

Review

# Microbial properties of Ethiopian dairy products: A review

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Milk is considered as nature's most perfect food known to man. It provides nutrients to all ages of the human race. Similarly, it is a good growth medium for spoilage and pathogenic micro-organisms. The purpose of this review was to synthesize the earlier report on microbial properties of milk and fermented milk products in different parts of Ethiopia. The dairy products reviewed included milk, ergo (naturally fermented milk), Kibe (traditional butter), Arerra (defatted sour milk) and Ayib (Ethiopian cottage cheese). The existing microbial quality of dairy product produced in rural part of the country was substandard when compareds from standards set by various bodies. The problem was compounded from limited knowledge on the hygienic handling practices of dairy products coupled with inadequate dairy infra structures. This is good entry point monitoring the handling, processing and transportation of dairy products is to bring safe product to the consumer.

**Key word:** Milk, dairy product, microbial quality.

## INTRODUCTION

Milk and milk products play an important role in human nutrition throughout the world. Consequently, the products must be of high hygienic quality. In less developed areas and especially in hot tropics high quality of safe product is most important but not easily accomplished (Zelalem and Faye, 2006; Asaminew and Eyassu, 2011). In addition to being a nutritious food for humans, milk provides a favorable environment for the growth of microorganisms (Walstra et al., 2006). Food spoilage is an enormous economic problem worldwide.

Through microbial activity alone, approximately one-fourth of the world's food supply is lost. The highly perishable nature of milk and mishandling, the amount produced is subjected to high post-harvest losses in Ethiopia. Losses are up to 20-35% had been reported in Ethiopia for milk and dairy products from milking to consumption (Getachew, 2003).

The microorganisms principally encountered in the dairy industry are bacteria, yeasts, moulds and viruses. Some of the bacteria (lactic acid bacteria) are useful on

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milk processing, causing milk to sour naturally. However, milk can also contain pathogenic bacteria, such as *Salmonella* spp., *Staphylococcus aureus*, *Escherichia coli*, *Mycobacterium tuberculosis*, *Listeria* spp., *Brucella* spp., etc. The presence of these pathogenic bacteria in milk emerged as major public health concerns, especially those individuals who still drink milk (Lingathurai and Vellathurai, 2010). The consumption of raw milk and its derivatives is also common in Ethiopia (Zelalem, 2003), which is not safe from consumer health point of view as it may lead to the transmission of various diseases. On the other hand bacteria can cause spoilage of the milk and spoilage and poor yields of products (Oliver et al., 2005). Keeping fresh milk at an elevated temperature together with unhygienic practices in the milking process may also result in microbiologically inferior quality. Apparently, these are common practices for small-scale Ethiopian who produce milk and milk products and sell it to consumers (Zelalem, 2010). Moreover, an increasing number of people are consuming raw unpasteurized milk (Oliver et al., 2009).

It is a well-established fact that consumers want, wholesome and nutritious food that is produced and processed in a sanitary manner and is free from pathogens. However, inadequate dairy infrastructure coupled with limited knowledge on the hygienic handling of milk and milk products, the quality of smallholder milk and milk products in Ethiopia can generally be characterized to be substandard (Zezelem, 2010). Hence, for fulfilling consumer's demand, the hygienic improvement in milk production and processing is necessary (Khan et al., 2008).

The fragmented and un-compiled works on the microbial properties of milk and milk products in Ethiopia so far have failed to have a positive influence on traditional handling practices of milk. Which is evidenced by, the microbial qualities of the products produced from different part of the country remain substandard (Zezelem, 2010). Hence, understanding the existing situation concerning the microbial properties of milk and milk products produced, marketed and consumed in Ethiopia is critical to be able to make any improvement intervention. Therefore, the aim of this paper is to review the microbial properties of milk and fermented milk products in different chains and parts of the country.

