Contribution of Dairy Products to Farm Household Nutrition in Addis Ababa and Hawassa-Dilla Milk Sheds in Ethiopia

Dereje Duressa[1*], Sintayehu Yigrem[2], Yetenayet B. Tola[3], and Taye Tolemariam[4]

[1*]Department of Postharvest Management, Jimma University, Ethiopia

[2]School of Animal and Range Sciences, Hawassa University, Ethiopia

[3]Department of Postharvest Management, Jimma University, Ethiopia

[4]Department of Animal Science, Jimma University, Ethiopia

Abstract

Background: Consumption of traditional dairy products is a common practice in Ethiopia. However, there are limited evidences that show factors that may attribute to differences to the contribution of dairy products to family nutrition. A desegregation of factors by intra-household factors, farming systems, and milk sheds are necessary.

Objective: This study was aimed at assessing the contribution of dairy products to household nutrition, and also compared the two major milk sheds in Ethiopia, namely, the Addis Ababa and Hawassa-Dilla.

Materials and Methods: A cross sectional household survey was conducted in two purposively selected districts from each of the two milk sheds (Wachale and Angolela Tera districts from Addis Ababa) and Arsi Negelle and Dalle districts from Hawassa-Dilla). Four kebeles (the smallest administrative units) from each district were selected, followed by a random selection of 320 farm households owning dairy cows. The survey was conducted using semi-structured questionnaires.

Results: The study revealed that the two milk sheds were significantly ($P < 0.001$) different in the amounts of milk produced at the household level. In Hawassa-Dilla milk shed the proportions of milk used for family consumption and home processing were 29.50% and 42.70%, respectively. However, in the Addis Ababa milk shed, 66.54% of the milk produced was sold out as raw milk. Households at Wachale (15%), Angolela (18.8%), and Dale (10.3%) districts ranked dairy products, crop-based foods, and a combination of both as the essential food groups to the family food, respectively. About 21.6% and 11.9% of the households in Addis Ababa and Hawassa-Dilla milk sheds, respectively, had year-round access to milk and dairy products for household consumption. Milk is most commonly given to children under five-years of age in both milk sheds. Other foods sourced from animals such as beef, fish, chevon, poultry were consumed rarely and appeared only on certain occasions and holidays.

Conclusion: This study has demonstrated that dairy products are the most commonly consumed Animal Source Foods (ASFs) by the farm households in both milk sheds, which is an integral part of the food groups. Keeping the intra-household and district level differences, it was observed that the Addis Ababa milk shed is more accessible to raw milk markets; hence the proportion of milk sold out as raw milk is higher, and the proportion of milk that is traditionally processed into other dairy products is much less than that from farmers in the Hawassa-Dilla milk shed. The information generated in this study will help stakeholders to design a program that can best balance between market access/family income and family nutrition in the two milk sheds.

Keywords: Animal sourced food; Dairy product; Milk consumption; Ethiopian traditional dairy products

*Corresponding author: derejeduresa@gmail.com

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1. Introduction

The livestock sector makes up 40% of Ethiopia's agricultural gross domestic product and 27% of its national GDP (Shapiro *et al.,* 2017). Under the Ethiopian condition, dairy production is an integral component of animal production in various farming systems providing food and nutrition security, income generation, organic fertilizer, and draught power source (Kebebe Ergano, 2019). The total cattle population of Ethiopia is estimated at 65.35 million heads, of which female cattle constitute 55.90% (CSA, 2020). According to the same source, the total milk production was estimated at 4.2 billion liters. This amount of milk is too low for the current human population of Ethiopia, and hence the per capita milk consumption is much lesser than the world and sub-Sahara countries average figures of 84 liters and 36 liters, respectively. Even if the total cattle population of Ethiopia has been rising over the years, the per capita cattle holding has been reducing substantially. According to the 2020 estimate majority (4,817,176 households) keep 1 to 2 heads of cattle and 4,499,849 households keep 3 to 4 heads of cattle.

Milk is considered a nutrient-dense food, providing essential nutrients to humans. Important nutritional contents of milk and milk products include fat, protein, lactose, calcium, potassium, phosphorus, vitamin A, vitamin B12, riboflavin, niacin (or niacin equivalents), and vitamin D (Miller *et al.,* 2007). In response to an increasing population, urbanization, rising income, and emerging middle-class society, the demand for livestock products is rising in Ethiopia (Francesconi and Heerink, 2011).

The report of the Ethiopian Academy of Sciences indicates that shortage of animal-sourced foods, particularly milk has a negative consequence in the process of child growth and ultimately building a productive workforce that plays pivotal roles in the country's economic development (EAS, 2013). In Ethiopia, there is strong evidence on the link between the consumption of ASF (Animal Source Foods), notably milk, and improved nutritional outcomes among children (Hoddinott *et al.,* 2015; Sadler and Catley, 2009). In many developing countries in which staple foods dominate the composition of diets, a higher consumption of animal-sourced foods is associated with noticeable nutritional benefits (Fantu Bachewe *et al.,* 2017). Most of the milk produced by Ethiopian farmers is consumed at the household level in fresh or fermented forms. Popular Ethiopian fermented dairy products made using traditional methods include spontaneously fermented milk curd, butter, ghee, and cottage cheese), *hazo* (spiced fermented buttermilk), *arera* (defatted sour milk), and whey water (Tesfamariam Berhe *et al*., 2017).

Small-scale livestock holders supply the vast majority of milk and dairy animals that provide household food security which are a means of fast returns for them (FAO, 2013). Milk and fermented dairy products have a long history of use, as far back as the seventh millennium BC (Evershed *et al.,* 2008). The long-standing culture of dairy product consumption in Ethiopia indicates the importance and potential of dairying in the country (Azage Tegegne *et al*., 2013). However, variations may occur among the milk sheds due to the socio-cultural set-ups of the society and agro-ecological conditions, which affect the farming systems. As a nutrition, livestock products in general and dairy products in particular support the livelihood of a family by complementing other farm products. Nevertheless, the contributions of dairy products as compared to other animal source foods (ASFs) and crop-based foods (CBFs) were not well explored especially at household level. In the absence of such information, smallholder producers might not give sufficient emphasis to their dairy animals and dairy products.

