

## Milk Handling Practice and Awareness on Milk-Borne Diseases among Farmers of Mendefera Dairy Cooperative Union, Eritrea 2019

Medhanie Weldegergis Weldekidan, Michael Semere, Lwam Tesfaldet, Natnael Tesfamariam, Feven Ygzaw, Aron Rezene\*

Asmara College of health sciences

\*Corresponding Author: Aron Rezene, Asmara College of health sciences, Email: [aronrezene19@gmail.com](mailto:aronrezene19@gmail.com)

### Abstract

**Background:** Milk-borne diseases have been spread by contamination of milk through unhygienic handling of dairy workers, unsanitary milk utensils, flies and polluted water supplies. So this was prepared to assess hygienic handling practices of milk throughout the milk chain system and awareness of milk borne diseases among the personnel involved in the milk chain system in Mendefera dairy farmers cooperative union.

**Methodology:** A cross sectional study was carried out among Mendefera dairy farmers cooperative union from January to April 2019. Two hundred eighty seven farmers were selected randomly and all the milk handlers at the milk shops and collection Centre were included in this study. Data was gathered using pretested questionnaire and checklist for observation in the barns, collection Centre and milk shops. Finally data was analyzed using SPSS v.22.

**Result:** The findings of this study showed 67.2% of the farmers and 88.9% MHs wash their hands before and after handling milk. About 87.5% of the farmers use narrow necked plastic containers to transport milk to the collection Centre. And only 4.2% deliver their milk to collection site within two hours after milking is done. On the other hand, 46.4% of the farmers and 44.4% of the MHs are aware of MBDs. At the time of observation, none of the milk handlers had covered their hair. In 61.7% of the barns, the floor was concrete and easily cleanable and only 30% of the farmers had separated milking area from the cowshed. The two milk shops are adjoined with a toilet. Multivariate logistic analysis identified sex and educational level being independently associated with udder washing practices pre-milking. Whereas age, work, experience, and sex were significantly associated with awareness on milk-borne diseases.

**Conclusion:** This study concluded that awareness on milk borne diseases was poor and the hygienic practices of the personnel involved in the milk chain system in Mendefera dairy farmers cooperative union were relatively good.

**Keywords:** Mendefera dairy farmers, milk handlers, milk-borne diseases

### 1. INTRODUCTION

Milk is categorized among foods that are ranked at first place as it is a vital choice for humans from birth to senility. It is a better food choice not only of its good sensory properties but also its nutritional value in preventing or reducing risks of many nutritional deficiency diseases [1]. Milk consists mainly of water and the total milk solids; these are the sum of fat, protein, lactose and minerals which are the main nutritional foods that the body require to function properly [2]. Worldwide, dairy farms produced about 730 million tonnes of milk in 2011, from 260 million dairy cows [3, 4]. Throughout the world, there are more than six billion consumers of milk and

milk products and over 750 million people live within dairy farming households [5].

Moreover, as all foods have the potential to cause food borne illness; milk and milk products are no exception [6]. Milk is a good growth medium for many microorganisms because of its high water content, nearly neutral pH, and variety of available essential nutrients [7]. And it can be contaminated at any point in the milk value chain. So it is the responsibility of the milk producers to identify these points and implement control measures to protect milk from contamination [8]. Good milk hygiene gives dairy products that are safe for human consumption, and that have good keeping

quality. On the other hand, poor milk hygiene leads to spoiled products, product recalls (hence adverse publicity), food-borne diseases and unsatisfactory or declining product image [8, 9]. The key sources of milk contamination are: faeces from soiled animals, bacteria from poor milking practices, failure to detect abnormal milk mastitis pathogens, foreign bodies especially from perished components in milking machines and bulk tanks [9]. Low income countries are significantly suffering from milk-borne diseases. The increased number in owners of small dairy farming households is also aggravating the problem, this is because most of the time they use informal market channel in order to meet the needs of public without full microbial investigation [10].

