



Review

Hygienic and Sanitary Quality of Milk, a Farmers' Priority

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ABSTRACT

Background: Higher hygienic-sanitary quality of milk is a priority for farmers. However, the fulfillment of this goal could be affected due to several aspects that influence its indicators, from production on dairy farms to preservation and transport to the industry. **Aim:** To provide state of the art scientific information about the importance of meeting quality hygiene and sanitary parameters in milk, and the factors related to production.

Methods: A review of recent bibliography on the importance of milk in human nutrition, hygienic-sanitary quality, and the main conditioning factors, especially mastitis, was made.

Development: Milk is an important food in terms of nutrition, so its quality and safety must be ensured. Among the factors that modify its hygienic-sanitary quality are proper application of milking routines, hygiene, preservation conditions, transportation, and the presence of mastitis in herds.

Conclusions: Milk is an essential product in the diet of humans due to its nutritional value; hence, meeting proper hygiene and sanitary parameters that ensure safety and harmlessness is a priority for farmers. Among the main factors that can deteriorate these indicators are management of hygienic conditions of production, and the presence of mastitis.

Key words: milking, mastitis, milking hygiene, harmlessness (Source MeSH)

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INTRODUCTION

Milk and its by-products are some of the most commonly consumed goods by humans worldwide. In Cuba, milk production cannot meet the demand yet. Accordingly, dairies are allocated to the basic food supply, as well as institutions of health, schools, daycare centers, company restaurants, retail market chains, and hotels (Martínez-Vasallo *et al.*, 2017). Hence, the priority of the cattle raising sector, the dairy industry, and public health is to increase production with adequate hygiene-sanitary quality levels that ensure its safety and harmlessness.

The parameters that define milk quality embody physicochemical and hygienic characteristics, and their nutritional qualities. Inadequate animal management practices and deficient hygiene while processing, may affect these indicators (Gwandu *et al.*, 2018).

Accordingly, the aim of this paper was to provide state of the art scientific information about the importance of meeting quality hygiene and sanitary parameters in milk, and the factors that influence on production.

DEVELOPMENT

Milk

Cow's milk is a basic food for humans, as part of their diet for, at least, the last 10 000 years. Given its nutrient contents, and excellent relation between nutritional quality and energy contribution, milk is a major food at every age of human development (Fernández *et al.*, 2015).

This product is an important source of macro and micro nutrients. It provides proteins with a high biological value, lipids, carbon hydrates, liposoluble and B-complex vitamins, along with minerals such as calcium and phosphorus (Wakida-Kusunoki *et al.*, 2019). It contains numerous compounds that intervene in the biological processes of the body (Khan *et al.*, 2019), and some lipid components have positive effects on human health (Mojica-Rodríguez *et al.*, 2019). Milk consumption by children favors linear growth, bone development, and dental health (Wakida-Kusunoki *et al.*, 2019).

However, raw milk can be considered a risk food to consumers' health (Miranda and Arango, 2016). It is an ideal environment for the propagation of bacteria and etiological agents (Beniá *et al.*, 2018). Hence, it is important to provide the necessary hygienic conditions of production that guarantee the safety of this food (Jurado-Gámez *et al.*, 2019), and proper hygienic-sanitary quality.

Hygienic-sanitary quality of milk

López and Barriga (2016) consider that hygienic quality of milk comprises the level of hygiene and the absence of chemical substances during milking, storage, transport, and transformation. Poor hygienic quality can have a negative influence on technological applications of this product, especially in the industry, in process based on bacterial fermentation; for instance, in the making of cheese and yogurt, though it can also affect public health.

Concerning sanitary quality, they consider that cattle must be kept away from diseases to achieve adequate levels. Hence, it is necessary to control the development of subclinical mastitis, and keep animals free from brucellosis and tuberculosis.

Hygienic-sanitary quality is an important parameter to establish payments to farmers, one of the most demanding indicators, according to the legislation of countries (Remón-Díaz *et al.*, 2019). In Cuba, the economic hardships to conduct investments in technology improvements, such as the purchase of refrigeration equipment and inputs, in addition to the effect of high temperatures and relative humidity, create unfavorable conditions to produce and keep quality milk (Martínez-Vasallo *et al.*, 2017).

Achieving adequate parameters of hygienic-sanitary quality of milk means taking numerous risks. Many of them are linked to several factors that influence on their indicators, from collection to the end users.

