Evaluation of the Quality of the Buffalo Milk Produced in South-Western Romania

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Abstract. Milk has been used since the ancient times as staple by many people because of the optimal proportion of nutrients. Buffalo milk contains 58% more calcium, 40% more protein and 43% less cholesterol than cow milk. This paper makes an evaluation of the buffalo milk quality from the south-western area of Romania, Dolj (D) and Olt (O) Counties, by determining milk protein (Kjeldahl method), milk fat (extraction in organic solvents), lactose (iodometric method) and fatty acids (gas chromatography).

The following average values have been recorded (g/100ml milk): protein 4.866±0.826(D), and 5.075±1.003(O); fat 7.977±1.694(D), and 7.604±1.810(O); lactose 3.446±1.093(D), and 2.746±0.499(O); saturated fatty acids (SFA) 4.789±0.280(D), and 5.261±0.149(O); monounsaturated fatty acids (MUFA) 2.472±0.374(D), and 1.961±0.059(O) and polyunsaturated fatty acids (PUFA) 0.194±0.053(D), and 0.139±0.022(O).

Keywords: buffalo milk, quality, protein, PUFA

INTRODUCTION

The milk and the dairy products used as such as combined with other foods, play an important role for a rational feeding, because they contain adequate, readily assimilable, amounts of all substances required for body development. The western countries produce today large amounts of cow milk and they breed Holstein cows especially for increased milk productions. According to a study of McGee (2004), 90% of the cow stock in the United States and 85% in the Great Britain are Holstein cows. The world's largest milk producing countries are: India followed by the United States and the New Zealand.

Fat – this is the milk component with the largest quantitative variations according to animal species, breed and lactation period. It varies largely between 3-5%, with an average value of 3.7%. The lipids have the shape of globules of different sizes, under the form of an emulsion. Milk fat consists mainly of glycerides 98-99%, completed with other lipids: phosphatide 0.2-1.1%; sterols 0.25-0.4. The fat is coloured by pigments (carotin, xanthophyll) which come fro the green forages, because in summer the fat has a more pronounced yellow colour than in winter because of the grazing.

Proteins – milk proteins consist of casein, lactalbumin and lactoglobulin. Casein is the main protein component and it stands for 80% of the total protein matter of the milk. It can be obtained from milk by precipitation with an acid, at pH= 4.6. The pure casein is a white, insipid, inodorous powder. It clots under the action of enzymes (rennet, pepsin). Lactalbumin has a quite low content of nitrogen and a high level of sulphur. It contains no phosphorus, is water soluble, precipitates under heat (over 72°C). Lactoglobulin is found in trace amounts. It has a higher content of sulphur than the casein and very little phosphorus. The buffalo milk
proteins, particularly from the whey, are much more resistant to denaturation by heat compared to the cow milk proteins. The buffalo dairy products contain a much higher amount of non-denatured proteins, although the same processing methods are used.

Lactose – or milk sugar, gives the sweet taste of the fresh milked milk. Its sweetening power is about four times lower than that of the saccharose. It is secreted by the mammary gland and it can be found in nature only in milk. Chemically, it is a disaccharide consisting of a molecule of glucose and one of galactose. Under the action of microorganisms (bacteria, yeasts) it ferments and gives thus specific flavours and tastes to a range of dairy products.

The US Department of Agriculture published in 2007 a comparative study on the main milk nutrients in different species of ruminants. Thus, the highest level of milk protein was found in sheep with 5.98g/100 ml fresh milk, followed by buffalo milk with 37.3% less protein, goat milk with 40.5% less protein, and cow milk with 44.9% less protein.

The highest level of milk fat was also found in sheep with 7.01g/100ml fresh milk, followed by buffalo milk with 1.7% less fat, not significant statistically, goat milk with 40.9% less and cow milk with 52.35% less fat. The mineral content of buffalo milk also is superior in terms calcium, iron and potassium: about 92%; 37.7% and 11.8% higher than in the cow milk.

Buffalo milk has a much clearer white colour than cow milk, which is creamy-pale yellow (due to its fat). The dairy products such as UHT milk have different texture according to the animal. Thus, in the buffalo dairy products calcium and potassium conversion is higher in the colloidal form, making it the choice for UHT milk. Milk fat contains almost all the saturated and unsaturated fatty acids. Among them, 10 fatty acids are in higher amounts: butyric, caproic, caprilic, lauric, myristic, palmitic, stearic, arachic, oleic and linoleic.

Recent research shows the beneficial effect of the polyunsaturated fatty acids, particularly of the conjugated linoleic acid in the prevention of cancer, cardiovascular diseases and diabetes. The content of conjugated linoleic acid depends on milk origin, the species particularly and the food (Sloniewski et al., 2005; Bisig, 2005). The conjugated linoleic acid also enhances the immune system (Schmid, 2005).

