

# Evaluation of Mazzi Cane on Keeping Quality of Milk in Wondogenet District of Sidama Zone, Southern Region, Ethiopia

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## Abstract

The study was conducted in Wodndogenet district of Sidama zone with the objective to identify the quality of the milk under Mazzi cane and traditional milking device. About 30 households owning minimum two lactating cows at the early lactation stage were involved in the experimental and preference evaluation study. The selected households has three types of milking devices such as Clay pot, Qil and Mazzi cane which is donated by SNV Netherlands Development organization. About 35 lactating cows were selected for the study from the households. From the total sample, 5 of the cows were found mastitis positive. The sampling for bacterial identification was from the 30 mastitis free lactating cows after milking in the three devices. The current finding revealed that lower count for both Coliform ( $0.81 \times 10^5$  cfu/ml) and Total bacterial count ( $2.52 \times 10^5$  cfu/ml) was observed for Mazzi cane milking and transporting device (MTs) than samples from "Qil" and clay pot milking devices. In spite of the lower count for both bacteria types among the three devices, the count is within the suggested standard (i.e less than 10,000cfu/ml for Total bacterial count and less than 50cfu/ml for coliform count). Regarding milking device preference, mazzi cane was best preferred by the respondents' interims of its durability, easy for cleaning and availability of its own cover (lid). Moreover, the multi functionality of the material, it makes it more preferred than the two traditional equipment. Although the more advantages of the improved device, the constraints were also ranked. The 1st, 2nd and 3rd constraints ranked by the respondents are the material are unsuitability for smoking, easily detachable cover and inadequate volume for milking respectively. In general from different perspective, the quality of the milk under mazzi cane is better than the other two traditional milking devices. Therefore by producing the equipment in different size, providing training, demonstrating it for different stakeholders such producers (farmers), collector's processors and cooperatives, then the quality of the milk will be enhanced.

**Keywords:** Mazzi cane; Clay pot; "Qil"; Milking device; Quality; Bacterial count

## Introduction

Milk and milk products play an important role in human nutrition throughout the world. Consequently, keeping the hygiene quality of milk was very much important from consumer's health point of view. Quality of milk products were easily affected due to different factors of which performance of milking procedures and cleanness of the milking utensils and equipment as a major one [1].

The unsafe handling practice results in the higher bacterial count, which in turn may cause spoilage of the milk and poor yields of its products [2]. Bacterial contamination of raw milk can originate from different sources such as from air, milking equipment, feed, soil, faeces and grass [3]. It is also influenced by the health and hygiene of the cow, the environment in which the cow was housed and milked, and the procedures used in cleaning and sanitizing the milking and storage equipment. Concerning the health condition of the cow, mastitis was a global problem as it adversely affects animal health, quality of milk and the economics of milk production, affecting every country, including developed ones and causes huge financial losses [4].

Moreover, specifically the study of [5] also indicated that equipment used for milking, processing and storage determine the quality of milk and milk products as well. Besides, different utensils were used for collecting, storing and processing of milk in Ethiopia. The materials were different from place to place. The milk handling vessels used were clay pots, plastic buckets, stainless steel and calabash "Qil" [6, 7]. Some of these milk containers were easily broken, difficult for handling, small in size, narrow opening which makes difficult to clean and even they don't have own lid (cover). In one or another ways, these utensils cause milk deterioration that leads to highly post-

harvest loss during milking, storage and transport. The Mazzi milking and transportation device is a safer, more affordable milking, storage, and transportation system that allows clean and efficient collection and transportation of milk from cow to the consumer [8, 9]. Additionally, the container is branded as Mazzi (which is derived from the Kiswahili word for milk, maziwa) is a durable 10-liter container with a calibrated volumetric scale on the outside of the container, which helps to reduce disagreements between traders and farmers when determining the total yield of milk provided by farmers. Therefore the objective of the study was to identify the quality of the milk under improved MTs device and assesse the preference of the material as compared to the traditional milking devices.

## Material and Methods

### Description of the Study area

The assessment was conducted in Wodndogenet district of Sidama zone. Wodndogenet district has been located 43 km from Hawassa and 318 km from Addis Ababa. The district's latitude and longitude was

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6°.95' - 7°.13'N, and 38°.52'-38°.69' respectively and elevation ranging from 1501-3000 meter above sea level (Source).

### Sample procedure and data collection

**Sample size and sampling:** About 30 households owning minimum two lactating cows at the early lactation stage were purposively selected. The selected households has three types of milking equipment's such as Clay pot, Qil and Mazzi cane delivered by SNV Netherlands Development organization. Before milk sample collection, 35 lactating (milking) cows were selected for the study from the 30 households. About five of the households registered for two milking cows for the sampling. The lactating cows in the early stage were required for enough milk accumulation in three different milking equipment. Minimum 5 liter milk was accumulated in three different devices in one session milking. Thus, samples were taken after checking mastitis and milking on three different devices.

