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RESEARCH REGARDING CHANGES IN THE CHEMICAL COMPOSITION OF ANIMAL FATS DURING FREEZING STORAGE

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In this article the chemical composition of 2 types of animal fats (pork fat and buffalo tallow) following the variation of saturated and unsaturated fatty acids proportion during freezing storage was studied. Determination of the chemical composition of animal fats is important in establishing organoleptic and physico-chemical parameters, their variation in time, nature and proportion of fatty acids providing them with specific characteristics. For pork fat the following chemical components was determined: saturated fatty acids 48.32% (SFA), monounsaturated fatty acids 36.78% (MUFA), polyunsaturated fatty acids 14.89% (PUFA). After 4 months of storage under freezing there was a change in fatty acids proportion; saturated fatty acid content increased slightly to 48.83%, monounsaturated fatty acids content decreased to 35.99%, and polyunsaturated fatty acids content decreased to 13.18% due to the oxidation process when the degree of unsaturation decreased due to unsaturated fatty acids oxidation, pork fat presenting the most profound changes. In the case of buffalo tallow, there was an increasing of saturated and monounsaturated fatty acids content and a decreasing of polyunsaturated fatty acids content.

Keywords: fatty acids, pork fat, buffalo tallow, storage

1. Introduction

In chemical terms, fats are glycerol esters with fatty acids. Theoretically there is a 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 (Banu et al., 2002). Nowadays, there are registered many metabolic imbalances, accounted for on the one hand, to reduction of physical effort, sedentariness, and, on the other, to the nerve growth factor demand and daily stress, to environmental pollution, food pollution implicitly. Excessive consumption of fat food, especially saturated fat led to the emergence of health problems – increasing blood pressure and cholesterol levels, increasing the number of patients with cardio-vascular diseases. Unsaturated lipids are less dangerous and contain significant amounts of liposoluble vitamins useful to the body, which have antioxidant function in fat food and body, preventing many diseases due to oxidative stress. Of unsaturated fatty acids, very important are linoleic, linolenic and arachidonic acids called essential fatty acids that cannot be synthesized by the body, they should be brought by food intake. Some fats are themselves an important source of vitamins, butter and fish fat (Banu et al., 2002).

Samet-Bali et al., 2008 reported that the content of SFA in cow milk fat was higher (68.35%) than MUFA (39.25%) and PUFA (2.4%), the major fatty acids present in milk fat were palmitic, capric and oleic acids. Palmitic acid was determined in the largest proportion (26.85%), these results are in agreement

with previous studies on different types of milk butter. Glew, Okolo, Chuang and Vanderjagt, 1999, reported that SFA level in „Fulani butter oil" made from cow's milk was 53.3% and the major fatty acid was palmitic acid (30.2%). Percentage of SFA in traditional „Turkish butter" was 67.06% and palmitic acid was the major one (33.72%) (Sağdiç et al., 2004).

In addition, Fatouth, Mahran, El Gandour and Singh, 2005, reported that SFA rate in butter made from buffalo milk was 70.72% and the palmitic acid was also the major fatty acid (31.89%). Butter made from milk of other animal species was studied (Özkanli and Kaya, 2005; Sağdiç et al., 2004). Özkanli et al., 2005 found a lower SFA level (59.13%) and the major fatty acid was oleic acid (31.08%) in butter produced from sheep's milk. Sağdiç et al. 2004, reported that the percentage of SFA was 73.88% and 69.10% in butter made from goats' and ewes' milk respectively.

The aim of the paper was to study the significant changes in fatty acids composition of pork fat and buffalo tallow during freezing storage, when alterative processes are installed, that is important in establishing organoleptic and physico-chemical parameters, Manglano et al.,2005; Olsen et al., 2007, reported variations in fatty acids composition for cow milk fat during the freezing storage.

2. Materials and methods

2.1. Samples

Pork fat was obtained by fresh bacon and lard melting, buffalo tallow was obtained by raw tallow melting, collected by female, aged 8 years, samples were packed in vacuumed bags for which the chemical composition was determined in a fresh state and after 4 months of storage under freezing (-15 ...- 18^{o}C).

