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Review paper

Review on Milk and Milk product Handling Practices, Utilization and Microbial quality in Ethiopia

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Milk is yellowish-white non-transparent liquid secreted by epithelial cells in mammary gland of mammals. It is very nutritious food rich in macro and micronutrients. Being nutritious and liquid, it is an ideal for microbial growth and multiplication. The aim of this review is to compile information from earlier works on milk and milk products handling practices, utilization, quality and safety in Ethiopia. Milk and milk products to be safe and to have high quality, responsibility should be taken on dairy producers, retailers and manufacturers. Ethiopia is known by huge number of livestock; however, milk production and consumption is below the expected standard. In Ethiopia, milk hygiene practices are below the standard due to insufficient pre-milking and post-harvest handling practices. Milk quality is a blend of characteristics (chemical, physical, bacteriological and aesthetic) that boost up the acceptability of the milk product. Commonly used microbial quality tests for milk and milk products are determination of Total Bacterial Count (TBC) or Standard Plate Count (SPC), Coliform Count (CC), Yeast and Mould Counts, Enterobacteriaceae, and Somatic Cell Counts (SCC). In general, microbial content of milk and milk products is an indicative of the hygienic levels at milking, cleanliness of utensils, storage, and transportation.

Key words: - Milk quality, Milk safety, Total bacterial count, Coliform count, Milk hygiene

INTRODUCTION

Milk is yellowish-white liquid secreted by epithelial cells in mammary gland of mammals, which is very nutritious food, rich in carbohydrates, proteins, fats, minerals and some vitamins (Pandey and Voskuil, 2011).It is the most nearly perfect food which provides the primary source of nutrition for young mammals before they are able to digest other types of food (Olatunji *et al.,*2012). However, due to its high water activity and nutritional value it serves as an excellent medium for growth of many kinds of microorganism under suitable environment (Mesfin *et al*., 2017).It is virtually a sterile fluid when secreted into alveoliof udder. However, beyond this stage of production, it is contaminated with microorganism that might from within the udder, exterior to the udder and from the surface of milk handling and storage equipment (Melese and Tesfaye, 2015). Although milk is a valuable source of both macro and micronutrients, it is highly perishable and can lose its quality within a short period of time if not handled under hygienic conditions (Mekonine and Mengistu, 2017).

In Ethiopia, milk and milk products mainly used for home consumption as it have high nutritional value. In addition, it is a source of cash income to purchase farm inputs like feed, fertilizer and improved crop varieties as well as food and non-food items like educational materials for their children (Melese and Tesfaye, 2015). However, the quality of milk produced in Ethiopia is poor and below the standard. This is due to poor pre-milking and post-harvest handling practices and highly perishable

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characteristics of the milk (Tsadkan and Gurja, 2018).
Mishandling and disregard of hygienic measures by milk handling personnel may enable undesirable microbes to come into contact with milk and in some cases to survive and multiply in sufficient numbers and make the milk unsafe for both direct consumption and further processing (Chatterje e *et al.,* 2006). High microbial count in milk is an indication of poor hygienic conditions of the milk; consequently it reduces the nutritional quality of milk and causes unpleasant effect on the taste. Moreover, it reduces the market value of milk causing income losses to producers and traders. Furthermore, high microbial count in milk threatens the health of consumers due to toxic metabolites produced by different organisms growing in it (Karmen and Slavica, 2008). Having an introduction of this way; the objective of this review is therefore to compile and organize information about milk and milk product handling practices and microbial quality of milk in Ethiopia.