According to Wytze *et al.* (2013), about 98% of milk comes from smallholder farmers that constitute about 85% of the country's population. Of all livestock products, the share of dairy products is the highest. Overall, 70% (national level) of the milk consumed in Ethiopia is sourced from own farms, but there exists a great difference between rural and urban dwellers. Only 14.5% of urban dwellers source milk from their farms, while 80% of dwellers in rural settings produce and consume milk from their farms. Therefore, milk plays a great role in family nutrition, notably to children. A study by Sintayehu Yigrem *et al.* (2015) has shown the associations between milk production/consumption and the nutritional status of children in farm households.

The nutritional contribution of animal-sourced foods, in general, is indisputable. However, there is limited evidence that shows factors that may attribute to differences in the contribution of dairy products to family nutrition. Desegregation of factors by intra-household factors, and by farming systems and milk sheds are necessary. If the disaggregation is done, useful information could be generated to design specific development and nutrition intervention programs across the milk sheds. In addition, exploring such evidences at household level will help the producers and consumers

had better understand the nutritional outcomes of dairy products. The present study was designed to answer the research question "how do milk and dairy products contribute to family nutrition of farm households in the two milk sheds"? Therefore, this study was aimed at assessing and analyzing contributions of dairy products to household nutrition and compared the Addis Ababa and Hawassa-Dilla milk sheds.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted between December 2018 to February 2019, in four districts selected from two major milk sheds in Ethiopia. Angolela Tera and Wachale districts are from the Addis Ababa milk shed whereas Arsi Negelle and Dale districts are from the Hawassa-Dilla milk shed. The districts were selected purposively due to their potential for dairy production. The assessment report of Wytze *et al.* (2013) indicated that Addis Ababa (North Shewa) and Hawassa-Dilla milk sheds were ranked first and third, respectively, for the milk value chain and sector development objectives of the country. This was the reason why the two milk sheds were selected for this study.

Angolela Tera district is located in the North Shewa Zone of Amhara National Regional State, situated at the distance of about 120 km from Addis Ababa in the northerly direction between 9° 38' 0" North latitude and 39° 26' 0" east longitude. The altitude of the district ranges between 1,700 and 3,044 meters above sea level. According to the population projection for 2017, the district has a total population of 95,476 of which 47,516 were females and 47,960 males; and 89,638 were rural inhabitants (CSA, 2013). There are 19 rural and one urban kebeles in the district.

Wachale district is one of the districts in the North Shewa zone of Oromia National Regional State. It is located between 9° 24' 59.99" North latitude and 38° 49' 59.99" East longitude at the distance of about 78 km from Addis Ababa in the northerly direction on the main road to Fiche, the capital of the zone. The altitude of the district ranges from 1200 to 2880 meters above sea level. The census report projected for 2017 (CSA, 2013) showed that Wachale district has a total population of 124,126 of whom 61,902 were men and 62,224 were women; and 116,268 of its population are rural inhabitants. The district has 24 rural and one urban kebeles. Both Angolela and Wachale districts are characterized by highland agro-climatic conditions.

Arsi Negelle is one of the districts in the West Arsi Zone of Oromia National Regional State located at the distance of about 25 km from Shashamane, the capital of the zone in the Central Rift Valley region of the country. The district is located between 7.15°N to 7.75°N latitudes and 38.35°E to 38.95° E longitudes at an altitude range between 1500 to 3000 meters above sea level. According to the projected census report for 2017, the Arsi Negelle district has an estimated total population of 337,918 of which 166,162 are male, and 171,756 are females (CSA, 2013). Maize and wheat are the dominant crops grown in the district. Both rural and urban residents, playing a vital role in the people's livelihood, rear all livestock classes, including poultry. The district has 43 rural and three urban kebeles.

Dale is one of the districts found in the Sidama Regional State, which is located at the distance of about 40 km from Hawassa towards southerly direction. The district is located between 6° 50' 30" to 6° 39' 30"North latitude and 38° 17' 0" to 38° 32' 0" East longitude at an elevation ranging from 800 to 2600 meters above sea level. According to the national census report projected for 2017, Dalle district has a total population of 317,246 (male = 50.31% and female = 49.69%) of which 252,739 (79.67%) dwells in the rural parts of the district (CSA, 2013).

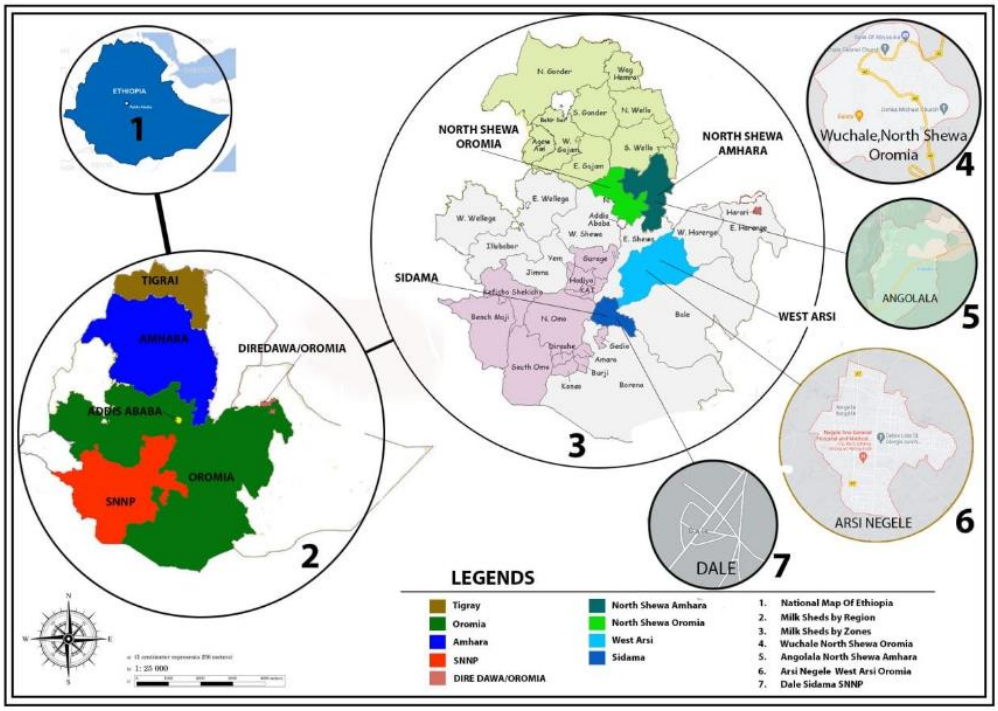

Figure 1. Map of the study districts in Addis-Ababa and Hawassa-Dilla Milk sheds.

