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Research article

Raw cow milk nutritional content and microbiological quality predictors of South Gondar zone dairy farmers in Ethiopia, 2020

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ABSTRACT

Background: Raw milk is a good growth medium for microbes because of its neutral pH and nutrient content. In Ethiopia; few studies were done to assess the microbial quality of raw cow milk. But, none of them focused on the nutrient content of raw cow milk. Therefore; this study aimed at evaluating raw cow milk nutrient content and predictors of microbial quality of raw cow milk among milk in the dairy farmers of South Gondar zone (SGZ), Ethiopia.

Methods: A community-based cross-sectional study was conducted from January to May 2020. 160 randomly selected raw cow milk, water, and utensil samples each were collected for microbial analysis. Besides, nutrient content indicators such as TotalSolid (TS), and Specific Gravity (SG) were analyzed from milk samples. Sequentially, The Knowledge, Attitude, and Practices (KAP) of millers were also assessed using a pretested structured questionnaire. Chi-square test and multiple linear regression models were used.

Results: The overall mean **SG** and T**S** of raw cow milk were 1.027 (95% CI, 1.013–1.039) and 12.55% (95%CI, 12.20%–12.89%) respectively.38.13% had the better nutrient content, and the rest, 61.87% of raw cow milk hadn't the better nutrient content. Besides, the mean (SD) in log CFU/100mL-1of the *Escherichia coli* count of raw cow milk was 15 (0.3). Educational status, milk handling experience, KAP of milkers, water microbial count, Nutrient content, and microbial load of milk utensils were independently predicted microbial quality of raw cow milk.

Conclusions and implications: The result signifies that the raw cow milk hadn't better nutrient content and the educational status and KAP of milkers, and the qualities of water were the major factors affecting the microbial quality of raw cow milk. It could greatly affect the Food and Nutrition Security of the country. Hence, measures should be taken to enhance the KAP of milkers for improving this enteropathy.

1. Introduction

Milk is the single most complete food due to owing different essential nutrients. It is one of the most valuable and regularly consumed foods by millions of people across the globe. However, raw milk is a highly perishable food and serves as the best growth medium for pathogens because of its neutral pH, high water, and nutrient content [1]. Raw cow milk is aseptically drawn from a clean and healthy cow containing less than 1000 log CFU/100mL-1of milk microbial count [2].

The growth of pathogens in raw cow milk is prevented by implementing pasteurization. But, the demand of individuals for unprocessed cow milk is high globally [3]. Unprocessed cow milk contaminated with potentially hazardous microbes such as *Staphylococcus aureus (S. aureus)*, *Salmonella spp., Listeria monocytogenes, Campylobacter, Escherichia coli (E.coli)*, *Mold,* and *Yeasts* and accountable for Milk-borne disease (MBDs) for consumers [4]. According to a World Health Organization (WHO) report, MBDs are a serious public health threat for high and low-income countries and are predominantly affected the under 5 children [5].

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Cow milk microbial load is influenced by the Hygiene and Sanitation status of the milkers, milking environment, milking process, storage and transporting utensils, and water used to wash the milk utensils [6]. In a study conducted in Ivory Coast, 7.2% samples from milkers' hands, 4.4% samples from the water used to rinse milk utensils, 4.4% from environmental samples, 13.2% samples from milk utensils, and 4.9% samples from cow's udders contaminated with one or more pathogenic bacteria. As a result, 624.6 L of raw cow milk is discarded per day, resulting in a potential loss of €623.9 per day [7].

In Ethiopia, 85% of milk is produced by rural households, and raw cow milk is consumed more than processed milk. Some people perceive that raw cow milk contains better nutrients than pasteurized milk; others believe that raw milk helps to treat gastrointestinal problems. Less than 1% of milk is consumed after pasteurization [8], and 31.8% of dairy farmers consume raw cow milk [9]. Nevertheless, the Nutrient content of the milk, Knowledge, Attitude, and Practice (KAP) of the milkers, and Hygienic status of the communities concerning the production of raw milk was not assessed well in Ethiopia, rather than some studies on the microbial quality of raw cow milk [10].

