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CHANGES IN FATTY ACIDS COMPOSITION OF ANIMAL FATS DURING STORAGE

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ABSTRACT. In this article the fatty acids composition for 2 types of animal fats (pork fat and beef tallow), following the variation of saturated and unsaturated fatty acids proportion during freezing storage was studied. Determination of chemical composition of animal fats is important in establishing organoleptic and physico-chemical parameters, the variation of them in time, nature and proportion of fatty acids conferring specific characteristics to them. For pork fat was determined the following chemical composition: saturated fatty acids (SFA) 48.32%, monounsaturated fatty acids (MUFA) 36.78% and polyunsaturated fatty acids (PUFA) 14.89%. After 4 months of storage under freezing there was a change in fatty acids proportion, saturated fatty acid content increased slightly to 48.83%, due to installation of hydrolysis leading to release of fatty acids from triglycerides, monounsaturated fatty acids content decreased to 35.99%, and polyunsaturated fatty acids content increased to 15.18%. In the case of beef tallow there was an increasing in saturated and monounsaturated fatty acids content and a decreasing in polyunsaturated fatty acids content.

Keywords: fatty acids, animal fats, storage

INTRODUCTION

In chemical terms fats are glycerol esters with fatty acids. Theoretically there is the possibility that one group of alcoholic glycerine is esterificated with a fatty acid molecule (monoglyceride), or two alcoholic groups are esterificated with two fatty acids molecules (diglyceride). In nature we meet only triglycerides. There are opinions that fats are made from simple triglycerides such as tripalmitin, tristearin, triolein, etc. But it turned out that in most of cases, fats are glycerin esters with 2 or 3 different fatty acids [1, 5]:

$$\begin{array}{l} CH_2\text{–}OH \\ | \\ CH\text{–}OH \\ | \\ CH_2\text{–}OH \end{array} \quad \begin{array}{l} HOOC\text{–}R_1 \\ \\ HOOC\text{–}R_2 \\ \\ HOOC\text{–}R_3 \end{array} \quad \rightarrow \quad \begin{array}{l} CH_2\text{–}O\text{–}OC\text{–}R_1 \\ | \\ CH\text{–}O\text{–}OC\text{–}R_2 \\ | \\ CH_2\text{–}O\text{–}OC\text{–}R_3 \end{array} \quad + 3\ H_2O \qquad (1)$$

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Fatty acids represent the variable structure of lipids, the characteristics of the fats being conferred by the nature and proportion of fatty acids that enters into their composition [11].

Major fatty acids from animal fats composition are those who have a number of 4 to 18 carbon atoms in the molecule, namely [5, 7]:

Butyric acid	$CH_3–(CH_2)_2–COOH$
Caproic acid	$CH_3–(CH_2)_4–COOH$
Caprylic acid	$CH_3–(CH_2)_6–COOH$
Caprynic acid	$CH_3–(CH_2)_8–COOH$
Lauric acid	$CH_3–(CH_2)_{10}–COOH$
Miristic acid	$CH_3–(CH_2)_{12}–COOH$
Palmitic acid	$CH_3–(CH_2)_{14}–COOH$
Stearic acid	$CH_3–(CH_2)_{16}–COOH$

The main unsaturated fatty acids in animal fats are oleic and linoleic acid. Oleic acid has 18 carbon atoms and one double link located between C9 and C10: $CH_3–(CH_2)_7–CH=CH–(CH_2)_7–COOH$. Linoleic acid has 18 carbon atoms, but two double links located between C9 and C10, C12 and C13: $CH_3–(CH_2)_4–CH=CH–CH_2–CH=CH–(CH_2)_7–COOH$ [28].

Animal fats has nutritional-biological and sensory value through: the provision of essential fatty acids for human body (linoleic, linolenic and arachidonic acids); concentrated sources of energy (cca.9 kcal/g, proteins and carbohydrates providing approx. 4 kcal/g); medium for transport/storage of liposoluble vitamins (A, D, E, K); formation of phospholipids with essential role in proper functionation of membranes; precursors of prostaglandins, essential hormones for the body; texture formers; structure formers in certain products (fillings for bakery products and confectionery); lipids confer softness (a slight bite and mastication), smaller the dry and granular feeling of food consumption (due to the lubrication effect and the liquid part of the fat); flavor providers (with positive or negative effect on the overall flavor of the product) and medium for hydrophobic flavour compounds [2, 3].

