JRIIE Journal of Research Innovation and Implications in Education
Center for Research Implications & Practice

Website:www.jriiejournal.com ISSN 2520-7504 (Online) Vol.8, Iss.3, 2024 (pp. 307 – 318)

Assessment of Microbial Contaminants (enterobacteria) in Street Vended Cow's Raw Milk in Dodoma City, Tanzania

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Abstract: *This study was conducted on street vended raw milk to determine their microbial contamination in four selected wards of Dodoma urban district, Tanzania. A cross-sectional study was conducted on a statistically convenient sample size (N=60) of raw milk collected from street vendors in four selected wards of Dodoma city centre. Laboratory analysis was conducted in the biology laboratory, Department of Biology of St John's University of Tanzania. Mac Conkey, EC broth, Eosin Methylene Blue Agar (EMB AGAR) were used for culturing microorganisms. Biochemical tests were performed to confirm the presence of coliforms by using sugar fermentation, as well as the use of nutrient agar in culturing microorganisms for MPN [Most Probable Number], following the serial dilutions method. E. coli, Salmonella spp. and Krebsiella spp. were detected in 20/60 (31.33%), 6/60 (10%) and 5/60 (8.33%) of raw milk samples. Plastic containers were commonly used for storage and transportation of milk. The present study showed that the quality of milk in the study areas were poor. High MPN were over and above the recommended East Africa Community standards. The contamination was due to poor hygienic practices during milking, inappropriate transportation and storage facilities, for example packaging materials, lack of cooling systems and use of unsafe water. There is therefore the need to plan and offer simple and practical training courses on hygienic handling of milk for milk handlers in order to ensure safety of raw milk.*

Keywords: Microbial contaminants, Entero bacteria, Street vended, cow's milk, Raw milk

How to cite this work (APA):

Ruhembe, C. C. (2024). Assessment of Microbial Contaminants (enterobacteria) in Street Vended Cow's Raw Milk in Dodoma City. *Journal of Research Innovation and Implications in Education, 8*(3), 307 – 318. **https://doi.org/10.59765/nvyr8359.**

1. Introduction

Milk is an important food for pregnant mothers, growing children, adolescents, adults, normal and patients. Raw milk means milk (secreted by mammals and used as food) that has not been subjected to any processing intended to alter the quality or composition characteristics of the milk (Achon *et al*., 2019). Cow's milk consists of high moisture and is nearly neutral in pH and are rich in vitamins and minerals. Nutritionally, milk contains not less than 8.5 percent milk solids and not less than 3.5 percent milk fat. Milk constituents include water (87.20%), protein (3.50%), fat (3.70%), milk sugar or lactose (4.90%), ash (0.70%) and dry matter (12.8) (Uddin *et al*. 2010).

Due to its nutritionally rich and moisture nature, milk is an excellent medium for growth and multiplication of many microorganisms that could be introduced during collection, storage, transportation and processing (Abrams, 2013). These bacteria may significantly influence the quality of milk and milk products. Milk contains relatively few bacteria when it is secreted from the udder of a healthy animal. It gets contaminated from the exterior of the udder and the adjacent areas, dairy utensils, milking machines, the hands of the milking man, from the soil and dust (Pathot., 2019. In this way bacteria, yeasts and molds get entry into the milk and thus constitute the normal flora of milk (Karshima *et al.,* 2013). When the milk is contaminated with bacteria, it gets spoiled easily. Bacteria in milk may serve as potential causes of milk-borne diseases in humans. Studies show that up to 90% of all dairy-related diseases are due to pathogenic bacteria like

Brucella abortus, *Escherichia coli* 0157: H7, *Mycobacterium bovis*, *Campylobacter jejuni*, *Salmonella* spp, *Clostridium* spp., and *Staphylococcus aureus* (Gwandu *et al.*, 2018).

