Microbial Quality and Associated Public Health Hazards of Raw Cow's Milk Produced and Marketed in Ethiopia: A review

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Abstract: The aim of this review was to combine the earlier works on microbial quality and associated public health hazards of raw cow's milk produced and marketed in Ethiopia. Milk is a food of good nutritional value which ensures benefits from its consumption. Being a nutritional, balanced foodstuff, milk is a well-known medium that favours the growth of several microorganisms. The public health hazards are posed by milk-borne zoonotic diseases. The safety of dairy products with respect to food-borne disease 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 practice. In fact, the detection of food-borne pathogens such as Escherichia coli, Staphyloccocus aureus and Streptococcus species have been reported by several authors in raw milk samples. Milk produced at smallholders farm in Ethiopia is marketed without any form of pasteurization or quality control measures. According to former reports, about 71- 97% milk produced in Ethiopia were consumed through an informal market. In addition, there is no formal quality control system in place to monitor and control the quality of raw milk produced and marketed in Ethiopia. Therefore, it was concluded that the microbial quality of raw cow's milk produced and marketed in Ethiopia was poor and having public health significance. This suggests the need for improved hygienic practices and handling of milk at all levels of milk market chain.
[Teshome Gemechu. **Microbial Quality and Associated Public Health Hazards of Raw Cow's Milk Produced and Marketed in Ethiopia: A review.** *Biomedicine and Nursing* 2016;2(1): 12-21]. ISSN 2379-8211 (print); ISSN 2379-8203 (online). http://www.nbmedicine.org. 4. doi:10.7537/marsbnj02011604

Key words: Microbial Quality, Public Health Hazards, Raw Cow Milk

1. Introduction

Milk is an important source of nutrients to human and animals. It has a complex biochemical composition and high water activity. Due to its high nutritive value, raw milk serves a good medium for microbial growth that degrades the milk quality and shelf-life of milk. Therefore, milk and milk product handling need special care to reduce spoilage and foodborne illness. (Gudeta, 1987; O'Mohany, 1988; Ashenafi and Beyene, 1994; Degraaf *et al.,* 1997).

Milk is synthesized in specialized cells of the mammary gland and is virtually sterile when secreted into the alveoli of the udder. Beyond this stage of milk production, microorganisms may contaminate milk at various stages of milking, processing and distribution. The ill health of the cow and its environment, improperly cleaned and sanitized milk handling equipment, and unhygienic workers who milk the cow, and come in contact with milk due to a number of reasons could serve as sources of contamination for the milk. These have inevitably increased the risk of infection of many people from common source. Lack of refrigeration facilities at farm and household level in developing countries of tropical regions, with high ambient temperature implies that raw milk will easily be spoiled during storage and transportation (Kurwijilla *et al.,* 1992; Ombui *et al.,* 1995; Gilmour, 1999; Godefay and Molla, 2000).

The microorganism load and types found in milk shortly after milking are influenced by factors such as animal cleanness and health, equipment cleanness, season, feed, soil, faeces, ambient temperature, storage and personnel health of milk handlers. Due to these reason, the daily milk production and eventual marketing of milk requires special consideration to ensure its delivery to the market in hygienic and acceptable condition (Kivari *et al.,* 2006; Torkar and Teger, 2008).

The rate of microbial growth in milk will depend on initial numbers and the temperature at which milk is held immediately after milking (Kurwijilla *et al.,* 1992; Wolfson *et al.,* 1993). For example, in the highlands of Ethiopia, 45% of small-scale milk producers do not pasteurize milk before consumption, and organoleptic properties of dairy products are the commonly used quality tests at the time of purchasing (Zelalem and Faye, 2006). Out-breaks of human illnesses as a result of consumption of contaminated raw milk and/or milk products has been reported from the USA (Oliver *et al*., 2005; Bhushan and Jayarao, 2007), Senegal (Dawson and Canet, 1991), Canada and Brazil (Maria *et al*., 2010). This indicates that

milk and milk products serve as important vehicle for the transmission of zoonotic infectious diseases and it easily cause public health hazards particularly to children, pregnant women, lactating mothers and aged people (FAO/ WHO, 2007).