2.2. Study Design and Data Collection

A cross-sectional survey was employed for this study. A pre-tested semi-structured questionnaire (translated into the local languages of *Afaan Oromoo*, Amharic and *Sidamu affoo*) was used. Both quantitative and qualitative data were collected through a face-to-face interview. The collected data included socio-economic characteristics, the quantity of daily milk production and utilization, the importance of the major food groups, the relative abundance of dairy products and other animal source foods in family nutrition, animal source foods commonly consumed with crop-based-foods, frequency of consumption of animal source foods.

Moreover, interviewed households ranked the utilization of dairy products by family members. Finally, the main reasons for the traditional processing of milk at the household level were listed and ranked by farmers. Ranking of the importance of major food groups was based on the food type preferred in terms of its nutritional importance as compared to other food items. Abundance dairy products were to be compared with other animal source foods (beef, chevon, chicken, eggs, and fish) in terms of quantity in a given family food. Questionnaires were pilot-tested before the actual data collection, by well-trained enumerators.

2.3. Sampling Procedure and Sample Size

A total of 16 kebeles (the lowest administrative units) were randomly selected, from where twenty households were selected from each kebele using a systematic sampling technique by applying interval sampling procedure (Kothari, 2004):

$$i^{th} = \frac{N}{n}$$

Where, i = sampling interval, n = sampling units (20), and N = population (households owning cows).

Using this equation, the total number of households owning milking cows (N) was obtained from the fresh list of each kebele and divided by 20 to get the lists by interval (*i*). Then the first sample (individual) was randomly selected from the first (i) households and then after, every i^{th} individual was automatically included in the sample selection of each kebele. On this basis, twenty households were selected from each of the sixteen kebeles, making 320 households for primary data collection.

2.4. Data Analysis

Data were analyzed using IBM SPSS Statistics version 23 computer software (IBM Corp., 2016). The results of the survey data were summarized using descriptive statistics (frequencies, means percentages). Pearson chi-square test was applied to identify significant differences among the groups (milk sheds and study districts) concerning categorical variables. Mean differences between the quantitative variables for the two milk sheds were tested using Independent Samples T-tests. Data for ranked variables were analyzed and presented using the Ranking index (RI) formula (Musa *et al.,* 2006).

3. Results and Discussion

3.1. Socio-economic and Demographic Characteristics of Households

Socio-economic and demographic characteristics of the households are presented in Table 1. Family size showed a significant ($P < 0.05$) difference between the two milk sheds. The overall average family size (6.31) of the two milk sheds was higher than the national average of 4.7 (CSA, 2020). Overall, the interviewed household heads had an average age of 44 years, which is between that of Mi'eso (39.7) and Shashemene (51.9) average ages in years as reported by Azage Tegegne *et al.* (2013). In addition, other continuous variables namely land holding, cattle holding, number of lactating indigenous and crossbreed cows showed highly significant ($P < 0.001$) differences between the two milk sheds.

Households in both milk sheds kept mixed herds of local and improved breeds. The average number of heads of cattle held by households in the Addis Ababa milk shed (7.45 ± 0.35) was significantly higher than the number of heads of cattle held by Hawassa-Dilla milk shed (with 4.98 ± 0.29). Similarly, a highly significant ($P < 0.001$) numbers of lactating crossbred cows (1.84 ± 0.10) were owned by households of Addis Ababa milk shed. Amanuel Asefa (2014) reported an average holding of crossbred cows of Sululta, Welmera, and Berek as 2.81, 2.3, and 0.94, respectively, which is lower than the current findings. The variations might be attributed to the increasing demand for dairy products which might have in turn led household to having more exotic dairy animals. The relatively higher number of crossbred cows in the Addis Ababa milk shed might be attributed to factors such as the suitability of the area in terms of climate and market.

Grade 5–8 is the maximum educational level attained by most of the households in both milk sheds. However, the study by Habtamu Didanna *et al.* (2017) showed that about 50.5% of studied households in Ada'a district attained the level of secondary education. Among the demographic variables, religion and educational status of households showed highly significant ($P < 0.001$) differences between the two milk sheds. The majority of households were male-headed with 80.63 and 78.75% for Addis Ababa and Hawassa-Dilla milk sheds, respectively. The largest majority of households in the Addis Ababa milk shed were members of the Ethiopian Orthodox Tewahido Church whereas the majority of households in the Hawassa-Dilla milk shed are members of the Protestant (Evangelical) Churches or followers of Islam. This difference in religion has implications for the consumption of animal-sourced foods. The Ethiopian Orthodox Tewahido Church has over 200 days of fasting days in a year, notably fasting animal-sourced foods including milk.

Table 1. Socio-economic and demographic characteristics of households in Addis Ababa (A.A.) and Hawassa-Dilla (H-D) milk sheds.

