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THE IMPACT OF THE SEASON ON THE QUALITATIVE CHARACTERISTICS OF BEATEN CHEESE

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In our country, the interest of consumers for traditionally obtained cheeses is increasing and milk processing capacities are making efforts to industrialize their production process. The group of the most consumed traditional cheeses also includes beaten cheese.

Accordingly, the subject of analysis of our research was to determine the impact of seasonal changes in raw cow's milk on the qualitative characteristics of industrially obtained beaten cheese. Samples were taken over a period of one year. A total of 24 batches of beaten cheese were obtained in an industrial way of production, before every batch the quality of raw milk was analyzed. Milk samples were analyzed for physico-chemical composition (proteins, fats, lactose, solids-non-fat, minerals, added water, density, freezing point, and titration acidity) and hygienic condition (somatic cell count (SCC). Meanwhile, samples of beaten cheese were analyzed for their physico-chemical composition (proteins, fats, salt, moisture, dry matter, and titration acidity).

The results obtained from this research indicate the fact that seasonal changes have an impact on the quality and hygienic condition of raw cow's milk. Whereas the quality (percentage of proteins and fats) and the hygienic condition of raw milk largely determine the quality and physico-chemical properties of the beaten cheese.

Key words: *raw cow's milk, seasonal changes, beaten cheese*

INTRODUCTION

Traditional cheeses are consumed daily in Macedonia, like white brine cheese and beaten cheese (Talevski G., 2012). Beaten cheese is an autochthonous dairy product that used to be made from sheep's milk and originates from the area of Mariovo (Dubrova Mateva N. et al., 2008).

With the development of science and technology, it has become known that the final quality of cheese largely depends on the quality of the primary raw material, i.e. raw milk (Osama K. et al., 2015). In general, the quality of raw milk depends on the diet, breed, and lactation period of the dairy animal, as well as on environmental conditions (season) (Guetouache M. et al., 2014). Additionally, the quality of beaten cheese depends on the production process, as well as the implementation of hygienic practices, standards, and

systems that along with the quality guarantee the safety of the final product (Levkov V. et al., 2014).

MATERIALS AND METHODS

The subject of analysis of this research were samples of industrially produced beaten cheese from raw cow's milk. Milk and cheese samples were taken for a period of one year, twice a month, from the milk processing capacity in the Pelagonia region. A total of 24 bulk tank milk samples were analyzed. From this milk was produced beaten cheese and 24 batches were obtained.

Sampling for raw milk analysis was performed in the morning, before the start of the working day. Representative samples were taken from bulk tank milk. Samples for analysis of physico-chemical parameters were taken in plastic cups (100ml). Samples for the analysis of the hygienic condition of milk were taken in sterile cups (40ml) with the preservative Broad Spectrum Microtabs II (one tablet for 40 ml of milk). After sampling, the samples were well closed and transported at 4 °C to the laboratory. Analyzes were performed on the same day. The samples were analyzed at room temperature (20°C to 22°C). The compositions of milk (proteins, fats, lactose, fat-free dry matter, minerals, density, added water, and freezing point) were determined using the Lactoscan MCC an ultrasonic milk analyzer. Soxhlet Henkel method was used for the determination of titration acidity. The somatic cell count was analyzed by LACTOSCAN SCC based on fluorescent microscope technique of counting cells.

The samples of beaten cheese were randomly chosen from several vacuum packages (50g). The samples were placed in plastic cups and transported to the laboratory. The determination of the percentage of proteins was done by the method of Kjeldahl, while the percentage of fats was determined by the method of Gerber. The titration acidity was determined by the method of Soxhlet Henkel. The percentage of NaCl was determined by the Mohr method. Mettler Toledo MJ33 was used to determine the percentage of moisture and dry matter.

The obtained results were grouped into four groups: Winter (January - March), spring (April - June), summer (July - September), and autumn (October - December).

Statistical significance among the examined categories was analyzed at a significance level of 5% ($p < 0.05$) using Student's t-test.

