Fatty acid composition of dairy fat products of vegetable origin

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Abstract

Introduction. For enrichment of polyunsaturated fatty acids and increasing biological and nutritional value of dietary fiber of spreads it is offered to add sweet brier processing products (SPP) - oil and meal. The expediency and the use of these products is proved for producing of emulsive type dairy fat products of vegetable origin with dietary fiber as "Citri-Fi".

Materials and methods. With the method of gas-liquid chromotography peak samples products of sweetbrier processing are identified. Found that received dairy fat products of vegetable origin of emulsive type contain more unsatured fatty acids than butter, which is included to the recipe of spreads.

Results and discussion. Found that in the investigated spread the amount of saturated and unsaturated fatty acids are reduced (capric (by 1,136 %), lauric (at 1.958 %), myristic (by 3.03 %), palmitic (at 6.454 %), stearic (at 1,016 %), arachidonic (by 0,229 %) also the amount of trans-isomers that during the consuming of the product can cause cardiovascular disease (by 1,305 % compared with butter). The main ω-3 fatty acid in dairy fat products of vegetable origin with dietary fiber is linolenic, compared with butter its content increases by 0,038 %. Among the ω- 6 acids in samples linoleic dominates which increases by 0,458 %, linoleic cis-9, cis-12 $C_{18:2}$ – 15,282 %. From monounsaturated fatty acids in the spread of PSP the lower amount of such fatty acids as: mirystooleinic, palmooleinic, heptadecenoic, elaidonic but more oleic (by 1,831 %). The results can be used in determining the biological value of the PCA spreads due to current principles of nutrition science.

Introduction

Development of combined food-based analytical evaluation of the quality and quantity of nutrients contained in them, led to the need of methodological approaches that are based on the principle of selection of key nutrients, modeling and optimization quality. This direction was developed in methods of calculating quality of protein and less lipid components of some foods, especially in many components of milk-based mixtures.

There is a shortage of polyunsaturated fatty acids (PUFA): linoleic, linolenic, arachidonic in the diet of modern people. These acids in their biological properties belong to the essential matters which are not synthesized in the human body, and therefore must come from food. Biological properties of oils and fats and fatty acids are provided by their fatty and acidtriglyceride content as well as the presence of biologically active compounds (tocopherols, sterols, phospholipids, carotenoids, etc). However, the basic criterion of the nutritional value of these products is their fatty acid composition. Therefore not accidently one of the stages in the transformation of traditional fat product in a product with high biological value is the change of the fat phase by selecting balance in number and ratio of polyunsaturated fatty acids of fatty bases.

Analysis of the literature

According to the principles of healthy eating physiologically full value food fat appointed for feeding healthy body should contain 30-40% saturated fatty acids (SFA), 50-60% mono-unsaturated fatty acids (MUFA) and 10-20% PUFA. A fractional ratio of fatty acid component of "standard" lipid is adopted (g/100 g fatty acids): SFA: PUFA: MUFA = 3: 1: 6. And if we analyze the class of fatty acids ω-3 and ω-6, we will have the same ratio, %:SFA:PUFA $_{ω-3}$:PUFA $_{ω-6}$: MUFA=23,0:1,6:6,4:69,0

Research of fatty acid composition of natural oils showed that there is no "ideal" body fat in nature with the composition that provides admission of essential fatty acids in the right amounts and proper proportions for human body.There are several ways to provide body with PUFA:

- creation of genetically modified sources of vegetable oils high in PUFA, including ω-3;
- increasing the share of oil in the diet with high content of ω-3 PUFA (linseed, false flax, canola oil);
- use of nutritional dietary supplements in the form of oil products and powders with a high (30 %) content of ω-3 PUFA;
- obtain and use of blended vegetable oils in food with essential content and the ratio of acids ω-6 and ω-3;
- use of blended vegetable oils in food (dairy, emulsive and baby products).

The most effective way of creating milk-fat foods with balanced composition and ratio of ω-6 and ω-3 PUFA is enriching with vegetable oils. In the late 1990s the concept of creating such products was established by scientists of Moscow National University of Food Industry, and jointly with the Center of Innovation and Development "Healthy Foods" the technology of their production was offered, including a system of calculating the optimal fatty acid composition.

