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Hygienic Milk Handling and Processing at Farmer Level in Wolaita Zone, Southern Ethiopia

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Abstract
The study was conducted to assess milk handling and processing from January to May 2015 in Wolaita Zone, Southern Ethiopia. To undertaken the study, multistage sampling method was used. In the first step, Humbo and bolesoserea woredas were selected randomly; in similar way, in the second step, three districts from each selected Woreda were selected randomly thereby a total of six districts were selected. From these each selected districts, a total of 137 households were interviewed for survey study. Data was collected from both primary and secondary sources. The primary sources were obtained through a semi-structured questionnaire; it was pre-tested the questionnaire before the actual data collection was carried out. The result from the pre-test was used to implement for the final questions. The secondary data were collected from different sources such as books, research publications, journals etc. The collected data was analyzed statistically using SPSS (version 17) for windows by using descriptive statistics.
The study showed that, hand milking was practiced by 100% of interviewed household. The respondents also indicated that milking of their cows was undertaken by women; most were milking their cows three times per day during the morning, day and evening time this was especially true in wet season. However, some also milk their cows only once a day in morning and sometimes twice a day in morning and evening. Majority of the respondents washed milkier hand (95.6%) and cow udder (86.1%) before milking however, only a few washed their cow udder after milking (14.6%). In the study area, about 16.8% of respondents used individual towel to dry the udder of milking cow and the rest did not use any towel. When clean 26.5, 72.8 and 1.7% of respondents used warm, cold and both warm and cold water respectively but no one used soap or other disinfectant to wash milkier hand or udder or towel. Majority of the respondents (83.0%) were using local plants for washing and fumigating for milk handling equipment. The plants used for the cleaning of milking and fermenting utensils were *Hantecha, Gullo, Guntcha, Kosereatea, Azmate, zmano, nech shngurt, Korerima(local name).*The study area also showed that , milk was processed due to multiple reasons such as to increase shelf life, to value- add, to have variety of products, to increase all (shelf life, to value- add and to have variety of products) and to increase shelf life and to value –add; almost all of interviewed households, milk were processed either once every day or every three day/every two day. All equipment and utensils used for milking, processing, storage and marketing should be disinfected and rinsed with water hot (detergent) immediately before and after use. In condition where no possible facilitating equipment and utensils; dairy cooperatives should be established so as to assist in selling fresh milk for small holder farmers.

Introduction

The Ethiopian economy is highly dependent on agriculture. Agriculture accounts for 46.3 percent of the nation's Gross domestic Product (GDP), 83.9% of exports, and 80% of the labour force (FAO, 2004). Many other economic activities depend on agriculture, including marketing, processing, and export of agricultural products. Small holder mixed crop- livestock system is a dominant agricultural production system in the country. Cattle are an inseparable and integrated part of small holder subsistence farming system. Dairy farming is a part and parcel of many such systems, and it is often an important livelihood option such as milk, meat, blood, hides and skins, draft power (crop production) and manure production; cattle also use to generate cash income and foreign currency.

In Ethiopia, it has estimated 53.99 million heads of genetically diverse cattle which is also the largest population in Africa (CSA, 2013). Among the total population 9.9 million covered by dairy cattle (CSA,2013) which is in the hands of pastoralists, agro-pastoralist, mixed crop livestock producer, urban and per-urban dairy cattle producers (Zegeye, 2003).

The dairy industry occupies a special position among the other sectors of agriculture. Milk is produced everyday and gives a regular income to the numerous small producers. Milk production is highly labour-intensive and provides a lot of employment. Milk also known as white gold it can be used to make an enormous variety of high quality products (IDF,1996) such as **butter** which is made from separated cream (fatty part of milk) by churning (sweet cream butter); **ghee** is prepared by heating butte and separating the fat from the water; this is sweet cream butter may be salted up to 2% and it is called nitir kibein in Ethiopia; **yogurt** is fermented milk (‘Ergo’ in Ethiopia) .The fermentation thus acts to preserve the milk for a time from growth of potentially hazardous microorganisms; **cheese** is prepared from the curd precipitated from milk by rennet, purified

chymosin or lactic acid; **ayib** is a soft curd type cheese made in many parts of Ethiopia and **whey** is made up from the buttermilk resulting from the churning of sour milk and the fluid remained one; the protein in the milk has been removed during the ayib making process and fluid one is **whey** (Habtamu, 2015; Fikrineh et al., 2012; Yitaye et al., 2009).

