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Evaluation of Proximate Composition and Handling Practices of Raw Milk at Different Points of Oromia Regional State

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Abstract
The study was conducted at different critical points of Oromia special zone surrounding Finfine, Sebeta, Sululta and Holeta districts with the objective of assessing raw milk gross nutrient composition and its handling practices at different critical points of milk marketing chain. Multi-stage purposive sampling method was used to conduct proximate composition and handling practices of raw milk from different critical points from Finfine surrounding districts of Oromia. A total of 102 milk producing farmers at Holeta, Sebeta and Sululta districts were selected by using multi-stage purposive sampling method. A total of 60 raw milk samples were collected hygienically from each presumed critical points and examined for their gross nutrient composition. The channels in marketing of milk involved in this area include direct sellers, milk collection centers, informal merchants, milk cooperative unions, hotels, dairy product processing plants and retail shops. However, majority of the participants brought their milk to the collection center and private dairy processing plants. About 26.5, 6.9, 46.1, 2.9 and 17.6% of the participants use cold pipe water, warm river water, warm pipe, cold river water and cold well water, respectively for washing udder and teat before milking in the whole study site. About 98, 97.1 and 94.15% of the participants in the study sites used plastic utensils for milking, storing before transportation and transporting milk. Only 77.2% of the study participants wash their hands before milking in all the study sites. The protein content of milk sample ranged from 3.12 to 2.39, 3.29 to 2.70 and 3.04 to 3.08% at farmer and retail level of Sebeta, Holeta and Sululta, respectively. Sample collected from Sululta site had showed the highest protein content than other sites.Whereas, fat content of milk sample ranged from 4.47 to 3.76, 4.05 to 3.24 and 3.58 to 4.37 % from farmer and retail shop of Sebeta, Holeta and Sululta, respectively. Besides, protein and fat have showed a significant difference among critical points($p<0.05$). Besides, The mean total solid content of present study revealed that it ranged from 9.8 to 13.5% in Sululta collection center and Sebeta farmers respectively. The mean value of mineral element Fe ranged from 0.068 to 0.071, 0.082 to 0.060 and 0.072 to 0.072 mg/100gm for samples collected from Sebeta, Holeta and Sululta farmers and retail, respectively. Generally, the present study was revealed that milk samples contained unhygienic and poor handling practices and considered as substandard which will result in public health hazard to the consumer. Therefore, intensive study on adequate handling of milk in the study sites should be conducted to assure safety and quality and policies to be set to assure the supply of quality milk in the area.
Keywords: Handling practice, Critical points, proximate Composition, nutrient. AAS.

Introduction

Milk is a compensatory part of daily diet especially for the expectant mothers as well as growing children [Adil and Iman, 2011, Ahmed, 2011 and Ahmed, 2009]. Milk is virtually a sterile fluid when secreted into alveoli of udder. However, beyond this stage of production, microbial contamination might generally occur from three main sources; within the udder, exterior to the udder and from the surface of milk handling and storage equipments, but the surrounding air, feed, soil, feces and grass are also possible sources of contamination [Ali and Abdelgadir, 2011, Almaz et al, 2001 and APHA,1985].

Food spoilage is also a worldwide economic problem. Through microbial activity alone, approximately 25% of world's food supply is lost. These risks must be assessed and managed to meet growing and increasingly complex sets of national objectives. The agreement on the application of Sanitary and Phyto-sanitary Measures Agreement (SPMA) permits countries to take legitimate measures to protect the life and health of consumers provided such measures can be justified scientifically and do not unnecessarily impede trade [APHA,1992].

Nutritionally, milk has been defined as the most nearly ''perfect food". It is a compensatory part of daily diet especially for the mothers with child as well as growing children (Javaid *et al.*, 2009; Olatunji *et al.*, 2012). It is daily produced, sold for cash or readily processed. It is a cash crop in the milk-shed areas that enables families to buy other foodstuffs, contributing significantly to the household food security. It also constitutes a significant proportion of the value of all livestock food products in Ethiopia (about 56%), while livestock food products constitute an important proportion of the value of total food products in the country (Belete *et al.,* 2010).

