Trans fatty acids and conjugated linoleic acid in the buffalo milk

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ABSTRACT - The fatty acid content in milk samples, obtained from buffaloes of the Bulgarian Murrah breed reared in a buffalo farm in the Agricultural Institute - Shumen was investigated. Milk samples were obtained from the morning and evening milking. The determination of fatty acids was done with a combination of gas chromatography and high-performance liquid chromatography. It was found out that from the saturated fatty acids in buffalo milk, the highest amount was that of palmitic acid (29.39%), followed by myristic (11.28%) and stearic (10.58%) acids. Out of unsaturated fatty acids, the oleic acid (C18:1 cis-9) predominated with 18.79%, and the total sum of its trans isomers was 1.75%. The buffalo milk fat was with relatively little content of conjugated linoleic acid – 0.38%, with concentration of the biologically active isomer C18:2 cis-9, trans-11 of 0.29%. The total amount of saturated fatty acids in the studied buffalo milk was 72.15%, of monounsaturated – 24.70%, and of polyunsaturated – 3.15%.

Key words: Buffalo milk, Fatty acids, Conjugated linoleic acid.

INTRODUCTION - It is known that the specifics of fats, an essential component of foodstuffs, depends on the types of fatty acids that compose triacylglycerols. The fatty acid composition of dairy products is important for their biological and nutritive values of milk fat as well as for their physicochemical and taste properties (Bobe et al., 2003). On the other side, the excessive fat intake results in increased risk for development of cardiovascular diseases. During the last years, the interest towards the natural content of trans fatty acids and conjugated linoleic acid (CLA) in animal foodstuffs (milk, meat) is continuously increasing (Khanal and Olson, 2004). The studies concerning buffalo milk are considerably less compared to those on milk of other species. The fatty acid content of milk fat in the Bulgarian Murrah buffalo breed has been investigated by Dimitrov et al. (2003), Tzankova and Dimov (2003), Naydenova (2005). The aim of the present study was to determine the fatty acid profile, including the content of trans fatty acids and conjugated linoleic acid, in the milk fat of Bulgarian Murrah buffaloes.

MATERIAL AND METHODS - The study was performed with buffalo milk, obtained from purebred Bulgarian Murrah buffaloes from I to III lactation, reared in the herd of the Agricultural Institute - Shumen. Milk samples were obtained in the morning and the evening, proportionally to the milk yield, according to rules for milk sampling.
The fatty acid analysis was performed in the Institute of Nutrition of the Friedrich Schiller University - Jena, Germany. The methyl esters of fatty acids were analysed with a combination of two gas chromatographs (GC). The first analysis used a GC (Shimadzu, 17A Shimadzu, Kyoto, Japan) with flame ionization detector and automated injection system (AOC - 5000), DB - 225 MS capillary column (J & W Scientific, Folsum, USA; 30 m x 0.25 mm, i. d.; 0.2 µm film) and H₂ as a carrier gas. The separation of cis- and trans- isomers of C18:1 was done via a CP - Sil 88 capillary column (Chrompack, Middelburg, The Netherlands: 100 m x 0.25 mm, i. d.; 0.2 µm film). The data for CLA isomers, separated via GC, were controlled by Ag+-HPLC (Varian – Chrompack, International, Middleburg, The Netherlands), equipped with solvent delivery system, automated sample injector, UV-detector and a series of three silver impregnated columns (each one 4.6 mm i.d. x 250 mm stainless steal, 5 µm particle size). Fatty acids were identified by comparing of retention time of individual fatty acids with those of a standard solution of methyl esters (Sigma – Aldrich Chemie GmbH, Deisenhofen, Germany).

The data were statistically processed (Statistica for Windows, Release, 4.3, Stat. Soft. Inc., 1994).

RESULTS AND CONCLUSIONS - From all saturated fatty acids, a principal component of milk fat, the highest concentrations in studied buffalo milk samples were those of palmitic acid (C16:0) – 29.39%, followed by myristic acid (C14:0) – 11.28% and stearic acid (C18:0) – 10.58% (Table 1). The average values for C14:0 and C16:0 were considerably lower than the results of Tsankova and Dimov (2003) for milk fat from the same breed, 14.90% and 34.62%, respectively. Medium-chain fatty acids – C12:0 (lauric), C14:0 and C16:0 are not preferred as they increase systemic cholesterol concentrations. The total sum of these three fatty acids in the studied milk was 43.62%. Unlike them, C18:0 and short chain ones (C4:0, C6:0, C8:0, C10:0) have a neutral or cholesterol-decreasing effect. The total amount of saturated fatty acids in the milk of Bulgarian Murrah buffaloes was on the average 72.15%, varying from 64.92% to 77.60%.