Raw milk can be easily fermented and spoiled especially, in areas where the climate is hot and humid unless it is refrigerated or preserved (in processed manner). However, such storage and processing facilities are not easily available in rural areas 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, milk and 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). Therefore, dairy industry needs the highest degree of protection due to the economically vulnerable position of small milk producers. The high cost of milk as a raw material has necessitated a high-technology processing industry. The special nature of milk (perishable and bulky) leads to the necessity of strict and comprehensive quality regulation management. Furthermore, milk requires high-cost transportation and there is a cost limit on the range over which it can be sold. So, milk can only keep for a few days, which places a time limit on the period during which it must be used or processed and transformed into a more stable, longer keeping form (IDF, 1996).

Rapidly increasing population size with a growing urbanization and income of family is resulting in a growing demand for dairy products in Ethiopia. Dairy development can lead to growth in rural areas by increasing farm income and employment opportunities and cash income of the country as whole. However, handling and processing of milk are not well developed in the country in general, in the study area, in particular despite the fact that, milk production, processing and handling is traditional activity in the study area. As result, traditional milk products are generally low in quality and quantity mainly which is below the requirement of market by consumers due to in adequate dairy infrastructure such as refrigeration facility, improper cleaning procedure due to limited knowledge on the hygienic handling of milk and milk products. So, to alleviate such problems, supportive, constructive, detail and understandable information on processing and handling condition of milk and dairy products is vital for smallholder farmers in the study area so that it would be effective on efforts do to improve the productivity of smallholder dairy production and improvement strategies its market orientation (Asfaw, 2009). From the fact points of view, although, milk production is highly important part of the livelihood of the community in the study area, there was shortage of information with regard to hygienic milk processing and handling status. Therefore, assessing the existing traditional practices of milking, processing and handling is relevant to make future improvement interventions because hygienic handling of milk and milk products are a key due to produce quality products for consumer. Thus, the current study was focused on the hygienic conditions during handling and processing of milk in Wolaita zone, southern Ethiopia.

Material and methods

Description of the study area

The study was conducted from January to May 2015 in Wolaita Zone, Southern Ethiopia. The study area is located in 6.4° to 7.1° north latitudes and37.4° to 38.2° east longitudes, and it covers a total area of 3, 982 km2. Its altitude ranges from 1,200 to 2,950 m above sea level (masl), and it is subdivided into three agro ecological zones, namely, kolla or lowland (35%, <1,500masl), woina dega or intermediate highland (56%, 1,500 to 2,400 masl) and dega or highland (9%, >2,400 masl). Wolaita Zone has a bimodal type of rainfall pattern. The major and minor rain seasons usually last from June to September and March to May, respectively. The average total annual rainfall is 1,014 mm, and the mean daily temperature is 19.5°C (WZFEDD unpublished report, 2005).

Sampling method

In current study area, multistage sampling method was used. The study area has a total of twelve woredas of which Humbo and bolesoserea woredas were selected randomly; in similar way, three districts from each selected Woreda were selected randomly thereby a total of six districts were selected. From these each selected districts, twenty five households were selected purposively (focused farmers who have dairy cattle). Thus, a total of 150 households were selected for survey study. However, unfortunately 13 households were not responsible and experienced enough to response the questions requested by researchers.

Data collection

Data was collected from both primary and secondary sources. The primary sources were obtained through a semi-structured questionnaire; the questionnaire contains a list of questions on hygienist handling and processing of milk (in general). It was pre-tested the questionnaire before the actual data collection was carried out so as to evaluate the appropriateness of clarity of the questions, and interpretation of the questions by the farmers and time required for an interview. The result from the pre-test was used to implement for the final questions. The interviews were conducted by trained research assistants under close supervision by the researcher.

For conducting the field survey, six enumerators who have the knowledge about the area and well acquainted with the culture and can speak local language were recruited and "trained" on the methods of data collection and contents of the interview.

The secondary data were collected from different sources such as books, research publications, journals, office reports of zonal and woredas agriculture etc.

Data analysis

The collected data was analyzed statistically using SPSS version 17 for Windows by using descriptive statistics in percentage; represented in Table.

