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Physicochemical Properties and Microbiological Quality of *ititu* (Traditionally Fermented Cow Milk) in Selected District of Borena Zone, Oromia Regional State, Ethiopia

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Abstract

The study was conducted to investigate the physicochemical properties and microbial quality of *ititu* produced in the Borana zone. A total number of 35 *ititu* samples, 30 traditionally made plus 5 laboratories made *ititu*, were analyzed for their physicochemical properties and microbiological quality. The overall average (±SD) values for pH, titratable acidity, total protein, fat, total solids, and ash were 3.59% ± 0.04%, 2.86% ± 0.18%, 7.26% ± 0.41%, 9.85% ± 0.73%, 21.23% ± 1.48%, and 0.84% ± 0.11%, respectively for traditionally made *ititu*. The result of all physicochemical parameters of traditional *ititu* was not significantly) different ($P > 0.05$) with laboratory-made *ititu* (control sample).The average (±SD) total bacteria count (TBC), coliform count (CC), yeast and mould count (YMC), Staphylococcus aureus count and Listeria monocytogenes count were 8.36 ± 1.29, 3.47 ± 0.51, 8.06 ± 1.28, 3.79 ± 0.91 and 3.15 ± 0.17 $\log_{10}$cfu/ml, respectively for traditional *ititu*. Whereas, the corresponding values for the laboratory-made *ititu* were 4.17 ± 0.55 $\log_{10}$cfu/ml, 0, 5.76 ± 0.57 $\log_{10}$cfu/ml, 0 and 0, respectively. Significant ($P < 0.05$) differences were observed between traditional and laboratory-made *ititu* for coliform, S. aureus and L. monocytogenes count. The Prevalence of pathogenic microorganisms for S. aureus and L. monocytogenes were 33.33% and 6.67%, respectively for traditionally made *ititu* while not detected for laboratory-made *ititu*. The results indicated that the quality of traditional *ititu* was substandard and not safe for consumption. This in general, the production of *ititu* in the study area requires intervention such as awareness creation of keeping good hygienic quality and pasteurization (heating up to boiling) of milk to be used for *ititu* making in order to make it safe from the public

health point of view.

Keywords

ititu, Cow, Fermented Milk, Microbiology, Physicochemistry

1. Introduction

Livestock represents major national resources and forms an integral part of the agricultural production system in the country [1]. Ethiopia is one of the developing countries in which urban and peri-urban dairying constitutes an important sector of the agricultural production system [2]. Milk is considered one of the most important diet items of many people and is nutritionally defined as the most nearly "perfect food" which is a compensatory part of daily diet especially for the expectant mothers as well as growing children [3]. Milk production systems can be broadly categorized into urban, peri-urban and rural milk production systems [4]. The rural dairy system is part of the subsistence farming system that contributes up to 98% of the total milk production in Ethiopia and includes pastoralists, agro-pastoralists, and mixed crop-livestock producers [5] [6] and [7]. In Ethiopia, consumption of raw milk and milk products is common that may lead to the transmission of various diseases and has public health hazards [8] [9] Apart from the quality and safety concerns, poor handling practices in the country causes postharvest losses [9] [10].

Traditional fermented milk products are widely consumed in the entire world. These products are an important supplement to the local diet and provide vital elements for growth, good health [11] [12] and an appreciated flavor. Microorganisms of lactic acid starter cultures used for the conversion and preservation of milk products are unique bio-converters of energy. In the earlier days, fermentation was used to control the growth of harmful bacteria and some pathogens, while making indigenous milk products. The microorganisms principally encountered in the dairy industry are bacteria, yeasts, molds and viruses. Some of the bacteria (lactic acid bacteria) are useful in milk processing, causing milk to sour naturally. However, milk can also contain pathogenic bacteria, such as *Salmonella* spp., *Staphylococcus aureus*, *Escherichia coli*, *Mycobacterium tuberculosis*, *Listeria* spp., *Brucella* spp [13]. The presence of these pathogenic bacteria in milk emerged as major public health concerns, especially for those individuals who still drink raw milk [13].