2.2. Physico-chemical examination

Fatty acid composition was determined using gas chromatography (GC-FID) Shimadzu GC-17 A coupled with flame ionisation detector . 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., and held at this temperature for 3 min., then the temperature was raised up to 235^{o}C with a gradient of 4^{o}C/min and held at that temperature for 10 min. (SR EN 14082, 1998; ISO 3976, 2006).

Samples preparing to GC analysis: 50 mg of sample was mixed with 1 ml benzene, and from that dilution 100 µl was taken and mixed with 200 µl internal standard (nonadecanoic acid 19:0), 1 ml benzene, 2 ml methanol, 4 drops H_2SO_4 concc., was heated at 80^{o}C for 2 hours.

For the esters extraction the esterificated sample was passed into a separating funnel, where 10 ml hexane and 2 ml distilled water were added, the former being retained and filtered on a cellulose filter, anhidrificated with anhydrous Na_2SO_4, dried on a rotary evaporator, then resumed in 1 ml hexane and a 1 µl sample was injected into gas chromatograph.

The method consists in transforming the fatty acids in methyl esters in the sample under analysis, followed by the separation of the components on a chromatography column, and their identification by comparison with standard chromatograms and quantitative determination of fatty acids. 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 the unsaturated degree. By comparing the distances of each peak from the analyzed sample chromatogram with peaks distances from standard chromatograms, we identify each fatty acid present in the analyzed sample. Results were expressed as w/w (%) total fatty acids (SR EN 14082, 2003; ISO 3976, 2006).

3. Results and discussions

The content of SFA in pork fat was higher (48.32%) than MUFA (36.78%) and PUFA (14.89%), the major fatty acids present were palmitic, stearic, oleic and linoleic acids. Oleic acid was determined in the largest proportion (33.51%). These results are in agreement with the previous studies on this type of fat (Olsen, Vogt, Ekeberg, Sandbakk, Pettersen and Nilsson, 2005). Figure 1 illustrates sample chromatogram for fresh pork fat. As far as the pork fat sample is concerned, there occurred some changes over a 4 months time period of freezing as compared with the fresh pork fat sample, such as: the myristic acid content which decreased to 1.29%, the palmitic acid which increased to 27.15%, the palmitoleic acid which increased to 1.35%, the margaric acid which decreased to 0.35%, the *cis*-10-heptadecanoic acid remained constant, the stearic acid which increased to 20.03%, the oleic acid which decreased to 32.66%, the vaccenic acid remained constant, the linoleic acid which decreased to 13.41% and the alfalinoleic acid which decreased to 0.56%. In general, the saturated fatty acids content increased to 48.83%, the monounsaturated fatty acids content decreased to 35.99% and the polyunsaturated fatty acids content decreased to 13.18% (Figure2).

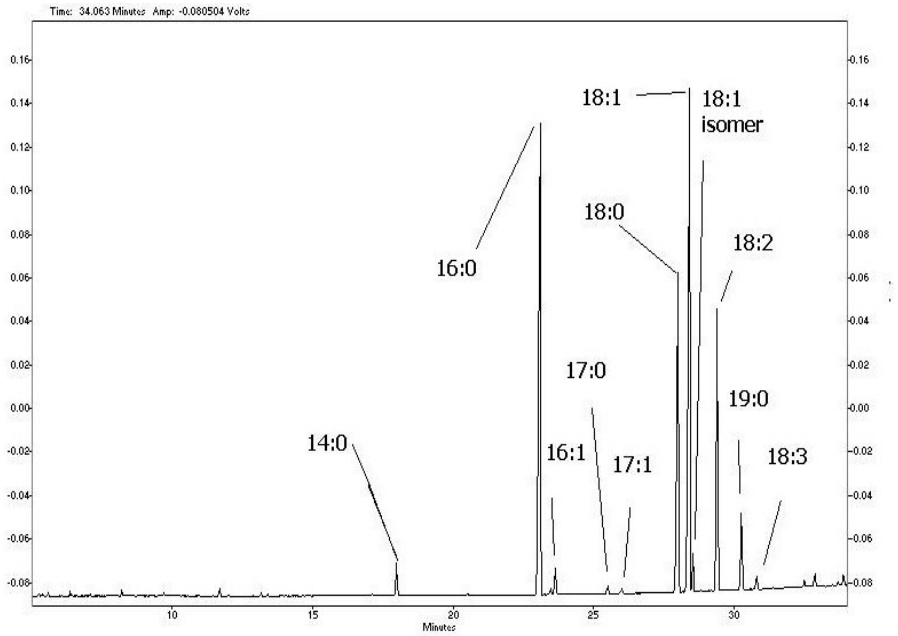

Figure 1. Fatty acids chromatogram of fresh pork adipose tissue

It was concluded that the increase of saturated fatty acids content is due to hydrolysis leading to the release of acids from triglycerides structure, and the decrease of MUFA and PUFA is due to the unsaturated fatty acids oxidation