Result and discussion

Hygienic practice during milk production

In Table 1, hygienic practices during milk production by respondents in percentage is presented. Effective handling practice during milking is important and necessary element to produce safe and suitable milk and milk products. Failure to maintain adequate sanitation practices has been shown to contribute to contamination of milk with undesirable or pathogenic micro-organisms or chemical or physical hazards. Because quality of dairy products are easily affected due to different factors of which performance of milking procedures and cleanness of the milking utensils and equipment are the major one (Gonfa et al., 2001). In the study area, hand milking was practiced by 100% of the household surveyed, no one used teat stripping and they were simply squeezing of teat for milking by finger. The respondents also indicated that milking their cows was undertaken by women; most were milking their cows three times per day during the morning, day and evening time this was especially true in wet season. However, some also milk their cows only once a day in morning and sometimes twice a day in morning and evening. However, the current result was disagreed to Haile et al. (2012) result from Hawassa, southern Ethiopia who reported that all of the medium and large size farms as well as 96% of the small size farms practiced milking their cows twice a day during the morning and evening times. As revealed from Table 1, majority of the respondents washed their hand (95.6%) and cow udder (86.1%) before milking however, only a few washed their cow udder after milking (14.6%). In closed to current study, Yitaye et al.(2009) in North western Ethiopian highlands who reported that 94 % of the farmers cleaned the udder before milking in both urban and peri-urban production system while only 6.7% (urban) and 5% (peri-urban) producers washed after milking. In similar way, Kivaria et al. (2006) also reported in Dar es Salaam Region, Tanzania who stated that 100% of households wash milkier hands prior to milking operations. However, in contrarily to current result, Haile et al. (2012) indicated under different farm size in Hawassa, southern Ethiopia about 15% of the small size farm owning household wash the udder before and after milking; 82.5, 90 and 87.5% of small, medium and large size farms wash udder only before milking while12.5, 10 and 2.63% of large, medium and small size dairy farm owning households do not practice udder washing at all. On the other hand, Fikrineh et al. (2012) reported from the areas of Mid Rift Valley of Ethiopia 52.7% of respondents washed udder before milking; 10.3% of washed udder after milking of their cow and 18.0% of used individual towel to dry their cow.

In the current study, the farmers commonly practiced stimulus for milk let down by using calf suckling, then after they washed udder of their cows for milking; for this case about 16.8% of respondents used individual towel to dry the udder of milking cow while the rest did not use any towel. However, Kivaria et al. (2006) from Dar es Salaam Region, Tanzania reported that 66% of milkier use a single piece of cloth for udder drying for all in herd lactating cows, whereas 30% reported to use bare hands to dry the udder and 4% do not dry the udder and of which majority were used soap to wash. But in the current study, no one used soap or other disinfectant to wash milkier hand or udder or towel. In similar way, Haile et al. (2012) also resulted from Hawassa, southern Ethiopia about 48% of all the interviewees in all farm size groups do not use towel to dry udder after washing rather they massage the udder with bare hands; while about 44% of them reported to use common towel while 4.6% reported that they do not practice udder washing and drying and only 3.8% used separate towel for each cow. To wash milkier hand, udder of their cow and equipments for storage, fermentation and transportation of milk, about 26.5, 72.8 and 1.7% of respondents used warm, cold and both warm and cold water alternatively respectively(Table 1). In similar to current study, Yitaye et al. (2009) in North western Ethiopian highlands who reported that in urban areas, farmers equally used warm and cold water to clean milk equipments while majority of peri-urban farmers (68%) used warm water.Whereas, Kivaria et al. (2006) from Dar es Salaam Region, Tanzania reported that household used either warm (74%) or cold (13%) water to wash the udder cows however, the current result was disagreed to Haile et al. (2012) result from Hawassa, southern Ethiopia who reported that about 60, 28 and 8.3% of the producers respectively used warm water, cold water and both warm and cold water alternatively for washing and cleaning udder.

