



## MILK FAT FATTY ACIDS IN RELATION TO MILK PRODUCTION AND QUALITY

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### ABSTRACT

Milk fat is from a nutritional point of view of the negative evaluation because of the dominant content of saturated fatty acid with high atherogenic index. Intake of milk fat in the diet is important because of the content of monounsaturated fatty acids, acting favorably against cardiovascular diseases and especially of essential fatty acids, linoleic, alpha linolenic and conjugated linoleic acid (CLA), which is found only in meat and milk of ruminants. These are precursors of biologically active substances - hormones and enzymes.

The analysis of relations of fatty acids in milk fat to qualitative-production parameters of milk shows that the correlations of fatty acids with lactation stage and qualitative-production parameters of milk are quite weak in dairy cows with stable type of nutrition in form of whole-the-year feeding mixed feed ration in lowland agricultural area. Changes in milk fat composition are caused by the change in the ratio of de novo and depot fatty acids. Relation of fatty acids to the evaluated parameters lies with their metabolic origin and neither acid nor group underlies the specific influence of the studied parameters, by the means of which it would be possible to influence its proportion in milk fat. And so it is not possible to influence some group or a desirable fatty acid, e.g. CLA, without the influence on total milk fat.

**Keywords:** milk, fat, fatty acids, lactation

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## INTRODUCTION

Milk fat is from nutritional point of view evaluated negatively because of dominant content of saturated fatty acids with atherogenic effect, as well as content of undesirable trans isomers, but this is negligible in milk fat compared with other fats. The occurrence of fatty acids' trans isomers, which are put into connection with incidence of heart-vessel diseases, is an important factor that influences the effect of fats on health, because they affect negatively the ratios HDL and LDL cholesterol similarly to hypercholesterolemic acids (**Mensink, 2005**). However, it is a problem mainly of hydrogenated fats. Trans isomers of mono unsaturated fatty acids are created in rumen during the biohydrogenation. This is a desirable process, which enables rise of chains of essential fatty acids, linoleic and alpha linolenic, and the main of them, the acid delta 11 trans C18:1 is the precursor of conjugated linoleic acid CLA, which occurs only in meat and milk of ruminants. These chains are precursors of biologically active substances – hormones and enzymes. Milk products are the main source of CLA, which is considered to be the functional component of foods with positive influence on health. The occurrence of other trans isomers of monounsaturated fatty acids MUFA in milk fat is minimal, on the border of detectability in relation to other fatty acids. The intake of milk fat in nutrition is important for the content of fatty acids increasing its biological value. Important are mainly unsaturated fatty acids in cis configurations, first of all of oleic acid C18:1n6cis, which operate positively against cardio-vascular disorders (**Haug, 2007**). Positive property of milk fat is also its good ratio, 1: (1.16-4), of omega 3 (n3) and omega6 (n6) fatty acids (**Colomb et al., 2004**). Assessment of milk fat importance in nutrition should be done by complex studies, not only on the basis of effect of individual types of acids, when they are studied separately.

It is necessary to know the course of milk fat biosynthesis in order to characterize the relations between nutrients in feed and milk components. Fatty acids with short chains up to C<sub>10</sub> come from the biosynthesis in milk gland. Acetic acid is the building stone, which arises at fermentation processes in rumen. In the process of reduction condensation it creates a prolongating chain in form of Acetyl-CoA, creating higher and higher fatty acids with even number of carbon atoms in this way. Higher saturated fatty acids from C<sub>18</sub> come predominantly from blood plasma, into which they got from feed or from reducing depot fat of dairy cow. Fatty acids from C<sub>12</sub> to C<sub>16</sub> can be of both origins. Odd fatty acids arise by

prolongation of propionyl-CoA instead of acetyl-CoA. Branched chain fatty acids arise by prolongation of chain that arose by oxidative deamination of branched amino acids (valine – isoaminovaleric acid, leucine – isoaminocaproic acid, isoleucine – anteisoaminocaproic acid). This construction can be realised by microorganisms in proventriculi/forestomachs at the synthesis of microbial fat, or by cells of secretion epithelium in milk gland. Milk fat unsaturated fatty acids C<sub>18:1</sub> and C<sub>16:1</sub> can originate from resorption of the feed fat but more unsaturated fatty acids originate from own synthesis by milk gland, because unsaturated fatty acids from feed lipids are hydrogenated in proventriculi/forestomachs of ruminants. Higher organisms are able to incorporate double bonds in molecule by means of dehydrogenating enzyme system and reactions of chain growth (**Melcher 1975, Jenkins and Mcguire 2006, Bauman et al. 2006**).

