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Assessment of Production Practice, Physicochemical Properties and Microbial Quality of Raw Cow Milk in Worabe Town, Silte Zone, Southern Ethiopia

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ABSTRACT

A cross sectional study was conducted in Worabe town, Southern Ethiopia, to assess milk handling practice, determine physicochemical properties and evaluate the microbial quality of raw cow milk produced in the town. Three kebele were purposely selected based on their dairy production potential one kebele from town two kebele from rural. A total of 120 dairy farms consisting of crossbred dairy cattle were selected. The result of the survey indicates that the majority of the respondents (86.7%) follow milking procedures that include washing hands and utensils before and after milking, while 91.7% of the producers wash the udder and teats before milking. Majority of the respondents (100%) used purchased feeds in the farm and the main source of water was tap water. A total of 30 raw milk samples were collected and laboratory work was conducted to determine microbial load. The results of overall means revealed that 4.54 ± 0.67 cfu/ml total bacteria count, 2.95 ± 0.44 cfu/ml ColiForm count and 2.63 ± 0.46 cfu/ml yeast and mould count. There was a significance variation ($p<0.001$) for total bacteria count and yeast and mould among the three kebele no significance difference for ColiForm count. The result revealed that overall mean for specific gravity (density), water, fat, protein, solid-non-fat and total solid milk samples were 1.02 ± 0.02, 88.54 ± 1.51, 3.54 ± 0.76, 3.23 ± 0.61, 8.15 ± 3.00 and 11.46 ± 1.51 respectively. Except SNF and TS the physicochemical property of milk from all milk production was under the acceptable level. The microbial quality raw milk produced by the milk shed was poor. Therefore, to ensure safety and quality of milk and health of the public, strict hygienic practice should be followed during milk production and handling.

Keywords: Chemical composition; Microbial quality; Physical property; Health

INTRODUCTION

Ethiopia has the largest livestock population in Africa, with 65 million cattle, 40 million sheep, 51 million goats, 8 million camels and 49 million chickens [1]. Despite the large cattle population and the prevailing favorable climatic conditions and resources for livestock production, the current milk production in the country is low. This is reflected by the low per capita milk consumption and increasing trend in imports of milk and milk products [2]. Like most developing countries, Ethiopia's increasing human population, urbanization and rising household incomes are leading to a substantial increase in the demand for livestock products, particularly milk and meat. In order to meet the growing demand, scientists suggest that milk production has to grow at least at a rate of 4 percent per year [3].

Per capita consumption of cow milk in Ethiopia was reported to be between 17 and 19 Litres, which is much lower than the east Africa regional average (i.e. 90 Litres per capita in Kenya and 50 Litres per capita in Uganda) [4,5]. However, milk demand is increasing due to migration to urban areas [6]. Milk is the natural product obtained from the secretion of the mammary gland of lactating mammals. It is a highly nutritious substance, which contains macro and micro-nutrients such as proteins, carbohydrates, vitamins, minerals and active compounds having a role in health protection [7]. Milk fat and lactose are important sources of energy. Cow milk is the most used product in the world followed by that of goat and camel milk [8]. In Ethiopia, cows contribute around 95% of the total annual milk produced in the country [9]. Milk is a complex biological fluid and by its nature serves as a good growth medium for many microorganisms, because of its high-water content, nearly neutral pH, and variety of available essential nutrients [10]. Therefore, the microbial load of milk is a major feature in determining its quality [11]. Milk intended for human consumption must be free from any pathogenic microorganisms [12]. Microbial contamination in milk may cause milk-borne diseases to humans while others are known to cause milk spoilage. Many milk-borne epidemics spread through milk contamination.

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Sources of microbial contamination in milk include primary microbial contamination from the infected or sick lactating animal. The secondary causes of microbial contamination occur along the milk value chain, which may include contamination during milking, milk handlers, unsanitary utensils and/or milking equipment, transportation and storage.

There is tertiary microbial contamination, which occurs mainly due to re-contamination of milk after being processed due to unhygienic conditions and/or poor or improper handling and storage of milk during consumption [13]. Meanwhile raw milk is an important vehicle for the transmission of milk borne pathogens to humans, as it can be easily contaminated during milking and handling [14].

Although milk and milk products are minor constituents in most diets, contaminated milk is responsible for up to 90% of all dairy related diseases of humans [15]. A study by Shirima et al. documented several pathogens resulting from milk-borne Zoonotic diseases including brucellosis, tuberculosis and enterotoxaemia [16]. The risk of infection by milk-borne Zoonotic diseases is one of the reasons for public health regulations, which discourages the informal milk markets and consumption of raw or unpasteurized milk [17]. Since dairy farms in resource-limited countries like Ethiopia strive in the widespread presence of disease and in compromised sanitary conditions, they produce milk of poor hygienic quality and higher public health risks [18].

