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Variation of the fatty acids in buffalo milk and cheese

[1]Aurelia Coroian, [2]Cristian T. Matea, [2]Constantin Bele, [1]Vioara Mireşan, [1]Camelia Răducu, [3]Antonia Odagiu, [1]Stelian Dărăban, [1]Cristian O. Coroian

[1] Faculty of Animal Science and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania; [2] Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania; [3] Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania. Corresponding author: C. Coroian, cristian_coroian@yahoo.com

Abstract. Lipids are major components of buffalo milk with great implications in nutrition and economical aspects. The nutritional value of buffalo milk is derived from its complex chemical composition and its high rate of assimilation. Major fatty acids found in both milk and cheese were: palmitic acid (16:0), oleic (18:1) and stearic (18:0). The ratio between UFA/SFA was 0.3, lower than the threshold of 1.5 which is considered to not raise negative health effects.
Key Words: Buffalo, milk, GC, cheese, fatty acid.

Introduction. Fatty acids (FAs) composition is an important parameter when determining the nutritional value in food. Major causes of death such as cardiovascular disease and cancer are linked to dietary fat intake (Chow 2000). Polyunsaturated fatty acids (PUFAs) should constitute up to 7 – 10 % of the total energy intake, where n-3 PUFA should be 1 – 2 % and the remaining part n-6 PUFA, for a healthy nutrition. Little attention has been paid to the study of buffalo milk composition and especially to its fatty acids distribution, thus data on the subject is scarce. Buffalo milk do their high dry matter content is one the most suitable raw material for cheese manufacture (Coroian et al 2011b). Buffalo milk fat is reported to have higher concentration levels of butyric, palmitic, stearic acids and PUFAs and lower values for the medium chain FAs (C6:0 - C12:0) when compared with cow milk (Ganguli 1979). The GC quantification method was utilized by (Farag et al 2006) for determining the fatty acids distribution and concentration levels in buffalo milk samples and adulterated buffalo milk. Alteration of milk occurs more often do the high range of total germs, or increased somatic cells (Coroian et al 2012a), and therefore is not suitable for processing. But not at least diary products quality production starts with a balanced feeding regime oncerning all nutritional components (Coroian et al 2011a). In case of disputes regarding cheese quality, recent research proved that infrared spectroscopy can be used with success for a rapid method of cheese and other milk products legalization (Coroian et al 2012b).

Najbullah et al (1998) also employs the GC method in analyzing the CLA content of 11 types of cheeses, with total lipids content for the samples ranging from 14 – 37 %. Chashnidel et al (2010) studied the seasonal variation in composition and fatty acid profile in a Iranian buffalo milk, with emphasis on CLA. In 2003 Bergamo et al conducts a study on fat-soluble vitamin contents and FAs composition in organic and conventional Italian dairy products. The major FAs identified by the group were the linoleic, conjugated linoleic and oleic acid (Bergamo et al 2003). Buffalo milk fat was widely criticized by nutritionists as it contains a substantial amount of myristic and palmitic acids and low amounts of MUFAs and PUFAs (Kennelly 1996). The aim of the present study is to determine the fatty acid profile in both cheese and buffalo milk, by means of Gas Chromatography.

Material and Method. A total number of 25 buffalo milk samples and 8 buffalo cheese samples were analyzed. All reagents and solvents were purchased from Merck (Germany). For the extraction of total lipids a modified (Folch 1957) procedure was used. 3 mL of buffalo milk, respectively 1 g of buffalo cheese were placed in a flask together with a 60 mL of a chloroform: methanol solution (2:1, v/v) and agitated for 2 hours. Afterwards the sample was filtered through a cellulose filter into a separation funnel. The chloroformic layer was retained and further anhidrified using anhydrous Na_2SO_4. The lipidic extract was concentrated to near dryness using a vacuum rotary evaporator at 35 ^{0}C. Fatty acids were converted to methyl esters by reaction with boron trifluoride/methanol at 80 ºC for two hours in a closed Pyrex glass tube. For the extraction of the fatty acid methyl esters a volume of 10 mL hexane was used. The hexanic fraction was then separated in a separation funnel and an-hidrified using anhydrous Na_2SO_4. Afterwards the sample was filtered, concentrated to near dryness and re-dissolved in 1 mL hexane prior to the GC-FID analysis. Fatty acids were analyzed by gas chromatography (GC) with flame ionization detection (FID). A 1µL sample was injected into the Shimadzu GC-17A series gas-chromatograph, equipped with a 30 M polyethylene glycol coated column (Alltech AT-WAX, 0.25 mm I.D., 0.25 µm film thickness). Helium was used as the carrier gas at a pressure of 147 kPa. The injector and detector temperatures were set at 260 ºC. For the oven temperature the following programe was used: 70 ºC for 2 min. then raised to 150 ºC at 10 ºC/min. rate and held at 150 ºC for 3 min., then further raised up to 235 ºC at a 4 ºC/min.