Likewise, few studies were done in the proposed study site to assess the microbial quality of raw cow milk. But none of them focused on the nutrient content of raw milk, how the microbial quality of water is used to wash milk utensils, the microbial quality of milk utensils, the worse nutrient content of raw cow milk, and the KAP of milkers predicts the microbial quality of raw cow milk.

Therefore, to fill those gaps, this study was done to (1) Determine the raw cow milk nutrient content using Total Solid (TS), Specific Gravity (SG), and water content, (2) Measure the microbial quality of raw cow milk using common indicator microbes, (3) Identify main predictors of microbial quality of raw cow milk in the dairy farmers of South Gondar Zone (SGZ), Ethiopia. This is the greatest tool to drive awareness and change of perception for Ethiopian communities.

2. Materials and methods

2.1. Study design, period

A community-based cross-sectional study design was used to assess the nutrient content and predictors of microbial quality of raw cow milk in the dairy farmers of SGZ, Northwest Ethiopia, on 160 randomly selected dairy farmers of SGZ during the ambient temperature of 17.22^{o}c, obtained a total of 160 raw milk, 160 milkers, 160 milk utensils, and 160 water samples from January to May 2020.

2.2. Sample and data collection

2.2.1. Milk sample collection

Milk samples were collected from milk storage tanks of dairy farmers. About 100ml (milliliter) of raw cow milk samples were aseptically collected into a sterile universal plastic screw-capped bottle placed in a cooled box with ice packs as per the recommendation of ET ISO 707, 2012 [11].

2.2.2. Swab sample collection

The surface swab technique is used as described in the Compendium of Methods for Microbiological Examination of Foods [12]. The swab sampling procedure was performed by swabbing a delimited area of100cm^2 from milk storage tanks which were washed and made ready for storing milk equipment and hand swab of the milkers. A sterile polypropylene template was used to sample each 100cm^2 surface. The wetted swab head rubbed slowly in two directions at right angles to each other, e.g., horizontally and vertically. The area was swabbed for approximately 20 s. The total surface swab for each milk contact surface was 100 cm^2. All swab samples were placed in an ice-cooled box and transported to the laboratory for analysis within 1 h of collection [13].

2.2.3. Water sample collection

About 160 water samples, each with 250ml collected from water storage tanks by using sterile glass sample bottles. The samples were placed in a cold box with an ice pack, labeled, and transported to the laboratory for analysis within 1 h of collection [14].

2.2.4. KAP of milkers

The Knowledge was assessed using 29 pretested structured questionnaires, an Attitude was determined using 20 pretested structured questionnaires, whereas the Practice pretested structured questionnaires consisted of14 among 160 milkers adapted from previous studies [15].

2.2.5. Operational definitions

2.2.5.1. Knowledge of milkers. The grading of scores to evaluate the Knowledge of the milkers was taken from the above-mentioned literature. The questions had two possible answers; each correct solution carried 2 marks while the wrong carried 1 mark. In the case of negatively quoted questions, reverse scoring was used. Example: Bacteria in milk cannot overgrowth at 4 °C (refrigeration)? 1. Wrong 2. Correct and Chilling process cannot kill any bacteria? 1. Wrong 2. Correct.

Milkers who scored less than or equal to 50% were categorized as having Poor Knowledge, categorized as average if they scored 51–69%, and categorized as having Good Knowledge if they scored 70% and above.

2.2.5.2. Attitude of milkers. The evaluation of the Attitude of milkers was also dependent on literature. The questions had five possible answers strongly agree, agree, neutral, disagree, and strongly disagree which carry 4, 3, 2, 1, and 0 marks consequently. For the negatively quoted checklist, applied inverse scoring. Then the subjects were classified as having a Good Attitude if they scored 70% and above, named as having a Fair Attitude if they scored 51–69%, and Poor if they scored less than or equal to 50%.