Benefits of using vegetable oils to correct lack of PUFA to dietary supplements and medicine are as follows - oil is traditional food consumption of which does not cause complications and adverse reactions in the body and is much cheaper than dietary supplements.

Features of milk-fat products technology are following: spreads with fillers give the possibility to use ingredients of vegetable origin, mainly oils along with dairy ones. Through their presence spreads have several advantages over butter: plastic consistency at different temperatures from 0 to 10ºC, contain of more vitamins and biologically active substances and less cholesterol.

Biological efficiency as an indicator characterizes the balance of product with the content of polyunsaturated fatty acids, essential amino acids, phospholipids, minerals, polyphenols compounds and vitamins. Increased biological value of milk-fat product is achieved by the following:

- natural extracts and vitamins that reduce the rate of aging and neutralize the negative impact of the environment;
- polyunsaturated fatty acids that strengthen the cardiovascular system of a person, reduce bad cholesterol in the blood;
- prebiotics - polydextrose, natural dietary fiber.

For the production of milk-fat products using oils with alternative raw materials for the enrichment with physiologically important components is very actual nowadays. In particular, sweetbrier oil should get special attention, which is extracted from the crushed seeds of orange-red sweet brier - a perennial shrub of the Rosaceae family. Sweet brier is one of the main plant for the production of multivitamin and other medicine that are essential for health.

Composition of sweet brier oil is represented with a wide range of components such as fatty acids (polyunsaturated: linoleic, oleic, linoleic), saturated (myristic, palmitic, etc.), vitamins C and A, tocopherols, carotenoids, trace elements (Mn, Cu, Mb), macro elements (Fe, Mg, K, Ca, P). Sweet brier contains: vitamins (P, B_1, B_2, K, E), 0,01 to 0,06 % carotene, up to 8 % carbohydrate, up to 3,6% acids, flavonoids (astrahalin, hiperozyd, quercetin), catechins, lycopene, xanthophylls, arumin. After extraction of oil as a byproduct protein meal is produced, according to the concept of a balanced diet by A. Pokrovsky, the daily requirement for an adult in dietary fiber is 25 g. Due to this information it is appropriate to enrich milk fat emulsion products with such products of complex plant processing as oil and protein meal of sweet brier.

Purpose of the study is to study the influence of plant processing products on the fatty acid composition of foods high in fat - spreads with dietary fiber.

Materials and methods

Objects of the study are spreads with oil and protein meal of sweet brier. Investigation the fatty acid composition of spreads with sweet brier processing products prototypes of the technology, based on the separate preparation of milk-fat emulsion and mixing with cream has been elaborated. Vegetable-fat mixture is prepared using orange dietary fiber. Recipe model of spreads samples is presented in Table 1.

Table 1

The recipe of spread of SPP with 15-% replacement of milk fat with vegetable fat with mass fraction of total fat 72,5% excluding losses (kg to 1000 kg)

Raw material	Traditional	Elaborated
Sweet cream unsalted butter (fat 72,5 %, moisture 25,0 %, dry fat-free matter 2,5 %)	799,0	799,0
Sweet brier oil (fat 99,9 %)	-	141,27
Sunflowerseed oil (fat 99,7 %)	141,27	-
Dry fat-free milk (fat 1,5 %, dry matter 95 %)	4,00	3,26
Emulsion stabilizer (fat 100 %)	4,25	4,25
Sweet brier protein meal	-	1,25
Orange dietary fiber Citri-Fi (dry matter 95 %)	-	0,3
Flavoring matter	0,3	0,3
Water	51,18	51,62
Total yield	1000	1000

Table 2

Concentration of fatty acids, lipids of studied fat dairy products, % (of total fatty acids)