Dairy products quality defects have been attributed to poor microbiological quality of raw milk and heat-resistant toxins. The production of high quality milk should, therefore, be priority for good quality end products of long shelf life and for marketing of value added products. This is generally not easy to achieve in developing countries due to factors such as poor hygiene and sanitation during milking and milk handling, unclean water, high ambient temperatures, lack of cooling facilities and inadequate infrastructures for milk transportation to the processing facilities (Zelalem and Faye, 2006).

Milk produced at smallholder farms in Ethiopia is marketed without any form of pasteurization or quality control measures. According to former reports in Ethiopia, of the total milk production, it is reported that 71- 97% of milk is consumed through an informal market that is basically characterized by selling of low quality milk and milk products (Tsehay, 2002). This implies the need for training in dairy production and processing in the country particularly at smallholders level to enhance the hygienic quality of the dairy products. Hygienic control of milk and milk products in Ethiopia is not usually conducted on routine bases. Apart from this, door-to-door raw milk delivery in the urban and peri-urban areas is commonly practiced with virtually no quality control at all levels (Godefay and Molla, 2000).

To improve the quality and safety of raw cow's milk produced and marketed, having basic knowledge about microbial quality and associated public health hazards are very important. However, there is a limitation to reviewing microbial quality and associated public health hazards and other related information and thereby to delivering such synthesized and summarized data to the beneficiaries.

Therefore, reviewing sensible findings on microbial quality and associated public health hazards of raw cow's milk produced and marketed in Ethiopia would be a milestone area to deliver combined information to the beneficiaries. Based on this outlined background, the objective of this paper is to: review on microbial quality and associated public health hazards of raw cow's milk produced and marketed in Ethiopia and thereby to deliver combined information for beneficiaries.

Most of the related research findings of milk handling practice, hygienic quality and related health hazards of raw cow's milk were reviewed. Related reports which focus on the impact of hygienic practices, isolation, identification and enumeration of microorganisms recovered from raw cow's milk were also reviewed and combined.

2. Hygienic Condition of Milk

In Ethiopia, there is no standard hygienic condition followed by producers during milk production. The hygienic conditions are different according to the production systems, adapted practices, level of awareness, and availability of resources. In most of the cases under smallholder condition, the common hygienic measures taken during milk production especially during milking, are limited to letting the calf to suckle for few minutes and/or washing the udder before milking. The quality of water used for cleaning purpose (to wash the udder, milk equipment, hands), however, is not secured (Zelalem, 2003; Teshome *et al.*, 2014).

According to Teshome *et al.* (2014) an early finding reported that about 71.79 % of the household milk producers wash the teats and udder of the cows before milking. However, it was observed that most of them did not use detergents for cleaning of udder and teats rather they cleaned only using tap water. Similarly, they did not use separate towels to dry the udder and teats of each cow. These practices may favor the contamination of milk from udder and teats of infected cows. Gran *et al*. (2002) stated that insufficient cleaning of the udder may result in contamination of milk. Furthermore, Bonfoh *et al*. (2006) reported that in milk production area, besides udder infection and water quality, hygienic behavior with respect to hand washing, container's cleaning and disinfection are the key areas that remain of relevance to milk hygiene intervention.

Keeping the sanitary condition of milking area is important for the production of good quality milk. The drainage condition of the milking area, in this regard, is one of the most determinant factors. The current review indicates that about 71% of the respondents had well drained and easy to clean barns. Although, about 87% of the respondents cleaned their barn on daily basis, about 9% of them cleaned only once or twice a week, and the remaining 4% did not clean at all (Zelalem, 2012). Similarly, Teshome *et al.* (2014) reported that about 71.79% of the respondents' cleaned milking area on daily basis, 10.26% cleaned once a week and 17.95% of respondents cleaned twice a week. However, Abebe *et al.* (2012) pointed out that about 47% of the respondents cleaned the barn three times a week, while 39% clean two times and only 11.7% of them reported to clean daily.