## **MICROBIAL PROPERTIES OF MAJOR ETHIOPIAN DAIRY PRODUCTS**

The microbial load of milk is a major factor in determining its quality (Fatine et al., 2012). It indicates the hygienic level exercised during milking, that is, cleanliness of the milking utensils, condition of storage, manner of transport as well as the cleanliness of the udder of the individual animal (Fatine et al., 2012). 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 further processing O'Connor (1994). These microorganisms are indicators of both the manner of handling milk from milking till consumption and the quality of the milk.

Microbial analysis of milk and milk products includes tests such as total bacterial count, yeasts and moulds and coliform estimation. They are useful to measure its sanitary quality and most grading of milk is on the basis of some method for estimating numbers of bacteria (Collins et al., 1995). The presence of defect producing types in butter can be indicated by estimating the presence of lipolytic organisms (O'Connor, 1994).

There are varieties of traditionally fermented dairy products in Ethiopia, in which the exact type of lactic acid bacteria responsible for fermentation is unknown due to uncontrolled and spontaneous fermentation. Most of these products are produced by smallholder producers where access to the required dairy infrastructure is limited. Certain reports of research efforts on the microbial properties of locally produced milk and milk products that have been carried out in different parts of the country are briefly summarized below.

## **MILK**

In Ethiopia milk is produced and marketed to consumer without being pasteurized or subjected to and quality standard. About 98% of the annual milk produced by subsistence farmers who live in rural areas where dairy processing in the country is basically limited to smallholder level and hygienic qualities of products are generally poor (Zelalem and Faye, 2006). The hygienic conditions are different according to the production system, adapted practices, level of awareness, and availability of resources (Zelalem, 2010). 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 (Zelalem, 2003) and the quality of the water used for cleaning purpose not secured.

Moreover, in the traditional practice the status of the cleanliness of the milkers, the udder of the cow, the milking environment and the milking equipments could be the chief sources of the initial milk contamination (Haile et al., 2012). The traditional milk equipment are reported to be often porous and therefore a reservoir for many organisms and difficult to clean (O'Connor, 1994). All these reasons might increase the microbial load of milk produced in traditional practices of Ethiopia. Producers need, therefore, to pay particular 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 (Zelalem, 2003).

Earlier research conducted in different part of the country revealed that the microbial counts of milk and milk

milk products produced and marketed are generally much higher than the acceptable limits (Zelalem, 2010). These were evidenced by milk collected from smallholder producers in Southern Ethiopia. The total bacterial count (TBC) reported by Abebe et al. (2012) in Gurage zone; Haile et al. (2012) in Hawassa town and Asrat et al. (2012) in Wollayta zone were on the range of 9.82 log cfu/ml - 4.57 log cfu/ml. It is comparable to the findings of Tollossa et al. (2012) 7.36-7.88 log cfu/ml of raw cow's milk in Borana, Ethiopia; Asaminew and Eyassu (2010) 7.58 log cfu/ml in Bahir Dar Zuria and Mecha districts, Ethiopia; and Solomon et al. (2013) 7.07 log cfu/ml in Debre Zeit town, Ethiopia.

However, raw milk samples from different part of the country TBC counts greater than 5 log cfu/ml which is higher than the given international standard set for minimum acceptable level of bacterial count in milk (IFCN, 2006). In other words, the above indicated 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.

As indicated by Chambers (2002) total bacterial count is a good indicator for monitoring the sanitary conditions practiced during production, collection, and handling of raw milk. Hence training of milk handlers about hygiene can significantly reduce the bacterial load in milk. A good example worth mentioning is a reduced total bacterial count observed in milk sampled from farmers who received training on hygienic milk production and handling, and who used recommended milk containers as compared to that produced by the traditional milk producers (Rahel, 2008).

