ASSESSMENT OF PRODUCTION, HANDLING PRACTICES AND MICROBIAL QUALITY OF MILK PRODUCED IN ALETA CHUKO DISTRICT OF SIDAMA REGIONAL STATE OF ETHIOPIA

M.SC.THESIS

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HAWASSA UNIVERSITY

COLLAGE OF AGRICULTURE

HAWASSA, ETHIOPIA

MAY, 2021

ASSESSMENT OF PRODUCTION, HANDLING PRACTICES ANDMICROBIAL QUALITY OF MILK PRODUCED IN ALETA CHUKO DISTRICTOF SIDAMA REGIONAL STATE OF ETHIOPIA.

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A THESIS SUBMITTED TO THE SCHOOL OF ANIMAL AND RANGE SCIENCES, COLLEGE OF AGRICULTURE, HAWASSA UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ANIMAL AND RANGE SCIENCE

(SPECIALIZATION: DAIRY SCIENCE AND TECHNOLOGY)

HAWASSA, ETHIOPIA

MAY, 2021

HAWASSA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

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This is to certify that the thesis entitled ***"Assessment of Production, handling Practices and Microbial Quality of Milk Produced in Aleta Chuko District of Sidama Region in Ethiopia"*** submitted in partial fulfilment of the requirements for the degree of Masters with specialization in *Dairy Science and Technology,* the Graduate Program of the School of Animal and Range Sciences and has been carried out by *Alelign Rokonsa kalo* ID.No.GpDaScR/0001/11, under my/our supervision. Therefore, we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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ACKNOWLEGEMENTS

Above all glory to the Almighty God with his mother, who bestowed up on me his grace and blessing give strength to bring out this piece of work in to illumination. I would like to thank my advisors Dr.Mestawet Taye and Dr. Sintayehu Yigerem for their relevant suggestion, help, constructive advice and time devotion to correct this manuscript. I would like to acknowledge all the dairy science and technology laboratory assistances for their technical support on laboratory analysis. I would like to acknowledge Aleta Chuko district interiprize and industry office, Aleta Chuko agricultural bureau, finance and economy for supporting in secondary and primary data collection and giving valuable information. I would like to thank the community in the study area for their cooperation during the interview and sample collection. My heartfelt gratitude goes to Aleta Chuko district government they contributing transportation and stationary cost and securing my salary throughout the study period. My special appreciations go to my unforgettable and beloved friends Tibebu Legesse, and others have no word to express your love, kindness and friendship support during my studies Last but not least, I would like to thank Hawassa University College of agriculture school of animal and range science for availing me on opportunity, which was helped me lot to learn new things about my profession. Everyone who has supported me one or the other in successful completion of my work will be remembered at all times

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DEDICATION

I dedicated this thesis to my father Rokonsa Kalo**,** and especially to my mom Kawato Dima for all love they have given me and their dedicated partnership in the success of my life.

STATEMENT OF AUTHOR

I declare that this thesis is my work and that all sources of materials used for this thesis been duly acknowledged. This thesis has been submitted in partial fulfilment of the requirements for MSc degree at Hawassa University, College of Agriculture, and is deposited at the University library to be made available to borrowers under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate. Brief quotations from this thesis are allowable without special permission provided that accurate acknowledgement of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the College when in his or her judgment the proposed use of the material is in the interests of scholarship. In all other instances, however permission must be obtained from the author.

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College of Agriculture School of Animal and Range Science, Hawassa

Date of Submission: May, 2021

LIST OF ABBREVIATION

AGP	Agricultural Growth Program
CC	Coli form count
CFU	Colony Forming Unit
CSA	Central Statistics Agency
FAO	Food and Agricultural Organization of the United Nation
GDP	Gross Domestic Product
HPA	Health Protection Agency
IFCN	International Farm Comparison Network
LIVES	Livestock and Irrigation Value Chains for Ethiopia Smallholders
MOA	Minister of Agriculture
SNRS	Sidama National Regional State
SNV	Netherlands Development Organization
SPCA	Standard Plate Count Agar
SPSS	Statistical Package for Social Studies
TBC	Total Bacteria Count
TS	Total Solid
VRBA	Violet Red Bile of Agar

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ASSESSMENT OF PRODUCTION, HANDLING PRACTICES AND MICROBIAL QUALITY OF MILK PRODUCED IN ALETA CHUKO DISTRICT OF SIDAMA REGIONAL STATE OF ETHIOPIA**.**

By: Alelign Rokonsa

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ABSTRACT

*A study was carried out in Aleta Chuko District rural and peri urban Sidama regional states of Ethiopia. A total of 152 household heads, notably 101 and 51 from rural and peri urban Kebeles, respectively selected among milk producing smallholder household. For selection of rural and peri urban households the lists of farmers were provided by the respective PAs administration offices and interviewed to assessment of the row cow milk production practices and milk handling. For microbial analysis a total of 42 raw milk samples were collected aseptically using sterile sample bottles. The water sources used for cleaning purpose of milk handling equipment in peri-urban and rural households were from river 46.4%, pond 18.7.%, tap 34.9%,. Overall, majority of households (60.2%) used cold water for washing milk handling equipment, while the others (39.8) used warm water. The proportion of households using common towel was 71% and the other 29% used by their hands to dry udder before and after milking. About 81.3% of respondents in current study area smoke the "Weyra zaf" (OleaAfricana) to smoke milk handling equipments and other 18.3% not smoking practices Weyra zaf .Most interviewed household heads in the peri urban areas (15.7%) and rural areas (32.7%), over all mean (24.2%) practiced washing of milking utensils before milking and other over all mean practice before and after (75.2%). Overall 37.2% of the households used clay pot and metal utensils to keep milk and milk products, while 32.9% used glasses especially in urban areas. The majority of household heads (rural) and (peri urban) used for bedding materials, (58.3%) grass covered while others (41.7%) used iron sheet. The overall result indicated that, milk production for household consumption purpose accounts about 28%, whereas for market accounts about 12% and for both consumption and sale purpose accounts about 60%. The microbial quality of raw milk samples show that an average total bacteria of 5.8 and 6.2log10 cfu/ml samples taken from peri urban and rural household heads, respectively. This high level of contamination of milk might be due to initial contamination of milk originating from the udder surface, source of cleaning water, milkier hygienic condition and milking utensils. The mean CC from raw milk samples collected from peri urban and rural raw milk producer households were 5.6 and 5.9 log10 cfu/ml respectively with over all mean value of 5.8 log10 cfu/ml. The overall mean value of yeast mold in the study area5.7log$_{10}$ cfu/ml and staphylococcus count 5.3*log$_{10}$ cfu/ml *and5.4log$_{10}$ cfu/ml respectively from peri urban and rural Kebeles. In conclusion, the milk production potential and quality of milk in the study area needs the attention of the extension, research and other forms of support for improvement.*

Keywords: Milk production, Milk handling practices, Microbial quality

1. INTRODUCTION

1.1. Background

Milk is the most popular food for human consumption and contains numerous nutrients such as water, fat, protein, lactose, minerals and vitamins (Walstra *et al*., 2006). It is the major source of regular income for smallholder milk producers because it is produced and sold daily (Dugdill *et al*, 2013*)*. Besides its benefit, it serves as an excellent growth medium for a wide range of microorganisms (Walstra *et al*., 2006). Bacterial contamination of raw milk can be originated from three main sources; within the udder, exterior to the udder and from the surface of milking materials, milk handling and storage equipments. Similarly, the surrounding air, feed, soil, feces and grass are also possible sources of contamination (Parek and Sub hash, 2008; Torkar and Teger, 2008). If hygienic handling of milk is not secured, milk could turn to unsafe for direct consumption or unfit for further processing to more stable products (O'Connor, 1994).

Quality milk implies the milk which is free from pathogenic bacteria and harmful toxic substances, free from sediment and extraneous substances, of good flavor, with normal composition, adequate in keeping quality and low in bacterial counts (Khan *et al.*, 2008). Consumers need clean, wholesome and nutritious food that is produced and processed in a sound sanitary manner and free from pathogens. Hence, quality milk production is necessary for fulfilling consumers' demand (Khan *et al.*, 2008). To sell raw milk directly to consumers or to a processing factory, it must be handled hygienically and remains fresh and capable of being heated without curdling. Hygienic milk handling includes; using clean equipment, maintaining a clean milking environment, observing good personal hygiene and preserving the quality of milk during storage and transportation to the consumer or processing plant (Kurwijilla, 2006). Milk quality should not be ignored at all stages of the dairy value chain from farm to table. As the bacterial quality of raw milk is important to product shelf-life, flavor and product yield, it is important that dairy enterprises should strive to obtain the highest quality raw material possible from their own farm as well as their suppliers. It is therefore essential to produce best quality raw milk in the dairy farm in order to manufacture milk products of acceptable quality (Zelalem, 2012).

In Ethiopia milk produced at smallholder farm is marketed without quality control measures. Hygienic control of milk and milk products 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). Although, properly operational formal marketing and grading system targeted towards relating quality

of products to market price is not well established, provision of milk and milk products of good hygienic quality is desirable from consumer's health point of view (Zelalem, 2012).

On the other hand, the chemical composition, particularly milk fat content is used as quality test (Zelalem, 2010). The nutritional as well as the economic value of milk is directly associated with its solids content. The higher the solids content better its nutritional value and more of a milk product can be made (Pandy and Voskull, 2011). Protein content being one of main quality determining criteria applied to milk payment to producers in many countries where others are priced according to fat and solids-non-fat composition (FAO, 2004).

1.2 Statement of Problems

Post-harvest loss of milk and milk product in Ethiopia is estimated to be in the range of 20-35 percent of the total milk produced (FAO, 2001). Most losses are associated with poor handling, contamination, the level of technology applied in the conservation of milk to extend its shelf life and lack of market. Losses occur along the whole milk chain and are most serious at farm level, with smallholder farm families incurring the highest losses. Where potential sources of contamination occur at farm level, care in milk handling during milking and subsequent storage is the first and most important step in clean milk production.

