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Abstract- This study was conducted to evaluate physicochemical quality and consumption pattern of milk at smallholder urban dairy farms in Jimma town of Oromia Regional State, Ethiopia. A total of 54 smallholder dairy farming households were randomly selected and interviewed with pre-tested, structured questionnaire. The results revealed that the mean fat, protein, lactose and solids-not-fat (SNF) content were 4.38 ± 0.06 , 2.96 ± 0.01 , 4.34 ± 0.13 and 7.79 ± 0.60 , respectively. The organoleptic characteristics of the raw milk samples were more or less similar except milk from two farms which showed off-flavour (in 10% milk sample). The mean daily milk production was 36.43 ± 32.74 kg per household. The study revealed that most (98.1%) of the respondents consume milk and processed milk products as a major part of their diet. Fresh whole milk was the most widely consumed dairy product (35.2%) and consumption of processed milk products was low. Farm household average daily per capita milk consumption was 215.38 milliliter (ml). The major dairy products produced and consumed by the respondents were naturally fermented whole milk (*ergo*), butter (*Kibe*), butter milk (*Arera*), cottage cheese (*ayib*), whey (*agwat*) and ghee (*nitir kibe*).

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I. INTRODUCTION

Population growth, increasing urbanization and rising incomes are predicted to double the demand for, and production of, livestock and livestock products in the developing countries over the next 20 years (Delgado et al., 1999).

Per capita food consumption of animal products continues to increase both in developing and developed countries, as well as in countries in transition, as a result of increasing average per capita real income (Popkin and Du, 2003; Speedy, 2003). Projections indicate a large increase in demand for dairy products, particularly in developing countries including sub-Saharan Africa (Delgado et al., 1999).

Ethiopia holds the largest cattle population in Africa estimated at about 53.4 million heads of cattle (CSA, 2011), of which 10 million is dairy cows yielding 3.2 billion kg per year, with national average milk yield per cow per day of 1.54 kg for indigenous cows (CSA, 2008). Despite the large dairy cattle population of Ethiopia, the total national milk production remains among the lowest in the world and even by African standard. Milk and milk products are economical important farm commodities and dairy farming is an investment option for smallholder farmers in Ethiopia (Tsehay, 2001) and dairy products form part of the diet of many Ethiopians.

Milk is considered as nature's single most complete food (O'Mahony, 1988) and is definitely one of the most valuable and regularly consumed foods. Milk is a complex mixture of fats, proteins, carbohydrates, minerals, vitamins and other miscellaneous constituents dispersed in water (Harding, 1999). According to Byron et al. (1974), the average composition of milk are water (87.20%), protein (3.50%), fat (3.70%), lactose (4.90%), ash (0.70%) and dry matter (12.80%). Milk should have normal composition, not adulterated and produced under hygienic condition (Chamberlian, 1990).

The compositional and organoleptic properties of tropical milk products may differ from similar products manufactured in cool temperate climates (ILCA, 1992). According to O'Connor (1994), the chemical quality of milk is may be ascertained by measuring its content of fat, protein and total solids, which is affected by genetic and environmental factors. Breed, feeding, individuality within the breed, stage of lactation, age, health and interval between milking are among the factors responsible for variation in milk composition of cows (Zelalem et al. 2004; O'Connor, 1994).

In the study area demand for cow milk is rapidly increasing because of population growth, increases in per capita intake, changes in consumption pattern and economic expansion of the urban residents. However, there is little information available on the chemical composition and microbial quality of raw milk in Ethiopia (Zelalem and Faye, 2006; Eyasu and Fekadu, 2000). In the study area there are hardly any studies on

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consumption pattern of dairy products. To this end, the need to understand milk physicochemical composition and consumption pattern under urban dairy systems is important for meeting the demand for consumers. Therefore the aim of this study was to investigate the physicochemical characteristics and farm household consumption pattern of milk and its products at urban dairy farms in Jimma town of Oromia Regional State, Ethiopia.