Food Hygiene Regulations (2006) of England reported that the milking area must minimize the risk of contamination from any source, including dust, flies, birds or other animals. The introduction of proper training and hygiene practices during milking or post-milking process to milk producers and

marketers were found to be efficient in reducing the bacterial load or contamination of the raw milk and pathogenic causing microorganisms (Zelalem, 2003; Bonfoh *et al*., 2006; Teshome *et al.*, 2014).

3. Impact of Handling Practices on Milk Quality

Equipment used for milking, processing and storage determine the quality of milk and milk products. Producers should pay attention for the type as well as cleanliness of milk equipment. Milking equipment should be easy to clean. Aluminum and stainless steel equipment are mostly preferred for milking, processing and storage. According to the finding from Teshome *et al.* (2014), the majority (82.61%) of milk producers and sellers used plastic buckets for milking and collection. The rest used plastic jars or jerry-can (11.94%) and stainless steel (5.45%). This result is similar with the findings of Yitaye *et al*. (2009) and Teklemichael *et al.* (2013) who reported that 83% of the surveyed urban dairy farms in Bahir Dar and Gondar and 75% of the surveyed in Dire Dawa town used plastic utensils, respectively. Since proper metal milk containers are expensive, milk producers use plastic containers which are difficult to clean and disinfect and thus it might contribute to poor quality of the milk (Omore *et al.*, 2005).

The left-over of milk and other dirt particles within the container may result in the contamination of milk. Omore *et al*. (2005) had also reported that lack of formal training and use of plastic containers are the main factors that contribute to the low quality of raw milk sold by producers and informal milk traders. Non-food grade plastic cans, buckets and Jerry-cans must not be used (Kurwijila, 2006).

The production of milk and various dairy products at smallholder farmers take place under poor sanitary conditions. At the production level, milking and handling of milk are the concern because personal as well as milking equipment hygiene is insufficient among the milk handlers (Mogessie, 1990; Zelalem and Faye, 2006). In line to these facts, the contamination of milk during milking and handling is high due to the use of unclean milk handling equipment and water used for cleaning, unclean personnel hands, insufficient washing of udder and lack of cooling facilities, absence of any test to screen abnormal milk and storing milk at room temperature before selling. These could lower milk quality and have significant concern on consumer's health (Jayarao and Wang, 1999; Jayarao *et al*., 2004; Teshome *et al.*, 2014).

4. Microbial Quality of Raw Cow Milk

The microbial content of milk indicates the hygienic levels during milking that include cleanliness of the milking utensils, proper storage and transport as well as the wholesomeness of the udder of the individual cow. The hygienic conditions are different according to the production system, adapted practices, level of awareness and availability of resources (Zelalem, 2012). Being a nutritional, balanced foodstuff, milk is a well-known medium that favours the growth of several microorganisms. The public health hazards are posed by milk-borne zoonotic diseases. Even if milk produced from mammary gland of healthy mammals is sterile fluid, contamination of microbes starts from udder of milking animal, poor milking practice, milking environment (contaminated air, excreta of animals), poor handling practices (lack of treatment like cooling with refrigerator, appropriate heating and others) and lack of cold chain transportation and storage system until table for consumption (Robinson, 1990; Fernandes, 2008).

