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Full length Research paper

Physico-Chemical Analysis of Milk Collected From Urban Areas of Oromia Special Zone Surrounding Finfinne, Ethiopia

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The present study was aimed at analyzing the physico-chemical quality of milk, collected from the urban areas of Oromia special zone surrounding Finfinne, central highland of Ethiopia namely Burayu, Sabeta and sululta. A total of 30 milk samples (10 from farm/producer, 10 from milk collectors, and 10 from the cafeteria) were collected from each urban area and the samples were analyzed for the physic-chemical parameters namely Added water, pH, specific gravity freezing point ,titrable acidity, protein ,lactose, fat, total soiled ,ash, and solid nonfat to assess the quality of milk. For the analyses of data General Linear Model (GLM) was implemented. The result of (mean±SE) percentage of added water, pH, and Specific gravity were a significant difference ($p<0.05$) between the study town but there was no significant difference between the study town in the finding of titratable acidity and freezing point. All the physical parameters namely Added water, pH, specific gravity titrable acidity of milk quality obtained from farms, milk collectors, and cafeterias were significantly different ($p<0.05$) except freezing point. The mean result of protein, lactose, fat, and TS were significantly different ($p<0.05$) between Burayu, Sabeta, and Sululta but no statistical difference between study town in the result of SNF and ash percentage. Except for ash, all the chemical compositions of milk were significantly different ($p<0.05$) among the producer, collectors and cafeteria. From this result, most of the physicochemical property of milk sample obtained from farm fulfill the minimum requirement of Ethiopia quality standard but when comas to the milk collectors and cafeterias, the physicochemical quality was below the limits of Ethiopia quality standard, this indicated that the adulteration of milk in the study area increased from producer to end-user. The finding of this study provided recent information on milk physicochemical quality from farm to the cafeteria which can be an important input for regulatory bodies (EFDA) of Ethiopia.

Keywords: physicochemical, milk quality, milk composition, added water, adulteration, protein, Fat; pH, SNF and Freezing point

INTRODUCTION

Milk a white advanced biological fluid secreted by the mammary glands of female mammals. It is a vital supply of nutrients needed for the growth, maintenance, production, and correct functioning of the bodies of mammals. Most milk consumed by humans is usually obtained from 5 different species of mammals such as cows' buffalos, sheep, goats, and camels. Milk has consisting of an alimentary substance that contains macro and micronutrients of fats, proteins, carbohydrates, vitamins, minerals, and active compounds having a task in health protection (Merwan et al., 2018). Harding, (1999) stated that milk could be contained the mixture of fats, proteins, carbohydrates, minerals, vitamins, and alternative various constituents spread in water.

One gram of milk fat gives 9.3 Cal and one gram of protein and lactose gives 4.1cal (Zerihun A, and Getenesh

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T.2019). In Ethiopia, 95% of milk has occurred from cattle (CSA, 2010), and Cow milk is the utmost used up in the world followed by that of goat, camel, and donkey (Cisse et al., 2019). Cattle is the major economically necessary farm unit and investment opportunity for smallholder farmers within the country (Zelalem et al., 2011). The Ethiopian per capita consumption was very lower (17 kg) compared to it of different African nation average that was relating to 62.5 kg endorsed as a minimum level to satisfy the requirement for a diet and so the world's per capita average that was relating to100 L/year (FAO, 2010).

The composition of cows' milk is most important for the dairy trade, since, its quality is extremely influenced by the composition. In order that physical properties and chemical compositions of milk were the indication of qualities of milk with the hygienically normal (Haftu K et al., 2018). In Ethiopia most milk assortment centers and milk shade area unit inspecting the standard of milk victimization physical properties of alcohol check and relative density for its freshness throughout milk assortment. Additionally, pH scale and titratable acidity were help to check the standard of milk for process in milk plant (Zerihun A, and Getenesh T.2019). For this reason, identifying the physical characteristics and chemical composition of milk helps to assure the quality of milk for the consumers/dairy industry processers. In this study area, the limited studs has been reported on the physical characteristic and chemical composition of raw milk. Therefore, the authors were initiated to examine the physical characteristics and chemical composition of raw milk from farm to cafeteria to assure the quality for the consumers. The laboratory analysis result was compared with Ethiopia quality standard agency and EU/FAO.