Characteristic	A.A. milk shed (n = 160)	H-D milk shed (n = 160)	T-test	Overall (N = 320)
	Mean (± SE)	Mean (± SE)	p-value	Mean (± SE)
Household head's age (years)	44.20 ± .83	44.89 ± 1.03	0.599^{ns}	44.55 ± 0.66
Family size (heads)	6.04 ± 0.18	6.59 ± 0.19	0.041*	6.31 ± 0.13
Landholding (hectare)	2.69 ± 0.17	1.22 ± 0.08	0.001***	1.95 ± 0.10
Cattle holding (heads)	7.45 ± 0.35	4.98 ± 0.29	0.001***	6.21 ± 0.24
Lactating indigenous cows (heads)	0.43 ± 0.05	0.92 ± 0.07	0.001***	0.67 ± 0.04
Lactating cross breed cows (heads)	1.84 ± 0.10	0.77 ± 0.11	0.001***	1.30 ± 0.08
Lactating pure exotic cows (heads)	0.19 ± 0.05	0.13 ± 0.03	0.255^{ns}	0.16 ± 0.03
Experience in cattle keeping (years)	17.68 ± 0.82	18.23 ± 0.93	0.657^{ns}	17.96 ± 0.62
Distance from the nearest market (km)	4.79 ± 0.52	3.57 ± 0.24	0.036*	4.18 ± 0.29
Socio-demography	Freq. and (%)	Freq. and (%)	χ^2– value	
Gender			0.17 ns	
Male	129 (80.63)	126 (78.75)		255 (79.7)
Female	31 (19.37)	34 (21.25)		65 (20.3)
Educational status			29.44***	
None	50 (31.25)	18 (11.25)		68 (21.3)
Grade 1–4	34 (21.25)	27 (16.88)		61 (19.1)
Grade 5–8	38 (23.75)	73 (45.63)		111 (34.7)
Grade 9–10	19 (11.88)	28 (17.5)		47 (14.7)
Grade 11–12	6 (3.75)	5 (3.13)		11 (3.4)
Above Grade 12	13 (8.13)	9 (5.63)		22 (6.9)
Religion			195.59***	
Islam	2 (1.25)	44 (27.5)		46 (14.4)
Orthodox Christian	156 (97.5)	33 (20.63)		189 (59.1)
Protestant Christian	2 (1.25)	78 (48.75)		80 (25.0)
Catholic Christian	0 (0.0)	2 (1.25)		2 (0.6)
Wakefata	0 (0.0)	3 (1.88)		3 (0.9)

Note: **** and * refer to levels of significance at P < 0.001 and P < 0.05, respectively. ns = non-significant at 5% level of probability. n and N = sample sizes. SE = Standard error of the mean; A.A. = Addis Ababa and H-D = Hawassa-Dilla.*

3.2. Daily Milk Production and Utilization

As depicted in Table 2, significant differences were observed between the two milk sheds (P< 0.001) in the amounts of milk produced per farm and day. The mean daily milk production was higher for Addis Ababa (17.87±1.17 litters) than for Hawassa-Dilla milk shed (8.9±0.92 litters), which could be due to the more significant number of cross and pure exotic breed cows owned by households of the former milk shed. The average value reported in this study is almost similar to a recent study reported for Ada'a district, which is within the Addis Ababa milk shed (Habtamu Didanna *et al.* (2017). Out of the total milk volume produced daily, about 29.50% and 42.70% of the milk in the Hawassa-Dilla milk shed was used for home consumption and processing, respectively. However, most of the daily milk produced by households in the Addis Ababa milk shed is sold out as raw milk (66.54%). As the Addis Ababa milk shed is located within the capital city, it has access to the largest number of milk processing plants. Hence, milk collectors have been expanding the radius of their operation now reaching up to 150 km range. Market proximity to raw milk has many implications for the amounts of milk left at home for either consumption or processing into other traditional dairy products.

In both milk sheds, a considerable amount of milk (31.07±1.69) is still home-processed to get more shelf-stable traditional dairy products like butter. Butter is the most marketable dairy product for rural farmers in Ethiopia. On average, 47% of the daily produced milk is used for the market to generate income for households in both milk sheds (Table 2). Getachew Ahmed *et al.* (2018) reported that dairy products' expenses make up almost half of Ethiopia's animal sourced food expenditures. A study conducted in Fogera woreda, Ethiopia, indicated that 13.8% of the total milk produced is used to generate

income (Belete Anteneh *et al.,* 2010) which is much smaller than the findings of the present study in the two prominent milk sheds. As presented in Table 2, the daily consumption of milk of the two milk sheds with 14.05% for Addis Ababa and 29.50% for Hawassa-Dilla, is higher than that reported by Habtamu Didanna *et al.* (2017) for Ada'a district with 6.03% of the mean daily milk produced. The overall mean milk retained for home processing in the two milk sheds (31.1%) is less than the report of the Government of Ethiopia (GOE, 2007) that indicated 40% of the milk to be processed into butter. The variations in the proportion of milk consumption might be attributed to the religion of the household especially with regard to fasting by followers of Orthodox Christianity.

Table 2. Farm-level quantity of milk produced daily (liter) and percentage utilization.

Variable	A.A. milk shed (n = 160)	Hawassa-Dilla milk shed (n = 160)	T-test	Overall (N = 320)
	Mean±SE	Mean±SE	p-value	Mean±SE
Farm-level milk production (liter/day)	17.87±1.17	8.9±0.92	0.001***	13.39±0.77
The proportion of milk for family consumption (%)	14.05±0.78	29.50±1.6	0.001***	21.77±0.99
The proportion of milk for home processing (%)	19.42±2.03	42.73±2.38	0.001***	31.07±1.69
The proportion of raw milk for the market (%)	66.54±2.52	27.56±2.60	0.001***	47.05±2.11

Note: **** refers to level of significance at P < 0.001. n and N = Sample sizes. SE = Standard error of the mean. A.A. = Addis Ababa.*

3.3. Major Food Groups and Family Nutrition

Table 3 shows common food groups that play essential roles in terms of both relative importance and abundance as family nutrition in the two studied milk sheds. Compared to all animal-sourced foods, dairy products were observed as the most frequently consumed animal-sourced food items. The most common dairy products in Ethiopia are cow milk and products processed from the milk, which includes *Ergo* (naturally fermented milk), butter, cottage cheese, and *Arera* (buttermilk, defatted sour milk), and ghee (*Nitir kibe*). Other animal-sourced foods (OASFs) indicated in this study were animal-sourced foods (ASFs) other than dairy: beef, the meat of small ruminants, chicken, eggs, and fish. The households at Wachale (15%), Angolela (18.8%), and Dale (10.3%) districts rated dairy products, crop-based foods, and the combination of the two as the essential food groups in their family nutrition, respectively. This is in agreement with the results of Getachew Ahmed *et al.* (2018) who reported that the most critical animal-sourced food (ASF) consumed in Ethiopia in terms of quantity is dairy products.

