Physico Chemical Properties of Cow Milk Produced and Marketed in Dire Dawa Town, Eastern Ethiopia

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Abstract

The present study is primarily aimed at assessing the physico chemical properties of cow milk samples sold by dairy farms and milk vendors in Dire Dawa Town. A total of 30 cow milk samples were collected and examined. The mean values for pH, specific gravity, titratable acidity, protein, fat, total solids and solids-not-fat contents of milk samples collected from dairy farms were 6.627 ± 0.135, 1.030 ± 0.001, $0.165\pm0.022\%$ lactic acid, $3.42\pm0.139\%$, $3.862\pm0.412\%$, $12.575\pm0.635\%$ and $8.75\pm0.301\%$ respectively. However, the corresponding values for milk vendors were 6.43 ± 0.062, 1.025 ± 0.001, $0.195\pm0.009\%$ lactic acid, $3.274\pm0.083\%$, $3.85\pm0.284\%$, $12\pm0.572\%$ and $8.15\pm0.308\%$. On the other hand, the respective values for pasteurized milk were 6.65 ± 0.070, 1.031 ± 0.0007, $0.15\pm0.014\%$ lactic acid, $3.05\pm0.098\%$, $3.7\pm0.141\%$, $10.8\pm0.282\%$ and $7.1\pm0.141\%$ respectively. Significant differences ($p<0.05$) were found for the values of total solids, solids not-fat and protein between the sources of milk samples. The present study showed that dairy farm milk producers and milk vendors follow poor milk handling practices.
Keywords: Fat, PH, Protein, Raw milk, Pasteurized milk.

1. Introduction

Under normal condition, milk is sterile until it reaches the milk ducts of the udder of the healthy milking animals. It is a highly nutritious food and ideal for microbial growth. As a result, it often deteriorates and becomes inappropriate for human consumption (FAO, 2001).

Physiochemical analysis is important tool to monitor the quality milk and other dairy products. Adulteration in food is done either for financial gain or lack of proper hygienic conditions of processing, storing, transportation and marketing. This ultimately leads to the stage that the consumer is either cheated or often becomes victim of diseases. Such types of adulteration are quite common in developing countries. It is equally important for the consumer to know the common adulterants and their effects on health (Faraz et al., 2013). Increased concentration of hard water in milk showed the adverse effect on quality of milk by increasing the acidity, thereby reducing the shelf life of milk. Usage of hard water leads to high number of coliforms in milk, while the addition of soft water decreased the acidity and reduced the levels of coliforms in raw milk leading to improvement in shelf life. The consumption of boiled milk is necessary, as raw milk adultered by vendors with water irrespective of its type could be a major source of contamination (Deshmukh et al., 2006).

The water contaminated with fecal matter, sewage, manure or either with industrial and domestic effluents, is likely to have a number of pathogens. Milk can harbor a variety of microorganisms and can be important sources of food-borne pathogens (Oliver et al., 2005). Compared to raw milk pasteurized fluid milk presents little health hazard. However, several food-borne disease outbreaks have been linked to pasteurized milk and this is traced to inefficient pasteurization temperature, poor packaging material and storage temperature abuse (ICMSF, 2005). In the study area adulteration is mostly practiced by producers and milk vendors. This could result in the contamination of milk and milk products. Though most bacteria are destroyed by pasteurization, there are certain types and certain bacterial stages that are not destroyed. Bacteria in milk, originating from different sources such as the cow or the environment, can significantly influence the quality of dairy products and therefore consumer acceptance. The objective of the study is to evaluate the quality of cow milk produced and marketed in Dire Dawa town.

2. Materials and Methods

2.1. Sample collection

A total of 30 milk samples each containing 500 ml of raw and pasteurized milk were collected from March 2011 to June 2011. Raw milk samples were collected directly from bulk milk containers used by the dairy farms (16 samples) and the milk vendors (12 samples). Two pasteurized milk samples were, however, collected from Hamdael Dairy Farm. After aseptically collecting the milk samples with sterile bottles, they were transported to Haramaya University Dairy Technology Laboratory.

