RESEARCHES REGARDING THE INFLUENCE OF EWE MILK PROCESSING METHODS ON THE STRUCTURE AND THE CONTENT IN PUFA OMEGA 3 AND CLA OF MILK PRODUCTS

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Researches had mainly aimed to establish the impact of some ewe milk processing methods (pasteurization, lactic fermentation by inoculating selected crops of lactic bacteria and transformation in cottage cheese and pressed cheese) on the profile of fatty acids and, especially, of polyunsaturated fatty acids (PUFA) Omega 3 (C 18:3, EPA, C 22:3, C 22:5 and DHA) and CLA (conjugated linoleic acid, specially C 18:2 n-9c, 11t isomer, also named rumenic acid). Industrial processing of ewe milk by pasteurization and then transformation into acid fermented milk products, cottage cheese or pressed cheese, cause a slight increase in the share of saturated fatty acids, but, there was an improved quality of fat by increasing Omega-3 polyunsaturated fatty acids and CLA, in particular, in acid fermented milk products. The best quality of ewe milk fat, analyzed in terms of influence on human health, it is obtained by strengthening it with lactobacillus culture or by conversion to fresh cheese.

***Key words**: ewe milk, ewe cheese, PUFA Omega 3, CLA*

The dairy products characteristics depend on a large number of factors linked to animal management systems sheep breed, climatic conditions, feeding, stage of lactation, etc [Claps S. et. al. 2007; Mierlita, D., et al. 2009].

An increasing interest in enhancing polyunsaturated fatty acids (PUFA) Omega 3 (C 18:3, EPA, C 22:3, C 22:5 and DHA) and CLA (conjugated linoleic acids) content in food products is attributed to its potential anticarcinogenic, antidiabetic, antiobesity, antiatherogenic, and immunomodulatory functions in experimental animal models. CLA is synthesized in the rumen from linoleic acid or from the endogenous conversion of t-11 C 18:1 in the mammary gland by desaturated [Ip, S., et al. 2004]. More than a dozen isomers of CLA have been detected in foods of ruminant origin, of which c-9, t-11 comprising 80 to 90% [Khanal R., et al. 2004].

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MATERIAL AND METHOD

Given that a very small amount of ewe milk production is consumed fresh, most of it being consumed as dairy products, the main purpose of this research was to study the effect of milk processing methods on the structure and content of Omega 3 PUFA and CLA in milk products, namely the determination of transfer efficiency of polyunsaturated fatty acids from raw milk in dairy products. In this direction there were taken into account the following aspects:

- pasteurization of milk;
- processing milk in acid milk products;
- processing milk in cheese (fresh cheese: cottage cheese, fermented cheese: pressed cheese).

Before processing milk into diary, the milk is pasteurized to destroy vegetative forms of microorganisms and, partially, the sporulated ones. In our investigations ewe milk, originating from commercial farms from the western area of the country, it was pasteurized in terms of factory, at a temperature of 73^0C for 20 seconds, after which it was turned into cottage cheese, pressed cheese (maturation period was 60 days) and acid milk product obtained by inoculating pasteurized milk with selected cultures of Lactobacillus.

To quantify the effect of these milk processing methods on the quality of fats from dairy products, we established the profile of fatty acids in fresh milk (raw milk) and, also, in the obtained milk products.

Samples of milk and dairy products have been processed by the Folch method (1987) in Pyrex tubes until obtaining fatty acids in form as methyl esters (FAME), which were kept at -20^0C until qualitatively and quantitatively identification by gas chromatography. Lipid extract was transesterificated with saturated methanol and isothermally identified as FAME with an HP 5890 II/5972 GC-MSD gas chromatograph coupled with mass spectrophotometer. For identification it was used putty PUFA No. 2 (Animal Source).

Laboratory findings were statistically processed and interpreted using the "t" test and they were presented as average values. To mark the significations there were used small letters placed as representatives of the analyzed values; values marked with different letters present significantly differences, for letter "a" it is set the smallest concentration (a <b <c).