The chi-square result showed significant (P < 0.001) differences among the study districts concerning the rank of most common food groups that contributed to family nutrition. About 17.2% of households of Addis Ababa milk shed ranked dairy products as the most common food group. In comparison, 16.6% of households in the Hawassa-Dilla milk shed ranked a combination of dairy and crop as essential food groups. Cow's milk contains about 3.5% protein by weight, which accounts for about 38% of the total solids-not-fat milk content and contributes about 21% of whole milk's energy. Cow's milk contains about 4.8% lactose (12 to 12.5 g lactose/cup) compared with 7% (15 to 18 g lactose/cup) in human milk (Miller *et al.*, 2007). The use of dairy products in the family food reported in the present study is, therefore, an opportunity to get those constituents in human nutrition. Getachew Ahmed *et al.* (2018) reported that animal source foods' relative importance was low at 11.2% in 2011 based on Ethiopia's per capita consumption expenditure. According to Abdulhalik *et al.* (2016), the highest intake of milk (with 80.7%) and lowest (with 14%) were recorded in Somali and Benishangul Gumuz National Regional States of Ethiopia, respectively.

Table 3. Food groups rated as most important and most abundant for family nutrition (% of households) in Addis Ababa and Hawassa-Dilla milk sheds.

ASFs in nutrition	Districts						Milk shed			
	Angolela (n = 80)	Wachale (n = 80)	Arsi Negelle (n = 80)	Dale (n = 80)	Total (N = 320)	χ^2	Addis Ababa	Hawassa-Dilla	Total	χ^2
Most important										
Dairy products	2.2	**15.0**	3.1	6.3	26.6	119.7***	**17.2**	9.4	26.6	37.8***
Other ASFs	0.3	**0.6**	0.0	0.0	0.9		**0.9**	0.0	0.9	
Crop based foods	**18.8**	7.8	15.3	6.6	48.4		**26.6**	21.9	48.4	
Dairy + other ASFs	0.3	0.0	0.0	**1.3**	1.6		0.3	**1.3**	1.6	
Dairy + crop-based food	2.8	1.3	6.3	**10.3**	20.6		4.1	**16.6**	20.6	
Dairy + Other ASF + Crop foods	**0.61**	0.3	0.3	0.59	1.9		**0.91**	0.89	1.9	
Most abundant										
Dairy products	23.8	24.1	24.4	24.1	96.3	3.29ns	**47.8**	**48.4**	96.3	1.10ns
Other ASFs	0.9	0.9	0.6	0.9	3.4		1.9	1.6	3.4	
Both dairy and Other ASFs	0.3	0.0	0.0	0.0	0.3		0.3	0.0	0.3	

Note: *ASFs = Animal source foods, numbers in bold indicate the majority of households (%) who ranked respective food groups as most important. n = sample size. *** refers to level of significance at P < 0.001; and ns = non-significant at 0.05 level of probability.*

3.4. Relative Abundance of Animal Source Foods (ASFs)

Households were asked to rank the abundance of ASFs (dairy products, other animal source foods, and their combinations) and their contributions to family nutrition (Table 3). The chi-square analysis showed that relative abundance of animal-sourced foods showed non-significant ($P > 0.05$) differences among districts and milk sheds. However, dairy products are relatively more abundant than other animal-sourced foods playing more contributions to the family nutrition of Hawassa-Dilla milk shed. In contrast, other animal-sourced foods are relatively plentiful in the meals of Addis Ababa milk shed's households. In terms of the quantity of ASF consumed, the most important ASF is dairy products, as was the case for expenditures at the national level (Getachew Ahmed *et al.,* 2018).

The findings of this study further indicated that dairy products are more abundant in the meals of households in both milk sheds compared to other animal-sourced foods. The reason behind this might be the preference for milk by people of all ages. Besides, the possibility of processing the milk into various traditional products at home could give its relative abundance over other animal-sourced foods. This is because many types of dairy products are traditionally processed from milk and used in different forms as family food. The report of Befekadu Teshome *et al.* (2019) in the Borana zone of Ethiopia indicated that 17.17% of the households process milk for the preservation and diversify products for consumption. Consistent with the results of this study, Hoddinott *et al.* (2013) stated that close to other micronutrient-rich foods (particularly animal-sourced foods), milk is consumed in relative abundance in many developing countries and is generally one of the largest sources of animal-based proteins. Contrary to the finding of this study, however, Abdulhalik *et al.* (2016) reported that cereals were the most commonly (96%) consumed food groups consumed in Ethiopia.

3.5. Animal-Sourced Foods Commonly Consumed with Crop-based Foods

The chi-square value showed significant differences ($P < 0.05$) for the ASFs commonly consumed with crop-based family foods (Table 4) among the study districts and milk sheds. In Hawassa-Dilla milk shed dairy products, the meat of small ruminants and beef are the three ASFs commonly consumed with crop-based foods with 38.1, 4.4, and 3.4%, respectively. On the other hand, dairy products (36.6%), eggs (5.6%), meat of small ruminants (4.1%), and chicken (3.4%) are in order of importance, commonly consumed with crop-based foods by households of Addis Ababa milk shed.

Diets without Livestock-sourced foods (LSF) can be deficient in vitamin A and B12, riboflavin, calcium, iron, and zinc (Murphy & Allen, 2003). FAO (2013) stated that milk and dairy products can add the much-needed diversity to plant-based diets and can contribute to promoting child growth. Getachew Ahmed *et al.* (2018) reported that beef and dairy products are the most important animal-sourced food groups consumed in Ethiopia. They further indicated that cow milk constituted 45% of the total consumption of dairy products in 2011. The findings of the present study indicated that traditional foods comprising animal-sourced foods could provide those nutrients lacking in the staple crop-based foods. Moreover, the habit of the community, which is consuming dairy products with crop-based foods, may support the fact stated by FAO (2013) as "Dairy foods and their nutrients are not consumed in isolation and no single food can supply all essential nutrients".