Results and Discussion. A typical chromatogram for the buffalo milk sample is presented in figure 1.

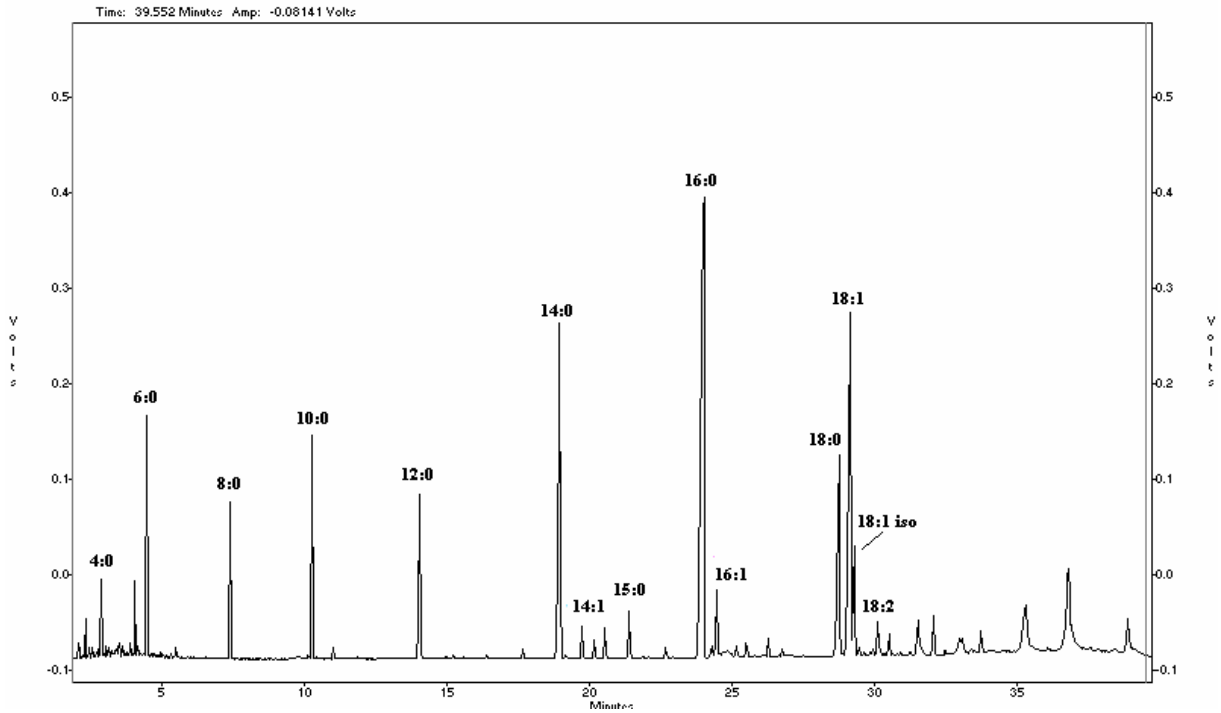

Figure 1. GC chromatogram for buffalo milk.

In tables 1 and 2 mean values for fatty acids found in buffalo milk and cheese samples are presented. For both types of samples the main fatty acids were: palmitic (C 16:0), oleic (C 18:1c9), myristic (C 14:0) and stearic (C 18:0). The fatty acid composition of the analyzed buffalo milk is similar to that studied by other groups. Varricchio et al (2007) reports that for the Mediterranean buffalo milk five fatty acids are representative: C16:0 (mean 30.6 ± 3.0), C18:1c9 (21.4 ± 2.0), C18:0 (12.2 ± 2.4), C14: 0 (10.6 ± 1.1) and C 4:0 (3.4 ± 0.5), these represent more than 78 % of the fatty acids identified. Fatty

acids distribution for the Romanian buffalo milk is: SFA – 71.16 %, MUFA - 21.46 % and 1.75 % for PUFA. When compared with other data from literature we find that the SFA values are slightly higher, while the MUFA and PUFA values are lower (Talpur et al 2008). Similar results for the distribution of fatty acids in buffalo milk were obtained by (Mihaylova & Peeva 2007), the major saturated fatty acids identified were: palmitic (C16:0) – 29.38 %, followed by myristic (C 14:0) – 11.28 % and stearic (C 18:0) – 10.58 %. When compared with cow milk, buffalo milk has higher percentages for saturated fatty acids and lower values for unsaturated fatty acids (Ménarda et al 2010). In Figure 2 a typical chromatogram for the telemea buffalo cheese is presented. Buffalo telemea cheese was obtained from the same buffalo milk by means of traditional processes.