The quality of raw milk is very important for the quality of products made of it; therefore, quality of raw milk should be controlled properly. Safety of dairy products with respect to food-borne diseases is of 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 [19]. Worabe Town is one of the new urban centers in the country with a fast growing population and urban life. As a result, there is huge demand for agricultural products including milk and dairy products. Though studies related to evaluation of quality and safety of milk and dairy products are extensively conducted in different parts of the country, there is limited if any or no such work has been done in this town while the need for the information related to milk production, quality and safety of milk and dairy products is of paramount importance. Therefore, the aim of this study is to assess production practices and to investigate physicochemical and microbial quality of raw cow's milk produced in Worabe town.

MATERIALS AND METHODS

Description of the study area

The studies were conducted in Worabe town, which is administrative capital of the Siltie zone South Nations, Nationalities and Peoples Regional state. Worabe Town is located on the main road from Addis Ababa to Hosanna 172 KM apart from Addis Ababa to the south and 160 km far from Hawassa City. It is bordered on the South by Dalocha woreda, on the North by Wulbareg woreda, on the West by Alicho Woreda and on the East by Silte woreda. It comprises of 10 Kebele and has a total area of 15,733 hectares, from which 655 ha was covered by perennial crop, 4896 ha covered by annual crop, 3004 ha covered by forest and the rest 7178 ha land covered by urban area [20]. About 35.3% of the area is used for crop cultivation, 19.1% forest bushes, 2% grazing land, 1% degraded land and land covered by urban is 45.62%. Agriculture is the main source of income for the town. Mixed crop-livestock farming system is common in the area, the district has two major agro-ecologies, kola (40%) and Woyina dega (60%).Temperature is the quantity that tells us how hot or cold something is relative to some set standard atmosphere. The Meteorological data of 2019/2012E.c/indicate that the mean annual maximum and minimum temperature of the town is 22°C and 15°C. Worabe Town is Geographically located between 7° ′48′04″ and 7° 55′15″/N latitude and from 38° 08′42″ to 13′42″ E/8.017; 38.333 longitude coordinates. The topography of the woreda is mountainous and hilly 50%, undulating 35%, flat and plain 10%, and rugged valley and gorge areas cover 5% [20].

Study design

Questionnaire survey and milk sampling: The study involved both cross-sectional survey methods aimed to assess handling practices and a laboratory-based investigation and to determine the physicochemical properties and microbial quality of raw cow's milk produced and marketed in Worabe town. Both primary and secondary data are utilized for this study. For the primary data semi-structured questionnaires were prepared and pre-tested and the surveys were conducted by interviewing people who were involved in production and marketing of milk. Secondary data are collected from Worabe town agricultural and enterprise offices.

Worabe town administration has 10 kebele out of which three one from town kebele and two from rural kebele of them are known for their dairy potential as reported by Worabe [21]. For this study, therefore, three of them namely Worabe, Alkeso and Fuga were selected purposely based on their dairy potential. According to the information obtained from the Woreda agricultural office there are 170 dairy cow rearing farmers in Worabe town administration. From these a total of 120 were included in this study for the purpose of data collection. Households were selected so as to have a representative sample according to the formula [22].

$$N = N\{(1 + Ne2)\}$$

Where n:-the desired sample size

N: Total population of the study

E: Marginal error between the population and sample size

Milk sample collection and transportation: Prior to the laboratory analysis 30 sampling glass bottles were sterilized. Then, approximately 300 ml of raw milk samples were aseptically collected from a bulk milk container and placed into sterile glass bottles. Consequently, samples were labeled and put in an ice box (4°C) to restrict microbial multiplication and transported as early as possible to the Arbaminch University laboratory for microbial quality and physicochemical the laboratory analysis was performed within 4 hours after collecting the sample [23].

Data collection: For the survey part, the data collected include feeding management, ventilation systems, milk and milk utensils hygienic practices, udder management, culling practices, milk marketing system, and milk production constraint and milking practices (time and frequency). In addition, the LACTOSCAN, LSS001, Bulgaria was used for determination of the physical and chemical properties of milk samples. Standard methods were followed for the microbial qualities tests considering Standard Plate Counts (SPC), Coliform Count (CC) and Yeast and Mould Count (YMC) are considered [23].

Total bacterial count (TBC): The bacterial count was made by adding 1 ml of milk sample into a sterile test tube having 9 ml of

peptone water. After thoroughly mixing, the samples were diluted up to 1:10-7 and the duplicated samples (1 ml) were poured using 15-20 ml standard plate count agar and mixed thoroughly. The plate samples were allowed to solidify and then incubated at 30oC for 48 hours. Colonies will be counted using colony counters [23].

