Food Science and Quality Management
ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online)
Vol.126, 2026

Milk Handling Practices and Physicochemical Properties in North Shewa Zone Central Highlands of Ethiopia

Mebrate Getabalew
Holland Dairy Private Limited Company, Milk Collection Point Coordinator, Debrziet, Ethiopia

Abstract
The study was conducted in in North Shewa Zone Central Highlands of Ethiopia in two districts. The average proportion of male respondents in the study area was 61.6%. This shows that males participated more at the field work with grazing of their livestock and play a dominant role in livestock production practices compares to females who spend most of their time at home. Education is an important entry point for empowerment of their production and productivities of the rural societies. About (72.5%) smallholder micro-enterprises and (38%) smallholder farmers underscored that they knew how to detect milk quality characteristics by using their organoleptic characteristics like odor or smell of fresh milk, changes in thickness as well as abnormal smell and taste might be due to adulterated. The respondents feel that abnormalities can be caused by environment defect like addition of water/flour, removing of fat/cream, barn /cow, feed dust and physiological taints such as hormonal imbalance in genotypes and stage of lactation. Morning milk samples were kept in a refrigerator below 4^0C and milk sample used for chemical analysis was shacked, before undertaking the required test for chemical composition. As Table 2, illustrates physico-chemical properties of milk samples from project mercy Chacha. There was significant difference in all physico-chemical properties among different breeds of cattle except the freezing point of milk. The study shows that the highest fat (4.09±0.63), TS (12.71±0.44) and conductivity (3.73±0.06) were recorded on Boran breed and, highest protein (3.26±0.13), FP (0.57±0.03), lactose (4.95±0.26), SNF (9.01±0.47), density (29.67±0.34) and salt (0.74±0.04) were recorded on Fogera breed of cow respectively.
Key words: Smallholder, Milk, Physico-chemical, Fat, Breed, Fogera.
DOI: 10.7176/FSQM/126-01
Publication date: February 28th 2028

INTRODUCTION

Ethiopia is the leader in case of livestock population in the continent Africa. While, its productivity and commercialization remains low because of different reason. Due to the huge livestock population Ethiopia holds large potential for dairy development, which comprises 59.5 million cattle, 30.70 million sheep, and 30.20 million goat populations (CSA, 2018). Ethiopian dairy production depends on low producing capacity of local breeds of dairy cow. The sub-sector plays an important role in the contribution of the country economy by farmer's income generation, providing opportunities for job, improving food security, providing services, contributing to cultural, social asset, environmental values, and sustaining livelihoods (Sintayehu *et al*., 2010).

On average daily milk production liters/Cow (1.371), average lactation period (months) (6 month) and total milk production (liters) (3,317,786,694 litters) while camel produce average daily milk production (liters/camel) (3.909), average lactation period (months) (10 month) and total milk production (liters) (327,638,287 litters) (CSA, 2018).

Milk is the most complete food contributed for the nutritional improvement of the people (Habtamu, 2015). Ethiopia has a low level of milk consumption compared to other countries in the region (Kenya = 90 lt/cap; Uganda = 50 lt/cap). The national per capita consumption of milk and milk products is estimated at 19 kg (Mebrate *et al*., 2019). The Amhara National Regional State contributed 22% of the national milk production and almost all of the milk produced comes from small holder dairy cattle producers. The most known milk producing areas in the region are South Gonder, Awi, North Shewa and East and West Gojjam Zones (ANRS, 2015).

The most widely used farm animal for milk production in Ethiopia is come from cow (Bereda *et al*., 2014). Cows covered around 94.58% of the total annual milk produced at country level (CSA, 2017). In Ethiopia, there is no good hygienic condition followed by producers, transporter and processor during milk production it reduced its quality. More recent study conducted in and around Asosa town showed that, there is no standard

hygienic condition followed by producers during milk production which may cause for contamination and affect milk quality (Nigatu *et al*., 2017). Since, the handling practice and production system is traditional, the cow's milk in Ethiopia is mostly contaminated with external sources which are bacteria and categorized as poor quality, and this is mainly because of less attention for hygiene (Merhawit *et al*., 2014).