2.2. Physicochemical Properties of Milk

2.2.1. Determination of temperature and pH

The temperature of the milk samples was determined at the collection point using thermometer while the pH of the milk samples was determined in the laboratory using a digital ph-meter (EUTECH, Serial No. 1366514, Model P/N: 54×002606; made in Malaysia) (AOAC, 2005). The Ph meter was first calibrated using buffers of pH 7.0 and 4.0 each time before the pH of milk sample was measured.

2.2.2. Titratable acidity

Titratable acidity of the milk samples was determined according to the method of the Association of Official Analytical Chemists (AOAC, 1990). Nine ml of milk sample was pipetted into a beaker and 3 to 5 drops of 1 % phenolphthalein indicator was added to it. The milk sample was then titrated with 0.1N NaOH solution until a faint pink color persisted. The titratable acidity, expressed as % lactic acid, was finally calculated using the following formula.

$$\text{Titratable acidity (\%)} = \frac{0.1N \text{ NaOH (ml) } x0.009}{\text{Weight of milk sample}} \times 100$$

2.2.3. Specific gravity

Fresh milk samples were filled sufficiently into a glass cylinder (100 ml capacity). Then lactometer was held by the tip and inserted into the milk. The lactometer was allowed to float freely until it reaches equilibrium. Then the lactometer reading at the lower meniscus was recorded. Immediately, thermometer was inserted into the milk sample and the temperature of the milk was recorded (O, Mahoney, 1998). The following formula was used to calculate the specific gravity of the milk.

$$\text{Specific gravity} = (L/1000) + 1$$

Where, L = corrected lactometer reading at a given temperature, i.e., for every degree above 60 ^{0}F, 0.2 was added to the lactometer reading but for every degree below 60 ^{0}F, 0.2 was subtracted from the lactometer reading.

2.2.4. Total solids

For the determination of total solids content, fresh cow milk sample was thoroughly mixed and 5 g was transferred to a pre-weighed and dried flat bottom crucible (AOAC, 1990). The milk samples were dried in a hot air oven (Serial No-96H203, Model-EDSC made in England) at 102°C for 3 hours. Finally, the dried samples were taken out of the oven and placed in desiccators to cool to room temperature. Then samples were weighed again and total solids was calculated by the following formula according to (Richardson, 1985).

$$\text{Total solids} = \frac{\text{Crucible weight+Ovendry sample weight - Crucible weight}}{\text{Sample weight}} \times 100$$

2.2.5. Fat content

The fat content was determined by the Gerber method according to (Richardson, 1985). Ten ml of sulfuric acid (density 1.815 gm/ml at 20°C) was pipetted into a butyrometer. Then eleven ml of milk sample was added into the butyrometer and mixed with the sulphuric acid. This was followed by addition of 1 ml amyl alcohol into the butyrometer which was then closed with a lock stopper. Then the mixture was shaken and inverted several times until the milk was completely digested by the acid. Finally, the butyrometer was kept in water bath for 5 minutes at 65^{0}C and centrifuged in a Gerber centrifuge for 5 minutes. The butyrometer was placed in water bath again at 65^{0}C for 5 minutes. At the end, the butyrometer reading was recorded.

2.2.6. Solids not-fat

Solids-not-fat (SNF) content was determined by difference as reported by (Getachew, 2003) using the following formula:

SNF content (%) = TS (%) – Fat (%)

2.2.7. Crude protein content

The crude protein content of milk samples were determined by the Kjeldahl method (AOAC, 1995).

Digestion: 5 g of milk sample was warmed in water bath at 38^{0}C and poured to a Kjeldahl tube. A mixture of 15 g potassium sulphate, 1 ml of copper sulphate solution and 25 ml of concentrated sulphuric acid was added into the tube and mixed gently. The digestion was carried out for 120 minutes at 350^{0}C using micro-Kjeldhal digester in the presence of catalyst (1 ml of copper sulphate and 15 g potassium sulphate) where sulphuric acid was used as an oxidizing agent. Then it was allowed to cool at room temperature over a period of 25 minutes. The digested solution was diluted with 250 ml of distilled water.