The consumption of milk and milk products varies geographically between the highlands and the low lands and even in the level of urbanization. In the lowlands like Borena, one of the pastoralists group in Ethiopia, where livestock keeping is the main occupation, milk is consumed by all groups of the society. In Borana, pastoralists traditionally ferment cow milk and this product is called *ititu*. It is considered as one of the special foods and served to many respected

guests as well as to weaning-age children and the elderly. It is consumed as a side dish with traditional porridge or thin baked cereal bread [14]. During the traditional production of *ititu*, fresh milk is collected in a well-smoked fermenting vessel called Gorfa. It is prepared at 27˚C - 30˚C for 15 - 30 days with periodic removal of whey with wooden pipet (Dhumaa) & the addition of fresh milk every 3 - 4 days, which needs a longer time of fermentation. The process of whey removal and addition of fresh milk is repeated several times until the product is concentrated enough and is ready for consumption [14].

However, there is limited work so far undertaken regarding *ititu* (traditionally fermented cow milk) and the recently available report also lacks bacteriological quality and physicochemical properties in particular to the Borana zone. Therefore, this work is aimed to evaluate physicochemical properties and microbiological qualities of traditionally fermented cow milk, *ititu*, in the selected districts of Borana Zone Oromia regional state, Ethiopia. The study also attempted to manufacture a prototype sample using the standard procedure of *ititu* in the laboratory for comparison of qualities.

2. Materials and Methods

2.1. Study Area

The study was conducted in Yabello, Arero and Dire districts of Borana zone, Oromia regional state, Ethiopia, focusing on pastoralists who own cow and produce cow milk in order to get background information regarding production practices of the traditional fermented cow milk *ititu* in the area. The districts were purposively selected based on potential of cow possessions and accessibility and willingness of the households to take part in the study. Yaballo is located at a distance of 563 km from Addis Ababa, the Capital city of Ethiopia. Arero and Dire are located at equidistant (100 km), each to east and south of Yabello town, respectively. Yabello is located at 1350 - 1800 meter above sea level (m.a.s.l.) and it is located between latitude 4˚30'55.81" and 5˚24'36.39"N and longitude 7˚44'14.70" and 38˚36'05.35"E. Borana rangeland is found in the south most part of Ethiopian lowlands occupying about 555,000 hectares total land area [15]. The mean annual rainfall is about 700 mm which is bimodal in distribution with 59% of total annual precipitation occurring from March to May and 27% from September to November. The mean monthly maximum and minimum temperature is 19˚C and 24˚C, respectively [16].

2.2. Traditional *ititu* Making Procedure

According to respondents, *ititu* is made from cow milk by natural spontaneous fermentation without addition of any starter culture. Some respondents suggested that, it is also made from goat milk but it has no consistency like that of *ititu* made from cow milk. Souring of milk is practiced at any time when surplus milk is available and mainly during wet season. The complete process of fermentation takes place for 15 days but for immature *ititu*, which is locally called

"Kelba", the process of fermentation is only about 2 - 3 days. The study shows that the storage utensil used for preparation of *ititu* is called *Gorfa* (made from root fiber of some plants) and it is also used for churning of milk for butter production in the study area. Almost all respondents followed the same procedure for making *ititu* in the study area. According to the interviewed households, the procedure for making was: first the *Gorfa* is washed with water and mainly smoked with *Olea africana* (Ejersa), *Terminallia brownii* (Bireessa), Daansee, *Acacia nilotica* (Burquqqee) *Maerua triphylla* (Dhumasoo) and *Combretumhereroense* Schinz (Kennoo) were common Then the fresh raw milk is filled and tightly closing the *Gorfa* and hanging it in the *Sepana* (a part of the house in which some tool is hanging on it). The milk becomes traditionally fermented after 3 - 4 days and more than 4 days in *Gorfa* under room temperature. Whey liquid (*Dhama*) is removed from the container by wooden pipette after which fresh milk is added and the removed "*Dhama*" was usually drunk by group of people in the village. Further incubation of fermented milk for about 3 - 4 days forms "Kelba (immature *ititu*)" which is not hard and lacks consistency The removal of the whey liquid (*Dhama*) from fermented milk is more practiced within 3 - 4 days of interval and followed by addition of the fresh milk to fill *Gorfa*. This process continuous until the *Gorfa* is filled with hard curd). The result of survey indicated that, to obtain the hard card which is *ititu* it takes about 15 days.