Coliform count (CC): For Coliform count 1 ml of milk samples were added into a sterile test tube having 9 ml distilled water. After mixing, the samples were serially diluted up to 1:10-5 and the duplicate sample (1 ml) was poured using 15-20 ml Violet Bile Agar Solution (VRBA). After thoroughly mixing, the plate samples were allowed to solidify and then incubated at 30oC for 24 hours. Finally, colonies were counted using the colony counter. Typically, dark red colonies were considered as coliform colonies. After counting and recording bacterial colonies in each Petridis, the cfu/ml in milliliter milk was calculated by the following formula given [24].

$$N = \sum C / [(n1 \times 2) + (0.1 \times N2)] * d$$

Where
N=number of colonies per milk

Σ C: Sum of colonies on plates counted

n1: Number of plates on lower dilution counted. n2=number of plates on lower dilution counted.
d: Dilution from which the first counts are obtained.
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) (Oxoid, Pvt. Ltd. MU 096: UK). The dried plates will then be incubated at 25°C for 3 to 5 days. Colonies with a blue-green colour and white creamy colonies were counted as yeasts and moulds [25].

Statistical data analysis

The primary data were collected from household surveys through semi-structured questionnaires were processed where data are checked for accuracy, data entries were coded, and the coded data are entered into the computer. Processed data were analyzed by using Statistical Package for Social Science (SPSS) version 20. Descriptive statistics such as percentage, standard deviation, and ANOVA were used to analyse the data quantitatively. Data from microbial counts were first transformed to logarithmic values (log 10) before statistical analysis in order to make the frequency distribution more symmetrical, and then SPSS version 20 statistical software was used to analyse the data. Mean comparison done using least significant differences was considered statistically significant at 95% of significance.

The following model was used for the analysis of the physicochemical properties and microbial quality of milk

$$Yij = \mu + \beta i + eij$$

Where,

Yij: Individual observation for each test the physicochemical properties and microbial quality of raw cow milk (dependent variable)

μ: Overall mean of the respective variable βi=the effect of its kebele respective variable Eij=the error term

RESULTS

The current study was carried out to investigate factors influencing production practice, physicochemical properties and microbial quality of raw cow milk produced in Worabe town, in the Southern part of Ethiopia. Overall, assessment of lactating dairy cattle production practices in the study area was based on observational questionnaire data and laboratory works were done for raw milk microbial quality and physicochemical properties findings.

Characteristics of the respondents

During the study different age groups with different educational background were addressed, with regard to age group, majority (33.3%) dairy farm owners were between age of 41-50 years old, 30% of the respondents were between age of 31-40 years, 23.3% of them between 51-60 years old, 10.9% and 2.5% of them were above 61 and between 20-30 years old respectively were addressed. The educational status of respondents, 59.1% of them were elementary level and 31.7% of them illiterate and 30.83% of them were receiving short term training by woreda livestock department and different governmental and non-governmental sectors while 69.17% of the respondents did not get any training. The age group, educational status and the training information of the respondents in the study area is summarized in Table 1.

Table 1: Characteristics of respondent in the study area.

Variable	Worabe N40	Alkeso N 40	Fuga N 40	Mean
Age group				
20-30	2 (5%)	1(2.5%)	-	2.50%
31-40	12 (30%)	6(15%)	18(45%)	30%
41-50	15(37.5%)	13 (32.5%)	12(30%)	33.30%
51-60	7 (17.5%)	14(35%)	7(17.5%)	23.30%
61 and above	4(10%)	6 (15%)	3(7.5%)	10.90%
Level of education				
Illiterate	13(32.5)	14(350	11(27.5%)	31.70%
Elementary	24(60)	20(50)	27(67.5%)	59.10%
High school	3(7.5)	6(15)	1(2.5%)	8.40%
Diploma	-	-	-	-
Degree	-	-	1(2.5%)	0.80%
Training received				
Yes	6(15%)	13(32.5%)	18(45%)	30.83%
No	34(85%)	27(67. %)	22(55%)	69.17%

Note: *N= Number of respondents representing 40 respondents from each kebele and making a total of 120 from the three.

Hygienic quality of milk during productions

Barn type and hygienic practices: The housing system of all dairy houses assessed during the survey 95.83% of the respondents were used (closed type) housing system for their cattle, 2.5% of them used semi-closed and 1.67% used open barns (Table 2). The purpose of fencing was to protect the dairy cattle from predators, rainfall, sunlight's and other external environmental factors affecting the productivity. This was in agreement with the finding of other previous reports by [26-29] who reports comparatively 35.8% of farms practice using a free grazing system. In contrast to this study

17.5% of the respondents were exercised zero grazing and hence all the animals were in total confinements and 46.5% of respondents were exercised both [29].

