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## Bacteriological Quality and Safety of Raw Milk in Addis Ababa City Nifas Silk Lafto Subcity Jemo District, Ethiopia.

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### Abstract

Ethiopia possesses significant potential for dairy development. However, dairy products safety is worldwide major concern particularly in developing countries like Ethiopia. Milk provides suitable living environment for different types of microbes and its microbial load is a critical determinant of quality. A lack of scientific knowledge regarding microbial quality and milk handling hygienic practice contributes to the contamination of milk in many areas. In the study area Addis Ababa city, specifically at Jemo District, there is considerable milk production potential. Nevertheless, due to limited awareness of modern milk processing techniques, producers primarily sell milk and dairy products through traditional methods within informal marketing chains. Therefore, this cross-sectional study main objective was to assess the raw milk bacteriological quality and safety produced by producers and sold by vendors in Nifas Silk Lafto Sub-city Jemo District of, Addis Ababa. Randomly selected 50 samples of raw milk were tested for their bacteriological quality and safety. For microbiological analysis, in 0.85% sterile saline solution 1 ml was added in sterile test tube to prepare the first  $10^{-1}$ , followed by further serial dilutions as necessary ( $10^{-2}$ ,  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-6}$ ,  $10^{-7}$ ). The mean counts of bacterial contaminants in the raw milk samples were as follows: Aerobic Mesophilic Bacteria:  $5.48 \pm 1.25 \log_{10}$  CFU/mL, Coliforms:  $3.58 \pm 0.12 \log_{10}$  CFU/mL, *Escherichia coli*:  $4.35 \pm 0.57 \log_{10}$  CFU/mL, *Staphylococcus aureus*:  $3.20 \pm 0.21 \log_{10}$  CFU/mL and *Salmonella* species:  $3.04 \pm 0.38 \log_{10}$  CFU/mL. Alarmingly, 37(74%) of samples were detected by *Escherichia coli*, *S. aureus* detected in 31 (62%) samples and *Salmonella* detected in 25 (50%) samples. These levels exceed the acceptable safety guidelines and render the milk unfit for consumption, posing a significant risk to public health. To address these challenges, educational programs, particularly professional training on food handling and hygiene, are strongly recommended. Such initiatives are essential to improve milk producers and vendors milk handling attitudes and practices, thereby enhancing milk quality and safety distributed in Jemo district.

**Keywords:** Bacteriological quality, *Escherichia coli*, Raw milk, Safety, *Salmonella*, *Staphylococcus aureus*

### 1. Introduction

Ethiopia has substantial dairy production potential, primarily because of high number of livestock and suitable

environmental conditions to livestock production (Tsegaye *et al.*, 2004). However, the quality of milk products in relation milk-borne diseases remains

significant attention globally, especially in developing country, where milk production

process takes place in traditional way under unsanitary condition (Habtamu Korma *et al.*, 2018).

Consumers increasingly demand dairy products which are nutritious, wholesome, and high-quality milk and milk products processed in hygienic condition free from contamination. Nevertheless, the lack of recent scientific knowledge coupled with enough dairy infrastructure and hygienic milk handling awareness and quality management among smallholder producers in Ethiopia, has resulted in poor product quality (Mihiret Frew & Kirose Abebe, 2020).

Milk, by its nature, provides an ideal environment for microbial growth because of its neutral  $P^H$ , essential nutrients and appropriate water content. These factors make it an excellent medium for the proliferation of microorganisms (Guesh Mulaw & Anteneh Tesfaye, 2017).

Raw milk is highly prone to bacterial contamination due to its nutrient-rich composition, which offers favorable conditions for the growth and proliferation of harmful microorganisms. This contamination can result in spoilage, milk-born illnesses and toxic effects (Yodit Ayele *et al.*, 2017). The presence of bacteria in milk and its products poses a serious threat to public health, as contamination may occur during different stages of milk production and handling processes (Milligo *et al.*, 2010).

The primary purpose of using bacterial indicators is to evaluate hygienic quality of milk and its products. A microbial count exceeding  $10^5$  CFU/ml is an indication of poor hygiene during milk production,

whereas counts below this threshold suggest adherence to good sanitary practices (Jermen Mamo, 2016). The identification *Escherichia coli*, *Staphylococcus aureus* and *Salmonella* species in raw milk indicates contamination by pathogenic bacteria, which can endanger consumer health safety and highlight potential safety concerns in the milk supply of the study area (Zelalem Yilma and Bernard Baye., 2006).