Majority of the respondents (83.0%) were using local plants for washing and fumigating for milk handling equipments (Table1). The plants used for the cleaning of milking and fermenting and storage utensils were *Hantecha, Gullo, Guntcha, Kosereatea, Azmate, zmano, nech shngurt, Korerima.* According to the farmer

suggestion, the practice of fumigating the milk equipment by burning wooden chips of specific trees and shrubs has an advantage of imparting special taste and odour to the product, and to disinfect the vessels, thus reducing the numbers of micro-organisms and thereby extending the shelf life of the product. Similar to present result, a study was conducted by Yitaye et al. (2009) from North western Ethiopian highlands who stated that 73.4% of farmers used leaves of shrubs with water to clean the equipment such as *Combretum molle (*Abalo*)*, *Ocimum suave* (Dama Kessie) and *Buddleja polystachia* (Anfar)) and smoking plants specifically used for this purpose are *Rosa abyssinica* (Qega), *Osyris quadripartite* (Keret), *Otostegia integrifolia* (Tinjut), *Olean Africana* (Woira), *Thymus vulgaris* (Tosgne) and *Juniperous procera (Tid)*). More ever, Lemma (2004), Sintayehu et al. (2008) and Fikrineh et al. (2012) had also reported similar finding to current result who described that different plants are usually used to clean and fumigate milk equipment in different areas of Ethiopia.

Milk processing practice by respondents in percentage is presented in Table 2. The produced milk was traditionally processed to different products in the study area; they usually used traditional utensils such as *menacha, kl, yesamiya, jok*, and other *ensra* products (*local name*). As indicated from Table 2, majority of the respondents (92.7%) processed milk in to different products. Milk has to be fermented before it has been processed to further products. The Fermented milk produced were sour milk (*Ergo*), yoghurt, butter (*Kibe),* buttermilk (*Arrera*), cottage cheese (*Ayib*) and whey (*Aguat).* It is prepared by keeping milk in a container and letting it to ferment naturally without using any starter culture. Butter is prepared by manually churning the fermented milk in a clay pot. Butter is used for cooking and it is also used for hair beautification especially for women. Buttermilk is the product left after the fermented milk has been churned and butter is made. The buttermilk is used for home consumption. Cottage cheese is made by mild heating of the buttermilk and extracting the solids out of the liquid. Whey is the last remaining residue in the traditional milk processing system; it is used for livestock feeding (calves, thin cows and dog) and children. However, some farmers get rid of the whey because they perceive that it is useless. In consistent to the present study, Yitaye et al. (2009) from North western Ethiopian highlands stated that only traditional household utensils were used for collecting or milking, storing and processing milk products; the major dairy products found are yoghurt–like fermented/sour milk (*Ergo*), traditional butter (*Kibe*), traditional ghee (*Neter Kibe*), cottage cheese (*Ayib),* traditional hard cheese (*Metata Ayib*), buttermilk (*Arrera),* and whey (*Aguat*). However, the traditional milk processing is generally time consuming and the products are limited (not more than six products varieties types). It might have also problem in safe quality products from contamination and limitation of supposing to quantity of product (like less milk fat recovery turned into butter per unit of milk processed and protein cheese and yoghurt) as it is performed by manually. So, if the farmers could not produce greater varieties of products and quality, it is most likely that farmers could not get the supposed full value-added products from milk production.

The majority of the farmers in the present study area, were processing milk due to multiple reasons; 11.2, 14.2, 24.6, 45.5 and 4.5% of respondents were processed milk to increase shelf life, to value- add, to have variety of products, to increase (all) the shelf life and value- add and to have variety of products; and to increase shelf life and to value- add respectively (Table 2). In similar to current study, Abebe et al. (2013) in Ezha district of the Gurage zone, Southern Ethiopia reported that 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%). The finding of current study was also in lined to Lemma (2004) study who indicated that milk was processed in order to increase the family income through sale, diversify the products for consumption and to increase the shelf life of the products as marketing is limited once a week due to the need to travel to long distance to reach market places. In the same way, Fikrineh et al. (2012) also reported from the areas of Mid Rift Valley of Ethiopia about 97.2%, 57.1%, 38.8%, 7.4% and 3.4% of respondents are processed milk for home consumption, for marketing, to increase shelf life of the product, due to surplus production of milk and to diversify products, respectively.

