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ESTIMATING THE ECONOMIC LOSSES IN DAIRY PRODUCTION, BASED ON MILK QUALITY

Ljubica Trajkoska^{1*}, Andrej Stojkoski¹, Dragan Ilievski^{1,2}, Borce Petkovski¹

Mentors: Asst. Prof. Biljana Trajkovska¹, Prof. Ljupce Kocoski¹

¹University “St. Kliment Ohridski”, Faculty of Biotechnical Sciences, Bitola, Macedonia

²Mlekara AD Bitola, Macedonia

Summary: *One of the challenges farmers face is how to compete in the market by producing quality milk, but also to reduce milk production losses. The purpose of our research was to determine the economic losses caused by changes that occur on milk quality (protein and fat) and hygiene (somatic cell count (SCC/ml) and total number of bacteria (CFU/ml) in dairy milk production. The results obtained from the analyzed samples from the four farms in the Pelagonia region indicate that these parameters as quality measures vary from producer to producer and are a result of insufficiently implemented milk quality control.*

Key words: *raw cow's milk, losses, somatic cells.*

INTRODUCTION

The chemical composition of raw milk (Guetouache M. et al., 2014), especially the percentage of milk fat and protein, are important parameters for its quality. Consequently, any decrease in their nutrition or poor health would result in lower quality milk production. In order to produce milk that will be a quality raw material, in addition to its chemical composition, special attention must be paid to the health of the cows and the udder. The total number of bacteria (CFU/ml) and the total number of somatic cells (SCC/ml) are direct indicators that the cow is infected with mastitis (Forback L. et al., 2010).

The simplest and easiest way to detect clinical mastitis is physical control of the udder (FAO, 2014). The diseased udder is swollen, palpable and reddened, and the secreted milk is most often mild or has clumps of milk (Makarijoski B. et al., 2015). On farms where Good Hygiene and Manufacturing Practice is well conducted (Trajkovska B. et al., 2016) analysis of the total number of bacteria in raw milk is a good way to detect the possible occurrence of mastitis. The most common causes of this type of infection are bacteria such as: *Streptococcus agalactiae* and *dysgalactiae*, *Staphylococcus aureus*, and in addition *E. coli*, *Enterobacter* and *Klebsiella* from coliforms (Asfaw M. and Negash A., 2017). The increased number of somatic cells in the milk is a reliable indicator of the inflammatory process of the udder (Musliu A. et al., 2009). Approximately 98% of somatic cells in milk are leukocytes, which increase as a result of bacterial invasion, and the remaining 2% are epithelial cells resulting from umbilical regeneration (Kochoski Lj., 2011).

MATERIALS AND METHODS

The research was conducted over a period of three months in four farms in Pelagonia region. Samples for analysis of the bulk tank raw cow's milk were taken once a month, in accordance with official dairies control for monitoring the quality of raw milk. A total of 24 samples were analyzed. Samples for the analysis of protein and milk fat percentages were taken in plastic cups. Reference methods were used for both analyzes, the protein percentage was analyzed by the Kjeldahl method (MK EN ISO 8968-1: 2001) and the fat by the Gerber ISO 488: 2008 method (IDF 105: 2008). Samples for analysis of milk hygiene were taken in sterile bottles with Broad Spectrum Microtabs II preservative (one tablet for 40 ml of milk). The total number of bacterial count (CFU/ml) was determined by the colony count method MK EN ISO 4833: 2003, while the total number of somatic cell count (SCC/ml) was determined by LACTOSCAN SCC apparatus. After sampling the samples were well sealed and transported at 4 °C to the laboratory, in accordance with the *Rulebook on how to store raw milk and to take samples for analysis and superanalysis, the content, form and manner of filling in the minutes, the methods of analysis of raw milk, the method of classification and method of evaluation of raw milk, as well as the method of training and the program for conducting the training for controllers* (Official Gazette of R.M.No. 151/2011). The examinations were completed during the same day.

The determination of the price per liter of raw milk that should be obtained by the producer was carried out in accordance with the formula published in the marketing authorization (Official Gazette of the Republic of Macedonia No. 151/2011):

$$PPM = (M \times mp) + (P \times pp) + K,$$

where, PPM - purchase price of raw cow's milk; M - % of milk fat; P - % of protein; mc - price for milk fat percentage; pp - price for percentage of protein; K - Correction (quality supplement).

In the formation of the purchase price of raw milk (PPM) milk fat should participate with 40%, and milk proteins with 60%. In addition, a quality adjustment of PPM will be made, where the correction (%) will be + 10% for milk with extra quality, 0% for Class I and -10% for Class II milk. The calculations that will be done in this paper will refer to the average purchase price of 17 MKD per liter of raw cow's milk, for Class I milk, with 3,5% milk fat and 3,2% milk protein, where as extra-class milk - milk containing up to 100.000 CFU/ml and up to 400.000 SCC/ml is taken. Milk with a total CFU/ml of between 100.000 and 200.000 and a SCC number not exceeding 400.000/ml is classified as Class I milk, while milk exceeding these limits is classified as Class II.

RESULTS AND DISCUSSION

There are a number of published papers worldwide about the economic consequences of changes in the physico-chemical composition of milk and hygiene propriety. From an economic point of view, the purchase price of raw cow's milk is the sum of the losses from reduced milk yield or poor quality milk and the costs of veterinary surveillance and animal treatment (FAO, 2014). According to Hogeveen H. (2011) the increase in milk producers' losses is a result of minimal investment and inadequately implemented Good Hygiene Practice, while expenditures are inevitable. According to Petkovski B. (2019) surveys, only 4,01% of farms meet the conditions for extra-class milk production, i.e. in accordance with the *Rulebook on the special requirements for safety and hygiene and the manner and procedure of official controls on milk and dairy products* (Official Gazette of RM 26/12, 145/14, 59/16, 197/16 and 16/2019) category Ist farms, or are eligible for extra quality milk production.