The influence of lactation stage on milk fat composition corresponds with metabolic origin of fatty acids, when acids synthesized *de novo* are lower at the beginning of lactation than in later stages as a result of negative energy balance, and with their growth in the course of lactation decrease fatty acids with longer chain. The authors found changes during the first third of lactation, which cease gradually up to 10 weeks or to first 100 days. During the beginning of lactation increases the content of lower acids synthesized *de novo*, and decreases the content of higher acids from deposit fat (**Garnsworthy et al., 2006**). **Komprda et al. (2001)** studied representation of fatty acids in first third of lactation. Content of myristic acid rose significantly and content of stearic acid decreased irrespective of feeding ration. Results from studies of composition changes in fatty acids (**Kirchnerová et al., 1988**) showed that during the first 18 weeks of lactation decreased the summary content of fatty acids C<sub>18:0</sub> and C<sub>18:1</sub> from 40 to 30%, and content of fatty acids C<sub>14:0</sub> and C<sub>16:0</sub> increased from 35 to 45 % out of total content of fatty acids, whereas the content of linoleic (C<sub>18:2</sub>) and linolenic (C<sub>18:3</sub>) acids was relatively stable. Changes in milk fat composition during early lactation were connected with different intensity of nutrition during the preparation for lactation in the period of drying off.

The objective of our study was to study relations among lactation stage and qualitative and production parameters of milk and representation of fatty acids of milk fat in dairy cows with stable type of nutrition by system of round-the-year feeding the mixed feed ration in lowland agricultural area.

## **MATERIAL AND METHODS**

### **Selection of animals**

We selected herds with stable type of nutrition by round-the-year feeding the mixed feed ration based on maize silage to study and monitor milk fat in dairy cows in first lactation. We processed data on their milk efficiency on the basis of milk recording. We sampled milk from the whole amount of milked milk on individual selected farms at regular milk recording. In the milk samples we assessed basic qualitative and technological properties as well as composition of fatty acids in milk fat. Individual milk samples from individual dairy cows (n=100) sampled on farms in lowland agricultural area were analysed for physiological and biochemical parameters. They were also processed for the analysis of fatty acids in milk fat by gas chromatography, which was subsequently performed.

### **Analysis of fatty acids by gas chromatography**

Milk fat was isolated from lyophilised milk samples by extraction in petroleum ether according to Röse-Gottlieb, then it was re-esterified by methanol potassium hydroxide solution, and methyl esters of fatty acids were extracted by hexane. Methyl esters of fatty acids were analysed by gas chromatography (apparatus GC Varian 3800, Techtron, USA), using FID detector in capillary column Omegawax 530; 30m. Irregular temperature gradient from 40 to 240<sup>o</sup> C, injection and detection at 250<sup>o</sup>C were used. Nitrogen flow rate was 6 ml.min<sup>-1</sup>. In the chromatography record were identified 54 fatty acids inclusive of particular isomers by standard reference sample of milk fat and analytical standards Supelco, followed by GCMS analysis. Their representation was expressed relatively in percents (%). Groups of fatty acids and their abbreviation as well as calculated indexes were created according to traditional structural-chemical and nutrition criteria in line with works given in References.