Distillation: The Kjeldahl tube was placed in the distillation equipment. 75 ml of 40% sodium hydroxide solution was added into the tube. Then ammonia was distilled using 50 ml of 4% boric acid solution with bromocresol green/methyl red as indicators until blue color appears. Finally, the sample was titrated with 0.1N hydrochloric acid solution until a faint pink color is formed and the burette reading was taken to the nearest 0.01 ml. Blank test was carried out using the above procedure except that water was used instead of the test sample. The percentage of nitrogen in the milk samples was calculated using the formula provided (AOAC, 1995).

$$\% \ N = \frac{1.4007x \ (vs\text{-}vb) \ X \ N \ HCl \ x \ 100}{Weight \ of \ sample}$$

$$\% \ CP = \% \ N \ x \ 6.38$$

Where, % N = percentage of nitrogen by weight
Vs = volume of HCl used for titration of sample
Vb = volume of HCl used for titration of the blank
% CP = percent of crude protein

2.2.8. Ash content

The ash content of milk samples was determined according to (Richardson, 1985). The dried milk samples used for the determination of total solids content were ignited in a muffle furnace (Serial No, F144098, Model EF5 made in Holland) at a temperature of 550°C until they were free from carbon (residue appears grayish to white) for four hours, then the samples were transferred to the desiccator to cool down. The dish containing the sample was then re-weighed after the dish was completely cooled. The ash percent of the sample was calculated as follows:

$$\% \ Ash = \frac{Weight \ of \ residue}{Weight \ of \ sample} \ x100$$

3.   Statistical Analysis

Data on the physicochemical characteristics of milk samples from different sources were compared statistically and analyzed using analysis of variance (SAS 9.3 software). Mean separation was carried out using the Tukey's Honestly Significant Difference (HSD) Test.

4.   Result And Discussion

The physical properties of raw and pasteurized milk collected from dairy farms, vendors and Hamdael Dairy Farms in Dire Dawa town are shown in Table 1. The temperature of milk collected from dairy farms was significantly higher than those of the pasteurized milk collected from Hamdael Dairy Farm and the raw milk collected from vendors.

The high temperature of milk samples collected from milk vendors and dairy farms is favorable for bacterial growth (Table 1). Higher microbial counts were observed in raw goats' milk kept at room temperature (25°C) which ranged from 1.7×10^7 to 4.22×10^{10} cfu/ml contrary to microbial counts of milk kept at 4°C which ranged from 2.2×10^5 to 1.46×10^{10} cfu/ml at 96 hours of storage (Eyassu , 1998). In the study area, the lack of cooling system in dairy farms and inefficient use of refrigerator in milk vendors might increase the bacterial counts. As a result of this, the temperature of the milk samples in the current study was very high. This might be contributed for the increase number of microbial contaminants in the study area. Inadequate cooling will increase bacterial counts by allowing a better environment for bacterial growth during storage (O' Mahoney, 1988).

The pH of milk samples collected from vendors was significantly lower (P<0.05) than the pH of milk obtained from dairy farms and the pasteurized milk sample (Table 1). The pH of milk collected from milk vendors was lower than the normal pH value of fresh cow milk. The normal pH of fresh cow milk ranges from pH 6.6 - 6.8 (FAO, 1999). The average pH of milk samples obtained from vendors were not within the normal pH range indicating that there were bacterial growth in the milk samples. The low pH of milk collected from vendors might probably be due to the production of acid resulting from bacterial growth and multiplication in the milk samples.

Normal fresh milk has an apparent acidity of 0.14 to 0.16% as lactic acid (O'Connor, 1995). The titratable acidity milk obtained from vendors was significantly (P<0.05) higher than that of pasteurized milk and milk collected from dairy farms (Table 1). The higher in acidity of milk collected from vendors may be due to the high bacterial growth and multiplication during transportation of the milk to the vending sites and longer storage of the milk before sale. Higher acidity (0.216% lactic acid) for milk collected from vendors were reported by (Hossain et al., 2010). In the current study, 60% of milk samples obtained from dairy farms had a titratable acidity value of greater than 0.16%. In contrast, 100% of the milk samples obtained from vendors had a titratable acidity of >0.16%.