Table 2: Milk marketing the study area.

Variable	Worabe N 40	Alkeso N 40	Fuga N40	Mean
Sales				
Hotel	24 (60%)	18(45%)	27(67.5%)	57.50%
Shop	16 (40%)	8(20%)	5(12.5%)	24.20%
Consumer	-	14 (35%)	8(20%)	18.30%
Marketing problems				
Yes	-	-	8(20%)	6.70%
No	40(100%)	40(100%)	32(80) %	93.30%

The current study showed that only 27.5% of the respondents have maternity pens on the farm and 62.5% of them don't have maternity pens. In relation to the floor type majority of the respondents 67.5% used muddy floor, 17.5% of them were used barn floor made from concrete the rest 15% made from stone. Based on the result, 95.83% of the farms had closed type of housing while the remaining 2.5% and 1.67% of them had semi-open and open type of housing respectively. In Alkeso among the animals assessed 39 (97.5%) of them were kept under closed type of housing system followed by Worabe 38 (95%) and Fuge 37 (92.5%). With regard to bedding material, among the results observed in Worabe, all 40 (100%) of the dairy farms use bedding materials followed by Alkeso 23 (57.5%) and Fuga 9 (22.5%) other results of barn type and cleaning practices indicated in Table 3. The majority 60% of the respondents used bedding materials and (40%) were not use for their cattle; this finding is similar to the findings of Guremesa et al. [29]. However using clean, dry and comfortable bedding is necessary to minimize the growth of pathogenic microorganisms. Ruegg stated that absence of proper bedding material exposes the teat end to microorganisms and wet or muddy pens increase the risk of mastitis and milk contamination [30]. Donald et al. similarly stated that maintaining the sanitary condition of the barn is important for the production of good quality milk [31]. The hygienic conditions are different according to the production system, adapted practices, level of awareness, and availability of resources [32]. In Ethiopia there is no standard hygienic condition and the exogenous sources of milk contamination with bacteria are very common due to weak attention on dairy hygiene [33].

Table 3: The culling practices in the study area.

Variable	Worabe N 40	Alkeso N 40	Fuga N 40	mean
Culling				
Yes	40 (100%)	40(100%)	40(100%)	100%
No				
Reason of culling				
Health problems	6(15%)	1(2.5%)	12(30%)	15.80%
Space shortage	1(2.5%)	3(7.5%)	4(10%)	6.70%
Feed shortage	21(52.5%)	22(55%)	11(27.5%)	45%
Reproductive problem	11(27.5%)	7(17.5%)	7(17.5%)	20.80%
Low performance	1(2.5%)	7(17.50%)	6(15%)	11.70%

The current study showed that 23.3% of the farms were with good drainage condition of barns, 29.2% of the farms were with satisfactory drainage and 47.5% poor drainage condition was observed during the study period. Since a well-built barn can drain easily, it has positive correlation with the overall hygienic condition of a given milking environment, favoring production of better quality milk. However, the barns with satisfactory and poor drainage systems could lead to poor quality milk production. It is therefore important that producers should consider appropriate drainage conditions of the milking environment as an integral part of production hygiene to ensure the supply of safe and good quality milk and its derivatives. The drainage condition of the milking area is one of the determinant factors [34]. The results related to the labour for cleaning system of the study area showed that 69.2% respondents cleaned by owners, 30.8% used by workers. As to the cleaning frequency, 100% of the respondents in the study area clean their milking barn every day (Table 4).

Table 4: Barn type and cleaning practice in the study area.

Variable	Worabe N 40	Alkeso N 40	Fuga N40	mean
Types of housing				
Closed type	39(97.5%)	39(97.5%)	37(92.5%)	95.83%
Semi open	1(2.5%)	1(2.5%)	1(2.5%)	2.50%
Open	-	-	2(5%)	1.67%
Floor type				
Mud	39(97.5%)	15(37.5%)	27(67.5%)	67.5
Concrete	-	10(25%)	11(27.5%)	17.5
Stone	1(2.5%)	15(37.5%)	2(5%)	15
Bedding				
Yes	40(100)	23(57.5%)	9(22.5%)	60%
No	-	17(42.5%)	31(77.5%)	40%
Maternity pens				
Yes	-	24(60%)	9(22.5%)	27.50%
No	40(100%)	16(40%)	31(77.5%)	62.50%
Drainage conditions of the Barn	5(12.5%)	5(12.5%)	5(12.5%)	5(12.5%)
Poor	12(30%)	17(42.5%)	28(70%)	47.50%
Satisfactory	10(25%)	20(50%)	5(12.5%)	29.20%
Good	18(45%)	3(7.5%)	7(17.5%)	23.30%
Cleaning of the barn				
Owner	29(72.5%)	31(77.5%)	23(57.5%)	69.20%
Worker	11(27.5%)	9(22.5%)	17(42.5%)	30.80%
Feeding system				
Both	21(52.5%)	25(62.5%)	10(25%)	46.70%
Grazing	18(45%)	7(17.5%)	18(45%)	35.80%
Stoll feeding	1(2.5%)	8(20%)	12(30%)	17.50%