Unsaturated fatty acids (UFA) are extremely important for human health. The highest monounsaturated fatty acid (MUFA) levels were those of oleic acid (C18:1 cis-9) – 18.79%. The average content of trans isomers of C18:1 was 1.75%, varying between 1.31% and 3.28%. Buffalo milk fat was poor with regard to polyunsaturated fatty acids (PUFA) – 3.14%, and about 50% of PUFA content was due to linoleic acid (C18:2 cis-9,12). Milk and dairy products are the principal natural source of CLA. The total sum of CLA in studied buffalo milk was low – 0.38%, and the biologically active isomer C18:2 cis-9, trans-11 constituted 80% of this amount.

The present study was focused on the concentrations of rumenic and vaccenic acids as well as on their ruminal precursors: linoleic and linolenic acids. Rumenic acid (RA), the main isomer of CLA is closely related to vaccenic acid (VA). The VA/RA ratio in the studied buffalo milk was 1.38. The atherogenic index (AI) of Bulgarian Murrah milk fat, calculated on the basis of the content of medium-chain fatty acids (C12:0, C14:0 and C16:0) and MUFA and PUFA groups (Chilliard et al., 2003), was 2.78, whereas the Δ⁹-desaturase index (calculated as C14:1/C14:0) was 0.07.

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Table 1. Average fatty acids composition of milk.

| Components | Mean value | Standard deviation | min  | Range | max  |
|------------|------------|--------------------|------|-------|------|
| C 4:0      | 5.15       | 1.033              | 3.74 | 6.90  |
| C 6:0      | 3.01       | 0.365              | 2.23 | 3.52  |
| C 8:0      | 1.40       | 0.212              | 1.01 | 1.69  |
| C 10:0     | 2.53       | 0.393              | 1.92 | 3.13  |
| C 10:1     | 0.12       | 0.046              | 0.06 | 0.20  |
| C 12:0     | 2.95       | 0.395              | 2.29 | 3.46  |
| C 13:0     | 0.13       | 0.062              | 0.09 | 0.29  |
| C 14 iso   | 0.22       | 0.070              | 0.13 | 0.33  |
| C 14:0     | 11.28      | 0.628              | 9.60 | 12.35 |
| C 14:1     | 0.74       | 0.279              | 0.33 | 1.16  |
| C 15 iso   | 0.33       | 0.056              | 0.21 | 0.41  |
| C 15 anteiso| 0.77      | 0.189              | 0.38 | 1.11  |
| C 15:0     | 1.37       | 0.492              | 0.84 | 2.58  |
| C 16 iso   | 0.54       | 0.135              | 0.34 | 0.79  |
| C 16:0     | 29.39      | 3.516              | 25.44| 35.21 |
| C 16:1     | 1.80       | 0.453              | 1.01 | 2.48  |
| C 17 iso   | 0.37       | 0.067              | 0.29 | 0.52  |
| C 17 anteiso| 0.70      | 0.186              | 0.52 | 1.16  |
| C 17:0     | 0.80       | 0.237              | 0.55 | 1.28  |
| C 17:1     | 0.40       | 0.104              | 0.24 | 0.62  |
| C 18:0     | 10.58      | 2.089              | 8.67 | 15.23 |
| C 18:1 trans-6/7 | 0.22 | 0.092 | 0.12 | 0.45 |
| C 18:1 trans-9 | 0.12 | 0.038 | 0.08 | 0.22 |
| C 18:1 trans-10 | 0.29 | 0.418 | 0.08 | 1.49 |
| C 18:1 trans-11 | 0.39 | 0.144 | 0.16 | 0.63 |
| C 18:1 trans-12 | 0.15 | 0.032 | 0.10 | 0.21 |
| C 18:1 trans-13 | 0.28 | 0.089 | 0.12 | 0.47 |
| C 18:1 trans-15 | 0.11 | 0.025 | 0.07 | 0.18 |
| C 18:1 trans-16 | 0.17 | 0.036 | 0.08 | 0.20 |
| C 18:1 cis-9 | 18.79 | 3.148 | 14.53 | 26.16 |
| C 18:1 cis-11 | 0.73 | 0.381 | 0.42 | 1.68 |
| C 18:1 cis-12 | 0.14 | 0.030 | 0.09 | 0.18 |
| C 18:2 trans-9,12 | 0.28 | 0.053 | 0.16 | 0.35 |
| C 18:2 cis-9,12 | 1.69 | 0.290 | 1.38 | 2.32 |
| C 18:3 cis-9,12,15 | 0.33 | 0.069 | 0.23 | 0.47 |
| C 18:2 cis-9, trans-11 (CLA) | 0.29 | 0.077 | 0.17 | 0.43 |
| C 20:0     | 0.22       | 0.048              | 0.13 | 0.29  |
| C 20:4 n6  | 0.13       | 0.023              | 0.09 | 0.17  |
| Σ CLA      | 0.38       | 0.084              | 0.26 | 0.54  |
| Σ C18:1 trans | 1.75 | 0.537 | 1.31 | 3.28 |
| Σ SFA      | 72.15      | 3.639              | 64.92| 77.60 |
| Σ MUFA     | 24.70      | 3.409              | 19.56| 31.42 |
| Σ PUFA     | 3.15       | 0.404              | 2.63 | 3.81  |
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