### **Analyses of milk samples**

Content of fat, proteins and lactose was determined by infrared analyser Milkoscan FT 120, firm FOSS Electric, with DID detector (diode array = diode field in whole red spectrum) according to ISO 9622: 1999 Whole milk – Determination of milk fat, protein and lactose

content – Guidance on the operation of mid-infrared instruments. Somatic cells count (SCC) was determined in apparatus Somacount 150, firm Bentley Instruments, on the principle of through-flow cytometry, according to STN EN ISO 13366-1: 2008. Temperature of milk freezing (TMF) was determined in thermistor cryoscopic apparatus Cryostar, firm Funke Gerber, according to the norm ISO 5764: 2002 Milk – Determination of freezing point. Content of urea was determined photocolometrically with Ehrlich's agent, at wave length 530 nm.

### **Mathematic-statistical evaluation of results**

Results of analyses were processed by variation-statistical methods of the system programme Statgraphics. Following statistical characteristics were calculated: arithmetical mean  $\bar{x}$ , minimum and maximum, standard deviation  $S_x$ , variation coefficient  $V_k$ . The test of two means agreement (T-test - type for uneven variances) was used to determine significance of difference. Coefficients of linear correlation ( $r$ ) were calculated to express relations among the studied parameters, and their statistical significance was tested.

## **RESULTS AND DISCUSSION**

If we are looking for possibilities how to improve the profile of fatty acids in milk fat, it is necessary to evaluate mutual relations of production parameters in set of dairy cows as well as the qualitative properties of milk, which reflect their condition and spectrum of fatty acids. Changes in qualitative production parameters and composition of milk fat during lactation were not very large with round-the-year feeding the mixed feed ration in lowland agricultural area. The graphic presentation does not show values or change in course in relation to the number of lactation days, which would indicate dissection of lactation into linear parts. On this basis we studied the relations among the detected parameters by means of linear regression for the total number of lactation days. We studied the period from 22 to 369 days of lactation. The set of dairy cows from herds with round-the-year feeding ration has a quite high average daily production of milk, fat and proteins ([27.78, 1.03 and 0.85] kg/day) with low variability (20 %). This stability manifested evident also in relations among the studied parameters.

At the sight of tables with correlation coefficients (table 1 and 2) we can see that they are quite low. Coefficients among volatile fatty acids (VFA) and values of lactation sum

achieved the limit of statistical significance  $P < 0.01$ , when  $r < -0.3$ . These coefficients are decreasing with the length of chain in individual acids C4:0, C6:0, C8:0 and C10:0. They are the highest in absolute value with butyric acid (C4:0), namely -0.418 to the number of lactation days, -0.342 to the amount of produced milk, -0.322 to the amount of fat, and -0.372 to the amount of proteins.

Coefficients  $r > 0.3$  for the values of lactation sum were observed at monounsaturated fatty acids (MUFASC), 0.467 for days, 0.307 for milk, 0.353 for fat, and 0.340 for proteins, caused mainly by myristic acid (C14:1), which is out of all evaluated acids in the closest relation to the level of production for the past lactation period; 0.597 for days, 0.481 for milk, 0.431 for fat and 0.508 for proteins. In connection with it is also, opposite to other desaturation indices, the extraordinary relation of desC14 (0.545 days, 0.474 milk, 0.330 fat, 0.488 proteins) to sum parameters. C14:1 has also a high correlation coefficient to the content of proteins in milk  $r = 0.409$ .

The most important fatty acids, as far as content is concerned, C12:0, C14:0, C16:0, C18:0, C18:1n9, the ratio of which is higher than 5% in milk fat and they represent together about 75 % of milk fat, show no significant relations either to sum or to daily production parameters or to the content of components in milk. With the exception of C16:0, palmitic acid ( $30.93 \pm 4.81$  % in milk fat), which has negative relation to daily milk production (-0.404) and proteins (-0.345). This acid has positive relation to the content of fat in milk (0.444) and negative relation to the content of lactose in milk (-0.311), which manifested also in the relation of saturated fatty acids with medium chain length (SAFAMC) to the content of fat ( $r = 0.446$ ) and lactose ( $r = -0.306$ ) in milk. The relation to lactose was transferred also into the relation to TMF ( $r = -0.274$ ), to which has lactose a positive relation. This fatty acid with medium chain usually does not change markedly its content in milk fat in the course of lactation, which was manifested also at lower milk yield, where more marked changes in other acids took place, also showed that it has a similar function among fatty acids as lactose among milk components; its production capacity, which is determining for milk amount, becomes exhausted at higher production. **Hanuš et al. (2010)** was engaged in the relations of fatty acids, which are important for health, to milk components. In their study they did not observe significant relations between the most important saturated palmitic fatty acid C16:0 and milk components.