MATERIALS AND METHOD

Description of the Study Areas

The study was conducted in Oromia Special Zone around Finfinne, in the central high lands of Ethiopia. The Oromia Special Zone has seven administrative towns, out of seven cities/towns from Oromia Special Zone around Finfinne/Addis Ababa, three cities/towns, namely Burayyu, Sebata, and Sululta were purposively selected for this study due to their high potential for urban dairy production.

Sample Size Determination and Sampling Techniques

The sample sizes for data collection through dairy farmers' survey were determined by using the sample size determination formula proposed by Yemane (1967).

$$n\frac{N}{1+N(e)^2} = \frac{840}{1+840(0.1)2} = 90$$

Where, n= designates the sample size the researcher uses; N= designates total number of households heads. e= designates maximum variability or margin of error; 1= designates the probability of the event occurring. Accordingly, the total sample size was 90. Out of 90 milk samples, 30 were collected each town, 10 from the farm/producer, 10 from collectors, and 10 from the Cafeteria of each study town. Then random sampling technique was applied to determine samples from each city.

Accordingly, the dairy farm, milk collectors, and cafeteria were the sources of data. Raw milk samples were collected from pooled containers of dairy farms, bulk tank containers of milk collectors, and by ordering cups of milk in the cafeteria. All samples collected were subsequently analyzed in the Dairy Laboratory of the Ethiopia meat and dairy industry development institute. About 250 ml of milk samples were collected in sterilize glass bottles. Samples were labeled and put in an icebox maintained at 4°C and transported to the laboratory and transferred into a refrigerator adjusted at a temperature of 4°C. Then, the milk samples were analyzed for physicochemical quality parameters. Samples from the farm were collected during the early morning. Milk samples from collectors were during 8:00am-9:00 am and samples from the cafeteria were collected during midday.

Physicochemical analysis

Analyses of physicochemical properties of cow milk were performed at Dairy Laboratory of the Ethiopia meat and dairy industry development institute using a Lacto scan(model number SL30 and brand name Sri Balaji Instruments) to determine the percentage composition added water, specific gravity/density, titratable acidity/lactic acid, freezing points, pH, lactose, protein, fat, SNF ash and total solid(ST). Percent Solids-not-fat was calculated by this formula: %SNF=%Total solids–% Fat.

Statistical analysis

The acquired data was arranged and analyzed using the General Linear Model (GLM) procedure of the Statistical Analysis System version 9.1. Mean separation was administered using the Least Significant Difference (LSD) method once the associate analysis of variance (ANOVA) shows significant differences between means. The results were expressed as mean ± standard mean error. Differences were considered statistically significant at 5, and 1% significance levels. The following models were used for the milk physicochemical statistics:

$Y_{ijk}=\mu+\alpha_i+\beta_j+e_{ijk}$

Where Y_{ijk}=individual observation for each sample

μ=the overall mean

α_i=the ith milk sources sites effects (i.e Burayu, Sabeta, and Sululta)

βj=the jth milk sample type effect (farm, collectors, cafeteria)
eijk= Random error

RESULT AND DISCUSSION

Raw Milk Physical Characteristics

Added Water

The mean ± (SEM) of the added water of milk sampled from the Burayu, Sebeta, and Sululta urban areas are shown in Table 1. The current study indicated that there was an adulteration of milk in all study areas. The added water of milk samples collected was significantly varied (P<0.05) among the three towns. The average mean values of added water content in the farm (producer), milk collectors, and the cafeteria was 0.58±1.017, 2.31±1.203, and 5.68±2.19, respectively. The result revealed that there was a statistically significant difference (P<0.05) of added water among dairy farms, milk collectors, and cafeteria (value chain point). Generally, it was found that the overall mean of added water was similar to findings of Dessalegn (2017) and Tsedey and Asrat (2015), higher than the results of Dehinenet *et al.* (2013) and contrast with the result of Abdissa Tadesse *et al.,* (2020). The addition of water to exploit not solely reduces the nutritionary worth of milk however conjointly contaminated water may cause a health risk (Pitty, 2011) and if contaminated, it poses a health risk to consumers (Kandpal *et al.,* 2012). The remains of the rinse water within the milk instrumentation before milking and therefore the addition of the wash water to the tank once the milking might have subsidized the presence of added water in milk Wangdi*et al.,* (2016).