Raw milk serves a good medium for microbial growth such as *Lactobacillus* spp, *Leuconostoc* spp, *Lactococcus, Streptococcus, Enterococcus, yeast, moulds* and *Enterobacteria*. More importantly, in terms of public health the detection of food-borne pathogens such as *Listeria monocytogenes, Salmonella* spp, *E. coli, Campylobacter* spp, *Staphylococcus aureus, Bacillus cereus, Clostridium botulinum M. tuberculosis and Shigella* spp have been reported by several authors in raw milk samples (Gran *et al.*, 2003; Herreros *et al*., 2005; Mufandaedza *et al*., 2006; Tollessa *et al*., 2012; Shunda *et al*., 2013). In Ethiopia the milk produced and marketed to consumers are without being pasteurized. According to Zelalem and Faye (2006) report, about 98% of the annual milk produced was from subsistence farmers who live in rural areas. Dairy product processing in the country is basically limited to smallholder level and the hygienic qualities of products are generally poor.

4.1. Total bacterial count

Total bacterial count (TBC) is one of the most commonly used microbial quality tests for milk and milk products. Previous research conducted in different part of the country revealed that the microbial counts of milk produced and marketed are much higher than the acceptable level of 1 x 10^5 bacteria per ml of raw milk (O'Connor 1994). These were evidenced by milk collected from dairy farms and smallholder producers in different part of Ethiopia. Teshome *et al.* (2014) stated that the mean total bacterial count of raw cow's milk is 7.125 $\log_{10}$cfu/ml) in Shashemene town which is lower than the earlier findings of Haile *et al.* (2012), Zelalem (2012) and Teklemichael *et al.* (2013) who reported a total bacterial count of 10.28 $\log_{10}$ cfu/ml from distribution containers (at selling point) in Hawassa town, 9.10 $\log_{10}$ cfu/ml for milk samples collected

from different parts of Ethiopia and 9.137 log_{10}cfu/ml from vendors in Dire Dawa town, respectively.

The total bacterial count (TBC) reported by Abebe *et al.* (2012) in Gurage zone and Asrat *et al.* (2012) in Wollayita Zone were on the range of 4.57 - 9.82 log_{10}cfu/ml. It is comparable to the findings of Tollessa *et al*. (2012) 7.36-7.88 log_{10}cfu/ml of raw cow's milk in Borana; Solomon *et al.* (2013) 7.07 log_{10}cfu/ml in Debre Zeit, Ethiopia. Furthermore, about 7.58log_{10}cfu/ml of total bacterial counts were reported by Asaminew and Eyassu (2011) for milk samples obtained from individual farmers and dairy cooperatives in Bahir Dar Zuria district. Similarly, Alganesh (2007) reported higher total bacterial count of cows' milk produced in Bila Sayo and Guto Wayu districts of eastern Wollega to be 7.4 $x10^7$and 2.0 x 10^7cfu/ml, respectively.

Conversely, the total bacterial count of raw cow milk samples collected from different part of the country is greater than 1 x 10^5 cfu/ml which is higher than the given international standard set for minimum acceptable level of bacterial count in raw milk (IFCN,2006). In other words, the above indicated total count of milk samples collected from the country were considered to be below the standard set for good quality milk. This implies that the sanitary conditions in which milk has been produced and handled are substandard subjecting the product to microbial contamination and multiplication.

4.2. Coliform count

Coliforms are group of bacteria, which inhabit the intestinal tracts of human and animals. They are excreted in large number with human excreta and animal droppings. They may be found in the soil, on vegetables and untreated water (Gebra-Emanuel, 1997). The presence of coliform organisms in milk indicates unsanitary conditions of production, processing and storage. Hence their presence in large number in dairy products is an indication that the products are potentially hazardous to the consumers' health (Godefay and Molla, 2000).

Earlier workers reported the values of coliform counts in raw cow's milk sampled from different part of the country that range between 4.03 - 6.57 log_{10} cfu/ml (Alganesh, 2002; Zelalem and Faye, 2006; Asaminew and Eyassu, 2011; Abebe *et al*., 2012; Asrat *et al*., 2012; Teshome *et al*., 2014).