Handling practices of raw cow's milk produced and marketed in Shashemene town was traditional (Teshome *et al*., 2014). The quality of milk consumed by children is poor and affected by different factors such as udder hygiene, cleanness of hands and utensils (Fanaye *et al*., 2015). On the other hand the consumption of raw milk and its derivatives is common in Ethiopia, which is not safe from consumer health point of view as it may lead to the transmission of various diseases. Therefore, availability of hygienic quality milk and milk products is necessary in all production systems to ensure good health condition of the consumers, reduce the amount of milk products imported and to compete in international market. Any improvement in the handling and quality of milk could contribute to the insurance of public health safety while at the same time having positive economic consequences (Grimaud *et al*., 2017).

North Shewa zone is known by milk production especially in and around Debre Berhan town like Bassona Worana and Angolelana Tera district in these areas there is a research gap on milk handling practices and its bacteriological quality. To have quality dairy products and to benefit properly, identifying the existing trends of milk handling, processing, and utilization and bacteriological quality is important to undertake different improvement measures.

Objectives of the study

- To access milk handling practices in North Shewa Zone Central Highlands of Ethiopia.
- To examine physicochemical composition of milk produced in in North Shewa Zone Central Highlands of Ethiopia**.**

MATERIALS AND METHODS

Description of the Study Areas

The study was conducted in in North Shewa Zone Central Highlands of Ethiopia in two districts.

Site 1: Bassona Worana: is one of the 22 districts in North Shewa Zone of Amhara Regional State. Located 130 km Northeast of Addis Ababa, It is bordered on the South by Angolelana Tera district, on the Southwest by the Oromia Region, on the West by Siadebrina Wayu district, on the North West by Moretna Jiru district, on the North by Mojana Wadera district, on the North East by Termaber district, and on the East by Ankober district. Debre Berhan town is enclave inside of this district have comprised of 30 kebeles and covers about 1,208.17 sq.km and located in the altitude ranges between 2,250 to 3,200 masl (BWDAOfR, 2019 unpublished).

Site 2: Angolelana Tera district

This is one of the districts in the Amhara Region north Shewa Zone of Ethiopia. It is named in part after one of the capitals of the former principality of Shewa, Angolelana. Located at the eastern edge of the Ethiopian highlands in the north Shewa Zone, Angolela Tera is bordered on the south by Hagere Mariamna Kesem, on the west by the Oromia Region, on the north by Basona Worana, and on the southeast by Asagirt. The administrative center of this woreda is Chacha. Angolelana Tera was part of former Angolelana Tera Asagirt woreda. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 99.1% reporting that as their religion.