According to Ramesh (2006), the major components of milk are water (87.4%), milk solids (12.6%), solids-not-fat (9.0%), fat (3.6%), protein (3.4%), milk sugar or lactose (4.9%) and ash or minerals (0.7%). According to the report of USDA (2008), the mineral elements specially calcium, phosphorus and iron in raw cow milk in mg/100gm were 113, 91 and 0.03 respectively. Dawd *et al*. (2012) reported average concentrations of the mineral element Zn and Fe were (4.92±0.28mg/kg),(1.21±0.077mg/kg) respectively for raw cow milk samples collected from selected sub-cities in Addis Ababa. Ghada (2005) reported the main mineral elements from raw cow milk in Egypt; Ca, P, Zn and Fe 119±0.690, 95.03±0.72, 0.38±0.00 and 0.070±0.02mg/100g, respectively.

Milk is a complex biological fluid and by its nature, a good growth medium for many microorganisms. Because of the its physico-chemical properties, it needs strict hygienic condition to avoid contamination of milk with microorganisms. Therefore, the microbial content of milk is a major feature in determining its quality [Argudin, 2010].

Food quality and safety standards in Ethiopia are one of the most concern areas because producers need to minimize loss while the general public would like to have a fair idea of what standard of food to buy for consumption. Also the safety of the food supplied for consumption especially for foods like milk is of paramount concern. Microbial load is a major factor in determining milk quality. It indicates the hygienic level exercised during milking, cleanliness of the milk utensils, condition of storage, manner of transport as well as the cleanliness of the udder of the individual animals [Asperger and Zangerl, 2003 and Aycicek, 2005].

The initial microbiological quality of milk can vary substantially based on factors such as the health of the animal, the sanitary condition of the milking environment and milker [Aydin et al, 2011]. Microbial contamination of milk can therefore originate from within the udder; the exterior of the teats and udder; and from the milk handling and storage equipment [Aydin et al, 2011 and Benkerroum, 2004]. Hygienic practices during production, processing and handling of milk and milk products in the central Ethiopia are substandard [Beyene, 1994].

However, there is scanty information on the microbial properties and composition of raw milk in Ethiopia[Bintsis et al, 2008 and Biruk et al, 2009]. Such reports coupled with notion of problems related to milk supply chain and detection of milk microbial in dairy products after transportation and storage in the of Peri-Addis Ababa to milk retail in the city calls for systematic study and remedy for the malady. Therefore, the objective of assessing raw milk gross nutrient composition and its handling practices at different critical points of milk marketing chains.

Materials and Methods

Study Area Description

The study was conducted in three Peri-Addis Ababa districts (*Sululta, Holeta and Sebeta*) of Oromia Regional States of Ethiopia. The study sites were selected based on their milk production potential as well as their lion's share to milk retail market at Addis Ababa. Sululta is located between 9°4'30"N to 9°30'59"N and 38°31'26"E to 38°58'49"E. Animal production system is mainly mixed crop-livestock type of farming system (CSA, 2004).

Holeta is situated at a distance of 31 km West of Addis Ababa and located at 9°02' N latitude and 38°29' E longitude in Oromia National Regional State (ONRS) of Ethiopia. It is found at an average altitude of 2449 m a.s.l. The area is one of the major dairy potential sites in Oromia Regional State Sebeta is located 24km from South west of Addis Ababa at a latitude and longitude of 8^{o}55'N38^{o}37'E and an elevation of 2356 masl. These areas take the lion's share in terms of their milk production potential and contribution to Addis Ababa milk market.

The main agricultural practices of the study areas are mixed, crop-livestock production system, in which *Teff*, wheat, lentil and chickpea are widely grown. Agriculture is strictly rain fed. The areas' rainfall and temperature ranges between 800-1500mm year^{-1} and 10-25^{o}c, respectively. Animal products, especially dairy products, play a headstone role in household food security both by direct consumption and purchasing of other food items in the area (WARDO, 2012).

Study population

A total of 60 milk samples were collected from different critical points (farmers, collection centers, informal merchants, and dairy cooperative unions) and following the route milk retail centers in Addis Ababa were also engaged. Totally 12 samples were collected from each critical points following milk marketing chain.

Questionnaire Survey

A semi structured questionnaire was used to assess the hygienic status of milk production, handling transportation and marketing. one-hundred thirty-two farmers, six collection centers, two milk cooperative unions eight informal merchants and six retail centers were interviewed. Consequently, milk handling and hygienic practices employed, and others conditions thought to affect the hygienic quality of milk were assessed.