The burden of Zoonotic diseases estimates about 61% of the human infection [11] and about 90% the dairy linked diseases are because of pathogens found in milk [12]. Some of the microbial contaminants are responsible for milk spoilage while others are pathogenic with potential health effects which cause milk-borne diseases [13]. These cause several milk-borne zoonotic diseases in the human population with brucellosis, tuberculosis, leptospirosis, and campylobacteriosis [14]. The common raw milk pathogenic bacteria contaminants include: *Brucella abortus*, *Mycobacterium bovis*, *Campylobacter* spp., *Coxiellaburnetii*, *Leptospira*, *Listeriamonocytogene*, *Yersinia enterocolytica*, Shiga toxin producing *E. coli*, *Staphylococcus aureus*, *Salmonella* spp., and *Clostridium* spp. [15]. In Eritrea yet there in no any documented data on milk handling practices and awareness of MBDs. So, this study was designed to assess the awareness and safe handling practices of milk among the personnel of the Mendefera dairy farmers union so that to set educational training to the milk producers on safe handling of milk during milking, collection, storage, transportation and distribution.

## **2. METHODOLOGY**

### **2.1. Study Setting and Study Population**

The study was conducted in Mendefera dairy farmers cooperative union 54Km from Asmara to the South. Mendefera, the capital city of the Debub zone is a temperate place which is 1972 meters above sea level and has a population of about 50,000. The Mendefera dairy cooperative was established as an association in 15<sup>th</sup> January 1996 under the shelter of Ministry of Agriculture, Debub zone. The union encompasses 950 dairy

farmers and 9 milk handlers in their two milk shops that are located inside the city of Mendefera and one collection centre located near Adi-wegri secondary school, 1km to south. The union produces about 10,000 litres per day which is directly distributed to the two shops located there and is believed to meet the needs of the public. Quality control for the raw milk is done on the basis of the laboratory procedure daily on every sample at the collection centre. The quality control procedure includes ethylene blue reduction test and lactometer test. After the quality of the milk is assured, it is kept in refrigerator at 4°C. In this study about 287 dairy farmers and all the milk handlers at the milk shops and collection centre were included.

### **2.2. Study Design**

The study was a cross sectional study designed to assess milk handling practice and the awareness on MBDs among the personnel involved in the milk chain system in Mendefera dairy farmers co-operative union from January to April 2019.

### **2.3. Sample Size and Sampling Technique**

Multistage stratified random sampling method was used. The raw milk for Mendefera dairy farmer's cooperative union is provided by a total of thirty-six villages, of which twelve villages were selected randomly. Out of these twelve villages two hundred eighty seven farmers were selected using the sample size formula; [16].

$$N1 = z^2 pq / d^2$$

Where n1= calculated sample size

Z= population normal standard deviation

P= proportion (prevalence) good handling milk and knowledge on MBDs

Q=1-p

D= precision

And all the milk handlers in the milk shops and collection Centre were included in this study.

### **2.4. Data Collection Tools**

Data was collected using pretested questionnaire and checklist for observation both in the barns and milk shops. The questionnaires encompassed questions to assess the hygienic handling practices of milk and awareness of milk borne diseases among the personnel involved in the milk chain system in Mendefera dairy farmers cooperative union. The checklist included observations related to the setting of

the milk shops, barns and collection centre. Furthermore, it also assessed Personal Protective Equipment usage and other safe milk handling practices among the milk handlers.

### 2.5. Data Processing and Analysis

All the raw data were coded, cleared and entered in Microsoft excel-2013 spread sheet. The analysis was carried out statistically using (SPSS V. 22, Chicago). Frequencies and proportions were used for the descriptive analysis; presented in tables and graphs. Differences in proportions were compared for significance using Chi-square ( $\chi^2$ ) test and Variables found having significant association in the  $\chi^2$ -test were analysed using multivariate logistic regression in order to control possible confounding variables. P-values were calculated and  $p < 0.05$  were considered as statistically significant.