A lack of scientific knowledge regarding microbial characteristics and clean milk production techniques continues to play great role in poor quality of milk hygiene. Producing milk and dairy products of acceptable hygienic quality requires the integration of scientific knowledge with traditional practices to consistently ensure high-quality; safe fermented dairy products, thereby adding value and reducing spoilage-related losses.

In Addis Ababa, specifically in the Nifas Silk Lafto Sub city, Jemo district, there is significant potential for milk production. However, producers predominantly market milk and dairy products through traditional, informal channels, largely because of shortage of awareness about modern milk production techniques-despite the study area found in the capital city of Ethiopia.

Therefore, the main objective of this study was to evaluate the hygienic status of milk producers and vendors and bacteriological quality of raw milk in Addis Ababa city Nifas Silk Lafto Sub-city Jemo district.

## 2. Materials and Methods

### 2.1. Study Area

This study presided in Addis Ababa, Nifas Silk Lafto sub-city, Jemo district. It is

found at 8°57.192'N latitude and 38°43.728' longitude. Jemo experiences two main rainy seasons Belg (March-May) and Kiremt (June-September) as any other

Addis Ababa areas, The Kiremt rainy season typically brings the most rain fall. The main source of income for Jemo people is trade.



Figure 2.1. The map of Addis Ababa, Nifas Silk Lafto sub-city and Jemo district respectively

## 2.2. Study population

Dairy producers who keep cow to produce milk and vendors operating raw milk in local shops within the Jemo district were the study population. Jemo district, recognized for its high dairy potential, was purposively selected from among the other districts in the sub-city.

According to data from the Nifas Silk Lafto Sub-city Urban Agriculture Office (2016 E.C.), there are 224 individuals in the sub-city who collectively own 458 dairy cows. Specifically, in Jemo district, there are 37 dairy farmers managing approximately 106 dairy cows, alongside 98 raw milk vendors. Additionally, there are around 120 raw milk vendor shops supply raw milk and milk products in the district.

## 2.3. Study Design

From January 2024-January 2025 cross-sectional study was presided to assess the bacteriological quality and safety of raw

milk retailed in producers and vendors in Nifas Silk Lafto sub city Jemo district. Likewise, the handling and sanitation practice of producers and vendors in Nifas Silk Lafto sub city Jemo district was assessed.

## 2.4. Sample Size and Sampling Techniques

From the study population found in Nifas Silk Lafto sub city Jemo district, 10 from producers integrated in individual household level and 40 from vendors total 50 raw milk samples were selected.

## 2.5. Sample Collection

Samples were collected under aseptic conditions in sterile airtight sampling bottles from 4-5 hour and bring to Addis Ababa University Microbiology Laboratory Room in an ice box and keep aseptically under refrigeration at 4 °C for 2-3 hour until bacteriological analysis.

## 2.6. Bacteriological Analyses

To assess the bacteriological quality and safety of raw milk samples, tests were conducted for aerobic mesophilic bacteria, total coliforms, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella* using standard colony count methods within the acceptable range of 10-300 colony-forming units.

## 2.7. Sample Preparation

Each raw milk samples were collected aseptically. 0.85% NaCl solution (physiological saline solution) was prepared in a clean 1000ml flask and sterilized by autoclave. In sterile test tube 9ml of saline solution added through sterile pipette, raw milk samples added with 1 ml amount to make  $10^{-1}$  dilution and serially diluted as need  $10^{-2}$ ,  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-6}$  and  $10^{-7}$  (Fufa Abunna *et al.*, 2019).

For microbial culturing 20 to 25 ml of selective melted media was poured into sterilized Petri-dishes using a sterile pipette. From selected dilution, 0.1ml inoculum was poured into sterilized petri-dishes containing media by using sterile micro-pipette and spread with sterile cotton swab. Plates became labeled and inverted then incubated for 24-48 hours at 37°C. Petri-dish containing appropriate colony were selected for count and analysis within 24-48 hours.