Proper and clean housing environment is a prerequisite to produce milk and milk products of acceptable quality [35]. The current study shows that there was a significant difference ($p<0.05$) among

the feed sources used by the dairy farms in the observed kebele (Table 4). The feeding system of the study area is considered, 35.8% of the respondents used a grazing system, 17.5% used Stoll feeding and the rest 46.7% used both grazing and Stoll feeds system.

Among the observed dairy farms in the study area majority (96.7%) commonly used feed staff was roughage few 3.3% of them were used concentrate feed purchased from different feed suppliers due to the fact that the dairy owners have lack of knowledge on how to prepare animals feed, money (capital) problems and shortage of spaces. This finding was comparable with other reports, management in terms of feeding and nutrition has great effect on chemical composition of milk. Managing daily ration of dairy cows feed can change milk composition [36].

Feeding and watering management practice

The current study shows that there was a significant difference ($p<0.05$) among the feed sources used by the dairy farms in the observed kebele (Table 5). Concentrate feed is the main supplementary feed resources used by all (100%) of the respondents in the study area. Among the observed dairy farms majority (96.7%) commonly used feed staff were roughage. Roughage feed resources are purchased and used by 24.2% while 37.5% of the respondents produced roughage feeds from their own farm and the rest 38.3% producers used both purchased and farm produced feeds. About 30.8% and 34.2% of the feeding work is done by laborers and owners of the milk barn in the study area, respectively while up to 35% respondents fed their animals by family members. Few farms 3.3% of them were used concentrate feed purchased from different feed suppliers due to the fact that the dairy owners have lack of knowledge on how to prepare animals feed, money (capital) problems and shortage of spaces. This finding was comparable with other reports, management in terms of feeding and nutrition has great effect on chemical composition of milk. Managing daily ration of dairy cows feed can change milk composition [36].

Table 5: Feeding and watering practices used in the study area.

Variable	Worabe N-40	Alkeso N 40	Fuga N40	mean
Source of concentrate				
Purchased	40(100%)	39(100%)	40(100%)	100%
Farm produced	-	-	-	-
Both	-	-	-	-
Source of roughage				
Both	19(47.5%)	21(52.5%)	6(15%)	38.30%
Farm produced	20(50%)	16(40%)	9(22.5)	37.50%
Purchased	1(2.5%)	3(7.5%)	25(62.5%)	24.20%
Common used feed				
Roughage	40(100%)	37(92.5%)	39(97.5%)	96.70%
Concentrate	-	3(7.5)	1(2.5%)	3.30%
Storage condition				
Satisfactory	21(52.5%)	27(67.5%)	30(75)	65%
Poor	18(45%)	11(27.5%)	8(20%)	30.83%
Excellent	1(2.5%)	2(5%)	2(5%)	4.17%
Water source				
Tap	22(55%)	24(60%)	17(42.5%)	52.50%
River	16(40%)	15(37.5%)	20(50%)	42.50%
Wall	1(2.5%)	1(2.5%)	1(2.5%)	2.50%
pond	1(2.5%)	-	2(5%)	2.50%
Cleaning of the barn				
Family	29(72.5%)	31(77.5%)	21(52.5%)	67.50%
Worker	11(27.5%)	9(22.5)	17(42.5)	30.80%
Owner	-	-	2(5)	1.70%
Feeding of the animal				
Family	7(17.5%)	14(35%)	21(52.5%)	35%
Owner	22(55%)	17(42.5%)	2(5%)	34.20%
Worker	11(27.5%)	9(22.5%)	17(42.5)	30.80%

Data from the survey in this study shows that the main source of water in the study area was tape water (52.5%) for hygienic purpose (washing teats, hand, milking equipment and sanitizing the milk shed), 42.5% of the respondents used river water; 2.5% used pond (Well) water and 2.5% used stagnant water source for cleaning and washing purposes. Finally 4.17% of the respondents have good feeding storage practices and they prepared a separate feeding stocks room which is used to protect feed from sunlight, rainfall and other dirty materials,65% the respondent satisfactory feed storage the rest 30.83% poor storage system in the study area (Table 5). According to Asaminew et al. when water from non-tape sources is used for cleaning purposes, it is important that producers should at least filter and heat treat it before use because the quality of water can determine the amount of bacterial count [34]. The major losses of dairy products occurs as a result of poor production handling practices and lack of technical knowledge on clean milk production and prevention of contamination, use of unclean milking equipment and lack of clean water for cleaning purpose of equipment's contributed to the poor hygienic quality of dairy products produced in central Ethiopia [37].