Factors that condition hygienic-sanitary quality of milk

The hygienic-sanitary quality of milk is conditioned by several factors. They include proper milking routine, hygiene of production areas and milking staff, preservation and transport conditions, and the presence of mastitis in the herds. Below is a brief description of their influence:

Milking routine

García Sánchez *et al.* (2018) refer that good cattle raising practices should be fostered in order to ensure bacteriological quality of milk, such as the implementation of hygienic measures that guarantee clean, dry, and healthy teats. In that sense, it is important to consider the implementation of an adequate milking routine (Martínez Vasallo *et al.*, 2014; Jara Blancom, and Molina Montero, 2018).

Among the deficiencies of milking that affect hygienic-sanitary requisites for milk are inappropriate organization of the herd, depending on the lactation time, and the presence of mastitis; inadequate teat washing, causing the accumulation of dirt on the upper part, which increases contamination when milking. This situation is aggravated when the teats are not dried

(Martínez Vasallo *et al.*, 2014), which must be properly done by using adequate individual disinfecting towels or cloth to prevent the transmission of mastitis in the milking group.

A survey published by Valdivia *et al.* (2020) to farmers from a livestock raising company, found that 18% showed deficiencies during the milking routine. The main difficulties observed were change in the order of operations, and the omission of final teat disinfection step. Meanwhile, another questionnaire made in Peru showed that only 5% of 20 cattlemen surveyed were able to seal the teats (Alvarado-Yachi *et al.*, 2019). This is a critical action to prevent mastitis (Jara Blanco and Molina Montero, 2018).

Hygiene of production areas and farmers

Several predisposing factors can be found in cattle milking areas that cause the existence of a large number of microorganisms during milk counts. Some of them are the existence of inappropriately cleaned milking areas, and the utilization of unheated water to disinfect the milking tools and containers where the milk is stored, which might accumulate fat and other substances (Gwandu *et al.*, 2018).

The lack of drinking water and inadequate hygienic quality should be considered among the most important aspects when evaluating cattle milking areas. This is a critical element to cleanse equipment and tools used, which can cause milk contamination, and favor the transmission of diseases to animals and man. Brousett-Minaya *et al.* (2015) proved that mesophilic and aerobic bacterium counts, and *E. coli* in the milk, are directly linked to the quality of the water used for collection.

Milk contamination is also frequently linked to the contact with equipment under unhealthy conditions (Jurado-Gómez *et al.*, 2019). Recently, Valdivia *et al.* (2020) noted that proper cleansing of the milking equipment, and implementation of the milking routine, contribute to the collection of milk with a lower microbial content and higher hygienic and sanitary qualities.

The high presence of flies in cattle areas is another element that favors the contamination of teats, milking tools, and milk. These insects are vectors of gastrointestinal diseases (Martínez Vasallo *et al.*, 2014).

The absence of hygiene by the milking and sales staff may influence on the deterioration of milk quality, and favor the presence of *Salmonella* and high numbers of mesophilic aerobes, total coliforms, and *Staphylococcus aureus* that can be found in milk. Research done in six provinces of Cuba, where the hygiene of the milking process, and rudimentary cheese making, were checked, included the collection of swab samples from the hands, forearms, and outfit of the staff, along with nasopharyngeal swabs. The presence of *Streptococcus spp.* and *S. aureus* (Martínez, 2015) was detected in the samples. The possible contamination of the milk with these

microorganisms is a risk to consumer health, which has a high relevance in the Cuban conditions, where milk is mainly distributed to vulnerable sectors of the society.

It is also important to consider that in Cuba, an important part of the milk is produced by private farmers, who do not use mechanical milking equipment or typical housing for cattle. In this context, Martínez Vasallo *et al.* (2014) evaluated the implementation of good milking practices within a production chain comprising 30 farmers from a Cooperative of Credits and Services, two haulers, and sales people, who found that the implementation of hygienic-sanitary quality requisites of milk was affected by the following issues:

- I. Deficiencies in the structure of facilities, related to inadequate systems for waste disposal, draining problems, absence of shade in the waiting area, and milking areas without concrete flooring.
- II. Poor cleansing and hygiene associated to low water availability, unstable supply of chlorine and hot water, and the presence of domestic animals during milking.
- III. Only 33% of farmers applied simple measures to control mastitis.
- IV. Most framers failed to meet the requirements for preservation and collection of milk, and the means of transportation used was informal, and unrefrigerated.
- V. At the point of sale, milk preservation and handling was inadequate, including the lack of hygienic and manipulation regulations set for this food.

Transportation and storage conditions

In most countries, milk preservation is recommended at 4 °C, for effective bacterial growth (Jurado-Gómez *et al.*, 2019; Guevara-Freire *et al.*, 2019). In warm climate countries, like Cuba, with a predominance of high temperatures, this measure is necessary. This is particularly seen in the summer months, where high temperature and humidity favor the development of pathogenic microorganisms.

