

# Indigenous knowledge on preservative plants and preservation techniques of milk and milk products in south wollo zone, northern ethiopia

## Abstract

**Background:** Indigenous knowledge on traditional milk handling practice and traditional plants is of tremendous importance in many societies, including most rural African communities. The indigenous knowledge is especially important to preserve milk and its products and as traditional medicines. In this study, the traditional milk and milk products handling practices was known and the milk preservative plants used in the study area were identified.

**Methods:** The study was conducted around Dessie administrative city. A total of one hundred twenty women, twenty from each of the six PAs were individually interviewed using semi-structured questionnaire. Moreover, samples of the preservative plants were taken from the field to identify their scientific name. The data collected was analyzed by using SPSS software and explained by descriptive statistics.

**Results:** Only few respondents (10%) practice adequate sanitary practices before and after milking. About 57% of the respondents used locally growing milk preservative plants for washing and fumigating their milk equipment used for milking, storing and processing with the intention of extending the fermentation time and provide good flavor for the milk. The major preservative plants to clean the milk vessels were *Lippia adoensis*, *Senecio myriocephalus*, *Sida cuneifolia*, *Lhymus schimperi*, *Hypericum revolutum* and *Rumex nervosus* while the most frequently used plants to smoke milk utensils were *Olea Africana*, *Clerodendrum myricoides*, *Terminalia brownie*, *Juniperous procera* and 'Mitie'.

**Conclusion:** Majority of the households of the study area did not carry out adequate milk sanitary practices hence the milk sanitary practices of the area should be improved. The preservative plants identified in this study were imperative to the community. The active ingredients of these plants, i.e., the extent and technique of utilization, their efficacy on the microorganisms and impact on the consumer body should be further studied.

**Keywords:** milk, milk product, technique, preservative plant

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**Abbreviations:** ANRS, afar national regional state; OAZ, oromia administrative Zone; Pas, peasant associations; SPSS, statistical packages for social sciences; SWZ, south wollo zone; WU, wollo University

## Background

Storage stability problems of dairy products exacerbated by high ambient temperatures and distances that producers have to travel to bring the products to market places make it necessary for smallholders to seek products with a better shelf-life or to modify the processing methods of existing once to get products of better shelf-life. The first step that the producers or product handlers can take to ensure a high quality product is to make sure that the production and the manufacturing process are hygienic. These will result in fewer spoilage organisms in the dairy products and thus better quality with longer shelf life in the final products. Another option to ensure good quality is to take maximum care in handling and storage of the products during transport and marketing. The fact that milk is relatively perishable and a high percentage of it is consumed in a relatively natural state, handling of milk and its products to preserve its natural and desired characteristics is very important.<sup>1</sup> The less perishable

the products, the longer the smallholders can retain it to obtain good price and surplus made during the production season can be stored for consumption during the season in which the products are in short supply. Smallholders add different spices to butter as a preservative and /or to enhance its flavor for cooking.<sup>2</sup> In areas where the climate is hot, the raw milk spoils easily during storage unless it is cooled or when possible treated with preservatives. But these preservatives are not readily available in rural areas and cooling systems are not feasible because of lack of facilities.<sup>3</sup> In these areas, the farmers have to rely on traditional technology to increase the storage stability of milk and milk products either by converting the milk to its stable products like butter or by treating with traditional preservatives.

Identification and characterization of the traditional herbs and methods of utilization could be very crucial in developing appropriate technologies for milk handling and preservation. The study was also important for giving chance for further study of the materials. This study was therefore designed with the objectives to identify and characterize the traditional preservative materials of milk and milk products; and to assess the indigenous knowledge on the preservation techniques in and around Dessie.

## Materials and methods

### Description of the study area

The study was conducted around Dessie administrative city which is a potential milk shed area. Dessie administrative city is the capital city of SWZ and it is located at 401km north of Addis Ababa (capital city of Ethiopia). The area comprises 16 PAs (the smallest administrative unit), from which six of them were rural PAs and the rest ten were city PAs. The study was particularly conducted in the six rural PAs (Tita, Qurqur, Boru–meda, Boru–selasie, Gerado–15 and Gerado–16). The predominant agricultural production system in this area is mixed crop–livestock farming.