№	Fatty acids	Concentration, %	
		Sweet cream butter	Spread of SPP
1	Oleic ($C_{4:0}$)	4,308	3,338
2	Caproic ($C_{6:0}$)	2,624	1,854
3	Caprylic ($C_{8:0}$)	1,555	0,995
4	Capric ($C_{10:0}$)	3,011	1,875
5	Undecanoic ($C_{11:0}$)	0,328	0,191
6	Lauric ($C_{12:0}$)	3,983	2,025
12	Tridecanoic ($C_{13:0}$)	0,224	0,141
13	Myristic ($C_{14:0}$)	9,636	6,606
15	Myristeoleic ($C_{14:1}$)	0,512	0,434
17	Pendadecynic ($C_{15:0}$)	1,122	0,883
19	Palmitic ($C_{16:0}$)	26,255	19,801
21	Palmitooloic ($C_{16:1}$)	1,344	0,717
26	Heptadecoic ($C_{17:0}$)	0,046	0,032
27	Heptadecenoic ($C_{17:1}$)	0,240	0,216
28	Stearic ($C_{18:0}$)	10,038	9,022
29	Elaidic ($C_{18:1}$)	3,205	2,044
30	Oleic ($C_{18:1}$)	22,046	23,877
31	Linoleic ($C_{18:2}$) trans	0,446	0,302
32	Linoleic ($C_{18:2}$) cis	2,966	18,248
33	Arachidonic ($C_{19:0}$)	0,203	0,031
34	Linoleic ($C_{18:2}$) ω-6	0,206	0,244
35	Linolenic ($C_{18:3}$) ω-3	0,519	0,977

As a control, traditional butter was used, which is produced by classical technology.

Investigation of fatty acid composition of milk fat products peaks of spreads sample of sweet brier processing products were identified. The measurements were performed by comparing the retention time of the control mixture using a gas chromatograph "Kupol-55" of column length 30 m, internal diameter 32 mm, thickness 0,25mm, injector temperature 250°C, detector temperature 260°C. Thermostat of the column: initial temperature - 60°C with 15 min of aging, finish temperature - 220°C with 150 min of aging. As a standard sweet cream traditional butter was taken with a mass fracture of fat 72,3% produced by classical technology . The method is founded on the principle that the methyl esters of fatty acids are prepared by interesterification, and then are shared and determined by capillary gas-liquid chromatography.

Results and discussion

The concentration of fatty acids, lipids of studied fat dairy products, % (of total fatty acids) is presented in Table. 2 and chromatograms (Figure 1-2).