In this data, the highest specific gravity (1.031) was recorded for pasteurized milk samples of Hamdael Farm; whereas the lowest specific gravity (1.025) recorded for raw milk collected from vendors. The specific gravity of normal milk ranges from 1.028-1.033 g per ml (FAO, 1999). Addition of water or other substances changes the specific gravity (Abebe and Markos, 2009). There was no significant difference in specific gravity between pasteurized milk and the raw milk obtained from dairy farms. However, the specific gravity of milk obtained from vendors was significantly lower (P<0.05) than the specific gravity of milk obtained from dairy farms and the pasteurized milk (Table 1). The fact that the milk samples from vendors were slightly lower than the minimum (1.028) suggests that the milk from vendors had been adulterated with addition of water at vending sites.

Table 2: Physico-chemical properties of raw and pasteurized milk of cows' obtained from dairy farms and milk vendors in Dire Dawa town.

Variables	Pasteurized milk	Raw milk	
	Hamdael farm (n = 2)	Dairy farms (n = 16)	Vendors (n = 12)
Temperature	22.500 ± 0.707^c	30.00 ± 2.780^a	26.166 ± 1.800^{bc}
pH value	6.650 ± 0.070^a	6.627 ± 0.135^{ab}	6.43 ± 0.062^c
TA (%)	0.150 ± 0.014^c	0.165 ± 0.022^{bc}	0.195 ± 0.009^a
S. gravity	1.031 ± 0.0007^a	1.030 ± 0.001^{ab}	1.025 ± 0.001^c
TS (%)	10.800 ± 0.282^c	12.580 ± 0.635^a	12.000 ± 0.572^b
S N F (%)	7.100 ± 0.141^c	8.750 ± 0.301^a	8.150 ± 0.308^b
Protein (%)	3.050 ± 0.098^c	3.420 ± 0.139^a	3.274 ± 0.083^b
Ash (%)	0.645 ± 0.035^c	0.795 ± 0.028^a	0.713 ± 0.043^b
Fat (%)	3.700 ± 0.141	3.862 ± 0.412	3.850 ± 0.284

Means followed by different superscript letters within a row are significantly different (P<0.05),
TA= Titratable acidity, n= number of samples TS= Total Solids, SNF= Solid Not-Fat

In the present study, the data indicate the presence of significant difference (P<0.05) in the total solids (TS) content between milk samples (Table 1). The total solids content of milk samples collected from dairy farms (DF) was significantly (p<0.05) higher than milk samples from vendors and the pasteurized milk. Total solids content of milk from dairy farms averaged $12.58 \pm 0.635\%$. Similar value (12.57%) was reported by Mirzadeh et al (2010). However, slightly lower value of total solids content (12.33%) of cow milk samples were reported by Bille et al (2010). Total solids content of milk collected from milk vendors (MVS) and the pasteurized milk averaged between 12 ± 0.572 and $10.8 \pm 0.282\%$, respectively (Table 1). Different values for total solid content of raw milk samples have been reported by different scholars. The variation could be due to difference in breed, feeding and management practices which have important effects on milk composition and quality (O'Connor, 1995). The standard for SNF content of whole cow milk is a minimum of 8.25% (FDA, 1995) and that of fat content ≥3.25% (USPHS, 1993). Furthermore, the standards for protein content of unprocessed whole cow milk should not be less than 2.97% USDA (2003) and the European Union established standards for total solids content of cow milk not to be less than 12.5% (FAO, 2007).

The average SNF content of pasteurized milk obtained from distribution center of Hamdael farm is lower than the findings of (Elrahman et al., 2009) who reported SNF of pasteurized cow milk in Sudan farm to be $7.93 \pm 0.007\%$. The difference observed in SNF content of milk could be due to difference in the feeding practices, season, milking method and lactation period exert (Suman et al., 1998). On the other hand, the lower value of SNF content of pasteurized milk in the present study could be due to the loss of some chemical components of the milk during heating.