#### California mastitis test (CMT)

About 35 experimental lactating crossbred cows were checked for mastitis prior to collecting milk sample from the three different milking equipment. California mastitis test (CMT) was carried out by using CMT paper for screening. This was basically done to avoid the risk of bacterial load during sampling due to mastitis case. (Source with regard to CMT paper)

#### Identification of total bacterial count and Coliform bacteria

**Total Bacterial Count (TBC):** The milk samples were diluted in 0.1% peptone water (by transforming 1ml of the previous dilution in 9ml of 0.1% peptone water). Total Bacterial Count (TBC) was made on plate count agar (PCA) by incubating aerobically surface plated duplicate plates with appropriate decimal dilution of milk samples at 32°C for 48hrs (Richardson, 1985). Single bacteria or tight clusters (e.g. chains or clumps) grow to become visible colonies that are then counted. All bacterial plate counts are expressed as the number of colony forming units (cfu) per milliliter (ml).

**Coliform Count (CC):** One ml of milk sample was added into sterile test tube having 9 ml peptone water. After mixing, the sample was serially diluted up to 1:10<sup>-5</sup> and duplicate samples (1 ml) were pour plated using 15-20 ml Violet Red Bile Agar solution (VRBA). After thoroughly mixing, the plated sample was allowed to solidify and then incubated at 32°C for 24 hrs. Typical dark red colonies (>0.05 mm in diameter) were considered as coliforms and counted accordingly. Finally, colony counts were made using colony counter and dark red colonies were considered as Coliform colonies. (Source)

#### Farmers' preference

The preference of farmers for the three milking equipment's and constraints on milking devices was gathered from 10 participated farmers. Checklists were used to gather information for preferences analysis and the farmers involved in this study responded preferences of the three milking equipment in terms of different parameters. The information gathered for the preference of milking and transporting equipment were in terms of suitability for smoking utensils, suitability for cleaning, volume (size) for milking and transporting, durability (how long it serves), having its own suitable cover (lid), purpose of equipment (other than milking) and also constraints of each equipment.

#### Statistical analysis

Descriptive statistical tools were largely employed to analyze the preference response and experimental result. The results of

total bacterial count and coliform counts were first transformed to logarithmic values (log 10) and these values were analyzed using means and standard error in SPSS (version 20). For the prefer responses descriptive analysis such as frequencies, percentiles were used. Moreover parameters like constraints of milking devices were ranked based on the respondents. For the colony forming unit's calculation per ml of milk, it was calculated using the following formula.

$$\text{Count} = \frac{Sk}{n1} + 0.1n2 \times d$$
 Where,

$$Sk = \text{sum of all colonies counted}$$

n1 = number of plate from the lowest dilution used for computing the count

n2 = number of plates in the next dilution factor used for computing the count,

d = reciprocal of the dilution factor of the lowest dilution used for computing the count corresponding to n1.

## Results and Discussion

### Mastitis

Based on CMT results, out of 35 lactating cows, 14.3% (5) of the cows were positive for mastitis. From the positive 5 lactating cows, 2(40%), 2(40%) and 1(20%) cows had one, two and four infected quarter, respectively. In this study, relatively lower percent of mastitis case was recorded as compared to the study of [10] (71.05%) in HOLETA town in Central Ethiopia and [6] report in Wondogenet and Hawassa town, Ethiopia (63.11%) and [11] study in western zone of Tigray Region, Ethiopia (27.89%). This variation may be due to variation in management practices, weather conditions and small number of sample size in this study since the objective was basically for mastitis but the screening of it for the next sampling.

### Microbiological identification of raw milk from sampling equipments

**Total Bacterial count and Coliform bacteria count:** Microbial contamination of raw milk can occur from a different sources. It can occur from the udder (mastitis associated organisms), from environmental organism transfer via dirty udder and teat surfaces, and from improperly cleaned and sanitized milking equipment (Source.). According to the experiment, the result indicated that lower count for both Coliform (0.81 X 10<sup>5</sup>) cfu/ml and Total bacterial count (2.52 X 10<sup>5</sup>) cfu/ml for Mazzi cane milking and transporting device (MTs) than samples from "Qil" and clay pot milking devices (Table 1). However the bacterial count for all the three equipment samples is within the standard. According to Murphy (2008) review report, the suggested and regulatory standard for standard plate count or Total bacterial count is less than 10,000 cfu/ml and less than 100,000 cfu/ml respectively. In the same report, the suggested and regulatory standard for Coliform is less than 50 and less than 750cfu/ml respectively. The