### 2.6. Ethical Consideration

This study sought ethical approval from Asmara college of Health Sciences, school of Public Health ethical review committee and the zonal branch of the ministry of agriculture. Written informed consent was obtained from the participants at Mendefera dairy farmer's cooperative union. The written informed consent clearly stated potential risks and benefits of the study and sought their voluntary participation.

## 3. RESULTS

### 3.1. Socio-Demographic Characteristics of the Dairy Farmers and Milk Handlers

From the total interviewed respondents, there were more males in dairy farms whereas there were more females in the milk shops. The Mean age of the dairy farmers and MHs were  $47.5 \pm 16.2$  years and  $42.4 \pm 8.5$  years respectively.

### 3.2. Milk Handling Practices of the Farmers

Majority (67.2%) of the farmers wash their hands both before and after handling milk as shown in table 1. About three- fourth (71.4%) of the farmers practice udder washing before milking and from these who use udder drying technique, 24% of the farmers use common towel to dry the udder of the cows, (32.6%) use individual towels for each cow, 19% using bare hands and the rest 24.4% do not use towel at all. It was found that (86.4%) of the farmers use detergents and water to clean milk containers but 13.6% use water only. Most of the farmers (92.3%) keep their milk for overnight and combine it with the milk they collect in the morning before it is delivered while 4.2% deliver the milk in less than two hours. It was also observed (70.4%) of the farmers' store their milk in closed containers within the barn, 13.2% in open tank while 16.4% store in refrigerator. Another noticed fact is, around 34.8% of the farmers have non-dairy animals (dogs, donkey, hens, sheep, oxen and cats) within the farm.

**Table1:** socio-demographic characteristic of the farmers and milk handlers

Characteristics	Categories	Dairy Farmers		Milk handlers	
		Frequencies	(%)	Frequencies	(%)
Gender	Male	253	88.2	3	33.
	Female	34	11.8	6	66.7
Age	20-30 years	62	21.6	0	0
	31-40 years	40	13.9	3	33.3
	41-50 years	36	12.5	5	55.6
	Above 50	149	51.9	1	11.1
Educational level	Illiterate	18	6.3	0	0
	Primary level	61	21.3	1	11.1
	Junior level	109	38.0	5	55.6
	High school level	95	33.1	3	33.3
	Collage level	4	1.4	0	0
Work experience in years	<1year	26	9.1	1	11.1
	Up to 5years	110	38.3	2	22.2
	>5 years	151	52.6	6	66.7

**Table2:** Hygienic handling practices of farmers at the farm

Types of practices (variables)	Frequencies
Milker's Hand washing	
Hand washing before milking	90(31.4%)
Hand washing after milking	4(1.4%)
Both before and after	193(67.2%)

Udder washing practices	
Before milking	205(71.4%)
No washing	82(28.6%)
Udder drying technique(205)	
Common towel	49(24%)
Separate	67(32.6%)
No used	89(43.4%)
containers washed with	
Detergents and water	249(86.8%)
Water only	38(13.2%)
Frequency of cleaning of containers	
Once	22(7.7%)
Twice	217(75.6%)
Three and above	48(15.7%)
Milk duration at the barn	
Less than 2hrs	12(4.2%)
Over night	10(3.5%)
Overnight + morning	265(92.3%)
Milk storage before leaving the barn	
Refrigerator	47(16.4%)
Open tank	38(13.2%)
Closed tank	202(70.4%)
Presence of non-dairy animals	
Yes	100(34.8%)
No	187(65.2%)

### 3.3. Milk Handling Practices of the Mhs at the Milk Shops and Collection Centre

Majority (88.9%) of the MHs wash their hand before and after handling milk with 77.8% of them use detergent to wash their hand. In addition, about 77.8% of the MHs disinfect the milk equipment but 22.2% do not practice it. Few (11.1%) of the MHs said that they give the leftover milk to the workers but the remaining said that they store it in refrigerator to use in the following day. One of the good habits of the union is that all of the milk handlers attend general medical check-up every three months. About 62.7% of the farmers and 88.9% of the MHs stop handling milk when they get sick, 24.4% of the farmers and 11.1% of the MHs said it depends on the severity of the disease, however, 12.9% of the farmers continue milk handling even they are sick.