The milk utensils holding the raw milk and pasteurized milk sample from critical points as indicated by Zelalem and Faye (2006) could also contribute to further contamination. A number of research finding reported similar values of aerobic mesophilic counts milk sampled from udder, milking bucket, collection center, milk vending shops and cafeteria is range between 7.28 and 10.28 log cfu/ml (Godefay and Molla, 2000; Haile et al., 2012; Tollossa et al., 2012; Shunda et al., 2013). In all cases increasing trend of counts as the milk passed through udder, milking bucket, collection centers and upon arrival at the processing plant. This could be due to improper handling, storage and transport time after the milk leaves the dairy farms. Milk produced under hygienic conditions from healthy cows should not contain more than 4.7 log cfu/ml (O' Connor, 1994).

Coliform count, on the other hand, is especially associated with the level of hygiene during production and subsequent handling since they are mainly of fecal origin. Previous workers reported similar values of coliform counts in raw cow milk sampled from different part of the country that range between 4.03 log cfu/ml to

6.57 log cfu/ml (Fekadu, 1994; Alganesh, 2002; Zelalem and Faye, 2006; Asaminew and Eyassu, 2010; Asrat et al., 2012; Abebe et al., 2012). Higher counts of different species of *Enterobacteriaceae* were reported with *E. coli* being the most abundantly isolated species (Zelalem et al., 2007a), which is a good indicator of recent fecal contamination (Bintsis et al., 2008). Similarly, the mean coliform counts of raw milk in different part of Ethiopia are similar with the reports of Rai and Dawvedi (1990) from India (5.89 log cfu/ml); Kurwijila et al. (1992) from Tanzania (5 cfu/ml), and Ombui et al. (1995) from Kenya (4.67 log cfu/ml) and Bonfoh et al. (2003) from Mali (6 log cfu/ml).

Even if, it is not practical to produce milk that is always free of coliforms. Their presence in raw milk may therefore be tolerated. However, if present in large numbers, over 100 coliform organisms per milliliter of raw milk, it means that the milk was produced under improper procedures (Walstra et al., 2006). 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). It is not only the bacterial counts, which affect the hygienic quality of milk but also the type of bacteria. Microorganisms like *Staphylococcus* spp.; *Streptococcus* spp. and *Escherichia* spp. and *Bacillus* spp. being the most abundantly isolated species in raw milk samples (Tollossa et al., 2012; Shunda et al., 2013), however, the occurrence of pathogenic strains in milk products, which could be hazardous for consumers.

## ERGO (NATURALLY FERMENTED MILK)

Ergo is a traditional fermented milk product, which is made by natural fermentation of milk under ambient temperature, with no defined starter cultures used to initiate the fermentation processes (Assefa et al., 2008). As a result, the microbial load of fermented milk samples, including *Ergo*, could vary from sample to sample based on the microbial load and types of microbes in the original raw milk (Abdulkadir et al., 2011).

Ergo is semi-solid, smooth and uniform appearance and usually has a white milk color with pleasant odour and taste when prepared carefully. It constitutes primary sour milk from which other products may be processed. Depending on the storage temperature, it can be stored for 15-20 days (Almaz et al., 2001). It is popular and is consumed in all parts of Ethiopia by all age categories of people (YONAD, 2009).

Ergo has received extensive microbiological works and it has been found that lactic acid bacteria (LAB) dominated all other microorganisms, followed by yeasts and then moulds. Almaz et al. (2001) reported that Ergo fermentation is carried out by lactic acid bacteria belonging to the genera, *Lactobacillus*, *Lactococcus*, *Leuconostoc*, *Enterococcus* and *Streptococcus*. Same

authors also reported that *Micrococcus* sp., coliforms and spore formers were also present in fairly high numbers during the first 12-14 h of fermentation. Their population decreased substantial thereafter, which implies an antimicrobial activity besides low pH in the fermented milk (Savadogeet al., 2004).