The safety of dairy products with respect to food-borne diseases is a great concern around the world. This is especially true in developing countries where production of milk and various dairy products take place under rather unsanitary conditions and poor production practices, which is not safe from consumer health point of view, as it may lead to the transmission of various diseases (Zelalem, 2003; Zelalem and Faye, 2006); moreover, an increasing number of people consuming raw unpasteurized milk (Oliver, 2011). This is one reason why milk and its derivatives testing and quality control include hygiene as well as microbial qualities in addition to testing for fat content and heat stability (Zelalem, 2003).Microorganisms may contaminate milk at various stages of milk procurement, processing and distribution. It is hypothesized that differences in feeding and housing strategies of cows may influence the microbial quality of milk (Coorevits*et al*., 2008). However, inadequate dairy infrastructure coupled with limited knowledge on the hygienic handling applied call for systemic study to assess microbial quality and traditional handling milk and milk products in selected Woreda. Therefore, this study will be undertaken with the following objectives:

1.3. OBJECTIVES

1.3.1. General objectives

The general objective of this study was assessment of production, handling practices and microbial quality of milk produced in Aleta Chuko district, Sidama Region.

1.3.2. Specific objectives

- To assess production, handling practices and constraints of milk in the study area
- To assess microbial quality of milk in the study areas.

2. LITERATURE REVIEW

2.1. Milk Production in Ethiopia

Ethiopia possesses the largest livestock population in Africa. Recent estimates indicated that the country have about 57.83 million heads of cattle, 22.6 million goats, 28.89 million sheep and 1.23 million camels, poultry 60.51 million, (CSA, 2016) Milk production system can be categorized based on agro-ecology, socio-economic structures of the population and type of breed and species used for milk production can be classified into two major systems, namely rural dairy system (pastoralists, agro-pastoralists, and mixed crop–livestock producers) and urban and peri-urban dairy systems (Getachew and Gashaw, 2001). Milk production depends on mainly indigenous livestock genetic resources dominated by small holder farmers specifically on cattle, goats and camels. The indigenous breeds accounted for 99.19 percent, while the hybrids and pure exotic breeds were represented by 0.72 and 0.09 percent, respectively (Zelalem *et al.,* 2011).

Milking cows in the traditional sector have an average lactation length of 190 days and an average milk yield 1.9 liters per day excluding the calf has suckled (MOA, 2005). The total annual national milk production in Ethiopia received from 9.6 million dairy cows and the product is estimated to be 2.9 billion liters which is, 1.69 liters yield per cow per day on average (FAO, 2010).

2.2. Traditional Milk Handling and Processing Practices in Ethiopia

The area where predominantly milk and butter is produced from local cows is therefore, classified as the butter-fat system while the area that produce milk from the cross breed animals for commercial milk supply is classified as liquid milk system. Cows are the main source of milk, and it is cows' milk that is the focus of processing in Ethiopia (Layne *et al.*, 1990). Cows are highly valued for their milk which is soured and converted to butter fat and partially fat extract sour milk which is essential part of the Sidama diet ' Kocho' made from Enset (the false banana) (Mesfin, 2015). The milk in these rural areas comes from local/indigenous zebu cows which are kept in traditional management (LIVES, 2012).

Dairy processing in Ethiopia is generally based on *ergo* (fermented milk in Ethiopia), without any defined starter culture, with natural starter culture. Basically limited to smallholder level and hygienic qualities of products are generally poor; about 52% of smallholder producers and 58% of large-scale producers used common towel to clean the udder or they did not at

all. Raw milk is either kept at ambient temperature or kept in a warm place to ferment prior to processing (Mogesie, 2002).

2.2.1. Milk processing tradition (practice) in Ethiopia

In rural areas, milk may be processed fresh or sour. The choice depends on available equipment, product demand and on the quantities of milk available for processing. In Africa, smallholder milk-processing systems use mostly sour milk. Allowing milk to ferment before processing has a number of advantages and processing sour milk will continue to be important in this sector (Yien, 2014). Where greater volumes of milk can be assembled, processing fresh milk gives more product options, allows greater throughput of milk and, in some instances, greater recovery of milk solids in products. Equipment not available locally, such as a milk separator, has a cost advantage and quickly gives a good financial return in terms of increased efficiency. Hand-operated milk separators are durable and have a long life when properly maintained. Importing of such equipment is, therefore, advantageous (Yien, 2014).

According to Belete (2006), milking frequency in Fogera district under smallholder system is twice per day (in the morning and evening). After milking, the milk is transferred into a smoked clay-pot and kept closed at room temperature. Milk from the evening milk is added to the morning milk and kept until the next morning. The quality of curd formed was visually evaluated and readiness of the curd for churning was determined by the woman household. The churning operation started after stirring the content and transferring to another smoked clay pot. The clay pot is agitated until butter grains are formed. The developed gas is released every 2-3 minutes by opening the top of the churn during the first 10-15 minutes of the churning operation. The churning operation, a back and forth movement, is manually performed in a traditional way (Tsadkan, 2012).

2.3. Sources of Microbial Contamination of Milk

The common predisposing factors of milk contamination by microorganisms are milking environment, cows, milking personnel, milking equipments, and water (Mbabazi, 2005).Sources of bacterial contaminations of raw milk can be divided into three general categories: environment, udder and milking equipment. Inadequate cooling of the milk, improper udder preparation methods, unclean milking equipment and the water used for cleaning purposes are considered as the main source of milk contamination (De Graaf *et al*., 1997).The conditions necessary for bacterial multiplication are moisture, suitable

temperature, air and nutrient. Milk which supplies all these essentials to bacterial existence is one of the most favourable media for the growth of microorganisms (Garry, 2003). Although the air of the milking environment rarely contributes a significant number of the total microbial count of milk, extremely dusty conditions may increase the counts.

2.3.1. Milking environment

Maintaining the sanitary condition of the milking area is important for the production of good quality milk (Zelalem, 2010). Dirty milking places tend to breed flies, which may fall in milk causing contamination and thus spoilage may occur (Mbabazi, 2005).When a cow urinates or defecates in the course of milking some of its urine or dung particles may drop into the milk (Mbabazi, 2005).

2.3.2.Cowudder

Cleaning the udder of cows before milking is one of the most important hygienic practices required to ensure clean milk production (Zelalem, 2010). This is important since the udder of the milking cows could have direct contact with the ground, urine, dung and feed refusals. Cleaning and removal of soil particles, bedding material and manure from the udder and flanks is necessary to prevent the entry of many types of bacteria into the milk (O'Connor, 1995). Udder washing with clean water and drying using hand towels reduces milk contamination by transient bacteria located on the udder (Robert, 1996). Special care must be given to the cloths used for cleaning the udder. The re-use of cloths for cleaning and sanitizing may result in re-contamination of the udder. It is therefore recommended that separate cloths be used for cleaning and sanitizing and, if possible, each cloth should be used for one cow only) (O'Connor, 1995. Not washing the udder before milking can impart possible contaminants into the milk. A maximum reduction of teat contamination of 90 % can be achieved with good udder preparation before milking.

This depends on the initial level of contamination and the way of udder preparation. So with high initial contamination levels this90% reduction might not be reached (Murphy, 1996).

2.3.3. Milker

Milk handling personnel (milker) may contribute various organisms including pathogens especially when they are careless, uninformed, or willfully negligent, directly to milk (Ashenafi, 1994). Organisms may drop from hands, clothing, nose, and mouth and from sneezing and coughing. It is important for milk men to be in good health so that they can be a source of infectious diseases such as tuberculosis (Kurwijilla, 1998).

2.3.4. Milking equipments

Poorly cleaned and sanitized milking utensils may be the source of many microorganisms (Banwart, 1989). Milk drops left on the surface of milking equipments act as excellent media for the growth of a variety of bacteria (Bramley and McKinnon, 1990). Milk equipment is not properly cleaned and sanitized after use. Milk residues left on equipment and utensil surfaces provide nutrients to support the growth of many microorganisms, including pathogens (Bryan, 1983). In case cracked milking equipments large number of bacteria enter and grow in thecracks, are difficult to clean (Thomas *et al*., 1966). The bacterial load of milk increases during transportation and if the transportation equipment is not appropriate the bacterial counts increase causing spoilage before milk reaches its destination (Grillet *et al.*, 2007). Milking equipment should be easy to clean. Aluminum and stainless steel equipment are mostlypreferred (Zelalem, 2010).

2.3.5. Water

Water serves as primary sources of microorganism's contamination (Mbabazi, 2005). If Water is obtained from an open water supply care should be taken to prevent drainage that may contain human feces and other contaminants gaining entry into the source (Jay, 1992).

2.4. Control Measures of Microbial Contamination Raw Milk Cooling:

To prevent or retard growth of bacteria in milk and to maintain its quality for domestic consumption or during transport to the processing plant, it is essential to cool the fresh milk as quickly as possible (O'Connor, 1995). Prompt cooling or chilling of milk at a temperature of 5°C or below is necessary to minimize microbial growth and prevent milk quality deterioration during handling, storing and transporting before the raw milk being processed. In order to facilitate bulking of raw milk supply and transport the incoming milk, refrigeration facilities are provided at points of collection and transport means to maintain the temperature as much as possible (Getachew *al.,* 2008). In the tropical countries of Africa with high ambient temperatures, lack of refrigeration facilities at the farm and household level imply that raw milk will acidify very fast (Godefay and Molla, 2000). Therefore the collection systems must be designed to move the milk to the cooling and/or processing center in shortest possible time. In addition every effort should be made to use available systems such as water cooling, air circulation or shaded areas to reduce milk temperature (Dello Castillo, 1990).

Boiling: It is the easiest and most practicable method of making milk safe in every home. As soon as raw milk is produced or delivered, it should be boiled. Boiling involves raising the

temperature to the boiling point and maintaining at this temperature for a few minutes. Then the milk should be cooled immediately. The temperature should be maintained below 10ºc. Since this may be impracticable at home, preferably the milk must be consumed as soon as possible after cooling and not an extended period of time after it has been boiled and cooled (Gebra-Emanuel,1997,Linton,1982).

Pasteurization: it is the main safeguard against pathogenic organisms in milk. The combination of pasteurization, care in production and processing, and improved storage has resulted in relatively safe milk supply. Milk borne diseases like tuberculosis, diphtheria, and scarlet fever have been practically eradicated. Also, the shelf-life of milk has been increased from a few days to a few weeks (Vasavaoa and Smith, 1987).