Table 4. Animal Source Foods (ASFs) commonly consumed with crop-based foods in districts of Addis Ababa and Hawassa-Dilla milk sheds (% of households).

Types of ASFs	Districts						
	Angolela (n = 80)	Wachale (n = 80)	Arsi Negelle (n = 80)	Dale (n = 80)	Total (N = 320)	χ^2	p-value
Dairy products	17.2	19.4	19.7	18.4	74.7	30.19	0.003*
Beef	0.3	0.0	2.2	1.3	3.8		
Small ruminant meat	1.9	2.2	1.3	3.1	8.4		
Chicken	2.5	0.9	0.3	2.2	5.9		
Eggs	3.1	2.5	1.6	0.0	7.2		

Note: * *refers to level of significance at P < 0.05.*

3.6. Year-round Availability of Milk and Family Nutrition

A significant ($P < 0.001$) difference was observed for the year-round availability of milk in family nutrition between the two milk sheds (Table 5). In Addis Ababa milk shed, 21.6% of households access a certain amount of milk for the year-round nutrition of their family, whereas 10.3, 7.2, and 10.9% of the households access some milk in their food for nine, six, and less than three months per year, respectively. In the Hawassa-Dilla milk shed, about 12.2% of households get some milk for six months of a year while a certain amount of milk was accessed the whole year by 11.9% of the households. About 19.2% of households in the Hawassa-Dilla milk shed access milk for less than three months of a year. The length of time for availability of other animal sourced foods may depend on access, economic status, and knowledge or custom of the consumers.

The results of this study indicate that households use milk and milk products in the diets of their family, which shows that they are aware of the nutritional value of milk as an essential food for the growth, health, and strength of family members. Getachew Ahmed *et al.* (2018) reported that almost 80% of dairy products are obtained from production in Ethiopian rural areas, with a few households relying on purchases to get these products. The researchers indicated that dairy products show much less seasonal variation than meat products among which butter shows less seasonal variation across the year as it is usually used to cook other animal-sourced foods.

Table 5. Availability of milk for family nutrition across the year (frequency and percent of households).

Yearly availability of milk in family nutrition	Milk shed (N = 320)			χ^2	p-value
	A.A. (n =160)	H-Dilla (n = 160)	Total (N = 320)		
Some amount available across the year	69(21.6)	38(11.9)	107(33.4)	23.29	0.001***
Some amount available for 9 months	33(10.3)	21(6.6)	54(16.9)		
Some amount available for 6 months	23(7.2)	39(12.2)	62(19.4)		
Some amount available for 3 months or less	35(10.9)	62(19.4)	97(30.3)		

Note: *A.A. = Addis Ababa and H-D = Hawassa-Dilla. *** refers to level of significance at P < 0.001.*

3.7. Frequency of Consumption of Animal-sourced Foods

The frequency of consumption of animal-sourced foods (dairy products and other animal source foods) is depicted in Table 6. Yogurt or fermented milk is the basic raw material for the production of most Ethiopian dairy products. About 0.6% of the households in the Addis Ababa milk shed consume whole milk more than once per day while the value for Hawassa-Dilla milk shed is 19%. Ghee is mainly consumed on special occasions and ceremonies in both milk sheds. The consumption habit may vary due to food habits, income, and availability of the ASFs. For instance, some families who commonly consume *enset* (*Ensete ventricosum*) based foods include butter, cheese, or meat as mandatory components of the meal thereby obtaining balanced nutrition. Among the other animal-sourced foods, beef, meat of small ruminants, and chicken are frequently consumed on special ceremonial occasions such as holidays and festivities in both milk sheds. These products are also consumed with a frequency of 1–2 times/month. The frequency of consumption of OASFs per day, more than once per day, and 3–6 times per week are low compared to the consumption of dairy products in both milk sheds.

Table 6. Frequency of consumption of Animal Source Foods (ASFs) by households of Addis Ababa and Hawassa-Dilla milk sheds (N = 320).

Type of animal product	Frequency of consumption in the milk sheds (%)																
	More than once per day		Ones per day		3–6 times per week		1–2 times per week		1–2 times a fortnight		1–2 times per month		On special occasions		Not common		χ^2
	A.A.	H-D	A.A.	H-D	A.A.	H-D	A.A.	H-D	A.A.	H-D	A.A.	H-D	A.A.	H-D	A.A.	H-D	
Dairy																	
Whole milk	0.6	0.0	15.3	19.1	11.6	10.0	18.8	16.6	3.4	2.5	0.0	0.3	0.3	1.6	0.0	0.0	0.221^{ns}
Yogurt	0.0	0.0	4.1	6.6	11.3	19.7	21.9	10.9	6.6	5.0	5.3	1.3	0.6	5.9	0.3	0.6	0.001***
Butter	0.0	0.0	4.1	4.1	10.9	15.0	15.6	11.6	6.3	7.2	10.0	7.8	1.9	4.4	1.3	0.0	0.057^{ns}
Butter milk	0.0	0.0	1.6	13.8	9.4	15.9	12.8	10.6	5.0	1.3	9.7	1.9	5.0	0.6	6.6	5.9	0.001***
Cheese	0.0	0.0	3.4	1.6	15.0	4.1	14.4	6.6	6.3	9.4	6.6	7.5	3.1	15.3	1.3	5.6	0.001***
Ghee	0.6	0.0	8.8	3.4	8.4	7.8	8.8	13.1	3.1	4.1	7.2	5.3	12.2	12.8	0.9	3.4	0.011*
Whey	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	2.5	0.0	0.3	0.0	45.0	50.0	0.001**
OASF																	
Beef	0.0	0.0	0.0	0.0	1.3	3.8	5.0	3.4	3.1	5.6	16.6	10.0	24.1	24.7	0.0	2.5	0.001**
Shoats	0.3	0.0	0.3	0.0	0.6	3.4	2.2	5.6	8.1	3.8	10.0	8.4	24.1	26.9	4.4	1.9	0.002*
Chicken	0.0	0.0	0.6	0.9	2.5	7.5	4.7	4.4	3.4	1.9	5.0	7.2	23.4	23.8	10.3	4.4	0.005**
Eggs	0.6	0.0	0.9	1.6	10.6	13.1	14.4	9.7	6.9	5.3	1.9	16.6	6.9	1.3	7.8	2.5	0.001***
Fish	0.0	0.3	0.0	0.0	0.0	0.9	0.6	1.3	0.3	0.9	0.6	3.1	4.4	2.8	44.0	41.0	0.051^{ns}

