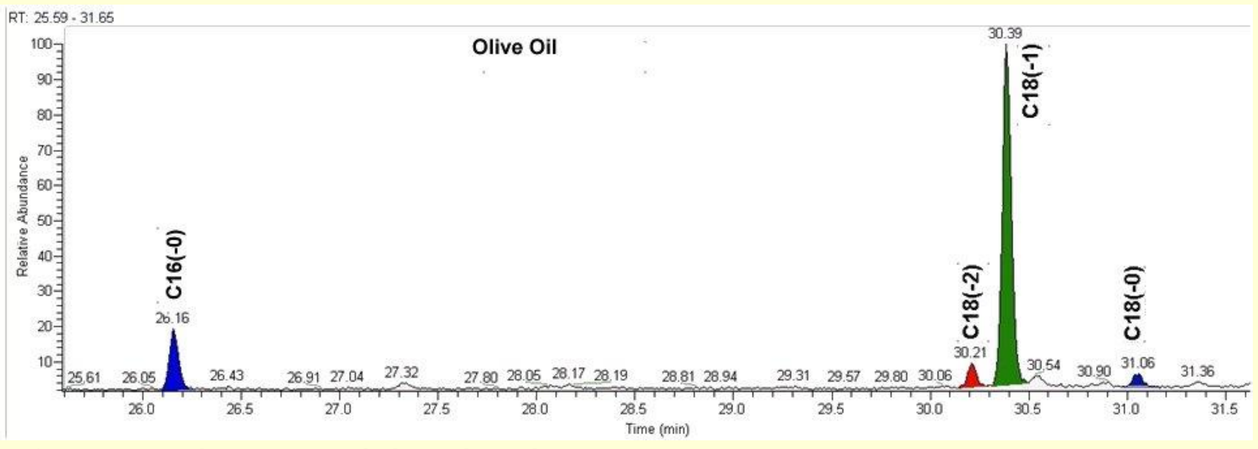

Fig. 4. GC-MS Chromatogram of Olive Oil sample

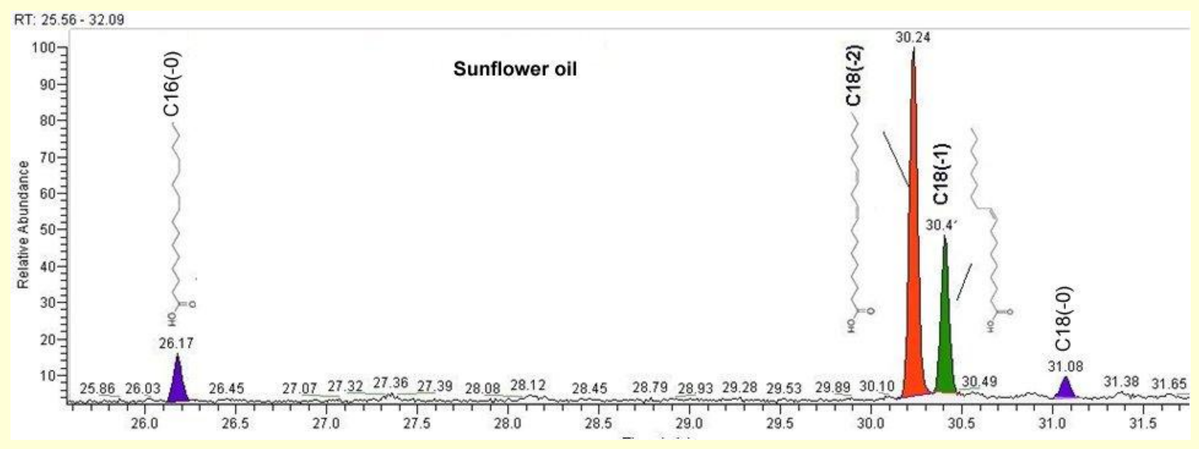

Fig. 5 GC-MS Chromatogram of Sun flower oil sample

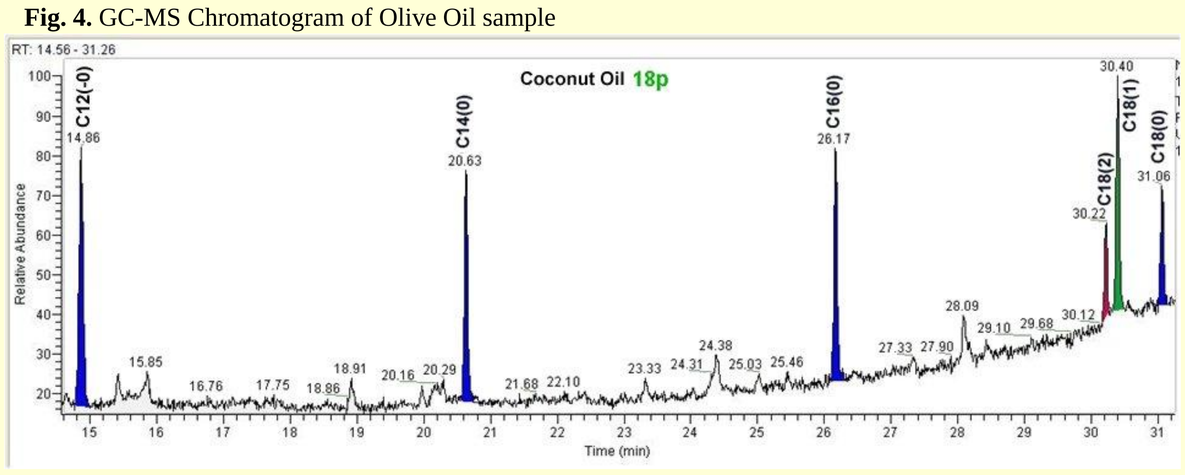

Fig. 6. GC-MS Chromatogram of Coconut oil sample

Table 1. MUFA concentration of edible oils (% of fatty acids)

No	Origin of oil	MUFA	No	Origin of oil	MUFA	Nr	Origin of oil	MUFA
1	Olive	**77**	11	Hazelnut	**79**	21	Maize	**30**
2	Almond	**62**	12	Turkey	**40**	22	Chicken	**34**
3	Nut	**34**	13	Egg White	**27**	23	Rape	**64**
4	Rice	**41**	14	Chest turkey	**47**	24	Duck	**60**
5	Palm	**44**	15	Yolk	**14**	25	Grapes	**28**
6	Sunflower	**27**	16	Linsed oil	**35**	26	Apricots	**68**
7	Pumpkin	**35**	17	Margarine 1	**50**	27	Ostrich	**64**
8	Cock	**18**	18	Margarine 2	**38**	28	Susan	**40**
9	Avocado	**67**	19	Sheep meat	**32**	29	Butter	**46**
10	Peanuts	**63**	20	Fish	**28**	30	Lard	**50**

Conclusions

The relative concentration of SFA, MUFA and PUFA compounds were determined for thirty natural products. For a number of nine samples the values are higher as 60 % and for three samples concentration is under 30 %. Smaller concentration were obtained for sample resulting from eggs (yolk and white) and from Coconut oil.

References

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