Table No. 1 - Spreadsheet overview of the results of the quarterly control of raw cow's milk at the first farm

Farm No. 1	First control	Second control	Third control
% of milk fat	3,52%	4,07%	4,12%
% of protein	3,43%	3,60%	3,39%
CFU/ml	304.879	426.996	1.304.581
SCC/ml	385.987	374.094	419.531
Milk yield (L) on a monthly basis	5.433	5.360	4.446
Purchase price of raw milk (MKD)	19,37	19,56	17,31
Total monthly price (MKD)	56.831,58	49.897,56	43.413,48
Monthly change compared to first control (MKD)	/	- 6.934,02	- 13.418,1

Satisfactory chemical composition and hygienic quality of raw milk at the first and second controls result in increased milk yield and milk purchase price (farm 1). Whereas in the third control the increased total number of bacteria and number of somatic cell counts are thought to be the result of mastitis infection (Forsback L. et al., 2010) and they are the cause of the reduced milk yield as well as the reduced milk purchase price (farm 1).

Table No. 2 - Spreadsheet overview of the results of the quarterly control of raw cow's milk at the second farm

Farm No. 2	First control	Second control	Third control
% of milk fat	3,70%	4,24%	4,29%
% of protein	3,43%	3,46%	3,58%
CFU/ml	652.610	691.010	330.655
SCC ml	232.161	285.736	215.169
Milk yield(L) on a monthly basis	2.508	2.551	2.934
Purchase price of raw milk (MKD)	18,13	19,74	20,15
Total monthly price (MKD)	45.470	50.356	59.120
Monthly change compared to first control (MKD)	/	4.886	13.650

Increasing the total number of bacteria and somatic cells, in addition to reducing milk production (Makarijoski B. et al., 2015), reduces the purchase price of milk. Starting from the fact that the farm's low hygiene also affects the health of the milking heads (Petkovski B., 2019), the hygiene improvement was expected and the relatively higher purchase price of milk in the third control (farm 2).

Table No. 3 - Spreadsheet overview of the results of the quarterly control of raw cow's milk at the third farm

Farm No. 3	First control	Second control	Third control
% of milk fat	3,58%	3,54%	3,50%
% of protein	3,35%	3,15%	2,96%
CFU/ ml	295.566	230.751	85.585
SCC/ml	235.724	320.393	291.395
Milk yield(L) on a monthly basis	6.325	6.632	5.168
Purchase price of raw milk (MKD)	18	17,05	16,52
Total monthly price (MKD)	113.850	113.075	85.375
Monthly change compared to first control (MKD)	/	- 775	- 28.475

Table No. 4 - Spreadsheet overview of the results of the quarterly control of raw cow's milk at the fourth farm

Farm No. 4	First control	Second control	Third control
% of milk fat	4,13%	4,24%	4,26%
% of protein	3,24%	3,25%	3,31%
CFU ml, for period	334.118	99.897	110.607
SCC ml, for period	410.730	454.075	334.234
Milk yield(L) on a monthly basis	3.739	4.524	4.011
Purchase price of raw milk (MKD)	17,05	17,85	19,47
Total monthly price (MKD)	63.750	80.753	78.094
Monthly change compared to first control (MKD)	/	17.003	14.344

The reduction in the milk purchase price at the third and fourth investigated farms is a result of the decrease in the percentage of milk fat and protein which are important parameters when forming it in accordance with the marketing authorization (Official Gazette of RM no. 151 / 2011). In addition, the hygienic integrity of the milk is satisfactory.

Corresponding to the classification of raw milk tested is the Musliu A., (2009) study, where in order to calculate financial losses, a correction factor based on the requirements of the Ministry of Agriculture, Forestry and Rural Development of Kosovo was used (MAFRD Administrative Instruction MA 20/2006). Loss in third-class milk producers results in a reduction of the basic price by 20% (the purchase price is 80% of the normal price), while the purchase of the extra class milk increases the basic price by 15% (the purchase price is 115% from the standard price). On the other hand, milk producers whose milk contains up to 400.000 SCC/ml have a loss in milk production of 1,4L (8%), and those who produce milk with about 800.000 SCC/ml incur losses of 2L (11%) per head (Kalevska, T., 2009). The high total number of somatic cells i.e. reduced milk production requires additional veterinary services that increase costs in order to reduce losses (Asfaw M. and Negash A., 2017).

CONCLUSION

For the successful operation of the milk producers and the economic viability it is essential to control the chemical composition and hygienic quality of the milk. Milk quality changes results in a considerable reduction in a profit in Macedonian farms. On the other hand, increased number of somatic cell count and total bacteria count may reflect on a presence of mastitis on dairy farms and this result more on less persistent decrease in milk yield.

In practice, the purchase price of raw cow's milk is not established in this way, i.e. the purchase price is the result of a previously concluded agreement between the producer and the dairy industry. If the requirements of the Rulebook (Official Gazette of the Republic of Macedonia No. 151/2011) were applied, changes in the milk purchase price on a monthly

basis would force farmers to change their approach to the raw milk they produce, and would address much greater attention to improving hygienic conditions on farms. This is an important step in motivating farmers to implement effective management practices aimed at improving milk quality and reducing the losses.

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