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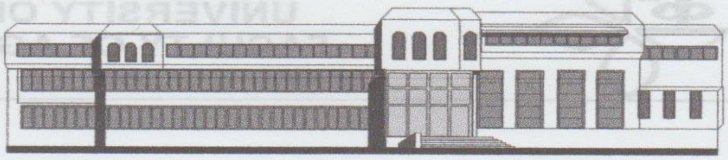
Faculty of Agronomy – Čačak
Cara Dušana 34, 32000 Čačak
e-mail: afdekanat@kg.ac.rs
www.kg.ac.rs



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Changes in the physicochemical composition of the milk as a result of the increased number of somatic cells

Marija Runcevska[1*], Ljubica Trajkoska[1], Dragan Ilievski[1,2], Aleksandra Grozdanovska [1,2], Natasa Gjurcinovska[2]

*Undergraduate student (third year)

Mentors: Ljupche Kochoski, Biljana Trajkovska

[1]University "St. Kliment Ohridski", Faculty of Biotechnical Sciences, Bitola, Macedonia,

[2]Mlekara AD Bitola, Macedonia,

e-mail: runmarija@gmail.com

Abstract: Milk loses its characteristics because of the increased number of somatic cells (SCC) (which appear as a result of the organism fight against bacteria in the udder) that also produce enzymes which later on degrade proteins and fats. Additionally, the enlarged number of somatic cells has negative influence on milk termostability. The quality of raw milk is defined by a few factors, among which is the chemical structure (milk fat, proteins and the volume of lactose), the total number of somatic cells (SCC), the total number of bacteria, the sensory quality and the storage-keeping temperature.

The aim of this study is to determine the influence of the somatic cells count upon the physico-chemical characteristics. In these milk samples the number of somatic cells, bacteria, milk fat, lactose and proteins were analyzed. Each analysis was performed in a duplicate sample. Milk is separated in three groups, according to the number of somatic cells (ex. up to 100 000 cells/ml, from 100 000 to 400 000 cells/ml, and more than 400 000 cells/ml.) in order to determine the structural milk changes.

Key words: somatic cells (SCC), lactose, proteins, mastitis

Introduction

Milk structure and microbiological characteristics are important factors for the farmers (quality of the raw milk), as for the milk industry (technological process and dairy products quality), and as well as for the consumers (food quality and safety). Due to that, the increased number of somatic cells (which

appear as a result of the fight of the organism against bacteria in the udder) and which, also produce enzymes that later on tear down proteins and fats, causes loss of milk characteristics. Additionally, the enlarged number of somatic cells has negative influence on milk termostability. Considering the fact that the number of somatic cells is directly connected to the animals' health, it could be an indicator of the quality and hygiene status of the milk itself. Several factors influence the number of somatic cells in milk, such as: factors that provoke mastitis (pathogenic microorganisms, toxins and tissues' damaging), physiological-pharmacological factors (lactation stadium, bred, giving certain veterinarian medical preparations) and stress factors (diet change, transportation, conditions of raising, way of milking and technical accuracy of milking machines (Sharma et al., 2011).

Somatic cells mainly originate from the epithelium cells of milk alveoli which are removed from the mucous membrane of the milk gland as well as from blood cells, most frequently from white blood cells (leucocytes) which enter into the milk gland as a result of injury or infection (Dairyman's digest, 2009). That is why the number of somatic cells (SCC) in milk is an important indicator of the udder's health and it has been recognized as a useful parameter for evaluation of the relation between intramamar infection and changes appearing in the milk characteristics (Raynal- Ljutovac et al., 2007).

The increased number of somatic cells is connected with the protein quality change, change of structure of the fat acids, lactose, concentration of ions and minerals, the enlarged enzyme activity and pH rising with the raw milk (Ogola et al., 2007). The increased number of somatic cells leads to increasing of the whey proteins, and reduction of the casein, to shorter period of permanent date of milk products and unpleasant milk taste (Kalevska, 2013).

The raw milk quality is defined by a few factors, among which are: the chemical structure (milk fat, proteins and lactose content), the total number of somatic cells (SCC), the total number of bacteria, the sensory quality and the temperature of keeping. According to Kalevska (2009), the changes appearing with the milk which has an erased number of somatic cells, refer to the negative relation of the casein fractions, the increased pH value, the changes within the coagulative capability of milk, reduced yield and cheese quality.