PH-Value

The mean (±SE) pH of milk from Burayu, sabeta, and sululta was 6.4±0.127, 6.24±0.041, and 6.28±0.032 respectively. The result indicated that there was a significant difference between Burayu and the other two towns, but no significant difference between sabeta and sululta at the level of (p>0.05). The pH scale of all the sampled milk that collected from farms, milk collectors, and cafeterias were found to be 6.41±0.048, 6.28±0.036, and 6.24±0.0303, respectively (Table 1). Milk samples collected from the farm were considerably higher in pH scale than the other kinds of samples, however, slightly below the desired normal, but milk sampled from collectors and cafeteria was more acidic. The milk pH provides a clue of milk sanitation and freshness; the pH value of this study was below the normal pH of fresh cow milk. According to O'Connor (1995) and FAO (2009), fresh normal cow milk has a pH scale that bound from 6.6 to 6.8 when milk temperature is 20℃. In the current study milk, pH-value was out of the normal fresh milk. This might be due to the increased acidity of milk by bacterial multiplication. The result of this study was comparable with the result of Abdissa Tadesse et al., (2020) and Teklemichael et al. (2015) and disagree with the finding reported by Eshetu et al., (2019).

Titratable acidity

The overall mean (±SE) of Titratable Acidity of sampled milk from Burayu, sabeta, and sululta was 0.198±0.006, 0.179±0.0033, and 0.176±0.01 respectively. The mean Titratable Acidity/lactic acid percentage of raw milk sampled were not significantly different (P >0.05) among the three towns. The overall mean (± SE) of Titratable Acidity milk sample collected from the farm, collectors, and cafeterias were 0.176±0.0034, 0.187±0.0084, and 0.189±0.004 respectively. The result showed that there were significant differences (P<0.05) in milk from farm to collectors and cafeteria. In the current study, the milk samples collected from three cities had a titratable acidity was larger than 0.17% which indicates that the milk samples were kept at normal temperature for many time and below poor handling practices till they were oversubscribed and/or consumed. According to the Ethiopian Standards Agency, the titratable acidity of ordinary fresh milk is between 0.14 and 0.17%. The current study is comparable with the result of Teshome G and Tesfaye A (2015) and lower than the finding reported by Asaminew and Eyassu (2011). In this study milk sampled from collectors and cafeteria were high percent of titratable acidity than milk sampled from the farm, maybe due to the high microorganism growth and multiplication throughout transportation of the milk to the hawking sites and longer storage of the milk before consumption.

Specific Gravity

The mean result of specific gravity that milk obtained from Burayu, Sabeta and sululta were 1.035±0.01, 1.028±0.001, and 1.027±0.0011 respectively. The result revealed that the specific gravity of milk sampled from Burayu was above the particular specific gravity of milk obtained from Sabeta and Sululta. Therefore, important variations (P<0.05) were perceived for density between Burayu town to the other study towns. The specific gravity/density of collected samples from farms, collectors, and cafeterias were 1.029±0.00039, 1.026±0.0091, and 1.026±0.0023 respectively. The study revealed that the specific gravity of milk sample in producer, collectors and cafeteria was significantly different (P<0.05) between milk sampled from farm to the other collectors and cafeteria, but there was no significant difference (p>0.05) between collectors and cafeterias. The density of normal milk ranges from 1.027 and 1.035 with mean value of 1.032 at 16°C (FAO, 1999). In this finding, the specific gravity of raw milk samples obtained from collectors and cafeteria in a milk source chain was less than that obtained from producers and also below the standard limit. These variations could be because of the various sources of milk mixed along that may are debased with water. An analogous result was additionally reportable by Teklemichael *et al*., (2015) and Eshetu *et al*., (2019). Many factors can affect the density of milk. For instance, the specific gravity of milk decreases by the adulteration and addition of cream; while it is increased by the elimination of fat and dropping of temperature.

