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Handling, processing and utilization of milk and milk products in Ezha district of the Gurage zone, Southern Ethiopia

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A survey study was conducted in Ezha district of Gurage zone to understand the hygienic practices during production and further handling of milk and milk products; and their utilization. One hundred and twenty households were selected based on ownership of dairy cows, milk processing practice and willingness to participate in the study from two agro-ecologies (Dega and Woyna Dega) within the district. None of the respondents washed udder before milking. The majority of women washed the equipments (90.8%) and their hands (71.5%) before milking. *Olea africana* and *Hygenia abyssinica* plant leaves were the most commonly smoking and cleaning plant species in the district. The average volume of milk churned at a time was 6 L. Women preserve butter by mixing with spices such as *Nigella sativa*, *Aframomum angusti-folium*, *Trigonela fenum* and *Ocimum hardiense*, while Ayib is preserved with the use of *O. hardiense*. Out of the total monthly milk production (55 L), 13.5 L were consumed, whereas the remaining was accumulated for further processing. Among milk and milk products produced, only butter and Ayib were supplied to local markets. Lack of clean water for cleaning purpose; limited knowledge on hygienic handling of milk and milk products; and unimproved milk processing materials were the three major constraints reported by the respondents according to their importance. 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.

Key words: Milk and milk products, hygiene, processing, utilization, Ezha, Ethiopia.

INTRODUCTION

Ethiopia holds a substantial potential for dairy development mainly due to its large livestock population coupled with the relatively suitable environment for livestock production (Mohammed et al., 2004). In 2011, Ethiopia was home for an estimated 53.4 million cattle, 22.8 million goats, 25.5 million sheep, 49.3 million chicken and 1.1 million camels (CSA, 2011). However, the productivity of the livestock resources and the benefits obtained from the sector does not commensurate with the high livestock population. Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of the dairy sector in Ethiopia can contribute significantly to poverty alleviation and nutrition in the country (Mohammed et al., 2004).

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Smallholder farmers and pastoralists together produce and supply 98% of the total annual milk production of the country (YONAD, 2009).

According to CSA (2011), over 85% of the milk produced by rural households is consumed within the producer households with the proportion marketed being less than 7%. The small amount of milk produced by a large number of producers but the low marketable output in Ethiopia posses limitations 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 areas where the climate is hot and humid, the raw milk gets easily fermented and spoiled during storage unless it is refrigerated or preserved. However, such storage facilities are not readily available in rural areas and cooling systems are not feasible due to lack of the required dairy infrastructure and when available high cost of facilities such as refrigerator for resource poor smallholder producers (O'Mahony and Peters, 1987). In Ethiopia, in general and in the study areas in particular milk, milk products are important for producer family consumption and as a source of income through sale of products such as butter and Ayib (Ethiopian cottage cheese).

Due to small volume of daily milk produced, producers keep milk produced over 3 to 4 days until sufficient amount is accumulated to process into the aforementioned more shelf stable products. In the study area, traditional milk production, processing and handling is a typical feature. Traditional milk products are generally reported to be of substandard quality mainly due to inadequate dairy infrastructure such as refrigeration facility and clean water and limited knowledge o the hygienic handling of milk and milk products. This necessitates better understanding of the traditional processes and handling of milk and milk by products, which is a prerequisite for development. Although, milk production represents an important part of the livelihood of the community in Ezha district of the Gurage zone, there is shortage of information with regard to milk processing, handling and utilization.

Understanding the prevailing traditional practices of milk production, processing and storage is of paramount importance to make future improvement interventions. The objectives of the current study were therefore to assess the hygienic conditions during handling and processing, and utilization of milk and milk products in Ezha district of the Gurage zone.

MATERIALS AND METHODS

Study area

The study was conducted between February and March 2010 in Ezha district of the Gurage zone, which is located at 200 km South west of Addis Ababa. The altitude of the district ranges from 1800 to 3098 m above sea level and receives an annual rainfall of 900 to 1600 mm with the mean minimum and maximum annual temperatures of 5 and 38°C, respectively.

Sampling procedure

A random sampling procedure was employed to select sample kebeles and households for the study. The district was first stratified as Dega and Woina Dega agro-ecologies. From a total of 28 Kebeles located in the district 2 Kebeles were randomly selected from each of the two agro-ecologies. A total of 30 households per Kebele that own at least one local milking cow were randomly selected. Thus, a total of 120 (30 households × 4 kebeles) households were interviewed. A semi-structured questionnaire was used to gather the required information on the hygienic practices during handling and processing of milk and milk and milk products, and their utilization.