Sample Collection and Transportation

The study was conducted from December 2013 to April 2014 to assess the proximate composition of raw cow milk. Raw milk samples were collected from different critical points(farmers, collection centers, informal merchants, milk cooperative unions and retail centers). The samples were collected aseptically in sterilized universal bottles in cold icebox with ice bag and transported to Ethiopian Public Health Institute (EPHI) Food microbiology laboratory and then stored in refrigerator at 4°C before 24hrs of sampling as described by APHA (1992) and analyzed within 6hrs of sampling.

Chemical Analysis

Determination of Fat

Ether extract as an estimate of crude lipid was determined using Soxhlet extraction method (AOAC, 2005) official method 989.05.The ether extract was calculated as:

Weight of fat (Wf) = Wa-Wb

Where; *Wa* = Weight of extraction flask after extraction

Wb = Weight of extraction flask before extraction

Crude fat content (g/100) = (Wf [100 - moisture, %]/Wd)

Wd = Dried sample obtained after determination of moisture

Determination of crude protein

The protein content of the samples was determined on the basis of total nitrogen content by micro Kjeldahl method of crude nitrogen determination(AOAC, 2005) using the official method 991.20.

$$\%N_2 = \frac{14 \times M \times V_t \times V_{100}}{\text{Weight of sample (mg)} \times V_a}$$

$$\%\text{Crude Protein} = \%\ N_2\ (\text{Nitrogen}) \times 6.38$$

Where, M = Actual molarity of Acid

V = Titer value (Volume) of HCl used

V_t= Total volume of diluted dig

V_a = Aliquot volume distilled

Determination of Total Solid

TS was determined by method of (O'Connor, 1994).

$$\textit{Total solid} = \frac{\textit{crucible Wt + oven dried sample wt-Crucible Wt}}{\textit{Sample Wt}} \times 100$$

Determination of Solids- not -fat

The solids not fat (SNF %) was determined by subtracting the percent fat from total solids (O'Mahoney, 1988).

$$SNF = \left[(TS\text{-}fat) \times 100\right]$$

Determination of Ash

Total ash by (AOAC, 2005).

Calculation; % Ash = (W2-W1)*100/W3

Where: W3-weight of fresh sample

W2- weight of crucible and dried sample

W1- weight of empty dried crucible

Determination of Mineral Element

AOAC (2005) was used to estimate minerals. The samples were ashed in a muffle furnace at 550^0C for 1 hour and some drops of deionized water and 5 drops of concentrated HNO_3 were added and evaporated on hot plate.

The minerals, *viz*. calcium, iron, and zinc were analyzed using Shimadzu atomic absorption spectrophotometer (AA-6800/ "AA Wizard" software). Phosphorous was determined using UV-visible spectrophotometer (CECIL Instruments, Cambridge England, deuterium F 500mA, power T3. 15A) based on AOAC (2005) method 970.39. Absorbance of standard, blank and samples were read at 660 nm using UV Visible Spectrophotometer. Absorbance versus concentration calibration curve was constructed and the equation obtained was used to calculate the unknown phosphorus concentration in the samples.

$$\text{Phosphorus in mg/100gm} = \frac{(A_S - A_B)\text{*dilution factor*extracted volume*100}}{\text{Slope*weight of sample*1000}}$$

Where, A_s= absorbance of sample

A_B= absorbance of blank
Slope= from the calibration curve

Data Management and Analysis
Microsoft excel spread sheet was employed for raw data entry. SPSS version 16.0 software was used for descriptive statistics. For all analysis, 95 % CI and *P*-value<0.05 was set for statistical significance of an estimate.

RESULTS AND DISCUSSIONS

Hygienic practices

Hygienic practices are major pathways to produce safe and quality products for the consumers there by reduces microbial contamination and loss of product. Table 1 indicates major hygienic practices followed by milk producers in the study sites. Source and type of water used for washing hand and utensil have profound effect on microbial contamination of the milk. About 26.5, 6.9, 46.1, 2.9 and 17.6% of the participants only used cold pipe water, warm river water, warm pipe, cold river water and cold well water, respectively for washing udder and teat before milking in the whole study site (Table 1).
Additionally, through hand washing (especially in the developing countries) in between milking, during pre-milking and post-milking stages by using safe disinfectants can enhance the safety of fresh milk (Oliver, 2005).

However, none of them wash hands before and after milking. On top of this, only 77.2% of the study participants wash their hands before milking in all the study sites. The proportion was higher at Sebeta then Holeta 77.2 and 76.5%, respectively. This might be due to lack of training for producers and other milk handlers on the washing of their hands and milk utensils that mitigate the growth of microorganisms and maintaining the safety of products thereby enhancing the safe product available for consumers and reduce the loss of product that have profound effect on food security.