The content of SFA in buffalo tallow was higher (57.13%) than MUFA (34.47%) and PUFA (8.4%), the major fatty acids present in beef tallow were the palmitic, the stearic and the oleic acids. The oleic acid was determined in the largest proportion (30.14%). Figure 3 illustrates sample chromatogram of fresh buffalo tallow. In a buffalo tallow sample, over a 4 months time period of freezing, there occurred some changes as compared with the fresh sample, such as: the myristic acid content increased to 3%, the pentaedecanoic and myristoleic acids were not detected, the palmitic acid increased to 27.03%, the palmitoleic acid increased to 1.77%, the margaric acid decreased to 1.19%, the *cis*-10-heptadecanoic acid

decreased to 0.35%, the stearic acid increased to 30.09%, the oleic acid decreased to 30.09%, the vaccenic acid increased to 4.64% and the linoleic acid decreased to 1.32%. In general, the content of saturated fatty acids increased to 61.3%, the monounsaturated fatty acids content to 36.86% and the content of polyunsaturated fatty acids decreased to 1.84% (Figure 4). It should be noted that in the case of buffalo tallow over a 4 months congelation, polyunsaturated fatty acids decrease was not so pronounced as in the case of pork fat, and the increase of saturated fatty acids was more pronounced. It was concluded that the most pronounced changes in fatty acids composition took place in pork fat, which suggests that it is more likely to alterative processes; hydrolysis and oxidation were installed faster in pork fat than in beef tallow.

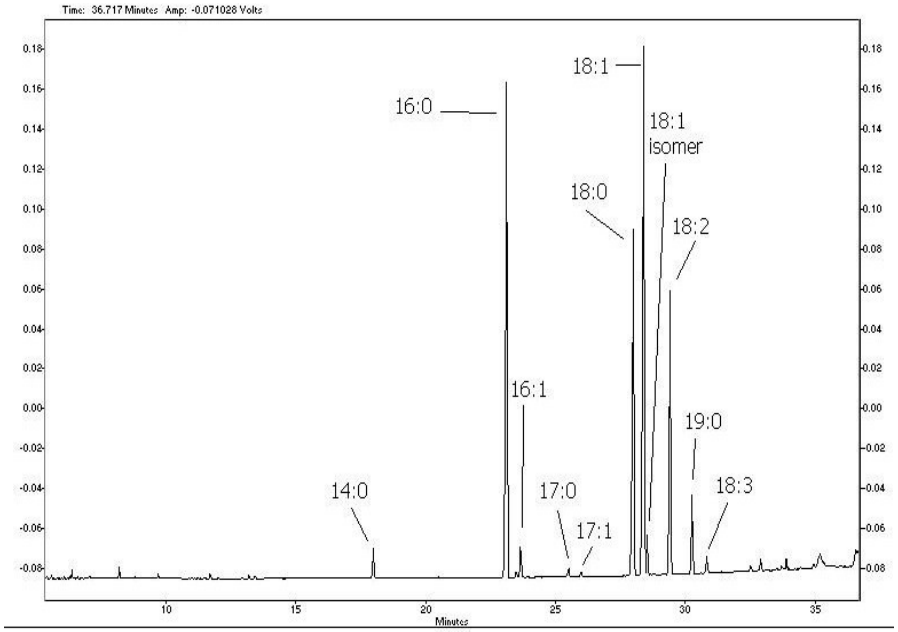

Figure 2. Fatty acids chromatogram of pork adipose tissue over a 4 months freezing time period