Data analysis

Both qualitative and quantitative data collected on hygienic practices during milk production, processing and storage at household level were analyzed and summarized using both mean and frequency procedures of SPSS statistical package for social science version 13.

RESULTS and DISCUSSION

Handling practices during milking, milk processing and storage

Generally, proper sanitary milking practices were not followed by the majority of the respondents in the study area. Although, most of the respondents reported to wash their hands and milk vessels before milking their cows, washing of udders was not reported (Table 1). Moreover, milkers dip their fingers in the milking vessel and moistening teats of the cows with the intention of facilitating milking. However, such practice may cause microbial contamination of the milk from the milker's hand. The majority of the respondents (57.2%) had access to river water followed by tap water (28%) and hand dug well water (7.2%) (Table 1). However, the quality of both river and hand dug well waters used for cleaning may not be of the required standard thus can attribute to the poor quality of milk in the area. It is, therefore, important to heat treat water from river and hand dug wells intended for cleaning purpose.

The interviewed households used different utensils for milking, storage and processing. All of the respondents reported to use plastic jar for milking, while clay pot was the only material used for churning (butter-making). As reported by most of the respondents (92%), clay pot is also used for storage of milk until the desired volume is collected for processing. Wondu (2007) reported a similar result where 88% of small-scale producers in Southern Ethiopia used traditional clay pot for fermentation and butter-making. As indicated by the respondents, clay pot keeps milk well at the prevailing high ambient temperature as compared to

Table 1. Handling practices during milking by households in the two agro-ecological zones.

Variable	Agro-ecology	
	Dega (n=60)	Woina Dega (n=60)
Milk hygienic practice (%)		
Wash udder before milking	0	0
Wash hand after milking	95.0	48.3
Wash milking utensil with hot water	80	95
Source of water for cleaning milk utensils (%)		
Tap water	10	61
Hand dug well water	3.3	11
River water	86.7	28
Milk utensils used for milking (%)		
Plastic jar	100	100
Nickel	10	0
Milk utensils used for storage (%)		
Clay pot	88.3	96.7
Plastic jar	16.7	5
Milk utensil used for churning (%)		
Clay pot	100	100

n= Number of observations.

plastic containers.

The production of milk of acceptable hygienic quality for consumers requires good hygienic practices. One of the major factors affecting the quality of dairy products is related to the practice of proper milking procedures and cleanness of the milking utensils (Almaz et al., 2001). About 30% of farmers reported to rub milk storage vessels with leaves of shrubs such as 0 (Kosso in Amharic), *Sida tenuicarpa* Vollesen (Ojaja in the local language), Odaterk *Conyza spinosa* (Odaterk), *Olea africana* (Weira), and Korekonda (maize cob) and wash with water before use. Washing is commonly followed by drying and smoking the containers with embers of wood sprinters of plants specifically used for this purpose (*Hygenia abyssinica*, *Sida tenuicarpa* Vollesen, *O. africana*, maize cob, *Thymus vulgaris*, Enset fiber, *Conyza spinosa* and *Thymus schimperi* are the most commonly used). Procedures of cleaning and disinfection of milking utensils prior to milk collection reported herein were similar to previous results from Ethiopia (Sintayehu et al., 2008).

Reasons for smoking milk containers using different parts of various plant species as reported by the respondents were similar to earlier reports in Ethiopia (Lemma et al., 2004; Yitaye, 2008). Smoking is also reported to give a good flavor to the product and disinfect the vessels, thereby reducing the microbial load and therefore extending the shelf life of the product. As reported by Mogessie and Fekadu (1993), smoked containers tend to lower the microbial load of milk as compared to unsmoked containers.

Processing milk and shelf life of milk and milk products

As it is the case under smallholder setting in other rural areas of Ethiopia, naturally fermented milk is the basis of processing milk into more shelf stable fermented milk products in the present study area. The major milk products produced in the study area were Ergo (Ethiopian naturally fermented milk), traditional butter (Kibe), traditional ghee (Neter Kibe), cottage cheese (Ayib), sour defatted milk (Arrera), and whey (Aguat). According to most of the respondents, milk is fermented for the main reason that the daily production is small and to get the volume that justifies processing (primarily churning for butter-making), the daily milk yield should be accumulated over a few days. In this process, milk ferments naturally at the prevailing tropical ambient temperatures.