**Table3:** knowledge of farmers and MHs concerning MBDs

Types of variables (categories)	Farmers	MHs
Knowledge of MBDs		
Have knowledge	134(46.7%)	4(44.4%)
Haven't knowledge	153(53.3%)	5(55.6%)
Types of MBDs (n=134) (n=4)		
TB	84(62.7%)	2(50%)
Brucellosis	2(1.5%)	0
TB + brucellosis	32(23.9%)	0
TB + brucellosis + leptospirosis	14(10.4%)	2(50%)
Others	2(1.5%)	0
Mode of transmission (n=134) (n=4)		
Flies	4(3%)	0

### 3.4. Knowledge of the Farmers and Mhs about the Mbds

Less than half (46.4%) of the farmers and (44.4%) MHs have knowledge about MBDs. Most of the farmers cited TB (62.7%), brucellosis (1.5%), TB + brucellosis (23.9%), TB + brucellosis + leptospirosis (10.4%) and others (1.5%) as the most MBDs. TB was seen to be the most recognized MBDs by both of the farmers and MHs.

Few of the farmers and MHs consumption of raw milk, unwashed hands, unhygienic containers and flies think as the most common mode of transmission of MBDs. More than 50% of the farmers and MHs have received training regarding safe milk handling and the health burdens of MBDs as shown in table-3.

unhygienic containers	16(11.9%)	0
Unwashed hands	10(7.5%)	0
Row milk consumption	20(14.9%)	1(25%)
Mentioned more than one	84(62.7%)	3(75%)
Training received		
Yes	144(50.2%)	7(77.8%)
No	143(49.8%)	2(22.2%)

**3.5. Observation of the Barn/Farm, Milk Shops and Collection Centre**

*3.5.1. Hygienic Practices of the Farm, Milk Shops and Collection Center*

Most of the farmers contain ventilated barn with 61.7% of the barn made of concreted floor while the remaining 38.3% with soil ground area. Additionally, 61.3% of the floor was sloppy drain while 66.6% of the cowshed floor was with non-slippery floors. 39.4% of the barn was very clean, clean (39.7%) while 20.9 were found to be dirty. The milk shops and collection Centres were well-ventilated and concreted with clean, non-slippery and sloppy floors. Though the milk shops have wash basin, sinks with drain boards and separate dressing room, it is adjoined with toilets. In the collection Centre separate

**Table4:** *hygienic of the milking area, milking equipment and milk containers during transportation*

Cleanness of milking area	
Clean	119(41.5%)
Not clean	168(58.5%)
Manure heap away from the barn	
Yes	169(58.9%)
No	118(41.1%)
Milking area	
Within the cowshed	201 (70%)
Outside the cowshed	86(30%)
Milking equipment	
Aluminum	10(3.5%)
Plastic	248(86.4%)
Bucket	29(10.1%)
Milking containers during transportation	
Aluminum	8(2.8%)
Narrow neck plastic	253(87.5%)
Bucket	28(9.8%)

*3.5.3. Hygienic Condition of the Milk Handlers at the Milk Shops and Collection Centre*

Majority (88.9%) of the MHs do not wear apron or gown at the milk shops while 11.9% practices apron or gown wearing. In addition, all of milk handlers do not cover their hairs and wear hand gloves. However, all of the milk handlers wear coveralls at the milk shops and collection Centre. About 88.9% of the milk handlers were observed fetching milk using a cup with dipper but the remaining 11.9% uses a cup without dipper.

toilets were observed but wash basin and sinks with drain boards were all absents.

*3.5.2. Hygienic Conditions of Milking Area and Milk Containers at Barn and During Transportation*

About 58.5% of the milking areas were not clean with a manure heap inside accounting a 58.9% of the milking area. Majority (70%) of the farmers milking area were within the cowshed while 30% outside the cowshed. Only 3.5% of the farmers use aluminium for milking, 86.4% plastic and 10.1% use bucket. Majority (87.5%) of the farmers use narrow necked plastic containers for transportation to the collection Centre, bucket (9.8%) whereas 2.8% use aluminium containers as seen intable-4.

