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Assessment of Traditional Butter Production and Preservation Techniques in West Shewa Zone, Oromia Regional State, Ethiopia

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Abstract
The study was carried out in Dire Inchini and Ambo Districts, West Shewa Zone, Oromia Regional State, Ethiopia, to assess traditional butter production, processing and handling techniques, consumption and marketing, to identify traditional butter preservatives and preservation techniques. To generate data, semi-structured questionnaire was prepared for the total of 120 respondents, 60 from each district residing in Highland (40), Midland (40) and Lowland (40) representing agro-climate of the districts and owning at least one milking cow and interviewed individually. The findings showed that, the mean volume of milk required to produce a kg of butter was 20.74lit and the average butter produced /week/HH was 0.44kg. The only marketed products were butter (65.91%), "ayib" (17.14%) and fresh milk (1.88%). Butter is usually stored in small clay pot (75%), plastic materials (15%) and cans (10%). Traditional butter preservation methods identified were traditional ghee making (100%), spicing (98.33%), melting (29.17%) and salting (11.67%).To make traditional ghee; Trachyspermum ammi, Nigella sativa, Aframomum angusti-folium, Trigonella foenum, Zingiber officinale and Allium sativum are the commonly used spices. The major constraints of milk and butter production, processing and marketing were scarcity of feed, animal diseases, low milk production, low fat recovery, low price and price fluctuation over time and lack of collection centers. Therefore, extension services need to be promoted in improving livestock management systems and producers need to process milk into more stable products and traditionally preserve butter by making traditional ghee and salting.
Keywords: Butter, preservation, traditional

INTRODUCTION

Since prehistoric times, milk fat is the major source of energy and man has satisfied his need for fat by eating foods from a variety of animal and vegetable sources. Among these foods, milk from animals has been a prime source of nutrients (O' Brien, 1998). Still there is an increasing demand for the dairy products in Sub-Saharan Africa (ILCA, 1992; O'Connor, 1993). Like most countries in sub Saharan Africa, Ethiopia is unable to meet the increasing demand for milk and milk products for its increasing population (Azage*et al*., 2000).In Ethiopia, smallholder farmers and pastoralists together produce and supply 98% of the total annual milk production of the country (YONAD, 2009). The vast majority of milk produced outside urban centers in the country is processed into milk products at household level using traditional technologies (Muriuki and Thorpe, 2001). In the rural areas of Ethiopia, it is estimated that 40% of the milk produced is converted to butter, while only 9% is converted to cheese. Traditional butter ferments slowly at room temperature, offering rural consumers a readily storable and durable dairy product (GOE, LMP, 2007).

For many reasons (limited market outlet, shorter shelf life, and lower price for whole milk as compared to butter and ease of handling and product diversification for consumption) in rural areas, producers are attracted to produce butter (Alganesh, 2002; Ayantu, 2006 and Kassahun, 2008).So, in Ethiopia, at national level, out of the total butter production, 80% is used as food ingredient and the rest used as cosmetics for hair dressing. Out of the 80% used for food 70% was used in rural and nearby urban areas; while 30% is channeled in to Addis Ababa market (Getachew, 2003). Therefore, traditional milk products such as butter, ghee, and milk protein based foods contribute much to the dietary requirements of rural society and save the milk from spoilage and diversifies its use (FAO, 1990).

However, in Ethiopia and most of sub Saharan countries, the climate is hot and humid; leading milk and milk products spoil easily during storage unless it is cooled or treated with preservatives. On top of that commercial preservatives are not readily available in rural areas, while cooling systems are not feasible in some areas because of lack of facilities (O'Mahoney and Peters, 1987). In different rural areas of Ethiopia, producers use different traditional preservatives and preservation methods to increase butter shelf life (Alganesh, 2002; Lemma, 2004 and Mekdes, 2008). These traditional preservatives used as a principle of acidification and moisture reduction and can thus make butter of good storage stability (O'Mahony and Peters, 1987).

Workneh and Ulfina (2011) observed the significant importance of dairy products; particularly butter in the case of gender role and income generation for the whole house hold members at Ambo area of West Shewa Zone. The same authors indicated that, about 75% of dairy farmers in Ambo district process milk to butter and most of them use processed products in home consumption.

Dire Inchini is a district which is found in West Shewa Zone of Oromia Region and well known with its peculiar livestock and livestock products. Milk and milk products particularly butter are very prominent commodities on the market and butter of this district is well known all the way from Ambo Zone to the capital city of the country Addis Ababa, fetching more prices.

Though the processing of milk in to butter is nutritionally and economically important for rural peoples and saves the milk from spoilage and diversifies its use, the production processes, handling, traditional preservatives and preservation techniques of butter in these districts were not studied. Besides, the efficiency of these preservation techniques were not yet evaluated and needs to intervene for analyzing their efficiency to optimize the best and applicable ones. Therefore the current study was initiated with the following objectives:

General objective:

- To assess traditional butter production, preservatives and preservation techniques in the study area.

Specific objectives:

- To assess traditional butter production, marketing and processing techniques in the study area,
- To identify traditional butter preservatives and preservation techniques in the study area,
- To compare efficiency of traditional butter preservation techniques in the study area and
- To identify the major butter production constraints and opportunities in the study areas

RESEARCH METHODOLOGY

Description of the study areas

The study was conducted in Ambo and Dire Inchini Districts, which are found in West Shewa Zone of Oromia Regional State, Ethiopia. The Zone is located at 115 km west of the capital city of the country. The total human population of the Zone is 2,500,482 (male= 1,245,472 and female= 1,255,010) (CSA, 2014). The total land area of the district is about 1,434,929 ha out of which 880,211.61, 30,455, 249,645.52, 104,799.01, 200,272.86ha is used for cultivated land, irrigation, grazing land, forest land and for other purposes, respectively (PSEP, 2011). The Zone is found between 8.017" north to 9.060"north latitude and 370 17"east to 380 45'east longitude. West Shewa Zone generally lies with the altitude range between 1000 and 3500 meters above sea level (PSEP, 2011). Weather condition of the Zone is classified in to three; namely highland (27%), midland (56%) and low land (17%). The mean annual temperature over the central part of the district ranges 23-25^{0}C. The rainfall is weakly bi- modal with spring, a small rainy season during the months of April and May while summer is a long rainy season during the months of July, August and September (PSEP, 2011).

The Zone is divided in to 18 districts and Ambo town is the capital town of the Zone. In these administrations, there are 529 rural and 39 urban kebeles. The predominant farming system in the two areas is mixed crop-livestock and cattle are the most important livestock species in the areas as most of the Zones topography is a leveled field (PSEP, 2011).

Ambo district

Location and area coverage

This area is found in West Shewa Zone, Oromia Regional State, Ethiopia. The district is located between 8.047'N to 9.021'N and 370 32'E and located at 115 km West of Addis Ababa (ADADO, 2014). The total human population of the district is 129, 162, out of which 64, 377 are males and 64, 785 are females (CSA, 2014). The total land area of the district is about 111683 ha, out of which 57262 ha is cultivable, 13550 ha is forest land and 40871ha used for others purpose (PSEP, 2011).

Climatic condition and topography

It has a mean annual temperature and rain fall of 23-25^{o}C and 1300-1700mm, respectively. Topography of the district covers 17% lowlands, 60% midlands and 23% highlands and altitudinal ranges of the district fall between 500 and 3,200m.a.s.l (ADADO, 2014). The vast areas of this district are considered as undulated and intermediate plateau that is highly ideal for the farming mechanization and do lies within an altitude of 2000-2500 M.A.S.I (PSEP, 2011).

Dire Inchini district

Location and area coverage

The district is located at about 162km West of Addis Ababa and 50km from zonal town Ambo. The total human population of the district is 129,305 out of which 43, 414 are males and 85, 891are females (CSA, 2014). The total land area of the district is about 38541 ha out of which 24929 ha is cultivated; 2705.96ha is forest land and 10906 ha used for other purposes (PSEP, 2011).