### Sampling technique and sample size

Six of the peasant associations located around Dessie was selected. From each PAs, twenty women who owned milking cows and process milk was purposively picked up and interviewed. Accordingly, a total of one hundred twenty participants from the study area were individually interviewed using a semi–structured questionnaire in the study to be undertaken.

### Data sources and method of data collection

Primary and secondary data was used for the analysis. Semi–structured questionnaire was prepared to collect information. The questionnaire was pre–tested before the actual survey. Enumerators was recruited and trained to manage the formal survey, using the semi–structured questionnaire with female farmers. The preservative plant species identified from the questionnaire was further transported to the herbarium of Addis Ababa to identify their scientific names. Relevant secondary data was collected from internet and annual reports.

### Data analysis

The data collected was analyzed qualitatively and quantitatively. Generally for the qualitative and quantitative data generated through the survey descriptive statistics like mean and percentages was used to examine and explain the milk handling practices and preservation techniques in the area. SPSS computer software package version 20 was<sup>4</sup> used to analyze the collected data. The mean and percentage values of various parameters were compared across the studied PAs.

## Results and discussion

### Milk and milk products handling practices

Only few respondents (10%) practice adequate sanitary practices before and after milking. This result agrees with<sup>5</sup> who indicated only few respondents (10.3%) were washing udder of their cow after milking. Whereas 55% of the respondents practice udder washing before milking. The result of this study is in contrast to,<sup>6</sup> who reported that most farmers do not wash the udder of their cows before milking; they assume allowing the calf to suckle before milking is sufficient to clean the teats. The current study also disagreed with the report of<sup>7</sup> who indicated that udder of the cow is washed before milking only by few farmers (5.6%). In all of the respondents, calves were allowed to suckle their dams prior to milking for some time. Only 2% of the respondents use individual towel to dry the udder of their cows (Table 1).

In most instances, women dip their fingers into the milk bucket and moisten the teats of the cow to facilitate milking. This practice may allow microbial contamination of the milk from the milker’s hand. The lack of proper cleaning of udder could lower milk quality and have significant concern on public health.<sup>8</sup> About 57% of the respondents used locally growing milk preservative plants for washing and fumigating their milk equipment used for milking, storing and processing with the intention of extending the fermentation time and provide good flavor for the milk (Table 1). The equipment were washed thoroughly using different plants prior to smoking. The plants used for the cleaning of milking and fermenting utensils are presented in Table 2. However cleaning plants differ from place to place and even from household to household based up on preferences.<sup>7</sup>

**Table 1** Milking and hygienic practices in the study area

Milking practices	Reponses (%)
Udder washing before milking	55
Udder washing after milking	10
Suckling and milking	100
Use of individual towel to dry the udder of cow	2
Use of local plants for washing and fumigating milk equipment	57

### Locally growing plants used for cleaning milk utensils

The most frequently used cleaning plants for milk equipment in the study area were *Lippia adoensis*, *Senecio myriocephalus*, *Sida cuneifolia*, *Lhymus schimperi*, *Hypericum revolutum* and *Rumex nervosus* (Table 2) (Figure 1). About 83% of the nature of these plants was shrubs whereas 17% was herb. According to the respondents, the techniques of application of these preservative plants were rubbing the leaf and/or twig of the plants against the internal wall of the milk vessels. The result is similar with the observations made by Coppock et al.<sup>9</sup> in the semi–arid pastoral system of Ethiopia, who reported a milk utensil locally called *Gorfa* may be scrubbed with leaves of locally growing preservative plants before being filled with milk. Plants used for rubbing milking vessels deserve further investigation to determine their active ingredient and the efficacy of the active ingredients on the desirable and /or undesirable microorganisms.