2.2.5.3. Practice of milkers. The criteria used to evaluate the Practice of milkers are obtained from the literature. The questions were always, often, sometimes, rarely, and never responses that carry 4, 3, 2, 1, and 0 marks, respectively. For negatively quoted questions, reverse scoring was used. Accordingly, milkers are classified as having Good Practice if they scored greater than or equal to 70% Fair if scored 51–69%, and classified as having Poor Practice if they score less than or equal to 50%.

2.3. Laboratory analysis

2.3.1. Microbial analysis

2.3.1.1. Staphylococci (staph) analysis. The following was done in order to analyze *Staph:* On pre-dried surfaces of Mannitol Salt Agar (Oxide) plates, 0.1m1 aliquots of the proper dilutions were spread out in duplicate. Golden colonies were counted as *Staph* after the culture media were incubated at 30-32^{O}C for 37 h. Mannitol, 10 g; peptone, 10 g; 5 g of NaCl; 0.24 g of phenol red; 1000 mL of distilled water; and the pH were adjusted to 7.2. To assess fermentation and the creation of golden color, a colony was chosen, inoculated into the broth, and incubated at 37 °C for 18–24 h [16].

2.3.1.2. E.coli analysis. On the pre-dried surfaces of Violet Red Bile Agar (Oxoid) plates, 0.1 ml aliquots of the appropriate dilutions were spread out in duplicate. Purplish-red colonies that were encircled by a reddish zone of precipitated bile were enumerated as *E. coli* after the culture plates were incubated at 30–32 °C for 24 h. In our labs, a regular test has been utilized to check for the formation of gas (Positive (+ve)) and indole (Positive (+ve)) at a high incubation temperature of 37 °C [16].

2.3.1.3. Analysis of molds and yeasts. On pre-dried surfaces of yeast extract glucose chloramphenicol bromophenol blue agar (YGC), made from the following ingredients: yeast extract, 5g; dextrose, 20g; chloramphenicol, 0. lg; bromophenol blue, 0.0 l g; agar, 15g; distilled water, 1000ml; pH, 6–6.4, 0.1ml aliquots from appropriate dilutions were spread-plated in duplicates. For three to five days, the culture plates were incubated at 25–28 °C. Smooth (non-hairy) colonies were counted as Yeasts rather than Mold when they lacked an extension at the margin (margin) [16].

2.4. The nutrient content of raw cow milk

Borosilicate Glass Round High Accuracy Milk Lactometer was used to determine the SG of milk. Milk samples were heated to bring the temperature between 10 °C and 21 °C. Samples were then poured into a glass cylinder, and the lactometer was slowly dipped into the milk until it floated. After some time, the scale reading and temperature were recorded and added or subtracted 0.1 for each Fahrenheit degree to the lactometer reading if the milk temperature was high or less than 15.56°c. After correction, the lactometer reading is called Corrected Lactometer Reading (CLR) [17].

The TS and water contents of raw cow milk were determined by the VWR, Blue-M, and Fischer Scientific oven-dried method. Row milk was taken in a pre-weighed china dish and evaporated in a steam bath. After evaporation, milk was dried in an oven at 101 °C. Dried milk samples were kept for 1 h in desiccators in the presence of silica gel and weighed, and the process was repeated until a constant weight was obtained [17].

2.5. Water sample analysis

Exactly 100 ml of the water sample was measured and filtered into a sterile filter paper with a 0.45-micrometer pore size which retains bacteria and allows the passage of a water molecule. Then the filter paper was placed on a Julius Richard Petri dish that initially contained a wetted absorbent pad [18]. Then the Petri dish was incubated at different temperatures for *different microbes*. For example, Yellow colonies from 37^{o}Cincubated plates were identified as presumptive *E. coli*. Plates having a bacterial count of 20–80 for *E. coli* were considered as an ideal countable range to calculate the number of colonies per 100 ml of water sample filtered. The maximum countable range was 200 colonies and calculated the *E. coli* bacteria per 100 ml of a water sample [19].