Climatic condition and topography

An average annual rainfall of the district ranges between 1000 -1400mm. Average minimum and maximum temperatures are 8.8^{o}c and 21.6^{o}c, respectively. The vast areas of this district are considered as undulated and intermediate plateau that highly ideal for the farming mechanization and do lies within an altitude of 2000-2500 M.A.S.I (PSEP, 2011).

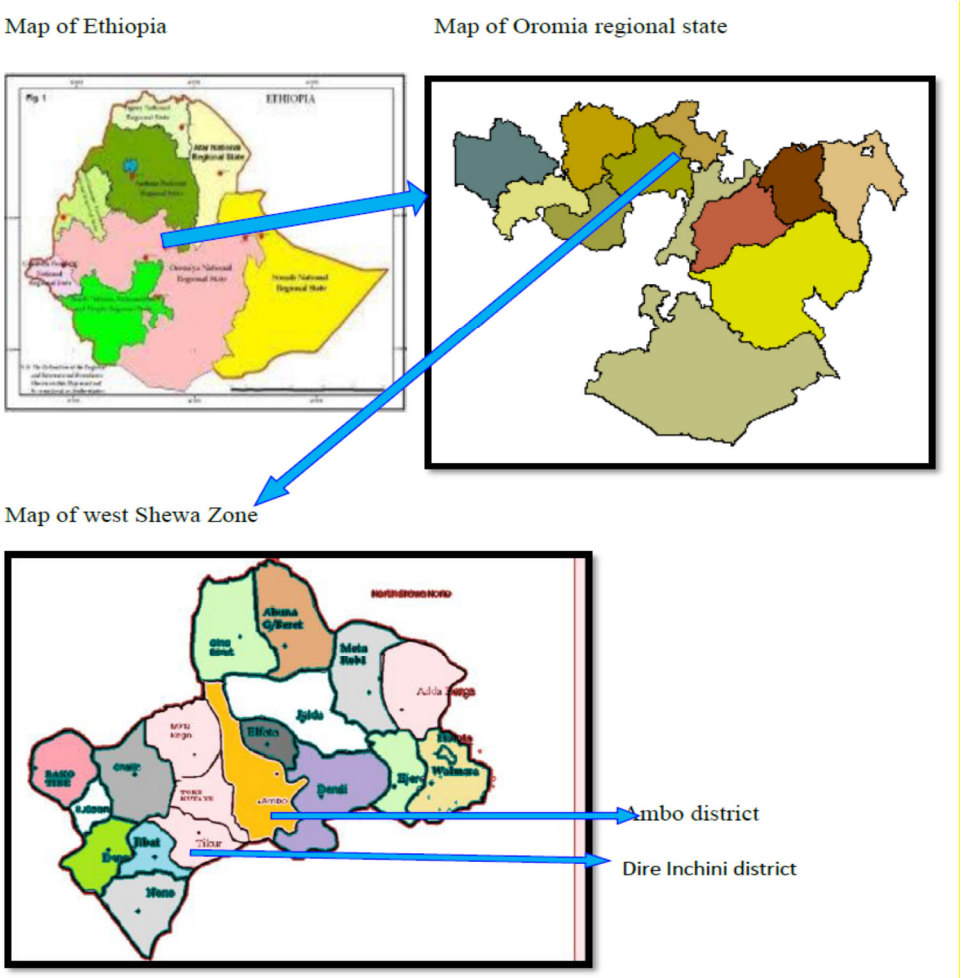

Figure 1: Map of Dire Inchini and Ambo districts
Source: Ambo Woreda Administration Office, 2014

Sampling Methods and Procedures

Method of Data Collection

Data for the study was collected on butter production, preservatives, preservation methods, consumption and marketing practices in Ambo and Dire Inchini districts of West Shewa Zone

Sampling Techniques

Three kebeles from each district representing the three agro-ecologies (Highland, Midland, and Lowland) were selected purposively. From each kebele, 20 respondents who own at least one lactating cow and produce butter were purposively selected. Accordingly, a total of 120 respondents from the two districts were selected and interviewed to obtain information on butter production, handling, processing, preservatives, preservation methods, utilization, marketing and the challenges and opportunities related to butter production.

Methods of Data Analysis

The collected data were analyzed using descriptive and inferential statistics such as means, frequency distribution, percentage and one way ANOVA using SPSS (ver.16). Mean comparison was done using LSD of SPSS software (ver. 16).

RESULTS AND DISCUSSION

Household size and age structure

Average family size and age structure of the households in the study areas are depicted in (Table 1). The average total family sizes in Dire Inchini and Ambo were 5.87 and 5.58, respectively indicating that the family sizes in both districts are similar.

In Dire Inchini, 40.91% of the family size were under dependent age group (<18 and >59 years of age), while, 59.09% of family size represented productive age group (19-59 years of age). Furthermore, 44.49% of sampled respondents in Ambo had family size under dependent age group. The remaining 55.52% of family size represented productive age group.

In general, more than half (57.35%) of sampled respondents in the study areas had productive age group,

which could indicates that; there is a potential of human power for dairy development in the area. The remaining 42.65% had dependent age group. In particular, Dire Inchini relatively had more productive age group of family members than Ambo for development activities. Ayantu (2006) also found the dominancy of productive age group at Wollayita Zone.

Table 1: Average family size and age structure of households in the study areas.

Age groups (yrs)	Districts				Overall mean (N=120)	
	Dire Inchini (N=60)		Ambo (N=60)			
	Mean ± SE	%	Mean ± SE	%	Mean ± SE	%
<18	2.59 ± 0.16(122)	34.66	2.56 ±0.10(141)	42.10	2.58 ±0.09(263)	38.28
19-59	3.53 ± 0.14(208)	59.09	3.15 ±0.16(186)	55.52	3.34 ±0.11(394)	57.35
>59	1.29 ± 0.19(22)	6.25	1.14 ±0.14(8)	2.39	1.25 ±0.14(30)	4.37
Total family/HH	5.87 ± 0.19(352)	100	5.58 ±0.20(335)	100	5.73 ±0.14(687)	100

N = Number of respondents
HH=Household
Numbers in parenthesis indicate number of observations

Livestock production and productivity

Cattle holding

Cattle producers in the study areas keep different herd composition for different purposes depending on feed availability, man power for herd management and income level for fulfilling different facilities required. Accordingly, the total average cattle holding per household in Dire Inchini and Ambo were found to be 7.60 and 7.47, respectively with the overall mean of 7.54 (Table 2). Agajie, *et al.* (2002) also reported average cattle per household of 7.2 at West Shewa Zone; which is similar to the current study.

In Dire Inchini, the mean average local breed and crossbred milking cow owned per house hold was 1.73. While, in Ambo district, only local breed cow was recorded with 1.75 cows per household. Even though the recorded value is not different; in Dire Inchini district, crossbred cows were observed which could create potential difference of milk production.

