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Microbiological Quality of Raw Milk at Farm, Collection and Manufactory Level in Albania

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Abstract

Milk production has a long tradition in Albania due to favourable natural resources for large and small ruminants and still plays an important role in agriculture and rural development. The total domestic milk production in Albania is currently about one million tons from which cow milk production is about 86% whereas 14% come from small ruminants. Regular testing of the quality of raw milk is a very important instrument for the development of the Albanian dairy sector and to protect the consumer in buying a safe domestic milk product.

The purpose of this study was to determine the microbial quality (using enumeration of total bacterial count) of raw cow's milk at different sampling points received from individual farmers, at milk collection centers points in the villages or in more professional milk collection centres (MCC), in three selected regions Fier, Korce, Shkoder. Average of TBC for samples collected on farms (903 samples) resulted 3.890.000 cfu/ml, on milk collecting center (297 samples) 5.170.000, cfu/ml, at manufactory (631 samples) 3.800.000 cfu/ml. On average the level of Total Bacteria Count (TBC/ml) is much higher than national threshold which is for TBC/ml < 1,000,000. Large number of farm holdings, about 85 %, show the TBC level higher than 1,000,000 /ml, only 15 % of samples on farm level fulfil the requirements of Albanian transitions criteria, but are far way with the EU standard.

Keywords: milk; microbial quality; Total Bacteria Count, regions Fier, Korce, Shkoder

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1. Introduction

Milk production has a long tradition in Albania due to favourable natural resources for large and small ruminants and still plays an important role in agriculture and rural development. According to the official statistic of the Albanian Ministry of Agriculture Food and Consumer Protection [14] for the year 2010 the total domestic milk production in Albania is currently about 1 Mio tons from which cow milk production is about 86% whereas 14% come from small ruminants. Presently, there are about 219,952 dairy cow farms with a total of 355,000 cows producing 0.80 Mio tons of milk per year. There are 74,005 farms rearing small ruminants (SRs) with some 1.9 million milking sheep and goats producing about 0.14 Mio tons of milk per year. [14] In addition to the domestic milk production about 10% of milk consumed (in raw milk equivalent) had been imported during the 2011 year. Milk production holdings as well as milk processing units are in average very small in Albania. In the majority of production holdings and processing units traditional technologies are applied. Farm gate price for milk is usually not based on parameters for quality.

Milk is one of the most precious natural materials and has been a basic component of human food for a long time [6] Chemically, milk is a complex mixture of fat, protein, carbohydrates, minerals, vitamins and other miscellaneous constituents dispersed in water, make it a complete diet [9] Milk is considered as nature's single most complete food [18] and is definitely one of the most valuable and regularly consumed foods. But at the same time, it is highly vulnerable to bacterial contamination and hence is easily perishable [13,19]. Though it is provided with high nutritional value, but is an excellent medium for microbial growth [22]. The composition of milk makes it an optimum medium for the growth of microorganisms that may come from the interior of the udder, exterior surfaces of the animal, milk handling equipment and other miscellaneous sources such as the air of the milking environment [21]. Microbial contamination of milk can therefore originate from within the udder; the

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exterior of the teats and udder; and from the milk handling and storage equipment [4].

The safety of dairy products with respect to food-borne diseases is a great concern around the world. This is especially true in developing countries where production of milk and various milk products takes place under unsanitary conditions and poor production practices [15] The microbial content of milk is a major feature in determining its quality (Beyene, 1994). Milk produced under hygienic conditions from healthy animals should not contain more than 5×10^5 bacteria per milliliter (mL) of milk [17].

The health and hygiene of the cow, the environment in which the cow is housed and milked, and the procedures used in cleaning and sanitizing the milking and storage equipment are all also key factors in influencing the level of microbial contamination of raw milk. All these factors will influence the total bacteria count and the types of bacterial present in bulk raw milk [16].

It is thus difficult to not only to determine the quality status of the milk but also the economic impact, due to the fact that most of the farmers consume their own milk and seldom sell it [5].

Regular testing of the quality of raw milk is a very important instrument for the development of the Albanian dairy sector and to protect the consumer in buying a safe domestic milk product.