To differentiate closely related bacteria, catalase biochemical test used to identify closely related bacteria by selecting small sample colony, adding a drop of hydrogen peroxide and observe with high magnification power. Motility test also used to identify *Salmonella* from *Shigella* by placing small culture colony on glass slide and place slide cover on the sample

then observe by high magnification power (Akabanda, 2010).

Media used for different bacteria were Plate Count Agar (PCA-2304, India), MacConkey agar (M081, 0000628622, India), EMB (TM336, India), Mannitol Salt Agar ((MH118, India) and *Salmonella-Shigella* Agar (M108, Canada) for aerobic mesophilic bacteria, total coliforms, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella* respectively to identify from others morphologically.

## 2.8. Assessments of the Hygienic Practices of Raw Milk Venders and Vending Area

An observation checklist and interviews were used to assess the vending area sanitation conditions and milk producers and vendors hygienic practices. Hygienic practices of producers, vendors, and the vending environment were evaluated based on 50 milk handler participants, who were purposively selected from the sample sources.

## 2.9. Data Analysis Techniques

The collected data were processed using SPSS software version 20, employing both descriptive and inferential statistical techniques. Relevant variables were summarized using frequencies and percentages, while bacterial load were expressed as the logarithm of colony-forming units per milliliter (log CFU/ml).

## 3. Results and Discussion

### 3.1. Socio-demographic Profile of the Raw Milk Producers and Vendors

Socio-demographic profile of 50 raw milk samples producers and vendors assessed and presented in table 3.1 below. Most of

milk handlers of producers 7 (70%) were male, however most of vendors 30 (75%) were female, with most of vendors 32(80%) and half of producers 5 (50%) falling within the age range of 21 to 30 years. Regarding educational status, most of both producers and vendors 6 (60%) and 27 (67.5%) had completed at least primary education, while 2 (20%) and 6 (15%) respectively had no formal education. In terms of marital status, most of producers 8 (80%) were married but most of vendors 36 (90%) were single.

Alarminglly, almost all of the participants (48 or 96%) had not received any training in food hygiene. This lack of formal

training is concerning given the direct impact of food handling practices on public health. A study presided in United States reported that unhygienic food handling practices were caused 97% of foodborne illness cases occurring both in food service establishments and at home (Fufa *et al.*, 2019). Moreover, food safety training has been shown to positively influence handlers' practices. Therefore, it is essential that food hygiene training and ongoing motivation be provided to milk producers and vendors to improve food safety standards (Mulugeta Kibret and Bayeh Abera, 2012).

Table 3.1. Socio-demographic Profile of the Raw Milk Producers and Vendors in Addis Ababa Nifas Silk Lafto sub city Jemo district, Ethiopia, 2025

| Parameter                            | Producers |            | Vendors   |             |
|--------------------------------------|-----------|------------|-----------|-------------|
|                                      | Frequency | Percent(%) | Frequency | Percent (%) |
| Age (year)                           |           |            |           |             |
| 15-20                                | 2         | 20         | 6         | 15          |
| 21-30                                | 5         | 50         | 32        | 80          |
| >30                                  | 3         | 30         | 2         | 5           |
| Educational background (grade level) |           |            |           |             |
| 1-8                                  | 6         | 60         | 27        | 67.5        |
| 9-12                                 | 2         | 20         | 7         | 17.5        |
| No formal education                  | 2         | 20         | 6         | 15          |
| Marital status                       |           |            |           |             |
| Married                              | 8         | 80         | 4         | 10          |
| Single                               | 2         | 20         | 36        | 90          |
| Received food hygiene training       |           |            |           |             |
| Yes                                  | 0         | 0          | 2         | 5           |
| No                                   | 10        | 100        | 38        | 95          |

## 3.2. Handling Practices and Sanitation of Raw Milk Producers and Vendors

### 3.2.1. Personal hygienic practices of raw milk producers and vendors

Producers and vendors used for the sources of raw milk samples personal hygiene practices during milking and

selling milk were assessed and presented in table 3.2 below. The findings showed that, 23 (46%) of the participants did not wash their hands before handling milk, while 37 (74%) did not wear aprons or gowns during milk handling. Additionally, 35 (70%) did not cover their hair, and 32 (64%) wore hand jewelry during milk

handling. Only 16 (32%) of the respondents maintained short, unpolished fingernails, whereas the majority 34 (68%)

did not adhere to this basic hygiene standard during food preparation.