2.3. *ititu* Sample Collection and Transportation

A total of thirty-five *ititu* samples of fifteen days old *ititu* were collected from the pastoral households and laboratory-made to investigate the physicochemical properties and microbial quality of *ititu*. Thirty *ititu* samples from pastoral households and five *ititu* samples from laboratory-made were collected. *ititu* samples were prepared in the laboratory by simulating the traditional methods except for Pasteurization of raw milk and the addition of stature culture for fermentation (acidification). A total of five raw cow milk samples were collected from Yabello Research Pastoral and Dry Land Agricultural Research Center's (YPDARC) dairy farm with proper hygiene from milking up to arrival to a laboratory of YPDARC for laboratory-made *ititu*. During collection, approximately 250 ml *ititu* sample was taken from the container into sterile glass bottles. The milk samples taken from the different containers at a market (from the sellers) were pooled in sterilized containers and thoroughly mixed and then, placed into sterile glass bottles. Then the samples were labeled and transported in icebox the same day to the Dairy Laboratory of Hawassa University where its physicochemical properties and microbial quality were analyzed.

2.4. Physicochemical Analysis

2.4.1. Titratable Acidity Test

Titratable acidity (TA) of the *ititu* samples was determined according to the method of the Association of Official Analytical Chemists [17]. Nine ml of *ititu*

sample was pipetted into a beaker and 3 to 5 drops of 1% phenolphthalein indicator was added to it. The sample then titrated with 0.1N NaOH solution until a faint pink color persisted. The titratable acidity expressed as % lactic acid, was finally calculated using the following formula.

$$\text{TA\%} = \frac{\text{N/10 NaoH (ml)} \times (0.09)}{\text{Weight of sampple}} \times 100$$

2.4.2. pH Determination

The pH of the *ititu* samples was determined in the laboratory using a digital pH-meter based on the procedure described by O'Connor (1995). The pH meter was calibrated using buffers of pH 7.0 and 4.0 each time before the pH of *ititu* samples was measured. pH was measured by dipping the electrode of the pH meter into each representative sample (250 ml) upon arrival of the samples at a laboratory. Cleaning of the tip of the electrode with distilled water was employed between the testing of each sample.

2.4.3. Total Solids (TS)

The total solids content of the *ititu* was determined by oven drying at 105˚C overnight. Moisture and the total solid content were determined according to [18] methods. About 5 g of sample was weighed into a dry and pre-weighed crucible and the samples were labeled carefully using a pencil. The crucible and its content was then transferred into the oven at a temperature of 105˚C and dried for 12 h. The crucibles were allowed to cool in desiccators and weighed. The crucibles were returned into the oven for another half hour and again cooled and reweighed. The process was repeated until a constant weight was reached. The total solids content was calculated according to the following formula:

$$\text{TS} = \frac{\text{weight sample Cwt} - \text{weight sample dry Oven}}{\text{crucible weight}} \times 100$$

were, Cwt = crucible weight

2.4.4. Crude Protein Determination

The total protein content of the *ititu* samples was determined by the Kjeldahl method [17] according to the following procedures: For digestion: Five grams of *ititu* samples were warmed in a water bath at 38˚C and poured into a Kjeldahl flask. Fifteen-gram potassium sulfate, 1.0 ml of copper sulfate solution and 25 ml of concentrated sulphuric acid was added into the flask and mixed gently. The digestion was carried out in a digestion block until a clear solution appeared. Then it was allowed to cool to room temperature. For distillation: The digestion flask was placed in the distillation equipment and then 30 ml of distilled water and 75 ml of 50% sodium hydroxide solution were added into it. Then, ammonia was distilled then 50 ml of 40% boric acid solution using bromocresol green indicator was added until the blue color appeared. Finally, the sample was titrated with 0.1 N hydrochloric acid solution from a burette until a faint pink

color solution was formed and the burette reading was taken to the nearest 0.01 ml. The blank test was carried out using the above procedure except that water was used instead of a test sample. The percentage of nitrogen in the samples was calculated as follows:

$$\%N = \frac{(Vb - Vs)HCl\ consumed \times NHCl \times 1.4007}{Sample\ weight} \times 100$$

%CP = %N × 6.38 where,

%N = percentage nitrogen by weight;

Vs = volume of HCl used for titration of sample;

Vb = volume of HCl used for titration of the blank;

% CP = percentage of crude protein.