Note: *OASF = Other animal sources foods. A.A. = Addis Ababa and H-D = Hawassa-Dilla. *, ** and *** refer to significance level at P < 0.05, P < 0.01 and P < 0.001, respectively; and ns = non-significant at 0.05 probability level.*

As shown in Table 6, once per day consumption of dairy products is more common for Hawassa-Dilla milk shed households than for Addis Ababa milk shed households. The findings of the present study indicated that households of both milk-sheds more frequently consume dairy products compared to other animal-sourced foods. Among the dairy products, whey and buttermilk are the less commonly consumed ones in both milk sheds. Similarly, fish consumption is less common in the two milk sheds due to shortage of the food in the localities.

Kassahun Melesse and Fekadu Beyene (2009) reported that whole milk was the most frequently consumed dairy product in the Ada'a district, where almost 100% of the high and 66.7% of the medium income group households in urban areas drink raw milk more than 3 to 6 times per week. The same authors further reported that 33.3%, 33.6%, and 6.7% of urban low, peri-urban low, and rural high-income households consumed raw milk only on special occasions and holidays. Amanuel Asefa (2014), on the other hand, reported that following milk, the most widely used dairy product in Addis Ababa is spiced ghee and soft cheese mainly during holidays.

The frequency of consuming whole milk daily is higher in Addis Ababa milk shed households, which might be attributed to a relatively more number of the cross and pure breed milk cows associated with milk supply and availability. The report of Habtamu Didanna *et al.* (2017) for Ada'a district indicated that the majority (66.5%) consumed milk, of which 63.1% drank it once a day, 25.4% more than once a day, 6.2% three to six times per week, and 5.4% once or twice per week.

3.8. Intra-household Variations in Utilization of Dairy Products

As depicted in Table 7, utilization of various traditional dairy products by family members of different age groups showed highly significant ($P < 0.001$) differences between the two milk sheds. Whole milk is commonly saved and given to children under five years of age in both milk sheds. Other age groups usually utilize other products like yogurt, butter, buttermilk, cottage cheese, and ghee. In Addis Ababa milk shed, butter, cheese, and ghee are dairy products mainly consumed by family members of all age groups, compared to Hawassa-Dilla, where these products are more commonly consumed by household heads. The utilization of all products by household heads is optimum except for whole milk, which is mainly meant for children. It is seen from the Table that family members of all age groups utilize all dairy products, though the degree of utilization varies. Whey is the least utilized product, and if any, by youths in both milk sheds, which might be related to cultural issues. This is in agreement with the report of Tesfamariam Berhe *et al.* (2017) that stated *Aguat* is thus usually given to animals (calves, cows, and dogs) and sometimes consumed by humans but not in agreement with Teshome Gemechu and Tesfaye Amene (2017) who reported about 6.7 and 16.7% of households in Debub and Shey Bench districts, respectively use whey for consumption.

The study conducted in Ada'a district by Habtamu Didanna *et al.* (2017) indicated that 85% of children in households consume milk. The report of the Ethiopian National Food Consumption survey (2013) also indicated that consumption of dairy is highest for children. Similarly, the survey results by Potts *et al.* (2019) from four regions of Ethiopia indicated that milk is the most commonly consumed ASF (48%) by young children. The review report of Tesfamariam Berhe *et al.* (2017) indicated that buttermilk is mainly used to supplement the diets of children and the elderly in rural areas whereas traditional ghee (*nitir kibe*) is consumed in all parts of the country by all classes of people. Many authors (cite the authors here) stated the importance of dairy products for family members of different age groups. Grace *et al.* (2018) reported that livestock-derived foods (LDF) are considered as key to improved nutrition during the first 1000 days of age, from conception up to two years.

These micronutrients, necessary for infants and young children, are mostly insufficient, absent, or poorly bio-available in plant-based diets. This makes dairy products an essential source of nutrition (Randolph *et al.,* 2007). Hoppe *et al.* (2004) also indicated that the positive association of milk consumption and improved child growth and consumption of fermented milk resulting in the prevention of diarrhea, consumption of even small quantities of milk, can markedly improve the nutritional quality and diversity of the diet. Cow milk is a source of vitamin B12, a micronutrient commonly deficient in populations that consume low amounts of ASF, and can thus help to improve children's nutritional status (Allen and Dror, 2011).

Table 7. Dairy products utilization by family members of different age.

Dairy products	Family members	Utilization (frequency and %)			χ^2
		Addis Ababa (n = 160)	Hawassa-Dilla (n = 160)	Total (N = 320)	
Whole Milk	Children ≤ to 5 yrs	92(28.8)	78(24.4)	170(53.1)	26.50***
	Children 6–18 yrs	2(0.6)	19(5.9)	21(6.6)	
	Youths above 18 yrs	2(0.6)	1(0.3)	3(0.9)	
	HH heads	6(1.9)	21(6.6)	27(8.4)	
	All age groups	58(18.1)	41(12.8)	99(30.9)	
Yogurt	Children ≤ to 5 yrs	13(4.1)	8(2.5)	21(6.6)	18.16***
	Children 6–18 yrs	38(11.9)	40(12.5)	78(24.4)	
	Youths above 18 yrs	49(15.3)	26(8.1)	75(23.4)	
	HH heads	26(8.1)	54(16.9)	80(25.0)	
	All age groups	34(10.6)	32(10.0)	66(20.6)	
Butter	Children ≤ to 5 yrs	2(0.6)	5(1.6)	7(2.2)	53.45***
	Children 6–18 yrs	22(6.9)	8(2.5)	30(9.4)	
	Youths above 18 yrs	23(7.2)	32(10.0)	55(17.2)	
	HH heads	17(5.3)	66(20.6)	83(25.9)	
	All age groups	96(30.0)	49(15.3)	145(45.3)	
Buttermilk	Children ≤ to 5 yrs	6(1.9)	8(2.5)	14(4.4)	28.29***
	Children 6–18 yrs	20(6.3)	21(6.6)	41(12.8)	
	Youths above 18 yrs	57(17.8)	43(13.4)	100(31.3)	
	HH heads	27(8.4)	54(16.9)	81(25.3)	
	All age groups	33(10.3)	34(10.6)	67(20.9)	
	Not common	17(5.3)	0(0)	17(5.3)	
Cottage cheese	Children ≤ to 5 yrs	3(0.9)	1(0.3)	4(1.3)	58.69***
	Children 6–18 yrs	23(7.2)	5(1.6)	28(8.8)	
	Youths above 18 yrs	28(8.8)	32(10.0)	60(18.8)	
	HH heads	18(5.6)	74(23.1)	92(28.8)	
	All age groups	88(27.5)	48(15.0)	136(42.5)	
Ghee	Children ≤ to 5 yrs	8(2.5)	4(1.3)	12(3.8)	73.37***
	Children 6–18 yrs	6(1.9)	1(0.3)	7(2.2)	
	Youths above 18 yrs	19(5.9)	39(12.2)	58(18.1)	
	HH heads	19(5.9)	74(23.1)	93(29.1)	
	All age groups	108(33.8)	42(13.1)	150(46.9)	

