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Original article

Milk and milk products processing, preservation and utilization in Gimbi district, West Wollega zone, Ethiopia

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ABSTRACT

This study was conducted in Gimbi district, West Wollega zone to understand the traditional handling, processing and utilization of milk and milk products. 128 households were selected based on ownership of dairy cows, milk processing, handling, and utilization practice. Accordingly, *Lantana trifolia* (Kusaayee), *Ocimum sanctum* (Basoobilaa), *Olea Africana* (Qoraasuma) and *Deinboll* (Dabaqqa) were the most commonly cleaning and smoking plant species in the district. Yoghurt-like fermented/sour milk, traditional butter, traditional ghee, cottage cheese (Ayib), buttermilk and whey were the major milk products produced in the district. Women preserve butter by mixing with spices such as *Zingiber officinale* (Jinjibila), *Allium sativum* (Qulubbii adii), *Ocimum* (Siqaqibee) and *Trigonella foenum* (Sunqoo). Out of the total daily milk produced, most of it was processed (70.5%), 8% was sold while the left was consumed within the household (21.5%). Among milk and milk products produced, only butter was supplied to local markets. Lack of cooling facilities; low volume of milk production; unimproved milk processing materials and limited knowledge on handling and processing of milk and milk products were the major constraints. Recognizing the importance milk and milk products to the producing household nutrition, health and income, development

interventions are required to boost production, improve the quality of the products and efficiency of the traditional milk processing equipment.

1. Introduction

The small volume of milk produced by a large number of producers is marketable at low output in Ethiopia, which possesses limits on the possibilities of exploiting distant but rewarding markets due to high transaction costs arising from transportation and high opportunity costs of labor involved. As reported by Muriuki and Thorpe (2001), the vast majority of milk produced outside urban centers in the country is processed into milk products at household level using traditional technologies. In the region where environmental temperature is hot and humid, unless it is cooled and treated with different preservation methods the raw milk easily spoiled. For example, in the highlands of Ethiopia, most of the dairy producers use 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, because of lack of cooling facilities (Lemma et al., 2004). Milk and milk products processing play a great role in the improvement of the livelihood of the community in Gimbi district. However, so far reliable information on milk processing, preservation and consumption is little known. Therefore, the main objective of the current study was to explore the existing traditional dairy products processing, preservation and consumption pattern and related constraints in the study area.

2. Materials and methods

2.1. Description of the study area

Gimbi district is located at about 441 km away from Addis Ababa, the capital city of the country to the west. Geographically the district is located 9°10°-9°17° North latitude and 35°44°-36°09° East longitudes; covering a land area of 100,965 hectare (1009.65 km^2). The area has one long rainy season extending from March to mid-October with annual rainfall ranging from 1400-1800 ml. The mean minimum and maximum annual temperature ranges between 10°C and 30°C and the elevation of the study area ranges from 1200m-2222m a.s.l. Mixed crop-livestock agriculture is the main stay in the area. Like to many parts of Ethiopia, the study area is endowed with significant number of domestic animals; 93,640 cattle, 46,115 sheep, 7,207 goats, 131 mules and 80,370 poultry (CSAGW, 2016).

2.2. Sampling procedure

A random sampling procedure was employed to select sample Kebeles and households for the study. The district was first stratified as highland and midland agro-ecologies. Since about 83% of the study area has midland agro-ecology (GDLEPO, 2016), which is equivalent to sub-tropical climate and out of the district's total Kebeles (32), 27 Kebeles found in this agro ecology; and in view of the fact that this agro-ecology includes many Kebeles having high potential and viability of dairy cattle production, milk products processing, handling and utilization in the area. From a total of 27 Kebeles located in this agro ecology 4 Kebeles were purposively selected. A total of 32 households per kebele that own at least one milking cow of any breed were randomly selected. Thus, a total of 128 (32 household × 4 Kebeles) households were interviewed. A semi-structured pre-tested questionnaire was employed to collect the required information on the handling, processing and utilization of milk and milk products in the study area.

2.3. Data analysis

The data collected were recorded on specially designed formats. The data were then coded and entered to computer Microsoft excel spread sheet then data collected from different sources were analyzed using the procedure of Statistical Package for Social Sciences (SPSS) software version 20.0 computer programs. Descriptive statistics such as means, frequency distribution, percentage and ranking were used to summarize the data.

3. Results and discussion

3.1. Milking methods and hygienic practice

The milking system practiced was entirely hand milking and usually performed by women. Out of the total sampled respondents only 10% of dairy producers wash the teats before milking (Table 1). Washing teats of local cows were being paid attention only during contaminated with dirty comparing with crossbred cows. About 96.2% of the respondents indicated that milking was carrying out two times a day: during morning and evening; low attention was given about the regularity of milking. The left respondents (3.8%) decrease the milking frequency to once in the dry season due to critical feed shortage (Table 1).

Table 1
Washing of teats and milking frequency in the study area.