2.4.5. Fat Content

The fat content of *ititu* was determined according to the Official Methods of Analysis [18]. Thus 10 ml sulphuric acid was added into the butyrometer (8 calibrations) followed by 11 ml of well-mixed samples for whey and *ititu*. Three grams (3 g) of *ititu* sample was added with 8ml water. Then 1 ml of Amyl alcohol was added and immediately insert stopper and shake the butyrometer carefully until the curd dissolves and no white particles can be seen. The butyrometer was kept in the water bath at 65˚C until a set was ready for centrifuging. Finally, the butyrometer was placed in the centrifuge for 5 minutes and kept in the water bath at 65˚C for the other 5 minutes to be settled and ready for reading.

2.4.6. Ash Content

The ash content *ititu* was determined by incinerating 5 g in a muffle furnace at 550˚C for 6 h. After cooling in desiccators for a period of 45 minutes, the % of total ash content was calculated on a dry basis according to Official Methods of Analysis [18].

$$Ash = \frac{weight\ Residue}{weight\ Sample\ weight\ Residue} \times 100$$

2.5. Microbiological Quality Analysis

2.5.1. Total Plate Count

For total plate count, appropriate decimal dilutions were prepared that result in a total number of colonies on a plate between 30 and 300 [19]. A standard Plate Count Agar (PCA) (Oxoid, CM0325: UK) was first sterilized according to the manufacturer's instructions and then it was cooled to 45˚C before pouring. One ml of *ititu* sample was added into a sterile test tube containing nine ml of peptone water (15%) and was mixed thoroughly. Then one ml of the sample from appropriate decimal dilution was placed on duplicate Petri dishes and then about 15 ml of the molten agar was added to it and mixed thoroughly. The plates were incubated for 48 hours at 32˚C [19]. Finally, colony count was made using a colony counter (RDC, M671: England). The estimated number of colonies per

ml of the sample was calculated by the formula.

$$N = \frac{\sum CN}{(1 \times n1) + (0.1 \times n2)} \times d$$

where,

N = Number of colonies per ml of milk sample

∑C = Sum of all colonies on plates counted

*n*1 = Number of plates used in lowest dilution counted

*n*2 = Number of plates used in highest dilution counted

d = dilution factor of the lowest dilution used.

2.5.2. Coliform Count (CC)

One ml of *ititu* sample was dispensed into sterile test tubes containing 9 ml of 0.1% peptone water and thoroughly mixed using whirl mixer. Subsequent serial decimal dilutions were prepared in a similar manner using 0.1% peptone water. Duplicate appropriate decimal dilutions were surface plated on Violet Red Bile Agar (VRBA) and incubated at 45˚C for 24 hours. After complete incubations, typically dark red colonies on uncrowned plates were considered as coliforms for colony counts. This was followed by a confirmatory test by transferring five colonies from each plate to tubes of 2% Brilliant Green Lactose Bile Broth (BGLBB). Gas production after 24 h of incubation at 32˚C was considered sufficient evidence of the presence of coliforms [19].

2.5.3. Yeast and Mould Count (YMC)

For yeast and mould count, *ititu* samples were serially diluted in peptone water and volumes of 1 ml of appropriate dilutions were plated in duplicate Petri dishes by the pour plate technique using Potato Dextrose Agar (PDA) (Oxoid, Pvt. Ltd. MU 096: Uk). Colonies were counted after incubation at 25˚C for 5 days [19]. The number of microorganisms or colony-forming units (CFU) per milliliter of *ititu* samples was calculated as indicated for the total plate count above.