Table 1: Percentage hygienic practices of dairy farmers followed during milking at different study sites

	Districts		
Hygienic practices	Sebeta n=32	Sululta n=30	Holeta n=40
Practicing barn cleaning daily	94.4	95.7	98.6
Using bedding materials for milking cows	26.6	63.4	78.6
Producers followed during milking			
Washing udder before and after milking	--	--	--
Washing udder before milking only	82.5	86.3	93.3
Not common practice	3.7	3.2	--
Some times	13.2	10.5	6.7
Washing hands before milking	77.2	70.9	76. 5
Type of water used for udder washing			
Cold	28.1	20.0	37.5
Warm	59.7	70.0	50
Both alternatively	9.7	-	8.3
***Sources of water for farm* activities**			
Warm tap/Pipe water	76.7	73.6	79.0
Well water	4.6	1.2	2.0
River water	18.7	25.1	19.0

Majority of participants did not use bedding materials for milking cows in the whole study areas. But the proportion was very low for Sebeta which was related to high price of material and unavailability.

Only 26.6, 63.4 and 78.6% of the respondents at Sebeta, Sululta and Holeta, respectively, use bedding materials. Use of bedding materials and frequent cleaning of barn have profound effect on reducing microbial contamination of teat and udder(Sintayehu *et al.,* 2008). According to study participants, about 40% uses traditional flavoring agents and anti-microbial effect for cleaning milk transporting equipments. Among them about 22.5% and 20.6% used 'woira' and 'Kosorot' respectively and the remaining used 'Ajekis' and 'Largo' for washing equipments.

Almost all of the participants in the study area use plastic materials for milking, storage and transportation of milk and only insignificant number of participants;1.2% and 1.3% used metal can and stainless steel respectively and 1.1 % used clay pot for storage before transportation.

Table 2: Percentage milking procedure and frequency of dairy farmers followed during milking at different study site

	Districts		
	Sebeta	Sululta	Holeta
Pre-milking procedure	n=32	n=30	n=40
Use of towel for drying udder			
Common towel for cleaning and drying udder and teat	48.1	51.3	72.2
Individual towel for each	3.4	4.5	3.8
Massage with bare hand	64.4	59.1	50.3
No washing and drying	3.5	10.0	12.4
Milking procedure			
Hand milking(%)	100	100	100
Machine milking(%)	--	--	--
Milking Frequency			
Once daily	2.1	2.6	2.0
Twice a daily	96.3	96.8	97.3

Almost all participants households in the study sites follows milking their cows per day, (91.2%)morning and afternoon, (6.9%)morning only and (1%) milk cows either mid day, evening or morning. The result of present study was similar to that of Sintayehu *et al.* (2008) who stated majority of the participants (96.3%) milk their cows twice daily in Shashsmane-Dilla area, Southern Ethiopia.

Milk production and marketing have a significant effect on the household food security as well as contributing to the national GDP. Table 3 indicates milk production per household.

Table 3: Mean number of milking cows per/household and milk produced per study sites

Variables	Districts		
	Sebeta n=32	Holeta N=40	Sululta N=30
No. of cows currently milked			
One	8(27.5)	10(24.5)	8(24.1)
Two	6(22.5)	7(16.7)	6(17.2)
Three	5(18.6)	7(17.2)	11(29.6)
More than three	9(31.4)	12 (29.8)	10(28.8)
Amount of milk produced/day			
1-5 liters	1(2.9)	1(3.4)	1(3.1)
6-10 liters	11(38.6)	15(37.3)	13(36.9)
>10 liters	14(52.0)	20(49.1)	18(53.4)
>15 liters	2(6.5)	4(10.2)	2(6.6)
Use of cooling system			
Refrigerator	1(3.3)	1(1.6)	1(2.6)
Traditional system	11(40.0)	20(49.1)	17(49.6)
At room temperature	16 (56.7)	19(49.3)	16(47.2)

The mean number of cow from which milk is pooled daily was 2.59±0.114 per household in the whole study areas (Table3). Majority of participants in the study areas pool milk from more than three cows (31.4%), from two cows(22.5%), from three cows(14.1%) and the remaining were from only one cows(20.7%).