2.5. Microbial Tests of Raw Milk

2.5.1. Standard plate count:

The standard plate count is generally accepted as the most accurate and informative method of testing bacteriological quality of milk (Kurwijilla *et al.,* 1992; Godefay and Molla, 2000). The total plate count of microbes in milk provides useful general information on the microbiological quality of milk. Total or aerobic plate count shows only the mesophillic aerobic organisms as incubation is done under normal atmospheric conditions at 35°C for 48 hours (Jay, 1992). The number of bacteria in aseptically drawn milk varies from animal to animal and even from different breasts of the same animal. On average, aseptically drawn milk from healthy udders contains between 500 and 1000 bacteria ml/l. High initial counts (more than 10^5bacteria ml/1) are evidence of poor production hygiene (O'Connor,1994).

2.5.2. Coli form bacteria

Coli forms are aerobic or facultative anaerobic, Gram-negative, nonspore forming rods that ferment lactose to produce gas when incubated on agar for 48 hours at 35°C (FAO, 1986). Coli forms are important mastitis pathogens (Hogan and Smith, 2003) and are widely distributed in the farm environment (Hogan *et al*., 1989; McKinnon *et al.*, 1990; Sanderson *et al*., 2005). Coli form count (CC) is a non-regulated test that has been used historically to assess milk production practices such as milk refrigeration, milking machine sanitation, and pre milking udder hygiene (Guterbock and Blackmer, 1984; Davidson *et al*., 2004). Coli form organisms contaminate raw milk from unclean milker’s hands, improperly cleaned and unsanitized or faulty sterilization of raw milk utensils especially churns, milking machines,

improper preparation of the cow's flecks or dirt, manure, hair dropping in to milk during milking, udder washed with unclean water, dirty towels and udder not dried before milking(Ombui *et al*., 1995). The presence of coli form organisms in milk indicates unsanitary conditions of production, processing or 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). Coli form count provides an indication of unsanitary production practices and/or mastitis infection. A count less than 100 Colony Forming Units (CFU)/ml are considered acceptable for milk intended to be pasteurized before consumption. Counts of 10 CFU/ml or less are achievable and desirable if raw milk will be consumed directly (Ruegg, 2003).

2.5.3. Staphylococcus count

It is contagious pathogenic infection of udder leads cause of food borne diseases of human being throughout the world. The milk and milk products can contaminate by Staph. Count due to absence of mastitis control methods, inappropriate milking procedure and use poor hygienic condition practice in the farm (Nickerson, 2014 and Dufour et al., 2011). Use of good hygienic condition of milk production, use mastitis control and adequate pasteurized the milk can prevent the contamination of Staph. Count. The Staph. Count has been cause of mastitis in dairy animal lead to food borne intoxication in milk and milk products.

2.5.4. Yeast and mold count

Yeasts and molds are obligate aerobes (require free oxygen for growth) their acid/alkaline requirement for growth is quite broad, ranging from PH_2 to PH_9. Their temperature range (10-35^{o}c) is also broad, with a few species capable of growth below or above this range. Moisture requirements of molds are relatively low; most species can grow a water activity (^{a}w) of 0.85 or less, although yeasts generally require a higher water activity (Tournas *et al*, 2001:259-263).Contamination of milk and milk products by yeasts and molds can result in substantial economic losses to producers, processors and consumer, may also be hazards to human or animal health because their ability to produce toxic metabolites known as mycotoxins.

2.6. Microbial Properties of Raw Whole Milk in Ethiopia.

Earlier researches conducted in different parts of the country revealed that the microbial counts of milk and milk products produced and marketed are generally much higher than the acceptable limits (Zelalem, 2010). These were evidenced by milk collected form smallholder producers in Southern Ethiopia the total bacterial count (TBC) reported by Abebe *et al*. (2012) 9.82 log cfu/ml in Gurage zone, Asaminew and Eyassu, 2010) 7.58 log cfu/ml in

Bahir Dar Zuria and Mecha districts,; and Solomon *et al.* 2013) 7.07 log cfu/ml in Debre Zeit town, Ethiopia.

Other research findings also 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 logcfu/ml (Godefaye and Molla, 2000; Haile *et al*., 2012). 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 4.69 log cfu/ml (O' Connor, 1994). However, raw milk samples from different part of the country TBC counts greater than the counts which is given by international standard set for minimum acceptable level of bacterial count (10^5cfu/ml) 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).Coli form 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 (Omore *et al.*, 2001).Previous workers reported similar values of coli form 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). Even if, it is not practical to produce milk that is always free of coli forms. Their presence in raw milk may therefore be tolerated. However, if present in large numbers, say over 100 coli form 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).Other research findings also reported similar values of aerobic

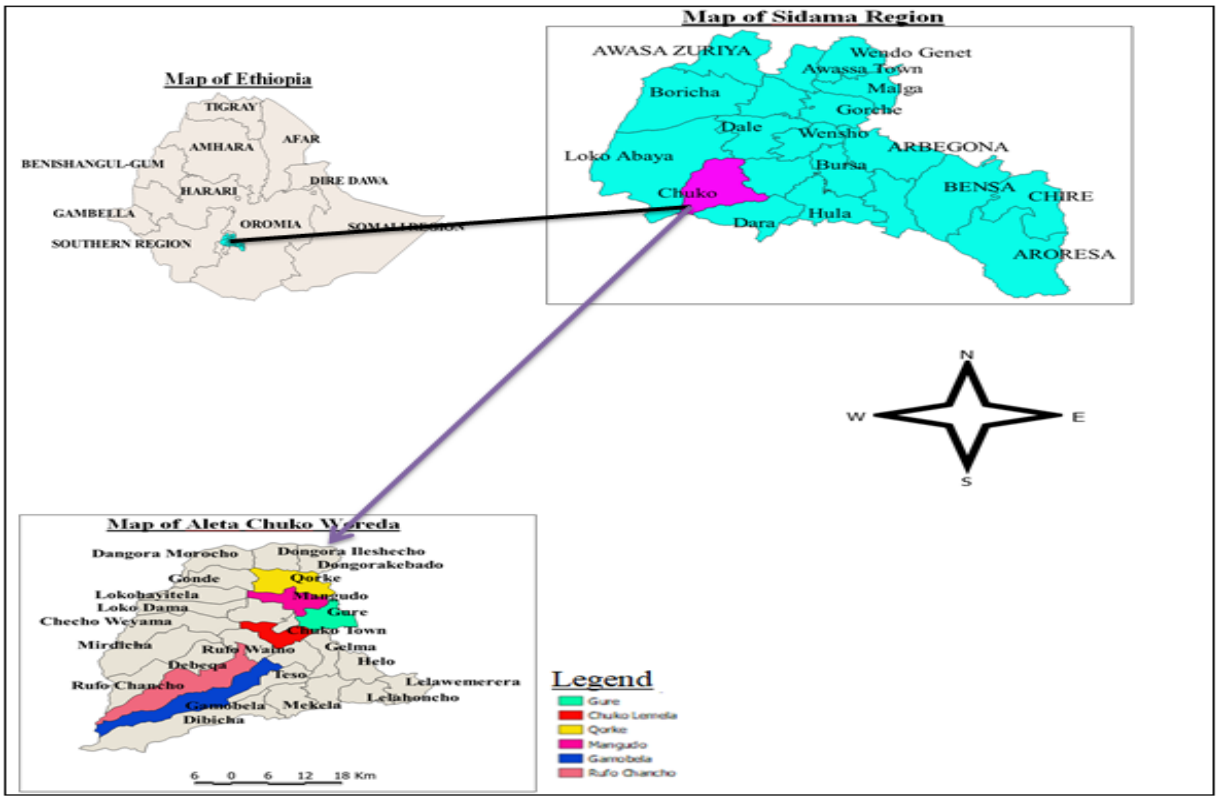
mesophilic counts milk sampled from udder, milking bucket, collection center, milk vending shops and cafeteria is range between 7.28 and 10.28 logcfu/ml (Godefaye and Molla, 2000; Haile *et al*., 2012). In all cases increasing trend of counts as the milk passed through udder, milking bucket, collection 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 4.69 log cfu/ml(O'Connor,1994).However, raw milk samples from different part of the country TBC counts greater than the counts which is given by international standard set for minimum acceptable level of bacterial count (10^5cfu/ml) 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.10As 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). Coli form 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 (Omor *et al*., 2001). Previous workers reported similar values of coli form 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). Even if, it is not practical to produce milk that is always free of coli forms. Their presence in raw milk may therefore be tolerated. However, if present in large numbers, say over 100 coli form 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).

3. MATERIAL AND METHODS

3.1. Description of the Study Area

The study was conducted in Aleta Chuko district which was purposively selected based on dairy potential. Aleta Chuko is located in Sidama Regional State, 330 KM south of Addis Ababa and 62 KM south of Hawassa, the capital of Sidama Regional State. Its geographical location extends from $6^0$46'N to$7^0$01'N and $38^0$04'E to $38^0$24'E.Administratively the district is divided into 26 rural Kebele and 5 urban Kebeles. According to CSA annual sample survey report 2016/2017, the total population of Aleta Chuko District is 209,886, of which 102,215(48.7%) is male and 107,671(51.3%) female. The District has an estimated land area of 332.2 square kilo meters. Altitude varies between 1400 and 2300m above sea level and annual average rain fall 1100-1400m and 10c^o-26c^o mean annual temperature characterized by midland and lowland agro-ecological zones (CSA, 2019/20).

Livestock are reared by many people living in the rural and peri urban areas in extensive or semi- intensive production system. The estimated numbers of livestock reared in the area are cattle (87771), sheep (11246), goat (18760), and poultry (68276), horse (272), and mule (892) (ACWLFO 2019).



Source: CSA developed from Arc GIS soft ware (2015)

Figure 1: Administrative Map of Aleta Chuko District

3.2. Sampling Techniques and Sample Size

The study followed a multi-stage sampling procedure where combinations of purposive and random sampling technique was employed for selecting the study area and sampled according to potentials of crossbreed and local cattle in the District .In the first stage, Chuko District was selected purposively due to high milk production potential. In the second stage, four rural Kebeles (Gure, Rufo-waeno, Korke and Gambela) and two peri urban Kebele (Mangudo and Chuko-lamala) were selected out of 31Kebeles in the District purposively based on the potentials of crossbreed and local cattle together with the District dairy expert. Then, 152 households were selected from four rural Kebeles and two peri urban Kebele using proportional sampling method. Systematic sampling method was used to select respondents from each selected Kebele proportionally. In this case, the lists of the households were collected first from households having at least two and more than two dairy cattle's based on their experience in dairy farming and also their active involvement on dairy cattle production. An element of randomness was usually introduced in systematic sampling method by using set of random numbers to pick up the unit with which to start. This sampling procedure was useful when sampling frame was available in the form of a list. In such design the selection process start by picked some random point in the list and then every n^{th}element was selected until the desired number is secured.