1) *Staphylococcus aureus*

Presumptive colonies of *Staphylococcus aureus* were selected and subcultured on nutrient agar and incubated aerobically at 37˚C for 24 - 48 h. After this incubation on nutrient agar, bacteria were identified according to their Gram reaction, morphology and the catalase test. *S. aureus* was identified by the tube coagulase test (4 h), hemolysis (blood sheep as substrate), pigment production (golden yellow), mannitol and maltose fermentation. Samples were considered as positive for S. *aureus* when at least one colony was identified as *S. aureus*.

2) *Listeria monocytogenes*

For the detection of *Listeria monocytogenes*, well-mixed testing samples (25 ml) were homogenized in 225 ml of Listeria Enrichment Broth A and B and incubated for 24 h at 37˚C [20]. A loop full of the enrichment culture broth was streaked in duplicate onto Polymyxin-Acriflavin-Lithium Chloride-Ceftazidime-Aesculin-Mannitol (PALCAM) agar and incubated for 48 h at 37˚C. Suspected

Listeria monocytogenes colonies were further characterized using staining, catalase reaction, umbrella-shaped motility pattern, hemolysis on sheep blood agar, fermentation of mannitol, rhamnose, xylose, glucose and maltose, and Acronym for Christie Atkins, Munch, Petersent (cAMP) tests, in accordance with Bergey's Manual of Systematic Bacteriology.

2.6. Data Analysis

The results of physicochemical and microbial counts were first transformed to logarithmic values (log10) and these transformed values were analyzed using the General Linear Model (GLM) for least squares means in SAS 9.1 (SAS, 2009) using a fixed-effect model. The Least Significant Difference (LSD) test was used to separate the means and differences were considered significant at $P < 0.05$.

The following model was used for the analysis of physicochemical and microbial test of *ititu*;

$$Y_{ij} = \mu + \beta_i + E_{ij}$$

Y_{ij} = Individual observations for bacteriological quality and physicochemical properties of *ititu* (dependent Variable);

μ = Overall mean;

β_i = *ititu* manufacturing types effect;

E_{ij} = Random error.

3. Result and Discussion

3.1. Physicochemical Properties of *ititu*

Traditionally made and laboratory-made *ititu* (control) were analyzed for physicochemical properties (Table 1). There was no significant difference observed between the traditional and laboratory-made *ititu* for all physicochemical analyses. The average pH values were 3.59 ± 0.04 and 3.55 ± 0.34 traditional and laboratory-made *ititu*, respectively.

Table 1. Physicochemical parameters, pH and acidity of traditional and laboratory-made *ititu* in the study area.

Variables	Traditional *ititu*	Laboratory made *ititu*
Total Solid (%)	21.23 ± 1.48	21.58 ± 0.67
Fat (%)	9.85 ± 0.73	10.12 ± 0.62
Protein (%)	7.26 ± 0.41	7.31 ± 0.03
Ash (%)	0.84 ± 0.11	0.88 ± 0.18
pH	3.59 ± 0.04	3.55 ± 0.34
Titratable Acidity (%)	2.86 ± 0.18	2.92 ± 0.2

Values in the table are means ± SD of two replications; Values with the same letters in the raw are not statistically significant difference ($P > 0.05$).

The average total solid of traditional and laboratory-made *ititu* was 21.23% ± 1.48% and 21.58% ± 0.67%, respectively (Table 1). There was no significant difference ($P > 0.05$) between traditional and laboratory-made *ititu* in total solid percentage. The higher total solid in the current study for both traditional and laboratory-made *ititu* was due to the addition of fresh milk at every time of removing the whey liquid during the manufacturing of *ititu*.

The highest value of fat percentage in both traditional and laboratory-made *ititu* in the current study was due to the difference in manufacturing procedure that continues the concentration of *ititu* was made by removing the whey component that comes due to syneresis.