Table 2: Average cattle holding per household and herd structure in the study areas

Herd structure		Districts				Overall mean	
		Dire Inchini		Ambo			
		Mean ± SE	%	Mean ± SE	%	Mean ± SE	%
Local breed	Calves	1.58 ± 0.08 (92)	20.18	1.63 ± 0.13 (98)	21.87	1.58 ± 0.08 (190)	21.02
	Heifers	1.08 ± 0.12 (65)	14.25	1.17 ± 0.17 (70)	15.63	1.13 ± 0.10 (135)	14.93
	Milking cow	1.58 ± 0.08 (95)	20.83	1.75 ± 0.18 (105)	23.44	1.67 ± 0.10 (200)	22.12
	Dry cow	0.45 ± 0.08 (27)	5.92	0.22 ± 0.05 (13)	2.90	0.33 ± 0.05 (40)	4.43
	Bulls	0.73 ± 0.09 (44)	9.65	0.87 ± 0.10 (52)	11.61	0.80 ± 0.07 (96)	10.62
	Oxen	1.62 ± 0.11 (97)	21.27	1.83 ± 0.12 (110)	24.55	1.73 ± 0.08 (207)	22.90
Crossbred	Calves	0.17 ± 0.07 (10)	2.19	-	-	0.08 ± 0.04 (10)	1.11
	Heifers	0.12 ± 0.04 (7)	1.54	-	-	0.06 ± 0.02 (7)	0.77
	Milking cow	0.15 ± 0.07 (9)	1.97	-	-	0.08 ± 0.03 (9)	1.00
	Dry cow	0.02 ± 0.02 (1)	0.22	-	-	0.01 ± 0.01 (1)	0.11
	Bulls	0.12± 0.06 (7)	1.54	-	-	0.06 ± 0.03 (7)	0.77
	Oxen	0.03 ± 0.02 (2)	0.44	-	-	0.02 ± 0.01 (2)	0.22
Overall mean cattle/HH		7.60 (456)	100	7.47 (448)	100	7.54 (904)	100

Numbers in parenthesis indicate number of cattle observed
HH= Household
Calves = un-weaned age of both sexes of cattle

Livestock production

In Dire Inchini and Ambo districts, farmers keep cattle for deferent purposes like for draught power, milk production, income generation by selling live animals in case of need (i.e., in the form of live bank), manure for fertilizing farm land and for fuel in the form of dung cake and in some cases they keep large number of herd for prestige value. The first priority of keeping cattle was for draught power followed by milk production, income generation, manure and prestige (Table 3). In addition to draught power, oxen are used for threshing cereal crops and transporting construction materials. This finding is in accordance with the findings of Alganesh (2002) who reported that, producers in Eastern Wolega keep livestock for different purposes including draught power, milk production, animal sale, and fertilizing the land in their order of importance. Even though respondents rank milk production as the second priority of rearing cattle, they use milking cows not only for milk production, but also for production of calves, which can be either sold in case of risk or used as replacement heifer or bull. In some cases, they also believe that, lacking milking cows indicates poverty and women loose income from selling butter. According to the study done in Ambo town, 30% of women respondents earn income from sales of livestock products while 65% of male earn income from sell of animals (Workneh and Ulfina, 2011).

Table 3: Priority ranking of functions of livestock in the study areas

Purpose	Priority Ranking (%)					Overall (%)
	1	2	3	4	5	
Draft power	82.50(99)	8.33(10)	5.83(7)	2.50(3)	0.83(1)	100(120)
Milk production	5(6)	51.67(62)	42.5(51)	0.83(1)	-	100(120)
Income generation	12.5(15)	40(48)	47.5(57)	-	-	100(120)
Manure	-	-	3.33(4)	64.17(77)	32.5(39)	100(120)
Prestige value	-	-	0.83(1)	32.5(39)	66.67(80)	100(120)

NB: Numbers in parenthesis indicate number of observations

Productive and reproductive performance of Livestock

Estimated average milk yield, lactation length, calving interval and age at 1st calving of female cattle in the study areas are presented in Table 4. In the study areas, the overall mean average daily milk yield for local breed cows was estimated to be 0.99 liter, while it was 4.08 liters for crossbred cows. The present finding is not in conformity with the finding of Alganesh (2002) who have reported an average daily milk yield of 1.80 liters for local breed in Eastern Wollega. This could be attributed to variability between breed and management. The study done at Wolaita Zone also reported an average milk yield of local cow with 1.13 liters per day (Mekdes, 2008); which is slightly greater than the current finding. While, average milk yield of crossbred cow reported at Delbo with 3.16liter per day was smaller than the current study record, which could be attributed to variability in the blood level of the cow and managements provided.

An estimated overall mean lactation length of local breed and crossbred cows recorded were224.84and 280.83 days, respectively (Table 4); which is lower than the mean average lactation length of 288days for local breed reported at Eastern Wolega (Alganesh,2002). This may be attributed to the variation in management and breed in these two independent study areas.

Both average calving interval and age at first calving in Ambo was relatively shorter compared to Dire Inchini. This may be relatively attributed to warmer temperature in Ambo area, which could facilitate the physiological and hormonal activity of animals. The recorded overall average calving interval of the study areas for indigenous cow was 1.45 years, which is in line with the findings of Mekdes (2008) who reported the mean average calving interval of 1.48months in Wolayita Zone.

Likewise, the recorded overall average age at 1st calving for indigenous breed was 4.48 years. The current finding is not agreed with the average age at 1st calving of 3.8 years for indigenous breed reported from Metekel Zone (Solomon, *et al.,* 2014). This variation may be attributed to the variation in managements provided and rate of body weight gain of animals in these independent study areas.

Table 4: Estimated average productive and reproductive performances of female animals in Dire Inchini and Ambo districts

Parameters	Breeds	Districts		Overall mean
		Dire Inchini	Ambo	
		Mean ± SE	Mean ± SE	Mean ± SE
Average milk yield (lit./day)	Local (57)	1.00 ± 0.03	0.98 ± 0.03	0.99 ± 0.22
	Cross (6)	4.08 ± 0.20	-	4.08 ± 0.20
Average lactation length (days)	Local (57)	231 ± 4.41	218.50 ± 4.68	224.84 ± 3.26
	Cross (6)	280.83 ± 25.83	-	280.83 ± 25.83
Average age at 1st calving (yrs)	Local (57)	4.56 ± 0.52	4.40 ± 0.05	4.48 ± 0.37
	Cross (6)	4.00 ± 0.13	-	4.00 ± 0.13
Average calving interval (yrs)	Local (57)	1.54 ± 0.06	1.37 ± 0.04	1.45 ± 0.04
	Cross (6)	1.92 ± 0.3	-	1.92 ± 0.30

Yrs = years

Numbers in parenthesis indicates number of observations

SE = Standard Error of mean

Hygienic milk and milk products production and handling practices

In the study areas, milking is performed twice per day by female members of the family. While during dry season and at late dry period of the cow, milking frequency reduced to once per day. The present finding is in line with Lemma (2004), who reported milking frequency of twice per day, while during dry season limited to once per day in East Shewa Zone. During milking, some farmers keep sanitary practices to some level. Out of the interviewed farmers, 86.7% of them wash milking equipment and their hand and smoke the equipment before milking to reduce contamination and for good flavor (Table 5). Out of which, 76.9% and 53.80% use warm water for washing equipment and hand respectively to facilitate washing and to kill some microorganisms. While the rest farmers do milking without washing and smoking equipment. But this allows contamination to the milk and milk products. But, with regard to washing udder, only 40% of the respondents wash udder before milking out of which 16.67%

of them use warm water for washing cow's udder to facilitate milking and produce clean milk. While, the rest (60%) do milking allowing calve to suckle first which assists in milk letdown and cleaning the udder; which allows contamination to the milk and milk products. This finding is inconsistent with the findings of Zelalem and Faye (2006) and Mekdes (2008) who reported that small-scale producers in the central highlands of Ethiopia (79%) and Wolayita Zone (49%), respectively wash udder before milking to reduce contamination. This variation might be attributed to the variation in awareness of the respondents on hygienic milk and milk products production.

Table 5: Hygienic milking practices in the study areas

Hygienic practices		Districts				Overall mean N=120	
		Dire Inchini N=60		Ambo N=60			
		N	%	N	%	N	%
Washing hand, equipment and smoking		54	90	50	83	104	86.7
Washing udder before milking		27	45	21	35	48	40
Use of warm water	For washing udder	2	7.41	6	28.57	8	16.67
	For washing equipment	42	77.78	38	76	80	76.92
	For washing hand	24	44.4	32	64	56	53.85

Farmers in the study areas use different types of plants or herbs for the purpose of smoking and cleaning milk equipments based up on the availability and preference (Table 6). In Dire Inchini, "shokonota", "masarata" and "Altufa" were commonly used for cleaning milk equipment; as these plants could be planted at backyard and available almost all the time.