Informal milk marketing is of public health concern in most developing countries including Tanzania, because it is facing hygiene and safety problems in all areas of food production and retailing (Solution Exchange, 2008). In developing countries such as Tanzania, more than 80% of the cow's milk consumed is informally marketed as loose, raw milk (Kilango *et al*., 2012). Milking and milk handling practices in informal sector are done commonly without observing hygienic practices. It is a common practice to vend milk in inappropriate milk holding and storage equipment's. Such practice possesses a threat to public health as chances of consuming unsafe milk are very high. Since there is little or no quality control for milk produced and handled in the informal channels, there is potential risk of contamination by zoonotic pathogens, adulterants and antimicrobial drug residues hence public health risks to consumers (Kurwijila *et al.,* 2006). Boiling kills the microorganisms but adversely affects the quality, taste and flavor of milk, as milk constituents are heat-labile (Sakalle *et al.,* 2014) therefore most people prefer raw milk which is usually unsafe.

Dodoma is among the areas in Tanzania which produces milk. Most residents prefer to buy raw milk from shop outlets, bicycle vendors who collect milk from farmers or vendors who sell milk along the road during morning or evening hours. Consumers drink as boiled or consume as raw milk directly. Pathogens involved in causing food borne diseases due to the consumption of raw milk include *Escherichia coli, Listeria monocytogenes, Salmonella, Campylobacter, Brucellaabortus, Staphylococcus aureus, Bacillus cereus, Mycobacterium spp. and Clostridium botulinum.* If these pathogenic bacteria are present in raw milk, they can cause major public health concern, especially for those individuals who drink raw milk frequently (Chye*et al.,* 2014). The present study attempted to assess microbial contamination in street vended cow's raw milk in Dodoma city. This study aimed at assessing public health risks from the informally contaminated marketed milk. The study concentrated on informally marketed milk because in Tanzania, the informal market comprises over 90% of market share (Omore*et al*., 2001).

1.1 Objectives

This study set out to achieve the following objectives:

1. To determine the prevalence and concentration of enterobacteria in street vended cow's raw milk within Dodoma City.

2. To determine practices and observable characteristics in milk vended sites

2. Literature Review

Assessment of microbial contaminants, particularly enterobacteria, in street vended cow's raw milk is a critical issue, not only in Dodoma City but also globally. Numerous studies have highlighted the prevalence and risks associated with microbial contamination in raw milk. For instance, a study conducted in Nigeria by Ojo and colleagues (2021) found high levels of enterobacteria in raw milk samples from street vendors, emphasizing the importance of regular monitoring and quality control measures. In a sub-Saharan context, research by Nyariki et al. (2019) in Kenya demonstrated a similar pattern of microbial contamination in street vended milk, with enterobacteria being one of the major contaminants identified. This underscores the regional nature of the issue and the need for interventions to ensure the safety of raw milk sold by street vendors across different countries in sub-Saharan Africa. Recent studies have also focused on the specific challenges and potential solutions related to the assessment of microbial contaminants in raw milk. For example, a study by Singh et al. (2022) in India proposed the use of rapid molecular techniques for the detection of enterobacteria in milk samples, offering a more efficient and accurate method compared to traditional culture-based approaches.

2.1 Global Perspective

Raw milk consumption is a common practice globally, especially in regions where pasteurization is not widely adopted or enforced. This practice poses significant risks of microbial contamination, leading to various health concerns (Gale et al., 2019). Several key pathogens have been identified in raw milk, including Brucella abortus, known for causing brucellosis, a zoonotic disease with significant public health implications (Ciftci et al., 2020).

Escherichia coli, particularly E. coli O157 is another well-documented pathogen found in raw milk. It can lead to severe gastrointestinal illnesses, highlighting the importance of monitoring and controlling microbial contamination in milk production and distribution (Jayarao et al., 2004). Mycobacterium bovis, the causative agent of bovine tuberculosis, is another critical concern in raw milk. Its transmission to humans through consumption of contaminated milk can result in severe health consequences, underscoring the need for rigorous testing and hygiene practices in dairy farming (Grange and Yates, 1994). Campylobacter jejuni and Salmonella spp. are commonly associated with foodborne illnesses linked to

raw milk consumption. Both pathogens have been implicated in outbreaks worldwide, emphasizing the global nature of the risk associated with consumption of unpasteurized milk (Oliver et al., 2005; Scallan et al., 2011). Clostridium spp., including Clostridium perfringens, are spore-forming bacteria found in raw milk and are known to cause food poisoning upon ingestion of contaminated milk products (Uzal et al., 2014). Staphylococcus aureus is a ubiquitous bacterium that can contaminate milk through poor hygiene practices during milking or handling. It produces heat-stable toxins that can cause illness if ingested in sufficient quantities (Kérouanton et al., 2007).

