Quality control of raw cow milk from Galati county

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Abstract

Due to the importance of milk in the human diet, it is essential to increase milk production and to improve its quality. In order to obtain a complex image of milk quality in Galati county there was made a study based on analyzing raw milk, from January until December 2010, taking into account the influences of animals feeding and conditions of transport and storage (including summer period, when the milk production is maximum, and autumn period, when milk production decreases).

To determine the quality and safety of raw milk in Galati county there have been concerned: determinations of physical and chemical characteristics (density, protein content, lactose content, fat content, freezing point) and determinations of microbiological characteristics (total number of mesophyllic germs (NTG) and number of somatic cells (NCS)).

Keywords: cow milk, quality monitoring, physicochemical characteristics, microbiological quality

1. Introduction

Physicochemical and microbiological analyses are an important tool to monitor the quality of food products [3]. Milk has been known as nature’s most complete food [1,8]. However, the traditional and contemporary view of the role of milk has been remarkably expanded beyond the horizon of nutritional subsistence of infants.

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, milkborne 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 [2,5].

Recent studies have shown that milk furnishes a broad range of biologically active compounds that guard neonates and adults against pathogens and illnesses, such as immunoglobulins, antibacterial peptides, antimicrobial proteins, oligosaccharides, and lipids, besides many other components at low concentrations (so-called “minor” components, but with considerable potential benefits).

During the past decades, major progress has been made in the science, technology, and commercial applications of the multitude and complexity of bioactive components, particularly in bovine milk and colostrum. Cow milk has been the major source of milk and dairy products in developed countries, especially in the Western world, although more people drink the milk of goats than that of any other single species worldwide [10].

Among the many valuable constituents in milk, the high levels of calcium play an important role in the development, strength, and density of bones in children and in the prevention of osteoporosis in elderly people [4, 8].
Calcium also has been shown to be beneficial in reducing cholesterol absorption, and in controlling body weight and blood pressure.

Recent numerous research activities and advanced compositional identification of a large number of bioactive compounds in milk and dairy products have led to the discovery of specific biochemical, physiological, and nutritional functionalities and characteristics that have strong potential for beneficial effects on human health. Four major areas of bioactivity of milk components have been categorized: 1) gastrointestinal development, activity, and function; 2) infant development; 3) immunological development and function; and 4) microbial activity, including antibiotic and probiotic action [2, 8].

This study is useful for development of H.A.C.C.P. systems for healthy milk products. The results are valuable for considering risk of contamination relating to health problem of consumers. However, it is not reported many of food-borne illness since people are not fully understood about contaminated food and therefore bacterial infections [6, 7, 10].

The objective of present study was to evaluate physicochemical properties as well as microbiological quality of raw milk from different collecting centers from Galati county, destined to processing in a big capacity unit.

2. Materials and Method

Materials: The provenience of cow milk samples is a dairy products factory from Galati county, that is supplied by the local farmers from the villages of the county (Schela, Branesti, Barbosi).

Dairy company produces fermented milk products, yogurt, butter, cheese, collecting between 12000 L (in winter) and 20000 L (in summer) milk.

The research was carried out an entire year (from January until December 2010). All samples were collected directly from homogenized bulk milk of a tank in the factory and put in the 330 mL sterile bottles, stored at 4–6 °C in a cool box and immediately transported to the laboratory to be analyzed.

Physicochemical analyses. The density, temperature, protein, lactose, fat, minerals, freezing point values were determined using a milk analyzer (LACTOSCAN MCC).

Microbiological analyses. The total number of mesophylic germs of milk samples was detected in accordance with standard SR EN ISO 4833/2005. The samples were incubated at 37 °C for 72 hours, growth colonies were monitored and analyzed using a colony counter STUART. For identification of microorganisms the following media were used: tryptic peptone, yeast extract, anhydrous glucose, agar.

The number of somatic cells count was determined according to SR ISO 13366b3/2001, were used the fluora-opto-electronic method, using SOMACOUNT 150.

3. Results and discussion

As a result of the physicochemical characterization an annual average of the milk components was calculated for three units in 2010 (Table 1).

### Table 1. Chemical composition of cow milk – annual average

<table>
<thead>
<tr>
<th>Parameter/Component</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollution load, class</td>
<td>II</td>
</tr>
<tr>
<td>Density, g/L</td>
<td>1.029</td>
</tr>
<tr>
<td>Acidity, %</td>
<td>18.75</td>
</tr>
<tr>
<td>Total dry substance, %</td>
<td>11.98</td>
</tr>
<tr>
<td>Total dry nonfat substance, %</td>
<td>8.50</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.56</td>
</tr>
<tr>
<td>Protein, %</td>
<td>3.36</td>
</tr>
<tr>
<td>Lactose, %</td>
<td>4.33</td>
</tr>
<tr>
<td>Mineral salt, %</td>
<td>0.68</td>
</tr>
<tr>
<td>Freezing point, °C</td>
<td>-0.515</td>
</tr>
</tbody>
</table>
The pollution load. The tested samples of milk fell into the second and third quality categories of unclean milk with a very large number of impurities of different shapes and sizes. This is due to the improper conditions of milking and to the absence of some mechanical filters at the milk collection centres.

The values of the density of the raw material milk ranged from 1.024 g/cm\(^3\) (unit 2) to 1.030 g/cm\(^3\) (unit 1).

The acidity. On the whole, the average values of this parameter decreased under the maximum limit permitted by the Romanian legislation (maximum of 19 °T) though, values of 19 °T were recorded particularly from June to August.