About 52% of the participants in study sites produce on average more than 10 liters of milk daily and 45.1% and 2.9% of participants respectively produces 6-10 and 1-5 liters of milk per day/cow. This implies that majority of study participants produce and market high amount of milk that helps to sustain their household food security. Consumption of milk at household level was very low and majority of milk was sold per households that helps to generate income. On the contrary to the present finding, another study Teshager *et al.* (2013) found higher mean (96%) of milk consumption per household.

About 96.1% of the participants intended to expand milk production for the future while the remaining were not interested to do so. About (96.1%) and (2.3%) of the participants, respectively responded that milk production maintains household food production and generates income/ profitable.

Major factors that affect quality of dairy products are related with type and hygienic status of milking utensils used as well as method and frequency of cleaning udder, storage of milk and transportation utensils.

About 98, 97.1 and 94.15% of the participants in the study sites used plastic utensils for milking, storing before transportation and transporting milk. The result of present study was higher than that reported by Sintayehu *et al*. (2008) in Southern Ethiopia. Besides, significant number of respondents use plastic jar having narrow neck which may not be suitable for cleaning and may cause for microbial growth. More than half of the study participants did not use aroma producing plants like woira (*Olea africana*) that have profound effect on reducing growth of microorganisms (Sintayehu *et al*., 2008 and Asfaw, 2008). On the other hand, some participants use 'Ajekis' and Largo 'liquid soap' for washing utensils.

The major components of milk are water (87.4%), milk solids (12.60%), solids-not-fat (9.0%), fat (3.60%), protein (3.40%), milk sugar or lactose (4.90%) and ash or minerals (0.70%). These constituents may vary with genetic (breed and individual cow and variability among cows within a breed) and environment (interval between milking, stage of lactation, age, feeding regime, disease and completeness of milking)(Ramesh, 2006). The ash content which reflects the mineral composition of milk sample and ranged from 0.47±0.032 to 0.86%±0.067 and the milk sample collected from Sebeta collection center have the highest ash content and the least was from milk sample collected from Sululta retail shop.

The mean ash content obtained from present finding was in the range of Ramesh (2006) who reported 0.70%; Tola (2007) 0.70±0.01; Enb *et al.*(2009) 0.65 in raw cow milk in Egypt; but it was higher than that of Ibrahim *et al*. (2014); which was 0.37 from raw milk collected from different points in Nigeria.

The ash content of present study was showed a significant difference among critical points and between districts. Samples collected from Sebeta site had showed higher ash content than other sites. The sample collected from Sebeta collection center had showed significantly higher($P<0.05$) ash content than other critical points. The variation in ash content of milk might be related to status of provision of mineral lick and supplements in the area and other environmental and genetic factors.

The protein content of milk sample ranged from 3.12 to 2.39, 3.29 to 2.70 and 3.04 to 3.08 at farmer and retail level of Sebeta, Holeta and Sululta, respectively. Sample collected from Sululta site had showed the highest protein content than other sites. Due to sample from Sululta collection center critical point had showed significantly higher($p<0.05$) protein content than other critical points. However, milk sample collected from Holeta retail shop had showed the least protein content.

Protein content of the present study was lower than that reported by Negash *et al*. (2012) which was 3.46 ± 0.04; but the present finding agrees with that of Rehrahie and Yohannes (2000) which was 2.67% protein; Ramesh (2006) 3.40% and Tola (2007), 3.31±0.01. The result was also within the range of the acceptable limit of cow milk protein of 2.9 to 5.0% that was reported by (O'Connor, 1994). The protein content of sample collected from Sebeta farmer had showed significant difference ($P<0.05$) than retail shop critical point.

However, the low protein content that decreasing along critical points from producer to final retail might be due to higher microbial load along the chain, lack of protein supplement for the animal and other environmental and genetic related factor of the animal.

The fat content of milk sample ranged from 4.47 to 3.76, 4.05 to 3.24 and 3.58 to 4.37 from farmer and retail shop of Sebeta, Holeta and Sululta, respectively. Due to the sample collected from Sebebta farmer had showed the higher fat content than other critical points and the least with milk samples collected from Sululta collection center. However, Sample collected from Sebeta informal merchants had showed significantly higher ($p<0.05$) fat content than other critical points.

There was significant difference in fat content of sample ($p<0.05$) among critical points and between districts. The result of proximate composition of raw cow milk from different critical points in the study sites was revealed in Table 4.