3.2. Microbial Counts of Traditional and Laboratory Made *ititu*

3.2.1. Total Bacteria Count (TBC)

The overall total bacterial counts (TBC) of traditional and laboratory-made *ititu* were 8.36 ± 1.29 and 4.17 ± 0.55 $\log_{10}$cfu/ml, respectively (Table 2). The present result shows that there was a significance difference ($P < 0.05$) between traditional and laboratory *ititu* (Table 2). The present study also showed that the highest result of TBC was recorded in traditionally made *ititu* while the least was in laboratory-made *ititu* (Table 2). This difference was due to hygienic practice followed during milking and Pasteurization of laboratory-made *ititu*. The value of TBC for traditional *ititu* exceeds the acceptable limits of unpasteurized milk and milk product ($\leq 10^5$ cfu/ml) while the value of laboratory-made *ititu* was below acceptable limits of pasteurized milk and milk product (below 2×10^4 cfu/ml) [21] which was safe for consumption. This was due to hygienic practices followed during all manufacturing steps and pasteurization of laboratory-made *ititu*.

3.2.2. Coliform Count (CC)

The mean coliform count (CC) of traditionally made *ititu* was 3.47 ± 0.51 $\log_{10}$cfu/ml; while no CC was detected for laboratory-made *ititu* (Table 2). There was significance ($P < 0.05$) of mean count for CC between laboratory and traditional made *ititu* (Table 2). The highest value of CC was detected in traditional while not detected in laboratory-made *ititu* (Table 2). The significance

Table 2. Mean microbial counts ($\log_{10}$ CFU/mL) of traditionally and laboratory-made *ititu* samples in the study area.

Microbial counts	Traditional *ititu*	Laboratory made *ititu*
Total bacteria (TBC)	8.36 ± 1.29^a	$4.17^b \pm 0.55$
Coliform (CC)	3.47 ± 0.51^a	ND
Yeast and mold (YMC)	8.06 ± 1.28^a	5.76 ± 0.57^b
Staphylococcus aureus	3.79 ± 0.91^a	ND
Listeria monocytogenes	3.15 ± 0.17^a	ND

Superscripts in the same raw having different letters indicate a significant difference ($P < 0.05$) among the *ititu* samples; values in the table are means ± SD of two replications. ND= Not detected.

Difference ($P < 0.05$) between traditional and laboratory-made *ititu* samples might be due to the existence of coliform bacteria in milk and milk products which is an indicator of fecal contamination and unsanitary practices during production, processing, or storage for traditionally made *ititu*. The result of the present study for coliform counts of traditional *ititu* exceeds the acceptable limits of raw milk and milk product which was below ≤100 cfu/ml. This implies the traditional *ititu* was not safe for consumption while vice versa for laboratory-made *ititu*.

3.2.3. Yeast and Mould Count (YMC)

The mean yeast and mould count (YMC) of traditional and laboratory-made *ititu* were 8.06 ± 1.28 and 5.76 ± 0.57 $\log_{10}$cfu/ml (**Table 2**), respectively. There was a significant ($P < 0.05$) difference between traditional and laboratory-made *ititu* for YMC. Traditional *ititu* had the highest YMC and the least record was in laboratory-made *ititu* samples (**Table 2**). The higher YMC observed in traditional *ititu* might be attributed to contamination from the air, storage temperature, humidity, the containers or poor hygienic conditions followed by the producers and poor personal hygiene of individuals. The values for both traditional and laboratory-made *ititu* were much higher than the acceptable value (<10 cfu/gm) [22].

1) ***Staphylococcus aureus***

The mean count of *S. aureus* of traditionally made *ititu* was 3.79 ± 0.91 $\log_{10}$cfu/ml, while was not detected in the laboratory made *ititu* (**Table 2**). The average counts of *S. aureus* of traditionally made *ititu* were significantly different ($P < 0.05$) between traditional and laboratory-made *ititu* for the present study (**Table 2**). The highest value for *S. aureus count* was detected in the traditional *ititu* while not detected laboratory-made *ititu* (**Table 2**). This might be due to pasteurization of raw milk and hygienic condition followed during milking production of laboratory-made *ititu*. The value of *S. aureus* for traditional *ititu* was higher than the acceptable values in which pathogenic microorganisms should not be detected in 9 ml of the product [23].

2) ***Listeria monocytogenes***

The overall mean of *Listeria monocytogenes* count for traditional and laboratory-made *ititu* was 3.15 ± 0.17 $\log_{10}$cfu/ml and not detected (**Table 2**) respectively. There was a significant difference ($P < 0.05$) between the traditional and laboratory-made *ititu*. The difference was due to proper hygiene during milking up to the production of *ititu* and Pasteurization of raw milk that used for laboratory-made *ititu*. The value of *Listeria monocytogenes* for traditional *ititu* was higher than the acceptable values in which pathogenic microorganisms should not be detected in 25 ml of the product [23].