2.6. Hand swab laboratory analysis

Upon arrival at the laboratory, the swab head was rinsed into sterile 10 ml buffered peptone water to make the first dilution (10°). From this dilution, one ml was taken and transferred to the second and continued in this manner to each of the remaining test tubes having nine ml of sterilized buffered peptone water. The process was continued until the desired dilution was obtained. For example: To enumerate *E. coli* bacteria, 0.1 ml from the two consecutive dilutions were spread on separate MacConkey sorbitol agar dispensed petri-dish to get the accurate colony count. After incubation at 37^{o}c for 24 h, the pink colony (sorbitol fermenter) was counted and sub-cultured onto EMB agar [20].

2.7. Data management and statistical analysis

The data were coded and entered using Epi info 7 and exported to Stata 14.1. Then the mean prevalence, variability, and linear regression were executed by using Stata 14.1 statistical software. Chi-square and multiple linear regression models were used to determine the relationship between associated factors with milk microbial quality.

2.8. Quality assurance

Before the actual data collection, training, and discussion with 02 MSc Environmental Health Professional supervisors, 03 BSc Environmental Health Professional data collectors, and 02 Laboratory technicians were undertaken for 02 days. To keep the quality of the sample, every essential procedure was taken starting from collecting to the analysis of samples such as sterilization of sampling equipment, utilization of personal protective clothing, gloves, cold box to bring and take the sample, proper handling of sterilized materials, safe incubation of samples and use the control (blank) like using of non-inoculated media for samples and antibiotics. To check the sterility of the prepared media, 5% of the prepared batch of media was incubated overnight and checked for microbial growth in the media.

3. Results

3.1. Socio-demographic characteristics of the milkers

Out of 160 milkers included in the study, 104 (65.0%) were female, while the rest were male. About one-third of the milkers were aged between 35 and 50 years. 64(42.67%). 61(40.67%) of the study subjects had no education and completed their elementary school, respectively. About two-fifths of the milkers had one to two years of milk handling experience.

3.2. Nutrient content of the raw cow milk

Among 160 milk samples collected from dairy farmers, only 38.1% of raw cow milk SG lies in the better nutrient content range. But, 48.75 lies below the normal range and 13.1% lie above the normal range. This variation also resulted in a deviation in the nutrient content of raw cow milk. 38.1% were classified as having better nutrient content and the rest 61.87% of raw cow milk were worse nutrient content.

The statistically significant difference in the nutrient content occurred at the SG of raw cow milk below normal (Df = 2, Chi-square = 11.23, and P-value = 0.0034). But, no much likely statistically significant difference in raw caw milk's nutrient content occurred at the SG of raw milk above the normal range (Df = 2, Chi-square = 9.5, and P-value = 0.5300) (Table 1).

3.3. Microbial quality of the raw milk, water, utensil, and milkers

The mean (SD) microbial count in raw cow milk*E.coli* was 15 (0.3)log CFU/100mL-1, *S. aureus* was 8 (0.2)log CFU/100mL-, and Mold and Yeast were 4 (0.1)log CFU/100mL-1 and 9 [1] logCFU/100mL-1 respectively (Table 2). Besides In the water, milk utensil, and hand swab of milkers samples of *E. col* 4(0.3), 4(0.6), and 4 (0.5)log CFU/100mL-1

Table 1. The Chi-square test shows the nutrient content deviation of raw milk concerning the deviation in SG in Dairy farmers of SGZ 2020.

SG categories	TS (n = 160)	Water (n = 160)	Df	Chi-square	P-value
Below the normal	12.2% (78/160)	87.8% (78/160)	2	8.52	0.0034
Normal]1.032 (1.027–1.035)]	12.5% (61/160)	87.5% (61/160)			
Above normal	12.89 (21/160)	87.1% (21/160)	2	9.52	0.5300

Table 2. Microbial count (log CFU/100mL-1) in the d/t sampled media in South Gondar Zone, Ethiopia, 2020.