In the rural Ethiopia, in general and in the study area in particular, milk processing and other household activities are almost always the responsibility of women. In the Woina Dega area, the majority of the women (70%) process the milk twice per week followed by once per week (30%), while 53.4% the women around Dega area process their milk twice per week, whereas the remaining 38 and 8% of the respondents reported to process once per week and once fortnightly, respectively (Table 2).

Generally, high ambient temperature favors natural fermentation and therefore, due to the relatively high ambient temperature in the Woina Dega areas, producers in these areas processed milk at higher frequency as

Table 2. Milk processing practices (%) in the two agro-ecological zones.

Variables	Agro-ecology	
	Dega (n=60)	Woina Dega (n=60)
Processing of milk (%)	100	100
Processing frequency (%)		
Twice/week	53.4	70
Once/week	38.3	30
Once/two week	8.3	0
Volume of milk churned at a time (liter)	6.4±2.1[a]	5.5±1.14[b]
Reasons for processing of milk (%)		
To generate more income	85	68.3
To increase shelf life	88.3	96.7
To purchase agricultural commodity	91.7	61.7
Cultural reluctance towards consumption of fresh milk	7	5
Consumer preference	3.3	13.3

n= Number of observation.

Table 3. Milk products processing practice in the study area.

Variables	Agro-ecology	
	Dega (n=60)	Woina Dega (n=60)
Amount of butter recovered in a single churn (kg)	0.34±0.12	0.28±0.77
Amount of *Ayib* in single churn (kg)	1.07±0.11	0.97±0.05
Volume of milk used to produce kg of butter (lit)	21±1.6	23.07±1.2
Volume of defatted sour milk used to produce kg of *Ayib*	6± 0.56	6.7±0.54

compared to those in the Dega areas. As observed in the present study, about 93% of the respondents process milk to extend the shelf life of the product followed by generation of income to purchase agricultural commodities (76.7%) and to fulfill other day to day necessities (76.7%) (Table 2). Ayantu (2006) in her report in Delbo watershed area of the Wolayta zone also indicated that milk is processed in order to increase the family's income, diversify the products for consumption and to increase the shelf life of the products. Kassahun (2008), however, reported that milk is primarily processed whenever there is market constraint for fresh milk in the Ada'a district.

Butter making

All of the respondents produced traditional butter from naturally fermented whole milk. While churning, traditional churns are covered with materials such as dry Enset pseudo stem sheath and/or a piece of plastic material, which is stretched over the opening of the churn and securely tied. The average milk churned at a time observed was about 6 L at household level though markedly ($P<0.01$) varied between the two agro-ecologies (Table 3). Zelalem and Ledin (1999) also reported a similar value (6.4 L) in the central highlands of Ethiopia. However, lower values of 2.1 L (Ayantu, 2006) and 1.97 L (Rahel, 2008) were reported in the Wolayta zone. The amount of butter obtained from a single churn in the current study (0.25 kg) (Table 3) was higher than that reported in the Wolayta zone (0.13 kg) (Rahel, 2008) and (0.16 kg) (Ayantu, 2006), which is likely to be attributed to the difference in the volume of milk churned at a time.

In the present study, the amount of milk required to produce one kg of butter was 22.32 L (Table 3). This value is comparable with that of earlier reports of 25 kg in Borena plateau (Coppock, 1994), 20 to 22 L in rural areas of Southern Ethiopia (Fekadu, 1994) and 21 L in the central highlands of Ethiopia (Zelalem and Ledin, 1999). However, lower values were also reported; 15 to 20 L in Awassa (Wondu, 2007), 15.79 L in the Wolayta zone (Rahel, 2008), 16.7 L in East Wollega (Alganesh, 2002), and 17.1 L in East Shewa zone (Lemma et al., 2004). Such variations are likely attributed to the fat content of the milk used which in turn is a function of breed. Milk of local zebu cattle breeds has higher fat content as compared with that of pure exotic and crossbred cows.

All of the interviewed farmers used different spices as means of preservation for traditional butter. The major spices used for this purpose were Koserete (*Ocimum hardiense*), Korerima (*Aframomum angusti-folium*), Tikur azmud (*Nigella sativa*) and Abish (*Trigonela fenum*). As

Table 4. Production and consumption of milk and milk product in the two agro-ecological zones.