The report of Assefa et al. (2008) who indicated 12 LAB isolates from Ergo that include *Lactobacillus plantarum*, *Lactococcus lactis* ssp *cremoris*, *Lactococcus lactis* ssp *lactic*, *Lactobacillus acidophylus*, *Leuconostoc lactis*, *Pediococcus pentosace* and *Pediococcus* ssp. to have antimicrobial activities against different pathogenic microbes including *Shigella flexinery*, *Salmonella typhi*, *Escherichia coli* and *Staphylococcus aureus*. Eyassu et al. (2012) also found diversity of lactic acid bacteria isolated from the traditional fermented camel milk were *Lactobacillus plantarum*, *Lactobacillus delbrueckii subspecies bulgaricus*, *Lactococcuslactis subspecies cremoris*, *Lactococcuslactis subspecies lactis*, *Enterococcus faecalis* in Ethiopia, Savadogo et al. (2004) from Burkina Faso and Abdelgadir et al. (2001) from Sudan which comprised mainly of lactobacilli and lactococci.

According to Ashenafi (2002), in most households of Ethiopia no attempt is made to control the fermentation process of milk and products manufactured under traditional systems generally have poor qualities and do not meet the acceptable quality requirements set by various regulatory agencies. Zelalem (2010) observed the mean yeast and mould counts exceeded 8 log cfu/ml of Ergo sampled from different part of the country. Yeast and mould count of up to 4.6 log cfu/ml of fermented milk sampled from Southern Ethiopia was also reported (Fekadu, 1994). These values are much higher than the acceptable value <10 cfu/ml for yoghurt (Mostert and Jooste, 2002). The presence of different species of yeast in milk and its products may result in the spoilage of the product or conversely could contribute to the enhancement of the flavor of fermented milk, since different yeast species are able to assimilate different milk substrates (Gadaga et al., 1999). Zelalem et al. (2007a) identified *Klebsiella pneumoniae*, *Klebsiella oxytoca*, *Enterobacter cloacae*, *Citrobacter freundii* and *Enterobacter sakazakii* were isolated from Ergo samples collected from smallholder producers in the central Ethiopia.

The average total bacterial count during Ergo fermentation in raw milk collected from eight dairy farms in Awassa was greater than 9 log cfu/ml (Ashenafi, 1995). Similarly, TBC of Ergo was generally high ranging from 7.71 log cfu/ml in samples collected from Sheno to about 10 log cfu/ml in samples from Jimma (Zelalem, 2010). Fekadu (1994) also reported 8.6 log cfu/ml total bacterial counts greater than for 75% of fermented milk samples collected from three villages in Southern Ethiopia. Coliform count averaging at 6.57 log cfu/ml was reported for Ergo samples (Zelalem and Faye, 2006).

Lower values were also observed in which 75% of the samples showed coliform count less than 4.4 log cfu/ml (Fekadu, 1994). The average Enterobacteriaceae and coliform counts reported were 4.95 and 4.51 log cfu/ml from Ergo sampled Sheno to Jimma (Zelalem, 2010). The existence of coliform bacteria in milk and milk products is suggestive of fecal contamination and unsanitary practices during production, processing, or storage.

The common traditional milk processing techniques involve smoking of processing utensils using embers of *Olea fricana*. This smoking practice is reported to be beneficial to keep better quality of Ergo through its inhibitory effect on spoilage and pathogenic organisms. For instance, the inhibitory effect of smoking on *Listeria monocytogenes* was reported (Ashenafi and Fekadu, 1994). The effect of lower pH of Ergo in controlling the proliferation of undesirable microorganisms is more effective after 24 h of incubation. However, at this time, the Ergois considered to be too sour for direct consumption since Ergo coagulates within 24 h and preferably consumed at this time for its good flavor (Ashenafi, 2006). Accordingly, the same author recommended that milk should be boiled beforehand and a small amount of three days old Ergo that is normally free from pathogens but contains enough LAB should be inoculated to initiate fermentation.

## KIBE (TRADITIONAL BUTTER)

Traditional Ethiopian butter Kibe is always made from Ergo and not from cream (O'Connor et al., 1994). This traditional butter processed and sold by women in every community (YONAD, 2009). Kibe has an attractive appearance with a white to light yellowish colour. Like factory processed butter, it is semi-solid at room temperature. It has a pleasant taste and odour when fresh, but with increased storage, changes occur in odour and taste, unless refrigerated or further processed into NeterKibe (traditional Ghee) by boiling with spices.