RESULTS AND DISCUSSION

The content of SFA in pork fat was higher (48.32%) than MUFA (36.78%) and PUFA (14.89%), the major fatty acids present in pork fat were palmitic, stearic, oleic and linoleic acids. Oleic acid was determined in the largest proportion (33.51%), these results are in agreement with previous studies on this type of fat [4, 6].

Figure 1 illustrates sample chromatogram for pork fat in witch fatty acids are registered in the form of peaks separated from each other by increasing the length chain, and at the same length chain by increasing of unsaturated degree.

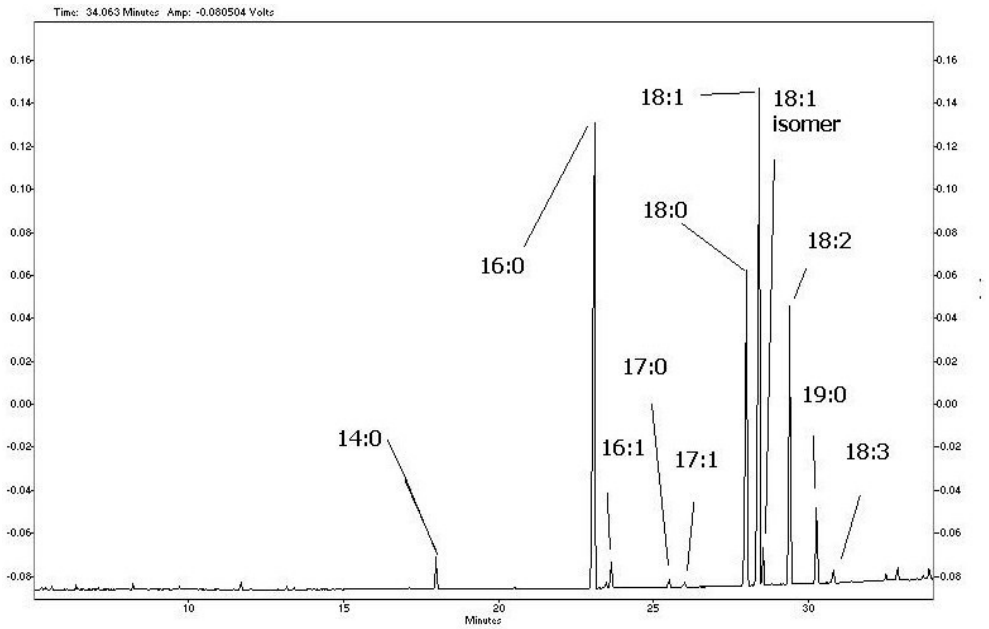

Figure 1. Chromatogram for fresh pork fat

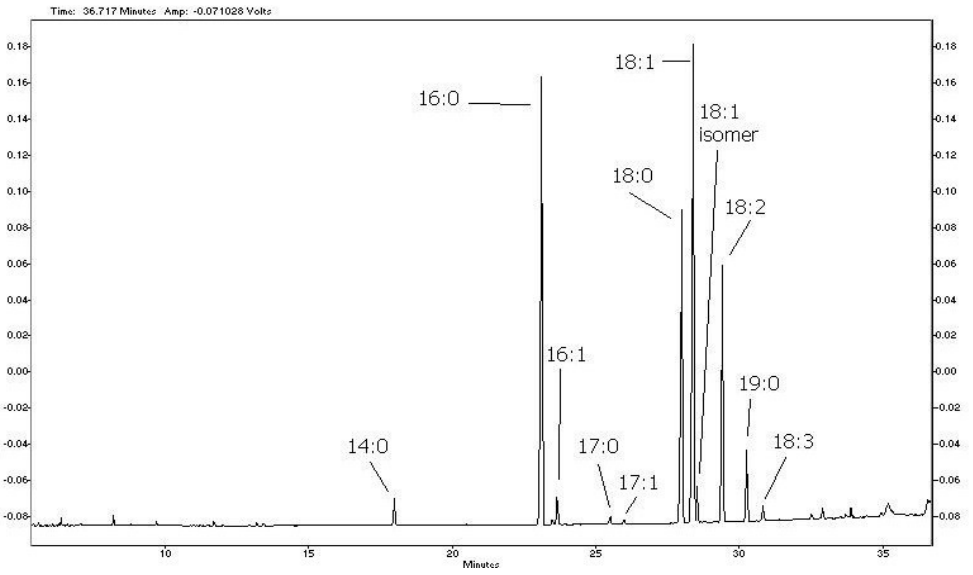

Figure 2. Chromatogram for pork fat at 4 months freezing

In pork fat sample to 4 months freezing there were some differences from the fresh sample: miristic acid content decreased to 1.29%, palmitic acid increased to 27.15%, palmitoleic acid increased to 1.35%, margaric acid decreased to 0.35%, *cis*-10-heptadecanoic acid remained constant, stearic acid increased to 20.03%, oleic acid decreased to 32.66%, vaccenic acid remained constant, linoleic acid increased to 14.41% and alfalinoleic acid increased to 0.76%. In general, the SFA content increased to 48.83%, the MUFA content decreased to 35.99% and the PUFA content increased to 15.18% (fig.2). The increas of saturated and polyunsaturated fatty acids content is due to the installation of hydrolysis leading to the release of acids from glycerides structure, which translates through the increas of titrable acidity.

The content of SFA in beef tallow was higher (57.13%) than MUFA (34.47%) and PUFA (8.4%), the major fatty acids present were palmitic, stearic and oleic acids [8, 10, 12]. Oleic acid was determined in the largest proportion (30.14%).

Figure 3 illustrates sample chromatogram for beef tallow in witch fatty acids are registered in the form of peaks separated from each other by increasing the length chain, and at the same length chain by increasing of unsaturated degree.