Table 1

Fatty acid percentage for the buffalo milk sample

Fatty acid	*Abreviation*	*n = 25*			
		Min	*Max*	*Mean*	*SD*
Butyric	C4:0	1.57	2.37	2.01	0.18
Caproic	C6:0	2.54	4.53	3.67	0.07
Caprylic	C8:0	1.65	3.28	2.52	0.08
Capric	C10:0	1.98	4.68	3.43	0.07
Lauric	C12:0	3.82	5.54	4.72	0.10
Myristic	C14:0	13.21	17.47	15.91	0.14
Myristoleic	C14:1	1.06	1.17	1.12	0.04
Pentadecanoic	C15:0	1.78	2.86	2.52	0.05
Palmitic	C16:0	21.18	26.43	23.87	0.08
Palmitoleic	C16:1	1.82	2.96	2.41	0.06
Stearic	C18:0	9.52	15.36	12.47	0.30
Oleic	C18:1	13.89	21.79	17.89	0.05
Elaidic	C18:1iso	0.19	0.24	0.22	0.08
Linoleic	C18:2	1.56	1.85	1.75	0.12
SFA[1]	-	57.25	82.76	71.16	0.33
MUFA[2]	-	16.77	26.03	21.46	0.26
PUFA[3]	-	1.56	1.85	1.75	0.09

[1] Saturated fatty acids, [2] Monounsaturated fatty acids, [3] Polyunsaturated fatty acids, SD - standard deviation, n - 25 (all samples were done in triplicate).

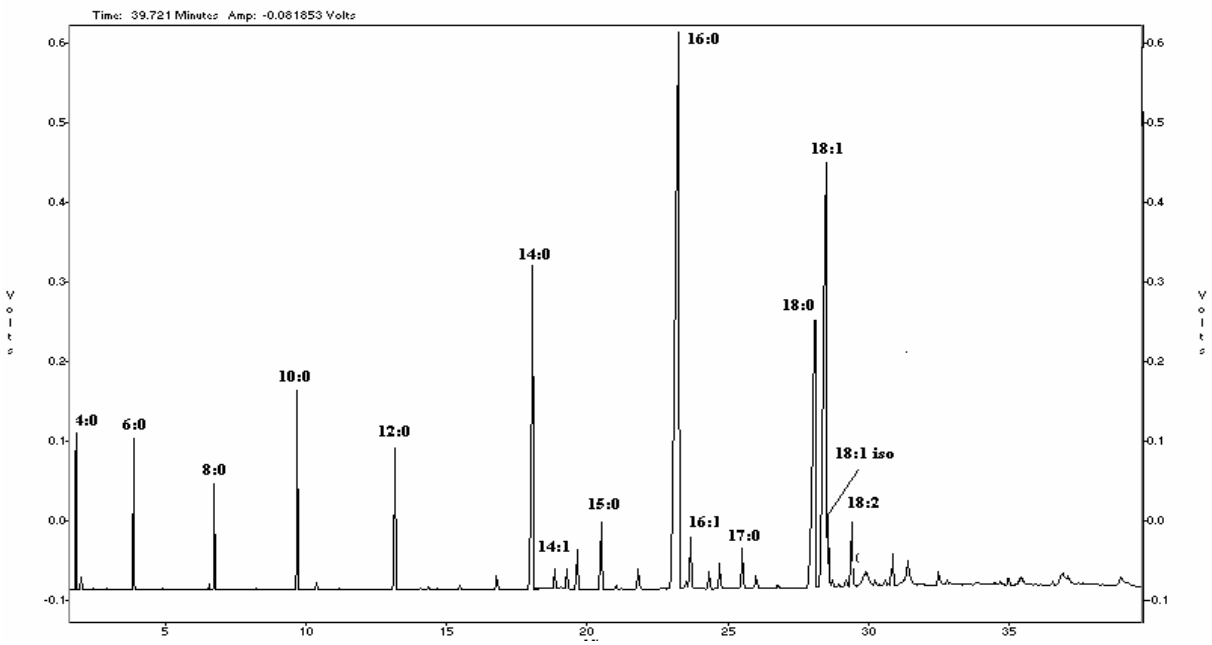

Figure 2. GC chromatogram for buffalo telemea cheese.