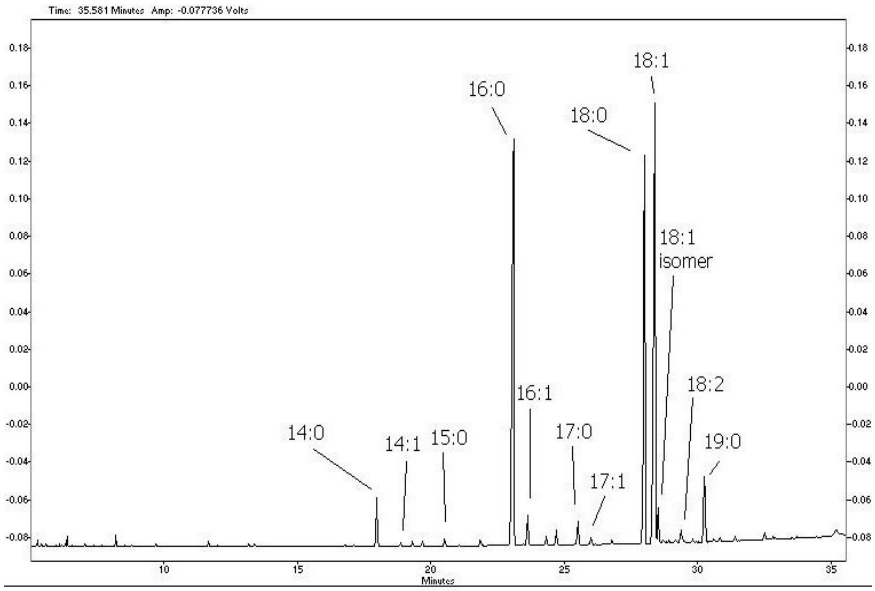

Figure 3. Fatty acids chromatogram of fresh buffalo tallow

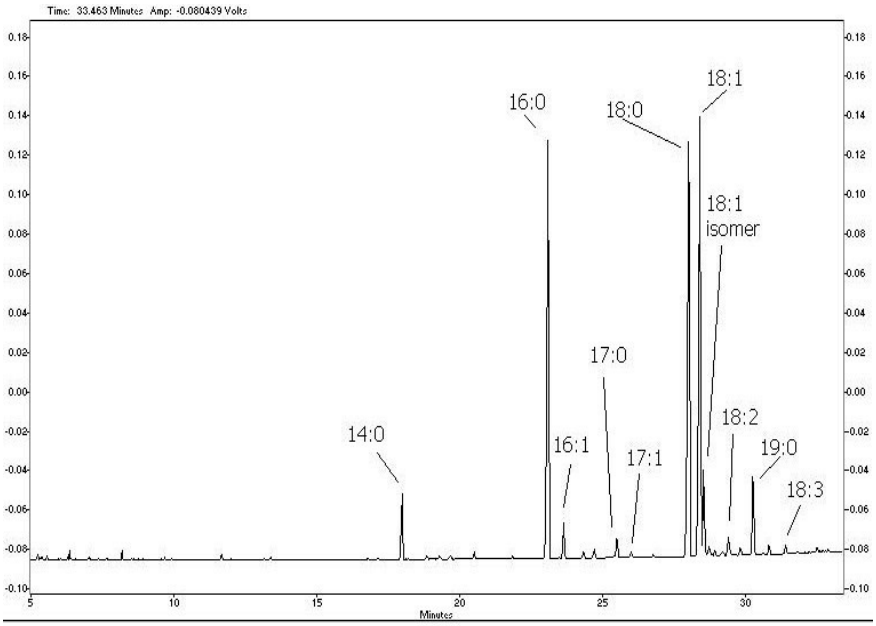

Figure 4. Fatty acids chromatogram of buffalo tallow over a 4 months time period of freezing

4. Conclusions

Determination of the chemical composition of animal fats is important in establishing organoleptic and physico-chemical parameters, their variation in time, being an indicator of their stability compared to the alterative processes. Of the studied fats, the most susceptible to oxidation is pork fat on account of its high content of polyunsaturated fatty acid (14.89%). In the case of buffalo tallow the changes in fatty acids composition were not so pronounced, which suggests that it can be preserved for a long period of time under freezing. It was concluded that the increase of saturated fatty acids content is due to hydrolysis leading to the release of acids from triglycerides structure, and the decrease of MUFA and PUFA is due to unsaturated fatty acids oxidation. During the freezing storage there are changes in the fatty acids composition, being an indicator of their stability under hydrolysis and oxidation processes.

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***Romanian Standard SR EN 661, 1998

***Romanian Standard SR EN 14082, 2003