Note: **** refers to level of significance at P < 0.001. Numbers in parentheses are percentages of households.*

3.9. Reasons for Processing the Milk into Traditional Products

The processing of milk into various forms of dairy products is dominated by traditional practices in Ethiopia. The objective of processing may vary with the socio-cultural setting of the society and the availability of milk. According to Tesfamariam Berhe *et al.* (2017), the processing of fresh milk into dairy products results in value-added products and improves the shelf life and functional properties of the product. On average 31.07% of the daily milk produced in the studied milk sheds was retained for traditional processing. The reasons for home processing of milk into various traditional products in both milk sheds were ranked using a ranking index (Musa *et al.,* 2006) and presented in Figure 2.

In the Addis Ababa milk shed, the primary reason for home processing of milk was for enhancing the shelf-life dairy products (index = 0.23) and value addition from available market opportunities and prices, ease of transportation of products, and make use of surplus milk to minimize the food loss. On the other hand, obtaining diversifying dairy-based products for better nutrition (index = 0.27) was ranked as the primary reason for processing milk by Hawassa-Dilla milk shed households. This fact indicates how dairy products are important in diversifying the diets of households in Hawassa-Dilla milk sheds.

Though the primary reasons are different, the index indicates that households of both milk sheds reflect

similar reasons for processing milk at home. Ease of transporting and surplus milk was ranked the least reasons for milk processing in both milk sheds. Sadler and Catley (2009) estimated that 40% of the milk produced is converted to butter in rural Ethiopia, while only nine percent is converted to cheese. Shapiro *et al.* (2017) stated two reasons for processing the milk into butter in Ethiopia, which are the rising of butter price over time and the increased shelf life of the products, particularly in rural areas.

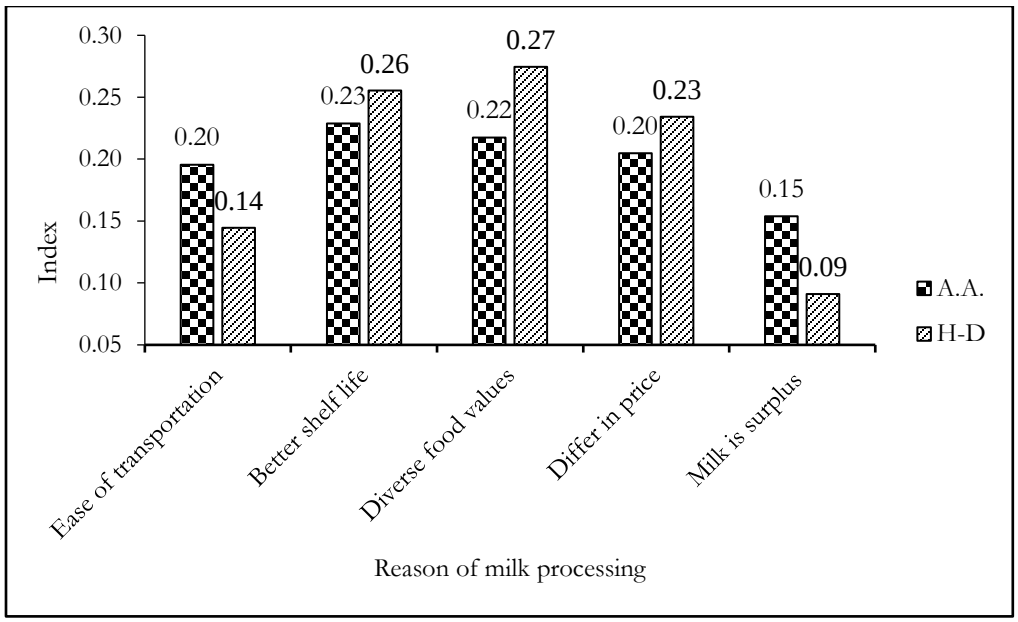

Figure 2. Index for the reason for processing milk at home by households of Addis Ababa (A.A.) and Hawassa-Dilla (H-D) milk sheds.

4. Conclusions and Implications

This study has revealed that households in the Addis Ababa milk shed hold more cross and pure-bred milk cows. As a result, the mean daily milk production (liters) is much higher than that of the Hawassa-Dilla milk shed. The results of the study indicated that dairy products are the most commonly consumed animal-sourced foods (ASFs) by the farm households in both milk sheds, which is an integral part of food groups. Keeping the intra-household and district level differences, it was observed that the Addis Ababa milk shed is more accessible to raw milk markets; hence the proportion of milk sold out as raw milk is higher, and the proportion of milk that is traditionally processed into other dairy products is much less than that from farmers in the Hawassa-Dilla milk shed. The information generated in this study will help stakeholders to design a program that can best balance between market access/family income and family nutrition in the two milk sheds. Detailed studies across the milk value chain are required to explore evidences that could substantiate the present study.

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