Milk Production in Ethiopia

Ethiopia has the highest cattle populations in Africa estimated about 59.5 million of cattle from, which about 98.2 % of the total cattle in the country are local breeds. The remaining are hybrid and exotic breeds that accounted for about 1.62% and 0.18%, respectively (CSA, 2017).
Asa result, milk production in Ethiopia is mainly dependent on indigenous breeds; more specifically on cattle, goats, camels and sheep. Cattle have the largest contribution (81.2%) of the total national annual milk output, followed by goats (7.9%), camels (6.3%) and sheep (4.6%) (CSA, 2014).
The estimate of total cow milk production for the rural sedentary areas of Ethiopia is about 3.06 billion liters (CSA, 2017).
The average daily milk yield (ADMY) performances of indigenous cows is1.85 liters/day and ranges from 1.24 liters in rural lowland agro-pastoral system of Mieso to 2.31 liters in rural highland dairy production system of Fogera (Azage *et al.,* 2013). For hybrid cows, milk production per day is8 to 10 liters (Tadesse *et al.,* 2015). Currently, in Ethiopia per capital consumption is very low, estimated at about 19 liters per person, but urbanization is driving up consumption in Addis Ababa about 52 liters per person per year (Azage, 2018).

Milk and Milk Products Handling Practices in Ethiopia

Milk and milk products are major food for human all over the world. Milk is virtually sterile when it is synthesized in a healthy cow's udder. However, as soon as it leaves from the heat becomes contaminated with microorganism and spoiled till consumption or further processing (Tollessa, 2016). It is an ideal medium for Microorganisms and as it is a liquid and nutritious, it is very easily contaminated and invaded by bacteria. As a result, hygienic milk handling practices should take into account such as the sanitation of milking environment, the hygiene of the milker and utensils used to collect and store milk (Tsedey and Asrat, 2015).
In Ethiopia, milk hygiene handling practice is below the standard due to insufficient pre-milking handling practices like washing udder with clean water, cleaning milking barn, drying the udder with individual towel, washing of milkers' hands and milking utensils, using of poor quality and non-boiled water for cleaning of udder and insufficient post handling practice like poor hygiene of milk equipment and storage containers, prolonged storage, transportation and retailing practices predispose the milk to microbial contamination (Tsedey and Asrat, 2015; Fufa *et al.,* 2019).
Moreover, use of plastic containers for handling and transporting of milk increase the risk of contamination of milk higher, since as the number of plastic containers increased the chance of contamination is also increased and most plastic containers have characteristics that make them unsuitable for milk handling (Tsedey and Asrat, 2015). In addition, using clay pot for storing milk is another factor. This device for producers is inconvenient for hygienic cleaning, it also harbors bacteria which causes milk spoilage and consequently imposes risk of quality deterioration (Tsedey and Asrat, 2015).
The dairy producers clean their milking utensils in different ways, for instance, washing with or without hot water followed by smoking with different aroma producing plants like Woira (*Oleaafrican*), and Tid (*Juniperousprocera*) used for flavoring and extending the shelf life, since fumigation have the power of disinfecting (sterilizing) the milking equipment. Thus, reducing the numbers of microorganisms and thereby extending the shelf life of milk and milk products, and thereby reducing spoilage (Tsedey and Asrat, 2015).
Shewangzaw *et al.* (2016) reported that about 55.6% of the producer should not used refrigerator for handling of milk and its products. This may favor the multiplication of bacteria and spoilage of milk and milk products. Generally, poor handling practices result in higher the bacterial count, which in turn may cause spoilage of the milk and poor yields of its products. Moreover, the rise of bacterial count is unsafe since it cause food borne diseases and imposes a great health risk on the consumers (Tolessa, 2016).

Milk and Milk Product Quality and Safety in Ethiopia

Despite milk is highly nutritious food, it can be easily contaminated with physical, chemical and microbiological hazards. Milk quality refers to a blend of characteristics such as chemical, physical, bacteriological and aesthetic that boost up the acceptability of the milk product and milk safety is freedom from pathogenic organisms and other contaminants that may constitute health hazards (Merwan *et al.,*2018). Specific gravity, chemical composition and microbial quality of milk are important to determine milk quality and safety. While for milk products, microbial quality and chemical composition are determinant for its quality and safety (Merwan *et al.,* 2018).

