



## ANALYSIS OF FATTY ACID CONTENT OF RAW MILK

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### ABSTRACT

In this work was analysed quality of raw cow's milk of dairy cows which was fed with winter food ration of feed. Milk was observed in terms of the composition of milk fat and fatty acids during the months of August, October, December and February. The proportion of saturated fatty acids in milk fat was 63.22 % and it was found the highest proportion of palmitic acid 34.85 % myristic acid accounted for 11.44 % and 10.86 % stearic acid. Linoleic acid, which is given special attention in view of the favourable effect on cholesterol, consisted of 3.48 % milk fat. The average proportion of unsaturated fatty acids in milk fat was 36.76 % of which 32.77 % were monounsaturated and polyunsaturated 4.0 %. A high proportion of milk fat formed monounsaturated oleic acid 30.92 %. The proportion of linoleic acid in milk fat was 3.48 % and 0.31 % linoleic acid.

**Keywords:** raw cow milk, fat, fatty acids, saturated fatty acids, unsaturated fatty acids

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## INTRODUCTION

Milk is the secretion of the mammary gland of female mammals, and it's often the sole source of food for the very young mammal. Milk is a complex biological fluid probably containing about 100,000 different molecular species in several states of dispersion, but most have not been identified. However, most of the major components – proteins, lactose, fat, and minerals – can be separated and isolated from milk relatively easily (**Robinson, 2005**).

Milk is more than a source of nutrients for any neonate of mammalian species, as well as for growth of children and nourishment of adult humans. Aside from nutritional values of milk, milk borne biologically active compounds such as casein and whey proteins have been found to be increasingly important for physiological and biochemical functions that have crucial impacts on human metabolism and health (**Korhonen and Pihlanto-Leppälä, 2004, Gobbetti et al., 2007**).

The main components of milk are water, lipid, protein, lactose and minerals, and additional components are vitamins, enzymes, gases (CO<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>), organic acids, dyes, non-protein nitrogen compounds and hormones (**Tamime, 2009**).

Regarding more particularly the lipids, they are a main source of dietary energy and bioactive molecules. Lipids are secreted in milk in the form of spherical entities of about 4 to 5 µm diameter called the milk fat globules, which are enveloped by a biological membrane known as the milk fat globule membrane (MFGM) (**Riccio, 2004**).

Milk fat contains mainly saturated fatty acids (about 70 %) with various chain lengths, and low amounts of unsaturated fatty acids (about 30 %) (**El-Zeini, 2006**).

A fatty acid is a carboxylic (organic) acid, often with a long aliphatic tail. The fatty acid composition of lipids is particularly important in determining their physical, chemical and nutritional properties. Approximately 400 fatty acids have been identified in cow's milk fat to date, an extensive review of which is provided by **Jensen (2002)**.

An overview of the major fatty acids in cow's milk lipids, from which it is clear that palmitic, oleic, stearic and myristic acids are the principal fatty acids in cow's milk lipids. short -and medium-chain fatty acids occur in lower amounts at least when expressed on a weight basis, these have the interesting characteristic that, unlike long-chain acids, they are

absorbed into the blood stream in non-esterified form and are metabolised rapidly (**Noble, 1978**). Furthermore, the chain length influences the melting characteristics of lipids.

Fatty acids (FA) in milk fat can be divided into different groups, based on the metabolic pathways of their production. Short- and medium-chain milk FA (SMCFA; C4:0–C14:0 and approximately half of C16:0) are the result of de novo synthesis in the mammary gland.  $\beta$  - Hydroxybutyrate and particularly acetate originating from ruminal fermentation are the major sources for this de novo FA synthesis. The remaining C16:0 and almost all of the long-chain milk FA (LCFA; C18:0–C22:0) originate from circulating blood lipids, after absorption from the small intestine or mobilization from adipose tissue (**Grummer, 1991**).

Milk FA composition also seems to be influenced by the stage of lactation. At the onset of lactation, cows are most often mobilizing adipose FA, which are partially incorporated into milk fat (**Palmquist et al., 1993**).

The composition of the fatty acids derived from two sources differs markedly. the fatty acids produced de novo are all those with a carbon chain of 4-14 atoms and proportion of the C 16 fatty acids, whereas the remainder of the C 16 fatty acids and almost all of the C 18 acids arise from the blood (**Palmquist, 2006**).

Lipids taken up by the mammary gland from the blood can originate from the digestive tract or from mobilised body-fat reserves. To overcome their insolubility in aqueous media, dietary triacylglycerols are transported in the form of lipoproteins or, more specifically, a subclass of lipoproteins, the very-low density lipoproteins. In the mammary gland, fatty acids are de-esterified from triacylglycerols by lipoprotein lipase, a process described by **Barber et al. (1997)**.