Table 3.2. Personal hygienic practices of raw milk producers and vendors in Addis Ababa Nifas Silk Lafto sub city Jemo district, Ethiopia, 2025

| Practice                                        | Producers |             | Vendors   |             |
|-------------------------------------------------|-----------|-------------|-----------|-------------|
|                                                 | Frequency | Percent (%) | Frequency | Percent (%) |
| Wash hand before milking /fetching              |           |             |           |             |
| a/ yes                                          | 8         | 80          | 19        | 47.5        |
| b/ no                                           | 2         | 20          | 21        | 52.5        |
| Wear safety clothes (apron, gown, etc.)         |           |             |           |             |
| a/ yes                                          | 6         | 60          | 31        | 77.5        |
| b/ no                                           | 4         | 40          | 9         | 22.5        |
| Covered hair                                    |           |             |           |             |
| a/ yes                                          | 0         | 0           | 15        | 37.5        |
| b/ no                                           | 10        | 100         | 25        | 62.5        |
| Worn hand jewelry                               |           |             |           |             |
| a/ yes                                          | 9         | 90          | 23        | 57.5        |
| b/ no                                           | 1         | 10          | 17        | 42.5        |
| Keep finger nails short and avoid nail polished |           |             |           |             |
| a/ yes                                          | 7         | 70          | 9         | 22.5        |
| b/ no                                           | 3         | 30          | 31        | 77.5        |

The overall level of personal hygiene among the majority of the milk handlers was found to be unacceptable. As Hamiroune *et al.*, (2016) reported only 17% of milk producers washed their hands before each milking session, while 83% failed to do so. Birhanu Yeserah *et al.* (2019) also highlighted the impact of poor hygiene, reporting coliform counts of  $4.86 \pm 0.2$  and  $5.48 \pm 0.48 \log_{10}$  CFU/ml in milk samples collected from handlers with unwashed and washed hands respectively, in Bahir Dar.

According to Fufa Abunna *et al.*, (2019), maintaining optimal hygiene conditions is essential to minimizing bacterial contamination of the udder and milk, particularly during milking when the cow's sphincters are open and vulnerable

to infection. Furthermore, the use of false fingernails and nail polish is prohibited in food handling due to the risk of microbial contamination (Mekonnen Haileselassie *et al.*, 2012). As human beings are one of the primary sources of food contamination, personal hygiene is critically important. Hand washing, in particular, is a fundamental component of infection prevention and control (Chauhan *et al.*, 2021).

### 3.2.2. Sanitary conditions of utensils and the vending environment

The sanitary conditions of this study participant milk producers and vendors were assessed by using both interviews and observational checklist. The results are presented in table 3.3. Among the

respondents, 32 (70%) had access to private toilet facilities, while the remaining 18 (30%) did not. Regarding water supply, 23 (46%) had private piped water, whereas 27 (54%) relied on shared piped water sources. In terms of milk sourcing, 30 (60%) of the raw milk was obtained from external suppliers, while 20 (40%) was sourced from the producers' own farms. A majority of the participants, 37 (74%), reported using refrigerators to store raw

milk after milking or upon receipt from producers.

Furthermore, 28 (56%) of the respondents reported cleaning milking and vending equipment after each use, while the remaining 22 (44%) did not adhere to proper cleaning practices. Observational findings revealed that 32 (64%) of the milk handling and storage environments were contaminated by dust and smoke, while only 18 (36%) were considered clean.

Table 3.3. The sanitation conditions of raw milk vending utensils and the environment in Addis Ababa Nifas Silk Lafto sub city Jemo district, Ethiopia, 2025