**Table 1:** Mean (+SE) for Total Bacterial Count and Coliform Count for different milking equipment.

Bacterial Type	Milking Equipment	M + SE (Cfu/ml)
Coliform Count (CC)	Clay pot (N=30)	1.05 ± 0.19
	Mazzi (N=30)	0.81 ± 0.19
	"Qil" (N=30)	1.35 ± 0.25
Total Bacterial Count (TBC)	Clay Pot (N=30)	2.67 ± 0.21
	Mazzi (N=30)	2.52 ± 0.31
	"Qil" (N=30)	3.33 ± 0.22



Figure 1: Milking on different milking equipment.

amount enumerated for Coliform and total bacterial count in the present study was only related with milking equipment sanitation since other factors were controlled. One of the most frequent causes of high TBC is due to poor cleaning of the milking system where as for coliform counts is associated with dirty equipment and in rare cases that is result from milking cows with environmental coliform mastitis [12]. The lower count for Mazzi cane might be due to the equipment nature of fabrication that the material was food-grade plastic material with reducing level of contamination and spillage [9]. A field tests conducted in Tanzania showed that switching from jerry cans to MTS led to a dramatic reduction of up to 76.3% in the levels of microbiological organisms present in raw milk samples taken from pastoralist farmers. Therefore, the material has an ability to minimize the risk of contamination and load of bacteria.

The other reason for reduced total bacterial and Coliform bacteria count of Mazzi as compared to clay pot and “qil” sample might be the sampling was after checking mastitis. The sample for identification of the bacteria’s was taken after checking mastitis and only from the free ones. The review of [12] described the possibility of increase of bacteria from natural flora, mastitis, dirty udder and dirty equipment. According to that the total bacterial count might be greater than 10,000 and 100,000cfu/ml is possible where as high Coliform count if the contamination is for both from dirty equipment. In contrary to the current finding, a higher Coliform count for the raw milk ( $2.0 \times 10^5$  to  $1.0 \times 10^4$  cfu/ml) was reported. The detection of Coliform bacteria and pathogens in milk indicates that there is a possible contamination of bacteria either from the udder, from the milk utensils or water supply used for cleaning [13]. Higher coliform counts more often result from dirty equipment and in rare cases result from milking cows with environmental coliform mastitis [12].

### Milking equipment preference

**Volume of Milking Devices:** The interviewed respondents categorized the adequacy of milking equipment interims of volume. The milking device adequacy was expressed by the respondents by indicating as small, medium (enough) and large sized for milking purpose. According to [8] report, mazzi is invented as 10 Liter volume with purposes of collection, storage, and transport for developing countries. The clay pot for milking purpose is prepared in smaller sized (1-2 liter) whereas clay pot for butter processing might reach up to 20 litter milk holding capacity (Figure 2 and 3). The reason for small size clay pot is because of the heaviness of the material and couldn’t hold in their hand until finishing the milking operation. The [14] report, mentioned that the container better enables farmers to milk using both hands, which increases the yield from the cow.

Moreover the response on the volume was in relation to their



Figure 2: Clay Pot, Calabash (Qil) and Mazzi cane.

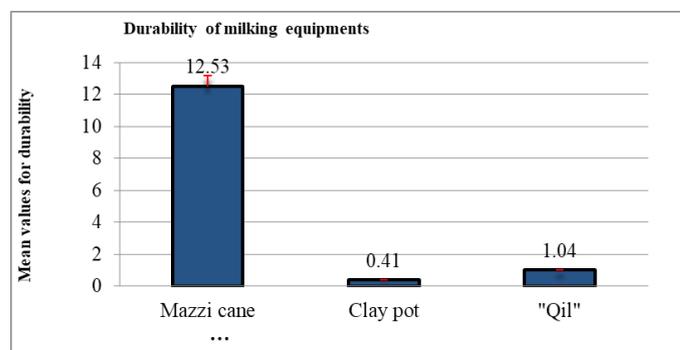


Figure 3: Durability of Milking Equipment.

current milk production of their cows. Accordingly, from interviewed respondents about 80% and 20% of Mazzi cane equipment was expressed by medium and large sized volume for milking, respectively (Table 2). The medium sized in the present study was to mean, the equipment was enough/adequate whereas the larger size was to mean the volume is excess for milking as compared to their production. Thus the respondents in the current study who especially said large, they have many cows and the volume for milking was not enough for one session milking. Besides the clay pot in the study area, they prepare it in different sizes.