II. MATERIALS AND METHODS

The study was carried out in Jimma town of Oromia Regional State, south western Ethiopian. Jimma town is located at 355km south-western of Addis Ababa, capital of Ethiopia, having a latitude of 7°41'N and longitude of 36°50'E and an elevation of 1704 meters above sea level. The area is characterized by a humid tropical climate of heavy annual rainfall that ranges from 1200-2000 mm. About 70% of the total annual rainfall is received during wet season, which lasts from the end of May to early September. The area has a relatively higher temperature of about 25°C-30°C from January to April, and a minimum temperature of 7°C-12°C during the months of October to December (OPEDJZ, 2002).

a) Sampling procedure

A simple random sampling technique was used to select the households for the purpose of this study, and a total of 54 urban smallholder dairy farmers were randomly selected to be interviewed. Information on number of dairy farmers was obtained from official records maintained by the Jimma city multipurpose dairy development private limited company and Office of Urban Agriculture Development for Jimma town. The total sample size represented about 55% of the total number of smallholder urban dairy farmers actively participating in dairy farming. Before the formal interview a preliminary visit was made to locate the farms, and to give a brief description to each respondent on research objectives and potential benefits of involving in this research.

b) Data collection

A single-visit-multiple-subject formal survey technique (ILCA, 1990) was used to collect data through face-to-face interviews, conducted in the local language by the researcher using a pre-tested, structured questionnaire. The questionnaire included information on household characteristics, milk production, consumption, processing and marketing, traditional milk processing materials and major constraints to production and marketing of milk. The questionnaire was administered by the researcher, who had a sound knowledge of *Afaan Oromo* and *Amharic* local languages spoken by the dairy farmers in the study area.

c) Collection and transportation of raw milk sample

Raw milk samples were collected from 20 different urban dairy farms located in Jimma town. The farms were selected randomly for physical and chemical quality examination of raw milk. About 250 ml of raw milk samples were collected from morning bulk tank at each farm after thorough mixing, and the samples for physical parameters were transported to the laboratory using ice containing box maintaining sterile condition.

d) Physical examination of the samples

Organoleptic test of raw milk was performed visually, lingually and nasally with the help of a panel of expert to determine color, flavor and texture. The organoleptic quality of raw milk from each farm was evaluated by a panel of experts with the help of appearance, smell, taste and texture characteristics as per standard score card (ISO, 1995). Specific gravity of the raw milk samples was determined using lactometer.

e) Analyses of chemical composition of raw milk

Chemical composition of milk samples were analysed at farm level using the Julie C5 Automatic analyzer (Scope Electric, Razgrad, Bulgaria) to determine milk fat, protein, lactose and solids-not-fat (SNF).

f) Data analysis

Data obtained were analyzed using Microsoft Excel spreadsheet and the procedure of Statistical Package for Social Sciences software version 16.0 computer programs. Descriptive statistics such as means, frequency distribution and percentages were used to summarize the data.

III. RESULTS AND DISCUSSION

a) Socio-economic household characteristics

Results of the analyses showed that the average age of the respondents was 51.26 ± 10.99 years. Average family size was 6.02 ± 2.52 per household. The observed family size was lower than the findings by (Asaminew and Eyasu, 2009) who reported average family size of 8.2 and 7.2 in Bahir Dar zuria and Mecha districts, respectively. The majority (35.5%) of the respondents had college level education, while 24.1 % and 7.4% had senior secondary school and university level education, respectively. The respondents with college and university level education (42.6%) were higher than the report by (Yousuf, 2003) who indicated 24% respondents in Harar milk shed had higher education. The study observed that dairy farming was mainly a male domain (75.9%) whereas only 24.1% were women. Similar observations have been reported in Addis Ababa milk shed by (Azage, 2004).