Milk Quality and Safety in Ethiopia

Specific Gravity and Chemical Constitutes

The specific gravity of milk, among others, is commonly used for quality test mainly to check for the addition of water to milk or removal of cream. Addition of water to milk reduces milk specific gravity, while removal of cream increases it.

Mekonen and Mengistu (2017) reported that the mean specific gravity of raw milk obtained from farmers and dairy cooperatives was 1.029. For normal whole cow milk, specific gravity ranges from 1.028g/ml-1.036g/ml based on the East African Community (EAC) (2006) standard. Having specific gravity below recommended level implies that there was adulteration of milk with water which contributes to production of poor quality milk (Ali *et al.,*2010). The solid constituents of milk make an important food item from nutritional as well as processing point of view. Milk fat and protein are most important components of different varieties of most shelf stable milk products (Mekonine and Mengistu, 2017).

Bacteriological Quality of Milk in Ethiopia

Milk when it emerges from healthy udder contains only a very few bacteria. It picks many bacteria from the time it leaves from the teats of the cow until consumption or further processing. Microorganisms can enter milk via the cow, air, feeds, milk handling equipment and the milker and once they get into the milk their numbers increase rapidly (Tollessa, 2016).

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 commonly used microbial quality tests for milk and milk products include determination of total bacterial count (TBC) or standard plate count(SPC) and coliform count (CC) and yeast and mould counts, *Enterobacteriaceae* (Alganesh, 2016; Tamirat, 2018; Fufa *et al.,* 2019).

Total Aerobic Bacterial Count (TABC)

According to Ethiopian Standard Agency (ESA, 2009), the bacteriological quality of raw cow milk is to be less than $2x10^5$ and $2x10^5$-$1x10^6$Cfu/ml for very good and good quality while $1x10^6$-$2x10^6$ and above $2x10^6$Cfu/ml for bad and very bad milk quality, respectively. However, different researchers reported that the Ethiopian milk quality is below the standard. Alganesh (2016) reported that for milk sample collected from smallholder the mean total aerobic bacteria was 8.2 log10Cfu/ml. Similarly, Fufa *et al.*(2019)found that for milk from dairy farms, vendors and restaurants were 8.55, 8.99, and 3.12 log10Cfu/ml, respectively. Habtamu *et al.* (2018) also reported that the overall mean total bacterial count were 7.32 log10Cfu/ml, 6.83 log10Cfu/ml and 6.75 log10Cfu/ml for household, dairy farm, and pasteurized milk samples. Mekonine and Mengistu (2017) reported that the mean total aerobic bacterial count of raw milk collected from farmers and dairy cooperatives were 6.99 log10 Cfu/ml and 6.87 log10 Cfu/ml, respectively. Tsedey and Asrat (2015) reported that in the raw milk samples, the mean total bacterial count for producers and consumers were 6.73 Cfu/ml and 7.15 Cfu/ml, respectively.

This high total aerobic bacterial count may be due to initial contamination of milk which is associated with unhygienic milking practices like milking without cleaning the udder, use of local un sanitized containers for milking, dirty milking areas, poor personnel hygiene of milker and milk handlers, unhygienic milking areas and lack of milk cooling systems (Debela, 2015; Mekonin, 2018;Tamirat, 2018;Habtamu*et al.,* 2018).

Coliform Count(CC)

Coliforms are other bacterial group which affects milk quality which is associated with the level of hygiene during and subsequent handling (Tollessa, 2016). According to the ESA (2009), good quality milk should not contain a total coliform bacterial count of more than 0-1000 Cfu/ml. However, different studies showed that this coliform is beyond the standard. For instance, Tsedey and Asrat (2015) reported the coliform count for the raw milk collected from producers was 4.00 log10Cfu/ml and 4.29log10Cfu/ml for producers and consumers, respectively.