Table 1. Development steps and targets in Albania to achieve EU milk quality standard

Period		Standard	
Step I	1 January 2008 – 31 December 2010	Total Bacteria Count/ml	< 2,500,000
Step II	1 January 2011 – 31 December 2012	Total Bacteria Count/ml	< 1,000,000
Step III	1 January 2014 EU norm	Total Bacteria Count/ml	< 100,000

The purpose of this study was to determine the microbial quality of raw cow's milk at different sampling points received from individual farmers, at milk collection centers points in the villages or in more professional milk collection centres (MCC), in three selected regions Fier, Korce, Shkoder.

Table 2. Milk production of the 3 selected regions in 2010

Region	Milk Production (tons)			
	Total	**Cow milk**	**Sheep milk**	**Goat milk**
FIER	213,305	202,505	8,519	2,281
KORÇE	95,312	79,443	9,537	6,332
SHKODER	100,292	90,280	4,851	5,161

Source: *MAFCP Statistics Yearbook of Albania for 2010*

2. Material and Methods

To carry out the milk quality assessment, there are some important components, influence the results of testing.

Taking into considerations those components, the study group, cooperated with national authorities of the MAFCP, NFA, ISUV.

The raw milk testing focused on the main indicator of milk quality, which is obligatory to be analyzed according to the Albanian legislation, Total bacterial count.

The milk samples were collected in the three regions Fier, Korce and Shkoder which are important regions for milk production in the country (see table 2).

903 raw milk samples (49.3%) had been collected directly on farms, 631 (34.5%) at the entrance of milk processors and 297 (16.2%) at milk collection centres points in the villages or in more professional milk collection centers (MCC). In total 1,831 raw milk samples have been collected and tested on the parameter Total Bacteria Count (TBC/ml).

Taking the milk samples in a most representative way. The milk samples were taken by qualified persons which were using the method of sampling in accordance with EU directives 853/2004 [20] ; 854/2004 and 882/2004, the Food Law and related implementing regulations. Based on the requirements of SSH ISO 707: 1999 [10] "Method of sampling milk and dairy products", inspectors using always sterile milk containers (250 ml, stainless steel) for the milk samples. Transport of milk samples to the lab was done in accordance with procedures to safeguard that the original microbiological status of the sample is not

affected by the transport, by using cooling boxes (refrigerators) with appropriate temperature.

The analysis of the milk samples in the laboratory were done efficiently, reliably and according to internationally recognized methodologies as well as in accordance with the Albanian legislation approved by the directive No. 5 date on 25.03.2011 on Specific Requirements of hygiene for the milk production holdings, milk collection and milk processing establishments.

For the determination of the total bacteria count, the method: EN ISO 4833-2003 " Microbiology of food and animal feeding stuffs – Horizontal method for the enumeration of microorganisms-Colony-count technique at 30 °C", were used. 1 ml of milk sample was added into sterile test tube with 9 ml peptone water. After thoroughly mixing, the sample was serially diluted up to 1:10-7 and duplicate samples (1 ml) were pour plated using 15-20 ml standard plate count agar solution and mixed thoroughly. The plated sample was allowed to solidify and then incubated at 30ºC for 72 hours. Colony were counted by using automatic colony counter, and calculated according to formula recommended by method.

Testing results from cow milk farms are grouped for the evaluation according to the source and farm size (1-5 cows, 6-10, 11-50, 51 and more cows per farm), milk collection centers and entrance of dairy processors.

3. Results and Discussions

The dates obtained from microbiological examinations, were grouped and processed. The following table 3 and figures 1, 2, 3 are summarising the results of raw milk testing done in the frame of the study.

Table 3. Average of TBC for samples

Level	TBC/ml
All farms (903 samples)	3.890.000
Milk collecting centre (297 samples)	5.170.000
Manufactory (631 samples)	3.800.000

On average the level of Total Bacteria Count (TBC/ml) is much higher than national threshold which is for TBC/ml < 1,000,000. The overall mean of TBC observed in the current study was also much higher than international recommendations and studies, such as the maximum acceptable limits given for raw milk intended for processing (1.0×10^5 cfu/mL) and direct human consumption (5.0×10^4 cfu/mL) [2]. Many dairy farms have serious problems with hygienic and cooling conditions (TBC). The results on TBC are in accordance with the visual observations at farms, milk collection centres and transport facilities.