2.2 Sub-Saharan Africa Perspective

In Sub-Saharan Africa, the consumption of raw milk is a cultural norm and a vital source of nutrition for many communities. However, this practice exposes populations to various microbial hazards. Studies have documented the presence of Brucella abortus in raw milk samples across the region, contributing to the burden of brucellosis (Migisha et al., 2015). Escherichia coli contamination is also prevalent in Sub-Saharan Africa, with studies indicating high levels of pathogenic strains in raw milk samples from informal markets (Sharma et al., 2017). Mycobacterium bovis remains a significant concern, particularly in regions where bovine tuberculosis is endemic. Studies have highlighted the transmission of this pathogen through consumption of unpasteurized milk, contributing to the persistence of the disease in both cattle and human populations (Cadmus et al., 2010). Campylobacter jejuni, Salmonella spp., and other pathogens have been identified in raw milk samples in Sub-Saharan Africa, underscoring the need for improved milk hygiene and regulatory oversight (Adesokan et al., 2013).

2.3 Tanzania Perspective

In Tanzania, the assessment of microbial contaminants in street-vended cow's raw milk in Dodoma City reveals a concerning prevalence of pathogens. Studies have detected Escherichia coli in significant proportions of milk samples, highlighting contamination risks associated with informal milk distribution systems (Mwambete and Mshana, 2011). Brucella abortus has also been identified in raw milk samples from various regions in Tanzania, posing a threat of brucellosis transmission through consumption of unpasteurized milk (Muma et al., 2012). Mycobacterium bovis remains endemic in Tanzania, with sporadic cases of bovine tuberculosis reported in both cattle and humans, indicating ongoing transmission through contaminated milk (Katale et al., 2013). The presence of Campylobacter jejuni, Salmonella spp., Clostridium spp., and Staphylococcus aureus in raw milk samples further underscores the public health risks associated with informal milk vending practices in Dodoma City and other urban centers in Tanzania (Makita et al., 2011).This study therefore aimed at assessing microbial contaminants (enterobacteria) in street vended cow's raw milk in Dodoma ciy, Tanzania

3. Methodology

This section elaborates how data were collected using various research methods.

2.1 Study area and design

A cross-sectional observation descriptive study was conducted around Dodoma city, Tanzania from July to september 2023 in order to assess microbes' presence and hygiene practices of Street venders of cow's raw milk in Dodoma City. The Dodoma city is within these coordinates 6 ° 10'19 "S35 ° 44'29" E. Dodoma city is characterized by a semi-arid climate. The study was carried out within four wards which were purposively selected to represent urban characteristics. These included, Kikuyu kaskazini, Makole, Nzuguni, and Majengo wards. These are the areas where the street milk vending business is conducted. The estimated current population of Dodoma is 324,347. A multistage random sampling technique was used to obtain representative wards in Dodoma city as described by (Louis, Manion & Morrison, 2007). Four wards were randomly selected. From each ward, two streets were randomly selected and from each street 15 milk vendors were randomly selected by using random table numbers. A total of 60 street vendors were selected to participate in the study.

2.2 Data collection procedures

In this study data were collected using an observation checklist and laboratory analysis of collected milk samples (Gaikwad, Saxena, Kamble & Upadhyay, 2017). Field survey began for a period of one month to 60 milk vendors from four selected wards. These street milk vendors were informed about the purpose of the study and their written consent of their voluntary participation was obtained. Each vendor and their vending site, utensils, water used and cooling facilities were observed to assess food safety practices, their personal hygiene, and environmental condition around their stalls. For easy collection of data, a checklist was designed containing the questions to be filled in during observation (Collin, 2014). Observed information were entered immediately in the prepared checklist, where by some questions were prepared to be delivered to the participants. Milk vendors were requested to provide 20 ml sample of milk to researchers and they were kept in

sterilized bottles, and then transported to St. John's University Biology laboratory for analysis.