The total dry substance content (S.U.T) is influenced by the variation of the other components (fat, proteins, lactose, mineral substances) depending on the animals’ food conditions and climate. The tests certified that the total dry substance fits into the limits permitted by the Romanian standards namely, values ranging from 10.80% (unit 3) to 12.77% (unit 1).

The fat in milk is the component with the largest variation depending on the breed, the season, the feeding and watering conditions, the lactation period, the number of milking and the milking time. The analyses of the milk sourced from the three routes do not highlight significant variations, probably because the milk is sourced from many small farm stead’s which have a small number of animals (1÷3) and, by collecting and mixing it the differences are no longer obvious.

The fat content in milk surpasses, in most cases the minimal accepted value of (3.5%). Still, there are also exceptions, 3.11% and 4.09% (unit 1 and 2). Higher values of the fat content in milk are recorded from May to September. For the rest of the year the values varied between 3.39% and 3.95%.

Milk is an import source of superior proteins with a high biological value and digestibility, rich in essential amino-acids. The analysis of the protein content in the raw material milk pointed out that its values range from 3.05% (unit 2 and 3) to 3.51% (unit 1), and that they are higher when it’s hot.

The value of the lactose content in the milk sourced from all the tested routes is lower than the normal values mentioned by the standard (4.6%) varying from 4% (unit 3 and 2) to 4.52% (unit 1). Since the lactose is the most constant constituent of the milk composition its variation is greatly influenced by the milk microbiota and the preservation conditions.

The tested milk samples indicated the largest amount of lactose in the milk collected from June to September (unit 1), generally surpassing 4.2% the lowest lactose content was recorded from unit 3.

The mineral substances content which also depends on the fodder diet was very close to the standard value of 0.7%, varying from 0.6% (unit 2 and 3) to 0.72% (unit 1 and 2). All the year round, the mineral salts content of the milk sourced from unit 3 varies less.

The freezing point. According to the Order 682/2006 and HG 1266/2006 the reference freezing point was established for Romania at -0.515 °C. A high value of freezing point indicates a colostral milk, a milk sourced from cows suffering from mastitis or a milk diluted with water or mineral salts. As for the tested samples the freezing point has values ranging from -0.458 °C (unit 3) to -0.559 °C (unit 1) which demonstrates that the milk sourced from unit 3 was highly diluted with water 11.73%. This result is closely connected to the lower content of dry substance and mineral salts in milk.

The microbiological analysis. The assessment of the milk innocuity from a microbiological viewpoint is a major condition for the control of the milk quality, the microbiological quality being determined by the number of the existing microorganisms in the milk at some point and by their nature. The following microbiological indicators were measured: the total number of mesophilic aerobic germs and the number of somatic cells.

The Order 1106/23, on December 2003 stipulates that, beginning with January 1st 2007 the milk has to contain less than 10 \(^6\) cfu/mL which requires very rigorous standards of hygiene and milk cooling so that it can comply with these sanitary regulations.

The milk contamination with mesophilic aerobic bacterium (Figure 1) is higher in value from January to May (3.8 \( \times \) 10\(^6\) cfu/mL ÷ 1.73 \( \times \) 10\(^6\) cfu/mL) (unit 3) the milk fitting into the fourth category of quality.
Beginning with June the microbial load the milk provided by this unit is lower in value due to the improved conditions of milking and cooling the milk in the summer.

Consequently, in January the milk sourced from unit 1 and 3 fits into the third category of quality (ncs/mL = 600.001÷1.000.000). The milk sourced from the unit 2 falls into the second category of qualities (ncs/mL = 400.001÷600.000).

For the other two unit the total number of mesophyllic aerobic germs recorded at the same time of the year is lower in value, ranging from $1.33 \times 10^6$ cfu/mL to $1.35 \times 10^6$ cfu/mL (unit 1), respectively from $1.11 \times 10^6$ cfu/mL to $1.35 \times 10^6$ cfu/mL (unit 2). Starting from June it began to increase in value probably because, in the dry season, at the milk collection centres the proper cooling and preservation conditions haven’t been respected.

The monthly test results highlight the fact that the milk sourced from cattle in 2010, from the perspective of the somatic cells (Figure 2) does not comply with the regulations imposed by the Order no. 682/2006 (400.000 cells/mL of milk), being unfit for human consumption and for dairy products processing. The most frequent cause of this phenomenon is the teat state of health.

The age of the animals, the mammary rest (the number of the somatic cells increases in value before and after the period of mammary rest), the incomplete milking rank among the factors which could also influence the somatic cells from the milk and which are mentioned in the speciality literature.

When it is cold the number of the somatic cells goes up in value. The situation has considerably improved as a result of the veterinaries’ and producers’ warning.

The high quality of the milk sourced from unit 2 from summer to fall is obvious. As for the third unit, although there has been a considerable improvement in the milk quality going up from the third category (in January) to the first category (in November), it is still considered a doubtful milk which requires further testing.

4. Conclusions

The major components of cow milk (total protein, fat, lactose and minerals) are affected by seasonal changes. Total dry substance content is influenced by the variation of those components such as: fat, protein, and lactose, in function of feed and climate conditions.

Acidity is a very important physical – chemical parameter, expression of freshness degree and hygienic degree of milk. Generally, medium values of this parameter are framed less that maximum limit admitted from Romanian legislation (max. 19 0C).

Analyzing these parameters it has been ascertained that it is framed in the admitted limits of Romanian standard

Microbiological indicator testing from raw milk in all the collected samples goes to conclusion that it is present a high microbial leading. Taking into account 1106/23.12.2003 MAPAM Order that establish for milk content a value less than 106 cfu/mL, result the constraint of hygiene and cooling severe measures for milk to correspond those sanitary norms.
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References