RESULTS AND DISCUSSIONS

Laboratory findings on the influence of ewe milk processing methods on fatty acids profile and on obtained milk products (pasteurized milk, lactic fermented milk vs. yoghurt, cottage cheese and pressed cheese) are presented in *Table 1.*

Table 1

Fatty acid profile from ewe milk under the influence of various methods of technological processing (g/100g FAME)

Specification	Raw milk	Pasteurized milk	Pasteurization + *Lactobacillus*	Cottage cheese	Pressed cheese
C 4 : 0	2.87[a]	2.94[a]	2.82[a]	3.38[b]	3.64[b]
C 6 : 0	2.07[a]	2.04[a]	2.81[b]	2.12[a]	2.27[a]
C 8 : 0	1.64	1.63	1.87	1.71	1.84
C 12 : 0	2.86[a]	2.94[a]	3.18[b]	2.96[ab]	2.98[ab]
C 14 : 0	8.46	8.87	9.07	8.24	9.22
C 15 : 0	1.18	1.18	1.26	1.26	1.24
C 16 : 0	20.36[a]	21.72[ab]	21.81[ab]	22.44[b]	21.88[b]
C 17 : 0	0.75[a]	0.76[a]	0.87[b]	0.78[b]	0.78[b]
C 18 : 0	10.14	10.62	10.53	10.79	10.31
C 14 : 1	0.15	0.16	0.16	0.19	0.19
C 16 : 1	1.13	1.17	1.16	1.18	1.15
C 17 : 1	0.14	0.15	0.15	0.15	0.15
C 18 : 1 9 trans	0.32	0.34	0.33	0.32	0.36
C 18 : 1 11 trans	1.35[a]	1.41[b]	1.31[a]	1.48[b]	1.51[ab]
C 18 : 1 9 cis	14.27[a]	14.48[a]	15.46[a]	15.92[b]	15.54[b]
C 18 : 1 11 cis	0.48[a]	0.44[a]	0.51[a]	0.34[b]	0.36[b]
C 18 : 2 n-6 trans	0.62	0.66	0.64	0.66	0.64
C 18 : 2 n-6 cis	1.75[a]	1.72[a]	1.77[a]	1.94[b]	1.96[b]
C 18 : 2 c9, t11	2.20[a]	2.28[a]	2.65[b]	2.21[a]	2,24[a]
C 18 : 2 t11, t13	0.14[a]	0.20[b]	0.21[b]	0.25[b]	0.15[a]
C 18 : 2 t11, c13	0.36[a]	0.38[a]	0.37[a]	0.51[b]	0.65[c]
CLA total	2.70[a]	2.86[b]	3.03[b]	2.97[b]	3.04[b]
C 18 : 3, n-3	1.55[a]	1.44[b]	1.65[a]	1.61[b]	1.61[b]
C 20 : 2, n-6	0.03	0.03	0.03	0.03	0.03
C 20 : 4, n-6	0.17	0.16	0.16	0.17	0.16
C 20 : 5, n-3 EPA	0.18[a]	0.20[ab]	0.24[b]	0.23[b]	0.22[b]
C 22 : 3, n- 3	0.10	0.12	0.18	0.14	0.13
C 22 : 5, n-3 DPA	0.14[a]	0.17[ab]	0.18[b]	0.19[b]	0.18[b]
C 22 : 6, n-3 DHA	0.07	0.08	0.10	0.10	0.09
Σ SFA	50.33[a]	52.70[b]	54.13[b]	53.68[b]	54.16[b]
Σ f.a. unsaturated	28.30[a]	28.65[a]	29.05[a]	30.59[b]	30.36[b]
Σ MUFA	18.29	18.19	19.08	19.62	19.26
Σ PUFA	7.31[a]	7.44[a]	7.98[b]	8.04[b]	8.06[b]
PUFA n-6	2.57	2.57	2.60	2.80	2.79
PUFA n-3	2.04[a]	2.01[a]	2.35[b]	2.27[b]	2.23[b]
Σ CLA	2.70[a]	2.86[b]	3.03[b]	2.97[b]	3.04[b]
SFA/MUFA	2.59	2.73	2.68	2.56	2.62
SFA/PUFA	4.74[a]	4.75[a]	5.15[b]	4.58[a]	4.55[a]
MUFA/PUFA	2.50	2.44	2.39	2.44	2.39
n-6/ n-3	1.26[b]	1.28[b]	1.10[a]	1.23[b]	1.25[b]
AI	2.01[b]	2.10[b]	2.11[b]	1.90[a]	2.03[b]
Σ trans isomers	2,29[a]	2,41[b]	2,28[a]	2,46[b]	2,51[b]
Σ cis isomers	16.95[a]	16.64[a]	17.74[a]	18.20[b]	17.86[b]

SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids; PUFA n-6 = C 18:2 n-6t + C 18:2 n-6c + C 20:2 n-6 + C 20:4 n-6; PUFA n-3 = C 18:3 n-3 + EPA + C 22:3 n-3 + DPA + DHA; CLA = conjugated linoleic acid; AI = atherogenic index: (C 12 + 4 x c14 + C16)/ (MUFA + PUFA) (Kelsey et. al. 2003); t = trans, c = cis, DPA = acid docosapentaenoic, EPA = eicosapentaenoic acid, DHA = docosahexaenoic acid, Letters placed as representatives indicate significantly differences of the values (a < b < c).

From the data presented in *Table 1* results, in general, that industrial ewe milk processing through specific methods correctly executed, does not adversely affect the dairy content in Omega 3 fatty acids and CLA, but in some cases provide even an improvement of their quality through increasing the share of fatty acids with high active biological activity (Omega 3 and CLA).

Compared with raw milk, pasteurized milk is found in a trend of increasing the share of saturated fatty acids (52.70 vs. 50.33% of FAME), because at high temperatures some unsaturated fatty acids undergo hydrogenation and saturation processes. Polyunsaturated fatty acids from Omega 6, Omega 3 and Omega 7 (CLA) series, showed no notable differences between the two presentations of ewe milk, respectively raw or pasteurized.

Transforming pasteurized milk in acid fermented milk products, cottage cheese or pressed cheese, it brought a slight increase in the share of saturated fatty acids, in turn it was significantly improved ($p < 0.05$) the quality of fat by increasing fatty acid Omega 3 and CLA quantity, particularly in acid fermented milk products (2.01 vs. 2.35% and 2.86 vs. 3.03% of total FAME) (Fig. 1). However, it is notable that changes in fatty acids profile from dairy products obtained by applying technological methods of processing ewe milk were small and often statistically uninsured.

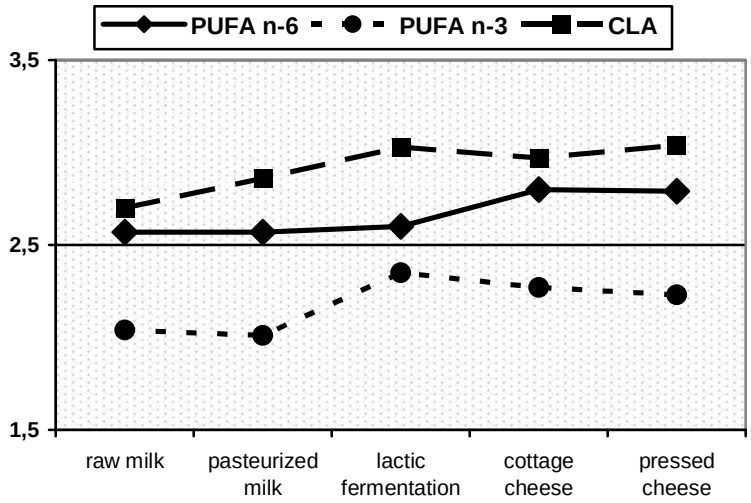

Figura1 **The influence of milk processing method on the structure of polyunsaturated fatty acids (PUFA)**

The results obtained by us, are confirmed by research conducted by Claps S., et. al. (2007); Buccioni A., et. al. (2007), Mele M., et. al. (2007); Nudda A., et. al. (2007), Addis M., et. al. (2005), that have shown that the between fatty acid profile

of milk and cheese are relatively small differences, very few being provided statistics.

The best quality of milk fat, analyzed in terms of influence on human health, given by the high content in PUFA Omega 3 fatty acids and CLA and low in saturated and monounsaturated fatty acids, it is obtained by fortifying it with selected cultures of lactic bacteria or by transformation in fresh cheese.

CONCLUSIONS

The ewe milk is a very good source of Omega 3 polyunsaturated fatty acids and CLA for healthy human nutrition. From farm animal species, ewe milk has the highest content of polyunsaturated fatty acids Omega 3 and CLA.

Industrial processing of ewe milk by pasteurization and then transforming it into acid fermented milk products, cottage cheese or pressed cheese, resulted in a slight increase in the share of saturated fatty acids, in turn it has improved the quality of fat by increasing the quantity of fatty acids Omega 3 and CLA.

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