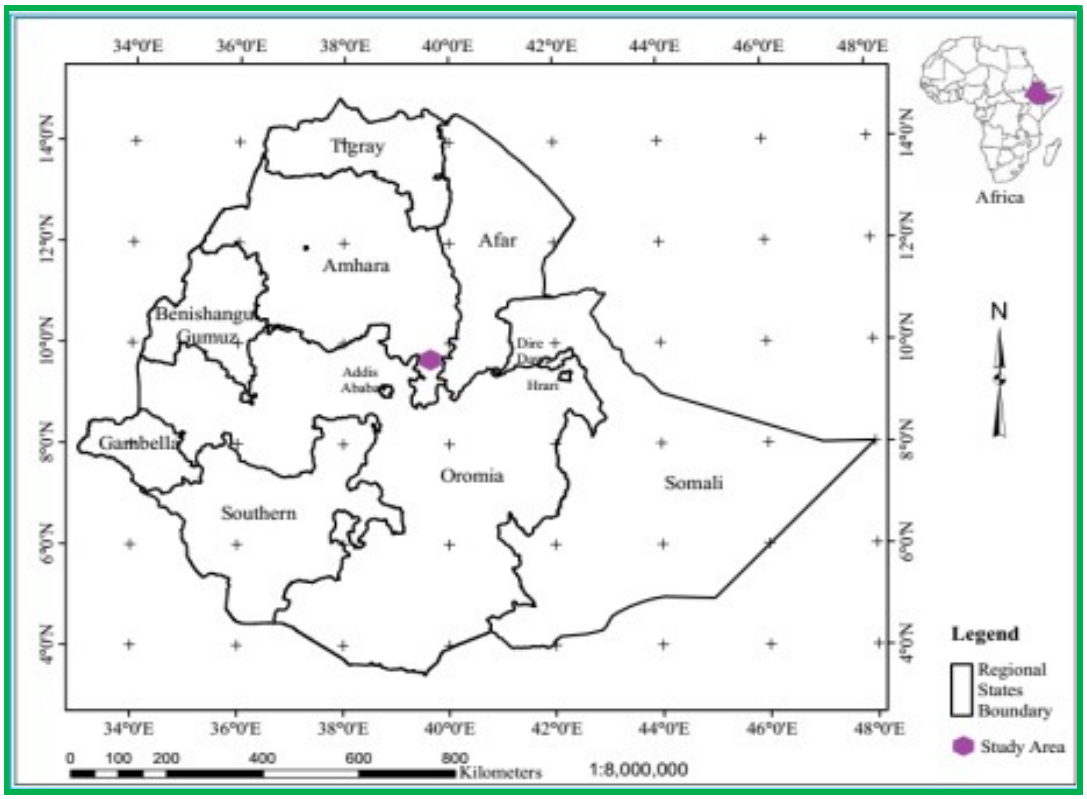

Figure 1. Map of Ethiopia showing location of the study area

Agro-Climatic Conditions and Soil Type

The climate in most parts of the area is characterized by cold temperatures. The mean annual minimum and maximum temperatures averaged between 2000-2014 years are 6.7^{0}C and 19.9 ^{0}C, respectively. The study sites were characterized by bimodal rainfall, a long/heavy rainy season from June to September and this contributes 75% of the annual rainfall (main cropping season for the district), short/light rainy season from February to May and dry season from October to February (BWDAOfR, 2019 unpublished). The mean annual rainfall within the span of the same years is 1026 mm with a potential evapotranspiration of 1396 mm; with potential evapotranspiration of 1396 mm from 2000-2014 (Molla, 2007). And about 98% of the people in the districts depend primarily on mixed crop-livestock production system (BWDAOfR, 2019 unpublished).

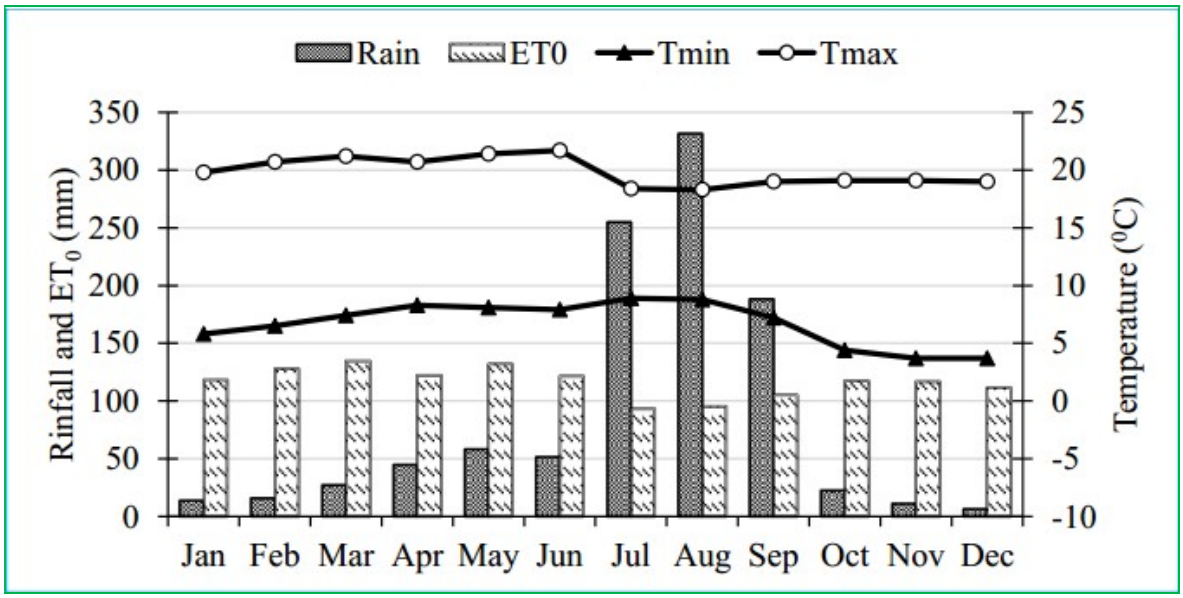

Figure 2. Average monthly rainfall, potential evapotranspiration (ET0), maximum (T_{max}) and minimum (T_{min}) temperatures at Debre Berhan weather station (monthly data averaged from 2000 to 2014)

Livestock species kept include indigenous cattle and their crosses with temperate origin, sheep, goats, donkeys, horses, mules and poultry. Cattle production with indigenous and crossbred animals predominates the livestock production followed by sheep production (Hassen *et al*., 2010; Bekele *et al*., 2017).