Similarly, Habtamu *et al.* (2018) reported that the mean CC of household, dairy farm, and pasteurized milk samples were 5.58, 6.63, 7.24 Log10Cfu/ml, respectively. In the same way, Fufa *et al.*(2019) found total CC of milk

from dairy farms, vendors and restaurants were 5.91, 5.77, and 2.17 log10Cfu/ml, respectively. Researchers suggested that the higher total coliform bacterial counts may be due to contamination of milk during milking either from poor milker's hygiene or fecal contamination from the udder and lower abdominal parts of the body of cows mainly from bedding materials as a result microorganisms gain access into milk during milking. The presence of coliforms indicates a safety risk, and the numbers should therefore be of the minimum recommended levels in milk products (Alganesh, 2016; Fufa *et al.,* 2019).

Enterobacteriaceae Count

The Enterobacteriaceae family includes the coliform groups like *Escherichia, Enterobacter, Citrobacter,* and *Klebisella*. In addition to many other genera, *Salmonella, Shigella, Morganella, Providencia, Edwardseila, Proteus, Serratia* and *Yersinia* which are isolated from animal intestines. Milk that is likely contaminated with feces might probably have higher Enterobacteriaceae counts. Enterobacteriaceae are indicator bacteria that are used to provide evidence of poor hygiene, inadequate processing or post-process contamination of foods (Alganesh, 2016). In Ethiopia, different studies have showed that Enterobacteriaceae count is higher due to substandard hygienic conditions practiced during production and subsequent handling. Alganesh (2016) reported the overall average of Enterobacteriaceae in milk sample collected from smallholder was 11.36 log10 Cfu/ml. Another study conducted by Abebe *et al.* (2012)reported that 4.15 log Cfu/mlof milk sample collected from producer. According to Teklemichael *et al.* (2013) the mean *Escherichia coli* counts from dairy farms and milk vendors were 3.64 and 5log10Cfu/ml, respectively. Mekonine and Mengistu (2017) also reported that the mean Escherichia coli count of raw milk collected from farmers and dairy cooperatives were 3.18 log10 Cfu/ml and 3.12 log10 Cfu/ml, respectively.

Spore-forming Bacteria Counts

Raw milk may contain a number of organisms known as thermodurics that can survive in mild pasteurization treatments. These are generally Gram-positives members of the genera *Micrococcus*, *Microbacterium, Lactobacillus* occasionally *Streptococci, Enterococcus*, and spore forming bacteria; *Bacillus* and *Clostridium*. Research conducted in Jimma showed that mean count of spore forming bacteria from 100 milk samples was 4.2log10Cfu/ml (Alebel *et al.,* 2013). These bacteria group may retain their activity and can affect quality of a post-pasteurized product and consumption of milk that contained these bacteria or their harmful metabolites might affect the health of the consumer (Alebel *et al.,* 2013).

Yeast and Mold Counts

Yeasts and molds commonly associated with milk and milk products are: *Saccharomyces spp.,Penicillium spp., Rhizophus spp., Aspergillus spp., Geotrichum Candidum, Alternaria spp.,* and *Cladosporium spp.*(Vishweshwar and Krishnaiah, 2005). The overall mean of yeast and mold count for a total of 78 milk samples collected directly from the udder, storage containers at farm level (bulk) and distribution containers upon arrival at selling points in Hawassa were 3.03, 4.65 and 7.13 log10Cfu/ml, respectively (Haile *et al.,* 2012).Mean count of yeast and molds was reported as 5.1 and 3.7log10Cfu/ml, respectively from milk samples collected in Jimma (Alebel *et al.,* 2013). Yeast and 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 (Mulugojjam and Aleme, 2015).