MATERIALS AND METHODS

The quality of the buffalo milk coming from south-western Romania was evaluated comparatively by county: Dolj County (19 samples) and Olt County (15 samples). The samples were collected from small farmers, during February – March; so that the feed given to the animals was specific to those particular areas during this period. The main nutrients were determined: protein - by Kjeldahl - semiautomatic AUTO 1030 -TECATOR ANALYSER, fat – by Soxhlet – extraction with organic solvent – on a SOXTEC HT6 – TECATOR SYSTEM, lactose – by iodometric titration and the fatty acids: saturated, mono-, and polyunsaturated – gas chromatography - Perkin-Elmer – Clarus 500 gas chromatograph with capillary column and flame ionization detector (FID).

Analytical methods in agreement with the current national (STAS) and international (ISO, AOAC) norms were used. The analytical results were processed statistically with Microsoft Office Excel 2007 and Origin 6.1.

RESULTS AND DISCUSSIONS

The nutrient content of the buffalo milk from the two regions of Romania is comparable with the literature data as shown in Tab.1.
Comparative data on the main buffalo milk nutrients (average values, g/100ml fresh milk)

<table>
<thead>
<tr>
<th></th>
<th>Protein</th>
<th>Fat</th>
<th>Lactose</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Department of Agriculture, (2007)</td>
<td>3.75</td>
<td>6.89</td>
<td>5.18</td>
</tr>
<tr>
<td>Long life buffalo milk – Great Britain</td>
<td>4.5</td>
<td>8.0</td>
<td>4.9</td>
</tr>
<tr>
<td>Tafta, V. et al., (1997)</td>
<td>4.5</td>
<td>8.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Banu C. et al., (2002)</td>
<td>5.0</td>
<td>8.0</td>
<td>5.2</td>
</tr>
<tr>
<td>Dolj County</td>
<td>4.866±0.826</td>
<td>7.977±1.694</td>
<td>3.466±1.093</td>
</tr>
<tr>
<td>Olt County</td>
<td>5.075±1.003</td>
<td>7.604±1.810</td>
<td>2.746±0.499</td>
</tr>
</tbody>
</table>

*a* significant differences (P≤0.05) from Dolj  
*b* significant differences (P≤0.05) from Olt

The highest average value for the protein (5.075±1.003 g/100ml) was recorded in the milk samples collected from Olt County, significant differences existing between the strings of values.

The highest average value for the fat (7.977±1.694 g/100ml) was recorded in the milk samples collected from Dolj County, with no significant differences between the strings of values.

Significant differences between the two counties have been recorded for lactose, the highest value being recorded in the milk samples collected from Dolj County (3.466±1.093 g/100ml).

Table 2 shows the results of a 2007 USDA study on the mono- and poly-unsaturated fatty acids in the milk from several ruminant animals.

<table>
<thead>
<tr>
<th>Fatty acids</th>
<th>MUFA (monounsaturated fatty acids)</th>
<th>g</th>
<th>Cow</th>
<th>Goat</th>
<th>Buffalo</th>
<th>Sheep</th>
<th>Human</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow</td>
<td>0.965</td>
<td>1.109</td>
<td>1.787</td>
<td>1.724</td>
<td>1.658</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td>0.124</td>
<td>0.149</td>
<td>0.146</td>
<td>0.308</td>
<td>0.497</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffalo</td>
<td>2.079</td>
<td>2.667</td>
<td>4.597</td>
<td>4.603</td>
<td>2.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

The highest levels of monounsaturated fatty acids-MUFA (2.472±0.374g/100ml milk); and polyunsaturated fatty acids-PUFA (0.194±0.053 g/100ml milk) were recorded in the milk samples collected from Dolj County, while the highest levels of saturated fatty acids-SFA (5.261±0.149g/100ml milk) were recorded in the milk samples collected from Olt County, significant differences (P≤0.05) existing between the two counties for all three classes of fatty acids (Fig. 1).

The oleic acid had the highest proportion (1.92±0.043g/100ml milk) among the monounsaturated fatty acids; the linoleic acid had the highest proportion (0.13±0.0267g/100ml milk), among the polyunsaturated fatty acids; the palmitic acid had the highest proportion (3.49±0.328g/100ml milk) among the saturated fatty acids, significant differences (p≤0.05) being noticed between the two counties Dolj – Olt (Fig. 2).
CONCLUSIONS

The milk samples differed significantly (p≤0.05) particularly in terms of the fat and lactose content, the highest values being recorded in Dolj County;

Significant differences (p≤0.05) were recorded in the fatty acids concentration for all three categories: monounsaturated, polyunsaturated and saturated, between the buffalo milk samples collected from the two counties Dolj and Olt;

Buffalo milk is increasingly used in human feeding because of the beneficial effect of the polyunsaturated fatty acids, particularly of the conjugated linoleic acid, in enhancing the immune system and in preventing the cardiovascular diseases, diabetes and cancer.

REFERENCES

3. The paper „Buffalo Milk from Britain” published in the LONG LIFE BUFFALO MILK; site: info@buffalomilk.co.uk.