b) Physical quality of raw milk

Physical characteristic of raw milk samples collected at Jimma dairy farms are shown in Table 2. Of

all the raw milk samples tested, the majority (75%) had yellow white, while 10% had white color. Among the milk samples, the highest percentage (75%) had normal flavor, while 10% of the sample had off-flavor indicating three farms fed their lactating cows with "atella"-liquid by-product of local beer breweries before milking. The entire panel of experts indicated that the off-flavor is the odor of "atella" in three of the farms. The majority (85%) of the milk samples had normal texture (free flowing liquid), while three milk samples had thin texture, which might be due to high percentage of water, type of feed consumed prior to milking or breed of the milking cows maintained by the farms. In addition, adulteration of milk

is a common practice in some of the dairy farms elsewhere in Ethiopia. The mean specific gravity of raw milk samples collected from urban dairy farms in this study was 1.027 ± 0.00 , ranging from 1.023 to 1.030. The result of the present study was slightly lower than the values of specific gravity of 1.030 reported by Alganesh et al. (2007) in eastern Wollega, Ethiopia. The normal specific gravity of milk ranges from 1.028 to 1.033 (FAO, 1988). Higher milk specific gravity of about 1.035 and lower than normal value (1.020) are indicative of fat skimming off and the addition of water (O'Connor, 1994).

Table 1 : Physical quality of raw milk samples collected from urban dairy farms, Jimma, Ethiopia

Physical Parameters	Number of samples	Quality	Percentage
Color	15	Normal	75
	3	Light white	15
	2	White	10
Flavor	15	Normal	75
	3	Sweat	15
	2	Off-flavor	10
Texture	17	Normal	85
	3	Thin	15
Specific gravity, mean \pm SD	1.27 0.00		

SD=standard deviation

c) Chemical composition of raw milk

Table 2 shows that the mean fat, protein, lactose and solids-not-fat (SNF) content of the raw milk samples were 4.38 ± 0.06 , 2.96 ± 0.01 , 4.34 ± 0.13 and 7.79 ± 0.60 , respectively. The mean values of fat and protein in this study were lower than the Ethiopian Standard (ES, 2009) value of 4.5% and 3.20%, respectively. However, fat and protein values obtained in the present study were within the accepted range of 2.5 to 6.0% and 2.9 to 5.0% for fat and protein respectively (O'Connor, 1994). All the chemical composition values of raw milk observed in the present study were higher than the earlier findings of Veronique et al. (2013), who

reported fat, protein, lactose and solids-not-fat (SNF) values of 4.36, 2.65, 3.96 and 7.22, respectively in urban dairy farms in Jimma. However, the results of the values of fat and SNF obtained in the current study were lower than the findings of Alganesh et.al. (2007), who reported 6.05% fat and 8.22% SNF, and also lower than the previous report of Zelalem et al. (2004) who indicated 5.43 and 8.43% of fat and SNF, respectively. The variation in milk composition values between the current and previous findings may be due to breed, nutritional status and health of cows, particularly that of udder health.

Table 2 : Chemical composition of raw milk of crossbreed dairy cows in urban dairy farms, Jimma, Ethiopia

Parameter	Minimum	Maximum	Mean \pm SD
Fat (%)	4.34	4.43	4.38 ± 0.06
Protein (%)	3.17	3.25	3.21 ± 0.06
Lactose (%)	4.25	4.43	4.34 ± 0.13
SNF (%)	7.35	8.24	7.79 ± 0.63

d) Milk production and utilization

Milk production and utilization in the study area is shown in Tables 2. Average milk production per household per day was 36.43 ± 32.74 kg and ranged

between 6 to 130 kg. The observed variation in milk production per household might be due to difference in number of lactating cows, exotic blood level, and standard of feeding and general management practices.

The average milk production per farm per day in this study was higher than the findings of (Sintayehu *et al.*, 2008) who observed average production of 10.21 ± 1.59 to 15.90 ± 2.36 kg per day in urban farms in southern Ethiopia. The study revealed that 31.91 ± 28.86 kg of the

total milk produced is sold, 3.34 ± 4.67 fed to calves, 1.30 ± 0.63 used for family consumption and the remaining 0.84 ± 1.92 was retained for home processing. The study revealed that the largest volume of the total milk produced was for sale to generate income.