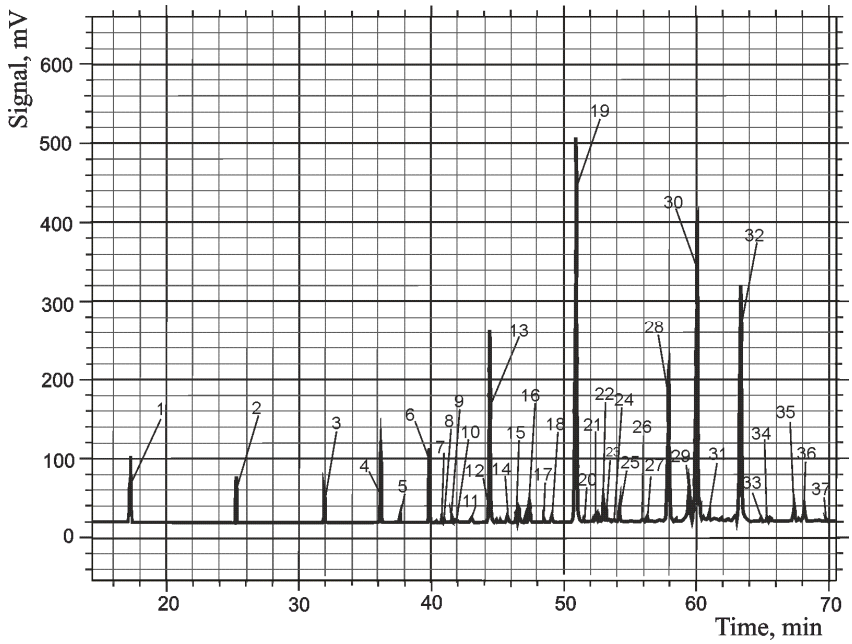

Fig 1. Chromatogram of sweet cream traditional butter

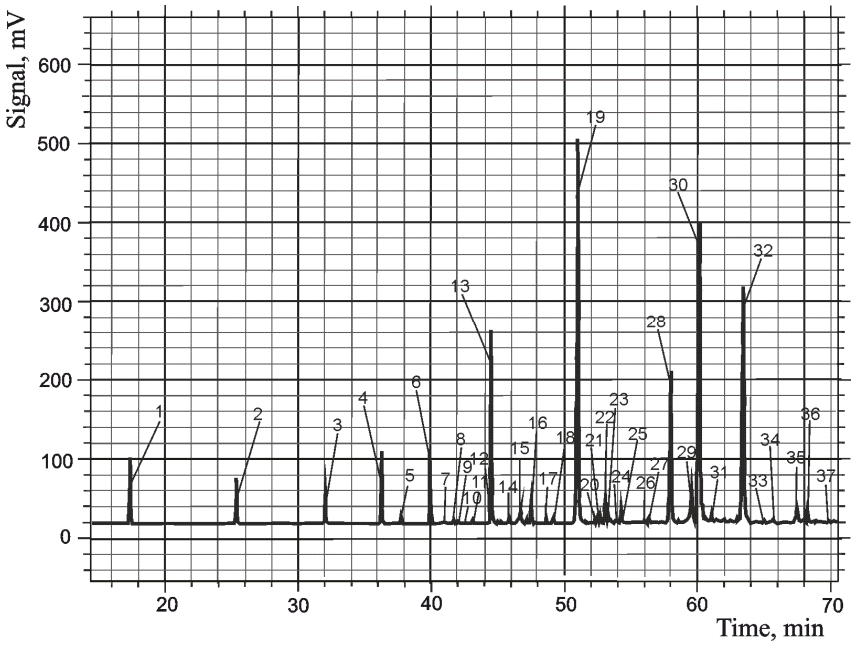

Fig 2. Chromatogram of spread of SPP

From the chromatogram presented in Fig. 1-2 is shown that elaborated spread with oil and sweet brier protein meal contains less saturated fatty acids compared with control. As you know , the most undesirable fatty acids of milk fat is medium- saturated fatty acids $C_{12:0}$, $C_{14:0}$ and $C_{16:0}$, as they increase the level of cholesterol and lipoprotein of low density in blood and, therefore, have atherogenic and thrombogenic properties. Instead, unsaturated acid analogues of this group do not have negative effects on human health. The biggest difference is in caproic (by 1,136 %), lauric (at 1.958 %), myristic (by 3.03 %), palmitic (at 6.454 %), stearic (by 1,016 %), arachidonic (by 0,229 %). In the spread of SPP from monounsaturated fatty acids there less: myristeoleic, palmitooloic, heptadecenoic, elaidic but more oleic (by 1,831 %).

Polyunsaturated fatty acids ω-3 and ω-6 series have antiatherogenic and antithrombogenic action, healthy diet strategy involves a rise in their contents in human diets. The main ω-3 fatty acid in milk fat foods is linolenic. Among the ω- 6 acids in samples linoleic dominates (cis-9, cis-12 $C_{18:2}$). These acids are essential, and therefore must come to the body with food. Spread contains more polyunsaturated fatty acids than sweet cream traditional butter: by 15,282 % linoleic, linolenic (ω-3) by 0,038 %, linoleic (ω-6) by 0,458 %. Number transisomers in the spread of dietary fiber compared with butter reduced by 1,305 %.

Conclusion

1. The study of fatty acid composition of SPP spread with oil and protein meal, it was found that received plant-derived milk fat emulsion type product contains more essential fatty acids than butter, which spread recipe includes.
2. The main ω-3 fatty acid in dairy fat products of vegetable origin with dietary fiber is linolenic, compared with butter its content increases by 0,038 %. Among the ω- 6 acids

in samples linoleic dominates which increases by 0,458 %, linoleic cis-9, cis-12 $C_{18:2}$ – 15,282 %.

3. Found that in the investigated spread the amount of saturated and unsaturated fatty acids are reduced (capric (by 1,136 %), lauric (at 1.958 %), myristic (by 3.03 %), palmitic (at 6.454 %), stearic (at 1,016 %), arachidonic (by 0,229 %) also the amount of trans-isomers that during the consuming of the product can cause cardiovascular disease (by 1,305 % compared with butter).
4. It is found that in the investigated spread saturated fatty acids and trans-isomers that can cause cardiovascular disease during the consumption reduces. The results can be used in determining the biological value of the SPP spreads under the current principles of nutritiology.

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