2.2.1 Laboratory procedures and analysis

All the media were prepared according to manufacturers' instructions. Streak-plate technique was used for the isolation and subsequent identification of the microorganisms. Briefly, samples were inoculated onto the Mac Conkey agar and blood and then incubated at 37ºC for 24 h. Plates were observed for macro morphology then isolated single colony was picked and sub cultured again on the Mac Conkey agar and blood agar for purification of the isolate. Simultaneously, another single colony with similar characteristics was picked, smeared, and Gram-stained for the examination of staining and micro morphological characteristics using a bright field microscope.

Most Probable Number (MPN)

Most Probable Number (MPN) is a method used to estimate the concentration of viable microorganisms in a sample by means of replicating liquid broth growth in ten-fold dilutions (William *et al*.,1999). It is commonly used in estimating microbial populations in soils, waters, agricultural products and is particularly useful with samples that contain particulate material that interferes with plate count enumeration methods (Shanker and Sing, 2014). MPN is most commonly applied for quality testing of raw milk samples to ensure whether the raw milk samples are safe or not in terms of bacteria present in it (Austin and Pagotto, 2003). A group of bacteria commonly referred to as fecal coliforms act as an indicator of fecal contamination of raw milk samples. The presence of very few fecal coliform bacteria would indicate that raw milk probably contains few disease causing organisms, while the presence of large numbers of fecal coliform bacteria would indicate a very high probability that the raw milk sample could contain disease producing organisms making the raw milk samples unsafe for consumption (Chandrapati and Williams, 2014).

Principle

Raw milk samples to be tested were diluted serially and inoculated in lactose broth, coliforms present in raw milk samples utilizes the lactose present in the medium to produce acid and gas. The presence of acid was indicated by the color change of the medium and the presence of gas was detected as gas bubbles collected in the inverted Durham tube present in the medium. The number of total coliforms was determined by counting the number of tubes giving positive reaction.

MPN test is performed in 3 steps

(a) Presumptive test
(b) Confirmatory test
(c) Completed test

(A) Presumptive test

The presumptive test is a screening test done to raw milk samples for the presence of coliform organisms. In some samples the presumptive test was negative, therefore no further testing was performed, and the raw milk samples source was considered to be microbiologically safe. In some samples, however, the tubes in the series shows acid and gas, the raw milk samples were considered unsafe and the confirmed test was performed on the tube displaying a positive reaction (Shanker and Signh, 2014).

(B) Confirmatory Test

Some microorganisms other than coliforms also produced acid and gas from lactose fermentation. In order to confirm the presence of coliform, a confirmatory test was done. From each of the fermentation tubes with positive results one loopful of medium was transfered to: 3 mL lactose-broth or brilliant green lactose fermentation tube, to an agar slant and 3 mL raw milk sample. Inoculated lactose-broth fermentation tubes were incubated at 37°C and gas formation was inspected after 24 ± 2 hours. If no gas production was seen, they were further incubated to a maximum of 48 ±3 hours to check gas production. The agar slants were incubated at 37°C for 24± 2 hours and Gram-stained preparations made from the slants were examined microscopically.
The formation of gas in lactose broth and the demonstration of Gram-negative, non-spore-forming bacilli in the corresponding agar indicated the presence of a member of the coliform group in the sample examined. The absence of gas formation in lactose broth or the failure to demonstrate Gram-negative, non-spore-forming bacilli in the corresponding agar slant constitutes a negative test for absence of coliforms in the tested sample.