The objective of the study was to determine the proportions of fatty acids in % in raw cow's milk during 4 months.

## **MATERIAL AND METHODS**

### **Sampling of milk**

Based on the objectives of work, we analyzed the raw cow's milk produced on the farm. Assessment was carried out in the months of August, October, December and February. Samples for the determination of fatty acids were taken each month in the first milk collection day. These samples were then analyzed in the laboratory.

### Analyzing of milk sample

Fresh milk samples were lyophilized for 48 hours at 20 °C (sublimed water in the solid state in a high vacuum).

This dried sample (about 25-30 g) was mixed with sodium sulphate and then petroleum ether was flooded into boiling flask (200 ml). The samples were shaken for about 1 hour. Through the filter, where was the anhydrous Na<sub>2</sub>SO<sub>4</sub> was poured liquid portion. Petroleum ether (50 ml) was added to solid and shaken again. Samples were decanted and evaporated using a rotary evaporator to a volume of about 10 ml. Sample (2 ml) was esterified addition of 2 ml trans esterification reagent and it was reacted for about 20 minutes.

Into flask with prepared sample was added 2 ml of methanolic HCl. The sample stood 45 minutes at least. Sample was diluted with petroleum ether (40 ml sample + 600 ml sample petroleum) and 1 ml sample was sprayed with syringe into the gas chromatograph column (Agilent Technologies, USA) It was dosed to the top layer. Flasks were stored in a refrigerator at 4-6 °C.

After analyzing a standard mixture of methyl esters of fatty acids, we found retention times of fatty acids. The retention times was used for compare of fatty acids of milk fat, we have identified various acids. The area of peak was calculated of peak's height and width of half peak's height. After counting areas of peaks was calculated relative percentage of fatty acids. Integrator performed these calculations after analysis automatically.

### Statistical evaluation

Values obtained from the analysis were processed using programmer Statgraphics. In this study  $\bar{x}$ ,  $s$ ,  $s_x$ , min, max and CV were observed.

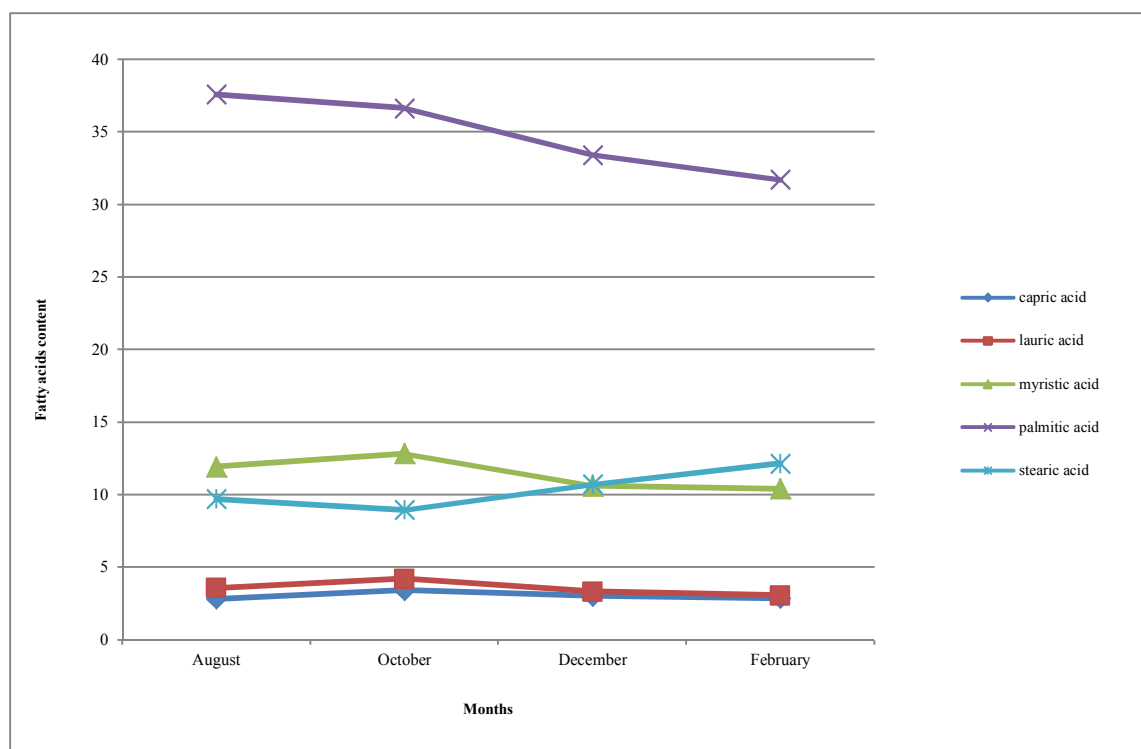
## RESULTS AND DISCUSSION

Based on the analysis of fatty acids (Table 1), we found out the average 3.60 % fat content. The highest proportion of fatty acids, palmitic acid accounted 34.85 %, and in contrast to our results **Grieger et al. (1990)** indicate significantly lower proportion of palmitic acid 23.8 %. Palmitic acid content was highest in August, 37.60 % and gradually decreased in October to 36.65 %, in December to 33.43 % and 31.72 % in February (fig. 1). **Sommer (1999)** shows the relationship of palmitic acid to the stage of lactation and states its lowest

