Nat. Volatiles & Essent. Oils, 2021; 8(6): 2550-2561

NVEO
Natural Volatiles &
Essential Oils

# Article Review: Changes In Cows' Milk Quantity And Quality Due To Bacterial Contamination

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**Abstract**

Worldwide, dairy products industry has went towards yielding high-safety milky products in the food markets. Food safety and milk quality are of great concerning for health and nutrition of consumers and for public health surveillance through prevention of different food-borne infections, poisoning of food and risk of zoonosis. The current study was focused mainly to investigate of milk bacterial contamination and its impacts on milk quantity and quality. This study summarized that there were several sources of contamination, which come throughout internal and external udder such as blood infections and mastitis as well as from the herd hygiene and health status, production environments, milking parlor and conserving practices in farm. Both raw and pasteurized milk as well as different dairy products may act as perfect condition for growing of many organisms that responsible on deterioration and decreasing the shelf life of milk and by-products. These organisms include those that capable for production of heat-resistant enzymes, withstanding heat temperature, and growing at room or refrigeration temperatures. In conclusion, the microbial quality of food is necessary to traceability in dairy product industry, and the food hygiene protocols are fundamental for reduction of bacterial contamination in raw and pasteurized milk regarding the health risk. Also, consumers education programs and practices of good handling of foods could reduce the exposure of milk to food-borne pathogenic agents and consumption of unsafe dairy products.

**Keywords:** Dairy products, Food-borne pathogen, Food safety, Raw milk, Pasteurized milk, Iraq

## Introduction

Milk is one of the most essentially components of the diets, which used by approximately 6 billion of peoples. Yearly, the global yielding of milk can reach 730 million tons (Siddiky, 2017; Lan et al., 2020). Although, field animals produce the milk for feeding of their newborns, in different worldwide regions human continues for consuming milk along its life (Thureen and Hay Jr, 2001; Sangild, 2006), in addition to numerous dairy products like cheese, yogurt, butter, and cream can be yielded and consumed (Park, 2009). Hence, the impacts of milk or dairy products on human health are concerned relatively, and have been the title of many investigations, on both whole products and their components (Thorning et al., 2016). Milk is synthesized in specialized tissues in mammary glands as it virtually sterile when secrete to udder's alveoli (Hassiotou and Geddes, 2013; Rainard, 2017). However, raw milk can be contaminated

with pathogens originated within the udders, from the dairy cows or from the environment (Latorre et al., 2010; Enger et al., 2018). Therefore, this study was aimed to focus on the main bacterial causes that potentially contaminate milk resulting in negative impacts on quantity and quality of milk production.

**Contamination of raw milk**

In udder of healthy cows, raw milk is secreted sterile and may contaminate at a normal very low number of bacteria that usually colonizes within the teat cistern, canal and apex (Rainard and Foucras, 2018). In some cases such as mastitis, milk of these cows can be contaminated with a significant large number of bacteria that potentially shed at great quantities into the supplied milk (Ssajjakambwe et al., 2017). However, the effect of mastitis of the number of total microorganisms follows mainly the percentage of infected cows at a herd, infection stage, and strains of the bacteria (Silanikove et al., 2014; Rudenko et al., 2021). Other environmental factors can contribute to the potential increase of pathogens in the mastitic milk such as dirty cow (Tongeľ and Brouček, 2010), poorly cleaning of equipments (Bekuma and Galmessa, 2018) improper milking time and machine function, and poor storage of forage (Smith and Hogan, 1993). Although the relationship of somatic cell responses to environmental mastitis was detected to be poor, their existence at large numbers can consider as a strong indicator for their originating from diseased animals (Kadarmideen and Pryce, 2001). The skin of udders and teats of dairy cows can naturally harbor for different types of bacteria that originated from the environments, in which, dairy cows are housed and subjected for milking. In general, the direct effects of these microorganisms as well as their growing in milk were found to be small (Younan and Abdurahman, 2004; Wallace, 2009). In muddy barnyards, udders and teats of dairy animals can become contaminated with a large number of bacteria that their influences on dairy cows are depending on the washing procedure prior to milking and extents of soiling of teat surface (Magnusson et al., 2006; Elmoslemany et al., 2009; Afzal et al., 2011).