This study followed a simplified formula provided by Yamane (1967) to determine the required sample size at 93% confidence level and level of precision (0.07%).

Yamane Formula

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{600}{1+600((0.07)2} = \frac{600}{1+600(0.0049)} \quad \frac{600}{1+2.94} = \frac{600}{3.94} = 152$$

Where n is the sample size, N is the population size (total household), and e is the level of precision. The respective numbers of households were allocated for each sampled Kebele based on probability proportional to size (PPS) of each selected Kebeles from rural area

Table 1: Sample Size of Rural Households per each Selected Kebeles

Name of Sample Kebeles		Target households	Sample size of households
Rural	GURE	154	$\frac{154}{600} \times 152 = 39$
	KORKE	82	$\frac{82}{600} \times 152 = 21$
	RUFO/CHANCO	70	$\frac{70}{600} \times 152 = 18$
	GAMBELA	90	$\frac{90}{600} * 152 = 23$
Peri urban	MANGUDO	108	$\frac{108}{600} \times 152 = 27$
	CHUKO/LAMALA	96	$\frac{96}{600} \times 152 = 24$
Total		600	152

Source, pps-probability proportionality to size

3.3. Data Collection

This study used primary and secondary data sources. Primary data was collected through household survey, focus group discussions, and key informant interviews. The household survey employs semi-structured questionnaires, while the group discussions and key-informant interviews used guiding open ended questions. Selected informant interviews of both households were used to assess row cow milk production practices, milk handling practice and constraints.Secondary data was collected from secondary sources that include both published and un-published documents.

3.3.1. Household survey

Semi-structured questionnaire were developed to assess the farmer's perception on milk production and handling practice. The household head surveys were conducted on 152household. In order to gain respondents trust, the objectives of the survey and benefits of the study was carefully informed to the respondents.

3.3.2. Focus group discussions

Farmers representing different age groups, with different education level both male and female farmers and different wealth groups were selected from each Kebele A total five FGDs (one per Kebele) each having ten individuals were conducted. The outcome of the FGD also enabled to refine the questionnaire to be used for household survey.The discussion was conducted to generate information about dairy milk production practices, milk handling; constraints of dairy development in the area. This helped to crosscheck the data obtained through household survey.

3.3.4. Key informant interviews (KII)

The key informant's interviews were conducted with people who have sufficient knowledge about the area and be able to memorize well its historical dairy milk production practice, milk handling practice, and milk quality constraints in the area. Members of key informants were Aleta Chuko Woreda livestock and fisher office employees and dairy model farmers.

3.3.5 Milk Sampling

Among the households involved in the interview, the house hold heads were further stratified to rural and peri urban based on the number of crossbred and local cows they possess .Accordingly, dairy herd owning 2 and above cows were considered. The total number of milk sample was monitored 42 (28 sample from rural Kebeles and 14 sample from per urban Kebeles), seven (7) milk sample from each Kebele. Morning milk samples were collected immediately after milking from each Kebele. From each household, 100ml milk samples was aseptically drawn from udder in sterile milk bottles, kept in ice box and transportedtoHawassa University Agricultural College Dairy Science and Technology Laboratory and kept in refrigerator until the time of analysis (Richardson, 1985).

3.3.6. Milk microbial analysis

Coli form count (CC): One ml of milk sample was added into sterile test tube having 9 ml peptone water. After mixing, the sample was serially diluted up to 1: 10^{-5} and duplicate samples (1ml) were pour plated using 15-20 ml Violet Red Bile Agar solution (VRBA). After thoroughly mixing, the plated sample was allowed to solidify and then incubated at 30ºC for 24 hours. Finally, colony counts are made using colony counter (Marth 1978). Typical dark red colonies were considered as coli form colonies.

Total bacteria count (TBC) was examined. For TBC plate count agar was used. One ml of the sample milk was diluted in 9 ml of peptone water up to five dilutions. Then one ml of

diluted milk samples were dropped on dish and 15ml standard plate count agar was added which have been autoclaved at 121º C for 15 minutes. The sample and the agar are gently mixed by clock and anti-clockwise rotations. The mixtures were allowed to stand for 10 minute until solidified. Then the plates were inverted and incubated at 37°C for 48hrs.

The number of colonies (colony forming units) per milliliter of raw milk was calculated using the following formula (APHA, 1992):

$$N = \frac{\sum c}{((n1 + 0.1n2xd))}$$

Where, N= number of colonies per milliliter of milk

$\sum c$ =Sum of all colonies on plate counted

n1= number of plate on lower dilution counted

n2=number of plate in the next higher dilution counted

d=dilution of from which the first counts was obtained

Staphylococcus. Count -For enumeration of Staph. Count 25ml of milk sample was mixed in 225ml flask on normal saline. From Homogenate and shake was transferred 1ml into test tube contains 9 ml of normal saline. 0.1ml sample was spread using spread plate technique on Baird Parker Agar with sterile bent glass rod and incubated at 37^0C for 24 hours. The black colonies surround by clear halo was considered as Staph. Count

Yeast and mould count

Samples of milk were serially diluted following similar methods as for total bacterial count but dilutions were surface plated on Potato Dextrose Agar (PDA) (High media). The dried plates were then incubated at 25^0C for 3 to 5 days. The plates that contain 10-150 colonies were counted. Colonies with a blue green and white colour were counted as yeasts and moulds (Ahmed, 2003:56).

3.7. Data Analysis

A descriptive statistical procedure (mean, standard errors, percentage) was used to summarize both the quantitative and qualitative variables collected during the individual interview and group discussions. Moreover, ANOVA test procedure was employed to compare the two locations with respect to various quantitative variables such as socio-economic characteristics of households (marital status, religion and education level), productivity (milk yield) as well as milk utilization and milk production practice related quantitative variables.

Data analysis was conducted using Statistical Package for Social Studies (SPSS Version 20). Student's t-test was used if the ANOVA signifies the presence of variation among the population for the study variables to separate mean variation at P-value of 0.05. The relationship of the studied variables was determined.

The ANOVA model statement for the test was.

$$Yij = \mu + Ai + eij$$

Where, Yij= the values of the above mentioned socioeconomic and milk utilization variables in the data corresponding to each house-holds.

- μ= the overall mean
- Ai = milk production and husbandry practice
- Eij= error

4. RESULTS AND DISCUSSION

4.1. Socio-Demographic Characteristics of Dairy Cattle Producing Households

Demographic information of the interviewed households is presented in Table 2. Out of the total interviewed dairy cattle producers (N=152), the overall mean male and female headed households were 85.2% and 14.8%, respectively. With regards to age and cattle rising, most of respondents' age lies between 20-65 years old 82.7% and greater than 65 cover 17.3% respectively. According on the religion orthodox covers 9.3%, protestant 68.5%, Muslim 7.4%and catholic 14.8% covers. Regarding the educational status of the household head, the majority 38.9% have attended elementary, 21.6% secondary schools 13.2% have attended 10+3 diploma certified in current curriculums and the rest only 4.4% degree. Education plays an important role in the adoption of new dairy technologies. Further, education is believed to improve the readiness of the household to accept new ideas and innovations marital states of households in area married 73.4%, widow 13.3%, divorces 6.9% and single 6.4% respectively covered.The current result was lessthanSintayehu*et.al.* (2008)who reported by indicating an overall proportion of illiterate farmers of 19% while about 81% were literate beyond elementary schools in Shashemene-Dilla area. Education plays an important role with regards to improving quality of life and improved agriculture where income generation and consumption of could be improved.

Table 2**: Socio- Demographic Characteristics of Dairy Cattle Producing Households**

Variable		RHH(N=(101) (%)	PUHH(N=51) (%)	Over all (%)
Gender (%)	Male	80.2	90.2	85.2
	Female	19.8	9.8	14.8
	Total	100	100	100
Age (years) (%)	20-65	77.2	88.2	82.7
	>65	22.8	11.8	17.3
	Total	100	100	100
Educational status (%)	Illiterate	39.6	5.9	22.8
	Elementary	38.61	39.2	38.9
	Secondary	9.9	33.3	21.6
	Diploma	10.9	15.7	13.2
	Degree	0.99	5.9	4.4
	Total	100	100	100
Marital status (%)	Single	6.93	5.9	6.4
	Married	70.3	76.5	73.4
	Divorce	7.92	5.9	6.9
	Widowed	14.85	11.7	13.3
	Total	100	100	100
Religion	Orthodox	1	17.6	9.3
	Protestant	82.2	54.9	68.5
	Muslim	4.9	9.9	7.4
	Catholic	11.9	17.6	14.8
	Total	100	100	100

N=number of respondents, RRP=Rural Raw milk producer, PURP= Per-Urban Row milk produce

4.2. Major Agricultural Activity in the Study Area

The major farming activity in the study area averagely only crop production records 2.5%, only livestock production records, 40.2% for both crop production and livestock production records 57.3% in rural and per urban house hold .According farming activity the chi square (84.608, $t<0.05$) result shows that there was statistical significant different between rural and per-urban households in terms of farming activity this is significantly differences ($t<0.05$) between two system. Cattle is important component of the mixed-farming system to in the study area since they provide, milk, income, saving and fertilizer the farmers. Cows were the only source of milk in Aleta Chukko district. The main purpose of milk production is presented in the Table 3. The primary purpose of milk production for sell and house consumption 91.1% in rural and for sell and consumption cover 9.9% in per-urban, 51.9%

both sell and house consumption in rural, while 41.2% in per-urban and for house hold consumption only3.9% used in the in the study area. However, comparing the two system for sell and income generate. From the above discussion chi square (34.236, $p<0.05$) result shows that there was statistical significant difference between in rural and per-urban households in terms of purpose of milk production.