District Human and Livestock Population

Human and livestock populations in the districts (*Basona Worana* and *Angolelana Tera*) are presented in Table 1. Human population comprises of 51.03% male and 49.97% female (North *Shewa* Zone Agriculture Office, 2013 unpublished).

Table 1. Area, human and livestock populations of Bassona Worana and Angolelana Tera districts in central highlands of Ethiopia

	Districts		
Description	Bassona Worana	Angolelana Tera	Total
Area (km^2)	1,150.4	836.3	1,986.7
Human (numbers)	130,536	89,642	220,178
Male	66,835	45,519	112,354
Female	63,701	44,123	107,824
Livestock Population (numbers)			
Cattle	110,945	125,052	235,997
Sheep	151,965	119,321	271,282
Goat	48,414	12,223	60,637
Donkeys	30,245	27,092	57,337
Horses	10,506	9,288	19,794

Source: North Shewa Zone Agriculture Office (2013, unpublished).

Survey Design and Data Collection

For the study, cross sectional survey and milk chemical composition test was conducted on milk producers (farmers), milk collection centers and cooperatives and will be selected according to the following procedures.

Sampling Procedures and Sample Size

Out of the 22 Districts found in North Showa zone, Bassona Worana and Angolelana Tera Districts were selected based on their dairy production potential and high demand of the product. A multistage sampling procedure was employed to select sample farmers (milk producers) to deliver fluid milk to the nearby milk collection point (MCP) and the study was also be used all cooperative and MCP found in the districts.

A multi-stage technique was used to draw an appropriate sample. In the first stage, among 22 districts found in North Shewa zone from those two of them (Bassona Worana and Angolelana Tera) was selected based on their potential of dairy production and market access. Secondly three kebeles from Angolelana Tera and four kebeles (Angolela, Bakelo, Woshawshegn and Kormargefya) from Basona Worana district will be selected purposely based on dairy production potential. Thirdly, list of households involved in dairy production was obtained from District Livestock Development and Livestock Health Office as well as rural kebeles (RKs). Fourthly, at survey time 2,315 households involved in dairy production were identifed from the list they belong in each RKs. Finally, among several approaches to determine the sample size, by simple random sampling Yamane is used and totals of 400 sample producers are selected for interview [19].

The numbers of respondents (farmers) per single kebele are determining by the proportionate sampling technique as follows (https://books.google.com.et/booksisbn).

W= [A/B] x No

Where;

W= Sample of farmers determines per single selecting kebele.

A = Total number of households (farmers) living per single selected kebele.

B = Total sum of households living in all sample kebeles.

No = the total required calculated sample size of the population

Finally, a total of 159 farmers (50 in the poor, 58 in the medium and 51 in the better-off wealth status) were selected using systematic random sampling with whom the questionnaires were administered.

Method of Data Collection and Organization

The survey questionnaire was pre-tested before administration and some re-arrangement, reframing and correcting was made in accordance with respondent perception. Data was generated by administrating a questionnaire survey, direct observation, employing field measurements and from secondary sources. Survey was carried out for each sampled households (HHs) found in some selected study kebeles to collect information on HH characteristics, status of keeping dairy cattle and their reproductive, productive, survival rate and management condition. Checklists and questionnaires were used to capture all information. The study was using both primary and secondary data. The primary data were collected from farmers having crossbreed and secondary data from different sources, such as the District Office of Agriculture and Rural Development (DOARD).

The selected Kebles were classified as peri-urban and rural kebles based on district finance office documentation; they tell peri-urban kebles which are found around to Debre Berhan city or found less than 5km from the city and rural kebles when they locate as far from the city or found greater than 5km, in accordance with this Bakelo, Kormargefya and Angolela kebles are grouped under peri-urban kebles and the rest Gudobert (far 30km from the city) and Keyit (far 18km from the city) are grouped in to rural kebles for this study.

Statistical Analysis

The data was entered using Microsoft Excel spreadsheets, 2010 and analyzed by using SPSS (Version, 25). The descriptive statistics was employed for describing milk handling practices and it physicochemical properties in North Shewa Zone Central Highlands of Ethiopia**.**

Result and Discussion

The average proportion of male respondents in the study area was 61.6%. This shows that males participated more at the field work with grazing of their livestock and play a dominant role in livestock production practices compares to females who spend most of their time at home. Education is an important entry point for empowerment of their production and productivities of the rural societies. The result of this study showed that comparatively there was more can abele to read and write in this will help to adopt new technologies is observed more rapidly than lower educated farmers. The average age of the respondents was 46.6 years which is in agreement with 46 years reported for Debre Berhan areas (Mekete Bekele, 2018) and higher than 43.3 years for the South Wollo zone (Hussien Sirag, 2018). The proportion of cattle keepers aged between 41-50 years was higher in the study area accounting for 50.94% it may have good experience on cattle production.