Revealed from Table 2, frequencies of processing milk in the study area were about 82.7, 6.8, 8.3, 0.8, 0.8 and 0.8% of the respondents processed every day, every two day, every three day, every four day, triple per day and twice per day respectively. However, Abebe et al. (2013) in Ezha district of the Gurage zone, Southern Ethiopia reported that 70% and 30% of respondents process milk twice per week and once per week, respectively (in Woina Dega areas); while 53.4% of in Dega areas process their milk twice per week, whereas the remaining 38 and 8% of the respondents process once per week and once fortnightly, respectively. The reason for processing frequency variation of milk in different study might be due to effect of handling management, ambient temperature and relative humidity. Milk is by nature it is highly perishable commodity that could be deteriorated and changed its quality nature quickly under ambient temperature that makes utilization and marketing difficult unless it is properly preserved. From milk production to finished products, products should be stored at appropriate temperature. Temperatures and for appropriate times such that the growth or development of a food safety hazard will be minimized and the product's suitability will not be adversely affected. Because milk and many milk products have sufficient moisture content to support the growth of pathogens, temperature and time controls represent key microbiological control measures to control growth

throughout the manufacturing process, from the handling of milk to the distribution and storage of perishable milk products For instance, for liquid milk; increased storage temperature will decrease the shelf life. This was also supported by Fikrineh et al. (2012) study from the areas of Mid Rift Valley of Ethiopia who indicated that fermentation time or length of milk is affected due to the temperature of the area, regular smoking of their milking, storage equipment, proper hygiene of storage equipments, storing milk separately (raw and fermented or morning and evening milked milk) and type of equipments used.

Table1: Hygienic practices during milk production by respondents in percentage

Parameters	**(N=137)**	**%**
Hand washing before milking(137)		
Yes	131	95.6
No	6	4.4
Udder washing before milking(137)		
Yes	118	86.1
No	19	13.9
Udder washing after milking(137)		
Yes	20	14.6
No	117	85.4
Do you use individual towel to dry the udder of your cow?(137)		
Yes	23	16.8
No	114	83.2
Type of water you use to wash milking equipments(137)		
Hot	36	26.5
Cold	99	72.8
Both cold and hot	2	1.7
Do you use local plants for washing and fumigating your milking and milk handling equipment?(137)		
Yes	115	83.94
No	22	16.05

N= respondents numbers

Table 2: Milk processing practice by respondents in percentage

Parameters	**(N=137)**	**%**
Do you process milk to different products?(137)		
Yes	127	92.7
No	10	7.3
Why you process milk?(134)		
To increase shelf life	15	11.2
To add value	19	14.2
To have variety of products	33	24.6
All(to increase shelf life, to add value and to have variety of products	61	45.5
To increase shelf life and to add value	6	4.5
Frequency of processing your milk(133)		
Every day	110	82.7
Every two day	9	6.8
Every three day	11	8.3
Every four day	1	.8
Triple per day	1	.8
Twice per day	1	.8

N= respondents numbers

Conclusion

- In the study area, all of the respondents were milking their cow by hand and milking was performed by women; most were milking their cows three times per day during the morning, day and evening time (in wet season). Majority of the respondents washed their hand (95.6%) and cow udder (86.1%) before milking however, only a few washed their cow udder after milking (14.6%). To wash milkier hand, udder of their cow and equipments for storage, fermentation and transportation of milk, about 26.5, 72.8 and 1.7% of respondents used warm, cold and both warm and cold water respectively.
- In traditional milk handling and processing system of the study area, there were different plant materials

which are being used by the farmers to give the product good favors and aroma, and to increase the shelf life of the product.

- The majority of the farmers in the study area were processing milk due to multiple reasons such as to increase shelf life, to value- add, to have variety of products, to increase all (shelf life, to value- add and to have variety of products) and to increase shelf life and to value –add; almost all of interviewed households, milk were processed either once every day or every three day/every two day.

Recommendation

- All equipment and utensils used for milking, processing, storage and marketing should be disinfected and rinsed with hot water (detergent) immediately before and after use so that organoleptic, microbial and compositional quality of milk and milk products would be assured.
- To produce and supply sanitary and quality milk and milk products to consumer, handling and processing facilities and market infrastructure should be improved; in condition where no possible facilitating equipment and utensils for farmers; the farmers should adopt to supply fresh milk to market of course most rural areas are far and remote from road and market service in such cases dairy cooperatives should be functional in assisting to sale fresh milk for small holder farmers.

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