As a result of their readily availability in the surrounding of the area, 100% of the respondents use *Lippia adoensis* and *Rumex nervosus* as cleaning plants (Table 2). The availability and the degree of utilization of the cleaning plants differ from place to place and even from household to household based upon preferences and abundance indicating the variety of materials that need to be exhaustively studied. All of the respondents claimed that cleaning plants of their choice were being used as they were known to improve the flavor of their milk. Moreover, when fermentation rate increase, the milk storage vessels were washed with the plants to retard the fermentation rate. The plants might act by helping to inoculate some desirable organisms in the milk or selectively inhibit the growth of undesirable acid forming organisms and create ideal environment for the former groups to grow and take the advantage for proliferation. Nowadays some of the participants who are near to and have road access did not ferment their milk for butter making. Around 43% of the respondents

in the study area directly sold their milk for the nearby collectors coming to their home gate immediately after milking. Hence, these

households did not use preservative plants instead detergents (*Ajax*, *Ommo*, etc.) and thin wire was used for washing their milk containers.

**Table 2** Locally growing plants used for cleaning/washing milk utensils

Name of the plants		Growth form	Parts used	Application technique	Status of utilization					
Local	Scientific				011	012	013	014	015	016
Kessie	<i>Lippia adoensis</i>	Shrub	Leaf	Rubbing	√	√	√	√	√	√
Weynagift	<i>Senecio myriocephalus</i>	Shrub	Leaf	Rubbing	√	X	√	√	X	X
Chifirig	<i>Sida cuneifolia</i>	Shrub	Leaf and twig	Rubbing	√	√	√	√	X	√
Tosign	<i>Lhymus schimperii</i>	Herb	Leaf	Rubbing	X	√	√	√	√	√
Amija	<i>Hypericum revolutum</i>	Shrub	Leaf	Rubbing	X	√	√	X	X	X
Embacho	<i>Rumex nervosus</i>	Shrub	Leaf	Rubbing	√	√	√	√	√	√

011: Tita site; 012: Qurqur site; 013: Kelem-meda site; 014: Boru-slassie site; 015: Gerado15; 016: Gerado16 site; √: used by the community; X: not used by the community



**Figure 1** Locally growing washing plants used as milk preservative in the study area.

### Locally growing plants used for smoking milk utensils

The most frequently used plant for smoking milk vessels in the study area were *Olea Africana*, 'mitie', *Clerodendrum myricoides*, *Terminalia brownie* and *Juniperous procera* (Table 3), (Figure 2), (Figure 3). Majority of the nature of these plants (80%) were trees whereas 20% was shrubs. According to the respondents, the techniques of application of these preservative plants to the milk utensils were either only by burning or both burning and immersing of the plant inside the milk vessels to include the plants smoke into the container. Majority of the plant materials (60%) were both burned and immersed to incorporate their smoke to the inside part of the milk equipment. The stem part of the plant was used from all the smoking plants (100%) for preserving the milk nevertheless in case of *Clerodendrum myricoides* the stem was used by the respondents when the plant was matured enough. Root was also used from *Olea Africana*, 'Mitie' and *Clerodendrum myricoides*. In case of *Terminalia brownie* the bark may be used together with the stem.

**Table 3** Locally growing plants used for smoking milk vessels

Name of the plants		Growth form	Parts used	Application technique	Status of utilization					
Local	Scientific				011	012	013	014	015	016
Weyra	<i>Olea Africana</i>	Tree	Root and stem	Burning and/or immersing	√	√	√	√	√	√
Misirij	<i>Clerodendrum myricoides</i>	Shrub	Root and stem	Burning	√	√	√	√	√	√
Mitie	Unknown	Tree	Root and stem	Burning and/or immersing	√	√	√	√	√	√
Abalo	<i>Terminalia brownii</i>	Tree	Stem and bark	Burning and/or immersing	X	√	X	√	√	√
Tid	<i>Juniperous procera</i>	Tree	Stem	Burning	√	√	√	√	√	√

011: Tita site; 012: Qurqur site; 013: Kelem-meda site; 014: Boru-slassie site; 015: Gerado15; 016: Gerado16 site; √: used by the community; X: not used by the community