(C) Completed Test

Since some of the positive results from the confirmatory test were false, it was desirable to do completed tests. For this inoculum from each positive tube of the confirmatory test was streaked on a plate of EMB or Endo agar. In this process, a loopful of a sample from each positive BGLB tube was streaked onto selective medium like Eosin Methylene Blue agar or Endo's medium. One plate each was incubated at 37°C and another at 44.5± 0.2°C for 24 hours. High temperature incubation (44.5 ±0.2) was for detection of thermo tolerant E. coli. Following incubation,

all plates were examined for the presence of typical colonies. Coliforms produce colonies with a greenish metallic sheen which differentiates it from non-coliform colonies with no sheen. The presence of typical colonies at high temperature (44.5 ±0.2) indicated the presence of thermos tolerant E. coli. After the serial dilutions, 1 ml of the diluted milk sample was added into a sterile Petri dish. Then approximately 22 ml of molten Nutrient agar (45ºC) was poured into inoculated Petri dish. 0.1 ml of dilutions were taken and spread on the sterile Petri dish which contain solid nutrient medium and spread well on medium the inoculum and the medium were allowed to solidify by leaving the Petri dishes standing on the horizontal surface of the biological safety cabinet. After complete solidification, all the Petri dishes were inverted and placed in the incubator at 37ºC ± 1ºC for 24 hours to allow for bacterial growth.

2.3. Data analysis

Data were analyzed using Statistical Package for Social Science (SPSS) version 16. Descriptive statistics of demographic information, food safety practices, personal hygiene, and environmental condition around the vending stalls were computed and expressed as frequency distribution and percentages.

4. Results and Discussion

4.1 Demographic characteristics

Table 1. indicates demographic characteirists interms of sex, age and if the respondents had food handling and processing and preservation knowledge. Results show that 66.6% of respondents were females and 33.5% were males. The age group between (19-35) had 75% of respondents which means this is the age that many people are active to engage in different kind of economic activities. As to whether the respondents are having knowledge about food handling and processing results indicated that 58.33% of respondents have gained informal knowledge of food processing and preservation through their homes and friends. About 30% obtain the knowledge through their homes and online learning. Less respondents (11.66%) have acquired the formal knowledge of food processing and preservation through formal known colleges in the country.

Table 1. Demographic characteristics

Demographic characteristic	Response	Frequency (n)	Percentage (%)
Gender	Male	20	33.35
	Female	40	66.65
Age	12-18	5	8.33
	19-35	45	75%
	35-60	10	16.67
Food handling and processing knowledge	Home and friends	35	58.33
	College	7	11.66
	Home and online learning	18	30

4.2 Most Probable Number (MPN)

The results of MPN for milk from vendors are summarized in table 2. The lowest MPN index per 100 mL was (17) collected from Makole street and highest was (1100) which had been collected from Kikuyu Kaskazini.The MPN index in Majengo was 460 per 100 ML and Kisasa street was 260 per 100Ml.

Table 2: Most Probable Number (MPN) index per 100mL count in raw milk samples

Concentration/Area	10^{-1}	10^{-2}	10^{-3}	MPN index per 100mL
Kikuyu Kaskazini	3	3	2	1100
Makole	3	2	1	17
Majengo	3	3	1	460
Kisasa	3	3	0	240

4.3 Prevalence of Salmonella spp., krebsiella spp. and E. coli

Biochemical tests were performed to confirm presence of coliforms by using sugar fermentation on triple sugar iron agar test as shown in table 1. From biochemical test, prevalence of *E. coli, krebsiella sp*. and Salmonella *spp*. were detected in 20 (31.33%), 6 (10%) and 5 (8.33%) of raw milk samples respectively, summarized in Table 3. The highest E. coli prevalence was observed in Kikuyu Kaskazini (35%) followed by Makole (25%). *Krebsiella spp*. prevalence was high in Kikuyu Kaskazini (33.35%) followed by Nzuguni (33.33%).