Bacteriological Safety and Quality of Milk Products in Ethiopia

Ethiopian Traditional Cottage Cheese (Ayib)

Ethiopian traditional cottage cheese (ayib) is a white, soft curd-type cheese made from buttermilk obtained after churning of sour whole milk by heating with moderate temperature. Cheese can be considered as a good medium for bacterial growth due to their nutrient content and long storage duration (Tollessa, 2016).Seifu *et al.* (2013) reported that the mean count of coliforms, Enterobacteriaceae and aerobic mesophilic bacteria count were 5.709, 6.504 and 8.844 Cfu/ml, respectively from a sample collected from vendors of open market places at Jimma town and its surrounding districts. The maximum and minimum total aerobic bacterial counts from study area were 8 log10Cfu/ml and 5 log10Cfu/ml, and coliform counts were 7.10 log10Cfu/ml and 4.23 log10Cfu/ml, respectively (Ashenafi *et al.,* 2016).Though pasteurization of milk can destroy most of the pathogens posing risk to public health, yet, the potential bacteriological hazards can still be found in the final

products after pasteurization through the improper handling(Senbetu, 2014).

Yogurt (Ergo)

Yoghurt is a diary product produced by the controlled fermentation of milk by lactic acid producing bacteria. Two species are commonly used in the commercial production, which are *Lactobacillus bulgaricus* and *Streptococcusthermophiles* (Makut *et al.,* 2014). It is the major fermented dairy product and nutritious food; it is popular and is consumed in all parts of the country. Being nutritious is also medium for bacterial growth and multiplication (Tolessa, 2016). Worku *et al.* (2015) reported that commercially prepared and traditionally homemade yoghurt (Ergo) retailed in Addis Ababa, the average count of LAB was found to be log 9.6 Cfu/ml; and that of aerobic mesophilic bacteria (AMB) and psychrophilic bacteria (PB) was shown to be around log 9 Cfu/ml and similarly the average count of coliform and fecal coliforms were indicated to be around log 6 Cfu/ml.

Butter

Butter is a traditional food which is widely consumed all over the world, directly or as ingredient in processed food such as pastries and convenience dishes. Its nutritional value (due to high content of fats, vitamins and minerals), and unique and pleasant flavour make butter practically appreciated by consumers. Ethiopian traditional butter (Kibe) is made from yoghurt (traditional Ergo) (Abebe *et al.,* 2014). The quality of butter is deteriorated due to microorganism purification when it stored in unrefrigerated condition for long period of time. Microorganisms having lipolytic activity highly cause the rancidity or loss of flavor of butter. Some researchers report the microbial quality of butter in different part of the country.

For instance, Abebeb *et al.* (2017) reported that the mean total aerobic mesophilic bacterial count (AMBC), coliform count(CC), mold count (MC) and lipolytic bacterial count (LPBC) 6.23, 2.5, 4.6 and 3.98log10 Cfu/ml of butter sample collected from producers, open market butter traders and dairy product shops respectively in selected areas of the central highlands of Ethiopia. Generally, this high count of bacteria might be due to poor sanitary equipments used to process the product, raw milk contamination, and absence of pasteurization, hygienic storage and transportation conditions (Abebe *et al.,* 2017).

CONCLUSIONS

Milk and milk products are perfect food of high biological value consumed all over the world including Ethiopia. Milk is virtually sterile when it is synthesized in a healthy cow's udder. However, as soon as it leaves from the teat becomes contaminated with microorganism and spoiled. Moreover, it has an effect to the final milk product. Generally, milk and milk products hygienic and handling condition practices in Ethiopia are below the standards due to insufficient pre-milking and post-harvest handling practices. The unhygienic and poor handling practices lead in to high microbial load in milk and milk products which results in poor quality and is unsafe for consumer. So, the concerned bodies and those who are interested to improve milk and milk products shall implement good production and handling practice to improve the quality of milk and its products.

DECLARATION

We declare thatall the authors were contributed equally, and we have no any conflicting of interests.

REFERENCES

Abebe B, Mitiku E, Zelalem Y (2014). Microbial properties of Ethiopian dairy products: A review. African Journal of Microbiology Research.8(23):2264-2271.