Variables	Agro-ecology	
	Dega (n=60)	Woina Dega (n=60)
Product (%)		
Milk	68.3	46.7
Butter	68.3	96.7
Ergo	3.3	5.0
Ayib	93.3	95
Whey	100	100
Average milk produced and consumed (lit) per month (±S.E)		
Produced	57.6±3.6	52.2±3.2
Consumed	18.73±2.9[a]	8.37± 2.6[b]
Daily milk consumption	0.62±0.09[a]	0.28±0.056[b]
Average Ayib produced and consumed (kg) per month (±S.E)		
Ayib produced	5.96±0.63	7.1±0.7
Ayib consumed	3.37±0.35[a]	4.95±0.51[b]
Average butter produced and consumed (kg) per month (±S.E)		
Butter produced	1.9±0.18	2.05±0.15
Butter consumed	0.94±0.12[a]	1.73±0.15[b]

Row mean bearing with different superscripts letters are significantly different from each other (P<0.05). S.E = Standard error.

reported by the respondents, the traditional butter can be stored at ambient temperatures on average for about one year without losing its desired flavour and taste.

Ethiopian cottage cheese (Ayib) making

The amount of Ayib obtained at a time in this finding was 1.05 kg, which is comparable between the two agro-ecologies. On average, 6.5 L of milk was required to produce one kg of Ayib in both agro-ecologies (Table 3). This value is in agreement with the 6 L reported by Zelalem and Ledin (1999) in the central highlands of Ethiopia. However, Rahel (2008) reported a higher value (8.69 L) in Wolayta zone. The spices mainly used as a preservatives to extend shelf life of Ayib were Koserete (*O. hardiense*), Tikure azmude (*N. sativa*), Korerima (*A. angustifolium*), Tena Adam (*Ruta chalepensis*) and Abish (*Trigonela fenum*) and in addition to these salt is also used to extend the shelf life of Ayib.

Consumption and utilization of milk and milk products

Like in most other rural areas of Ethiopia, the common milk products manufactured and consumed in the current study areas include fresh whole milk, whey (Aguate), butter, Ayib and ghee (Niter Kibe). Out of the total monthly milk production (55 L) per household, about 13.5 L was used for consumption within the producing households, the rest being left to be processed in to more value added products mainly butter and Ayib that have better shelf life and fetch better market price (Table 4). In the present study, about 68.3 and 47% of the respondents in the Dega and Woina Dega areas, respectively, used whole milk for consumption. Contrary to this finding, consumption of raw milk in the Wolayta zone is not a usual practice rather in most cases the small amount of milk produced daily is accumulated over a few days to manufacture the butter that fetches a better price (Ayantu, 2006).

Butter of the Wolaita zone is one of the most preferred butter for its taste not only in the area of production but also all the way up to Addis Ababa. Out of the total butter production (1.9 kg) per household per month, about 1.33 kg was used for consumption (Table 4). About 68.3 and 96.7% of the respondents in the Dega and Woina Dega areas, respectively, used butter for producer household consumption.

Butter consumption in the Woina Dega area was 1.73 kg/month/household, which was significantly (P<0.01) higher than that consumed by households in the Dega area (0.94 kg/month/household). This could be due to the common practice of accompanied butter while consuming the homemade flat bread (*Kocho*) made from Enset (*Ensete ventricosum*) in the Woina Dega area.

The mean monthly production of Ayib per household in the district was 6.6 kg. Out of this total monthly production, 2.16 kg is consumed within the household. The average monthly production per household observed in this study was much higher than 0.31 kg reported in the Ada'a Woreda (Kassahun, 2008) and 1.2 kg in Wolayta zone (Rahel, 2008).

Table 5. Marketing of milk and milk products in the two agro-ecological zones.

Variables	Agro-ecology	
	Dega (n=60)	*Woina ega(n=60)*
Average butter and Ayib sold per month in kg (±S.E)		
Butter	0.96±0.16[a]	0.32±0.07[b]
Ayib	2.54±0.38	2.23±0.44
Average price of butter and Ayib per kg (±S.E)		
Butter price	57.8±10.5	44.42±1.08
Ayib price	15.11±0.28[a]	17.46±0.35[b]
Selling practices (%)		
Butter selling practice (%)	60	35
Ayib selling practice (%)	76.7	65
Milk selling practice (%)	0	0
Reasons for not selling milk (%)		
Cultural restriction	60	46.7
Lack of market	28.4	11.7
Scarcity of milk	85	71.7

Row mean bearing with different superscripts letters are significantly different from each other (P<0.05). S.E= Standard error.