Table 1. Sex, educational level, age group and marital status of HHs head

Household heads characteristics		N	%
Sex	Male	98	61.6
	Female	61	38.4
Education level	Illiterate	20	12.58
	Read and write	78	49.06
	Primary (Grade 1-8)	39	24.53
	Secondary (Grade 9-12)	22	13.84
Age Group (year)	<30	13	8.18
	30-40	40	25.16
	41-50	81	50.94
	>50	25	15.72
Marital Status	Married	151	94.96
	Unmarried	8	5.04

N = Number of respondents

Milk and Milk Products Handling Practices

Milk and milk products are major food for human all over the world. Milk is virtually sterile when it is synthesized in a healthy cow's udder. However, as soon as it leaves from the heat becomes contaminated with microorganism and spoiled till consumption or further processing (Tollessa, 2016). It is an ideal medium for Microorganisms and as it is a liquid and nutritious, it is very easily contaminated and invaded by bacteria. As a result, hygienic milk handling practices should take into account such as the sanitation of milking environment, the hygiene of the milker and utensils used to collect and store milk (Tsedey and Asrat, 2015).

In Ethiopia, milk hygiene handling practice is below the standard due to insufficient pre-milking handling practices like washing udder with clean water, cleaning milking barn, drying the udder with individual towel, washing of milkers' hands and milking utensils, using of poor quality and non-boiled water for cleaning of udder and insufficient post handling practice like poor hygiene of milk equipment and storage containers, prolonged storage, transportation and retailing practices predispose the milk to microbial contamination (Fufa et al., 2019). Moreover, use of plastic containers for handling and transporting of milk increase the risk of contamination of milk higher, since as the number of plastic containers increased the chance of contamination is also increased and most plastic containers have characteristics that make them unsuitable for milk handling.

The dairy producers clean their milking utensils in different ways, for instance, washing with or without hot water followed by smoking with different aroma producing plants like Woira (Oleaafrican), and Tid

(Juniperousprocera) used for flavoring and extending the shelf life, since fumigation have the power of disinfecting (sterilizing) the milking equipment. Thus, reducing the numbers of microorganisms and thereby extending the shelf life of milk and milk products, and thereby reducing spoilage (Tsedey and Asrat, 2015). Shewangzaw et al. (2016) reported that about 55.6% of the producer should not use refrigerator for handling of milk and its products. This may favor the multiplication of bacteria and spoilage of milk and milk products. Generally, poor handling practices result in higher the bacterial count, which in turn may cause spoilage of the milk and poor yields of its products. Moreover, the rise of bacterial count is unsafe since it cause food borne diseases and imposes a great health risk on the consumers (Tolessa, 2016).

About (72.5%) smallholder micro-enterprises and (38%) smallholder farmers underscored that they knew how to detect milk quality characteristics by using their organoleptic characteristics like odor or smell of fresh milk, changes in thickness as well as abnormal smell and taste might be due to adulterated. The respondents feel that abnormalities can be caused by environment defect like addition of water/flour, removing of fat/cream, barn /cow, feed dust and physiological taints such as hormonal imbalance in genotypes and stage of lactation. Majority of the respondents reflected the common sources of milk contamination in study areas were due to addition of flour to milk; whereas significant number of farmers suggested addition of water to milk is another potential source of contamination or adulteration. Cows were hand milked and calves were not allowed to suckle dams prior to milking.

The milking practice was mainly carried out after washing their hands before milking by almost all respondents (over 96.1%). This result is in agreements with report of Bekele (2014) who reported 100% of the respondents in Dangila town of western Amhara region wash their hands before milking. However, the experience of dipping teat in sanitizer after milking was almost not available due to low awareness at both smallholders. This result similar with Ayalew and Abatenhe (2018) who reported 100% urban dairy producer cleans their hand and milking utensils before milking in Amara region and Eshetu et al. (2019) who reported 94.31% wash their hands before milking and no experience of dipping teats in sanitizer after milking in Eastern Hararghe.