Abebe B, Zelalem Y, Ajebu N (2012). Hygienic and microbial quality of raw whole cow's milk produced in Ezha district of the Gurage Zone, Southern Ethiopia. Wudpecker J. Agric. Res. 1(11):459-465.

Abebe B, Zelalem Y, Mitiku E, Mohammed Y (2017). Hygienic, Handling practices and quality of Ethiopian Traditional Butter (Kibe) along the Value in Selected Areas of the Central Highlands.In proceeding of the 25th annual Ethiopian Society of animal production conference. 18(1):59-74.

Alebel W, Anbessa D, Shiferaw D (2013). Bacteriological quality and detection of bovine mastitis pathogens of milk sold in Jimma town, South-western Ethiopia. International Journal of Current Research. 5(12):3622-3627.

Alganesh TG (2016). Assessment of Safety and Quality of Raw Whole Cow Milk Produced and Marketed by Smallholders in Central Highlands of Ethiopia.Food Science and Quality Management.Vol.49.

Ali AA, Irshad NB, Razaz SA, Manahil AA (2010). Microbiological safety of raw milk in Khartoum State, Sudan: 1-Khartoum and Omdurman cities. Pakistan Journal of Nutrition. 9(5):426-429.

Ashenafi K, Alemu A, Naod T, Biniam T, Asefa A (2016).

Bacteriological Quality Assessment of Raw Milk and Cheese in Selected Woreda of Wolaita Zone, Ethiopia. Global Journal of Science Frontier Research: D Agriculture and Veterinary 16 (6).

Azage T (2018). Why Ethiopia's dairy industry can't meet growing demand for milk. International livestock research institute. Addis Ababa, Ethiopia.

Azage T, Berhanu G, Dirk H, Berhanu B, Yoseph M (2013). Smallholder dairy production and marketing systems in Ethiopia: IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 31. ILRI, Nairobi, Kenya.

Central Statistical Agency (CSA) (2014).Agricultural sample survey. Vol. II. Report on livestock and livestock characteristics. Statistical Bulletin.AddisAbaba, Ethiopia.

Central Statistical Agency (CSA)(2017). Federal Democratic Republic of Ethiopia.Agricultural sample survey.Livestock and livestock characteristics (private peasant holdings), Volume II. Addis Ababa, Ethiopia.

Debela GT (2015). Microbiological quality and impact of hygienic practices on raw cow's milk obtained from pastoralists and market. The case of Yabello District, Borana Zone, Ethiopia.Global Journal of Food Science and Technology. 3:153-158.

Desalegn G (2017). An overview of dairy products quality and safety.In proceeding of the 25th annual conference of the Ethiopian society of animal production (ESAP) held in Haramaya University.

East African Community (ESA) (2006).Raw Cow Milk Specification.East African standard. http://www.dairyafrica.com Retrieved on July, 2016.

Ethiopian Standard Agency (ESA) (2009). Unprocessed Whole/Raw Cow Milk Specification. 2nd ed., ES 3460:2009

Fufa A, Nigus T, Fikru R, Dinka A, Kebede A (2019). Handling Practices, Quality and Safety of Milk along the Dairy Value Chains in Selected Sub Cites of Addis Ababa, Ethiopia. Journal of Scientific Techinical Research.13(1).

Habtamu K, Ajebu N, Edessa N (2018). Microbiological quality and safety of milk production and marketing in Hawassa district, Ethiopia. African Journal of Microbiology Research. 12(25):587-594.

Haile W, Zelalem Y, Yosef T (2012). Hygienic practices and microbiological quality of raw milk produced under different farm size in Hawassa, Southern Ethiopia. Agricultural Research and Reviews. 1(4):132-142.

Makut MD, Ogbonna A, Dalami H (2014). An Assessment of the Bacteriological Quality of Different Brands of Yoghurt Sold in Keffi, Nasarawa State, Nigeria. Journal of Natural Sciences Research, 4:2224-3186.