**Sources of contamination in milk and dairy products**

Milk markets require and offer great safety and quality products to prevent the sources of contamination based on better hygienic practical schemes throughout reducing possible exposures for food-borne microorganisms as well as residual of chemicals (Roesel and Grace, 2014; Velázquez-Ordoñez et al., 2019). The mammary glands acquire, during excretion, many materials from medications and contaminants that originate from milk and other chemicals from field crop, animal feedstuffs, and environmentally pollutants (Prandini et al., 2009; Vissers and Driehuis, 2009). High concentration existence of chemical residuals in milk and microorganisms can act as an indicator for quality of cow's milk (Sakowski et al., 2012; Zhao et al., 2019). To evaluate the bulk tank of raw milk in dairy farms, rapid data concerned the health status of udder, pathogenic infection from environments, residual of chemicals in milk and antimicrobials are necessary (Bianchi et al., 2004; Sharif and Muhammad, 2008).

Association of milk quantity, safety and quality can be take into account an numerous ways such as hygienic practices of a herd, conditions of feeding, cattle husbandry in animal welfare influences, and contamination of pasteurized and raw milk and bacterial aspects of milk properties and dairy products (Nada et al., 2012; Kashongwe et al., 2017; Anatolyevich et al., 2019). In addition, pollutants in environments and chemical agents from agriculture, residual of pesticides and veterinary therapies as well as management schemes in dairy production, which can be regulated selectively and auditably

throughout milk yielding for preventing of milk contamination (Battu et al., 2004; Kabak et al., 2006). The pathogenic contaminants can be tracked and monitored at milk processing, as well as during refrigeration of milk me through using of proper techniques that necessary in Dairy Industry Management and in the Control Analytical Methods to assurance the food safety (Noordhuizen and Metz, 2005; Sampers et al., 2012; Velázquez-Ordoñez et al., 2019).

Regarding events of climatic changes, food-borne disease and zoonosis have priorities in the program of public health throughout different countries (Newell et al., 2010; Deb, 2018). Thus, one of the most important surveillance tasks is the infections that transmitted due to consuming of raw milk as unpasteurized fresh milky products (Tauxe, 1997; Rangel et al., 2005). In milk, level of contamination caused by bacterial toxins appears to be severe health risk due to origination of carcinogenic and hepatotoxic influences, which reveal a great hazard on safety of milk and dairy products (Lanyasunya et al., 2005; Zastempowska et al., 2016). The risk of milk contamination can be initiated by the concentrated foods, corn and forages, which are polluted by fungal and bacterial toxins (Soejima et al., 2007).

At grazing, the controlled conditions are of relevant characteristics for production milk rich with sesquiterpenes, vitamins, lutein and beta-carotene during seasonal periods in monitored farms (Kilcawley et al., 2018). At dairy farms, grazing conditions must have an important effect on the physiological and chemical profiles of raw milk when compared to the milk produced from the cows that fed on concentrated diets (Yokus and Cakir, 2006; Muchenje et al., 2009). Silage is one of the potential sources for spores' contamination in comparison to maize silage and grass (Driehuis, 2013). The controlling procedures of outgrowth of anaerobic spores in this diet can be done through utilization of chemical additives and acid lactic bacteria which play a role through fermentation of the silage, which in role contributing in reduction of total spores loaded in raw milk (Te Giffel et al., 2002; Garde et al., 2011; Borreani et al., 2013).

The existence of carrier animals for pathogenic agents of Mycobacterium spp., Brucella spp., Escherichia coli and Salmonella spp. can implicate in health status of a herd and bacterial contamination of grassland or other feedstuff, which resulting in milk contamination, in particular zoonotic agents (Grant, 2006; Zheludkov and Tsirelson, 2010; Sonnier et al., 2018). Therefore, the level of health status is of great importance in maintenance of cattle hygiene and production of milk in addition to preventive management and controlling programs of diseases, which aimed for reducing the incidence of contagious infections in dairy cows (Chi et al., 2002; Barkema et al., 2009; Sadiq et al., 2017). Other sources for contamination of milk is include the existence of environmental pathogenic agents (Oliver et al., 2005), infectious bacteria in infected animals (Gharban and Yousif, 2020), and mastitis (Rysanek et al., 2007). However, there is a fact that the persistence of good hygienic practices is important for reduction the effect of contaminants on the udder (Pandey et al., 2014; De Silva et al., 2016). While in contrast, the poor hygienic practices may provide a source of bacterial contamination at milking process to disseminate these pathogens between dairy cows by milking machines and the hands of the milkier persons (Motarjemi et al., 2014; Berhe et al., 2020).