**Figure 2** Locally growing smoking plants used as milk preservative in the study area.



**Figure 3** Smoking plants purchased from markets used as milk preservative in the study area.

Smoking plants were used to convey good flavor to the milk and milk products. This result agreed with the result of Sintayehu et al.<sup>10</sup> who reported that milking utensils were smoked with different aroma producing plants like *Olea africana* and *Juniperous procera*. This result also agrees with the report of FAO<sup>11</sup> who stated that the milking equipment in Borana was smoked by burning chips of *Olea africana*. Similarly<sup>12</sup> from North western Ethiopian highlands stated majority of the farmers used smoking plants like *Olean Africana*, and *Juniperous procera*. The result is different from the findings of Coppock et al.<sup>9</sup> who indicated households in semiarid pastoral system of Ethiopia smoke their milk processing vessels with burning chips of *Acacia nilotica*, *Cordia glarfa*, *Cordia ovalis* or *Combertum molle*. Except *Olea africana* the current study result is also different from Alganesh Tola<sup>13</sup> who reported in Eastern Wollega *Deinbollo kilimandshorica*, *Syzygium guinecnse*, *Heeria reticulala* and *Olea africana* were the most commonly used smoking plants.

Similar to the cleaning plants, the use of smoking plants differs from place to place and even from household to household. For example, *Terminalia brownii* was not used by respondents from Tita and Boru-medea sampling sites (Table 3). Stem of *Clerodendrum myricoides* was used as preservative if it was matured enough. According to the respondents, smoking of milking and storage vessels was frequently done in order to extend the fermentation time besides its provision of good flavor. This agrees with the finding of Mogessie Ashenafi et al.<sup>14</sup>

that smoking reduced the undesirable microbial contamination that enhances the rate of fermentation. Whenever there is high production of milk, the milking and storage vessels were not smoked to increase the rate of fermentation. In<sup>9</sup> semi-arid pastoral system of Ethiopia also reported that sterilization helps to obtain an appropriate rate of fermentation. In cases where containers were limited and /or people need to sour fresh milk daily, the milk container may be reused without scrubbing or fumigating. During the cold season some households put the milk close to fireplace in order to facilitate fermentation within the shortest time possible if they have surplus milk and want to churn every day. The milk containers were fumigated by inverting them over the smoking plant chips until the smoke died out. The residual charcoal pieces were brushed out followed by rinsing with water. However, some respondents (43%) who did not ferment their milk sell fresh milk to the milk collectors to be sold at the nearby town (Dessie). From the smoking plants, *Terminalia brownii* and 'Mitie' were not naturally grown in the surrounding of the sampling sites of the study area. These plants were grown far away from sample sites in the lowlands of the study area near to the gorge of Abay River and neighboring Region and Zone (ANRS and OAZ). The communities of the study area obtained these smoking plant materials by purchasing from the nearby local markets (Figure 3).

## Conclusion

Majority of the households of the study area did not carry out adequate milk sanitary practices hence the milk sanitary practices of the study area should be improved. The major preservative plants to clean the milk vessels were *Lippia adoensis*, *Senecio myriocephalus*, *Sida cuneifolia*, *Lhymus schimper*, *Hypericum revolutum* and *Rumex nervosus* while the most frequently used plants to smoke milk utensils were *Olea Africana*, 'Mitie', *Clerodendrum myricoides*, *Terminalia brownie* and *Juniperous procera*. Milk vessel washing and smoking plants identified in this study deserves further investigation, i.e., the active ingredients of the identified plants should be studied in detail. Particularly, their effectiveness to keep the product for longer periods without deterioration, the efficacy of the active ingredients on the desirable and/or undesirable microorganisms, the amount and technique of utilization and their impact on the consumer body should be studied.

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## Ethics approval and consent to participate

Not applicable.

## Consent for publication

Not applicable.

## Availability of supporting data

The datasets and plant materials used for analysis of this work are available from the corresponding author on reasonable request.

## Competing interests

The authors declare that they have no competing interests that would otherwise interfere with the results pertaining to this research.

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## Authors' contributions

The corresponding author (author Tewodros A) conceived the research idea. The study was then carried out by author Tewodros A in collaboration with author Muluken G. Author Tewodros A together with author Muluken G undertook the collection of experimental samples, performed the analyses, and interpreted the results. The first draft of the manuscript was written by author Tewodros A and author Muluken G read and made final changes to the final manuscript as a research article.

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