Sampled media	E.coli count		S.aureus		Mold		Yeasts	
	Mean (SD)	95% CI	Mean (SD)	95%CI	Mean (SD)	95% CI	Mean (SD)	95% CI
Milk	15 (0.3)	14,16	8 (0.2)	7,15	4 (0.1)	3, 5	9 (1)	7,10
Water	4 (0.3)	3, 5	1 (0. 5)	0.8, 2	3 (0.4)	2, 4	2 (0.5)	1, 3
Utensil	4 (0.6)	3, 5	2 (0. 5)	1,4	3 (0.1)	2, 4	4 (0.6)	3,5
Hand swab	4 (0.5)	3, 5	2 (0. 1)	1,3	4 (0.3)	3,5	6 (0.4)	4,8

NB: log CFU/100mL-1 is for utensils and water and Cm^2 for hand swabs.
KAP of milkers.

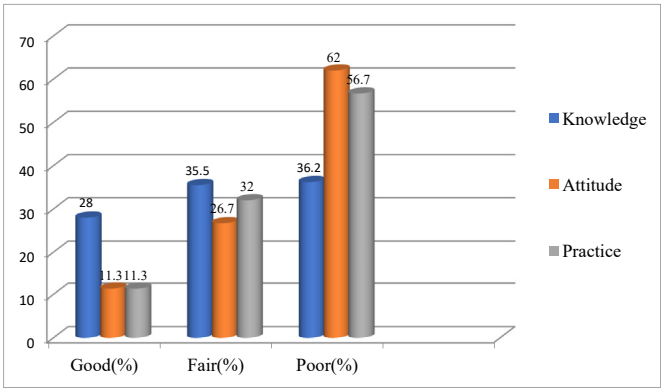

Figure 1. Knowledge, Attitude and Practices (KAP) of milk handlers in SGZ, Ethiopia, 2020.

or Cm^2 and *Mold* were 3(0.4), 3(0.1), and 4 (0.3)log CFU/100mL-1 or Cm^2 respectively (Table 2).

Over a quarter (28.0%) of milkers had good Knowledge. The proportion of milkers who had a good Attitude and Practices was 11.1%, each among 160 milkers (Figure 1).

3.4. Factors associated with microbial quality of raw cow milk

After checking the assumption for Binary linear regression; sex, age, educational status, milk handling experience, KAP of milkers, water microbial count, Nutrient content, and microbial load of milk utensils were entered into the multiple linear regression model (Table 3).

4. Discussion

Various pathogenic microbes and chemicals can contaminate raw cow milk. So the determination of vital indicators of its contamination is very important. The proliferation of the already existing microbes in raw milk and the introduction of other microbes from the external environment may lead to the deterioration of raw milk after it leaves the cow's udder [21]. This study aimed at evaluating the raw cow milk nutrient content and determinant factors of microbial growth among milk samples in the dairy farmers in the SGZ, Ethiopia.

In this, the overall mean **SG** and T**S** of raw cow milk were 1.027 (1.013–1.039) and 12.55% (12.20%–12.89%) respectively. 38.13% were classified as the better nutrient content, and the rest, 61.87% of raw cow milk deviated from the normal nutrient content.

The overall mean SG of raw cow milk is concordant with the study done in Addis Ababa, which reported the mean SG of 1.028and classified as the normal range of milk SG (1.027–1.035) [22] and the TS result of the current study is also closer to the study reported in East Wollega, Ethiopia (14.31 ± 0.1%) [23].

Over a quarter of milk samples were contaminated with *E. coli*, *S. aureus*, and *Mold*. The *S. aureu* result was in agreement with the study conducted in Ethiopia (21.2 %) [24], Oromia (20 %) [25], and Sebeta (19.6%) [25]. When compared with the study done in Jigjiga (7.0%) [2] and Iran (16%) [26], our finding is higher. The variation might be due to differences in the milkers' study area, period, and KAP of milkers.