Bacterial analyzing of raw milk samples could be influenced by number and type of microorganisms exist in surface of teat skin and in teat canals (Elmoslemany et al., 2010; Verdier-Metz et al., 2012). The poor hygienic practices, bad cleaning procedures of equipments, air-pollutants, condition of housing, feeding and water supply can influenced effectively on the level of milk contamination (Amenu et al., 2016;

Wanjala et al., 2018). Long storage of milk under low insufficient degrees of temperature can consider a possible cause for increasing the concentration of contaminated milk (Podolak et al., 2010; Najim, 2014). In general, the polluted environment is a potential source of spoilage bacteria and food-borne pathogens in raw milk as these pathogens can affect the quality of milk and emerging a public health risk (Faille et al., 2014). Therefore, many preventive strategies for health risks were suggested and applied for reducing the poor quality of dairy products, as well as differences in milk's component can provide insights for interactions between environmental health status and pollutants and dairy animals (Bennedsgaard et al., 2010; Driehuis, 2013; Hernández-Castellano et al., 2019). Bulk tank milk was utilized broadly to estimate the health status of udder (Jayarao and Wolfgang, 2003), and as an indicator for milk quality through studying the microorganisms contaminates the samples of milk and modification of hygienic practices (Gillespie et al., 2012; Ruusunen et al., 2013). When the outbreak of milk food-borne disease occurs, numerous causes for tracing and investigating should be targeted since these outbreaks are correlated to contamination of milk or dairy products post pasteurization by these pathogenic agents or subsequently during processing of milk (Kadariya et al., 2014; Lucey, 2015; Costard et al., 2017). The programs of health education for humans must be directed towards decreasing the exposure's risk to food-borne microorganisms by the adequately handling of milk and dairy products (Schlundt et al., 2004; Bentancor et al., 2012).

**Milk quantity and quality**

In cattle, there are many infectious diseases that having a significant influence on quality of industrial milk production resulting in severe economic looses (Najim, 2012; Perin et al., 2019). Worldwide, Streptococcus agalactiae and Staphylococcus aureus are the most commonly prevalent infectious pathogenic agents of bovine mastitis, which affecting a wide range of industrial sections (Phuektes et al., 2001; Elhaig and Selim, 2015). In lactating cows having sub-clinical mastitis, 3-5% of milk produced is loosed with a high content of somatic cell count (Oshima et al., 1990; Sharma et al., 2011). However, changes in quantity and quality of the produced milk depend mainly upon the duration and severity of mammary gland infection and its composition on somatic cell counts (Aitken et al., 2011; Ruegg, 2012; Argaw, 2016). Also, both clinical and sub-clinical mastitis influencing the composition of milk such as the proteolytic enzymes, proteins, and lipids as well as on the existence of abnormal proteins originated from inflammatory cellular responses and bacterial toxins (Kifaro et al., 2009; Ebrahimie et al., 2018; Harjanti and Sambodho, 2020). All these changes can cause a significant alteration in taste and flavor as well as stability of milk (Malmgren et al., 2017). Therefore, numerous controlling and prevention systems were applied to detect mastitis in lactating herds at different clinical stages, in addition to identification the types of microbial agents and herds somatic cell count (Ruegg, 2017; Klaas and Zadoks, 2018). These wide-prevalent investigations can provide strategic information to regular maintenance of milk processing, milking hygiene and herds hygienic status, and to monitor the somatic cell count during the dry and lactating periods (Middleton et al., 2014; van Soest et al., 2016).

At field, usual utilization of antibiotics to treatment of mastitis in dairy cows can maintain the udder health, milk hygiene and dismiss the transmission of pathogenic agents; however, increases in incidence of mastitis have potential risk for increasing of antibiotic residuals as well as the antibiotic-resistance in herds (Hovinen and Pyörälä, 2011; Fogsgaard et al., 2015). The development of antibiotic resistance in microbial pathogenic agents is represented an emerged public health risk in many countries due to

partial incrimination of this resistant to human medicine (El-Tawab et al., 2016; Abril et al., 2020). Strains of Staphylococcus aureus resistance to methicillin (MRSA) were demonstrated among herds of lactating cows (Hamid et al., 2017) as well as in companion animals (Loeffler and Lloyd, 2010) and human (Pirolo et al., 2019), suggesting the role of the agricultural department authorities in regulation of veterinary drug and antibiotic administration in animal food (Govender et al., 2019; Mdegela et al., 2021).

**Conclusion**

From production to distribution and consumption, the traceability of milk and dairy products is a good policy to assurance a quantity and quality as well as for decreasing the public health risks. Milk production loss after recovery from mastitis can cause major economic losses for dairy industries due to bacterial and chemical contamination. At field practices, declines in milk production and composition can be caused due to multiple factors including cow factors, microorganisms and therapies; however, exact influences of each factor has not been determined. Therefore, additional studies are of great importance to provide necessary information concerned to encounter the drawbacks that facing milk production.

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