RESULTS AND DISCUSSION

The results obtained from the conducted analyzes in raw milk are presented in Table 1.The percentage of basic nutritional components in milk, for the winter season was 3.31% proteins and 4.5% fats, while the lowest values were obtained in the summer season, when the percentage of proteins and fats was 2.8% and 3.24%, respectively. Significant differences were observed in the percentage of proteins and milk fat during the summer season compared

with spring, autumn, and winter ($p<0.05$). The percentage of proteins and fats is inversely proportional to ambient temperature (Ocak E. and Inci S., 2008), whereby, any increase in temperature leads to a reduction of these parameters (Nateghi L. et al., 2012). Additionally, the increase in the percentage of proteins in winter may be due to the use of a concentrated diet of dairy cows (Osama K. et al., 2015) or according to research by Rubporn K. et al., (2007) feeding of dairy cows with foods fortified with soy protein. Regarding the percentage of fats, similar results were obtained by Yang L. et al., (2013) who noticed that the percentage of milk fats is the highest in winter. According to Osama K. et al., (2015), at the beginning and at the end of the lactation phase of the dairy animal, there is an increase in the percentage of fats. Additionally, according to Vojtech K. and Sarka N., (2015), each increase in milk fats is followed by a decrease in solids-non-fat (SNF) and titration acidity. We obtained similar results, with the exception of the spring season (Table 1).

Table 2 - Physicochemical and hygienic analysis of raw cow's milk

Parameters	Spring	Summer	Autumn	Winter
Proteins (%)	$3.16\pm0,22^{b}$	$2.80\pm0,30^{a}$	$3.22\pm0,27^{b}$	$3.31\pm0,18^{b}$
Fats (%)	$4.25\pm0,25^{b}$	$3.24\pm0,33^{a}$	$4.13\pm0,11^{b}$	$4.35\pm0,23^{b}$
Lactose (%)	$5.43\pm0,49^{a}$	$4.65\pm0,49^{b}$	$5.48\pm0,30^{a}$	$4.24\pm0,62^{b}$
SNF (%)	$8.06\pm0,40^{a}$	$6.77\pm0,30^{b}$	$7.81\pm0,48^{a}$	$7.94\pm0,49^{a}$
Minerals (%)	$1.01\pm0,16^{ab}$	$1.19\pm0,22^{a}$	$1.04\pm0,02^{ab}$	$0.93\pm0,90^{b}$
Freezing point (°C)	-0.724±0.01	-0.730±0,01	-0.727±0,01	-0.723±0,01
Added water	0.0	0.0	0.0	0.0
Density (g/cm^2)	1.04±0,01	1.04±0,01	1.04±0,01	1.04±0,01
Titration acidity (˚SH)	$7.5\pm1,44^{a}$	$6.9\pm0,22^{ab}$	$6.8\pm0,26^{ab}$	$6.2\pm0,13^{b}$
Total number of somatic cell (SCC/mL)	$372,250 \pm 46,964^{a}$	$623,166 \pm 69,769^{b}$	$334,166 \pm 139,041^{a}$	$812,000 \pm 60,488^{c}$

*The differences in values with different superscripts in the same column are statistically significant at the level of: a:b; a:c; b:c $p<0.05$

The highest values for the percentage of lactose were observed in autumn (5.48%) and spring (5.43%), while the lowest in summer (4.65%) and winter (4.24%) and they are statistically significant at the level of $p<0.05$. The percentage of lactose is generally conditioned by the lactation of the dairy animal (Rubporn K. et al., 2007) and is not

significantly affected by seasonal variations (Ocak E. and Inci S., 2008). According to Yang L. et al., (2013) the percentage of lactose is highest in winter, while according to Nateghi L. et al., (2012) in summer. In addition, the percentage of lactose is conditioned by the total number of bacteria and somatic cells (Yarabbi H. et al., 2014), so when the percentage of lactose is lower it means that the total number of bacteria is higher and inversely. In our results this correlation was observed in all studied seasons (Table 1).

A significant increase in somatic cells was recorded in winter (812,000 SCC/ml) as well as in summer (623,166 SCC/ml), while in spring and autumn the somatic cell count was below 400,000 SCC/ml. Significant differences were observed between the examined seasons ($p<0.05$), with the exception only between the spring and autumn seasons ($p>0.05$). Similar results were obtained by Nateghi L. et al., (2012) and Yang L. et al., (2013). According to Nateghi L. et al., (2012), the increase in the somatic cell count is most pronounced in winter, while according to Yang L. et al., (2013) in summer. In general, the main cause of an increase in the somatic cell count is an injury to the mammary gland and according to Yarabbi H. et al., (2014) an increase in the somatic cell count in summer is a result of favorable environmental conditions for the growth of bacteria (Yarabbi H. et al., 2014). Other factors that affect the increase in these two seasons are the temperature change, i.e., temperature stress as well as the change in diet (Nateghi L. et al., 2012; Yang L. et al., 2013).