| Parameters                                          | Producer  |            | Vendor    |            |
|-----------------------------------------------------|-----------|------------|-----------|------------|
|                                                     | Frequency | Percent(%) | Frequency | Percent(%) |
| Have you private toilet?                            |           |            |           |            |
| a/ yes                                              | 10        | 100        | 22        | 55         |
| b/ no                                               | 0         | 0          | 18        | 45         |
| Have you private water piped water supply?          |           |            |           |            |
| a/ yes                                              | 8         | 80         | 15        | 37.5       |
| b/ no                                               | 2         | 20         | 25        | 62.5       |
| Where milk stored in?                               |           |            |           |            |
| a/ refrigeration                                    | 1         | 10         | 36        | 90         |
| b/ room temperature                                 | 9         | 90         | 4         | 10         |
| Source of the raw milk?                             |           |            |           |            |
| a/ Their own                                        | 10        | 100        | 10        | 25         |
| b/ Out side                                         | 0         | 0          | 30        | 75         |
| Do they properly clean the milking equipment?       |           |            |           |            |
| a/ yes                                              | 3         | 30         | 25        | 62.5       |
| b/ no                                               | 7         | 70         | 15        | 37.5       |
| Hygienic situation of area used for selling milk is |           |            |           |            |
| a/ clean                                            | 2         | 20         | 30        | 75         |
| b/ Not clean                                        | 8         | 80         | 10        | 25         |

Most of the raw milk and milk product outlets were located near main roads, increasing their exposure to dust and airborne contaminants. Additionally, repeated milk handling and transferring into plastic containers increase the risk of contamination. The likelihood of contamination rises with the number of

utensils used. Moreover, many plastic containers possess physical properties that make them unsuitable for safe milk handling (Zelalem Yilma, 2010).

### 3.3. Bacteriological Load in Raw Milk Samples

In this study, five main milk quality and safety indicator bacteria were identified and enumerated. Logarithm of colony forming unit per milliliter, Mean and Standard Deviation of bacteria detected from raw milk samples collected from this study participant 10 producers and 40 vendors were calculated and placed in table 3.4.

#### 3.3.1. Aerobic Mesophilic Bacteria Counts (AMBC)

The average count of aerobic mesophilic bacteria (AMB) detected in raw milk samples in this study was  $5.48 \pm 1.25 \log_{10}$  CFU/mL. This result generally conforms to East Africa Standard (EAS 67:2006), which allows a maximum of  $6 \log_{10}$  CFU/mL for aerobic mesophilic bacteria count in raw milk. Nonetheless, this value surpasses the European Union guideline, which limits such bacterial levels to a maximum of  $4.69 \log_{10}$  CFU/mL (equivalent to  $5 \times 10^4$  CFU/mL). Despite this, the count observed in the current study is lower than those reported in previous research. For instance, Kuribachew Endale and Melese Etifu (2023) found a higher average of  $6.25 \pm 1.43 \log_{10}$  CFU/mL in milk from Kolfe Keraniyo and Lemikura areas of Addis Ababa. Similarly, Alganesh (2016) reported a significantly higher AMBC of  $8.2 \log_{10}$  CFU/mL in the Central Highlands, while Amistu Kuma *et al.*, (2015) observed a mean of  $6.88 \pm 0.46 \log_{10}$  CFU/mL along the milk supply route from Oromia to Addis Ababa. The microbial load in raw milk is influenced by various factors such as substandard hygienic practices during milking, poorly

cleaned milking tools, incorrect storage temperatures and the cleanliness and health of both cows and milk handlers. Studies by Godefay and Molla (2000) and Haile *et al.* (2012) have shown that milk samples from different Ethiopian regions contained AMBC levels ranging from 7.28 to  $10.28 \log_{10}$  CFU/mL. These elevated counts are often a result of poor post-harvest handling, insufficient storage conditions and long transport durations. According to Mihiret Frew and Kiros Abebe (2020), milk sourced from healthy cows and handled hygienically should contain no more than  $4.7 \log_{10}$  CFU/mL.

#### 3.3.2. Total Coliform Count (TCC)

In this investigation, raw milk samples from producers and vendors showed an average total coliform (TCC) of  $3.58 \pm 0.12 \log_{10}$  CFU/mL. This result complies with the East Africa Standard (EAS 67:2006), which sets a threshold of  $4.70 \log_{10}$  CFU/mL for total coliform in raw milk. However, the result recorded here is lower than those found in earlier studies. For example, Asaminew and Eyassu (2011) found TCC levels of 4.41 and  $4.49 \log_{10}$  CFU/mL in Bahir Dar Zuria. Similarly, Amistu *et al.* (2015) reported TCC ranging from  $5.42 \pm 1.73$  to  $5.78 \pm 0.95$  in Sebeta,  $5.53 \pm 1.03$  to  $5.63 \pm 0.62$  in Holeta and  $4.18 \pm 1.22$  to  $6.35 \pm 0.43 \log_{10}$  CFU/mL in Sululta. Additional studies, including one by Zelalem and Bernard (2006), reported  $6.57 \log_{10}$  CFU/mL in Ethiopia central highlands and Chye *et al.* (2003) noted  $5.23 \log_{10}$  CFU/mL in Malaysian milk samples. In contrast, this study of TCC is greater than that reported by Jermon Mamo *et al.* (2016), who recorded only  $2.1 \pm 0.08 \log_{10}$  CFU/mL in Debre Birhan City.