This study used E. coli as an indicator organism that helps determine the microbial quality of milk, and their presence suggests enteric pathogenic bacteria probably contaminate the milk and milk products. mean *E. coli* value of this finding is higher than the result obtained from the rift valley of Ethiopia (4 ± 0.1 log CFU/100mL-1), Addis Ababa (5 ± 2 log CFU/100mL-1) [24], East Wollega (7log CFU/100mL-1) [23], Dawachefe, Ethiopia (5log CFU/100mL-1) [27] and Bench Maji-Zone, Ethiopia (5 ± 0.3log CFU/100mL-1) [28]. Moreover, the current result of the mean TC value was higher than the limit allowed by EU (5logsCFU/100mL-1) [29].

The result of *S. aureus* was 8 ± 0.2log CFU/100mL-1. This finding is higher than the acceptable limit set by the EU (absence in 1 ml) [29]. This may be attributed to these microorganisms contaminating raw cow milk through the poor hygienic condition of the milker, contaminated water supplies, not clipping, brushing, cleansing, and sanitizing udder, milking area, and milk utensils before milking. Besides, milk should be kept in the milk storage tank for less than10^{O}c after milking.

The mean value of the *Mold* concentration of the current study is agreed with a study done in Hawassa, Ethiopia (4 ± 0.1logsCFU/100mL-1) of raw cow milk [30]. However, this result was higher than the result obtained in Addis Ababa (2 ± 1log CFU/100mL-1) [24] and Dawa Chefe (0.6logCFU/100mL-1) [27]. The mean value of *Yeast* in raw cow milk is also higher than a result found in DawaChefe (0.46log CFU/100mL-1) [27], Eastern Ethiopia (3 ± 0.1log CFU/100mL-1) [30], and Addis Ababa (4 ± 0.5log CFU/100mL-1) [24]. The mean value of *Yeast* and *Mold* reported in this paper was higher than the limit allowed by the EU 2004 (5 log CFU/mL-1) [29].

Slightly higher than the Pakistan dairy farm study. This difference might be because Pakistan's weather is hot and exceeds 40^{O}c sometimes, which reduces the growth of bacteria [31]. And the lower result was obtained from Western Zambia [32]. Those could be due to poor personal hygiene of the milkers, utensils, contaminants from cow manure and milking area, and water used in milk production.

In Ethiopia, raw cow milk is consumed more than processed milk. People perceive that raw milk contains better nutrients than pasteurized milk; others believe that raw milk helps treat gastrointestinal problems, and less than 1% of milk is consumed after pasteurization [8]. Therefore about 31.8% of dairy farmers consumed raw cow milk [9].

But, this study disproved this perception because the study revealed that raw milk had worse nutrient content, and raw cow milk favored enteric bacteria's growth. Since raw cow milk is a common source of disease-causing pathogens. the use of pasteurized cow milk rather than consuming raw cow milk is critical to control gastrointestinal problems. This is documented by Sarkar S. 2015, pasteurization of raw milk helps destroy all pathogenic microorganisms, a good number of non-pathogenic and non-spore-forming bacteria, and improves certain enzymes in the nutritional value and the chemical nature of the milk because the pasteurization process is very important to eliminate all microorganisms and improve the nutrient content [33].

Table 3. Multiple linear regression analysis outputs of the study.

Variables	Estimate	Std. Error	T-value	Pr (>|t|)
Constant (Intercept)	6.23	2.50		
Sex	0.02	0.13	0.07	0.0600
Age	-0.09	0.07	-0.06	0.2100
Educational status	-0.18	0.08	-0.13	0.0021
Milk handling exp.	-0.20	0.60	-0.20	0.0070
Knowledge	-0.10	0.50	-0.47	0.0090
Attitude of MH	-0.25	0.01	-0.18	0.0030
MH practice	-0.52	0.01	-0.60	0.0030
Water coliform count	0.62	0.61	0.59	≤0.0010
Microbial load of milk Equipment	0.73	0.74	0.69	0.0070
Worse nutrient content	0.53	0.33	-0.21	0.0024

Dependent variable: Microbial count of raw cow milk.
Based on the Multiple linear regression analysis, the fitted regression model was: Microbial quality of raw cow milk = 6.23–0.18 educational status of milkers +0.62 water used for washing the utensils and hands of the milkers coliform count − 0.25 attitude of milker-0.52 practice of the milkers +0.73 microbial load of milk utensils −0.20 milk handling experience of the milkers +0.53 worse nutrient content of raw cow milk.