Physico-chemical parameters and milk quality are influenced by season as well as temperature variations (Ocak E. and Inci S., 2008; Osama K. et al., 2015), diet (Yang L. et al., 2013; Rubporn K. et al., 2007), and individual characteristics of the dairy animal. Guetouache M. et al., (2014) states that the milk obtained in the winter has the most favorable chemical composition, and this reflects on the quality of dairy products, which fully coincides with the results obtained (Table 3).

In general, the nutritional characteristics of beaten cheese depend on the nutritional quality of the raw milk (Ramzan M. et al., 2010), i.e. proteins and fats are largely transferred to the cheese (Ramzan M. et. al., 2010). As a result of the most favorable chemical composition of milk in the winter period, the cheese obtained in that period is characterized by the highest percentage of proteins (29.50%) and fats (35.90%). Similar results were obtained in the autumn period. While the percentage of proteins in the summer is 23.40% and in the spring 25.83%. The percentage of milk fats in cheese produced in spring is 33.50%, while in summer 32.24% (table 2). Also, no significant variations were recorded between the seasonal qualities of beaten cheese in our research. This is as a result of standardization of the parameters during industrial processing of beaten cheese (Levkov V. et al., 2014).

Table 3 – Physico-chemical analysis of the industrially obtained beaten cheese

Parameters	Spring	Summer	Autumn	Winter
Proteins (%)	25.83±1,74	23.40±1,34	28.40±1,25	29.50±1,22
Fats (%)	33.50±0,21	32.24±1,35	35.00±1,34	35.90±1,45
Salt (%)	$6.6±0,51^{ab}$	$6.2±0,16^{a}$	$6.4±0,35^{ab}$	$6.8±0,25^{b}$
Moisture (%)	$41.52±0,24^{a}$	$44.62±0,88^{b}$	$44.64±1,30^{b}$	$36.32±2,67^{c}$
Dry matter (%)	58.48±0,24	55.18±0,88	55.36±1,30	63.68±2,67
Titration acidity (˚SH)	$58±1,41^{ab}$	$56±4^{a}$	$58±2,58^{ab}$	$60±1,79^{b}$

* The differences in values with different superscripts in the same column are statistically significant at the level of: a:b; a:c; b:c $p < 0.05$

The percentage of salt ranged from 6.2% (summer) to 6.8% (winter) and these values were significant at the level of $p < 0.05$. Slightly lower results were found by Talevski G., (2012). The percentage of salt in beaten cheese ranges from 5 to 10% (Dubrova Mateva N. et al., 2008). The high percentage of salt in this type of cheese is a result of the combined salting method (dry salting and salting in brine) (Levkov V. et al., 2014; Klopcevska J. et al., 2016).

The percentage of moisture ranged from 36.32% to 44.82%. In addition, the percentage of moisture in this cheese shows a significant difference ($p<0.05$), except between summer and autumn ($p>0.05$). Similar results were obtained by Klopcevska J. et al., (2016). Compared to Dimitrovska G. et al., (2018) the cheese obtained in this study had a higher percentage of moisture, which indicates the fact that the ripening process was faster (Dubrova Mateva N. et al., 2008).

The recorded values for the titration acidity range from 56^{0}SH to 60^{0}SH (Table 2). These values differs significantly at the level of $p<0.05$. Similar results were obtained by Talevski G., (2012). Additionally, changes in titration acidity are accompanied by changes in active acidity that most often depend on added starter cultures (Ramzan M. et al., 2010).

CONCLUSION

In general, the season and the hygienic quality of raw milk determine the nutritional value of beaten cheese.