About 73 and 80% of interviewed respondents categorized clay pot and “Qil” as small volume respectively. This means that the devices are not enough for one session milking which might be due to better milk production in the household. Thus most of the respondents preferred Mazzi cane milking equipment for at least by its adequate volume for milking (May be see Tanzanias study report.)

### Suitability of materials for cleaning and smoking

Hygienic milking should take into account the sanitation of milking environment, the milkers and also the utensils used to collect and store milk. Sanitation is one of the basic factors for keeping the quality of the milk. [15] study report mentioned that milking equipment should be easy to clean so as to ensure the quality of the milk. Therefore in this study, the respondents in indicated that the materials preference was evaluated interims of its suitability for cleaning and smoking. Regarding that, mazzi cane was rated as best for cleaning by all of the respondents due to its wide opening (mouth) and its whitish color. Moreover, the materials suitability for smoking was by few respondents (33%) (Table 3). This was due to the material’s plastic nature and fear

Table 2: Volume of milking equipment.

Types of milking equipment	Categories (N=15) ((Frequencies / %)		
	Small	Medium	Large
Mazzi cane	-	12 (80)	3 (20)
Clay pot	11 (73)	4 (30)	-
“Qil”	12 (80)	2 (13.33)	-

Table 3: Suitability of materials (Cleaning, smoking, covering, durability).

Types of milking equipment	Materials suitability (N=15) (Frequencies / percent)			
	Cleaning	Smoking	Covering (have own cover)	Durability
Mazzi cane	15 (100)	5 (33.3)	15 (100)	15 (100)
Clay pot	2 (13.33)	15 (100)	-	-
“Qil”	-	12 (80)	-	-

Table 4: Types of covering materials for milking equipment.

Types of milking equipment	Type of covering material (Lid type used)	Values (N=15) (Frequencies / %)
Mazzi	Plastic cover/lid attached to the equipment	15 (100)
Clay	Enset leaf cover/lid	14 (93.3)
	Plastic cover not attached to the equipment/ “Pestal”	1 (6.67)
“Qil”	Enset leaf cover/lid	14 (93.3)
	Plastic cover not attached to the equipment	1 (6.67)

that it might melt during smoking. The news report by [9], mentioned that the material after milking and once emptied can easily be cleaned, because of its extra-wide opening that makes it fully accessible the interior section. Additionally the white transparent plastic enables farmers to detect dirt easily. In contrary, the milking devices such as clay pot and qil are not suitable for easy cleaning because of their narrow opening and the roughness of the interior portion. According to [7] study report, porous nature of clay pot easily harbors bacteria and also makes hygienic cleaning inconvenient and ineffective. Moreover, the study report mentioned that it is not only inflicting milk spoilage but also milk quality deterioration and health risks.

### Durability of milking equipment

The interviewed farmer utilizes clay pot and qil throughout their life where as mazzi cane equipment for at least a year. Thus upon their utilization, they said the mazzi container might be durable and it might serve for 12.5 years than “Qil” (1) year and clay pot 0.41 year (Figure 1). The materials durability is also mentioned by news report of [14]. For the clay pot, since it is made from clay soil, it can easily be broken and have very short life span. The same was true for “Qil” that it can easily be broken. Nevertheless, the short life span for the traditional equipments is probably related with carefully handling during washing, milking and transporting. Thus the materials can easily be broken due to carefulness and also the nature of the manufacturing material.

### Type of covering material (Lid) for milking equipment

The other mentioned preference of the milking equipments was based on the availability of having its own cover (lid). Other than mazzi cane, clay pot and “qil” lack their own cover. So, usually the respondents in the study area make cover for the materials from different plastic materials and from the leaves as well (Table 4). For the clay pot and “qil” users, about 93% of the respondents used enset leaf made cover and about 7% plastic cover for each which is not attached to the equipment (Table 4). Thus Mazzi cane was best preferred by the respondents due to availability of its own plastic cover attached to the equipment.

Regarding the covering materials for clay pot and “Qil”, enset leaf and “pestal” is not good for keeping the sanitation and safety of the milk. Contamination may occur due to the materials suitability for milk spillage and rise of bacterial load.

### Purposes of milking equipment

The milking utensils had different purposes. Some of the equipment had more than one purpose and some only one specific purpose. Regarding the traditional milking devices (clay pot and “Qil”), about 93.3% of interviewed respondents use the equipment only for milking. About 6.7 % of respondents utilize the equipment for both milking and transporting purpose (Table 5).