Mekonen T, Mengistu G (2017). Handling Practices, Evaluation of Adulteration and Microbial Quality of Raw Cow Milk around Bahir Dar, Ethiopia.Food Science and Quality Management.Vol.61.

Melese A, Tesfaye W (2015).Bacteriological Quality and Safety of Raw Cow's Milk in and around Jigjiga City of Somali Region, Eastern Ethiopia.International Journal of Research Studies in Biosciences. 3(5):48-55.

Merwan A, Nezif A, Metekia T (2018). Review on milk and milk product safety, quality assurance and control.International Journal of Livestock Production. 9(4):67-78.

Mesfine Z, BedasoM,Yoseph M (2017). Hygienic practices and bacteriological quality of raw cow milk along milk supply chain in Sidama high lands of southern Ethiopia. In proceeding of the 25th annual conference of the Ethiopian society of animal production (ESAP) held in Haramaya University.

Mulugojjam A, Aleme A (2015). Review on Microbiological Quality of Ethiopian Raw Bovine Milk. Food Science and Quality Management.Vol.35.

Olatunji E, Jubril A, Okpu E, Olafadehan O, Ijah U, Njidda A (2012). Bacterial Assessment and Quality Analysis of Raw Milk Sold in Gwagwalada Area Council of the Federal Capital Territory (FCT) Abuja, Nigeria. Food Science and Quality Management. 2224-6088.

Pandey GS, Voskuil GC (2011).Manual of milk safety, quality and hygiene. Golden Valley Agricultural Research Trust, Lusaka Zambia.

Seifu B, Taye T, Tadele T (2013).Microbiological quality of Ayib, traditional Ethiopian cottage cheese, in Jimma area, South-West Ethiopia. African Journal of Microbiology Research.7(13).

Senbetu DT (2014). Comparative study on microbiological evolution of cheese collected from two different markets. American Journal of Research Communication. 2:187193.

Shewangzaw A, Ahmed M, Nunu H (2016). Handling, Processing and Utilization of Milk and Its Products in Gondar Town, Ethiopia. Journal of Life Science and Biomedicine. 6(6):120-126.

Tadesse K, Girma G, David L (2015). Characterizing Milk Supply and Marketing Chains and Losses in Wolmera and Ejere Districts of Ethiopia.Journal of Service Science and Management.Pp. 8.

TamiratT(2018).Microbiological Quality Analysis of Raw and Pasteurized Milk Samples Collected from Addis Ababa and Its Surrounding in Ethiopia. Journal of Approach in poultry and dairy and veterinary sciences.4(5).

Teklemichael T, Ameha K, Eyassu S (2013). Quality and safety of cow milk produced and marketed in Dire

Dawa town, Eastern Ethiopia.Int. J. Int Sci. Inn. Tech. Sec. B. 2(6):01-05.
Tolessa M (2016). The microbiology of Ethiopian milk and milk products: review. International Journal of Current Research. 8(07):34606-34611.
Tsadkan Z, Gurja B (2018). Handling and utilization pattern of cattle milk and milk products in Northern Ethiopia. African Journal of Agricultural Research.13(34).
Tsedey A, Asrat T (2015). Safety and Quality of Raw Cow Milk Collected from Producers and Consumers in Hawassa and Yirgalem areas, Southern Ethiopia.Food Science and Quality Management.Vol. 44.
Vishweshwar SK, Krishnaiah N (2005). Quality Control of Milk and Processing (for the course of dairying).State institute of vocational education director of intermediate education govt. of Andhra pradeshs indoor graphics, India.
Worku KF, Tefera AT, Tuji FA (2015). Comparative analysis of microbial load of commercially prepared and traditionally homemade yoghurt (Ergo) retailed in Addis Ababa. Journal of Advances in Life Sciences. 5(58-63):1771-1776.

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