According to the European Union standards, coliform count for raw milk should be less than 10^2cfu/ml (Fernandes, 2008). However, most of milk samples collected from different part of Ethiopia exceed the standards given for raw milk by European Union and US regulations. Generally, the presence of high numbers of coliforms in milk indicates that the milk has been contaminated with fecal materials, unclean udder and teats of cow's, inefficient cleaning of the milking containers, poor hygiene of the milking environment, contaminated water and cows with subclinical or clinical coliform mastitis can all lead to elevated coliform count in raw milk (Ombui *et al.*, 1995; Jayarao *et al*., 2004; Britz and Robinson, 2008).

4.3. Spore-forming bacteria count

As indicated by Alebel *et al.* (2013) and Teshome *et al. (*2014) the mean spore forming bacterial count of raw cow's milk samples collected from different sources were 4.2 ± 0.4 log_{10}cfu/ml in Jimma town and 4.703 ± 0.069 log_{10} cfu/ml in Shashemene town, respectively. Likewise, Teklemichael *et al.* (2013) also reported 4.798 ± 0.745 and 6.392 ± 0.154 log_{10} cfu/ml spore forming bacterial count of raw milk samples collected from dairy farms and vendors in Dire Dawa town, respectively. Faeces and bedding materials contaminate the cow's teats. Teat cleaning prior to milking only partly reduces attached dirt and spores (Vissers *et al.*, 2007). During primary production of milk, the spore-forming microorganisms may come from silage, soil and water. In the digestive tract of dairy cows, the spore forming microorganisms are able to propagate up to ten times and disperse in faeces. Increased number of sporulates were observed in milk at the time of feed change when diarrhea occurred in cows (Lukášová *et al.*, 2001).

4.4. Yeast and mold count

Yeasts and molds commonly associated with milk and milk products are: *Saccharomyces* spp., *Candida* spp., *Torulopsis* spp.; and *Penicillium* spp., *Rhizophus* spp., *Aspergillus* spp., *Geotrichum Candidum*, *Alternaria* spp., *Cladosporium* spp., respectively (Vishweshwar and Krishnaiah, 2005). The overall mean of yeast and mold count for a total of 48 milk samples collected directly from the dairy cooperative milk collection centers, hotels, kiosks (small shops) and small scale milk producers in Shashemene town was 4.465 ± 0.107, 4.401 ± 0.117, 4.112 ± 0.016 and 3.846 ± 0.030 log_{10} cfu/ml, respectively (Teshome *et al.*, 2014). Similarly, Haile *et al.* (2012) reported higher Yeast and mould counts of 4.65log_{10} cfu/ml for milk samples collected from storage containers and 7.13log_{10} cfu/ml for milk samples collected from distribution containers in Hawassa, Southern Ethiopia.

The mean count of yeast and molds was reported as 5.1±0.5 and 3.7±0.6 log_{10} cfu/ml, respectively from 100 milk samples collected in Jimma town (Alebel *et al.*, 2013). In addition, the overall mean of yeast and mold counts for a total of 100 raw cow milk samples (88 from individual farmers and 12 dairy farms), collected from Jimma town was 4.9±0.6 and 4.7±0.52log_{10} cfu/ml and 4.61±0.5 and 4.09±0.2352log_{10} cfu/ml, respectively (Tadesse and Bacha, 2014).

Yeasts and moulds attack a number of food items and produce toxic metabolites which affect the health of the consumers. These organisms grow relatively in wider range of environmental conditions, that is, from a pH value of 2 to greater than 9 and temperature range of 10-35^{0}C. Moisture requirements of food-borne moulds are relatively low; most species can grow at a water activity of 0.85 or less, although yeasts generally require a higher water activity (IDF/ FAO, 2005).

Yeast and molds (non-filamentous and filament molds) may be found as part of the normal flora of a food product on inadequately sanitized equipment or as airborne contaminants. Different groups of fungi are found in soil, barn dust, feeds, manure, and unclean utensils. They can produce toxic metabolites, resistance to freezing environments, and cause off odors and off flavors of foods and which can spoil/reduce shelf life of milk and may also pose serious health problems to the consumer (Herrera, 2001).