Table 3: Major Agricultural Activity and milk production purposes of study area (n=152)

Variables	RHH	PUHH	Over all	Chi-square	P-value
	%	%	%		
Major agricultural activity					
Only Crop production	4.9	-	2.5		
Only livestock production	7.9	72.5	40.2		
Both	87.2	27.5	57.3		
Total	100	100	100	84.608	0.000
Purpose for milk produces					
For sale	3.9	41.2	22.5		
For house consumption	5	3.9	4.5		
Both	91.1	54.9	73		
Total	100	100	100	34.236	0.000

N=number of respondents, RRP=Rural Raw milk producer, PURP= Per-Urban Row milk produce

4.3. Milk yield and lactation length

The overall average amount of milk produced by local breed cows was 1.5 litter /day for 180 days of lactation. The improved cows produced 11 litter /day for 263 days of lactation length (Table 4). Therefore, there was statistical significance differences between rural and per urban households in terms of milk yields of local breed and cross breed per day (p value< 0.05) and also there was significant difference between lactation length per year according to rural and per urban(p value< 0.05) . The current result less than to Getu *e t, al* (2009) who reported crossbred cows 11.9litter/day for 270 days lactation length and in terms of milk yields this result was much lower than milk produced from local cows of 2.5 litter/day for 180 days lactation length in Wolmer district. These results were also lower than the overall

average lactation lengths of local and crossbred cows which were 9.8 and 10.1months, respectively in Burie district (Adebabay, 2009).

Table 4: Milk Yield and Lactation Length of Local and Cross Breed Cows of Study Area (N=152)

		RHH(n=101)	PUHH(n=51)	Overall Mean	t-value	p-value
Variables		Mean±SD	Mean±SD	Mean±SD		
Milk	Local	1.4±0.15	1.5±0.15	1.5±0.15	7.709	0.000
Yield(L/day)	Cross breed	10±1.4	11±1.4	11±1.4	8.941	0.000
Lactation length	Local	150±0.64	180±0.64	165±0.64	5.939	0.000
(days per year)	Cross breed	270±0.78	285±0.78	278±0.78	4.693	0.000

N=number of respondents, RRP=Rural Raw milk producer, PURP= Peri Urban Row milk produce

4.4. Milking Practices

Everyone in the study area practices hand milking (Table5).About 87.1% of the respondents milk their cows by letting their calf to suckle before and after milking, while the rest practices complete milking in order to maximize milk from a lactating cow. The chi-square test value (8.13, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in term of milk practices they used. From the total respondents 91.5% practicing milking the absence of calf or when calve dies which is common in all the six Kebeles while 8.5% respondents milking with calf. The chi-square test value(1.354,$p>0.05$) showed that there was no statistically significant difference between rural and per urban households in term of milk practicing milking without calf .They stimulated the milk let down by inserting air pressure inside the cow via reproductive organs, so that milk would easily come out. Group discussion revealed that farmers milk their cows twice a day during the morning 8-10 AM and 7-8 PM Evening. in study area,milkingis initiated by partial suckling of calves before milking. in agreement with this, most milk producers in Bench Maji Zone, south West Ethiopia let the calf to suckle before milking (Gemechu and Amene,2017). Asrat *etal*.(2013) also reported that about 90% of milk producers practiced partial suckling prior milking calves allowed in and around boditti south Ethiopia.

Table 5: Milking Practice in the Study Area (n=152)

Variables	RHH	PUHH	Over all	Chi square	p-value
	%	%	%		
Type of milking practice				8.13	0.004
milking without suckling	78.2	96	87.1		
suckle before and after	21.8	4	12.9		
Total	100	100	100		
Milking technique used					
With hand	100	100	100		
With machine	0	0	0		
Total	100	100	100		
Do you practices without calves				1.354	0.245
Yes	91.1	92	91.5		
No	8.9	8	8.5		
Total	100	100	100		

N=number of respondents, RRP=Rural Raw milk producer, PURP= Per-Urban Row milk produce

4.5. Types of Housing and Barn Cleaning Frequency

According to the present study 60.1% of the interviewed households shared the same house with their animals while about 39.9% used separate house (Table 6). The chi-square test value (17.498, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in term of separate house for their dairy cattle. The majority of households 58.3% use grass covered and 41.7% iron covered house for the dairy cattle. The chi-square test value (68.272, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in term of types of house used for dairy cattle they used. The majority of rural households 36.1% use natural earth as bedding materials but per-urban used concert, 54.5% while others 9.4%usewooden bedded. The chi-square test value (36.432, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in term of bedding material they used. It is hypothesized that differences in feeding and housing strategies of cows may influence the microbial quality of milk (Coorevits *etal*., 2008). Proper and clean housing environment is a prerequisite to produce clean milk. In many of the households the houses were unclean. This may have a negative impact on the quality and acceptability of milk and milk products produced and processed (Asaminew, 2007). Differences were observed in the barn cleaning

frequencies with 85.5% daily cleaning frequencies while other 14.5% two or more cleaning frequencies in study area higher proportion of the households from study area cleaned their barns every day as compared to the rural milk producer group which could be due to the effect of the extension service. The chi-square test value (4.308, $p>0.05$) showed that there was no statistically significant difference between rural and per urban households in term of house cleaning frequency. It is hypothesized that differences facility in the barn 41.7%availability of water and feed trough in house while 58.3% no water and feed trough availability in the barn at the level of rural and per-urban households. The chi-square test value (77.650, $p<0.05$)) showed that there was statistically significant difference between rural and per urban households in term facility in barn .Therefore, microbial contamination occurred from the unavailability of water trough in the barn and feed trough in the barn.

Table 6: Types of Housing and Barn Cleaning Frequency

Variables		RHH(N=101) (%)	PUHH(N=51) (%)	Over all (%)	X^2	p-value
Separate dairy house					17.498	0.000
	Yes	22.8	56.9	39.9		
	NO	77.	43.1	60.1		
	Total	100	100	100		
Type of floor					36.432	0.000
	Wooden bedded	14.9	3.9	9.4		
	Natural earth	56.4	15.7	36.1		
	Concrete	28.7	80.4	54.5		
	Total	100	100	100		
Barn cleaning Frequency					4.308	0.116
	Daily	79	92	85.5		
	Two or more aweek	21	8	14.5		
	Total	100	100	100		
Facility in Barn					77.650	0.000
	Water and Feed trough	6.9	76.5	41.7		
	No Water and Feed trough	93.1	23.5	58.3		
	Total	100	100	100		
Type of roof					68.272	0.000
	Grass covered	91	25.5	58.3		
	Iron sheet	9	74.5	41.7		
	Total	100	100	100		

N=number of respondents, RRP=Rural Raw milk producer, PURP= Per-Urban Row milk produce

4.5.2. Cows and milker Hygienic condition

The milker can be an important source of milk contamination. Therefore, keeping good personal hygiene and health of milkers during milking operation (Zelalem, 2010). Most of the interviewed dairy producers (88.7%) washed their hands before milking while the rest 11.3% did not wash their hands (Table7). Milk producers in the study areas did not cover their hair and dressed gown during milking. Cleaning of the udder of cows before milking is one of the most important hygienic practices required to ensure clean milk production. The chi-square test value (0.462, $p>0.05$) showed

that there was no statistically significant difference between rural and per urban households in term of udder washing. This is important since the udder of the milking cows could have direct contact with the ground, urine, dung and feed refusals (Zelalem, 2010). As observed in this study, 75.4% of the dairy producers washed their cow's udder before milking while24.6% were not washing (Table 7) and simply allowed their calves to suckle before milking. Calf suckles and milking follows without cleaning the teats, Saliva from the calf mouth and unwashed teats increase bacterial counts (Kurwijila, 1989). The chi-square test value (10.297, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in term towel used for udder drying. The current result was lower than Haile *et al.* (2012) who reported that 82.5% of the small size farm owning households in Hawassa city practice pre milking udder washing. Contrary to this result Abebe *et al.* (2012) who reported that all respondents did not wash udder before milking in Gurage Zone, Ezha district. The use of individual towel and following essential cleaning practices during milking is important for the production of quality milk (Zelalem, 2010).However, about 29% of the smallholder households did not use towels for udder drying, 71% used common towel (Table7). Milking in dry condition significantly reduces bacterial count. It is because no surplus water remains in the surface of the udder to drip into the milk and due to less chance of leaching dirt and bacteria from udder, teats and hands into milk (Islam *et al*., 2009) .Wallace (2009) reported that thorough cleaning of the udder followed by drying with a clean cloth was effective in reducing the number of bacteria in milk contributed from soiled teats.

Table 7: Hygienic Condition of Cows and Milker

Variables		RHH(n=101) (%)	PUHH(n=51) (%)	Over all (%)	X^2	p-value
Udder washing	Yes	70.3	80.4	75.35		
	No	29.7	19.6	24.65		
	Total	100	100	100	0.462	0.497
Towel used for udder drying	Common towel	58	84	71		
	Just with hand	42	16	29		
	Total	100	100	100	10.297	0.001

N=number of respondents, RRP=Rural Raw milk producer, PURP= Per-Urban Row milk produce

4.5.3. Milking container and sanitary practices

All of the interviewed milk producer farmers were used plastic made milk containers during transported the milk to collection centers (Table 8).And overall average milking material 54.3% used clay pot 44.7% plastic material milking. The chi-square test value (39.562, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in terms of milk utensil used for milking. Abebe *etal*., (2013) who reported similar result in Ezha district of Gurage Zone where all farmers used plastic jars during transported the milk to collector, Milk containers such as non-food grade plastic cans, buckets and jerry cans are not recommended in the production of clean milk (Kurwijila,2006). Aluminum containers are recommended because they don't have adhesive properties and therefore easy to clean when compared with plastic containers (Karuga, 2009). Milking and milk storage utensils are properly cleaned and maintained. Therefore, cleaning and disinfections of equipment after each milking is important for reduction of milk contamination from the equipment (Murphy, 1996). Producers should pay particular attention for the type as well as cleanliness of milk equipment. In the present study, almost all of the dairy producers 75.8 % and milk collectors washed milking utensils before and after every use while 24.2% washed milk utensil only before every use. The chi-square test value (6.752,

p<0.026) showed that there was statistically significant difference between rural and per urban households in terms of milk equipment cleaning frequencies. About 60.2% of the respondent washed their milk container with coldwater and soap while 39.8% used hot water and soap (Table 7). The chi-square test value (27.045, p<0.05) showed that there was statistically significant difference between rural and per urban households in terms of washing milk equipment with cold water and with hot water. The current finding was less comparable with the finding of Haile *et al.* (2012) who reported about 85.6% of the producers used warm water together with detergents to wash milk handling equipment while 14.4% of them cleaned with cold water.