Table4: (Mean±SD)Percentage proximate composition of raw cow milk in different critical point at study sites

Districts	***Sample Source***	***Ash fb(%)***	***Protein (%)***	***Fat (%)***	***Total solid(%)***	***SNF(%)***
ebeta	SEF	0.60±0.032[a]	3.12±0.133[a]	4.47±0.096[a]	113.54±0.29[a]	13.02±0.27[a]
	SEC	0.86±0.067[b]	2.72±0.190[b]	3.25±0.214[b]	112.38±0.46[b]	12.38±0.46[b]
	SEIM	0.67±0.020[a]	2.59±0.008[b]	4.58±0.085[a]	113.65±0.03[a]	13.01±0.04[a]
	SERS	0.78±0.002[b]	2.39±0.000[c]	3.76±0.012[b]	113.21±0.02[a]	12.64±0.03[b]
Holeta	HF	0.77±0.025[a]	3.29±0.020[a]	4.05±0.083[a]	110.86±0.08[a]	10.23±0.90[a]
	HOC	0.69±0.042[a]	3.27±0.040[a]	3.31±0.118[b]	111.38±0.21[a]	10.64±0.20[a]
	HIM	0.68±0.142[b]	2.28±0.007[b]	2.88±0.298[b]	110.38±0.57[b]	9.75±0.59[b]
	HDU	0.61±0.033[a]	2.79±0.133[b]	4.20±0.151[a]	110.81±2.45[c]	10.29±2.44[a]
	HRS	0.59±0.247[a]	2.70±0.040[b]	3.24±0.222[b]	111.67±0.35[a]	10.95±0.35[c]
Sululta	SUF	0.50±0.007[a]	3.04±0.012[a]	3.58±0.028[a]	110.54±0.10[a]	9.86±0.10[a]
	SUC	0.55±0.065[a]	3.41±0.165[b]	2.79±0.016[b]	9.82±0.52[a]	9.13±0.52[b]
	SUIM	0.49±0.017[a]	2.78±0.253[c]	3.10±0.122[c]	110.11±1.18[a]	9.65±1.27[a]
	SUDU	0.64±0.095[b]	2.92±0.020[c]	3.23±0.099[c]	110.04±0.00[a]	9.13±0.00[b]
	SURS	0.47±0.032[a]	3.08±0.114[b]	4.37±0.137[c]	111.85±0.44[b]	11.18±0.43[c]

The values were means of duplicate determinations. Means followed by different superscript letters for specific district within a column are significantly different($p<0.05$). SEF=Sebeta farmer, HF=Holeta farmer, SUF=Sululta farmer, SEC= Sebeta collection center, HOC= Holeta collection center, SUC=Sululta collection center, SUIM= Sululta informal merchants, HIM=Holeta informal merchant, SEM=Sebeta informal merchant, SUDU, Sululta dairy cooperative union, HDU=Holeta dairy cooperative union, HRS=Holeta retail shop, SURS=Sululta retail shop, SERS=Sebeta retail shop, FB=fresh weight base.

Besides, fat content of present study was in line with Ramesh (2006), 3.60%. On top of these, fat content of present finding was in the acceptable range of fat that is 2.5-6.0% reported by (O'Connor, 1994). Although, the fat content of the present study was lower than that reported by Negash *et al.*(2012) 5.48±0.19 from East Shoa Zone of Oromia; Tola (2007) 6.05±0.02 from East Wollega; Rehrahie and Yohannes (2000) obtained 5.88% and Zelalem *et al.* (2004) reported 5.43%. However, the lower fat content of present finding might be due to the high microbial load along different critical points in the study sites together with differences nutrition and genetic factors.

The mean total solid content of present study revealed that it ranged from 9.8 to 13.5 in Sululta collection center and Sebeta farmers respectively, which was agrees with that of Ramesh (2006),12.60%; Ibrahim *et al.*(2014) who found total solid content 11.69% from raw cow milk in Nigeria and Enb *et al.*(2009), 12.1±1.80. However, it was lower than that of Tola (2007) who reported 14.31±0.03 from East Wollega of Oromia. The sample collected from Sebeta site had showed higher total solid content than other sites. Due to sample from Sebeta informal merchant had showed significantly higher($p<0.05$) total solid content than other critical points. The higher total solid content in the case of Sebeta may due to milking cows were feeding brewery by-product from Meta brewery factory that act as supplement for milking cows in the area.