Parameters	Frequency	% of Respondents
Teat washing		
Yes	13	10
No	115	90
Milking frequency		
Once	5	3.8
Twice	123	96.2

The quality of milk and milk products depends on the type and cleanness of the equipments used. All of the respondents reported "*Qabe*e" is traditional made equipment for milking purpose, while bottle guard ("*Abuubbii* or *Ro*'*oo*'' in Afan Oromo) is exclusively milk vessel used for churning purpose.

3.1.1. Cleaning of milk equipments

Dairy producers in the Gimbi district practice smoking of milk and milk products equipments by using varieties of plant species to get pleasant aroma of the product and for the purpose of improving the shelf life of the products. Similarly, Helen and Eyasu (2007) indicated that the milk and milk products stored in smoked containers produce low acids. *Lantana trifolia* (Kusaayee), *Ocimum sanctum* (Basoobilaa), Kefoo sa'aa (*unidentified*), *Ruta chalepensis* (Cilaattama), Marga citaa (*unidentified*) and *Stephaia abyssinica* (Kalaalaa) were plants/herbs mainly used milk equipments cleaning in the present study area (Table 2). However, cleaning plants differ from place to place and even from household to household based upon preferences and availability of herbs. However, the utilization of these plants/herbs varies based on the availability.

Table 2
Plants/herbs used for the washing of milking equipments in the study area.

Types of plants/herbs			
Local name	**Scientific name**	**Frequency**	**% of Respondents**
Kusaayee	*Lantana trifolia*	51	39.23
Bsoobilaa	*Ocimum sanctum*	29	22.31
Tenadam	*Ruta chalepensis*	15	11.54
Marga citaa	-	10	7.69
Kalaalaa	*Stephaia abyssinica*	6	4.62
Kefoo sa'aa	-	19	14.61

3.1.2. Smoking of milk utensils

Based on their availability, "Ejersa/Qoraasuma" (*Olea Africana*), "Dabaqqaa" (*Deinboll kilimandshorica*), "Gaarrii" (*Syzygium guineense*) and 'Agamsa/Dhagamsa/ (*Carissa Edulis*), respectively plant species used for smoking.

Table 3
Major plant species used for the purpose of smoking milking equipments.

Plant species			
Local name	**Scientific name**	**Frequency**	**% of Respondents**
Ejersa/Qoraasuma	*Olea Africana*	76	59.35
Dabaqqaa	*Deinboll kilimandshorica*	21	16.4
Gaarrii	*Syzygium guineense*	18	14
Agamsa/Dhagamsa	-	13	10.25

3.2. Milk processing in the study area

Dairy producers in the study area fermented fresh whole milk into sour milk prior to churning. Out of the total daily milk produced, most of it was processed (70.5%), 8% was sold while the left was consumed within the household (21.5%). Even if it is difficult to estimate the amount of milk allowed for a calf per milking period, some amount of milk is also used for calf feeding. In the study area, only traditional milking equipments were used for all the processing activities of milk and milk products. The traditional milk processing is generally time consuming, varieties of products was limited. Naturally fermented milk is the basis of diversified milk products such as butter, ghee, yoghurt, Ayib, buttermilk and whey manufacturing.

3.3. Manufacturing of traditional dairy products

3.3.1. Fermented/sour milk (*Itittuu*)

'*Itittuu*' is produced from whole milk. Due to small volume of daily milk produced, producers keep milk produced over 3 to 4 days until sufficient amount is accumulated, to process it into the aforementioned more shelf stable products. Depending on the volume of milk and season of the year, the mean shelf life of fermented milk was 1.56±0.47 days in dry season and 2.95±0.51 in wet seasons. Environmental temperature and seasons of the year affects the duration of the fermentation. For example, during dry season, since the environmental temperature is very hot, the fermentation process is fast.

3.3.2. Butter making and preservation

Fresh butter is processed and sold by adult females in the study area. Milk is collected and stored for 3-4 days in milk equipments or *Okolee* for churning. Storing of milk for such days allow as the milk soured and make '*Itittuu*' or naturally fermented milk. To make butter, *Abuubbii*/*Ro'oo* is the only milk equipment used as a churner and churning is completely done by adult females in the study area. When sufficient amount of milk is accumulated (7-8 liters), it is transferred to *Abuubbii*/*Ro'oo* (*Lagenaria siceraria*); and churning was done on the lap (leg) until butter granules are formed. According to farmers' report the breakpoint, i.e., the point when butter grains start to form is detected by inserting a wooden plug and pulling out to release a few drops of milk and to check whether butter granules have formed or not.

The average volume of fermented milk churned at a time in the study area was 7.25±0.84 liters and the average churning interval was 3 to 4 days. Averagely, 16.02±1.56 volume of fresh whole milk required to produce one kilogram of butter. According to the respondents, volume of fermented milk churned at a time depends upon the number of milking cows, the amount of milk produced per day and the amount consumed by the family. This value is relatively similar to the findings of Tola (2002); but in contrast to Kassa and Dekamo (2016) and Asrat et al. (2013). Such variations might be due to the function of breed.