Table 3 : Milk production and utilization at urban dairy farms, Jimma, Ethiopia

Parameter	Mean \pm SD	Minimum	Maximum
Milk production /farm/day	36.43 ± 32.74	0	130
Milk fed to calf/ farm/day	3.34 ± 4.67	0	20
Milk for home consumption/farm/day	1.30 ± 0.63	0	3
Milk for processing/farm/day	0.84 ± 1.92	0	10
Milk for sale/farm/day	31.92 ± 28.68	0	128

SD= standard deviation

e) Household consumption of milk and milk products

Table 3 shows consumption pattern of milk and milk products at farm household. Almost all the respondents consume dairy products, which vary from household to household depending on the amount of milk produced and the need to generate income. The majority (98.1%) of the respondents reported that they consume fresh whole milk and processed milk products as a major part of their diet at household level. On average 1.30 ± 0.63 liter of the total milk produced per farm per day was consumed at home. The milk and milk products consumed at farm household were fresh whole milk (*wetet*), Ethiopian naturally fermented milk (*ergo*), butter milk (*Arera*), local cheese (*Ayib*-soft curd-type cottage cheese), local butter (*Kibe*) and local ghee (*Niter kibe*-a product obtained after most of the moisture content is removed by cooking at high temperature for its long shelf-life). Similar findings were reported by (Zelalem, 1999) in the central highland of Ethiopia. According to Azage and Alemu (1998) in Addis Ababa, of the total milk production 10% is left for home consumption.

Fresh whole milk (FWM) was the most frequently consumed (35.2%), while 37% of the farms

households consumed both FWM and fermented milk (*ergo*), and the remaining 24.1% consumed FWM and all types of milk products, except whey (*Aguat*). All of the respondents indicated that whey (*Aguat*) is not consumed by farm household family. However, it was fed by animals, and in few cases it is consumed by farm workers. This is in agreement with the results of (Zelalem, 1999) who indicated that at Debre Zeit, Holetta and Selale areas whey is not consumed by household.

The study observed that of the total milk consumed by household, children below age of ten years consume the lion share. The majority (59.3%) of the respondents stated that the demand for milk and dairy products is affected by seasonal fall of demand. Long fasting season and fasting days when the Orthodox Christians abstain from consuming dairy products for more than 250 days per year was reported to be the main reason for decreased demand for consumption of dairy products. This result is in line with previous findings of (Sintayehu *et al.*, 2008; Yitay *et al.*, 2008).

Table 4 : Household consumption pattern of milk and milk products at urban dairy farms, Jimma, Ethiopia

Variable	Percent of the respondents
Is milk consumed at home?	
Yes	98.1
No	1.9
Types of milk and milk products consumed	
Fresh whole milk	35.2
Sour milk, cottage cheese and butter	1.9
Fresh milk and sour milk	37.0
Fresh milk, sour milk, cheese and butter	25.9

Forms of milk consumption	
Raw fresh whole milk	3.7
Boil before consumption	92.6
Raw and boiled	3.7
Factors affecting household milk consumption	
Fasting season	59.3
Dry season	1.9

f) *Farm household per capita milk availability*

Table 4 reveals that respondents in the study area produce about 1967 kg of milk per day. Of the total milk produced per day, 3.56% was retained for home consumption. From this study, it was estimated that the farm household average per capita per day availability of milk was 215.38 milliliter (ml). This was in excess of the average national per capita per day milk consumption of 44.44 ml or annual per capita milk

consumption of 16 kg (Saxena, 1997). The results showed that dairy farmers' family members consume more milk per day than the national average. However, it was lower than the Indian Council of Medical Research (ICMR) recommendation of a minimum need of 250 ml of milk per capita per day (Singh, 1999). From this study it was observed that an increase in milk production will enable more amount of milk available for family consumption.

Table 5 : Household's estimated per capita consumption of milk at urban dairy farms, Jimma, Ethiopia

Parameters	N
Number of dairy farms	54
Total family size of the respondents	325
Milk retained for home consumption per day, liter	70
Per capita availability of milk per day, ml	215.38

N= number

III. CONCLUSION

Generally, it can be concluded that the physical and chemical quality of raw milk collected at Jimma town dairy farms almost meets the accepted standards. Milk and milk products are produced and consumed by the farm household on regular bases, being raw whole milk the most widely consumed dairy product. Regular inspection of the physicochemical quality of raw milk produced by smallholder dairy farmers in the study area needs to be conducted to maintain the standard quality of milk composition.

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