Freezing Point

The result indicated that there was no significant difference ($p>0.05$) among the 3 study cities. Average and commonplace error mean of the temperature of milk from the farm (milk producers), milk collectors, and cafeterias were evaluated. The freezing point of milk samples collected was considerably varied ($P<0.05$) among the milk value chain points. According to the Ethiopia standard agency, the normal freezing point of milk is between -0.55^{oC}to -0.525^{oC} (ES2009). The current study was not within the range of normal milk freezing point this may due to milk was adulterated and poor handling management, however, this finding was slightly similar to the average milk freezing points reported by Dessaleng (2017) of -0.55±0.03 ^{o}C and less than the results of -0.941 ± 1.40 ^{oC} reported by Shimelis (2016) with milk collected from the study conducted in Addis Ababa.

For dairy farmers and consumers, the freezing point of milk is the indicator of milk quality, especially adulteration with water. The environmental difference, breed, and management can all influence the freezing point of milk. The season, time, type of feed, and the amount of water the animal consumes can affect milk's freezing point.

Table 1:Physical quality of raw milk

Parameter %	Burayu	Sabeta	Sululta	P-valeu
Added water	4.42±1.302	3.9±1.19	3.59±1.24	0.002
PH-value	6.4±0.127	6.24±0.041	6.28±0.032	0.0001
Titratable acidity	0.198±0.006	0.179±0.0033	0.176±0.01	0.0004
Specific gravity	1.035±0.01	1.028±0.001	1.027±0.0011	0.434
Freezing point	-0.525±0.078	-0.475±0.053	-0.541±0.009	0.60
Parameter %	**Farm**	**Collector**	**Cafeterias**	**P-valeu**
Added water	0.58±1.017	2.31±1.203	5.68±2.19	0.0004
PH-value	6.41±0.048	6.28±0.036	6.24±0.0303	0.001
Titratable acidity	0.176±0.0034	0.187±0.0084	0.189±0.004	0.039
Specific gravity	1.029±0.00039	1.026±0.0091	1.026±0.0023	0.26
Freezing point	-0.56±0.0035	-0.553±0.009	-0.43±0.126	0.0021

Mean value with different superscript letters for each milk quality parameters in the rows are Significantly different ($p<0.05$)

Chemical composition of raw milk

The laboratory result for chemical composition of raw milk sampled such as protein, lactose, fat, ash, solid nonfat (SNF), and total solid are shown in Table 2

Protein content

The mean± SE protein content obtained in Burayu, Sabeta, and Sululta was (3.16±0.0551, 3.31±0.098, and 3.14±0.095) respectively. There was a significant difference ($P<0.05$) between the Sabeta and the other two towns but there is no statistical difference between Burayu and Sululta. The average protein contents of milk sampled from Farm, milk collectors and cafeteria were (3.45±0.051, 3.34±0.086, and 2.84±0.111) respectively. Statistical analysis showed that there was a significant difference ($P<0.05$) in protein percentage among the three value-chain points. In this study, the finding of protein content was like the result of Desalegn (2017), Debebe (2010) (3.2±0.22), Mirzadeh (2010) (3.2±0.22%), and Belay and Janssens (2014) (3.21±0.06). However, it is lower than the finding of (3.94±0.07), 3.67, 3.4, and 3.34 % reported by Gurmessa *et al*. (2015), Deresse (2008), Haftu, (2013), and Ayisheshim *et al*., (2015) in Yabello District, Borana Zone, cow milk of Western Shewa, Southern Ethiopia and Western Amhara region respectively. The current result was slightly higher than the result of 3.12±0.32 reported by Dehinnent *et al*. (2013). From the result, the protein content of milk decreased starting from the producer to the end consumer. This may due to the adulteration of milk by the water. According to the Ethiopian standards Authority, the minimum percent protein content of milk should be 3.2 percent (ESA, 2009).