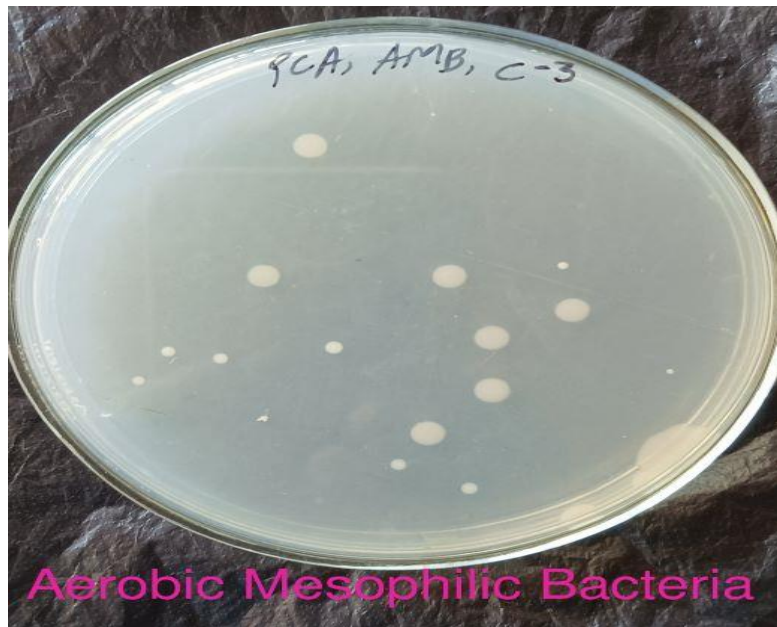


Figure 3.1. Aerobic Mesophilic Bacteria Colony on Plat Count Agar

### 3.3.3. *Escherichia coli* Count

The average *E. coli* count in the raw milk samples was measured at  $4.35 \pm 0.57 \log_{10}$  CFU/mL. This result contradicts the national regulation (CSA, 2021), which stipulates that raw milk should be completely free from *E. coli*. Compared to earlier findings, this study result is relatively high. For example, Kuribachew Endale and Melese Etifu (2023) observed

lower counts in Kolfe sub-city, Addis Ababa. Other studies, such as those by Amenu Kebede *et al.* (2019), Amistu *et al.* (2015) and Chye *et al.* (2003), recorded even lower levels of  $2.44 \pm 0.56$ ,  $2.5 \pm 0.23$ ,  $1.19 \pm 0.26$  and  $3.83 \pm 1.12 \log_{10}$  CFU/mL, respectively. However, this study result is less than the  $4.8 \pm 0.14 \log_{10}$  CFU/mL reported by Nigatu Disassa *et al.* (2017) in Assosa town.



Figure 3.2. Coliform colony on MacConkey Agar

The detection of *E. coli*, especially in raw milk sampled directly from the udder may result from intra-mammary infections or fecal contamination during milking. This underscores the critical importance of following strict hygiene protocols in the milking and handling processes to ensure milk safety (Amenu Kebede *et al.*, 2019).

The presence of *E. coli* in raw milk, particularly in samples collected directly from the udder, may be attributed to intra-

mammary infections or fecal contamination during the milking process (Kebede Amenu *et al.*, 2019). This highlights the importance of adhering to strict hygiene practices during milk production and handling to ensure consumer safety.

### 3.3.4. *Staphylococcus aureus* count

The average *Staphylococcus aureus* count in the analyzed milk samples was  $3.20 \pm 0.21 \log_{10}$  CFU/mL.