No significant difference (p>0.05) in fat content was observed between the three milk types (Table 1). Fat contents of milk obtained from various sources were relatively similar (P> 0.05) showing that fat was not affected by source (Table 1). The average fat content of milk obtained from dairy farms is similar with earlier findings of Janštová et al (2010) who reported a fat content of $3.79 \pm 0.18\%$ for milk produced in dairy farms. However, higher values of fat content (4.3%) was reported from milk of cows from dairy farms were reported by Mansson et al (2003) as compared to the present study.

Protein content of milk obtained from dairy farms was significantly higher (P<0.05) than milk obtained from vendors and pasteurized milk collected from Hamdael farm (Table 1). The average protein content of raw milk obtained in this study from dairy farms is in agreement with the reported value (3.48%) from Sudan (Elrahman et al., 2009). However, Mirzadeh (2010) reported lower protein content of milk ($3.2 \pm 0.22\%$) in the dairy farms of Lordegan region, Iran, compared to the present study. The lower protein content of pasteurized milk in this study could be due to excessive heating of milk which causes change in physico-chemical constituents, particularly the protein content (Asperger, 1993).

Ash content of raw milk from dairy farms averaged $0.795 \pm 0.028\%$ in contrast to $0.645 \pm 0.035\%$ for Pasteurized milk and $0.713 \pm 0.043\%$ for milk from vendors (Table 1). The ash contents of milk collected from dairy farms was significantly higher (P<0.05) than milk from vendors and Hamdael farms (pasteurized milk). The ash content of cow milk remains relatively constant 0.7 to 0.8% and it is influenced by breed, stage of lactation and feed of the animal (O'Connor, 1995).

5. Conclusion and Recommendation
5.1. Conclusion
Generally, this study showed that the quality of milk obtained from the different sources (dairy farms and vendors) was poor. Therefore, concerned bodies should regularly monitor the overall hygienic conditions of the

milk production and conduct frequent inspections of milk marketed in Dire Dawa town to check whether or not they are meeting the minimum legal standards.

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References

Abebe, T and Markos, T. (2009). "Milk Quality Control." Technical Bulletin No. 2. International Center for Agricultural Research in the Dry Areas (ICARDA), University of Aleppo

Elrahman, Abd., Ahmad, S.M., El Owni, A.M., and "Ahmed, M.K. (2009). Microbiological and Physicochemical Properties of Raw Milk Used for Processing Pasteurized   Milk in Blue Nile Dairy Company (Sudan)". *Australian Journal of Basic and Applied Sciences*, 3(4), 3433-3437.

AOAC (1990). "Official Methods of Analysis". Association of Official Analytical   Chemists Inc., Virginia, USA.

AOAC (1995). "Official Methods of Analysis", AOAC, Arilngton, VA.

AOAC (2005). "Official methods of analysis". The association of official analytical   chemists. 16th edition. 481. North Fredrick Avenue Gaithersburg, Maryland, USA,

Asperger, H. (1993). "Microbiology of pasteurized milk". Bull. Int. Dairy Fed., 281:14 -16.

Bille, P.G., Haradoeb, B.R., and Shigwedha, N. (2009). "Evaluation of Chemical and   Bacteriological Quality of Raw Milk from Neudamm Dairy Farm" In Namibia. *African Journal of Agriculture Nutrition and Development,* 9(7), 1511-1523.

Tamime, A. Y. (2008). "Advanced Dairy Science and Technology" - Edited by T.J. Britz and R.K. Robinson. *International Journal of Dairy Technology*, 61 (3): 314.

Deshmukh, Y. D., SrinivasaRao, R., Prita, S. B., and Khobragade, C. N., (2006). "Effect of   Addition of water on quality of milk". Journal of Dairing*, Foods* & *H.S.* 25 (3/4), 242-244.

Eyassu, S. (1998). "Chemical Composition, Microbiological Properties, and Keeping Quality of Raw and Pasteurized Goat's Milk". M.Sc. Thesis, Haramaya University, Dire Dawa Ethiopia.