Besides to this, the SNF (Solid-Not- Fat) content of milk samples ranged from 9.13±0.00 to 13.02±0.27 from Sululta dairy cooperative union and Sebeta farmers respectively. The lower SNF content was might be due to the higher moisture content reported from respective samples. The result of present study for SNF was higher than that reported by Tola (2007), 8.22±0.01; Zelalem *et al.* (2004), 8.43%; and Negash *et al.* (2012), 9.10 ± 0.09 from East Shoa and West Arsi Zones of Oromia.

However, the result for SNF of present study finding was agrees with the report of Rehrahie and Yohannes (2000), 9.27%. Negash *et al.* (2012) from East Shoa and West Arsi Zones of Oromia reported 5.48 ± 0.19, 9.10 ± 0.09 and 3.46 ± 0.04, for fat, SNF and protein respectively from raw cow milk collected from individual households. Similarity, Rehrahie and Yohannes (2000) obtained 5.88% fat and 9.27% SNF, but a slightly higher than 2.67% protein. The other study by Alganesh *et al.* (2007) reported 6.05% fat, 3.31% protein and 8.22% SNF.

On top of this, Zelalem *et al.* (2004) reported SNF, fat and protein percents, indicating 8.43, 5.43 and 3.17%, respectively from Ethiopian Boran cows. The acceptable range of fat and protein from cow milk reported by O'Connor was between 2.5 to 6.0% and between 2.9 to 5.0% for fat and protein respectively (O'Connor, 1994).

Mineral elements are the most important inorganic component of food-stuffs that play a crucial role in many chemical reaction and biochemical process in the body. Calcium and phosphorous are required for bone formation both in infant and adult, for cell membrane permeability, for blood coagulation and muscle response. Zn is essential for basic physiological processes, development, lipid metabolism, brain and immune functions. Iron on the other hand is an integral parts of many proteins and enzymes that maintain good health. It is an essential component of protein and is involved in oxygen transport in the body.

Most of the trace elements are also present in milk at minute levels (Zinc, copper, iron, iodine, fluorine and selenium) and they perform several vital body functions as catalyst, activators and regulators (IDF, 2008). According the report of USDA (2008), the mineral elements specially calcium, phosphorus and iron in raw cow milk in mg/100gm were 113, 91 and 0.03 respectively.

Dawd *et al*. (2012) reported average concentrations of the mineral element Zn and Fe were (4.923±0.277mg/kg),(1.213±0.077mg/kg) respectively for raw cow milk samples collected from selected sub-cities in Addis Ababa. Ghada (2005) reported the main mineral elements from raw cow milk in Egypt; Ca, P, Zn and Fe 119±0.690, 95.03±0.72, 0.38±0.00 and 0.070±0.02mg/100g respectively. The result for mineral element of milk samples are shown in the Table 5.

Table 5: Mean±SD values of mineral elements in raw cow milk in different critical points at study sites(*mg/100g*)

District	*Source of Sample*	*Ca*	*Fe*	*Zn*	*P*
Sebeta	SEF	124.69±1.23^a	0.068±0.00^a	0.299±0.00^a	89.850±1.41^a
	SEC	122.34±2.27^a	0.069±0.01^a	0.299±0.01^a	89.141±0.68^a
	SEIM	119.93±4.00^b	0.071±0.01^b	0.310±0.09^a	87.224±0.45^b
	SERS	123.49±0.24^a	0.071±0.00^b	0.306±0.09^a	88.051±0.19^b
Holeta	HF	116.31±1.60^a	0.082±0.02^a	0.356±0.03^a	92.474±1.58^a
	HDU	121.07±6.90^b	0.086±0.00^b	0.350±0.02^a	93.014±0.98^a
	HRS	120.64±4.57^a	0.060±0.00^c	0.346±0.03^b	92.236±1.13^a
Sululta	SUF	116.18±1.10^a	0.072±0.01^a	0.348±0.04^a	91.707±0.75^a
	SUC	117.23±1.58^a	0.074±0.01^a	0.347±0.08^a	90.562±0.98^a
	SUIM	118.01±1.67^a	0.062±0.00^b	0.354±0.03^b	91.077±1.70^a
	SUDU	117.80±2.78^a	0.069±0.00^a	0.355±0.00^b	90.819±1.99^a
	SULRS	117.87±0.27^a	0.072±0.01^a	0.353±0.08^b	89.951±1.62^a

The values were means of duplicate determinations. Means followed by different superscript letters for specific district within a column are significantly different(p<0.05). SEF=Sebeta farmer, HF=Holeta farmer, SUF=Sululta farmer, SEC= Sebeta collection center, HCC= Holeta collection center, SUC=Sululta collection center, SUIM= Sululta informal merchants, HIM=Holeta informal merchant, SEM=Sebeta informal merchant, SUDU, Sululta dairy cooperative union/Selale, HDU=Holeta dairy cooperative union, HRS=Holeta retail shop, SURS=Sululta retail shop, SERS=Sebeta retail shop.