Figure 3.3. *Escherichia coli* colony on Eosin Methylene Blue Agar

This result is similar to that reported by Birhanu Yeserah *et al.* (2019), who documented a mean of  $3.18 \pm 0.10 \log_{10}$  CFU/mL in Bahir Dar. However, it exceeds the level reported by Bogdanovieva *et al.* (2016), who recorded

$2.7 \pm 1.03 \log_{10}$  CFU/mL in samples from Czech Republic. Conversely, this study finding is lower than the  $4.08 \pm 0.62 \log_{10}$  CFU/mL observed by Chye *et al.* (2003) in Malaysia.

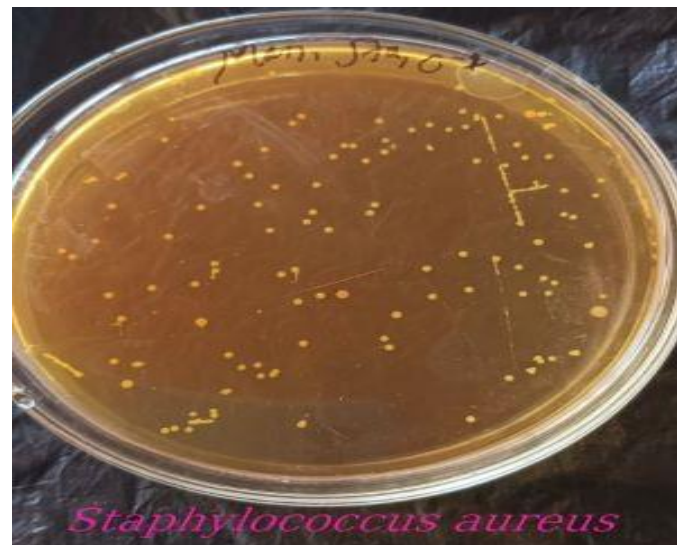


Figure 3.4. *Staphylococcus aureus* colony on Mannitol Salt Agar

### 3.3.5. Salmonella Count

The mean salmonella count detected in the raw milk samples was  $3.04 \pm 0.38 \log_{10}$  CFU/mL in this study. The existence of

Salmonella species caused through poor handling and hygiene problem of producers and vendors (Kuribachew Endale and Melese Etifu, 2023).



Figure 3.5. Salmonella colony on Salmonella-Shigella Agar

Table 3.4. Bacteriological count ( $\log_{10}$  CFU/mL) of raw milk samples from Jemo District, Nifas Silk Lafto Sub city, Addis Ababa, Ethiopia, 2025 (n = 50)

| Result        | Bacteria count ( $\log_{10}$ cfu/ml) |          |                |                  |            |
|---------------|--------------------------------------|----------|----------------|------------------|------------|
|               | AMB                                  | Coliform | <i>E. coli</i> | <i>S. aureus</i> | Salmonella |
| Mean $\pm$ SD |                                      |          |                |                  |            |

|        |                              |             |             |             |             |           |
|--------|------------------------------|-------------|-------------|-------------|-------------|-----------|
| Source | Raw milk from Producers n=10 | 5.86±0.43   | 2.46±1.02   | 4.68±1.08   | 1.64±0.62   | 2.56±1.24 |
|        | Raw Milk from vendors n=40   | 4.72±1.22   | 4.62±0.86   | 4.12±0.42   | 3.56±1.28   | 3.12±0.82 |
|        | Total n=50                   | 5.48 ± 1.25 | 3.58 ± 0.12 | 4.35 ± 0.57 | 3.20 ± 0.21 | 3.04±0.38 |

SD = Standard deviation, AMB- Aerobic Mesophilic Bacteria

Raw milk samples obtained from producers exhibited higher counts of aerobic mesophilic bacteria ( $5.86 \pm 0.43 \log_{10}$  CFU/mL) and *E. coli* ( $4.68 \pm 1.08 \log_{10}$  CFU/mL) than those from vendors. On the other hand, samples from vendors showed elevated total coliform ( $4.62 \pm 0.86 \log_{10}$  CFU/mL), *Staphylococcus aureus* ( $3.56 \pm 1.25 \log_{10}$  CFU/mL) and *Salmonella* ( $3.12 \pm 0.38 \log_{10}$  CFU/mL) when compared to producer-sourced raw milk.