The modern milking device (Mazzi cane) have multipurpose such as for milking, measuring the amount of milk, filtering and also for transporting purpose. It was even called as MTs equipment meaning it is a milking and transporting device. As transporting device, the attached lid is then secured onto the container, which itself is stackable for easy transport from the farm to collection centers that purchase milk. The container can easily be carried by hand, bike, truck, or animal. According to the manufacturer (Global Goods), the material was invented specifically to streamline the collection, storage, and transport of milk in developing countries [14]. Additionally the unique design helps the smallholder farmers and low income stakeholders in the dairy value chain maximize their yield and reduce costly spillage and spoilage. This 10 liter container is calibrated with volumetric scale on the outside of the container so that it is easy to know the amount of milk [8]. Moreover, the special characteristic of the modern equipment is the purpose of filtering by its detachable funnel (Table 6). The funnel in the mazzi benefits the famers as well as the processors by minimizing the rejection of supplied milk because the sieve prevents dirt materials from entering the milk [9]. It is not only that but also the possibility of milking operation directly into the container with a detachable funnel that limits contaminants, helps identify signs of udder infections, and reduces spillage when the container is tipped [8] . Therefore the multipurpose milking container not only keeping the safety, the quality of the milk but also maximizes the yield by reducing the rate of spillage

Table 5: Purposes of Milking Equipment.

Types of milking equipment	Purposes of milking equipment	Values(N=15) (Frequencies / %)
Mazzi cane	For milking, measuring, transporting & filtering	15 (100)
Clay	For Milking alone	14 (93.3)
	For Milking and transporting	1 (6.7)
"Qil"	For Milking alone	14 (93.3)
	For Milking and transporting	1 (6.7)

Table 6: Constraints of milking equipment.

List of Constraints	Milking equipment (Rank)		
	Mazzi Cane	Clay pot	Qil
Suitability for smoking (not suitable)	1	-	-
Lid/cover easily detached	2	-	-
Adequate volume (not enough)	3	-	-
Easily breakable	-	1	2
Suitability for cleaning (Not suitable)	-	2	1
Difficult to transport with the equipment	-	3	3
Not comfortable for milking	-	6	4
Washing takes time	-	4	-
Short life span	-	6	-
Develops bad odour	-	5	-
Small opening (Mouth part)	-	6	-

and spoilage and thereby reduced milk post-harvest loss.

### Constraints of milking equipment

The studied milking equipment had their own drawbacks and as well preferred criteria. For the two traditional devices, there are common constraints mentioned and ranked but for the mazzi cane the listed constraints are not common with the traditional ones. The mazzi cane milking device has its own constraint such as smoking suitability, its volume and its easy detachment of the lid. The three ranked constraints of Mazzi cane are unsuitability for smoking followed by easily detachable lid (cover) and the material is not enough for one session milking.

The traditional milking equipment had several constraints. For the clay pot, the top three problems were the material is can easily be broken, unsuitable for cleaning and difficulty of transporting with the equipment. Similarly the same top three problems were ranked for qil milking device. According to the news report by [9], traditional milking devices increases the risk of milk spillage and contamination as the farmers have to pour the milk from one container to another for filtering, storing and transportation. Most of the traditional containers are very difficult to clean and are not made of food grade materials.

### Conclusion and recommendation

Microbial contamination of raw milk can occur from different sources. But the current study investigation was focused on the contamination of the milk. The total bacterial and coliform bacterial count for the raw milk samples from the three equipment is within the standard. However, the count for both bacteria is a bit higher for the traditional milking devices than the improved MTs equipment. The lower count for Mazzi cane improved equipment might be due to the equipment nature of fabrication that the material was food-grade plastic material with reducing level of contamination and spillage. In addition to microbiological identification of the materials, the farmers

responded for the preferences of the Mazzi cane milking device over the traditional devices [16, 17]. The farmers/respondents rated the preference of the equipment interims of volume/size, effectiveness in cleaning, availability of own lid (cover) and by its durability. In all the mentioned parameters, Mazzi cane is the best preferred milking and transporting device by the respondents. Moreover, the material has multifunction as compared to the traditional clay pot and "qil device". The functions other than milking for Mazzi cane are transporting, storage, measuring the amount of milk, and also filtering. The improved device has also some drawbacks such as it is less suitable for smoking, the lid can easily be detached while transporting and for some of the respondents the material is also not enough for their daily milk yield. Nevertheless the mentioned constraints could probably be improved by manufacturing different sized mazzi and availing in the market, training on the smoking techniques and improving the strength and flexibility of the lid. In general the material has an ability to minimize the risk of contamination and load of bacteria and thereby keeping the quality of the milk. Therefore producing the equipment in different size, demonstrating it for different stakeholders such producers (farmers), collector's processors and cooperatives, the quality of the milk will be enhanced.

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