The most favorable physico-chemical composition of raw milk was recorded in the winter period and it is 3.31% proteins, 4.35% fats, 4.24% lactose, 7.94% SNF, and 0.93% minerals, while the most unfavorable in the summer period (2.80% proteins, 3.24% fats, 4.65% lactose, 6.77% SNF and 1.19% minerals). In spring and autumn, the physico-chemical composition of the milk has almost equal quality. In addition, seasonal changes in the environment lead to a

decrease in its hygienic condition, as a result of the increase in the somatic cell count. The highest somatic cell count was recorded in winter (812,000 SCC/ml) and summer (623,166 SCC/ml). The hygienic condition of milk was significantly reduced in these two seasons. In spring and autumn, the somatic cell count was below 400,000 SCC/ml.

The best nutritional quality of raw cow's milk in winter resulted in the most favorable nutritional quality of industrially obtained beaten cheese which is 29.5% proteins and 35.9% milk fats. Additionally, the percentage of salt in the beaten cheese obtained in this period is 6.8%.

REFERENCES

DIMITROVSKA, G., SRBINOVSKA, S., JOSHEVSKA, E., JOVANOVSKA, V. (2018): Quality and Technology of Indigenous Traditional "Bieno". Cheese in the Region of Mariovo, Macedonia. AGROFOR.2.10.7251/ AGRENG1702116D.

DUBROVA MATEVA, N., EFTIMOVA, E., SRBINOVSKA, S., KAROVSKA, E., MENKOVSKA, M., PACINOVSKI, N. (2016): Preserving and Marketing Farmhouse Artisanal Cheese.14.54-59.

GUETOUACHE, M., GUESSAS, B., MEDJEKAL, S. (2014): Composition and Nutrition Value of Raw Milk. Issues in Biological Sciences and Pharmaceutical Research.2.115-122.10.15739/ibspr.005.

KLOPCEVSKA, J., TEMKOV, M., DIMITROVSKA, D., VELICKOVA, E., RAFAJLOVSKA, V. (2016): Influence of the Salting Proces on the Beaten Cheese Quality. III International Congress "Food Technology, Quality and Safety".

LEVKOV, V., SRBINOVSKA, S., GJORGOVSKA, N. (2014); Microbiological and Chemical Characteristics of Traditional Ewe's Milk Cheese from Mavrovo Region. Mljekarstvo 64(3),195-206(2014).

NATEGHI, L., YOUSEFI, M., ZAMANI, E., GHOLAMIAN, M., MOHAMMADZADEH, M. (2012): The Effect of Different Seasons on the Milk Quality. Euro.J.Exp.Bio.,2014,4(1):550-552.

OCAK, E., INCI, S. (2008): The Effect of Seasonal Variation on the Composition of Cow Milk in Van Province. Pakistan Journal of Nutrition.7.10.3923/pjn.2008.161.164.

OSAMA, K., EKBAL, A., HEND, E., MAHDY, A. (2015): Effect of Seasonal Variation on Chemical Composition of Cow's milk. Benha Vet Med j.28.150-154. 10.21608/bvmj.2015.32728.

RAMZAN, M., NUZHAT, H., TITA, M., TITA, O. (2010): Relative Changes in Ph and Acidity During Ripening of Cheddar Cheese, Manufactured by using Lactobacillus Rhamnosusasan Adjunct Culture. Acta Universitatis Cibiniensis Series E: FoodTechnology. Vol. XIV (2011),no.1.

RUBPORN, K., ROMMANEE, S., SAKULBUMRUNGSI, R., PENPHIMON, P. (2007): Factors Affecting Lactose Quantity in Raw Milk. Songklanakar in Journal of Science and Technology.29.

TALEVSKI, G. (2012): Traditional Production of Beaten Cheese. Third International Scientific Symposium "Agrosym Jahorina 2012". 10.7251/AGSY1203524T.

VOJTECH, K., SARKA, N. (2015): Viscosity and Analytical Differences Between Raw Milk and UHT Milk of Czech Cows. Scientia Agriculturae Bohemica.46.78-83.10.1515/sab-2015-0020.
YANG, L., YANG, Q., YI, M., PANG, H. Z., XIONG, H. B. (2013): Effects of Seasonal Change and Parity on Raw Milk Composition and Related Indices in Chinese Holstein Cows in Northern China. J. Dairy Sci.96:6863-6869.
YARABBI, H., MORTAZAVI, A., MEHRABAN, M., SEPEHRI, N. (2014): Effect of Somatic Cells on the Physic-chemical and Microbial Properties of Raw Milk in Different Season. International Journal of Plant, Animal and Environmental Sciences 4(3)