Milking and milk handling practices

In the present study 97.5% of the respondent's milk their cows twice per day (morning and evening) while 1.7% of the respondents conduct milking operations three times a day. The rest 0.8% of them do milking once a day. Among observed majority (86.7%) of the farm owners were wash their hands before milking, 91.7% of them were wash udder or teat of their lactating dairy cows, 97.5% of them were practices routine washing of utensils during milking but also 84.2% were used common towels to clean and dry their cows udder this may result in spread of contagious mastitis agents. Milking frequencies and milking procedures used by the respondents in the study area is presented in Table 5. Similar study was reported by Gran et al. that inadequate cleaning of the udder and teat may result in contamination of milk [38]. Therefore, the use of detergent and good-quality water for cleaning could be expected to remove microorganisms that affect the microbial quality of milk.

As indicated that during milking and handling all the procedures should be kept under hygienic manner to reduce contamination of milk by microorganisms until reaching to processors or consumers. Following proper hygienic procedures is of paramount importance to produce good quality mil and its products [39]. One of the

objectives in dairy farming is to produce good quality milk which is saleable to and acceptable by the consumers. Provision of milk and milk products of good hygienic quality is desirable from consumers 'health point of view [34]. The present study also observed that the farm employees were focused on several additional workloads other than milking tasks (Table 5). Thus it was possible that those family 69.2% who were working in milking and other additional assignments like cleaning may contaminate the milk as most of them were not using detergents for washing their hands. This might be increasing the microbial counts of the milk marketed in the study area. This finding was in agreement with Bonfoh et al. in the milk production area, besides udder cleaning and water quality, hygienic behavior with respect to hand washing, container's cleaning and disinfection are the key factors that remain of relevance to milk hygiene intervention [40].

Milk marketing

As observed in this study producers supply their milk production for different types of consumers. According to the current study, 93.3% respondents had no market problem for raw milk and the remaining 6.7% respondent indicated marketing problems as presented in Table 6. The outlet of the raw milk in the study area showed that majority of the respondent's (57.5%) supply their fresh milk to hotels followed by shops (24.2%) and (18.3%) for individual household consumers. Moreover on average 6.7% of the respondents have marketing problems. The major milk production constraint in the study area was lack of access to quality feeds and due to the expensiveness of quality feeds unable to be afforded by the producers and additional problem is the presence of different dairy cattle related diseases (Table 7). Informal system producers supply their surplus production to their neighbors or local market, either as liquid milk or milk products [41]. This indicates that due to possibly poor quality product, health of the dairy consuming community is not secured [42]. All the listed factors had negatively affected the quality of milk and milk products.

Table 6: The microbial count result of the cow milk produced in the study area.

Parameter	Milk source			Over all mean	P-value
	Fuga	Alkeso	Worabe		
TBC	5.01 ± 1.00	4.37 ± 0.26	4.24 ± 0.16	4.54 ± 0.67	<0.001
CC	2.37 ± 0.19	3.21 ± 0.18	3.25 ± 0.11	2.95 ± 0.44	0.308
YM	2.93 ± 0.68	2.523 ± 0.16	2.42 ± 0.15	2.63 ± 0.46	<0.001

Table 7: Milking frequencies and milking procedures used in the study area.

Variable	Worabe N 40	Alkeso N40	Fuga N40	mean
Milking procedure				
Hand washing before milking				
Yes	30(75%)	34(85%)	40(100%)	86.70%
No	10(25%)	6(15%)	-	13.30%
Udder washing before milking				
Yes	39(97.5%)	32(80%)	39(97.50%)	91.70%
No	1(2.5%)	8(20%)	1(2.5%)	8.30%
Utensil washing during milking				
Yes	39(97.5)	38(95)	40(100)	97.5
No	1(2.5)	2(5)	-	2.5
Towels used individual				
Yes	6(15%)	12(30%)	1(2.5%)	15.80%
No	34(85%)	28(70%)	39(97.5%)	84.20%
Milking frequency				
Two	39(97.5%)	38(95%)	40(100%)	97.5
Three	1(2.5%)	1(2.5%)	-	1.7
One	-	1(2.5%)	-	0.8
Milkers				
Owner	29(72.5%)	31(77.5%)	23(57.5%)	69.20%
Labour	11(27.5%)	9(22.5)	17(42.5%)	30.80%

Culling practices

The current study indicated that all (100%) of the respondents in the study area were practiced culling in their farms due to many reasons as shown in Table 3. The higher (45%) culling practices were occurred due to feed shortage, 15.8% of theme due to health problems, 6.7% due to space shortage, 20.8% and 11.7% of them were due to reproductive problems and low performance respectively. The present finding was in agreement with other reports, reported that the culling reasons of dairy cows can be for low production or an excess animal, illness, injury, infertility or death. Similarly that the most common reasons for culling cows have been due to feed shortage, reproductive problems, and low production [43-45].