3.2.4. Prevalence of Some Pathogenic Microorganisms

1) ***Staphylococcus aureus***

The overall prevalence of *S. aureus* for traditional and laboratory-made *ititu* sample was 33.33% (10/30) and 0% respectively (**Table 3**). This attributed to

Table 3. Prevalence of *Staphylococcus aureus* and *Listeria monocytogenes* of traditional and laboratory-made *ititu* in the study area.

ititu types	Number of collected samples	Number of positive samples (n) (%)	
		Staphylococcus aureus	*Listeria monocytogenes*
Traditional *ititu*	30	10 (33.33)	2 (6.67)
Laboratory made *ititu*	5	0 (0)	0 (0)

poor in pre-milking washing udder, washing milking utensils with boiled water and quality water used for cleaning utensils in traditional fermented *ititu*. It also due to the fact that *S. aureus* appears in milk from cows affected with mastitis [24].

2) ***Listeria monocytogenes***

In the present study of the 30 examined traditional made *ititu* samples, 2 (6.67%) were positive for the presence of *Listeria monocytogenes*; while no detected in laboratory-made *ititu* (**Table 3**). Higher prevalence *Listeria monocytogenes* was detected in traditional *ititu*.

4. Conclusions

The result of all physicochemical parameters of traditional *ititu* was not significantly) different ($P > 0.05$) with laboratory-made *ititu* (control sample). *ititu* manufacturing was able to concentrate/increases the initial milk's total solid nearly by two folds that will be a significant improvement of food from a nutritional point of view. The result of microbial quality showed that traditional production of *ititu* in the study area was not hygienic and safe for consumption while laboratory-made *ititu was* safe for consumption. In addition there is no significant difference ($P > 0.5$) among the three districts (which are traditional *ititu*) in terms of physicochemical parameters and microbial analysis. These results appear to suggest the following recommendation:

- The present study revealed that *ititu* made traditionally by pastoralists was found to be poor in quality and this was attributed to the poor hygienic conditions followed during handling and preparation of *ititu*. This calls the need for awareness creation and training of pastoralists to follow proper hygienic practices during milking and production of *ititu* and heating up to boiling of raw milk before used it to make *ititu*.
- The adoption of physicochemical properties of whey part of *ititu*, will need further study in the future.
- In the present study, lactic acid bacteria (LAB) responsible for the fermentation of cow milk and the production of *ititu*, not studied. Thus, identification and isolation of LAB responsible for *ititu* production deserves detailed study in the future
- In the present study, some pathogenic microorganisms like *E. coli*, Tubercu-

losis and Salmonella spp. were also not examined in the *ititu* production. So this calls for detailed study in the future.

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Abbreviations

"BGLBB" means "Brilliant Green Lactose Bile Broth", "BPDO" means "Borana Zone Agricultural and Pastoral Development Office", "cAMP" means "Cyclic Adenocyne Monophosphate", "CC" means "Coliform Count", "Cfu" means "Colony Forming Unit", "EADD" means "East Africa Dairy Development", "EMB" means "Eosin Methylene Blue", "FA" means "Food and Agricultural Organization of United Nation", "FCT" means "Federal Capital Territory", "GLM" means "General Linear Model", "IDF" means "International Dairy Federation", "ILCA" means "International Livestock Center for Africa", "ILRI" means "International Livestock Research Institute", "LEB" means "*Listeria* Enrichment Broth", "LMP" means "Livestock Master Plan", "MFB" means "Modified Fraser Broth", "MOA" means "Ministry of Agriculture", "OARI" means "Oromia Agricultural Research Institute", "PDA" means "Potato Dextrose Agar", "TBC" means "Total Bacterial Count", "VRLBA" means "Volatile Red Bile Agar", "YMC" means "Yeast and Mold Count", and "YPDARC" means Yabello Pastoral and Dryland Agriculture Research Center.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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