Likewise, for smoking milk equipments, farmers in Dire Inchini commonly use "Qadida" followed by "Ejersa" (*Olea africana)*. In this area, "Qadida" was very common, preferable and abundant for use than "Ejersa" (*Olea africana)*; which creates non-uniform fermentation of milk as argued by many famers. According to Teshager*et. al*. (2013), "Urgeessaa" (*Premnaschimperi*), "Bakari" and "Ejersa" (*Olea africana)* in their order of importance are predominantly used for smoking purpose in Ilu Aba Bora Zone.

Similarly in Ambo, farmers commonly use "Shokonotaa", "Masarata", "Xoosanyii" and "Kusaayee" for cleaning purpose. Kusaayee (*Ocimum hardiency)* which is grown on the field and not used in Dire Inchini, but it is commonly used in Ambo District. Again, "Altufaa", which is commonly used in Dire Inchini, is rarely used in Ambo. This indicates that use of plants for cleaning and smoking milk equipment depends on availability and preference. The finding of Alganesh (2002); Mekdes (2008); Teshager et al. (2013) and Eyassu (2014) in different parts of Ethiopia also reported "Kusaayee" is commonly used for cleaning milk equipments. Unlike in Dire Inchini, in Ambo, relatively many farmers use "Ejersaa" next to "Qadiidaa" for smoking of milk equipments. The current finding is in line with the findings of Alganesh (2002); Lemma (2004); Zelalem *et. al.* (2006) in eastern Wolega, West Shewa, and central highlands of Ethiopia, respectively who reported "Ejersaa" is commonly used for smoking milk equipments.

Table 6: Plants and/or herbs used for cleaning and smoking equipment

Local name	Scientific name	Purpose	Districts				Overall mean	
			Dire Inchini		Ambo			
			N	%	N	%	N	%
Shokonota	*Ocimum hardiense*	Cleaning	60	100	56	93.30	116	96.7
Masarata	Un identified	Cleaning	37	61.70	27	45	64	53.3
Xoosanyii	*Satujera Sp.*	Cleaning	7	11.70	18	30	25	20.8
Altufa	Un identified	Cleaning	14	23.30	3	5	17	14.2
Cilaakkota	*Ruta graucolence*	Cleaning	2	3.30	1	1.70	3	2.5
Kusaayee	*Lantana Trifolia*	Cleaning	-	-	15	25	15	12.5
Qadiidaa	Un identified	Fumigation	60	100	49	81.7	109	90.8
Ejersa	*Olea Africana*	Fumigation	4	6.7	40	66.7	44	36.7
Xoosanyii	*Satujera Sp.*	Fumigation	1	1.7	3	5	4	3.3

N = Number of observation

Farmers in the study areas use different plants and/or herbs to clean and fumigate milk equipment for different reasons and purposes depending on individual's perception and experiences. In the study areas, farmers clean and fumigate milk equipment with different plants and herbs for good aroma of the product, for good taste, to increase shelf life and facilitating milk fermentation in their order of importance (Table 7). Respondents argued that, milk equipments cleaned and smoked with different plants and herbs deliver good flavor and taste to milk and milk products. As the respondents stated, milk stored in un-smoked equipment quickly deteriorates and creates unwanted odor and taste. Similarly, they reported that fumigated equipment attracts consumer as it adds good aroma and taste to the milk. The current finding is consistent with the findings of Alganesh (2002); Mekdes (2008); Teshager *et al. (*2013) and Eyassu (2014) who reported use of cleaning and smoking plants and herbs for good

aroma and flavor of the product and to arrest spoilage (increase shelf life) of the product in eastern Wolega, Wolayita Zone, Ilu Aba Bora Zone and North Western Ethiopia, respectively.

Table 7: Purpose of smoking and cleaning milk equipment by different herbs and plants in the study areas

Purpose of smoking	Districts				Overall mean	
	Dire Inchini		Ambo			
	N	%	N	%	N	%
For good aroma	56	93.3	50	83.3	106	88.3
For good taste	44	73.3	39	65	83	69.2
Increase shelf life	12	20	21	35	33	27.5
Facilitate fermentation	2	3.3	-	-	2	1.7

N = Number of observation

Milk and milk products storage, and processing equipments

Farmers in the study areas use different equipments for milk and milk products storage and processing because of the combinations of different reasons including materials availability, preferences and knowledge about advantage of the particular equipment. They also use one type of equipment for different purposes (Table 8). Accordingly, in Dire Inchini and Ambo, clay pot is commonly used for fermented milk storage (60.83%) as it creates uniform fermentation of the milk; deliver good aroma and test for milk and milk products after fumigation. Again, clay pot can also be used for churning fermented milk (100%) as it is suitable for rocking on the floor, and also it is used for storage of butter (75%) for longer shelf life of the butter. The current finding is consistent with the finding of Mekdes (2008) who reported the commonly use of small, medium and large sized clay pot for butter storage, fermented milk storage and churning purpose, respectively in Wolayita Zone. Likewise, woven grass material is more commonly used for milking purpose (95%) as it is suitable for smoking and retains aroma from fumigants and cleaning materials. The current finding is disagreed with the finding of Eyassu (2014) who reported that gourd is most commonly used for milking, fermented milk storage, churning and butter storage in North Western Ethiopia. The variation might be attributed to the variation in the availability, preferences and awareness about the advantage of the particular equipment.

Table 8: Storage and processing materials for milk and milk products in the study area

Equipments	Purposes of equipments(N=120)			
	Milking (%)	Fermented milk storage (%)	Churning (%)	Butter storage (%)
Clay pot	-	Uniform fermentation, good aroma and taste (60.83)	Suitable for rocking on floor (100)	For longer shelf life, culture and cheap (75)
Woven grass	Suitable for smoking and deliver good aroma (95)	-	-	-
Plastic	Handle large volume of milk (5)	Fast fermentation, hygienic and safety (24.17)	-	Safety and hygienic (15)
Cans	-	-	-	Security, hygienic and longer shelf life (10)
Gourd	-	Uniform fermentation, good aroma and taste (15)	-	-

N = Number of respondents

% = Percentage of respondents

Numbers in parenthesis indicate percentage of respondents using particular equipment for a specific purpose

Milk production and processing

In the study areas, farmers process milk in to different milk products for different ranked reasons (Table 9). The reasons for processing milk in the areas were because they produce small volume of milk, to increase shelf life of the product, to diversify the product and to generate better income by selling milk products particularly butter in their order of importance. Farmers reported that, as the milk produced per lactation or per day was too small to use immediately, it needs to be collected over time and processed in to different types of more stable and marketable milk products commonly in to butter and rarely into “ayib” either for consumption or to sell at better price.

Table 9: Priority ranking for reasons of milk processing in the study areas

Parameters	Priority ranking (%)				Overall
	1	2	3	4	
Small milk (milk scarcity)	38.33(46)	12.50(15)	23.33(28)	25.83(31)	1
To increase shelf life	23.33(28)	33.33(40)	21.67(26)	21.67(26)	2
To diversify the product	21.67(26)	32.50(39)	28.33(34)	16.67(20)	3
To generate better income	16.67(20)	21.67(26)	26.67(32)	35.83(43)	4
Total (N)	120	120	120	120	

NB: Numbers in parenthesis indicate number of observations
N= Number of respondents

The average souring time of milk recorded from farmers' response in Dire Inchini and Ambo was 3.66 and 3.33 days, respectively (Table 10). The time required for milk to ferment in Ambo was relatively shorter than the time required in Dire Inchini. This might be attributed to the fact that Ambo area is warmer than Dire Inchini which facilitates microbial activity for fermentation. The mean average volume of milk churned at a time in the study area was 6.15liters (Table 10). This result is slightly lower than the findings of Eyassu (2014) who reported that an average volume of 7.5liters of milk churned at a time in North Western Ethiopia. This variation might be attributed to either the variation in milk yield per cow per day or number of milking cows in these independent study areas.

The average time to complete churning in Dire Inchini and Ambo was 2.73hrs and 2.5hrs, respectively (Table 10). The longer time recorded in Dire Inchini might be due to relatively cooler temperature of Dire Inchini than Ambo which increases the churning time. O'Connor (1994) reported that as churning temperature decreases, churning time increases and vice versa.