Table 3: Prevalence of *E. coli, Krebsiella sp*. and *Salmonella sp.* in raw milk samples

Area	Number of samples	Number of positive *E. coli* (%)	Numberof positive *Krebsiella spp*(%)	Number of positive *Salmonella spp*(%)
Kikuyu kaskazini	15	7 (35%)	2 (33.35%)	2 (40%)
Majengo	15	4 (20%)	1 (6.66%)	2 (40%)
Nzuguni	15	4 (20%)	2 (33.33%)	1 (20%)
Makole	15	5 (25%)	1 (6.66%)	0 (0%)
Total	**60**	**20 (31.33%)**	**6 (10%)**	**5 (8.33%)**

4.4 Practices and observable characteristics in milk vending sites

Table no 4 below shows different activities and observable characteristics of milk vended areas in Dodoma city. Results reveal that most of the milk vending sites are located near roads (66%). The mostly used equipment to store and transport milk is a closed gallons with small mouth (87%) preferrable used water bottles. About 67% sellers of milk in the streets lacks cooling facilities like refrigerators to keep milk safe for a longer period of time. More results showed that 43% respondents agreed that the municipal has offered monitoring systems to ensure that food sold in the street is high in hygienic standard but about 57% denied about monitoring systems to ensure safe food provided by the city council.

Table 4: Practices observed in the street vended milk areas, n (%)

Observation Guide	Observation	Response	Percentage %
Location of vending site	Near the road	Yes	66
		No	36
Detergent used to wash utensils	Use of detergent for washing	Yes	74
		No	26
Utensils for keeping raw milk	Use of closed gallons with small mouth	Yes	87
		No	13
Cooling facilities	Presence of Cooling facilities	No	67
		Yes	3
Types of utensils used in keeping milk	Plastic bottles preferably re used water bottles	Yes	100
		No	0
Type of water which is used to	Boiled Water	Yes	47
		No	53
Any monitoring systems	If Municipal monitor these	Yes	43
		N0	57

4.5 Discussion

The overall objective of this study was to assess the Enterobacteriaceae in vended raw milk in Dodoma city. Generally, high MPN was encountered in high number of samples which was over and above the recommended East Africa Community standards (EACs, 2007). The enterobacteriaceae isolated were *E.coli, Krebsiella spp.* and *Salmonella spp.* Most Probable Number (MPN) is the number of bacteria in a sample that can grow and form countable colonies on Nutrient agar after being held at 37 °C for 24 hours. Bacterial load in milk indicates the degree level of hygiene practiced in the whole milk production process. Total bacterial count is a rough gauge to measure the quality of milk, herd health, efficacy of farm sanitation, milk handling and storage/transportation temperature (Fillimon *et al.*, 2011). Total bacterial counts further reflect the time elapsed since milking or the processing at ambient temperature.

The results of the present study may not be surprising since the untreated raw milk harvested from dirty animals, dirty houses, the unhygienic environmental and general milk handling may have contaminated the raw milk. The results of this study are in line with others done elsewhere in Tanzania by Kweka (2002) Tanga, Kivaria*et al.,* (2006) Dar es Salaam and Rwehumbiza *et al.,* (2013) in Bagamoyo and Kisarawe in which most of the samples tested had higher bacterial count above standards. These findings highlight the fact that raw milk from vendors has poor microbiological quality and poses a threat to consumes.

4.5.1 Enterobacteriaceae isolated in milk samples

Escherichia coli

E. coli was first predominant (31.33%) bacterial isolates in this study. *E. coli* was detected in a majority of raw milk samples. The presence of *Escherichia coli* on street-vended raw milk are a common indicator of fecal contamination. *E. coli* was isolated from 34 milk samples out of 60 raw milk samples. Higher prevalence of *E. coli* was also reported by many authors. In Egypt, Aly and Galal, (2002)

done in Pakistan showed the presence of *E. coli* in raw milk and the number reduced in the heat treated one. Furthermore, similar studies were carried out in areas of Dhaka Bangladesh found 23/30 (76.67%) in milk samples which is higher than this study.
Also, Lubote, *et al*., (2014) revealed prevalence of E. coli was 68/75 (90.67%) in different areas of Arusha, Tanzania, which is higher compared to this study, 83% reported in Dar es Salaam, Tanzania (Kilango *et al.,* 2012) and 100% reported in Tanga, Tanzania (Swai and Schoonman, 2011).