Zingiber officinale (Jinjibila), *Allium sativum* (Qulubbii adii), and *Ocimum spp.* (Siqaqibee) and *Trigonella foenum* (Sunqoo) were spices used for preservation for butter in the study area. Butter made as such might be stayed for about 3 months and either used for household consumption or sold for generating income. Some smallholder dairy producers also preserve butter by salting.

3.3.3. Ghee (*Dhadhaa Baqsaa*) and its importance

Traditional ghee (clarified butter oil) is made by melting butter on a frying pan on an open fire. Butter is placed in a clay pot and put on an open fire to melt. Heating and stirring continue until foam is formed and a clear liquid is obtained. Along heating the butter, spices are added to impart good aroma and taste to the butter. Then the pot is removed from the fire and allowed to cool. Finally, the liquid fat is filtered through sieve or a clean cloth

into a container. Similar procedures have been reported by different authors in Ethiopia (Abebe et al., 2013; Eyassu, 2014). Different species are used during ghee making, which varies from household to household depending on availability. The spices used during ghee making in the study area are shown in Table 4.

In Western Oromia in general and in West Wollega in particular, traditional ghee/*Dhadhaa Baqsaa* is usually used for flavoring and as condiment for different types of pulse, chicken and meat stews and sauces from different species of domestic animals. In the study area, ghee is added to a variety of traditional dishes such as *Kitifo* (minced raw beef), *Foon waaddii* (roasted meat), *Ancootee* (Anchote) and others. It is also used in mixture with cottage type cheese and *Qocqocaa* and served with indigenous diets such as *Cumboo*, *Cuukkoo*, *Caccabsaa*, *Cororsaa* and Porridge; serves as input for roasting coffee to make *Buna Qalaa.* As respondents pointed out traditionally made ghee/*Dhadhaa Baqsaa* might be stored for more than a year. Due to cultural taboo, ghee is not marketed in the study district. Similar result was reported by Alganesh and Yetenayet (2017).

3.3.4. Cottage cheese (Ayib) making and utilization

Dairy producers in the study area make Ayib from Arera/*Amma Raasee.* The Arera is placed on a clay pot and heated on slow fire at approximately 30°C to 40°C for about 25-30 minutes. After cooling, the whey is drained off. It was reported that about a kilogram of cottage cheese could be obtained from an estimated 10-12 litres of buttermilk. This result is disagreeing with the findings of Berhanu (2012). Ayib made as such is not marketed but used for home consumption. The whey obtained is either used for consumption by the family members or given to calves, cats or dogs. According to the respondents, Ayib can be stayed for up to 3-4 days without spoiled, if well-handled during processing.

Table 4
Spices used during manufacturing of butter (a), ghee (b) and Ayib (c) in study area.

Vernacular name (Afan Oromo)	Common name	Scientific name	Product used for
Qulubi Adi	Garlic	*Allium sativum*	a, b, c
Jinjibila	Ginger	*Zingiber officinale*	a, b, c
Oogiyoo	Korerima	*Aframomum korerima*	a, b, c
Cilaattama	Rue	*Ruta graveolence*	a, b, c
Basobila	Basil	*Ocimum basilium*	a, b, c
Qimamii Gurraattii	Black cumin	*Nigella sativa*	a, b, c
Irdii	Turmeric	*Curcuma domestica*	a, b
Qulubi dima	Shallot	*Allium cepa*	b, c
Senaficha	Mustard	*Brasica nigra*	c
Sunqoo	Fenugreek	*Trigonella foeniculum*	a, b
Siqaaqibee	Basil	*Ocimum spp*	a, b, c
Qulubi dima	Onion	*Allium cepa*	c

3.4. Constraints of milk and milk products processing

The absence of dairy cooperatives, private milk collecting and processing plants is the critical problems for milk processing and collections. Besides this, the main constraints pertaining to milk and milk products processing and consumption as reported by the respondents in the study area are summarized in Table 5.

Table 5
Major constraints of milk and milk products processing.

Parameters	% Respondents	Rank
Lack of cooling facilities	34.6	1st
Low milk production	21.5	2nd
Unimproved milk processing materials	10	3th
Limited knowledge	8.5	4th
Lack of clean water	6.2	5th

4. Conclusion

Producing diversified milk products enables to furnish various social, nutritional and economic values. Although milk and milk products are essential, the majority of the respondents did not practice recommended hygienic practices (such as hand and udder washing) during milking and further processing, preservation and marketing of milk and milk products. Producing milk and milk products of not only acceptable quality but also of high quality are important from consumer health point of view and may also lead to amplified demand and income to producers. Lack of cooling facilities, low milk production, unimproved milk processing materials for dairy processing, and limited knowledge on the hygienic practice of milk and milk products are among the major constraints hamper dairy processing reported according to their importance. Based on the above conclusion the following recommendation is forwarded;

- ✓ Excellent hygienic practices should be taken at all stages of dairy products processing through various channels of extension such as technology verification and demonstration, knowledge and skill enhancing training, experience sharing visits and others to produce milk and milk products of superior quality and protect the health of the consumers;
- ✓ Development interventions are required to boost the quality of dairy products processing through enhancing the indigenous knowledge of farmers and establishing dairy cooperatives and private milk collecting and processing plants in the study area.

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