Faraz, A., Lateef, M., Mustafa, M. I., Akhtar, P., Yaqoob, M. and Rehman, S. (2013). "Detection of Adulteration, Chemical Composition and Hygienic Status of Milk Supplied to Various Canteens of Educational Institutes and Public Places in Faisalabad". *Journal of Animal Plant Science*. 23(1 Suppl.), 119-124.

FAO (1999). **"**Extension Services for Quality Milk Production". Proceedings of an International Workshop in conjunction with the East-West-Forum of the Federal Ministry for Food, Agriculture and Forestry, Germany.

FAO (2001). "The lactoperoxidase system of milk preservation". Regional Lactoperoxidase workshop in west Africa., Burkina Faso.

FAO (2007). "Overview of the Turkish Dairy Sector within the Framework of Eu-Accession", Rome.

FDA (2010). "The Effect of Adopting California Fluid Milk Standards in the United States".

Fox P.F., and McSweeny, L.H. (1998). "Dairy Chemistry and Biochemistry". Kluwer Academic/plenum publishers, New York, USA.

Getachew, F. (2003). "Assessments report on the dairy subsector in Ethiopia". FAO (Food and Agriculture Organization of the United Nations), Rome, Italy.

Harding, F. (1995). "Milk quality". Blackie Academic and professionals, an imprint of Chapman and Hall, Glassgow, UK.

Hossain, J.T., Alam K. and Sikdar, D. (2010). "Chemical and Microbiological Quality Assessment of Raw and Processed Liquid Market Milks of Bangladesh". *Research Journal of Dairy Sciences* 4(4), 28-34.

ICMSF (1998). "Microorganisms in foods". Vol-6. Microbial ecology of food   commodities. London: Blackie Academic and professional.

ILRI (2000). "Handbook of livestock statistics for developing countries". Socioeconomics and policy research. Nairobi., Kenya.

Janštová, B., Necidová, L., Navrátilová, P. and Vorlová, L. (2010). Quality of raw milk from a farm with automatic milking system in the Czech Republic.

Kessler, H. G (1996). "*Lebensmittel- und Bioverfahrenstechnik, Molkereitechnologie*". Verlag A. Kessler, Freising, Germany.

Mansson, L.H., Fonden, R. and Erik Pettersson, H. (2003). "Composition of Swedish dairy milk". *International Dairy Journal*. 13(6), 409-425.

Mirzadeh, K.H., Masoudi, A., Chaji, M. and 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), 1582-1583.

Mohamed, I.E., El Owni, A.O., and Mohamed, G.E. (1997). "Effect of bacteria causing mastitis on milk constituents". *Journal of. Veterinary Science. Animal. Husbandry*, 36 (2), 125-136.

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

Oliver, S.P., Jayarao, B.M., Almeida, R.A. (2005).   "Foodborne pathogens in milk and the dairy farm environment": food safety and public health implications. *Journal of Dairy Science,* 2(2), 115- 129.

O Mahoney, F. (1988). "Rural Dairy Technology- Experiences in Ethiopia". ILCA manual No 4. Dairy Technology Unit. ILCA, Addis Abeba, Ethiopia.

Reinemann, J.D., Mein, G.A., Bray, D.R. and Britt, J.S. (2005). "Trouble shooting High Bacteria Counts in Farm Milk". Sources of Bacterial Contamination in Raw Milk.

Richardson, H.G. (1985). "Standard Methods for the Examination of Dairy Products. 6th edn", American Public Health Association, Washington DC.

Suman, C.L., Sexena, M.M., Pandey, H.S., Dubey, P.C., Rajendra, S. and Sanyal, M.K. (1998). "Some factors affecting milk constituents yield of Murrah buffalo". *Indian Veterinary. Journal.*75 (2), 176-177.

USDA, (2003). "Dairy Programs Agricultural Marketing Service United States"   Department of Agriculture. Raising the Minimum Nonfat Solids Standard to the National Average in Raw Milk: A Study of Fluid Milk Identity Standards.

USPHS, (1993). "Grade A Pasteurized Milk Ordinance". Publication No. 229,   Washington, DC: Public Health Service, Food and Drug Administration, U.S. Department of Health and Human Services.

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