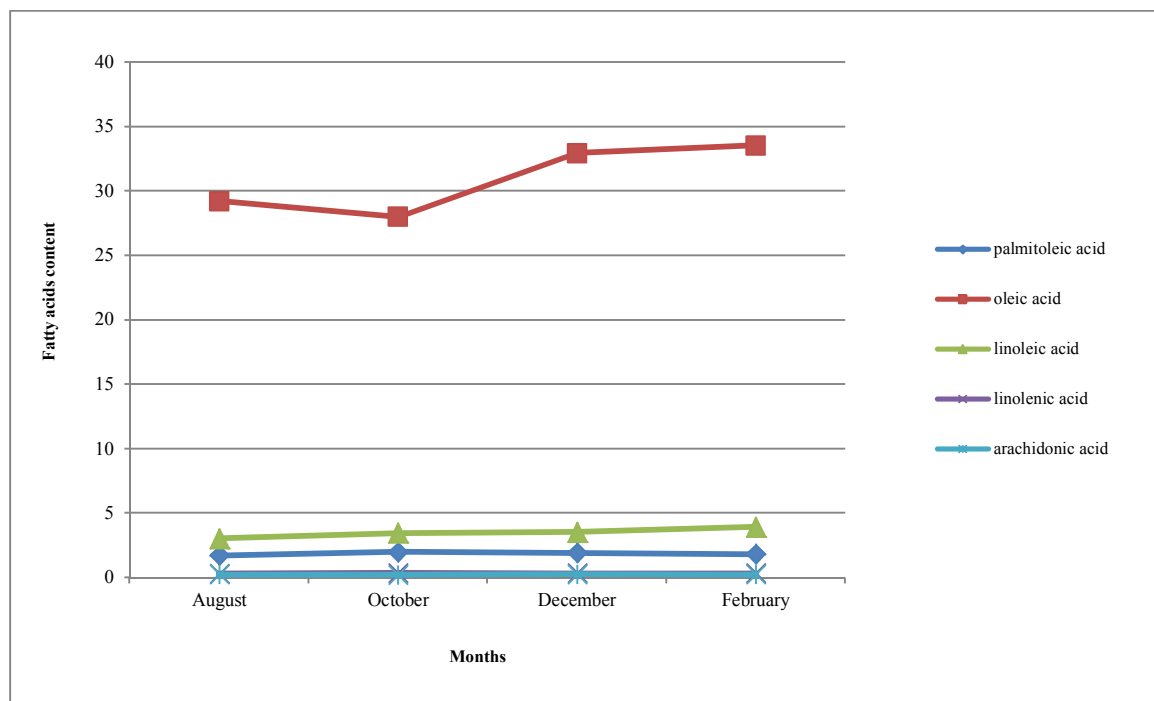
share of 25.6 % in the first week of lactation and gradually increased to 30.5 % in the twelfth week. Oleic acid accounted for 30.92 %. **Grieger *et al.* (1990)** indicate about the same results of proportion of oleic acid, 29.0 %. The lowest content was found in the second sampling of 28.00 % and the content is gradually increased up to 33.54 % in February (fig. 2). **Sommer (1999)** states that the oleic acid content of lactating procedure decreases from 28.8 % in the first week to 18.0 % in the twelfth week. Content of myristic acid was 11.44 % of the fatty acids in milk fat. In comparison to our results **Grieger *et al.*, (1990)** indicate a lower proportion of myristic acid in milk fat (8.9 %). Also **Sommer (1996)** indicates a lower proportion of myristic acid (10.0 %). The average stearic acid content was 10.38 % and the fluctuation of its content did not relate to the reporting period. In comparison to our results **Grieger *et al.*, (1990)** indicate a higher proportion of stearic acid 13.2 % and **Sommer (1996)** indicate about the same results of our results 10 % of its content in milk fat. **Sommer (1999)** states that the content of stearic acid was 11.1 % in first week of lactation and of its content was gradually reduced to eighth week (7.0 %) and in twelfth week saw a slight increase (7.2 %). Lauric acid content averaged 3.54 %. **Semjan (1994)** indicate about the same results of our results of lauric acid value 3.4 %. In comparison with our results **Grieger *et al.* (1990)** indicated the proportion only 2.9 %. The average value of capric acid in milk fat was 3.03 %. **Semjan (1994)** states in contrast to our results the milk fat content in only 2.7 %. The average content of palmitoleic acid in milk fat for the period was 1.85 %. Its content has been settled during lactation (**Sommer, 1999**). Linoleic acid content was 3.48 % on average. In contrast to our results **Sommer (1996)** indicated the content of only 2%. Based on Graph 2, we can conclude that the content of linoleic acid was increasing in the period character (august 3.02 % to 3.92 % in February). **Sommer (1999)** indicated a decreasing proportion of linoleic acid in milk fat (from 2.8 % in the first week of lactation to 2.3 % in the twelfth week of lactation). The highest value of linolenic acid was found in October (0.34 %). The average value was 0.31%. In contrast to our results **Semjan (1994)** indicates values 1.7 % of linolenic acid. The average value of arachidonic acid in milk fat was 0.22 %. Based on the analysis (table 1) we can conclude that the proportion of saturated fatty acids in milk fat was 63.22 % and proportion of unsaturated fatty acids was 36.77 %. Almost identical to our results **Sommer (1996)** indicate 65 % saturated fatty acids and 35 % unsaturated fatty acids in milk fat.