Valdivia *et al.* (2020) linked prolonged storage of milk to temperatures higher than 4 °C, with a progressive deterioration of MBRT (Methylene Blue Reduction Test), where the milking area storage tank lacked shaking equipment, and milk was preserved at 16 °C.

When the milk is refrigerated, knowing psychrophilic microorganism counts is important, since they grow at temperatures between -5 and 15 °C (López and Barriga, 2016). These microorganisms produce proteolytic enzymes, lipases, and heat stable phospholipases that can keep their activity after pasteurization, degrade components of this product, and deteriorate their quality and that of their derivatives (Velázquez-Ordoñez *et al.*, 2019).

The type of transportation used, and the level of technical expertise of haulers is also important to achieve appropriate levels of milk quality (Martínez Vasallo *et al.*, 2014). Transportation to industry must be ensured in a short time, avoiding unnecessary stops, particularly if the vehicle lacks refrigeration.

Mastitis

Mastitis is the swelling of the mammary gland, which is often caused by microbial infections, producing huge economic losses to the dairy industry, as well as changes in the chemical composition of milk (Benić *et al.*, 2018; Ramírez Vásquez, 2018). It is classified, according to their clinical signs, into clinical and subclinical (Hillerton and Berry, 2005).

This disease has become the main cause of condemnation of milk in Cuba. However, the most important negative effect has not been acknowledged: unproduced milk (Ruiz Gil *et al.*, 2016); it can lead to the loss of quarters, and affect udder function leading to animal rejection.

Andrade *et al.* (2017) and Sánchez Cejas (2018) pointed out that among the treatments used to cure this pathology, one of the most frequent ones is the utilization of antibiotics. The presence of these medication in the diet produces quality losses, and the incapacity for consumption, in addition to the fact that overuse leads to the development of resistant bacterial strains (Valdivia *et al.*, 2018), which may have a repercussion on the increase of persistent and chronic cases of the disease.

The milk from cows that suffer from this disease has higher bacterial contents compared to that of the healthy animals (Jurado-Gámez *et al.*, 2019). The cows that suffer subclinical mastitis can excrete the causal agent into the milk, and contaminate tools, the skin of animals, the environment, the water used for cleansing or fresh milk (Romero *et al.*, 2018).

Bovine mastitis may be caused by around 150 microbial species (Benić *et al.*, 2018). *Staphylococcus aureus* and *E. coli* are often isolated from the milk of cows that suffer the disease (Bedolla, 2017). Although other microorganisms, such as negative *Staphylococcus coagulans*, *Streptococcus* spp, *Klebsiella pneumoniae*, *Enterobacter* spp, and *Corynebacterium* spp (Sánchez Bonilla *et al.*, 2018; García Sánchez *et al.*, 2018; Ramírez Vásquez *et al.*, 2018), have been observed.

Some of the pathogens isolated from the mammary gland, which can damage human health are *Staphylococcus aureus* and *Streptococcus agalactiae*. The *Staphylococcus aureus* isolates also pose the risks of the presence of enterotoxins in the milk and by-products (Benić *et al.*, 2018).

Intramammary swelling caused by this disease is associated to an increase of somatic cell counts in the milk (Bedolla, 2017). Somatic cell counts (SCC) is a method used to determine the level of health of the mammary gland, and its results are highly related the California mastitis test (CMT) (Remón *et al.*, 2019). This is a simple technique that can be easily applied in field conditions. It is

commonly used in Cuba for the diagnostic of subclinical mastitis, and for decision-making in terms of reducing the presence of the disease based on the interpretation of the results.

The International Dairy Federation (IDF) has regulated the acceptable parameters for somatic cell counts in milk mixes, which corresponds to values from negative to weak positive in the CMT (Remón-Díaz *et al.*, 2019). Although the population estimation of subclinical mastitis should be considered, it may be overrated when the sample includes a high proportion of cows at the beginning or end of lactation, where the somatic cell count is normally high (Parra *et al.*, 1998).

General considerations

Although the factors that influence on the hygienic-sanitary quality of milk are varied, and in many cases, hard to control due to the economic hardships of Cuba, many of them depend on the conscious action of man, technological discipline, and the knowledge of the staff that perform this activity. Consequently, the requirements and training actions implemented in this sector will play an important role in improving milk quality indicators.

CONCLUSIONS

Milk is an essential product in the diet of humans, due to its nutritional value; hence, meeting proper hygienic and sanitary parameters that ensure safety and harmlessness is a priority for farmers. Among the main factors that can influence on the deterioration of these indicators are management of hygienic conditions of production, and the presence of mastitis.

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AUTHOR CONTRIBUTION

Author participation was as follows: Conception, design, and redaction of the manuscript: ALVA; review of the manuscript: YR and AB.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.