Table 8: Milking Container and Sanitary Practices

Variables		RHH(N=101) (%)	PUHH(N=51) (%)	Over all (%)	X^2	P value
Milk utensils used for milking	Plastics	18.8	70.6	44.7		
	Clay Pot	79.2	29.4	54.3		
	Stainless steel	2	0			
	Total	100	100	100	39.562	0.000
Cleaning frequency of milk utensils	Before every use	32.7	15.7	24.2		
	After every use	-	-			
	Before and After every use	67.3	84.3	75.8		
	Total	100	100	100	6.752	0.026
Washing of milk Equipments	Cold water and soap	81.2	39.2	60.2		
	Warm water and soap	18.8	60.8	39.8		
	Total	100	100	100	27.045	0.000

N=number of respondents, RRP=Rural Raw milk producer, PURP= Per-Urban Row milk produce

4.3.4. Source of water used for cleaning

For production of quality milk a good supply of clean water is essential. Water used for washing and rinsing milk equipments and containers during milk handling must be the same safety and purity as drinking water (Younan *et al.*, 2007).Smallholder producers in rural and

per-urban used different water sources for cleaning purpose *i.e.* tap water (12.9%, 56.9%), river (63.4%, 29.4%) and pond (23.7%, 13.7%), respectively. The chi-square test value (32.926, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in terms of sources of water for cleaning. Water from non tap sources used for different purposes can definitely contribute to poor quality milk and milk products. Therefore, it is important that producers should at least filter and heat treat it before use (Zelalem, 2010). Jay (1992) also reported high colony counts recorded on farms using wells as a water source. In per-urban better tap water accessibility than rural of study area. The quality of pond waters used for cleaning may not be up to the standard thus contributing to the poor quality of milk in the study area.

Table 9: Source of Water Used for Cleaning

Variables	RHH(N=101) (%)	PUHH(N=51) (%)	Over all (%)	X^2	p-value
Source of water					
Pond water	23.7	13.7	18.7		
Tap water	12.9	56.9	34.9		
River and Stream water	63.4	29.4	46.4		
Total	100	100	100	32.926[a]	0.000

N=number of respondents, RRP=Rural Raw milk producer, PURP= Per-Urban Row milk produce

4.3.5 Feed type and sources for dairy cattle

Nutrition has major effect on milk microbial quality and chemical composition. Manipulating a ration of dairy cows can change milk composition (Grummer, 1991; Castillo et al., 2003). As presented in (Table 10) there was a significance difference ($p<0.05$) among the feed source used, feeding and watering practices by the milk producers in the study area. Several scholars estimated the production costs and profitability of the smallholder dairy in different parts of the world including Ethiopia. Study by Dayanandan (2011) on production efficiency of dairy farm in highland of Ethiopia indicated that the share of variable and fixed cost of smallholder dairy farm was 90% and 10%, respectively. On the other hand, Ergano and Nurfeta (2006) who reported that feed cost alone accounted for 80% of total cost. The feed sources of dairy cattle in the study areas were from own source and market which included concentrate feed, improved forage, enset leaf, crop by-product and green leaf. The Present

study shows that, most of per-urban raw milk producer households and some of rural raw milk producer household practice development of improved forage like, Elephant grass and Rhodes grass for their dairy cattle in (Table10).About61.6% private grazing land at wet season for cattle, 19.3% crop residue and enset leaf at dry season and 10.3% Hay and crop by product, 9.9%of them supplementary feed 8.8% (Table 10). The chi-square test value (45.400, $p<0.05$) showed that there was statistically significant difference between rural and peri urban households in terms of feed source. The current greater with the report in the mixed-crop production system where majority 53.7% of the households use animal feeds from their own crop farm, while 23.7% use a combination of own farm and communal grazing (Sintayehu *et al*.,2008).The types of feeding systems noted from this study were private grazing and stall feeding. This study also indicated that the major sources of feed for livestock in the study area are natural pasture and crop-residues. Natural pasture (grazing) and crop residues are the major feed resources used as a basal diet for dairy production in rural and peri-urban dairy systems (Azage *et al*., 2013). Crop residues, natural pasture and aftermath grazing were the major feed resources for dry season, in their descending order. In general crop residues and natural pasture are the major feed resources of the area which agree with the report of Tolera *et al*., 2012) who indicated that natural pasture and crop residue to be the major feed resources for highlands of Ethiopia. Currently with the rapid increase in human population and increasing demand for food, grazing lands are steadily shrinking due to the conversion of grazing lands to crop lands, and are restricted to the areas that have little value of farming potential. Concentrates are rarely used with the exception of those milk producers who keep crossbred cows. This finding is in line with the report of Asaminew (2007) and Seyoum *et al*., 2007) who indicated that the major basal feed resources for cattle in Bahir Dara and Mecha districts and the highlands of Ethiopia, respectively, are natural pasture, crop residue and stubble grazing.

Table 10: Feed Type and Sources for Dairy Cattle

Variables	RHH(N=101)	PUHH(N=51)	Over all	X^2	p-value
	(%)	(%)	(%)		
Feed Type and Source				45.400	0.000
Private grazing land	84.1	39.2	61.6		
Crop residue and enset leaf	14.9	23.6	19.3		
Hay and Crop byproduct	1	19.6	10.3		
Supplement	-	17.6	8.8		
TOTAL	100	100	100		

N=number of respondents, RRP=Rural Raw milk producer, PURP=Per-Urban Row milk production

4.10. Milk Cooling and Preservation

After milking proper milk cooling method is essential to maintain the quality of milk. All producers in the study area used traditional cooling method putting in guard then process or churn in order to get butter and other milk product. About 66.5%cooling milk before sell while the rest 33.5% do not cool.The current assessment result indicated that dairy producers practice washing of milk handling equipment with plants. The chi-square test value (32.35, $p<0.05$) showed that there was statistically significant difference between rural and per urban households in terms of cooling milk before sell. Smoking of milk and milk handling equipment is a common practice in many parts of Ethiopia and milk vessels are usually smoked using wood splinters of “tid” (*Juniper usprocera)* to bring desirable aroma to the milk. Interviewed respondents mentioned that smoking is used to develop desirable flavor in the milk and increased shelf life of the products. This is comparable with, the report that stated in addition to imparting pleasant flavor, smoking has anti-microbial activity and thus inhibits growth of microorganisms in milk (Mogesie and Fekadu, 1993). About 81.3% of respondents in current study area smoke the Weyra zaf *(olea africanastem)* to smoke milk handling equipment and the other18.7% not used smoking practice in study area in order to increase milk shelf life and in addition to imparting pleasant flavour. The chi-square test

value (7.850, p<0.05) showed that there was statistically significant difference between rural and per urban households in terms of smoking milk vessel The production of milk of acceptable hygienic quality for consumers requires good hygienic practices. One of the major factors affecting the quality of dairy products is related to the practice of proper milking procedures and cleanness of the milking utensils (Almaz *et al.,* 2001). As reported by Mogesie and Fekadu (1993), smoked containers tend to lower the microbial load of milk as compared to unsmoked containers. Almost all (99%) in rural and per-urban households' disinfectant their milk equipment. The chi-square test value (1.994, p>0.05) showed that there was no statistically significant difference between rural and per urban households in terms of using disinfectant for the equipment

Table 11: Milk Cooling and Preservation

Variables		RHH(N=101)	PUHH(N=51)	Over all	X^2	p-value
		(%)	(%)	(%)		
Do you smok milk vessel	Yes	90	72.5	81.3		
	No	10	27.5	18.7		
	Total	100	100	100	7.850	0.005
Do you cool milk before sell	Yes	88	45	66.5		
	No	12	55	33.5		
	Total	100	100		32.345	0.000
Do you use disinfectant	Yes	101	98	99		
	No	-	2	1		
	Total	100	100	100	1.994	0.158

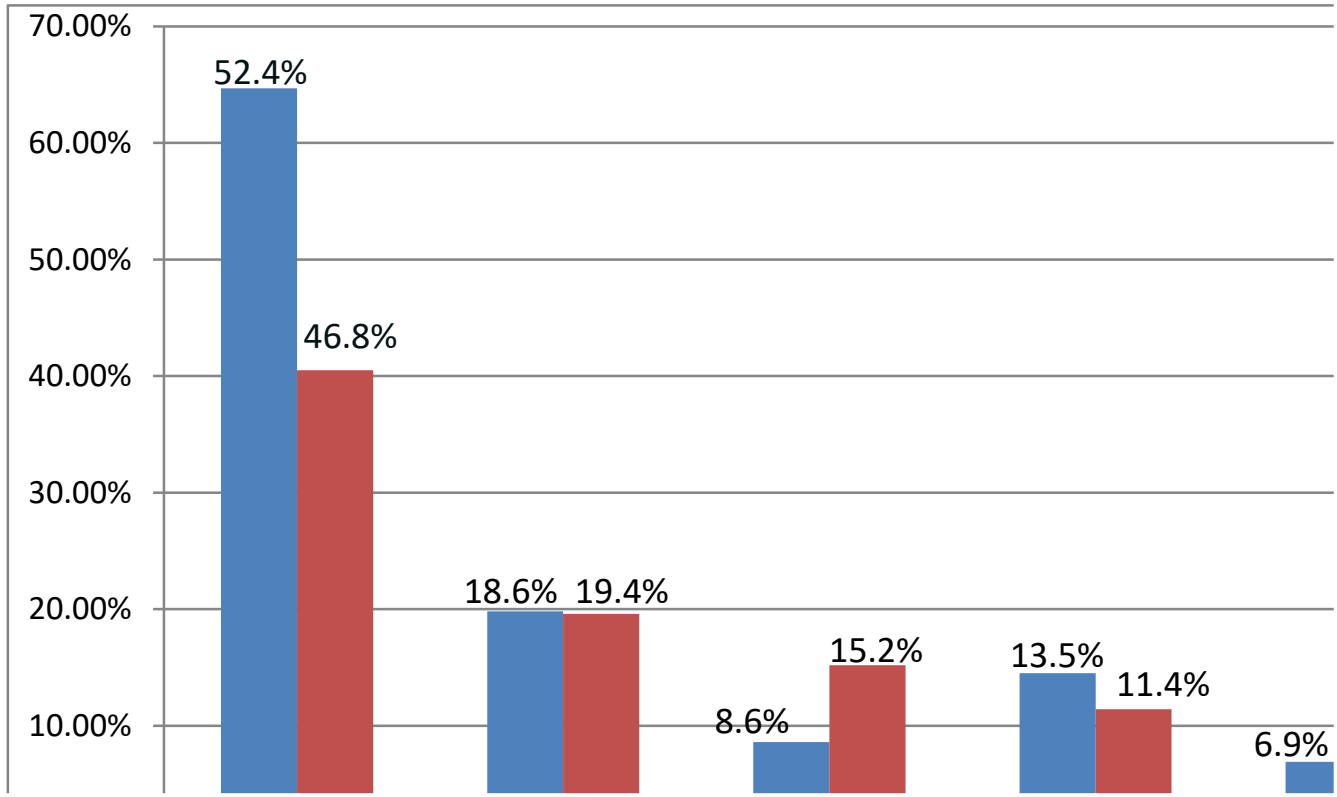
N=number of respondents, RRP=Rural Raw milk producer, PURP=Peri Urban Row milk productions