5. Pathogenic Bacteria Detected From Raw Milk

Pathogenic microbes that have been found in raw milk and naturally fermented raw milk include *Escherichia coli, Vibrio cholerae, Shigella* spp., *Staphylococcus aureus, Yersinia* spp., *Listeria monocytogenes, Mycobacterium tuberculosis, Mycobacterium bovis, Salmonella* spp., *Brucella abortus, Campylobacter jejuni* and *Bacillus cereus* (Gran *et al.,* 2003; Herreros *et al*., 2005; Mufandaedza *et al*., 2006). The most important pathogenic bacteria detected from raw milk samples collected from different part of Ethiopia are *E. coli, Staphyloccocus aureus and Streptococcus* species (Godefay and Molla, 2000; Molalign *et al.,* 2011; Tollessa *et al.,* 2012; Shunda *et al*., 2013; Teklemichael *et al.,* 2013 and Tadesse and Bacha, 2014), though, the occurrence of such kind of pathogenic microorganisms in milk products may pose public health hazard.

A number of food-borne illnesses may occur due to consumption of raw milk or dairy products vended on the street since the chance of contamination of dairy products sold on the street is very high. Poor sanitation of the vending environment, poor hygiene of the vendors, improper (inadequate) pasteurization or boiling, poor handling and absence of cooling facilities may cause contamination of dairy products by pathogenic microorganisms (Aberra, 2010; Debebe, 2010) .

5.1. *Escherichia coli*

The incidence of *Escherichia coli* **(***E. coli)* in raw milk samples collected from different part of Ethiopia was revealed by various researchers. The *E. coli* identified by Deresse (2011) in and around Hawassa town and Tollessa *et al.* (2012) in Abaya District of Borana pastoral area of Oromia Regional state were on the range of 9.8- 13.2 %. Alebel *et al.* (2013) and Shunda *et al.* (2013) identified 30.9 and 44.4% *E. coli* from milk samples, respectively. Likewise, Alehegne (2004) also reported that the minimum (3.9%) and maximum (83.3%) *E. coli* of raw cows' milk produced in smallholder dairy farms in Debre Zeit. According to Teklemichael *et al.* (2013) the average *Escherichia coli* counts from dairy farms and milk vendors in Dire Dewa town was 3.64±0.78 and 5±0.44 log cfu/ml, respectively.

E. coli is one of the bacteria that exist as a normal microbiota in the intestinal tract of humans and warm blooded animals. Most strains of *E. coli* are non-pathogenic; however, *E. coli* serotype O157:H7 (EHEC) differ from commensals in that they express virulence factors molecules directly involved in pathogenesis thereby causing disease (Stender *et al*., 2001; Schroeder *et al.,* 2004). E. coli frequently contaminates food and it is a good indicator of fecal pollution (Soomro *et al*., 2002; Benkerroum *et al*., 2004). Presence of *E. coli* in milk products indicates the presence of enteropathogenic microorganisms, which constitute a public health hazard. Enteropathogenic *E. coli* can cause severe diarrhea and vomiting in infants and young children.

5.2. *Staphylococcus aureus*

Previous studies conducted by different investigators in different parts of the country have showed the presence of *Staphylococcus species* (*S. aureus)* in raw milk. About 44.4% of *S. aureus* isolated by Shunda *et al.* (2013) from dairy farms, vending shops and homes/cafeterias in Mekelle town. Similarly, Alehegne (2004) and Deresse (2011) reported *S. aureus* from raw cows' milk produced in smallholder dairy farms in Debre Zeit and around Hawassa town with frequency of isolation 15.8-75% and 27.5-31.3%, respectively. In addition, Debebe (2010) also identified 24.4% of *Staphylococcus* species from milk samples collected from milk producers and street-vendors in and around Addis Ababa city (Kotebe, Bishoftu and Chancho).