Both smallholders (over 52%) respondents in study areas used hot water for cleaning of their milking equipment, while (over 47.2%) of both respondents used cold water. The variation might be due the difference in training and experience between the smallholders in study area. Since the use of hot water is the recommended for cleaning of milking equipment and storage before milking to reduce /elimination bacterial propagation, about half of the farmers still need further training on equipment handling and sanitization as well as personal hygiene. The use of detergents for cleaning the milking equipment and storage was not common practice in study area. The present study result was higher than the result reported by Tegegne et al. (2013) in peri-urban and urban dairy production system in Shashemene – Dilla milk- sheds 23% of the producers‟ clean milk utensil by hot water. In study area, (3.9% and 41.7%) smallholder micro-enterprises and smallholder farmers respectively responded that not washing the udder of cows before milking. This action is mainly due to lack of awareness that leads to production of poor-quality milk. Generally, cleaning of the cows‟ udder before milking is one of the most important hygienic practices required to ensure clean milk production. This is important since the udder of milking cows could have direct contact with the ground muddy, urine, dung and feed waste. Most respondents, (97.2% and 82.4%) smallholder micro-enterprises and smallholder farmers respectively, did not dip teats after milking. This is might be cause infection of teats by milk born pathogen like mastitis, E. coli and S. aureus. So that dipping teats after milking is the fundamental important points to produce high quality milk and protection of udder of cows from pathogen. Generally, the practice of properly cleaning of milk equipment as well as maintenance of equipment is preventing spoilage of milk and milk product by spoilage microbes. However, awareness creation and quality control mechanism should be installing to prevent the practice of adulteration to safeguard public health of the consumers. Food-safety hazards include biological, chemical as well as physical agent in a food that have a potential to cause an adverse health effect on the consumer (WHO, 2003).

Adulteration of milk is addition of any material to the milk, or removal of any component of milk as well as contamination of milk by microorganism. Milk quality characteristics is milk that free from any chemical taint and bacterial defects (FAO, 2017). All respondents had the culture of cleaning dairy cows shade/house. Unhygienic shade/house is one of the sources of milk contamination, so that the producers should give attention for shade/ house hygiene. Although the frequency of cleaning their dairy house/shed was almost daily by majority of the respondents (80.6% and 84.3%) smallholder farmers and smallholder microenterprises respectively, cleaning their dairy animals shade/house three times in a week is not acceptable to assure the hygienic quality of milk and subsequent public health safety issues.

The most limiting factor for quality milk productions is lack of awareness and lack of clean environment (over 31% and 43%) respectively reported from both smallholders. This result was better than Haile (2015) who

reported 65% clean manure from dairy house daily in Ejerie west Shewa. The main reason (over 84%) for milk adulteration in study area were for maximizing their daily income through addition of water to increase volume of milk and removing of fat from fresh milk. Therefore, the producer and consumer should pay attention on milk quality issue during marketing of fresh liquid milk at milk shops and on farms. On the other hand, milk contaminated areas can also be associated to cows and milking area/shade. Present study revealed factors like person, milk utensil, cows and milking shade were reported as the most serious sources of milk contamination. Therefore, smallholder dairy producers should pay special care for the type as well as sanitation of milk equipment indicated in Table (14). This result is similar with Bereda et al. (2014) who reported the milkers, udder of the cow, the milking environment and the milking equipment the chief sources of the initial milk contamination.

Physicochemical Quality of Milk

During the experimental period milk samples were collected from morning milk of experimental cows. Morning milk samples were kept in a refrigerator below 4^0C and milk sample used for chemical analysis was shacked, before undertaking the required test for chemical composition. As Table 2, illustrates physico-chemical properties of milk samples from project mercy Chacha. There was significant difference in all physico-chemical properties among different breeds of cattle except the freezing point of milk. The study shows that the highest fat (4.09±0.63), TS (12.71±0.44) and conductivity (3.73±0.06) were recorded on Boran breed and, highest protein (3.26±0.13), FP (0.57±0.03), lactose (4.95±0.26), SNF (9.01±0.47), density (29.67±0.34) and salt (0.74±0.04) were recorded on Fogera breed of cow respectively. And the highest pH (6.95) was recorded on Jercy X Boran cross breed. The overall mean value of the fat (3.93%) in the study site is higher than the Ethiopian standard value of 3.50% ES (2009). The overall fat content recorded in this study (3.93%) is lower than the result obtained by Dehinenet *et al*. (2013) on local cattle which is 5.22%. The overall average protein% and fat % of milk in the present study were lower than the study conducted by Dechas Adinan (2021) with the result of protein and fat (3.53 ± 0.03% and 5.19 ± 0.06%) respectively. The overall average milk protein content in early, mid and late lactation were 3.35%, 3.52% and 3.75% respectively. Lactation stages have significance effect on milk protein (Dechas Adinan, 2021). The mean milk protein content (3.15±0.06) in the present study was in line with (3.53± 0.03%) result reported by Gurmessa *et al*. (2015).