A multivariable logistic regression analysis shows that the male dairy farmers were eight times more likely to wash the udder of the cows as compared with females (AOR=8.58;95% CI:1.97-3.37), P<0.005). The illiterate dairy farmers were three times more likely to wash the udder of the dairy cattle than the literate dairy farmers (AOR=3.43; 95%CI; 1.25-9.43), p<0.05). The knowledge of the respondents on MBDs was significantly associated with gender, age and working experiences of the dairy farmers. Male responders have 63% less knowledge on the MBDs as compared with female respondents (AOR=0.37; 95%CI; 0.17-

0.82),  $p < 0.05$ ). The respondents whose age  $\leq 30$  years old twice more likely to have knowledge on the milk-borne diseases as compared with the farmers whose age is above 30 years (AOR=2.37; 95%CI; 0.17-0.82),  $p < 0.05$ ).

Farmers whose working experience  $\leq 1$  years have twice more knowledge than those who greater than one year (AOR=2.96;95%CI;1.19-7.36),  $p < 0.05$ ) (show table 5).

**Table5:** Variables associated with hand washing, udder washing and knowledge on MBDs of the dairy farmers

Independent	Hand washing		Udder washing		Knowledge on MBDs	
	OR(95CI)	P value	OR(95%CI)	P value	OR(95%CI)	P value
Sex						
Male	3(0.6-3.9)	1.23	8.58(1.97-3.37)*	0.004	0.37(0.17-0.82)*	0.014
Female	1		1		1	
Age						
$\leq 30$	0.23(0.2-12.1)	0.995	1.33(0.67-28)	0.401	2.37(1.29-4.34)*	0.005
$>30$	1		1		1	
Educational level						
Illiterate	1.56(0.2-2.36)	0.993	3.43(1.25-9.43)*	0.017	2.006(0.72-5.603)	0.184
Literate	1		1		1	
Work experience						
$\leq 1$ yrs	0.26(0.52-6.7)	0.58	0.76(0.433-1.335)	0.066	2.96(1.19-7.36)*	0.020
Up to 5yrs	2.6(0.89-11.91)	0.69	0.35(0.112-1.073)	0.339	1.26(0.76-2.100)	0.366
$>5$ yrs	1		1		1	

\*=  $p < 0.05$

#### 4. DISCUSSION

This study was seated to assess the hygienic milk handling practices among the dairy farmers and MHs and their knowledge on milk-borne diseases. Microbial analysis was out of scope of this study, but it was assured that the milk produced was inclined to microbial contamination during pre and post-harvesting milk handling practices, prolonged storage duration and transportation to the collection center. It is indorsed that the dairy farmers before milking should clean barn, wash and dry the udder with clean towels regularly on the daily basis. Teat dipping with appropriate disinfectant after milking is important to prevent entry from harmful microorganisms [17]. In this study, it was observed that milking was done at the site of the cowshed with manure heap nearby, sloppy floor and presence of non-dairy animals within the farm.

Majority of the farmers 65.9% clean their barns daily while 32.8% clean their barn three times a week but the remaining 1.3% clean their barn five times a week. And this result is almost similar with result reported from Addis-Ababa Ethiopia [18], 74% of the respondents cleans their floor daily. But different result was reported by [19], 47% of the farmers clean their barn three times a week. In addition to this 30% of the dairy farmers have separate milking area but 70% milked within the cowsheds or parlors. Similar results were reported from Turkey [20]

with 30% of the dairy farmers separated milking area. In this study, 67.2% of the farmers (milkers) wash their hand before and after milking. While the MHs at the milk shops and collection Centre in the study area did not wear apron or gown, cover their hair and gloves were not practiced during milk handling which is similar to [18].