4.11. Major Constraints of Raw milk Production in the Study Area

Majority of the respondent farmers' ranked feed shortage as the most important problem contributing for low milk yield and low milk productivity of cows in the study areas. Similar finding was reported by Derese (2008) for urban and peri-urban areas of west Shoa Zone. Fayo (2006) also reported feed shortage as the major constraint attributed to low production and productivity of cattle in and around Dire Dawa town. Similarly, Alemayehu (2002) and Kefena (2004) reported that nutrition is the most important constraint to milk production in Ethiopia. The respondents in the study areas also reported lack of grazing lands. According to the respondents there were different challenges faced in dairy production in the study area.

Among the challenges the most dominant debated with dairy producing households in per-urban area were shortage of feed for dairy cows and estimated about 52.4% to 46.8% followed by improved breed (18.6% to 19.4%) from rural and per-urban milk producing households respectively. The other important challenges, 15.2 to 11.4, 13.5to 11.4 and 6.9 to 7.2 from rural and per-urban household were disease, lack of extension services and Lack of market respectively. Of course for the next coming years with expansion of urbanization and population growth at per-urban areas, the problems of feed and farm land area debate of the sector for peri urban areas of Aleta Chuko milk shed in particular and all the urban areas of Ethiopian country in general.

Figure 2: Graph of Major milk production Constraints of the area



4.12. Major Milk Quality Related Constraints

Milk quality related constraints in the study areas prioritized by the respondents during group discussions were limited awareness on hygienic handling of milk, lack of cooling facility, shortage of clean water , lack of effective quality control system and absence of quality based payment system. In each study district constraints were ranked blow.

Table 12 Major Milk Quality Related Constraints

Variables	Ranked	
	RHHS	PUHHS
Limited awareness the hygienic quality of milk	1st	1st
Shortage of clean water	3rd	4th
Lack of cooling facility	2nd	3rd
Lack of effective quality control system	4th	2nd
Absence of quality based payment system	5th	5th

4.4 Microbial Quality of Raw Milk

4.4.1 Microbial Counts of the Raw Milk

Total Bacterial Count: As it is indicated on (Table12) there was a significance variation ($p<0.05$) in total bacterial count among the rural and per-urban Kebeles. The total bacteria were used as an important indicator of microbial quality and safety of milk and milk products. Generally the amount of TBC should not be higher than $5\log_{10}$ cfu/ml in order for the milk to remain in reasonable acceptable quality for consumption (Sintayehu and Haile, 2015). It was also indicated that the total bacteria count in milk of developing country fall between 5.301 to 5.875 $\log_{10}$cfu/ml (Febrhadt and Micholes, 2004). From the result of this study, it was found that the average TBC count was 5.8 $\log_{10}$cfu/ml and 6.2 log10 cfu/ml for both rural and per-urban Kebeles respectively. The result of this study was comparable with the value given for developing country, but lower than of 6.79 $\log_{10}$ cfu/ml and 6.85 $\log_{10}$cfu/ml reported by Sintayehu and Haile (2015) for both raw milk and 'Ergo' in Hawassa city, and it was also lower than that of 6.15 $\log_{10}$ cfu/ml, 6.98 $\log_{10}$cfu/ml reported by Bruktawit, 2016 and Saba, 2015; for Addis Ababa the capital city of Ethiopia and Adea Berga and Ejerie Districts of West Shoa Zone, Ethiopia respectively. The present finding showed that lower total bacterial count relatively from the mentioned studies in our country, but higher than the acceptable value of $1X10^5$ cfu/ml bacteria count per ml of raw milk (USAID, 2015) and American Public Health Association (1992) respectively. The presence of high total bacteria loads in the current study may be due to contamination possible from lactating cow, milking equipment's, storage containers, unsatisfactory hygiene/sanitation practiced at the farm level. Unsuitable storage condition, unclean udder/teats, poor quality of water used for cleanness and dirty hands of milkers.

Coli form Count: As a result of coli form count on the raw milk samples, different counts were recorded among the entire sample with an overall average of 4.91 ± 0.41.There was a significance($t<0.05$) variation shown in the different coli form count were recorded between milk samples collected from rural and per-urban Kebeles. In the present study the average coli form count of milk was found to5.6log^{10}cfu/ml and 5.9log^{10}cfu/ml from raw milk that collected from rural and per-urban Kebeles respectively. This result is higher than that of Saba (2015), Asaminew (2007), Rahel (2008), Derese (2008), Abebe et al., (2012) from Ethiopian who reported a coli form count 4.84 log_{10}cfu/ml milk sample collected from West Shewa zone of Oromia, 4.49 log_{10}cfu/ml I milk sample collected from West Shewa zone of Oromia, 4.84 log_{10}cfu/ml in milk sample collected from Bahir Dar milk- shads sample, 4.18 ± .01 log_{10}cfu/ml for raw milk sample and 4.03 log_{10}cfu/ml in raw whole cow milk in Ezha district of Gurage zone respectively. In other study, Sintayehu and Haile (2015), Bruktawit (2016) and Zelalem and Faye (2006) having higher reported value values 6.14log_{10}cfu/ml for raw milk collected from different Ergo producers in Hawassa city southern, Ethiopia, 6.1 log_{10}cfu/ml for raw milk collected from different dairy farms in Addis Ababa city, Ethiopia and 6.57 log_{10}cfu/ml raw cow milk collected from different producer in central highlands of Ethiopia respectively. However the present result of CC was comparable with the value reported by Saba (2015) and Rahel (2008) who reported a coli form count 4.84 log_{10}cfu/ml for milk sample collected from West Shewa zone of Oromia, 4.84log10cfu/ml in milk sample collected from Bahir Dar, Ethiopia respectively.

The presence of coli form in milk and milk products indicates that the milk has been contaminated with focal materials and it is an indicator of the sanitary conditions in the production and handling of the milk starting from the production site to the consumer table. Apart from safety and public health concerns, high contamination by coli forms results in off flavours in and reduces shelf life of dairy products (Sintayehu and Haile, 2015). Therefore the present result obtained in this study was above the accepted value reported by Ethiopian Meat and Dairy Industry Development Institute (2015).

Staphylococcuscount: Results on Staphylococcuscountof raw milk samples were indicated in (Table12). There was a significance variation ($p<0.05$) in staphylococcusaurous among the different farms from rural and pr-urban house hold heads. Staphylococcus aurous is an important pathogenic bacterium that can be affect quality and safety of milk and milk products. It is naturally present in milk and often associated with milk born disease due to the ability of some strains to produce heat stable toxins. Staphylococcus count is among

pathogenic microbes that cause minor skin infections and life threatening diseases. Dairy cows with mastitis may be the source of enterotoxigenic staphylococcuscount in raw milk, which may subsequently be commingled with other milk while collecting from cows (Sintayehu and Haile, 2015). In the present study the average value of Staphylococcus countwas 5.4±0.123 for raw milk collected from the study area. This result was lower than the value 6.13 log_{10}cfu/ml and 5.55 log_{10}cfu/ml for raw milk and ergo respectively reported by (Sintayehu and Haile, 2015) for milk sample collected from Hawassa city Ergo producers.

Yeast and mould count: There was a significance variation was observed in yeast and mould count among the rural and per-urban. The overall mean of YMC were 5.7log_{10}cfu/ml and 5.6log_{10}cfu/ml for milk samples collected from small holder house hold heads raw milk producers. Average value of yeast and mould counts were 5.7±0.503.This was significantly different ($P<0.05$) among milk samples collected from the study area (Table12). The present value of YMC was much lower than (Haile *et al*., 2012) and (Teshome *et al.,* 2014) who reported higher yeast and mould counts of 7.13log_{10}cfu/ml for milk samples collected from distribution containers in Hawassa, Southern Ethiopia and 4.206 log_{10}cfu/ml for raw milk sample collected from different critical points of milk sources in shashemene town, Ethiopia respectively. Yeast and mould are considered to be spoilage organisms. Some yeast and moulds, however, are public health concerns due to their production of mycotoxins, which are not destroyed during food processing or cooking (Mc Lands brough and Ann, 2005).

Table13: Mean (±SD) Microbial Counts (Log10cfu/Ml) Of Raw Milk Samples

Parameters	Milk source		Over all mean	
	Rural	Peri urban	Mean(±SD)	P-value
Total bacteria count	6.2±0.141	5.8±0.571	6.0±.356	0.000
Total coli form count	5.9± 0.094	5.6± 0.551	5.8±0.322	0.001
Staphylococcus count	5.4± 0.124	5.3±0.123	5.4±0.123	0.004
Yeast and mold count	5.7±0.932	5.6±0.074	5.7±0.503	0.032

CFU= colony forming unit, SD=standard deviation

5. CONCLUSIONS AND RECOMMENDATIONS

5. 1.Conclusions

The overall purpose of this study was to assess production, handling and microbial quality of milk in Aleta Chuko district area per-urban and rural households. This was fact that milk and milk products produced in Aleta Chuko per-urban and rural area was substandard and microbiologically inferior quality products which were higher microbial load counts than the acceptable level for international and national food standards. Per-urban household's milk productions were higher than rural households. The total bacterial count (TBC), coli form count (CC),yeast and mold count(YAM)and staphylococcus aurous value obtained from the per-urban raw milk producer were lower than rural raw milk producer households. This high level of contamination of milk might be due to initial contamination of milk originating from the udder surface, source of cleaning water, milkier hygienic condition and milking utensils. High amount of milk contamination could be associated to milking of cows within the same barn and hygienic practices implemented while milking; this practice might have led to soil, dung and urine contamination of milk and failure to milk quality production at household, This could lead to consumer health problem and loss of income from milk and milk products to households. The unhygienic conditions of milking, unclean milk handling equipment and the use of contaminated cleaning water were among the main sources of milk contamination. The problems of milk handling practices were scarcity of material resources, untargeted training and extension services and lack of access to new technology adoption. Generally, the presence of high numbers of Coli form in milk indicates that the milk has been contaminated with faecal materials, because of unclean udder and teats of cow's, inefficient cleaning of the milking containers, poor hygiene of the milking environment, unclean water sources and cows with subclinical or clinical mastitis can all lead to elevated Coli form count in raw milk.