Table 2. Quality parameters of raw local and cross breed cow milk in Project Mercy Chacha

Milk Quality parameters	Mean values of milk physicochemical quality parameters across Breeds				
	Boran	Jercy X Boran	Fogera	Overall	(P<0.05)
Fat	4.09±0.63^{a}	3.76±0.80^{b}	3.65±0.17^{c}	3.93±0.39	***
Protein	3.15±0.09^{a}	3.06±0.08^{b}	3.26±0.13^{ac}	3.15±0.06	**
Lactose	4.73±0.13^{b}	4.59±0.13^{c}	4.95±0.26^{a}	4.75±0.09	***
SNF	8.62±0.23^{b}	8.36±0.23^{bc}	9.01±0.47^{a}	8.65±0.17	***
TS	12.71±0.44^{a}	12.12±1.03^{b}	12.66±0.64^{ac}	12.58±0.32	**
FP	0.55±0.01	0.53±0.02	0.57±0.03	0.55±0.01	NS
Density	29.08±1.39^{b}	28.39±0.18^{c}	29.67±0.34^{a}	29.06±0.82	***
pH	6.94±0.02^{b}	6.95±0.015^{a}	6.91±0.02^{bc}	6.94±0.01	**
Conductivity	3.73±0.06^{a}	3.62±0.155^{b}	3.61±0.14^{bc}	3.68±0.05	**
Salt	0.71±0.02^{b}	0.68±0.02^{b}	0.74±0.04^{a}	0.71±0.01	***

SNF: solids-not-fat, TS: total solids, FP: Freezing Point, pH: Power of hydrogen, $^{a\ b\ c}$ means on the same row with different superscripts are significantly different (P<0.05); Ns = not significant; ***P<0.0001 and ** = P<0.01.

Conclusion and Recommendations

Conclusion

The study was conducted in in North Shewa Zone Central Highlands of Ethiopia in two districts with the objectives to access milk handling practices and to examine physicochemical composition of milk produced in in North Shewa Zone Central Highlands of Ethiopia. Dairy production was the main source of income for smallholder farmers (97.5%) and job opportunity (64.7%) for the youth organized as smallholder micro-enterprises. The major feed resource available for dairy animals was agro-industrial byproducts (bran of cereal crops, oilseeds cake), industrial byproducts like Meta brewery (brewery grain) and purchased hay grasses. The overall mean value of the fat (3.93%) in the study site is higher than the Ethiopian standard value of 3.50% ES (2009). The overall fat content recorded in this study (3.93%) is lower than the result obtained by Dehinenet *et al*. (2013) on local cattle which is 5.22%. The main constraints of dairy production in study areas were shortage and cost of feeds as the major bottlenecks for the development of dairy sector Milk collected from selling of shops and ready to sale for consumers had the lowest quality in terms of chemical composition, physical properties like specific gravity and bacteriological quality compared to the smallholder farmers and smallholder micro-enterprises due to poor hygienic practices and possible adulterations.

RECCOMMEDATION

Based on the current finding, the following can be recommended;

A) Dairy production in study area was challenged by low availability and high cost of feeds. Therefore, farmers need to be supported with more access to feed production and/or purchase as well as training skills for feed conservations.

B) Milk samples collected from all sampling points were indicative of adulteration and did not meet quality standards set by quality standard authority of Ethiopia and the world. Therefore, it is recommended to provide awareness creation about hygienic practice of milk handling and production among smallholder farmers, smallholder micro-enterprises, milk shops and consumers in addition to strong regulatory mechanism by the relevant authorities.

REFERENCES

Abebe Bereda, 2015. Milk Quality for Consumers‟ Safety. Ethiopian Meat and Dairy Industry, Development Institute: Proceedings.5 (2):284-291.