Constraints of milk production

According to the respondents there were different challenges faced in dairy production as presented in Table 8. The result showed that the feed shortage related problem is the biggest problem for all respondents in the study area 62.5% and the second problem 37.5% is disease faced by the dairy farmers in the study area.

Table 8: Main constraint of milk production in the study area.

Variable	Worabe N 40	Alkeso N 40	Fuga N40	mean
Main constraint of production				
Forage	25 (62.5%)	26(65%)	24(60%)	62.50%
Disease	15(37.5%)	14 (35%)	16(40%)	37.50%
mastitis				

Microbial quality of raw milk

Total bacterial count: The total bacterial count is used as an important indicator of microbial quality of raw milk. The result of microbial quality of raw milk as indicated in Table 8 shows that total bacterial counts in the study area were significantly different from each other among kebeles (P<0.001). The overall mean total bacterial count of raw cow milk produced in the study area was 4.54 log 10 cfu/ml. This result was lower than the result of Bascom et al. who reported the total bacterial count of Omdurman and Khartoum as 9.29 ± 0.66 and 8.23 ± 0.76 log 10 cfu/ml respectively [46]. Similarly it is also lower than the result, 6.98 log 10 cfu/ml, of (Saba, 2015) who reported the average total bacterial count of raw milk in Adea Berga and Ejerie districts of west Shoa zone also reported 7.25 log 10 of total bacterial count in Dawa Chefa District, Amhara region [46,47]. However, the result of the present study

is within acceptable range of Ethiopian microbial standard for unprocessed milk [48]. In addition, the value is within acceptable range of total bacterial count of raw milk of European standard. According to EU standards, total bacterial count of raw cow milk should be less than 5.6 log 10 cfu/ml [49].

Coliform count: The result of coliform bacterial count shows that there is no statically significant difference between kebele P>0.05 milk in study areas (Table 6). Difference might be attributed to factors like low hygiene during milking, contact of the udder with faecal matter and poor quality of milking equipment. The overall mean coliform count in the study area was 2.95 log 10 cfu/ml. This result is lower than the result of Terfa et al. in Bahir dar Zuria and Mecha district, Ethiopia who reported 4.49 log cfu/ml and it is also lower than the report of Weber et al. [50,51]. who reported the total coliform counts of milk in Yabello district Borena southern Ethiopia were 6.323 log 10 cfu/ml. The overall result of coliform count in the study area is within good standard of Ethiopian unprocessed milk microbial quality 4.6 log10 cfu/ml [47]. But, higher when compared with the recommended values of American public health standard which should be less than 100 cfu/ml for grade A milk and 101-200 cfu/ml for grade B milk [52]. The presence of more number of coli form in milk in the study area indicates that the milk has been contaminated with dirty materials like dung of the cow, poor farm hygiene, use of equipment's that are not properly cleaned, and unsanitary milking practice, use of contaminated water for cleaning of equipment's. CC is an indicator of low hygienic standard used in production of the milk in the study area.

Yeast and mould count: The overall mean value of YMC were significantly different (P<0.05) among milk samples collected from the producer, but the mean value of YMC count were significantly different between kebele (Table 6). The overall mean of YMC for the study area was 2.63 ± 0.46 log 10 cfu/l. The result was lower than the report of Duguma et al. who reported 3.902 ± 0.477 in Smallholders in Bench Maji Zone, South-western Ethiopia and less than the result of Constable et al. who reported the total count of YMC of sample of milk taken from the udder was 3.03 log 10 cfu/ml in Hawassa City [53,54].

Physicochemical properties of cow milk: The result of physical properties and chemical composition of milk samples showed that the raw milk content of mean Fat, SNF and TS were statistically significantly different in between kebele (P<0.05). Composition of milk can be affected by breed [55,56]. The total result of physical properties and chemical composition of milk is summarized (Table 9). Cow milk composition is very important to determine nutritive value and consumers 'acceptability [42]. Milk at normal state has unique Physico-chemical properties, which are used as quality indicators. The density/specific gravity of milk among others is commonly used for quality tests mainly to check for adulteration by water or removal of cream; addition of water to milk reduces milk density, while removal of cream increases it [42].

Table 9: Results physical properties and chemical composition of milk in the study area.