As shown in Table 2, SFA values for the buffalo telemea cheese samples have an average of 57.26 %, while for the MUFA and PUFA averages are 21.05 %, respectively 1.83 %. The major fatty acids identified for the buffalo telemea cheese are: palmitic – 27.15 %, oleic – 19.24 %, stearic – 11.17 % and myristic – 10.08 %. According to our knowledge there is no data about the fatty acid composition in Romanian buffalo telemea cheese.

Table 2

Average values and percentage variability of fatty acids of buffalo telemea cheese

Fatty acid	*Abreviation*	*n = 8*			
		Min	*Max*	*Mean*	*SD*
Butyric	C4:0	0.10	0.26	0.19	0.75
Caproic	C6:0	1.37	1.53	1.47	0.09
Caprylic	C8:0	1.06	1.09	1.08	0.03
Capric	C10:0	1.98	2.09	2.05	0.05
Lauric	C12:0	2.48	2.60	2.56	0.08
Myristic	C14:0	9.96	10.19	10.08	0.09
Myristoleic	C14:1	0.61	0.76	0.69	0.13
Pentadecanoic	C15:0	1.42	1.50	1.48	0.05
Palmitic	C16:0	25.19	29.10	27.15	0.37
Palmitoleic	C16:1	0.64	0.97	0.81	0.20
Stearic	C18:0	10.19	12.11	11.17	0.03
Oleic	C18:1	18.14	20.33	19.24	0.04
Elaidic	C18:1iso	0.21	0.26	0.24	0.04
Linoleic	C18:2	1.80	1.85	1.83	0.02
SFA[1]	-	53.79	60.49	57.26	0.25
MUFA[2]	-	19.64	22.35	21.05	0.15
PUFA[3]	-	1.80	1.85	1.83	0.10

[1] Saturated fatty acids, [2] Monounsaturated fatty acids, [3] Polyunsaturated fatty acids, SD - standard deviation, n - 8 (all samples were done in triplicate).

Conclusions. The average percent for SFA in Romanian buffalo milk are slightly higher than for other buffalo breeds, whereas MUFA and PUFA values are consistent with literature data. For both buffalo milk and buffalo telemea cheese the main fatty acids identified were: palmitic (C 16:0), oleic (C 18:1c9), myristic (C 14:0) and stearic (C 18:0). Results presented in this study should be helpful in updating the national database for food composition.

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Authors:
Aurelia Coroian, University of Agricultural Sciences and Veterinary Medicine, Faculty of Animal Science and Biotechnology, Romania, Cluj-Napoca, Calea Mănăştur Street, No. 3-5, 400372, coroian.aurelia@gmail.com
Cristian Tudor Matea, University of Agricultural Sciences and Veterinary Medicine, Faculty of Veterinary Medicine, Romania, Cluj-Napoca, Calea Mănăştur Street, No. 3-5, 400372, mateatcristian@gmail.com
Constantin Bele, University of Agricultural Sciences and Veterinary Medicine, Faculty of Veterinary Medicine, Romania, Cluj-Napoca, Calea Mănăştur Street, No. 3-5, cbele2002@yahoo.com
Vioara Mireşan, University of Agricultural Sciences and Veterinary Medicine, Faculty of Animal Science and Biotechnology, Romania, Cluj-Napoca, Calea Mănăştur Street, No. 3-5, 400372, vmiresan@usamvcluj.ro
Camelia Răducu, University of Agricultural Sciences and Veterinary Medicine, Faculty of Animal Science and Biotechnology, Romania, Cluj-Napoca, Calea Mănăştur Street, No. 3-5, 400372, craducu2001@yahoo.com
Antonia Odagiu, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Agriculture, Mănăştur Street, No. 3-5, 400372, Cluj-Napoca, Romania, aodagiu@gmail.com
Stelian Dărăban, University of Agricultural Sciences and Veterinary Medicine, Faculty of Animal Science and Biotechnology, Romania, Cluj-Napoca, Calea Mănăştur Street, No. 3-5, 400372, ovineusamv@yahoo.com
Cristian Ovidiu Coroian, University of Agricultural Sciences and Veterinary Medicine, Faculty of Animal Science and Biotechnology, Romania, Cluj-Napoca, Calea Mănăştur Street, No. 3-5, 400372, cristian_coroian@yahoo.com

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