Materials and methods

Material

The study was conducted in the farms of the Pelagonia Region during the period of time from August to September. For this purpose 29 samples of raw cow milk were taken. The milk samples were taken from cows that were randomly selected, followed by examination of physico-chemical characteristics

of the milk, the somatic cells and the total number of bacteria. The samples that were to be used for defining the somatic cells were conserved by using the Broad spectrum, microtabs II. And for the samples to be used for microbiological explorations, a special attention was paid on sterility while taking the sample. All the samples were transported to the laboratory in a transporting fridge with ice, and kept in a laboratory on 4°C up to the moment of analysis. Before performing the analysis, the samples were hit in a water bath on 40 °C temperature and cooled to 20 °C before continuing with the analysis. All the samples were analyzed during the same one day.

Methods

Physico-chemical parameters (proteins, fats and lactose were researched by Milk analyzer Lactoscan MCC, the somatic cells were analyzed by Bentley Somacount CC 150, while Bentley Bactocount IBC was used to define the total number of bacteria in the raw milk.

Results and discussion

The rising number of somatic cells leads to reducing the quantity of milk and changes in milk structure which can influence the quality of dairy products, for ex., prolonged time for coagulation with renin, reducing moisture in cheese, delayed growing of starter cultures, reduction of stability of coagulation and of quantity of cheese (Trajkovska et al. 2011; Kochoski, 2011). Mastitis causes damages on milk secretory cells in the milk gland that results in changes within the synthesis of lactose, milk fat and proteins (Schallibaum, 2001).

Changes in the physico-chemical structure of milk are in correlation with the number of somatic cells (Katic and Stojanovic, 2002), and therefore somatic cells are used to estimate its quality. Moreover, when it comes to infection of the milk gland and increasing number of somatic cells, disturbance within the milk synthesis in the cells of the secretory epithelia, accompanied by quantitative and qualitative changes within milk appears (Niketic, 2003), as reduction of the volume of lactose, casein and milk fat, and increasing of milk serum and enzymes.

In Table 1, chemical structure of milk and changes that appear as a result of the increasing somatic cells are shown. As of the results shown, it is obvious that there is a certain reduction of lactose percentage in milk, which is a result of the reduced synthetic activity of gland tissue and it reduces from 5,06% to 4,82% within the milk with mastitis.

Table 1. Chemical analysis of raw milk

Parameters	SCC ≤ 100000	SCC ≥ 100000 ≤ 400000	SCC ≥ 400000
milk fat	3,46	3,36	3,07
lactose	5,06	5,16	4,82
proteins	3,76	3,44	3,21
CFU/ml	10000.00	20916.67	838076.92
SCC/ml	69750.00	253166.67	1393923.08

Lactose is one of the most sensitive parameters with milk which shows the disturbance in the secretory tissues (Gajdusek, 1996). Cow milk has an average 4,7-4,9% lactose, and the udder health condition influences the reduction of lactose percentage, which, during the infection process could be reduced up to 2% (Antunac et al., 1999). Franke et al., (1983) claims that the percentage of lactose within the normal milk is 4,7%, i.e. 4% within the milk with mastitis.

In accordance to the scientific data, the total volume of proteins usually remains unchanged when the somatic cells are below 106 cells/ml (Walstra and Jenness, 1984), but the types of proteins in milk are changing. Synthesis of the main whey protein, β-lactoglobulin and α-lactoalbumin, is reduced, while the volume of the bovine serum albumin is increased (BSA), as a result of the blood flow (Korhonen and Kaartinen 1995). According to the results, it can be concluded that the protein percentage is reducing when the somatic cells are above 400000 cells/ml and is 3,21%, compared to the condition when the somatic cells are below 100000 cells/ml. Similar results were found by Jones (2006), showing that average value of that the total proteins appear as 3,61% and 3,56%, consequently for the normal milk and milk with mastitis, but, making the difference that with the normal milk the total casein is 2,8%, and the milk with mastitis has 2,3%, while whey proteins with the normal milk are 0,8% and the milk with mastitis is 1,3%.

Milk fat is a specific product of the milk gland and is the most changeable component which influences the pleasant taste of milk, aroma, consistency and texture. As for the percentage of milk fats, it is discovered that there is a slight fall as a result of the increased number of somatic cells. Korhonen and Kartmen (1995) had got the same results.

Conclusion

The increased number of somatic cells causes changes within the milk structure. As of the results it can be concluded that there is a reduction of lactose percentage, as a result of the reduced tissue synthetic activity. The most

significant changes with the proteins appear in the types of proteins, i.e. it comes to a reduction of casein and increase of whey proteins. Further on reduction with the percentage of milk fat in milk has been registered. It could be concluded that the milk quality is in a direct connection with the high number of somatic cells, due to which it is inevitable to follow the health of milk animals in the farm itself through the usage of farm tests, as California mastitis test is, as well as by using the good hygienic practices during the process of milking.

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