CLA and isomers C16:1 and C18:1 have negative correlation with daily fat production (for CLA -0.407) and content of fat in milk (for CLA -0.269) and index F/P (for CLA -0.420); for C18:1 -0.553 to fat in g/100g, and -0.528 to the F/P index. They indicate in this way that

they are of another origin than other higher unsaturated fatty acids, which are resorbed from blood of dairy cow, namely that they are probably synthesized *de novo* in secretion epithelium, and their proportion in milk decreases with the increase of fat content in milk. CLA content in milk fat increases during lactation, most closely in connection with increasing total milk production,  $r=0.427$  and proteins  $r=0.415$ . CLA biosynthesis increases in spite of gradual exhaustion of body fat reserves. **Hanuš et al. (2010)** observed statistically significant relations of CLA proportion in milk fat to fat content ( $r=0.379$ ;  $P<0.01$ ) and to the content of lactose ( $r=-0.542$ ;  $P<0.001$ ). Total production of fat and lactose plays probably an essential role in these relations.

The content of n6 acids (mostly C18:2n6LA) increases slightly in connection with sum of lactation and decreases with the rise of daily production of fat, and it decreases significantly with increasing content of fat in milk ( $-0.403$ ) and more markedly with F/P index ( $-0.464$ ;  $P<0.01$ ). It manifested itself also in marked decrease of the ratio n6/n3, mainly with fat content ( $-0.557$ ;  $P<0.001$ ). The less marked increase in n3 acids supported it also. Marked decrease in the content of polyunsaturated fatty acids (PUFA) ( $r=-0.418$ ) and essential fatty acids (EFA) ( $r=-0.433$ ) with the increase of daily fat production is the result. **Hanuš et al. (2010)** observed statistically significant relations of total sum of polyunsaturated fatty acids to the content of fat in milk ( $r=0.321$ ;  $P<0.05$ ) and to the content of lactose in milk ( $r=0.458$ ;  $P<0.01$ ). However, within this group it is important to evaluate separately n6 and n3 fatty acids.

The relation of alpha linolenic acid (ALA) with the content of dry matter (0.411) is positive, and with the absolute TFM value (expressed in  $-m^{\circ}C$ ) it is negative ( $-0.357$ ), which is contradictory, because if dry matter is rising, TFM should theoretically rise also. This shows complexity of TFM parameter as well as the fact that this theory has no unambiguous confirmation in results; TFM is more influenced by other milk properties, e.g. acidity, which influences dissociation of salts in milk.

SCC, which has low variation coefficient in the system with round-the-year feeding ration, and a standard maximum value to  $400.ml^{-1}$  that was kept during the study, has in this span no significant influence on representation of fatty acids in milk fat. Similarly **Hanuš et al. (2010)** did not observe significant relations between SCC and content of fatty acids in milk fat.

Content of urea has a slightly positive relation to the content of branched chain fatty acids (BCFA) (0.245), mainly to C14:0i (0.227) and C16:0i (0.357), which can be explained by the origin of these isoacids from deaminated chains of amino acids from proteins, which

are used as source of energy, the urea being created at the same time. Both these acids have negative correlation (-0.324 and -0.448) with rising daily production of milk, as well as with rising production of milk proteins (-0.283, -0.380), which means that their content is higher with the higher content of milk fat with which they have positive correlation (0.464, 0.562). Also the odd C15:1 decreases with daily production of milk (-0.475) and proteins (-0.384), which is related to equal origin of its chain.