Likewise, in the study areas, the overall average amount of milk used to produce a kg of butter was 20.74liters (Table 10). The current finding is slightly greater than the report of 18.1liters used to produce a kg of butter from North Western Ethiopia (Eyasu, 2014). This difference might be attributed to the variation in fat content of milk used for butter production from these independent study areas. In the same way, the overall buttermilk required to produce a kg of "ayib" was 13.63liters; which is much higher than the report from Eastern Wollega, with 10.2liters of buttermilk required for a kg of "ayib" production (Alganesh, 2002). This variation could be attributed to the variation of protein content of milk from these two independent study areas.

Table 10: Butter and "ayib' production in the study areas.

Parameters	Districts		Overall mean
	Dire Inchini	Ambo	
	Mean±SE	Mean±SE	Mean±SE
Average souring time (days)	3.66±0.08	3.33±0.06	3.49±0.05
Average milk churned at a time (lit.)	6.80±1.11	5.50±0.13	6.15±0.56
Duration of time to complete churning (hrs)	2.73±0.06	2.50±0.03	2.61±0.04
Volume of milk produce a kg of butter (lit.)	19.30±0.17	22.18±0.24	20.74±0.20
Volume of buttermilk produce a kg of "ayib" (lit.)	15.93±0.80	10.05±0.85	13.63±0.68

NB: Buttermilk is the milk obtained after its fat content is removed from soured milk in the form of butter.
SE = Standard Error of mean

Milk and milk products production and consumption

The estimated average milk and milk products produced per week per household is indicated in Table 11. According to respondents, milk production was heavily dependent on availability of feed, number of milking cows, and stage of lactation and genetic makeup of the cow. Accordingly, the average whole milk produced per week per household in Dire Inchini and Ambo was 13.20 and 11.28 liters, respectively with more production recorded in Dire Inchini than in Ambo. This may be due to slightly more number of milking local breed and crossbred cows and more milk production per cow per day in Dire Inchini than in Ambo. Higher average milk production (19.46liter/week/HH) was recorded in Ilu Aba Bora Zone (Teshager, 2013).This higher milk production difference might be attributed to the more number of milking cow per household and more milk yield per cow per day.

The average "ergo" produced for consumption from whole milk per week per household in Dire Inchini and Ambo was 1.64liters and 1.17liters, respectively with relatively more production recorded in Dire Inchini than in Ambo (Table 11). This might be attributed to the higher number of households recorded in Dire Inchini than in Ambo which can influence consumption level and the more volume of milk produced in Dire Inchini.

According to the respondents, the primary aim of sour milk was to produce butter, but the by-products like buttermilk, "ayib" and "aguat" were also obtained through the process. Accordingly, 9.46 liters and 8.65 liters of sour milk is used to produce an estimated average weight of 0.49kg and 0.39kg butter in Dire Inchini and Ambo, respectively with the more production recorded in Dire Inchini than in Ambo. This might be attributed to the more sour milk used for butter production and less volume of milk required for a kg of butter production in Dire Inchini

(1kg/19.31liters) than in Ambo (1kg/22.18liters). In turn, the higher volume of milk required for a kg of butter production in Ambo district is attributed to the relatively warmer temperature of Ambo than Dire Inchini which affects fat recovery. O'Connor (1994) reported that as churning temperature increases, fat recovery decreases and vice versa. Whatever, the overall average butter production in the study area were 0.44 kg/week/household. The current's finding result is much lower than 1.9kg/week/household of butter production reported from East Wolega Zone (Alganesh, 2002). The higher production recorded could be attributed to more number of milking cows owned per household and variation in fat content of milk used for butter production.

Likewise, buttermilk; 8.97liters and 8.20liters were produced in Dire Inchini and Ambo partly to produce 0.47kg and 0.92kg of "ayib", respectively. "Ayib" production was relatively higher in Ambo than in Dire Inchini from available buttermilk. This may be as "ayib" had economic importance in Ambo; they were more intended to produce "ayib" from buttermilk available. Generally, the overall mean average "ayib" production was 0.70kg/week/household (table 11).

Table 11: Estimated average milk and milk products produced/week/HH in the study areas

Products	Districts		Overall mean
	Dire Inchini	Ambo	
	Mean ± SE	Mean ± SE	Mean ± SE
Whole milk (lit.)	13.20 ± 0.48	11.28 ± 0.57	12.24 ± 0.38
Sour milk processed in to butter (lit.)	9.46 ± 0.36	8.65 ± 0.50	9.05 ± 0.31
Butter (kg.)	0.49 ± 0.02	0.39 ± 0.02	0.44 ± 0.01
***Buttermilk (lit.)**	8.97 ± 0.34	8.20 ± 0.47	9.59 ± 0.29
"ayib" (kg.)	0.47 ± 0.31	0.92 ± 0.12	0.70 ± 0.06
****Aguat (lit.)**	2.60 ± 0.17	2.48 ± 0.22	2.55 ± 0.13

* Buttermilk = is the milk obtained after its fat content is removed from soured milk in the form of butter.
** Aguat = is the liquid by-product obtained after "ayib" production and called whey.

The total estimated average milk and milk products consumed per week per household in Dire Inchini and Ambo was indicated in (Table 12) below. Accordingly, out of the produced milk and milk products, 12.42%, 11.76%, 34.10%, 48.60% and 82.85% were consumed in the form of fresh milk, "ergo", butter, buttermilk and "ayib", respectively. This indicates that, consumption of fresh milk and "ergo" (24.18%) was relatively lower than consumption of "ayib", buttermilk milk and butter. This result disagree with CSA, 2003 that reported 48.2% of the milk was consumed in fresh milk and fermented form. The interviewed farmers stated that, consumption of fresh milk and "ergo" are uneconomical and restricted to some family members like children, husband and sick persons for recovery. This indicates that, more volume of milk (73.94%) was processed in to butter after which products like buttermilk, butter and "ayib" could be used for all family members. CSA (2003) reported that, 46.6% of milk produced was processed to butter making. The finding of Teshager (2013) revealed that, out of the produced milk, 45.5% was used as fresh and sour milk and about 44% was processed in to butter in Ilu Aba Bora Zone. YONAD (2009) also found as butter could be utilized in different forms by all age groups and in addition, used for hairdressing and a skin cosmetic in Borana pastoralist area. "Ayib" consumption was higher followed by buttermilk and butter. This might be due to more amount of "ayib" produced was consumed at home and less is used for selling; especially in Dire Inchini, 100% of "ayib" produced was used for consumption as selling of "ayib" was not familiar. Again, consumption of buttermilk milk was high as its selling was unfamiliar and rather used for "ayib" production. Consumption of butter was relatively lower as compared to consumption of "ayib" and buttermilk. This was for the fact that butter fetches better price and thus sold for cash income. Lemma (2004) also reported that, in East Shewa Zone, out of the total production, around 85.7% of butter is marketed and the rest (14.3%) of the total butter produced is consumed per household per week as it is sold for cash income.

Table 12: Estimated average milk and milk products consumed/week/HH in the study areas

Products	Districts				Overall mean	
	Dire Inchini		Ambo			
	Mean ± SE	%	Mean ± SE	%	Mean ± SE	%
Fresh milk (lit.)	1.64 ± 0.10	12.42	1.46 ± 0.10	12.94	1.52± 0.07	12.42
"Ergo" (lit.)	1.64 ± 0.18	12.42	1.17 ± 0.11	10.37	1.44 ± 0.12	11.76
Butter (kg.)	0.16 ± 0.01	32.65	0.14± 0.02	35.90	0.15 ± 0.01	34.10
Buttermilk (lit.)	4.36 ± 0.24	48.61	4.96 ± 0.26	60.49	4.66 ± 0.18	48.60
"Ayib" (kg.)	0.47 ± 0.31	100	0.68 ± 0.07	73.91	0.58 ± 0.03	82.85

HH = Household

Marketing of milk and milk products

Marketable milk and milk products in the study areas were butter, fresh milk and "ayib" (table 13). Thus, in Dire Inchini, only 10% of the producers owning crossbred milking cows sell fresh milk while selling of fresh milk was not practiced in Ambo district. This could be related to the breed of milking cow owned in Ambo was local breed

and milk produced from them is not enough for both home consumption and selling. Generally, about 95% of the respondents in the study areas do not sell fresh milk arguing that there is scarcity of milk, cultural restriction to sell fresh milk and inaccessible market. According to Lemma (2004), selling of fresh milk was not common in East Shewa Zone for the same reasons. While, as butter is the best marketable commodity in the study areas, 95.83% of respondents sell butter. This finding is agreed with the finding of Mekdes (2008) who reported 96.65% sale of butter in Wolayita Zone.