5.2. Recommendations

The following recommendations were forwarded to improve milk Quality

- Trainings should be given for dairy farmers in milk production, handling and hygienic practices.

- Awareness creations needed for among per-urban and rural house hold for about the hygienic, production and handling of raw milk quality control and safety.

- If water source is not potable, it should be heat treated for washing udder and milking equipments
- efficient milk cooling system is required at producer and milk collectors' level. During milk transportation vehicles used to transport should be equipped with cooling facilities.
- All milk collectors should be regularly control the quality of milk and Quality based payments introduced for improvement of the quality of milk

- The milk production potential and quality of milk in the study area needs the attention of the extension, research and other forms of support for improvement

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7. APPENDICES

Appedix1: Questionnaires

Questioner 1.Household interview Schedule

Dear Participant, first of all, I appreciate your willingness to participate in this study questionnaire. This questionnaire designed with the purpose of investigating milk handling, hygienic practice and milk production practice which is part of my MSc thesis research entitled with **'assessment of milk production practices, Milk Handling Practices and Microbial Quality of Milk Produced In AletaChukko District of Sidama regional states Of Ethiopia'.** I assure you that all the information gathered during this interview is purely for research purpose and any sensitive or confidential maters will be kept closed and will not be transferred to other in a personal base. Thank you for your valuable time.

General Characteristics of household head

1.1. Zone: _____District (Woreda): _____Site/town: _____

1.2. Name of the household head: _____

1.3. Sex of the household head: A. Male B. Female

1.4. Age of the household head: _____

1.5. Educational level of the respondent

0.Illiterate	1.Primary level	2.Secondary	3.diploma level	4. Degree level	5. Above

1.6. Marital status of the household head?

1. Single	2.Married	3.Divorced	4. Widowed	5.Other (specify)

1.7. Religion of the household head

1.Orthodox	2.Protestant	3.Muslim	4. Catholic	5.Other (specify)

1.8. Who participates in the dairy farming activities with regard to the following activities?

		Participant			
No	Activities	a. men	b. Women	c. Children	d. Hired labour
1	Herding				
2	Milking				
3	Processing				
4	Cleaning				
5	Sale of products				
6	Sale of Animals				
7	Feeding of Animal				

1.9. What are your major agricultural activities?

1. Crop-livestock production_____2 .Crop production only _____ 3. Livestock production only _____

1.10. Which part of your agricultural activity contribute to the main source of family

1. Crop production_____2.Livestock production_____ 3.Both crop & livestock_____4.Off-farm activities_____5.Trade_____6. Salary_____

Livestock/Cattle Herd Structure.

2.1. Number of livestock of the HH?

No	Livestock type	Breed type		
		Local	Cross	Exotic
1	Cows			
2	Heifers			
3	Bull			
4	Calf			

2.2. Major purpose of Cattle keeping Prioritize (ranking from 1-5 from primary to last

1. for milk production

2. for meat production

3. for traction

4. for income generation

5. Other (specify)

2.3. Dairy farm barn and hygienic conditions of HH?

Type of barn	Bedding system
1.Building	1.Natural earth
2.Open fenced	2.Concrete
3.closed fenced	3.Grass bedded
4.Other(specify)	4. Other(specify

2.4. What are the facilities in the barn HH?

1. Water trough (WT) 2. Feed trough (FT) 3 .Both water trough and feed trough

4. No facilities

2.5. How frequent do you clean the barn of HH?

1. Every day 2. Once per a week 3. Twice per a week 4.some times

2.6. Is there separated house for your dairy cows from family house? 1. Yes 2.No

2.7. If your response to Q 2.6 is yes, is it ventilated 1. Yes 2. No

Feeds and Feeding

3.1. Feed sources (list according to order of importance) for your dairy Cattle?

Feed type	Wet Season	Dry season
1.Communal grazing		
2.Private grazing		
3.Crop residue (specific) enset leaf		
4.Hay		
5.Improved Forage		
6.Supplementation		

3.2. Do you supplement your lactating animals? 1. Yes 2. No

3.3. If your response to Q 3.2 is yes, indicate the supplement feed & for which animals?

3.4. Do you often encounter feed shortage? If yes, (specify the month)? ----------

3.5. How do you cope up with feed shortage in your locality? ----------

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Dairy production challenges

4.1. What are the common problems happened and affect dairy production in your area.

Constraints	Rank				
	1st	2nd	3rd	4th	5th
Feed					
Improved breed					
Lack of extension services					
Lack of market					
Disease					

Milk production, milk yield and lactation length

5.1. What type of cattle breeds do you have?

1. Exotic 2. Crossbred 3.Local.

5.2. What is average daily milk yield per cow in your farm?

1. Pure exotic: _____L/kg

2. Zebu: _____L/kg

3. Crossbred: _____L/kg

5.3. What is the lactation length for?

1. Pure exotic cows: _____ months

2. Zebu cows: _____ months

Housing and cleaning practices

6.1. Where are the animals housed? 1. within the family house 2. Separate barn

6.2. How frequent do you clean your cow's house/barn?

1. Daily 2. Two times a week 3.Three time's aweek 4. Once a week 5. Do not clean

6.3.. Other comments (indicate) _____

Hygienic practices during milking

7.1. Do you wash your hands before milking? (1) Yes…… (2) No……

7.2. Do you wash your cow's udder before milking? (1) Yes….. (2) No……..

7.3 If your response to Q 7.2 is yes, when do you wash it?

1. Before milking only 2. After milking only 3.Before and after

milking

7.4. If you wash the udder what materials do you use for drying?

1. Collective towel 2. Individual towel 3. Just with hands 4. Others (specify) 5. No drying

7.5. Temperature of water 1.Warm 2.Cold 3. Anyone of them

7.6. What is the source of the water used for washing the udder and milk utensils?

1. Piped/ tap…… 2.River/ stream 3. Hand dug well 4. *Other (specify)……*

7.7. What type of milk container do you use?

1. Plastic…… 2.Aluminum…… 3.Other……

7.8. How often do you wash the container?

1. before every use 2. After every use 3.Before and after every use

7.9. How do you clean the container

1, cold water 2.hot water 3.cold water and soap 4.hot water and soap 5.detergent and water

Milk handling practice

8.1. When you milk cows, do you use any of the following practices?

	Do you practice?	If yes; how often?(for 1-5)
Milking practices	1.Yes 2.No	1. Every day 2. At each milking times 3. After milking each cow 4. Weekly 5.Every two weeks 6. Once in a month 7. Other specifies?

1.Cleaning of hands before and after milking		
2.Cleaning the cows udder/teat before and after milking		
3.Cleaning milking equipments before and after milking		
4. Do you use towel for drying udder?		
1. Common towel		
2 .Individual towel for each cow		
3. No washing and drying		
4. Drying with hand		

8.2. What type of milking equipment do you use for the different dairy products?

Produced? ----------

8.3. What traditional methods do you use to preserve raw milk? ----------

8.4. Describe washing technique of milking equipment? ----------

8.5. Do you smoke milk vessels? 1. Yes 2. No

8.6. If your answer tom **Q 9.5** is yes, what is the purpose of smoking?

8.7. What are the plants used for smoking milking equipment? ----------

8.8. How do you keep milk for long time if need arises? ----------

8.9. Is there any means of preserving dairy products while

Transporting to market? 1. Yes 2. No

8.10. If your answer to question **Q 8.9** is yes , describe them ?

Milking technique

9.1. Milking procedure used: 1. Hand 2. Machine3. Both

9.2.Milking frequency per day: 1. Once 2. Twice3. Three or more times _____

9.3. What do you do with the milk? 1. Use it for home consumption 2. Sell fresh milk 2. Produce into different product for sale 3. Produce into different product for sale and home consumption

9.4. Do you cool the milk before sale? 1. Yes____ 2, No____

9.5. If your response to **Q 9.4** is yes, how? 1. Refrigerator 2. Traditional cooling system 3. Others (Specify) _____

Type of milking practices

1.Milking without suckling 2. Few suckle before and after milking

3. Suckling before milking only 4. Others (specify) _____

3. Do you practice complete milking practice? 1. Yes 2. No

4. Do you wash udder of milking cows? 1. Yes 2. No

5. Do you milk your animals in the absence (death) of their calves? 1. Yes 2. No

6. If yes, how? _____

7.What are your milking equipments? _____

8 Do you use disinfectants for milk equipment? 1. Yes 2. No

9. If yes, mention the type of disinfectant you use to disinfect_____

10. What methods do you use to increase the shelf life of milk and milk products?

1. Smoking of containers 2. Boiling before collection 3.Salting 4. Others (specify)

8. Bibliography

The Author of this thesis was born from his father Rokonsa Kalo and his mother Kawato Dima in Sidama region Aleta Chuko Woreda Mekela Kebele, in December, 1992 G.C. He attended his primary school (1-8) at Tesso elementary school (1998-2006G.C). He attended his secondary and preparatory school (2007 G.C) and (2008-2010 G.C) at Aleta Chuko high school and Aleta wondo high school and preparatory school respectively. After completing his high school education level, he followed his Bachelor of Science in Animal sciences from (2011-2013 G.C) in Ambo University. After completing higher education level, he employed in Aleta Chuko interiprize and industry offices the experts of youth job creation opportunity from(2017-2019) and he joined graduate studies in Hawassa University College of agriculture to follow his Master of Science in dairy science and technology.