According to Teklemichael *et al.* (2013) the percentage of detection of *S. aureus* in milk samples obtained from dairy farms and vendors was 25% and 50%, respectively. Similarly, the *S. aureus* identified by Tollessa *et al. (*2012) in Abaya District of Borana pastoral area of Oromia Regional state was on the range of 6.78 – 7.29 %. However, higher percentage of *S. aureus* (28.7%) was isolated by Zeryehun *et al.* (2013) from 118 quarter samples in and around Addis Ababa. In fact, the occurrence of *S. aureus* in raw milk may not be unusual as it is one of the pathogen that is commonly isolated from mastitic cows. The prevalence of mastitis, in most countries, reaches up to 50% in cows and 25% in quarters (Radostitis and

Arundel, 2000). Different studies conducted in Ethiopia have shown that *S. aureus* is implicated in nearly 40% of mastitic cows (Workineh *et al.,* 2002; Dego and Tarke, 2003; Getahune *et al.,* 2008; Abera *et al.,* 2010).

The higher rate of isolation of *Staphylococcus aureus* from vendors could be due to poor milk handling practices during selling and increased contamination of milk during transportation to vending sites. The occurrence of *Staphylococcus aureus* in dairy farm milk samples could be associated with poor udder preparation and poor milking hygiene. *S. aureus* is an important food-borne pathogen and causes a wide variety of diseases in humans and animals, ranging in severity from a mild skin infection to more severe diseases, such as pneumonia and septicemia (Lowy, 1998). The type of food poisoning caused by *Staphylococcus aureus* is characterized by nausea, vomiting, and abdominal cramps, often with diarrhoea but without fever. The onset of the symptoms is rapid, often appearing 1- 6 hours after ingestion of the contaminated food (Cliver, 1990).

5.3. Streptococcus species

According to Debebe (2010), the *Streptococcus* species identified from milk samples collected from milk producers and street-vendors in and around Addis Ababa was 5 %. Alehegne (2004) also detected *Streptococcus pyogenes* from bucket milk (2.9%), storage container (33.3%) and 5% from pasteurized milk samples collected from small holder dairy farms in Debre Zeit. In addition, different species of *Streptococcus* bacteria (8.7% of *Streptococcus dysagalactie*, 10% of *Streptococcus faecalis* and 21.2% of *Streptococcus agalactia*) were identified from 118 quarter samples in and around Addis Ababa by Zeryehun *et al*. (2013). Out of 180 milk samples collected, 26.7% of *Streptococcus* spp were isolated from 48 milk samples collected from different critical points in Mekelle town (Shunda *et al.,* 2013).

Eventually, according to Rysanek *et al. (*2007) mastitis is usually caused by contagious pathogens namely *Staphylococcus aureus* and *Streptococcus agalactiae* than mastitis caused by environmental pathogens such as *Streptococcus uberis* and *Escherichia coli.* Hence, an effective post-milking practices including proper disinfection of cattle's teat or workers' hand are imperative to curb this problem. The contribution of mastitis udder in the bacterial quality of cow milk is an established fact and therefore, adequate control of mastitis could help to enhance the production of high quality dairy products (Mekbib *et al.,* 2010). The type and number of bacteria present in the milk may influence the hygienic quality of milk and milk products.

Conclusion

The current review showed that the microbiological quality of raw milk samples collected from different part of Ethiopia was poor. High bacterial loads and the presence of several pathogenic bacteria in several samples not only affect the raw milk quality but definitely pose a public health hazard. Higher frequency of *E. coli, Staphyloccocus aureus and Streptococcus species* detection in milk samples collected from different part of the country could be associated to poor udder preparation, milkers hygiene, poor milk handling practices, poor environmental sanitation and sanitation of milking equipment. The introduction of proper training and hygiene practices during milking or post-milking process to milk producers and marketers were found to be efficient in reducing the bacterial load or contamination of the raw milk and pathogenic causing microorganisms. Therefore, strict hygienic control measures are needed for improved hygienic practices and handling of milk at all levels of dairy market chain.

Conflict Of Interests

The authors did not declare any conflict of interest.

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3/16/2016