To a lesser extent (by 15% of the respondents), "ayib" is sold in Ambo district and no selling is practiced in Dire Inchini. This variation might be relatively more demand of "ayib" in Ambo district at different hotels and consumer levels which attracts producers of nearby town. So in general, 7.50% of the respondents sell "ayib" in the study area. This finding is not agreed with 77.50% of respondents selling "ayib" in Wolayita Zone (Mekdes, 2008). This difference may be attributed to the variation in demand of "ayib" at markets' of these independent study areas which could attract producers to produce and sell it.

Table 13: Selling pattern of milk and milk products

Products	Districts				Overall	
	Dire Inchini		Ambo			
	N	%	N	%	N	%
Fresh milk	6	10	-	-	6	5.00
Butter	55	91.67	60	100	115	95.83
"Ayib"	-	-	9	15	9	7.50

N= Number of respondents selling milk and milk products.
% = percentage of respondents selling milk and milk products

Even though fresh milk, butter and "ayib" were produced and marketed in the study areas, they not equally marketed (Table 14). Accordingly, out of 12.24litres of whole milk produced/ week/HH, 0.23litre (1.88%) was sold. Similarly, out of 0.44kg of butter produced/week/HH, 0.29kg (65.91%) was sold. Likewise, 0.7kg of "ayib" was produced/week/HH, out of which 0.12kg (17.14%) was sold. Thus, the only marketed milk and milk products were butter (65.91%), "ayib" (17.14%) and fresh milk (1.88%).The variation occurred in marketability between these products might be attributed to the variation in price and demand at market. According to Lema, (2004), out of 1.4kg of butter produced/week/HH, about85.7% was marketed/week/HH in East Shewa Zone. This variation could be attributed to the variation in amount of butter produced and demand at market at these independent study areas.

Table 14: Estimated average milk and milk products sold/week/HH in the study areas

Products	Districts				Overall	
	Dire Inchini		Ambo			
	Mean ± SE	%	Mean ± SE	%	Mean ± SE	%
Fresh milk (lit.)	0.46 ± 0.22	3.48	-	-	0.23 ± 0.01	1.88
Butter (kg.)	0.34 ± 0.02	69.39	0.23 ± 0.01	58.97	0.29 ± 0.01	65.91
"Ayib" (kg.)	-	-	0.24 ± 0.05	26.09	0.12 ± 0.02	17.14

According to respondents, price of milk and milk products in the study areas vary with seasons and occasions (Table 15). Thus, during dry season and festivals, price of milk and milk products is higher and significantly different ($P<0.05$) from prices at wet season and fasting time. The relatively higher price of dairy products during dry season and festivals could be different reasons including; during dry season, milk production is very low due to scarcity of green pasture and using of supplementary feed is not common, and thus supply of milk and milk products is low and the price increase. While during festivals, demand for all dairy products increases which leads its price to increase. Nevertheless, during wet season, as milk production is relatively high, relatively it satisfies the market demand and price will not be as such high. Likewise, during fasting time, demand for dairy products is low which lowers its price too. Mekdes (2008) also reported, as the price of dairy products during dry season and festivals is relatively higher than the prices at wet season and fasting time due to the lower supply and higher demand of dairy products during dry season and festivals, respectively in Wolayita Zone. Therefore, when price of milk and milk products are low at market, producers are more intended to process and preserve butter in different forms. This study is in line with the finding of Alganesh, (2002) who reported that butter produced during wet season and fasting period is either sold at lower prices or preserved for later use.

Table 15: The total average prices of milk and milk products (in birr) at different seasons and occasions in the study areas

Products	Seasons and occasions			
	Dry season Mean± SE	Wet season Mean± SE	Festivals Mean± SE	Fasting periods Mean± SE
Fresh milk (birr/lit)	10 ± 0.41^{a}	7.50 ± 0.29^{b}	10 ± 0.82^{a}	8.75 ± 0.48^{ab}
Butter (birr/kg)	153.56 ± 1.29^{a}	117.58 ± 1.48^{c}	156.27 ± 1.21^{a}	132.29 ± 1.43^{b}
"Ayib" (birr/kg)	45.00 ± 2.89^{a}	20.67 ± 2.33^{b}	43.33 ± 1.67^{a}	21.67 ± 1.67^{b}

Means within the same row that bear different letters as superscripts are significantly different at ($P<0.05$).
SE = Standard Error of mean

Butter preservation and its shelf life

Butter produced by farmers in the study areas at different seasons and occasions were either sold or preserved and stored in different forms. During dry season, non-fasting and different festivals, butter had high demand; thus more of it is sold; but only small proportion is preserved. But, at wet season and fasting time, as butter demand is relatively low, more of butter produced is preserved and stored in different forms. Therefore, producers commonly preserve butter in the form of traditional ghee (100%) and mixing with spices (98.33%); which is done by mixing fresh butter with powdered spices. While, less than half of the respondents use melting butter (29.17%); which is done by melting butter on slow fire until foaming stops, cooled overnight and made free of excess water and any residual matter. Relatively, the less commonly used technique (11.67%) was salting butter (Table 16), which is done by thoroughly mixing fresh butter with salt. This salted butter can be sold and also used for further processing. Traditional ghee is done by boiling butter contained in a clay pot or pan on a slow fire until foaming stops along with adding powdered spices, after which the pan is removed from the fire to cool and sieve with "qaancaa", a by-product obtained during "enset" processing. For traditional ghee making, fresh butter, spiced butter, melted and salted butter are the bases. The same techniques of butter preservation were reported by Alganesh (2002) in East Wollega Zone of Oromia region. Spiced butter and traditional ghee are alternative methods of butter preservation techniques in North Western Ethiopia (Eyassu, 2014).

Table 16: Methods of butter preservation in Dire Inchini and Ambo districts.

Techniques	Districts				Overall mean (N=120)	
	Dire Inchini (N=60)		Ambo (N=60)			
	N	%	N	%	N	%
Traditional ghee	60	100	60	100	120	100
Mixing with spices	58	96.67	60	100	118	98.33
Melting	20	33.33	15	25	35	29.17
Salting	8	13.33	6	10	14	11.67

N = Number of respondents

According to the respondents in the study areas, butter preserved through different techniques had different shelf life (Table 17). Traditional ghee has the longest average shelf life followed by spiced, salted and melted butter in the study districts. The shelf life of butter preserved in Dire Inchini with same techniques had longer shelf life than butter preserved in Ambo. This could be related to the cooler temperature of Dire Inchini than Ambo that could retard the microbial growth in butter. The mean average shelf life of traditional ghee and melted butter (7.49 months and 3 months), respectively was lower than (11.10 months and 3.70 months) for butter preserved with the same technique at East Wollega Zone (Alganesh, 2002). But, the overall mean average shelf life of spiced and salted butter (4.97 months and 4.22 months), respectively was greater than (2.80 months and 3.70 months) for butter preserved with the same technique in East Wollega. According to Eyassu (2014), the average shelf life of butter preserved with traditional ghee and spiced butter was 19.2 and 11.4months, respectively in North Western Ethiopia.