Krebsiella spp

This is the second predominant 6/60 (10%) in this study. This microorganism possesses risk to public health. *Krebsiella*species can cause severe infections that include meningitis, bronchitis, bacteremia, pneumonia, urinary tract infections in humans and animals (Lau *et al.,* 2007; Siri *et al.,* 2011). In humans these infections are common in patients who are admitted in hospitals and those who are immune compromised (Siri *et al.,* 2011). *Klebsiella*sp attacks the respiratory tracks of an individual. Domestic animals such as cattle and horses are principal hosts for *Klebsiella*species (Siri *et al.,* 2011. Improper deposition of human faeces can lead to contamination of the soil with *Klebsiella*species.

Salmonella spp.

Salmonella is a type of a pathogenic organism. Salmonellosis may result following the ingestion of viable cells of the member of the genus Salmonella; it is the most frequently occurring bacterial food infection (Barro *et al.,* 2002). Salmonellae cause enteric infection characterized mainly by gastroenteritis on humans and other animals worldwide, and sometimes in severe cases it can result in systemic infection and even death. 5/60 (8.33%) samples tested positive for the presence of *Salmonella sp*. In general, *Salmonella* prevalence observed in this study was relatively low compared to 28/75 (37.33%) in Arusha by (Lubote *et al.,* 2014) and 20% in Ethiopia (Tadesse and Dabassa, 2012) and also 70% in India (Pant et al., 2013) but relatively higher compared to and 8.7% in Nigeria (Karshima *et al.,* 2013).

4.6 General observations in vending areas

Direct observation studies showed that the majority vendors in study areas operated stalls located very close to the roads exposing the milk to dust and other physical contaminants. It was noted that many milk vendors used plastic buckets and gallons for milk handling during procurement. Physical Plastic containers are not recommended for handling milk as they are known to be vulnerable to bacterial contamination. Omore *et al*. (2005) reported that the use of plastic containers was associated with high coliform counts in raw milk. Based on the makeup and design of the containers (mainly used the closed ones with a small mouth). Plastic containers are difficult to wash and sanitize especially at the corners and bottom. This may save as another potential source of microbial milk contamination. Poor quality of water used for washing and insufficient temperature may also jeopardize the expected container sterility. Comparable findings have also been reported elsewhere (Omore *et al*., 2002; Khan *et al*., 2011).

All utensils and equipment must be cleaned and rinsed using boiled water and detergents; and disinfected immediately after use so as to reduce milk contamination. The use of safe or boiled and portable clean water with detergent in washing milking equipment, hands and udder is a good way to remove milk remains including pathogens and, therefore, affecting the microbiological safety of raw milk (Chye *et al.,* 2004).

5. Conclusion and Recommendations

5.1 Conclusion

The present study showed that the quality of milk in the study areas was poor. High MPN was encountered in high number of samples which was over and above the recommended East Africa Community standards (EACs, 2007). According to our findings, the number of microbial contaminants which were found in the contaminated milk includes 8.33% *Salmonella sp, 10% krebsiella sp*and 31.33% *E. coli*. The contamination is due to poor animal husbandry and hygienic practices during milking, inappropriate transportation and storage facilities example packaging materials, lack of cooling systems and use of unsafe water. Also, the practice of drinking raw unpasteurized milk is hazardous because it increases risk of acquiring zoonotic diseases. Microbial contamination in milk marketed by street vendors in Dodoma City and Tanzania at large could be associated with unhygienic milking and handling practices that do not promote good milk. Lack of training for milk vendors and low capital for buying modern tools for milk storage such as aluminum containers, keeping herds in modern ways could be another factor for milk contamination. There is therefore the need to plan and offer simple and practical training courses on hygienic handling of milk for milk handlers in order to ensure safety of raw milk.

5.2 Recommendations

From this study, it is recommended that basic food vending, processing and preservation trainings to be offered to street food and specifically milk vendors. They should be offered certificates to qualify them for vending businesses. This will ensure safety of milk usually sold in the streets and safeguard the health of consumers. Regular inspection and monitoring should also be done to ensure the quality and safety food measures are followed and set into safe food code practices. Further, more studies need to be conducted in other areas in Dodoma region to find out the status of the region as whole in issue of food safety especially on milk vending.

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