In terms of prevention of cardiovascular diseases is mainly pursued proportion of unsaturated fatty acids in foods. Monounsaturated (palmitoleic acid, oleic acid) was 32.77 %. **Grieger *et al.* (1990)** indicate 31.8%, it is almost identical content to our results and **Sommer (1996)** indicate 31.0%. Polyunsaturated fatty acids (linoleic acid, linolenic acid, arachidonic

acid) were 4.00%. **Sommer (1996)** indicates about the same result 3.0% polyunsaturated fatty acids in milk fat.



**Figure 1** Saturated fatty acids



**Figure 2** Unsaturated fatty acids

**Table 1** Proportional representation of fat and fatty acids in milk fat

	Fat	Fatty acids (%)									
		capric acid	lauric acid	myristic acid	palmitic acid	stearic acid	palmitoleic acid	oleic acid	linoleic acid	linolenic acid	arachidonic acid
August	3.5	2.82	3.56	11.92	37.60	9.70	1.70	29.20	3.02	0.28	0.21
October	3.44	3.42	4.21	12.84	36.65	8.94	1.98	28.00	3.44	0.34	0.19
December	3.75	3.02	3.33	10.60	33.42	10.71	1.91	32.94	3.53	0.30	0.24
February	3.7	2.85	3.06	10.41	31.72	12.15	1.81	33.54	3.92	0.32	0.22
x	3.6	3.03	3.54	11.44	34.85	10.88	1.85	30.92	3.48	0.31	0.22
s	0.15	0.28	0.49	1.15	2.75	1.39	0.12	2.74	0.37	0.03	0.03
s <sub>x</sub>	0.07	0.14	0.25	0.58	1.37	0.70	0.06	1.37	0.18	0.01	0.01
min.	3.44	2.82	3.06	10.41	31.72	8.94	1.7	28.00	3.02	0.28	0.19
max.	3.75	3.42	4.21	12.84	37.60	12.16	1.98	33.54	3.92	0.34	0.25
v (%)	4.19	9.09	13.90	10.05	7.88	13.42	6.47	8.85	10.63	9.25	11.89

The table 1 has shown observed values of fatty acids in %. The values were obtained during 4 months and were statistically processed.

## CONCLUSION

Milk quality in view of fatty acids compositions during the year is nutritive balanced. The fat content of milk and fluctuation values of milk fat may be affected by low fiber content (below 18 %), a high proportion of grain feed and a high degree of fragmentation feed. In terms of the composition of milk fat, we found the highest proportion of palmitic acid 34.85 %, a lower proportion of oleic acid was 30.92 %. Myristic acid accounted 11.44% and stearic acid 10.88 %. Linoleic acid, which has a beneficial effect on reducing cholesterol consumer, consisted of 3.48 % milk fat. The average content of unsaturated fatty acids was 36.77%, monounsaturated fatty acids 32.77 % and polyunsaturated fatty acids accounted for 4.0 % of milk fat. Great importance for the future monitoring of the unsaturated fatty acids such as linoleic acid, linolenic acid and arachidonic acid for their beneficial effects on the body of the consumer, because according to literature sources pass into the milk directly from the feed. It can be assumed that the content of said fatty acids in alternative systems would be higher. Content of fatty acids can be therefore regulated with diet and the low-fiber, high degree of fragmentation of the diet and to ensure a high proportion of grain feed.

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