Table 17: Shelf life (in months) of butter preserved through different techniques in the study areas

Products	Districts		Overall
	Dire Inchini	Ambo	
	Mean ± SE	Mean ± SE	Mean ± SE
Traditional ghee	7.75 ± 0.33	7.25 ± 0.26	7.49 ± 0.21
Spiced butter	5.02 ± 0.32	4.93 ± 0.30	4.97 ± 0.22
Salted butter	4.75 ± 0.48	3.80 ± 0.66	4.22 ± 0.43
Melted butter	3.08 ± 0.15	2.91 ± 0.16	3.00 ± 0.11

In the study areas, producers argued that, there are different causes for butter spoilage (Table 18). Out of the interviewed farmers, 34 (56.67%) and 49 (81.67%) of them reported butter spoilage in Dire Inchini and Ambo, respectively. The more incidence of butter spoilage seen in Ambo could be related to warmer climate which

facilitates microbial activity for spoilage. In the study areas, the overall producers responded to butter spoilage was 69.17%, out of which 34.94, 28.91, 19.28 and 16.87% of them sated cause of butter spoilage as; methods of preservation, length of storage, handling systems and type of storage materials, respectively. Farmers argued that, preserving butter in the form of traditional ghee is more preferable as water is exhaustively removed during processing and spices added also retards microbial growth. The effect of these spices against the microbial growth needs further investigation. According to Alganesh (2002) and Eyassu (2014), butter preserved in the form of traditional ghee had more shelf stable than butter preserved with any other methods in Eastern Wolega and Ilu Aba Bora Zone, respectively. The respondents in the areas reported that, the longer the storage times the more spoilage butter and "ergo". Likewise, they argued that, the way of handling the preserved butter determines the rate of spoilage. In this case, they reported the container of treated butter should not allow air to enter and need to be closed securely. Again, the container of butter should be placed at relatively cooler area of the house. Furthermore, the farmers argued that, materials used to store treated butter should be selected purposely. In doing so, farmers in the study area use small sized clay pot as it relatively cools and allow butter storage for longer period of time. The finding of (Mekdes, 2008) also showed that, farmers selectively use treated butter storage material for longer shelf life.

Table 18: The prevalence of butter spoilage and its cause in the study areas

Sources of variation	Districts		Overall (N = 120)
	Dire Inchini (N = 60)	Ambo (N = 60)	
Methods of preservation	13 (38.24)	16 (32.65)	29 (34.94)
Length of storage	10 (29.41)	14 (28.57)	24 (28.91)
Handling systems	7 (20.59)	9 (18.37)	16 (19.28)
Type of storage materials	4 (11.76)	10 (20.41)	14 (16.87)
Total	34 (56.67)	49 (81.67)	83 (69.17)

N = Number of respondents to cause of butter spoilage

Numbers under parenthesis indicate percentages of respondents to cause of butter spoilage

Traditional ghee making and consumption

For traditional ghee making, farmers in the study areas follow some steps along adding different types of spices (Table 19). According to the respondents, to make ghee, cleaned saucepan made of either metal or clay pot containing butter is put on an open slow fire to melt. At this stage, butter preserved in the form of spiced butter, melted butter, salted butter and fresh butter can be used. Until foam forming stops, melting process continuous along with adding powdered spices. After foam forming stopped, the saucepan is taken out of the fire and allowed to cool, after which liquid fat is cleaned of unnecessary materials with sieve or piece of clean cloth through pouring in to other clean equipment. Similar procedure was identified at different part of Ethiopia by Alganesh (2002); Lemma (2004); Mekdes (2008) and Eyassu (2014). For Traditional ghee making, farmers use combination of different spices mainly for the purpose of adding good aroma to butter and increase its shelf life and to make butter tastier. Joe *et al*. (2009) also stated that spices are used to enhance aroma and flavor for preservation of food substances. Spice used depends on availability and individual preference even within the same area. The amount of spice used per unit weight of butter is done by guessing. Accordingly, "habasuuda adii" (*Trachyspermum ammi),* "habasuuda gurraacha" *(Nigella sativa),* "ogiyoo" *(Aframomum angusti-folium)* and "abishii" *(Trigonella foenum)* are commonly used as spices for traditional ghee making. "Abishii" (*Trigonella foenum)* and "habasuuda gurraacha" (*Nigella sativa)* are also commonly used for spiced butter making. The findings of Lemma (2004) and Mekdes (2008) also showed that, *Trachyspermum ammi, Nigella sativa* and *Aframomum angusti-folium* are the most commonly used spices in Wolayita Zone and West Shewa Zone, respectively. Traditional ghee prepared in this form is not used for marketing; rather, it is used for home consumption in sauce, coffee, "caccabsaa" which is prepared from bread especially made from "teff", "Unkuroo" made from enset, and roasting coffee beans called "buna qalaa" for special traditional ceremonies. Similarly, Alganesh (2002) found the use of butter in ghee form to be utilized in different type of sauce, drunk with coffee and for roasting coffee bean in East Wollega Zone.

Table 19: Types of spices and estimated amounts used per a kg of butter during spiced butter and ghee making in the study areas

Local name	Scientific name	Purpose	Dire Inchini (N=60)		Ambo (N=60)		Overall (N=120)	
			N	Amount (g)	N	Amount (g)	N	Amount (g)
Habasuuda adii	*Trachyspermum ammi*	For ghee	60(100)	30	60(100)	50	120 (100)	40
Habasuuda gurraacha	*Nigella sativa*	For ghee	60(100)	20	60(100)	30	120(100)	25
Ogiyoo	*Aframomum angusti-folium*	For ghee	48(80)	35	50(83.33)	45	98(81.67)	40
Abishii	*Trigonella foenum*	For ghee	49(81.67)	20	36(60)	30	85(70.83)	25
Jinjibila	*Zingiber officinale*	For ghee	26(43.33)	15	45(75)	25	71(59.17)	20
Qullubbii adii	*Allium sativum*	For ghee	23(38.33)	20	38(63.33)	20	61(50.83)	20
Irdii	*Curcuma domestica*	For ghee	-	-	3(5)	5	3(2.5)	5
Qarafaa	*Cinnamomum verum*	For ghee	2(3.33)	5	1(1.67)	3	3(2.5)	4
Dimbilaala	*Cordiandrum sativum*	For ghee	1(1.67)	5	-	-	1(0.83)	5
Qullubbii diimaa	*Allium cepa*	For ghee	2(3.33)	10	1(1.67)	15	3(2.5)	12.5
Qundeberbere	*Piper nigrum*	For ghee	1(1.67)	5	1(1.67)	10	2(1.67)	7.5
Abishii	*Trigonella foenum*	Spicing	60(100)	35	56(93.33)	25	116(96.67)	30
Habasuuda gurraacha	*Nigella sativa*	Spicing	51(85)	5	53(88.33)	15	104(86.67)	10

N = Number of respondents using particular spices
Numbers under parenthesis indicate percentage of respondents using particular spices

Constraints and opportunities of milk and butter production

The major constraints of milk production in the study area was feed scarcity, low productivity of animals, labor scarcity for herd management and animal diseases (Table 20). Farmers stated that, low quantity and quality of feed available for animals especially during dry season is the major constraint for milk production. As they argued that, less grazing land left from crop production. In addition, they argued that, industrial by-products are costly and inaccessible to feed milking cow. Similarly, low productivity of animal; resulting from poor genetic makeup was also the second major constraints. Likewise, farmers stated that, labor scarcity for any management activity required for animals limit farmers to keep more milking cow for more milk production. Disease outbreak like black leg, Bovine pasteourelosis and internal and external parasites at some seasons were also taken as the fourth major constraints for milk production. Farmers said that, if an animal caught by disease at any stage of lactation, she stayed with great reduction in milk production. Solomon *et al*. (2014) reported constraints of milk production in their order of importance as feed shortage, disease, lack of capital, water and labor scarcity in Metekel Zone. Disease prevalence was set in second order according to this authors; this may be due to relatively high temperature in Metekel Zone which facilitates disease outbreak. Mekdes (2008) also reported shortage of feed, lack of improved cattle breed and disease prevalence as the major constraints of milk production in Wolayita Zone. Therefore, extension services need to promote in improved feed and feeding management, genetic makeup and health status of animals.