Kibe is the most shelf stable of all traditionally processed fermented milk products except for Neter Kibe. Kibe is important role in the diet, both in rural and urban areas, and is utilized also by children of weaning age and the elderly. In addition to direct consumption as a side dish, it is used as oil for food preparation and, after processing into Neter Kibe, it is also used for hairdressing and as a skin cosmetic by both sexes (YONAD, 2009) and it is used for roasting coffee beans in special traditional ceremonies.

The moisture content of the traditional Kibe ranges from 20 to 43% as compared to the international commercial standard for butter of 16%. Spoilage occur when stored at room temperature for a long time is probably mainly by putrefactive microorganisms. Butter is highly stable against microbial spoilage after 2% salt addition, because of its high fat ratio, low moisture and

nitrogen ratio. Microorganisms having lipolytic activity are highly responsible for disorders such as rancidity or loss of flavor. Microbiological information on this product is not fully available in Ethiopia. However, there are some studies published on the microbiological quality of traditional butters from the country (Almaz et al., 2001; Wondu, 2007; Zelalem, 2010).

According to Zelalem (2010) the average total bacterial counts ranged from 6.18 cfu/g in butter samples collected from Selale area to 7.25 cfu/g in samples from Sululta. On another studies the average TBC of 7.49 cfu/g and the presence of high variability among samples depending on the sources were reported (Wondu, 2007). Samples collected from open markets and rural producers, for instance, had higher counts as compared to that obtained from dairy farms and urban producers of southern Ethiopia. In addition to this the TBC of fresh butter sampled from rural and public butter markets in Addis Ababa ranged from 8.27 to 4.7 log cfu/g of butter (ILCA, 1992). These values are higher than the acceptable limit of 4.69 log cfu/g (Mostert and Jooste, 2002). This indicates Kibe produced from different part of the country were substandard handling conditions at all stages in the milk chain.

Coliforms as a hygiene indicator besides moulds and total aerobic mesophilic bacteria as a general hygienic quality factor are important criteria for the determination of the microbiological quality of butter. Zelalem (2010) reported the average Enterobacteriaceae and coliform counts were greater than 4 cfu/g of butter sampled from different parts of the country. Coliform counts ranging from 1.92 to 4.5 log cfu/gm of butter are reported (Wondu, 2007; Asfaw, 2008; Zelalem et al., 2007a). These differences could be attributed to the wide variation in hygienic handling during milking, processing, storage and transport to market. In addition to this Aleme et al. (2013) observed the coliform count of butter samples made from camel and goat milk were 3.07 logcfu/g and 3.02 logcfu/g, respectively. Generally the Enterobacteriaceae and coliform count reported in the country were higher than the acceptable value of <10 cfu/g (Mostert and Jooste, 2002).

The primary spoilage factors in butter are moulds and mostly greenish colored moulds are seen, but red, black and brown colored ones are also seen in butter. The majority of the moulds growing in butter are composed of the species of *Thamnidium*, *Cladosporium* and *Aspergillus*. Through the application of a proper heat treatment, moulds cannot survive in cream even if contamination exists. So, the presence of mould contamination in butter indicates contamination by water or air after production. The protective effect of salt added to butter cannot be underestimated in terms of moulds. The mean yeast and mould counts observed in the Ethiopian highlands were exceeded 8 cfu/g of butter sampled from Addis Ababa to Jimma (Zelalem, 2010). Yeast and mould counts ranging between 4.3 and 6.86

log cfu/g of butter sampled from Wollayta area are reported (Asfaw, 2008). Average yeast and mould count of 7.65 log cfu/g of butter was also reported (Wondu, 2007). Higher values are observed (Zelalem et al., 2005) that varied depending on the type of producer where lower counts were observed for butter sampled from research centers and small-scale producers than that from large-scale producers.