The key findings of this study, are that more than half of raw cow milk deviated from the normal nutrient content. The statistically significant difference in the nutrient content occurred at the SG of raw cow milk below normal (Df = 2, Chi-square = 11.23, and P-value = 0.0034), But, no much likely statistical significant difference in the nutrient content of raw milk (TS and Water content) occurred at the SG of raw milk above the normal range (Df = 2, Chi-square = 9.5 and P-value = 0.5300). This indicated that more attention is required if the SG deviation is below the normal. This problem might occur due to the unintended presence of chemicals such as food additives and inadequate equipment cleaning. Besides, the mean (SD) in log CFU/100mL-1of the *E. coli* count of raw cow milk was 15 (0.3). Educational status, milk handling experience, KAP of milk handlers, water microbial count, Nutrient content, and microbial load of milk utensils were independently predicted microbial quality of raw cow milk.

As the number of water *microbial* counts increased by one unit, the microbial count of raw cow milk increased by 0.62 (Table 3). This idea is in agreement with the study done in Tanzania, where washing with stored water contributed significantly (P-value< 0.05) more microbial load for all possible sources of contamination [34]. During using water for any purpose in milking activity, bacteria can get access to enter into raw milk, milking utensils, and the hands of the milkers [35].

In this study, As the educational status of the milkers increased by one unit, the microbial count of raw cow milk decreased by 0.18. Also, as the Attitude of the milkers increased by one unit, the microbial count of raw cow milk was reduced by 0.25 and also the low sanitary condition of the food utensils might indicate that there is the possibility of cross-contamination and the presence of *E. coli* in milkers suggests that the milkers are poor in sanitary practice and they were strongly significantly associated with raw cow milk microbial quality (Table 3). A recent study in Brazil showed that low KAP of milkers contributes to the raised count of the bacterial population in raw cow milk [36]. The cross-contamination might occur due to unclean hands, utensils, equipment, and food contact surfaces storing raw food at appropriate temperature; storing food uncovered; washing unclean water, and using dirty cleaning cloths.

This study also identified that worse nutrient content is statistically associated with the high growth of bacteria in raw cow milk. The Worse nutrient content of raw milk i.e., having high water content and low TS increased by one unit, the microbial count of raw cow milk was increased by 0.53 (Table 3). because microbes require an appropriate Source of energy, Nitrogen source, Vitamins, and water, Microbes exactly grow at low carbohydrate and protein and high water [37].

Safe foods and also food quality, the accessibility of healthy and nutritious food highly support the food security needs of the country as large. So the development of Knowledge, secure resources, and interconnecting of Food Safety, Food Quality, Food security, and the environment was a blue sky or a realistic option for achieving the SDGs related to Health, Hunger, water, sanitation, and economic development [38].

The limitation of this study was focused on the isolation and enumeration of specific microbes and indicators of nutrient content in milk samples and the determination of the microbiological quality of water and swab samples during the dry season of the year. However, microbiological quality may vary between wet and dry seasons. Hence, future researchers may be advised to investigate the quality of milk in both seasons of the year. Additionally, quantification of other pathogenic bacteria and specific chemicals relevant in the dairy industry should be investigated.

5. Conclusions

Raw cow milk in dairy farmers was contaminated with various pathogenic microbes and had low essential nutrients (low TS and high water content). The study also identifies educational status, milk handling practice, KAP of milkers, and worse nutrients (low TS and high water content) were significantly associated with microbial quality of raw cow milk, Education in the community is crucial for improving milk safety and quality and avoiding Drinking raw milk. Therefore, the scientific community better prepares training for dairy farmers.

Declarations

Author contribution statement

Chalachew Yenew, Fitalew Tadele, Biruk Demissie: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Binyam Minuye, Ermiyas Sisay, Tadesse Asmamaw, Sileshi Mulatu: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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