ANRS 2015. Investment guide on horticulture, floriculture and dairy in Amhara Region. Published and commissioned by Embassy of the Kingdom of Netherlands in cooperation with Amhara National Regional State (ANRS), Addis Ababa Ethiopia.

Bekele, A., Fekadu, B. and Mitiku, E., 2014. Chemical composition and microbial quality of cow milk in urban and peri urban area of Dangila town, Western Amhara Region. Ethiopia. Global Journal of Dairy Farming and Milk Production, 3(1):081-085.

CSA (2018) Agricultural Sample Survey 2016/2017: Report on Livestock and Livestock Characteristics (private peasant holdings). Addis Ababa Ethiopia 2: 9-12.

CSA (Central Stasistics Agency) (2017). Agricultural sample survey. Report on livestock and livestock characteristics. Addis Ababa, Ethiopia. 194pp.

Dechas Adinan. 2021. Milk Production and Calve Growth Performance of Ogaden Cattle under Improved Feeding Management. MSc Thesis. College of Agriculture, Haramaya University, Haramaya, Ethiopia.

Dehinenet G., H. Mekonnen, M. Ashenafi, EmmanuelleG., 2013. Determinants of raw milk quality under a small holder production system in selected areas of Amhara and Oromia National Regional States, Ethiopia. Agriculture and biology journal of North America, USA.

Fanaye S, Ashenafi M, Getachew T, Hailu M. Evaluation of the quality of cow milk consumed by children in and around Bahir Dar. Ethio J Sci and Techn. 2015;71-79.

FAO/TCP/KEN/6611 2017: Milk Testing and Quality Control. Training Programme for Small Scale Dairy Sector and Dairy Training Institute Naivasha vol.2 pp.4-18.

Fufa A, Nigus T, Fikru R, Dinka A, Kebede A (2019). Handling Practices, Quality and Safety of Milk along the Dairy Value Chains in Selected Sub Cites of Addis Ababa, Ethiopia. Journal of Scientific Techinical Research.13(1).

Grimaud P, Serunjogi M, Grillet N. An evaluation of milk quality in Uganda: value chain assessment and recommendations. African J Food Agri Nutri and Development. 2017;1 16.

Habtamu L. 2015. The contribution of livestock in meeting food production and nutrition in Ethiopia. *Journal of Food Science and Technology*. 2(3):20-43.

Hussien Sirag. 2018. On-Farm Phenotypic Characterization, Breeding and Husbandry Practices of Indigenous Sheep Population in Legambo and Tenta Districts of South Wollo Zone, Amhara Region, Ethiopia. MSc Thesis. College of Agriculture. Haramaya University, Haramaya, Ethiopia. Pp. 31-47.

Mekete Bekele. 2018. Determinants of Livestock and Feedwater Productivity in the mixed crop-livestock production system of Debre Berhan Milk shed, Central Highlands of Ethiopia. Published doctoral dissertation. Addis Ababa University, Addis Ababa, Ethiopia.

Merhawit R, Habtamu T, Berihun A, Abrha B. Bacteriological quality assessment of milk in dairy farms, cafeterias and wholesalers in Adigrat, Tigray, Ethiopia. Euro J Bio Sci. 2014;88-94.

Nigatu D, Berhanu S, Shimelis M, Yimer M, Dinaol B. Prevalence and antimicrobial susceptibility pattern of *E. coli* O157: H7 isolated from traditionally marketed raw cow milk in and around Asosa town, western Ethiopia. Vet Med Int. 2017;4-7.

Shewangzaw A, Ahmed M, Nunu H (2016). Handling, Processing and Utilization of Milk and Its Products in Gondar Town, Ethiopia. Journal of Life Science and Biomedicine. 6(6):120-126.

Sintayehu G, Samuel A, Derek B, Ayele S (2010). Diagnostic study of live cattle and beef production and marketing: Constraints and opportunities for enhancing the system. ILRI and IFPRI, Addis Ababa, Ethiopia P 85.

Teshome G, Fekadu B, Mitiku E. Handling practices and microbial quality of raw cow's milk produced and marketed in shashemene town, southern ethiopia. Int J Ag ric Soil Sci. 2014;153-62.

Tolessa M (2016). The microbiology of Ethiopian milk and milk products: review. International Journal of Current Research. 8(07):34606-34611.

Tolessa M (2016). The microbiology of Ethiopian milk and milk products: review. International Journal of Current Research. 8(07):34606-34611.

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.Vol. 44.