## ARERA (DEFATTED SOUR MILK)

Arrera is another byproduct of Ergo obtained after removal of Kibe after churning. It has a similar color to Ergo, but its appearance slightly smoother and its consistency thinner, although thicker than fresh milk and basically contains the casein portion of milk. Its taste and odor are similar to those of Ergo. In contrast to other traditional dairy products, Arrera has less calories. It contains 91.5% moisture, 3.1% protein, 1.4% fat, 3.4% carbohydrate, and 0.6% ash (EHNRI, 1997).

Arrera has a shorter shelf life compared to all other fermented milk products (only 24-48 h), even when smoke is applied to the equipment used for its storage. The product is consumed in all parts of the country where fermented milk is produced and it serves as a beverage either plain or spiced. It is preferred by women for consumption as a side dish or as drink (YONAD, 2009). Surpluses are given to calves, lactating cows and dogs (Almaze et al., 2001). However, it may indirectly serve as additional income for the women by its use as raw material for cottage cheese (Ayib) manufacture, which may be sold in the market. Due to its relatively short shelf life and some traditional taboos or beliefs, Arrera is not sold in the market for direct consumption.

The average counts of total bacteria, Enterobacteriaceae and coliforms were greater than 9, 4.7 and 4.2 cfu/ml, respectively of Arera sampled from Addis Ababa to Jimma (Zelalem, 2010). These values are higher than the acceptable value of <10 cfu/gm (Mostert and Jooste, 2002). Traditionally produced Arera sampled from Wollayta area had total bacterial count of about 9 log cfu/ml (Rahel, 2008). The same author also reported coliform count of 4.86 log cfu/ml. Different species of bacteria were identified in Arera samples collected during both dry and wet seasons, which include: *K. pneumoniae*, *K. oxytoca*, *E. cloacae*, *E. sakazakii*, *E. coli* and some species of Salmonella (Zelalem et al., 2007a).

## AYIB (ETHIOPIAN COTTAGE CHEESE)

Ayib is a soft curd-type cheese typical of many regions in Ethiopia, and is made from the defatted sour milk resulting from the churning of sour whole milk by heating the defatted sour milk to coagulate the curd (O'Connor, 1994; Binyam, 2008). The product is white, acidic and it

is mainly consumed locally. Ayib is as important as Kibe and contributes to the overall nutrition of the people and forms part of the staple diet. The resulting Ayib contains 76% water, 14% protein, 7% fat and 2% ash (O'Connor, 1994).

Soft cheeses have higher moisture content when compared to hard cheese and have lower keeping quality due to microbial spoilage (Rhea, 2009). Most soft, unripened cheeses are microbiologically unstable due to metabolic activity of bacteria, yeast or mould contaminants. Rhea (2009) reported the isolation of pathogenic microorganisms such as *L. monocytogenes*, and *S. aureus* from soft cheese. *Escherichia coli* serotype 0157:H7 has been associated with the consumption of French Brie and Camembert soft cheese in the US and Scandinavia. The bacteria species identified in Ethiopian cottage milk samples were *Bacillus cereus* and *S. aureus* (Ashenafi, 2006; Mekonen et al., 2011) in Awassa and Debrezite, respectively. The occurrences of most food toxins caused by *S. aureus* were the result of bad hygienic practices in the household (Seifu et al., 2013). On the other hand *Klebsiella*, *E. coli*, *Enterobacter* and *Klyuvera* species were also reported (Zelalem et al., 2007b; Seifu et al., 2013).

The safety of cheese with respect to food born diseases is a great concern around the world and in developing countries (Ashenafi, 2006). This is especially true in Ethiopia where the consumption of Ethiopian cottage cheese (Ayib) which is typically manufactured in small dairy farms under poor hygienic conditions is common practices (Alehilign, 2004). In spite of the aforementioned prevailing situation and the presence of a number of public health concerns due to food born diseases resulting from the consumption of different food item in Ethiopia there is scarcity of well documented information in general and Ethiopian cottage cheese in particular.