## **CONCLUSION**

The analysis of relations of fatty acids in milk fat to qualitative-production parameters of milk shows that the correlations of fatty acids with lactation stage and qualitative-production parameters of milk are quite weak in dairy cows with stable type of nutrition in form of whole-the-year feeding mixed feed ration in lowland agricultural area. Changes in milk fat composition are caused by the change in the ratio of de novo and depot fatty acids. Relation of fatty acids to the evaluated parameters lies with their metabolic origin and neither acid nor group underlies the specific influence of the studied parameters, by the means of which it would be possible to influence its proportion in milk fat. And so it is not possible to influence some group or a desirable fatty acid, e.g. CLA, without the influence on total milk fat.



**Table 1** Correlation coefficients between parameters of production a quality of milk and groups of fatty acids of milk fat.

	Days of lactation D	Milk kg Sum of lactation	Fat kg	Protein kg	Milk kg.D <sup>-1</sup> Daily production	Fat kg.D <sup>-1</sup>	Protein kg.D <sup>-1</sup>	F/P index	Fat g.(100g) <sup>-1</sup> Milk composition	Protein	Lactose	SCC .10 <sup>3</sup> .ml <sup>-1</sup> Milk quality	TFM -m°C	Urea mg.l <sup>-1</sup>
SAFASC	-0,184	-0,203	-0,073	-0,204	0,046	0,198	0,023	0,122	0,041	-0,167	-0,121	0,167	0,092	-0,009
SAFAMC	0,013	-0,210	0,085	-0,165	-0,416	0,050	-0,357	0,376	0,446	0,170	-0,306	0,046	-0,269	-0,148
SAFALC	0,003	0,161	-0,017	0,141	0,268	-0,020	0,237	-0,096	-0,128	-0,052	0,230	-0,124	0,027	-0,048
SAFA	-0,162	-0,296	-0,009	-0,269	-0,183	0,217	-0,170	0,370	0,337	-0,044	-0,269	0,148	-0,111	-0,139
VFA	-0,332	-0,298	-0,224	-0,316	0,170	0,266	0,096	0,188	0,014	-0,323	-0,057	0,173	0,098	0,018
HCHFA	0,052	-0,158	0,149	-0,112	-0,382	0,067	-0,308	0,316	0,408	0,192	-0,316	0,081	-0,189	-0,135
BCFA	0,206	0,038	0,127	0,073	-0,392	-0,233	-0,333	0,038	0,137	0,185	0,112	0,083	0,191	0,245
MUFASC	0,467	0,307	0,353	0,340	-0,265	-0,243	-0,168	-0,364	-0,151	0,330	-0,119	-0,012	-0,057	-0,160
MUFAMC	0,105	0,049	-0,024	0,048	-0,170	-0,145	-0,162	-0,077	-0,050	0,063	0,141	-0,023	0,038	0,121
MUFALC	0,087	0,256	-0,029	0,224	0,254	-0,151	0,227	-0,334	-0,336	-0,016	0,277	-0,136	0,148	0,169
MUFA	0,128	0,282	-0,006	0,252	0,224	-0,179	0,205	-0,367	-0,352	0,011	0,281	-0,140	0,148	0,167
PUFA	0,352	0,284	0,118	0,291	-0,205	-0,418	-0,165	-0,243	-0,087	0,278	0,068	-0,154	-0,211	-0,127
USFA	0,162	0,296	0,009	0,269	0,183	-0,217	0,170	-0,370	-0,337	0,044	0,269	-0,148	0,111	0,139
SCFA	-0,147	-0,176	-0,047	-0,175	0,027	0,176	0,011	0,094	0,030	-0,140	-0,125	0,161	0,085	-0,020
MCFA	0,022	-0,205	0,082	-0,160	-0,427	0,037	-0,368	0,367	0,439	0,174	-0,292	0,043	-0,264	-0,137
LCFA	0,099	0,259	-0,014	0,231	0,240	-0,156	0,216	-0,295	-0,290	0,000	0,273	-0,149	0,096	0,098
desC14	0,550	0,474	0,330	0,488	-0,133	-0,345	-0,059	-0,548	-0,340	0,337	0,080	-0,139	-0,084	-0,146
desC16	0,177	0,283	0,052	0,258	0,132	-0,128	0,125	-0,292	-0,270	0,037	0,257	-0,069	0,177	0,197
desC18	0,111	0,113	-0,013	0,104	-0,060	-0,197	-0,045	-0,286	-0,225	0,086	0,076	-0,028	0,191	0,317
n6	0,316	0,354	0,078	0,328	0,017	-0,377	0,006	-0,464	-0,403	0,065	0,247	-0,168	-0,039	-0,149
n3	0,146	-0,039	0,057	0,008	-0,392	-0,201	-0,317	0,231	0,391	0,342	-0,198	-0,048	-0,336	-0,092