Results from samples collected on farms

Figure 1 illustrates the frequency of TBC analytical results from 903 samples collected directly on farms according to categories from < 500,000 to more than 10 Million TBC/ml.

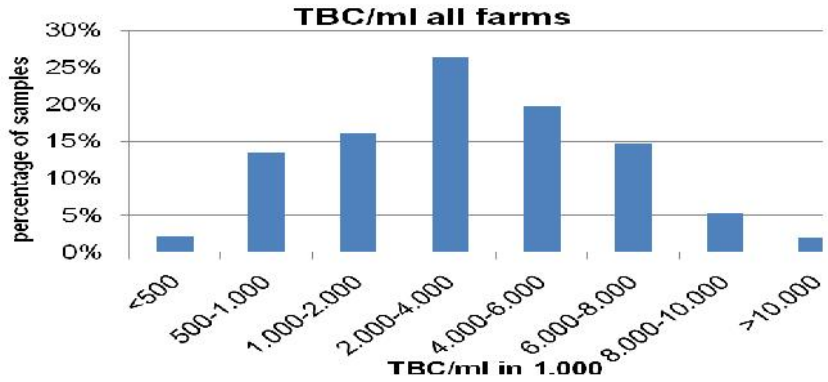

Figure 1. Percentage of sample results according to categories of TBC on farm level.

Large number of farm holdings about 85 %, show the TBC level higher than 1,000,000 /ml, only 15 % of samples on farm level fulfil the requirements of Albanian transitions criteria, but are far way with the EU standard [3]. As indicated by Beli at al. 2013, the high value of TBC and the milk contamination is a problem for Albanian authority.

Milk produced under hygienic conditions from healthy animals should not contain more than 5×10^5 bacteria per millilitre (mL) of milk [17]. This high

level of contamination of milk might be due to initial contamination originating from the udder surface, quality of cleaning water, milking utensils and materials used for filtering the milk. The most frequent cause of high TBC is poor hygienic practices at farm level, during milking. Milk residues on equipment surfaces provide nutrients for growth and multiplication of bacteria that contaminate milk of subsequent milking. Cows with mastitis, and failure to cool milk rapidly to < 4.4°C can also contribute to high standard plate count in raw milk. Milk from a healthy udder contains few bacteria but it picks up many bacteria from the time it leaves the teat of the cow until it is used for consumption or further processing. These micro-organisms are indicators of both the manner of handling milk from milking till consumption and the quality of the milk. Proper and clean housing environment is a prerequisite to produce milk and milk products of acceptable quality [1]. Generally, the microbial qualities of milk in the current study are poor compared to Albanian bacteriological established standards of dairy products, as well as international standard. As indicated by John [12] the plate count of grade A raw milk should be less than 2×10^5 cfu/mL, between 2×10^5 cfu/mL to 1×10^6 cfu/mL for grade B and greater or equal to 1×10^6 cfu/mL for grade C milk in USA. This implies that the sanitary conditions in which milk has been produced and handled are substandard subjecting the product to microbial contamination and multiplication. It is indicated that total bacterial count is a good indicator for monitoring the sanitary conditions practiced during production and handling of raw milk [4].

The following figure 2 shows that TBC is significantly higher in the Milk Collection Centres than on individual farms. During the process of transport and storage (usually without cooling) the number of TBC increased significantly. Failure to cool milk rapidly to < 4.4°C can also contribute to high standard plate count in raw milk samples of MCC, figures 2 and 3.