Lactose contents

The mean± standard error lactose contents of raw milk samples collected from Burayu, Sabeta, and Sululta was 3.55±0.133, 3.69±0.154, and 3.75±0.164 respectively.

These results showed that there was a significant difference (p<0.05) among the study town. The average lactose content of raw milk collected from Farm (producer), milk collectors, and cafeteria were (3.83±0.127, 3.72±0.148, and 3.45±0.176) respectively. Statistical analysis showed that there was significant difference (p<0.05) between producer, collectors, and cafeteria. In this study, the result of lactose contents was lower than the result of (4.34±0.13) Belay and Janssens (2014) who reported the sugar content of cow milk samples collected from diverse urban dairy farms located in Jimma town and 5.39±0.31 reported by Abdissa *et al* (2020)on milk handling, processing practices and quality evaluation.

As European Union determine that Quality Standards for raw whole milk, lactose content should not be less than 4.2% (Tamime, 2009). Therefore, the current result was below the recommended standards. This might be due to the action of lactose hydrolyzing enzymes produced by microorganisms as a result of storage temperature variation Dessalegn (2017). In general, the composition of milk can vary depending on the breed of the animals, management practices such as feeding management, and environmental factors that influenced the milk composition (Pandey and Voskuil, 2011).

Fat contents

The overall average and standard error of fat composition of raw milk sampled from Burayu, Sabeta, and Sululta were 3.64±0.204, 4.11±0.179, and 4.13±0.371, severally. The statistical analysis revealed that there was a significant difference (P< 0.05) among the study areas.

The mean value ± standard means an error of fat content in milk samples collected from Farm, Collectors, and cafeteria were 4.33±0.253, 3.45±0.314, and 4.103±0.186 respectively.

The result revealed that there were significant difference (p<0.05) among the milk value chain point. The current result of fat contents was higher than the report of Dessalegn (2017) who found (3.60±0.53) fat from Milk Value Chain and Quality in Bishoftu and Akaki Towns, Oromia Regional State, Ethiopia. However, this finding was less than the report of Teshome *et al*. (2015) that result (4.28±0.05) of fat from raw cow’s milk produced and sold in Shashemene town, Ethiopia. This result was comparable with the result of 3.9% raw milk reported by Kunda *et al.* (2015) on smallholder of dairy farmers in the Lusaka Province of Zambia.

The subordinate fat content of milk may be due to high milk-producing crossbreeds’ cows that reduce the milk samples' fat content or water is also additional with milk or part skimming the milk or because of the feed, they offered. In line with the Ethiopian commonplace agency, the minimum fat content of raw milk should not be less than 3.5% (ESA, 2009). Accordingly, the mean (±SE) fat content (3.96±0.25) observed from the three value-chain points milk samples was in the range of recommended standards.

Solid not Fat (SNF)

The average content of SNF in raw milk that collected samples from Burayu, Sabeta, and Sululta towns were 7.46±0.153, 7.71±0.172, and 7.603±0.197, respectively. From this result, there was no significant difference between the study towns (Table 2). The overall mean values of solid not fat (SNF) content of raw milk samples collected from farm, collectors, and restaurants were 7.99±0.126, 7.77±0.184, and 6.99±0.212 correspondingly. The current finding exposed that there were significant differences (P<0.05) within the SNF content of milk collected in the producer collectors and cafeteria. The current finding of SNF content of raw milk was slightly agreed with the result of Estifanos *et al.* (2015), who report the average SNF (7.98±0.98) of raw cow milk and Dessalegn (2017) who report the average SNF (7.78±0.41) Milk Value Chain and Quality in Bishoftu and Akaki Towns, Oromia Regional State, Ethiopia. But lower than the results of Fikrineh *et al.* (2012) that found the mean SNF percentage of raw milk of Adama town to be 9.05±0.16 and Debebe (2010) also reported the minimum (8.3±0.36) and maximum (8.7±0.36) SNF content of raw cow’s milk obtained from street-vendors and milk producers in, and around Addis Ababa. According to Food and Drug Administration (FDA) also as European Union (EU) quality standards, a minimum solid not fat (SNF) content of milk is 8.25% by Raff (2011). The present result's not found within the recommended range. This might due to a spread of things including the feed, genetics, season of the year, stage of lactation and disease.