The mean values for mineral element Ca in present study varied from 124.7, 116.3, 116.18 and 123.49, 120.64, 117.87mg/100g from farmer and retail at Sebeta, Holeta and Sululta, respectively. The results of present finding were higher than USDA (2008) report, calcium in mg/100gm in raw cow milk was 113; but it was in line with that of Ghada (2005) reported Ca,119±0.690mg/100gm.

Sample collected from Sebeta retail shop had showed higher Ca content than other critical points. Due to sample collected from critical point Farmer had showed significantly higher(p<0.05) Ca content than other critical points. There was significant difference(P<0.05) in Ca content between critical point farmer and informal merchants of Sebeta; besides, value obtained from Sebeta site was significantly higher(P<0.05) than Sululta sites. However, Ca content of sample collected from Sebeta was not significantly different (p<0.05) from that of Holeta except for sample from farmers.

The mean values of Zn ranged from 0.299 to 0.356, 0.348 to 0.306 and 0.346 to 0.353 for Sebeta, Holeta and Suluta farmers and retail shops, respectively. Sample from Sululta site had showed higher Zn content than Sebeta site. However, sample collected from Holeta farmer had showed significantly higher (*p<0.05*) than other critical points. Besides, sample collected from Sululta site was significantly higher(*p<0.05*) than Sebeta site. However, the results of present finding was lower than that of Ghada (2005), who reported mineral element Zn 0.38±0.00mg/100gm from raw cow milk in Egypt.

But it was higher than that of Dawd *et al.* (2012) who reported average concentrations of the mineral element Zn (4.923±0.277mg/kg) in selected sub-cities in Addis Ababa. There was a significant difference(*P<0.05*) observed in the Zn content among critical points of present study except in the case of Sebeta.

The mean value of mineral element Fe ranged from 0.068 to 0.071, 0.082 to 0.060 and 0.072 to 0.072 mg/100gm for samples collected from Sebeta, Holeta and Sululta farmers and retail, respectively. The values of present study was higher than that of Ghada (2005) but it was lower than that of Dawd *et al*. (2012) and USDA (2008) report which was 1.213±0.077mg/kg and 0.03mg/100gm respectively. Higher Fe content was obtained from samples collected from Holeta farmers.

However, sample collected from Holeta dairy Cooperative Union had showed significantly higher($p<0.05$) Fe content than other critical points. Besides, sample from Holeta farmer had showed significantly higher($p<0.05$) Fe content than Sebeta and Sululta farmers. The Fe content was significantly ($p<0.05$) different between critical points of the study areas.

The mean values of Phosphorus from present study was varied 89.850 to 88.051, 92.474 to 92.236 and 91.707 to 89.951 at Sebeta, Holeta and Sululta farmers and retail shop, respectively. Samples collected from Holeta dairy cooperative Union had showed higher P content than other critical points of the study sites.

CONCLUSION AND RECOMMENDATION

The nutritional composition of milk from different sampling points in the study sites were varied along the critical points and between districts. Generally, the study showed that the quality of milk obtained from the different sources such as dairy farmers, collection centers, informal merchants, dairy cooperative union and retail shops were substandard [compared to relevant North American or EU regulations].

The result obtained in this study concluded that milk available to the consumer at different supply chain critical points have a low quality and poor handling practice. It indicates that hygienic procedures were not strictly followed during milk production to supply route. The magnitude of the problem of milk handling deserves more elaborative studies from the point of production of milk to the point of milk retail for consumption.

The results of the present study indicate that strict preventive measures should be adopted to ensure contamination free milk and its products for the good health of all consumers. Therefore, stakeholder authorities should regularly monitor the overall hygienic conditions of the milk production and conduct frequent inspections of milk marketed to check whether or not the minimum legal standards are met. Remedial actions can be taken by:

Milk marketing actors especially from collection center to retail shop and/vendors should use refrigerated vehicle and cold chain in place of open container and vehicle to maintain bulk tank temperature there by minimize microbial growth during transportation and storage. Actors in each critical point should perform basic laboratory test for at least indicator microorganisms that are frequently detected in raw milk available for direct human consumption.

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