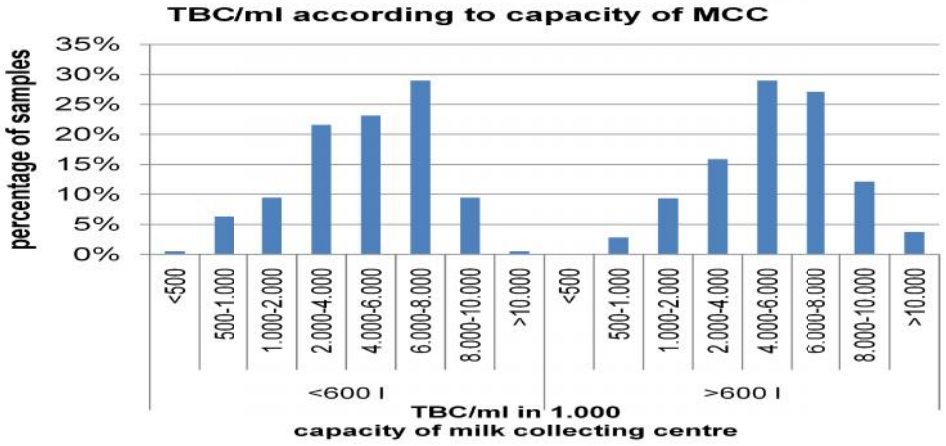

Figure 2. Percentage of samples according to TBC categories and capacity of MCC (297 samples)

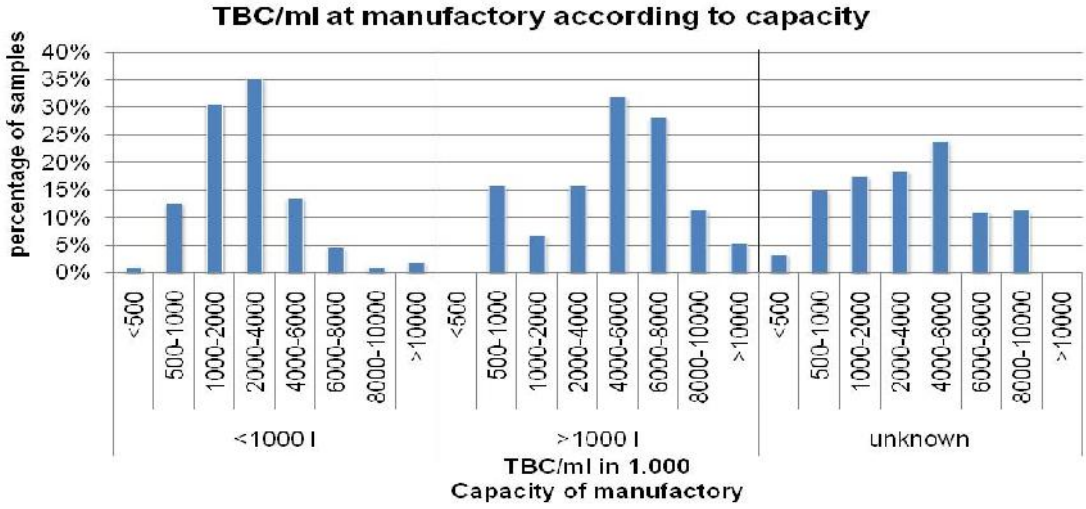

Figure 3. Percentage of samples according to categories of TBC and capacity of manufactory (631 samples)

To avoid the increase of the number of micro-organisms, the European Regulation 853/2004,[20] recommends that immediately after milking, milk must be held in a clean place designed and equipped to avoid contamination. It must be cooled immediately to not more than 8 °C in the case of daily collection, or not more than 6 °C if collection is not daily. During transport the cold chain must be maintained and on arrival at the establishment of destination, the temperature of the milk must not be more that 10 °C [20].

4. Conclusions

This assessment study of the status of the Albanian raw milk quality, provides substantial information about the current microbiological status of cow-milk.

The quality of milk samples collected in three Albanian districts was generally below standards.

This is mainly due to lack following strict hygienic practices during milk production and subsequent handling.

It is essential to heat treat milk intended for direct consumption as well as the water used for udder washing and cleaning of milk handling equipment.

Small and medium-sized dairy farms need assistance and training for meeting the hygiene requirements and need to get familiar with the Good Agriculture Practices (GAP) and Good Hygiene Practices (GHP).

In aim to achieve significant progress in milk quality grounds on the introduction of a functioning milk pricing system based on the quality classification of raw milk.

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