Total Solid (TS)

The overall common mean ± SE result of TS content in milk sampled in Burayu, Sabeta, and Sululta had been 11.097±0.307, 11.83±0.252 and11.73±0.507 respectively. Statistical analysis showed that there have been no significant differences (P>0.05) within the TS content of milk collected from the study towns. The mean value of total solid contents of milk samples collected from farms, collectors, and cafeterias were 12.34±0294, 11.88±0.315, and 10.44±0.46 respectively (Table 2). The result revealed that there were significant differences (p<0.05) within the milk value chain point. The total solids (TS) content of this result was lower than Eshetu *et al.,* (2019) who report average total solid (12.78%) milk production and marketing practices, along with milk qualities and supply chains of Haramaya District, Ethiopia. But the current result was agreed with Dessalegn (2017) who report the average total solid content (11.38%) Milk Value Chain and Quality in Bishoftu and Akaki Towns, Oromia Regional State. According to the Ethiopia standard agency, the total solid contents of cow milk should not be less than 12.80% (ES, 2009). Therefore, the result of this study was less than the recommended standard. The lower total solid content found from this study may be due to adulteration of milk (addition of water to milk) and removal of fat content.

Ash contents

The overall mean value± SE result of ash content in raw milk sampled from Burayu, sabeta, and Sululta were 0.74±0.101, 0.713±0.022, and 0.713±0.11 respectively (Table 2). The result showed that there have been no significant differences (P>0.05) within the ash content of various sorts of milk samples collected from study towns. The average± SE ash contents of milk samples collected from Farm, Milk collectors, and cafeteria were 0.73±0.187, 0.74±0.0187, and 0.697±0.026 respectively as shown in table 2. Statistically, it was found that there were no significant differences within the different types of raw milk samples collected from the different value chain points. The result of the current study was higher than the result of 0.62±0.05 reported by Dessalegn (2017) and also the result of Imran *et al.* (2008) and Estifanos *et al.* (2015) who observed that the means of ash in cow's raw milk collected from different locations were 0.64±0.07and 0.68±0.16, respectively. But an agreement with the finding of Teshome *et al* (2014) who reported the ash content (0.78±0.00) for the raw cow's milk collected from produced and marketed in Shashemene town, Southern Ethiopia.

Table 2:Chemical composition of milk

Parameter in %	Burayu	Sabeta	Sululta	P-value
Protein	3.16±0.0551	3.31±0.098	3.14±0.095	0.067
Lactose	3.55±0.133	3.69±0.154	3.75±0.164	0.75
Fat	3.64±0.204	4.11±0.179	4.13±0.371	0.063
SNF	7.46±0.153	7.71±0.172	7.603±0.197	0.161
Total solid	11.097±0.307	11.83±0.252	11.73±0.507	0.399
Ash	0.74±0.101	0.713±0.022	0.713±0.11	0.398
Parameter %	**Farm**	**Collector**	**Cafeterias**	**P-value**
Protein	3.45±0.051	3.34±0.086	2.84±0.111	0.0001
Lactose	3.83±0.127	3.72±0.148	3.45±0.176	0.018
Fat	4.33±0.253	3.45±0.314	4.103±0.186	0.0067
SNF	7.99±0.126	7.77±0.184	6.99±0.212	0.0001
Total solid	12.34±0294	11.88±0.315	10.44±0.46	0.001
Ash	0.73±0.187	0.74±0.0187	0.697±0.026	0.083

Mean value with different superscript letters for each milk quality parameters in the rows are Significantly different (p<0.05)

CONCLUSION

From the laboratory analysis of this study, it was concluded that the adulteration of raw milk were increased along with the milk chain in Oromia special zone around Finfinne. As results of physiochemical properties analysis indicated that, most of the quality parameters of sampled milk were not fulfilling the required quality of Ethiopia standard agency/FAO/EU. Milk chemical composition was an indicator of the quality, these decreased from producer to end consumer. Finally, it is concluded that the current condition of quality of milk in the study site in terms of physicochemical compositional aspect is at an alarming state, so it requires urgent action to reverse the situation.