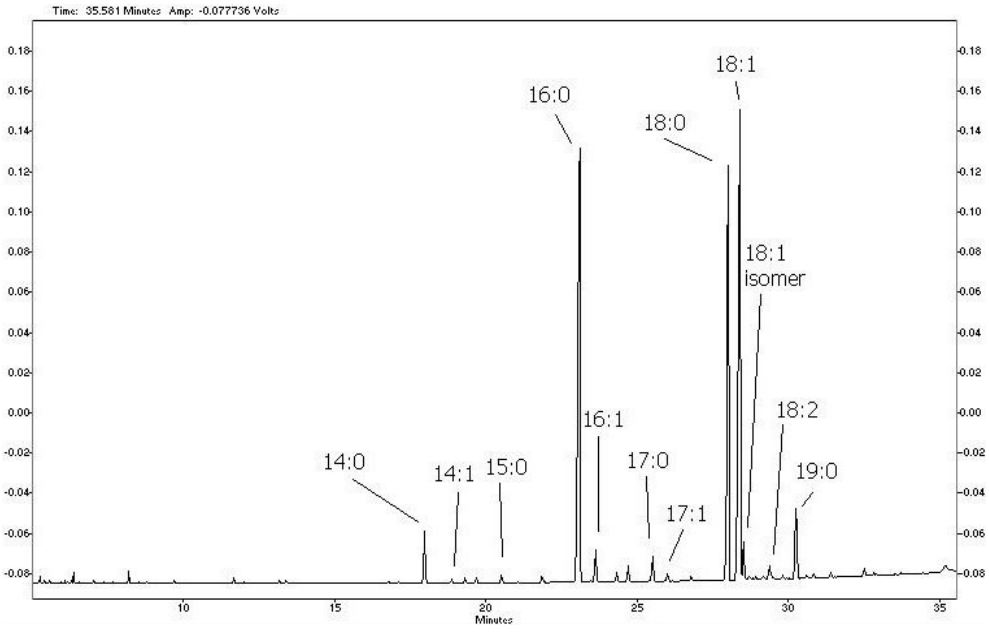

Figure 3. Chromatogram for fresh beef tallow

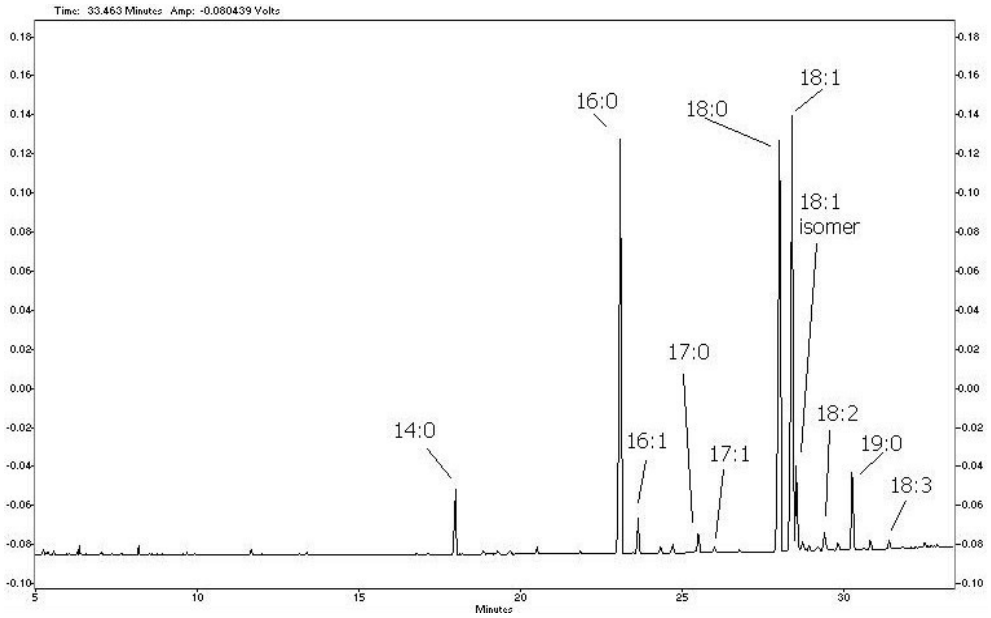

Figure 4. Chromatogram for beef tallow at 4 months freezing

In beef tallow sample at 4 months freezing there were some differences from the fresh sample: miristic acid content increased to 3%, pentaedecanoic and miristoleic acid were not detected, palmitic acid increased to 27.03%, palmitoleic acid increased to 1.77%, margaric acid decreased to 1.19%, *cis*-10-heptadecanoic acid decreased to 0.35%, stearic acid increased to 30.09%, oleic acid decreased to 30.09%, vaccenic acid increased to 4.64% and linoleic acid decreased to 1.32%. In general, the content of SFA increased to 61.3%, the MUFA content to 36.86% and the content of PUFA decreased to 1.84% (fig.4). In the case of beef tallow at 4 months congelation, monounsaturated fatty acids recorded an increase and polyunsaturated fatty acids a decrease, for pork fat at 4 months freezing we found the opposite.

Pork fat presents a highest proportion of mono and polyunsaturated fatty acids, than beef tallow, having aspect of alifios and homogeneous mass, beef tallow is presented as a compact and dense mass, fine granulated, with hard consistence, brittle to break or jam due to the higher content of saturated fatty acids [9, 11, 13].

CONCLUSIONS

Determination of chemical composition of animal fats is important in establishing organoleptic and physico-chemical parameters, the variation of them in time, being an indicator of their stability compared to alterative processes.

Beef tallow presented the lowest content of PUFA (8.4%), which are the most susceptible to autooxidation, it can be kept for a long period of time under refrigeration and freezing. Of studied fats, the most susceptible to altering is pork fat because its high content of PUFA (14.89%).