Washing teats and udder of dairy cows before milking is one of the most impressive hygienic practices prerequisite to ensure safe milk production. Because the teats and udder of the dairy cows have direct contact with the ground, urine, dung and feed remnants. Clean animals are more likely to remain disease free and at milking time, are less likely to contaminate the milk with harmful bacteria [21]. As a result, this study revealed that 71.4% of the dairy farmers wash the udder of their cow before milking but 28.6% do not practice udder washing before milking. A higher result was reported by [22], which is 85.2% of small size farm owning households in Hawassa city wash the udder of the dairy cow before milking. Opposing to this result [21] it was reported that the entire respondent did not practice pre milking udder washing. And also contrary results reported by [23] from Ghana who reported about 92% of the respondents did not wash the teats of their cow. Drying of teats and udder of the dairy cow with clean individual towels following cleaning practices during milking is essential for quality milk production [17]. During this study, 24% of

the farmers used common towel to dry the teats and udder of the cow, 32.6% used separate towel for each cow. Comparable to this result reported by [24], about 48% of the respondents failed to use towel after washing the udder, 44% used common towel while 3.8% used separated towel for each cow. Contrary results were reported by [25], that 83.2% of the respondents failed to dry the udder of the cow after washing. Narrow necked plastic containers are not easily washed especially in the inner corners and this leads to sticking of milk residues. In such a situation, microorganisms can rapidly build up milk residues in milk storage containers, and may contaminate the milk on subsequent uses [26-28]. In spite of their high value, aluminum containers are recommended because they do not have adhesive properties and are easy to clean [29]. In the current study, majority (75.6%) of the farmers wash their equipment two times between each milking practices. In addition, 86.5% of the farmers use detergent with water to clean their equipment which was found to be similar with a study reported by [30]. About 11.1% of the farmers' used aluminum while 88.9% of them used narrow necked plastic containers (Jerrycan) for storing and transporting the milk to the milk collection center. A study from Tanzania revealed that none of the farmers used aluminum containers to transport their milk to the collection centers [26].

Milk delivered to milk collection Centers directly after milking has less chance of contamination and must reach the collection Centre within 2-3 hours [31]. Milk kept in refrigerator between 2<sup>0</sup>c-8<sup>0</sup>c has an essential role to minimize bacterial multiplication [9]. According to the current findings, only 4.2% of the dairy farmers transport their milk to the collection center directly after milking unlike the results reported by [32] who found 100% of the farmers transport their milk directly to the collection station.

The finding of this study reveals that about 12.9% of the farmers continue to milk even they are sick. These finding coincide with other studies on the same fields in Vietnam [32]. However, reports in Tanzania [26] showed that all of the milk retailers stopped milk handling when they get sick.

Even though the union gives training regarding MBDs, the findings of this study showed that their knowledge on MBDs was poor. Less than half of the dairy farmers and MHs of this study

were aware of the general MBDs. 84.6% the farmers and 50% of the MHs explained TB as one of the MBDs. Concurrent findings were reported from Zimbabwe [33] and Tanzania [26] in regard to the knowledge and awareness of MBDs. In addition to this, some of those farmers who have knowledge on MBDs were able to mention the common mode of transmission of MBDs.

The floors of the milk shops and the collection centers were smooth which provides ease during cleaning in order to reduce cross contamination of milk. But the milk shops were adjoined to toilets and do not have smooth walls and washbasins as well. To conclude, the milk collection Centre of Mendefera dairy farmers association has similarities with the milk collection Centre of Zambia [34] and England [9] in infrastructure of the milk collection centers.

## **5. CONCLUSION**

This study showed that the hygienic practices of handling milk among the farmers and milk handlers at the milk shops and collection Centre was good, however, there was no adequate awareness on MBDs and their mode of transmission. Majority of them wash and disinfect their equipment and maintain their personal hygiene which is an indicator of their mind-set in preventing MBDs. This study recognizes that training and guidance about all the precautions which should be taken consistently throughout the milk chain system are necessary for the farmers and the milk handlers at the milk shops and the collection Centre in order to reduce microbial contaminations and entrance of foreign particles. And this should be corrected as it is required for the protection of milk from direct or indirect contamination.

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