REFERENCES

Abdissa Ta, Ulfina G, Amanuel B, (2020). Milk Handling, Processing Practices and Quality Evaluation.

Asaminew T, Eyassu S (2011). Microbial quality of raw cow's milk collected from farmers and dairy cooperatives in Bahir Dar Zuria and Mecha district, Ethiopia. *Am. J. Agric. And Biol.*, **19**: 21-27

Aysheshim B, Fekadu B, Mitiku E (2015). Chemical composition and microbial quality of cow milk in urban and pre-urban area of Dangila town Western Amhara Region, Ethiopia. *Global J Dairy Farm Milk Prod* 3(1), 081-085

Belay D, Janssens GPJ (2014). Physicochemical Quality and Consumption Pattern of Milk at Smallholder Urban Dairy Farms in Jimma Town of Oromia, Regional State,Ethiopia, *Global Journal of Science Frontier Research*: *Agriculture and Veterinary*,**14**: 30-36

Cisse H, Muandze-Nzambe JU, Somda NS, Sawadogo A, Drabo SM, Tapsoba F, Zongo C,Traore Y, Savadogo A (2019). Assessment of safety and quality of fermented milk of camels, cows, and goats sold and consumed in five localities of Burkina Faso. *Veterinary World*, 12(2), 295-304.

CSA. (2010). Agricultural Sample Survey, Livestock, Poultry and Beehives population (privatepeasant holdings).Federal Democratic Republic of Ethiopia Central Statistical Authority (CSA), Addis Ababa, Ethiopia

Dessalegn G (2017). PhD dissertation on Characterization of Dairy Cattle Husbandry Practice and Performance under Smallholder Systems and Analysis of Milk Value Chain and Quality in Bishoftu and Akaki Towns, Oromia Regional State, Ethiopia.

Dehinenet G, Mekonnen H, Ashenafi M, Emmanuelle G (2013). Determinants of raw milk quality under a smallholder production system in selected areas of Amhara and Oromia National Regional States, Ethiopia. *Agric. Biol. J. N. Am.*1): 84-90

Debebe W (2010). Physicochemical Properties and Safety of Street-vended Milk in andAround Addis Ababa City (Kotebe, Bishoftu and Chancho), MSc. Thesis, Haramaya University, Ethiopia, 83p

Derese T (2008). Present situation of urban and peri-urban milk Production and quality of raw milk produced in West Shoa Zone, Oromia Region, MSc thesis, Haramaya University, Ethiopia, 82p

ESA (Ethiopian Standard Agency) (2009). Unprocessed Whole/Raw Cow Milk Specification. 2nd ed., ES: 3460

Estifanos H, Tarekeg G, Yonas H, Eyassu S, Mengistu K, Mohammed A (2015). Physicochemical Properties and Microbial Quality of Raw Cow Milk Collected from Harar Milk shed, Eastern Ethiopia, *J. Biol. Chem. Research,* **32**(2): 606-616

Fikrineh N, Estefanos T, Tatek W (2012). Microbial quality and chemical composition ofraw milk in the Mid-Rift Valley of Ethiopia, *African Journal of Agricultural Research,* **7**(29): 4167-4170

FAO. (2009). Milk Testing and Payment Systems Resource Book a practical guide to assist milk producer groups. Rom, Italy: Food and Agricultural Organization United Nation.

Food and Agriculture Organization of the United Nations (FAO) (2010). Status and prospects forsmallholder milk production. A global perspective, By Hemme T and Otte J, Rome, Italy. http://www.fao.org/3/i1522e/i1522e.pdf

Gurmessa T, Mitiku E, Alemayehu R (2015). Physico-chemical qualities of raw cow milkin Ethiopia. The case of Borana zone, Yabello District. *Glob. J. DairyFarm. Milk Prod.,* **3**(2): 086-091

Haftu K (2015). Productive and Reproductive Performance of Holstein-Friesian Cows under Farmer's Management in Hossana Town, Ethiopia, *International Journal of Dairy Science,*

Harding F (1999). Milk quality. Chapman and Hall Food Science Book, first edition. Aspen Publishers, Incorporated Gaithersburg, Maryland, Edited by Harding, F.: 3-23.