Chemical composition of fats influence their consistency, pork fat having aspect of alifios and homogeneous mass, beef tallow is presented as a compact and dense mass, fine granulated, with hard consistence, brittle to break or jam, with a higher value for melting point and a lower value for refractive and iodine index.

EXPERIMENTAL SECTION

Samples

Pork fat was obtained by melting of fresh bacon and lard pork and beef tallow was obtained by raw tallow melting, collected from “Baltata Romaneasca” race, female, age of 8 years, which were determined the chemical composition in fresh state and after 4 months of storage under freezing (-15 ...- 18^{o}C).

Physicochemical examination

Fatty acid composition was determined using gas chromatography (GC) Shimadzu GC-17 A coupled with flame ionisation detector FID. Gas chromatography column is Alltech AT-Wax, 0.25 mm I.D., 0.25 μm thick stationary phase (polyethylene), used helium as carrier gas at a pressure of 147 kPa, temperature of the injector and detector was set to 260^{o}C, the oven programm was the following: 70^{o}C for 2 min., then the temperature was raised up to 150^{o}C with a gradient of 10^{o}C/min., a level of 3 min. and the temperature was raised up to 235^{o}C with a gradient of 4^{o}C/min.

The method consists in transforming of fatty acids in methyl esters in the sample under analysis, followed by separation of components on a chromatography column, their identification by comparison with standard chromatograms and quantitative determination of fatty acids. Esterificated analyzed sample is introduced in column chromatography. By chromatography separation the sample chromatogram is obtained in which fatty acids are recorded in the form of peaks separated from each other by increasing the length chain, and at the same length chain by increasing of unsaturated degree. By comparing the distances of each peak from analyzed sample chromatogram with peaks distances from standard chromatograms, we identify each fatty acid present in the analyzed sample [14, 15, 16].

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