n6/n3	0,015	0,185	-0,034	0,130	0,353	-0,026	0,272	-0,446	-0,557	-0,281	0,273	0,003	0,249	-0,018
AI	-0,023	-0,148	0,113	-0,122	-0,173	0,174	-0,138	0,251	0,268	0,039	-0,306	0,141	-0,120	-0,162
EMK	0,365	0,306	0,122	0,309	-0,190	-0,433	-0,156	-0,277	-0,127	0,262	0,090	-0,154	-0,208	-0,138

Legend: SAFASC-Saturated fatty acids (FA) with short chain, SAFAMC-Saturated FA with middle long chain, SAFALC-Saturated FA with long chain, SAFA-Saturated FA , VFA-Volatile FA, HCHFA-Hypercholesterolaemic FA, BCFA Branched chain FA, MUFASC-Monounsaturated FA with short chain, MUFAMC-Monounsaturated FA with middle long chain, MUFALC-Monounsaturated FA with long chain, MUFA-Monounsaturated FA, PUFA-Polyunsaturated FA, USFA-Unsaturated FA, SCFA-Short chain FA, MCFA-Middle chain FA, LCFA-Long chain FA, des-desaturase, AI-Atherogenic index, EMK-Essential FA

**Table 2** Correlation coefficients between parameters of production a quality of milk and ratio of fatty acids of milk fat.