Kandpal SD, Srivastava AK, Negi KS (2012). Estimation of quality of raw milk (open and branded) by milk adulteration testing kit. Indian Journal of Community Health, 24(3)

Kunda B, Pandey GS, Muma JB (2015). Compositional and sanitary quality of raw milk produced by smallholder dairy farmers in Lusaka Province of Zambia. Livestock Research for Rural Development. 27, Article #201.Available at lrrd.org/lrrd25/10/ayza25183.htm

Mirzadeh K, Masoudi A, Chaji M, Bojarpour M (2010). The Composition of Raw Milk Produced by Some Dairy Farms in Lordegan Region of Iran. Journal of Animal and Veterinary Advances, 9(11):1582-15

Merwan A, Nezif A, Metekia T (2018). Review on milk and milk product safety, quality assurance and control. Int. J. Livestock Prodn. 9(4), 67-78

O'Connor C.B. (1995). Rural Dairy Technology ILRI Training Manual I, International Livestock Research Institute, Addis Ababa, Ethiopia

Teshome G, Fekadu B, Mitiku E (2015). Physical and chemical quality of raw cow's milk produced and marketed in Shashemene Town, Southern Ethiopia. J. of Food and Agric. Sci., 5(2):7-13

Food and Agriculture Organization of the United Nations (FAO) (1999). Extension Services forQuality Milk Production. Proceedings of an International Workshop in Conjunction with theEast-West-Forum of the Federal Ministry for Food, Agriculture and Forestry, Germany P 35.

Teklemichael T, Ameha K, Eyassu S (2015a). Physicochemical Properties of Cow Milk Produced and Marketed in Dire Dawa Town, Eastern Ethiopia. Food Science and Quality Management 42:56-61.

Tsedey A, Asrat T (2015). Safety and Quality of Raw Cow Milk Collected from Producers and Consumers in Hawassa and Yirgalem areas, Southern Ethiopia, Food Science and Quality Management, 44:63-72

Tamime AY (2009). Milk Processing and Quality Management. Society of Dairy Technology, United Kingdom

Teshome G, Fekadu B, Mitiku E (2015). Physical and chemical quality of raw scow's milk produced and marketed in Shashemene Town, Southern Ethiopia. Journal of Food and Agricultural Science, 5(2):7-13

Raff H (2011). Market implications of changing fat content of milk and dairy products, fat content and composition of animal products. Journal of Food Science and Technology5(2):6- 17.Pitty (2011). A national survey on milk adulteration. Conducted by Food Safety and Standards Authority of India

Pandey GS, Voskuil GC (2011). Manual on Milk safety, quality and hygiene. Golden Valley agricultural Research Trust, Zambia. PP: 52.

Shimeles B (2016). Physicochemical properties and microbial quality of cow milk collected From selected sub city of Addis Ababa, Ethiopia. College of Veterinary Medicine and Agriculture of Addis Ababa University, Animal Production Studies. Bishoftu, Ethiopia:

Wangdi J, Zangmo T, MinduK Bhujel P (2016). Compositional quality of cow's milk and its seasonal variations in Bhutan. Livestock Research for Rural Development. Volume 28, Article #2.http://www.lrrd.org/lrrd24/7/ njar24122.htm.

Yemane T (1967). Statistics: An Introductory Analysis, 2nd Edition, NewYork: Harper and Row

Zelalem Y, Emannuelle GB, Ameha S (2011). A Review of the Ethiopian Dairy Sector. Ed. Rudolf Fombad, Food and Agriculture Organization of the United Nations, Sub Regional Office for Eastern Africa (FAO/SFE), Addis Ababa, Ethiopia P 81.

Zerihun A and, Getenesh T (2019), Physical Properties and Chemical Compositions of Raw Cow Milk in Milk Shades around Addis Ababa, Ethiopia.