Parameter	Milk source			Over all mean	P-value
	Fuga	Alkeso	Worabe		
TBC	5.01 ± 1.00	4.37 ± 0.26	4.24 ± 0.16	4.54 ± 0.67	<0.001
CC	2.37 ± 0.19	3.21 ± 0.18	3.25 ± 0.11	2.95 ± 0.44	0.308
YM	2.93 ± 0.68		2.42 ± 0.15	2.63 ± 0.46	<0.001

Note: SNF=Solid Non-Fat, TS=Total solid.

Solid not fat: In this present study the average result of SNF content of milk is 8.15%. The current finding is less than previous findings of Teklemichael et al. in and around Addis Ababa and Tamimi et al. [58] in Dire Dawa who reported 8.75% [57,58]. According to the European Union quality standard for unprocessed whole milk solid-non-fat should not be less than 8.59% [59]. The SNF obtained in this study did not fully fill the criteria set by the EU quality standard. The difference observed in SNF content of milk could be due to differences in feeding practices, season, stage of lactation and milking method [60].

Protein: The overall mean protein content of milk in the current study was 3.23%. This is higher than the protein content (3.1%). According to the Food and Drug Administration (FDA) protein content of whole milk is 2.73% [61]. Similarly, according to the European Union quality standard for unprocessed whole milk, total protein content should not be less than 2.9% [58]. The difference could be due to variability among the breed of cow, within a breed, feeds and stage of lactation. Therefore the average protein content in the current study is within the recommended standards.

Fat: The average fat content of milk obtained in the present study was 3.54%. The present finding is lower than the early finding of Teklemichael et al. and Payne et al. 3.86% and 3.79% respectively [57,62]. The fat content was significantly affected by factors such as feed, parity, and stage of lactation [63]. The fat content of milk can vary even between milking of the same cow whether diseased or not, however, according to who described mastitis as a cause for decrease in fat composition. According to the European Union quality standard for unprocessed whole milk fat content should not be less than 3.5% [58]. Similarly, the Food and Drug Administration (FDA) requires not less than 3.25% milk fat for fluid whole milk. Therefore the fat content of the current study is within the recommended standard.

CONCLUSION

Generally, the microbiological quality of milk collected from the study area were TBC and YMC within the acceptable range of Ethiopian unprocessed raw milk and European standared.CC with in the acceptance range of Ethiopia standard but not in acceptable range American public health standard due low hygienic practice and use of un cleaned material for storage and transportation. In the current study the quality and yield of raw milk were highly affected by the type of feed given to the animals and cattle breed type, the use of bedding materials in the farm house, drainage system, and farm cleanliness in the study area. Milk produce with poor drainage systems, those that don't use bedding materials, with poor dairy house cleaning practice and poor feeding were assessed to have great effect in terms of yielding as well as quality of milk. Based on the findings of this study it is possible to conclude that raw milk produced by the dairy farms assessed in the three kebele (Alkeso, Fuga and Worabe) found in Worabe town with the accepted level of bacterial load in the milk.

The microbial qualities of the milk obtained in the current study was low Total Bacterial Count (TBC), Yeast and Moulds (YM) and igh Coliform Count (CC) which were significantly higher than the international standards safe for human consumption. These microbial loads were probably due to the poor hygienic condition of the milking environment, poor sanitary condition of the milk

containers, poor udder and teats cleaning practice, failure to use separate towels for each cow and the poor personal hygiene of the milkers. Fat and protein the physical and chemical qualities of the collected raw cows'milk were within the recommended levels of Ethiopia, European Union and FAO established quality standards. Individual dairy farm owners and governmental and nongovernmental institutes working on dairy production should give emphasis on factors that influence milk production practice and control of microbial quality of raw cow milk produced in the study area. Furthermore, improvement of milk production by providing crossbred heifers with systemic mastitis control and prevention is very important. Even though the current and previous studies showed importance of investigation of different factors influencing production practice, physicochemical properties and microbial quality of raw cow milk produced, the economic impact is not well addressed; therefore, in line with the above conclusion, the following recommendations are forwarded:

- Awareness should be created in all milk producers with regard to the importance of hygienic milk production.
- Routine assessment of milk quality control should be done in order to safeguard the consumers from milk-borne Zoonotic infections.
- Practice and regulations, such as boiling of milk and implementation should be introduced to facilitate the production of cow milk of high quality and safety.
- Good husbandry practices should be applied during milking and milk handling practices, by educating as short term training of the dairy farm owners with regard to all process of milking, handling up to the reach of consumers in the study area
- Adequate sanitary measures should be taken at all stages from production to consumption to provide wholesome sound dairy products to the needy society.
- Further study should be done with involvement of different risk factors, economic impact and ways to improve milk production of local and exotic breeds.

DATA AVAILABILITY

The documents used to support the review of this article are available from the corresponding authors upon reasonable request.

CONFLICTS OF INTEREST

The author declares that there are no conflicts of interest.

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