Likewise, according to farmers, the major constraints of milk processing and butter production in the study area were low milk production, low fat recovery, non-uniform fermentation and delay fermentation in their order of importance (Table 20). Farmers said that, low milk produced resulted from small milking cows and low milk yield per cow was the primary constraint for butter production. Similarly, farmers also stated that, low fat recovered from available milk was the second major constraint for butter production. This indicates that, loss of butter in buttermilk was high. Gonfa, *et al.* (2001) also stated that fat recovery is an important factor determining the efficiency and profitability of smallholder dairy enterprises in the Ethiopian highlands. The study done at Wolayita Zone also found low milk yield and lack of improved churn as the major butter production constraints (Mekdes, 2008).

Milk and milk products' marketing is also constrained by many factors including low price, price fluctuation over time, lack of collection center and un-assessable to the market in their order of importance (Table 20). Respondents argued that price of milk and milk products do not match to the input required and farther its fluctuation over time depending on seasons and occasions. Mekdes (2008) also reported as low price, price fluctuation over time and lack of collection center constrained marketing of milk. Therefore, in that case, farmers prefer to process the product and store by treating traditionally. Likewise, for the un-assessable products to the market, they stated the possibility to combat through establishing collection center.

In case of milk and milk products consumption, producers said that some of milk and milk products are quickly perishable to consume and its availability in small amount also constrained the consumption level (Table 20). In that case, producers need to process the milk in to the more stable products like "ergo", butter and cheese as per required and simultaneously use the byproducts commonly in case of small milk available.

Table 20: Ranked constraints of milk and butter production in Dire Inchini and Ambo

Constraints	Ranks of constraints (%)				
	1st	2nd	3rd	4th	5th
Milk production					
Feed scarcity	78.33	15	7.50	-	-
Low productivity of animal	10.83	29.17	26.67	15	9.17
Labor scarcity	3.33	15	35	18.33	17.50
Disease	5.83	27.50	11.67	35	19.17
Others	1.67	13.33	19.17	31.67	54.17
Milk processing and butter production					
Low milk produced	48.33	21.67	15.83	13.33	
Low fat recovery	18.33	30.83	25.83	24.17	
Non-uniform fermentation	18.33	22.50	31.67	28.33	
Delayed fermentation	15	25	26.67	34.17	
Milk and milk products marketing					
Low price	63.33	22.50	13.33	6.67	-
Price fluctuation over time	18.33	46.67	33.33	12.50	-
No collection center	18.33	25.83	39.17	19.17	-
Un-accessible to market	-	5	14.17	61.67	-
Milk and milk products consumption			-	-	-
Perishable	57.50	43.33	-	-	-
Small	42.50	56.67	-	-	-

% = Percentage of respondents
Others = include; water scarcity, shortage of lactation length, delay of calving interval and delay of average age at 1st calving

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY AND CONCLUSIONS

In the study areas, number of cattle per household and herd composition depends on feed availability, manpower, economic level and purpose of keeping. Thus, the overall mean of cattle/household in the study area was 7.53.
The overall mean average daily milk yield (lit/day/cow), lactation length (days), calving interval (yrs) and age at first calving (yrs) for local breed and crossbred cows were estimated to be (0.99 and 4.08), (224.84 and 280.83) and (1.45 and 1.92), respectively.

During milking, respondents perform substandard sanitary procedures and thus, 86.70% of the respondents wash milking equipment and their hand and smoke the equipment before milking. Likewise, around 40% of the respondents wash udder before milking and the rest (60%) do milking allowing calve to suckle first which assists in milk letdown and cleaning the udder.

In the study areas, plants and/herbs commonly used for cleaning milk equipments are “shokonota”, “masarata”, “Altufa”, “Xoosanyii” and “Kusaayee”. Likewise, “Qadiidaa” and “Ejersa” are commonly used for fumigating milk equipments. Respondents are aimed to clean and fumigate milking equipments for good aroma and good test of the products, to increase shelf life and facilitate milk fermentation.

About 95% of the respondents use woven grass for milking, the rest (5%) use plastic materials. About 60.83 and 15% of the respondents use clay pot and gourd, respectively to ferment milk. The rest (24.17%) use plastic materials. Similarly, 100% of the respondents use clay pot for churning fermented milk. Butter is usually stored in small clay pot (75%), plastic materials (15%) and cans (10%).

In the study areas, milk processing is common, because of scarcity of milk, to increase shelf life of the products and diversify the products and to generate better income in their order of importance.

The average milk churned at a time in the study areas was 6.15litres. According to respondents, the mean volume of milk required to produce a kg of butter is20.74lit.

The mean average whole milk produced/week/household in the study areas was 12.24litres, out of which 1.52litres (12.42%), 0.23litre (1.88%), 1.44(11.76%) and 9.05litres (73.94%) are consumed at fresh, sold at fresh, consumed in “ergo” form and processed in to butter, respectively. Similarly, the mean average butter produced/week/household in the study areas was 0.44kg, out of which 0.15kg (34.10%) and 0.29kg (65.91%) are consumed and sold, respectively.

Marketed products are butter (65.91%);“ayib” (17.14%) and fresh milk (1.88%) and their price vary with seasons and occasions. When price of milk and milk products are low at market, producers are more intended to process and preserve butter traditionally in the form of traditional ghee (100%), spicing (98.33%), melting (29.17%) and salting (11.67%).

To make traditional ghee; *Trachyspermum ammi, Nigella sativa, Aframomum angusti-folium, Trigonella foenum, Zingiber officinale and Allium sativum* are the commonly used spices .For spiced butter, *Trigonella foenum* and *Nigella sativa* are the commonly used spices. Depending on environmental temperature, butter

preserved through traditional ghee has the longest average shelf life followed by spiced, salted and melted butter.

The major constraints of milk and butter production, processing and marketing in the study areas are scarcity of feed, low milk produced, low fat recovery, low price and price fluctuation over time and lack of collection center.

As a conclusion, Out of the produced milk, around 73.94% is processed in to butter and the mean volume of milk required to produce a kg of butter is 20.74liters and the mean average butter produced/week/HH was 0.44kg, out of which 34.10 and 65.91% are consumed and sold, respectively. Similarly, the mean average "ayib" produced/week/HH was 0.7kg, out of which 82.85 and 17.14% are consumed and sold, respectively. Thus, the only marketed products are butter (65.91%), "ayib" (17.14%) and fresh milk (1.88%). To store butter, small clay pot (75%), plastic materials (15%) and cans (10%) are usually used. Even though some farmers perform substandard sanitary procedures to reduce contamination during milking, processing and handling of milk and milk products, others do not give considerations even. In addition, traditional butter preservation methods identified are traditional ghee (100%), spicing (98.33%), melting (29.17%) and salting (11.67%) and to make traditional ghee, *Trachyspermum ammi, Nigella sativa, Aframomum angusti-folium, Trigonella foenum, Zingiber officinale* and *Allium sativum* are the commonly used spices. Preserving butter through traditional ghee and spicing is more effective than salting and melting.

The major constraints of milk and butter production, processing and marketing in the study areas are scarcity of feed, low milk produced, low fat recovery, low price and price fluctuation over time and lack of collection center.

RECOMMENDATIONS

Depending on the findings, the following recommendations were made:

It was found that farmers in the study area practice substandard sanitary procedures during milking, storing, processing, handling and transport of milk and milk products to market, which leads to quality deterioration and shortened shelf life. Therefore, producers/farmers should consider all possible hygienic milk and milk products production and processing practices to produce quality milk and milk products.

The hygiene of spices, herbs and/plants and salt used to preserve butter should be kept to reduce contamination of butter.

Through agricultural extension services, awareness creation on the economic significance of efficiently marketing milk and milk products and establishment of cooperatives on milk and milk products' production, processing, collection and marketing need to be initiated.

Traditional ghee and spicing were more efficient in preserving butter against quality deterioration and thus, further investigation should be initiated on the appropriate application level of spices and plants/herbs per unit weight of butter for the adoption of these techniques.

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