Although the microbial quality of soft, white cheese, high counts of microorganisms were found in the majority of the samples of Ethiopian cottage cheese samples collected from an open market in Awassa had high counts of mesophilic aerobic bacteria, yeasts and enterococci (Ashenafi, 2006). Same author also reported aerobic mesophilic bacterial counts of over 8 log cfu/g. Comparable counts are also reported (Zelalem et al., 2007b; Binyam, 2008; Seifu et al., 2013). The sources of contamination could be from handlers, and utensils, used for packaging and possibly imparting flavor (Ashenafi, 2006). Eyassu (2013) reported total viable bacteria count ranging from 5.4 to 7.8 log cfu/g from Metata Ayib samples which are made from Ethiopian cottage cheese in West Gojjam zone. The maximum limit of aerobic mesophilic bacterial count which is commonly employed to indicate the sanitary quality of food, for raw milk intended for processing is 5 log cfu/ml and intended for direct human consumption is 4.69 log cfu/ml (Council Directive 92/46 EEC 1992).

Earlier research done in different parts of the country the coliform counts of Ayib samples were reported on the range between 2 and 5.70 log cfu/g (Ashenafi, 2002, 2006; Zelalem et al., 2005; Binyam, 2008; Seifu et al., 2013) with differences being a function of source of samples and handling conditions. However, the coliforms were not detected in the MetataAyib samples collected from west Gojjam. The absence of coliforms in the Metata Ayib it is due to the low pH (4.0) of MetataAyib which might have inhibited the growth of coliforms. As indicated by Zelalem et al. (2005) coliform counts varied among samples collected from different producers where Ayib sampled from research centers had lower coliform counts (4.85 log cfu/gm) as compared to that sampled from large-scale (5.68 log cfu/gm) and small-scale (5.48 log cfu/gm) farms showing variations in the hygienic conditions practiced among the different producers. In all cases values are higher than the recommended level of <10 cfu/g (Mostert and Jooste, 2002) indicating the poor hygienic conditions practiced during production, processing and handling of milk and milk products.

According to Seifu et al. (2013) the mean count of Enterobacteriaceae Ayib sample collected from five vendors of open market places at Jimma town was 6.504 log cfu/g, similar values were reported (Ashenafi, 2006; Zelalem et al., 2007b; Tekletsadik and Tsige, 2011). Related literature values show that the count of Enterobacteriaceae in the cheeses made from heat treated milk is 3 log cfu/g (CEC, 2005), and in the ready to eat foods more than 4 log cfu/g is unsatisfactory (Gilbert et al., 2000). Binyam (2008) reported yeast and mould in Ayib sampled in Shashemane with average counts of around 6.35 log cfu/g of the product, which indicated a suboptimal microbial quality of market Ayib in the area. Ashenafi (2006) on the other hand reported lower values (5 log cfu/g) for most Ayib samples in Southern Ethiopia. Generally countries produced soft cheeses including Ethiopian cottage cheese due to poor keeping quality and public health risk to the consumer. Therefore, strict hygienic control measures along the food chain to improve the hygienic conditions during manufacturing, handling, storage and commercialization of cheese in order to guarantee the quality of this highly popular product in the country.

## CONCLUSION

Milk and milk products play a crucial role in human nutrition both urban and peri-urban area of the country. However, evidences showed that the microbial properties milk and Ethiopian traditional fermented milk products made from different dairy producer were substandard in quality. This is due to absence standard hygienic condition followed by producers during milk production. The hygienic conditions under smallholder conditions is limited to letting the calf to suckle for few minutes and/or

washing the udder before milking. Moreover, unhygienic cleaning and handling of milk containers and inadequate dairy infrastructure coupled with limited knowledge of the hygienic production and handling of milk and milk products result in the contamination of the milk. Therefore, strict hygienic control measures along the food chain to improve the hygienic conditions of milk from production to consumption are necessary.

### Conflict of Interests

The author(s) have not declared any conflict of interests.

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