	Days of lactation D	Milk kg Sum of lactation	Fat kg	Protein kg	Milk kg.D <sup>-1</sup> Daily production	Fat kg.D <sup>-1</sup>	Protein kg.D <sup>-1</sup>	F/P index	Fat g.(100g) <sup>-1</sup> Milk composition	Protein	Lactose	SCC .10 <sup>3</sup> .ml <sup>-1</sup> Milk quality	TFM -m°C	Urea mg.l <sup>-1</sup>
C4:0	-0,418	-0,342	-0,322	-0,372	0,260	0,287	0,152	0,180	-0,043	-0,401	-0,028	0,107	0,093	0,046
C6:0	-0,353	-0,318	-0,259	-0,341	0,178	0,258	0,088	0,185	-0,010	-0,363	-0,055	0,161	0,072	-0,005
C8:0	-0,288	-0,280	-0,184	-0,293	0,113	0,242	0,054	0,198	0,047	-0,282	-0,068	0,189	0,100	0,007
C10:0	-0,197	-0,199	-0,084	-0,202	0,074	0,218	0,051	0,162	0,068	-0,182	-0,072	0,209	0,104	0,009
C12:0	-0,020	-0,084	0,069	-0,068	-0,066	0,120	-0,034	0,089	0,103	0,006	-0,120	0,173	0,083	-0,036
C14:0	0,196	0,109	0,278	0,141	-0,179	-0,009	-0,090	-0,024	0,116	0,228	-0,175	0,056	0,085	-0,001
C15:0	0,144	0,026	0,124	0,043	-0,208	-0,134	-0,176	-0,323	-0,212	0,120	-0,242	-0,053	-0,192	-0,219
C16:0	0,013	-0,205	0,090	-0,161	-0,404	0,057	-0,345	0,374	0,444	0,170	-0,311	0,045	-0,274	-0,158
C17:0	-0,176	-0,310	-0,242	-0,291	-0,298	-0,114	-0,314	0,097	0,069	-0,039	-0,113	-0,031	-0,190	-0,030
C18:0	-0,008	0,153	-0,026	0,132	0,277	-0,012	0,242	-0,097	-0,138	-0,069	0,239	-0,121	0,035	-0,044
C20:0	0,301	0,330	0,253	0,343	0,004	-0,164	0,062	-0,107	0,070	0,323	-0,033	-0,181	-0,131	-0,104
C14:0i	-0,165	-0,315	-0,035	-0,270	-0,324	0,117	-0,283	0,477	0,464	0,037	-0,039	0,124	0,087	0,227
C15:0ai	0,254	0,097	0,200	0,120	-0,309	-0,190	-0,257	-0,162	-0,050	0,147	-0,018	0,110	0,126	0,025
C16:0i	0,068	-0,146	0,075	-0,095	-0,448	-0,049	-0,379	0,474	0,563	0,243	-0,063	0,127	0,119	0,357
C17:0i	0,053	0,140	-0,068	0,119	0,101	-0,170	0,074	-0,303	-0,350	-0,103	0,348	-0,090	0,212	0,128
C14:1	0,597	0,480	0,431	0,508	-0,213	-0,325	-0,105	-0,529	-0,275	0,409	-0,021	-0,113	-0,039	-0,151
C15:1	0,094	-0,148	0,088	-0,091	-0,475	-0,064	-0,384	0,366	0,511	0,328	-0,155	0,097	-0,052	0,088
C16:1n7cis POA	0,158	0,100	0,079	0,107	-0,170	-0,097	-0,139	-0,044	0,026	0,147	0,074	-0,038	0,009	0,108
C16:1	0,157	0,095	-0,064	0,085	-0,152	-0,301	-0,163	-0,280	-0,269	-0,006	0,241	-0,035	0,047	-0,006
C17:1n7cis	-0,277	-0,259	-0,322	-0,274	-0,008	0,053	-0,070	0,165	0,027	-0,221	0,101	0,073	0,091	0,214
C18:1n9cis OA	0,077	0,249	-0,030	0,218	0,259	-0,134	0,235	-0,313	-0,314	-0,010	0,271	-0,131	0,159	0,184
C18:1	0,143	0,272	-0,056	0,229	0,193	-0,298	0,137	-0,528	-0,553	-0,111	0,319	-0,169	0,029	-0,008
C20:1n9cis	0,355	0,411	0,319	0,421	0,009	-0,159	0,087	-0,211	-0,065	0,261	0,151	-0,151	0,049	0,132
C18:2n6cis LA	0,321	0,373	0,091	0,345	0,045	-0,358	0,034	-0,474	-0,417	0,062	0,259	-0,165	-0,042	-0,154
C18:3n3cisALA	0,167	-0,013	0,057	0,029	-0,386	-0,236	-0,319	0,196	0,351	0,327	-0,185	-0,044	-0,357	-0,110
C18:2 9,11 CLA	0,394	0,427	0,179	<b>0,415</b>	-0,034	-0,407	-0,007	<b>-0,419</b>	-0,269	0,248	0,136	-0,138	-0,047	0,021
C20:4n6cis ETA	0,026	-0,069	-0,071	-0,068	-0,226	-0,203	-0,233	-0,085	-0,062	0,002	0,069	-0,091	0,119	-0,042
C20:4n3cis	0,104	-0,030	0,139	0,028	-0,225	0,067	-0,115	0,270	0,443	0,387	-0,233	-0,057	-0,061	0,061
C20:5n3cisEPA	0,029	-0,110	0,064	-0,060	-0,283	0,021	-0,202	0,322	0,462	0,318	-0,251	0,028	-0,228	-0,022

**Acknowledgments:** Contribution was based on project-APVV 0153-07. This article was written during realization of the project „CEGEZ no. 26220120042“, supported by the Operational Programme Research and Development funded from the European Regional Development Fund.

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