Marketing of milk and milk products

As observed during the current study, the sale of fresh whole milk was not a common practice (Table 5). Among different multiple reasons, inefficient milk production (78.3%) and cultural restrictions (taboos) toward selling fresh whole milk (53.3%) followed by lack of market (20%) are the most common reasons reported (Table 5). A similar situation was reported in Eastern Wollega where about 21.3 and 19% of the women did not sell fresh milk mainly due to scarcity and cultural reasons, respectively (Alganesh, 2002). On the other hand, about 60 and 35% of the respondents in the Dega area and Woina Dega area, respectively, stated that they sold butter, while the rest of the respondents never sold, while 29% of the respondents did not sell Ayib.

In the study areas, Ayib is the most important marketed product. Ayib sold per household per month was 2.4 kg (Table 5). This result is lower when comparable with results (3.4 kg) of Rahel (2008). The average weight of the butter sold per household per month in this district was 0.64 kg (Table 5). Significant difference (P<0.05) was observed between the Dega and Woina Dega areas in average monthly butter sold per household where households in the Dega area sold significantly high amount of butter. This difference could be attributed to the lower consumption of butter per household in the same (Table 5). The average butter sold per household per month in the current study is much less than the amount (7.2 kg) reported by Rahel (2008).

The average prices of Ayib and butter were 16 birr and 52 birr/kg, respectively (Table 5). The mean price of Ayib in the Woina Dega area was 17 birr, which is significantly higher (P<0.001) than that of the Dega area (14 birr) (Table 5). The price base of the product is subjective and depends on weight estimation by the customers who estimate by putting them on their hands. The price of Ayib reported in the current study is comparable with that (15 birr/kg) reported by Rahel (2008) and Zewide (2010) (16.5 birr/kg) in Sebeta. Kassahun (2008) and Zewdie (2010), however, reported lower prices in urban areas of Lume (12 birr/kg) and Zeway (13 birr/kg), respectively.

In Ethiopia, studies indicate that butter prices differ from place to place. Zewdie (2010) reported the price of butter in Sebeta, Ziway, Debre Berhan and Jimma to be 75, 66, 61 and 60 birr/kg, respectively, during the dry season. As indicated by Zelalem and Ledin (1999), such price differences may arise from factors such as access to better market in urban areas as compared to rural areas in the central high lands of Ethiopia. In addition, Zewdie (2010) indicated that price of butter and Ayib differences may arise due to season, highest price in the dry season than wet season. This could be due to the good supply of butter during the rainy season owing to better grass availability following the rain, which leads to high production of milk.

Constraints of handling, processing and utilization of milk and milk products

The major constraints pertaining to milk handling, processing and utilization as reported by the respondents in the Ezha district of the Gurage zone are summarized in Table 6. Close to 80% of the respondents reported lack of clean water for cleaning purpose, limited knowledge on the hygienic handling of milk and milk products and unimproved milk processing materials to be the three major constraints listed according to their importance.

Table 6. Major constraints to milk handling, processing and utilization

Variable	% of total respondents	Rank
Lack of clean water	37	1st
Limited knowledge	24	2nd
Unimproved milk processing materials	17	3rd
Lack of access and high price of cooling facilities	11	4th
Lack of electricity	7	5th
Low milk production	4	6th

Conclusion

Dairy production is an important and integral part of the crop-livestock mixed production system in Ethiopia in general and in the study area in particular; milk processing is a culture of the community of the Ezha district of the Gurage zone and milk products have various social, nutritional and economic values. The milk production system of the study areas can generally be characterized by small herd size with no improved crossbred cattle and poor productivity of cows with very low milk yield, and long calving interval and lactation length. 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 handling (processing, storage 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 increased demand and income to producers. Among others, lack of clean water for cleaning purpose (milkers' hand, cows udder, and containers and equipment of milk and milk products); limited knowledge on the hygienic handling of milk and milk products; and unimproved milk processing materials in terms of capacity (volume), time elapsed to recover the intended milk product and the quantity of final product obtained from a given volume of raw material used (milk, naturally fermented milk, defatted sour milk) are the three major constraints reported by the respondents according to their importance.

Recognizing the importance of dairy farming to the livelihood of the community in question and 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. Such interventions coupled with linking producers with other important actors in the dairy value chain of the study district will definitely improve the benefits that producers should get from the dairy sub sector.

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