### 3.4. Detection of Pathogenic

#### Microorganisms

In evaluating the microbiological safety of milk, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella* species serve as key indicator organisms. The identification of *E.coli* in raw milk is often an indication

of fecal contamination and suggests the possible presence of other intestinal pathogens (Kuribachew Endale and Melese Etifu, 2023). A high prevalence of *S.aureus* typically reflects inadequate hygiene during the stages of milk production, handling and distribution (Zakary *et al.*, 2011). *Salmonella* species, known for their widespread environmental presence, may contaminate milk and its surroundings through various routes. Although thermal processing like pasteurization and specific measures such as those used in hard cheese manufacturing can eliminate *Salmonella* infections still occur due to the consumption of raw milk and unpasteurized dairy products (Abebe Bereda *et al.*, 2013).

Table 3.5. Presence of pathogenic bacteria; *E.coli*, *S.aureus* and *Salmonella* in Jemo District, Nifas Silk Lafto Sub-City, Addis Ababa, Ethiopia (n=50), 2025

| Study area                                          | Source and No. of sample | Number of positive sample (%) |                  |                   |
|-----------------------------------------------------|--------------------------|-------------------------------|------------------|-------------------|
|                                                     |                          | <i>E. coli</i>                | <i>S. aureus</i> | <i>Salmonella</i> |
| Addis Ababa Nifas Silk Lafto sub-city Jemo district | Producer (n=10)          | 8(80%)                        | 5(50%)           | 3(30%)            |
|                                                     | Vendor (n=40)            | 29(72.5%)                     | 26(65%)          | 22(55%)           |
|                                                     | Total n= 50              | 37(74%)                       | 31(62%)          | 25(50%)           |

According to the findings presented in table 3.5, *Escherichia coli* was detected in 37 (74%) out of 50 raw milk samples analyzed, this is notably higher than the 51.7% detection rate reported by Amenu Kebede *et al.* (2019), who examined milk

across different points in the production and supply chain. Similarly, *Staphylococcus aureus* was found in 31 (62%) of the raw milk samples examined. Past studies have indicated that *S.aureus* contamination is often linked to subclinical

mastitis in dairy animals, especially in both communal and commercial farm setting (Fufa Abunna *et al.*, 2019). The current result aligns closely with the 61% prevalence report by Chye *et al.* (2003), but it exceeds the 36.9% reported by Farhan and Salk (2007) in Palestine, where *S.aureus* was detected in 48 out of 130 raw milk samples.

Furthermore, Salmonella was identified in 25 (50%) of raw milk samples collected from dairy producers and vendors in the study area. This detection rate surpasses the recommended safety limits, which specify that Salmonella should not be present in 25 mL of milk (Zafalon *et al.*, 2008). The presence of Salmonella at this level indicates a significant public health concern, making the milk unsafe for human consumption (Chaung *et al.*, 2007). In this study, samples obtained from vendors showed higher contamination with *Staphylococcus aureus* and Salmonella, whereas samples from producers were more frequently contaminated with *Escherichia coli*.

#### 4. Conclusion

The evaluation of raw milk samples collected from Jemo District in Nifas Silk Lafto Sub-City, Addis Ababa, showed that the levels of aerobic mesophil bacteria (AMB) and total coliforms were within the acceptable thresholds outlined by the East African Standards. However, the concentration of *Escherichia coli*, *Staphylococcus aureus* and Salmonella surpassed the permissible limits, indicating a potential health risk for consumers. These elevated bacterial counts are most likely a result of poor hygiene practices and unsanitary conditions during milk production and handling.

Among the sampled sources, milk obtained directly from producers showed the highest levels of aerobic mesophilic bacteria and *E.coli*. On the other hand, samples from vendors had the highest total coliform, *Staphylococcus aureus* and Salmonella levels in comparison to those from producers.

The presence of *Escherichia coli*, *Staphylococcus aureus* and Salmonella in the raw milk samples indicates that these products are potentially hazardous and should be deemed unacceptable for consumption. Poor hygiene practices by food handlers, coupled with unsanitary conditions on dairy farms and in retail shops, can contribute to the spread of foodborne illnesses. To mitigate these risks, it is crucial to implement proper sanitary measures throughout the production process and up to the point of consumption.

To enhance milk safety, it is essential to promote hygiene education programs targeting milk handlers, producers and vendors. Moreover, conducting routine inspections and sanitary assessments will help ensure compliance with hygiene standards and reduce the likelihood of milk born disease transmission.

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