Journal of Veterinary Science & Animal Husbandry

Open Access

Austin Publishing Group

Research Article

Assessment of Milk Quality and Dairy Production Practices in Sebeta Town of Oromia Regional State, Ethiopia

Abdi Ahmed Umer[1*]; Samuel Abose Bongase[2]; Taye Tolemariam[2]; Abebe Olani Bulto[1]

[1]Animal Health Institute, Microbiology Research Laboratory, Ethiopia

[2]Jimma University College of Agriculture and Veterinary Medicine, Ethiopia

***Corresponding author: Abdi Ahmed Umer**
Animal Health Institute, Microbiology Research Laboratory, PO Box, 04 Sebeta, Ethiopia.
Email: abdivet2014@gmail.com

Received: March 29, 2023
Accepted: June 28, 2023
Published: July 05, 2023

Abstract

The study was conducted in Sebeta town South West Shoa Zone, from February to July, 2020 with the objectives of assessment of milk quality and dairy production. From a total of nine kebeles of Sebeta town, three representative kebeles were selected, purposively based on their dairy production potential. From the selected kebeles, 36 smallholder farmers and 51 smallholder micro- enterprises were randomly selected and interviewed. Twenty one pooled milk samples were taken from smallholder farmers (9), smallholder micro-enterprises (9) and selling point of shops (3) were evaluated for microbial and chemical compositions. The result showed that male respondents dominant at both smallholder farmers (77.8%) and smallholder micro- enterprises (64.7%). The present study has identified two production systems; namely, peri-urban and urban dairy production systems where the later type is dominating. Purebred dairy cattle were dominantly owned at both systems. The average milk yield per cow per day in Sebeta town was 11.5 liters. The major feed resources were agro-industrial byproducts, industrial byproducts (brewery grain) and purchased hay grasses. Tape water was the main sources of water and animals were housed in constructed separate sheds/barns with concrete floor. AI was the most common methods for cattle breeding. Feed shortage, cost of feed and shortage of land are the major challenges in the study area. Laboratory examination revealed that the overall mean percent fat content, Solid Nonfat (SNF), total solid, protein, lactose, added water and solid were; 2.56±0.28, 7.96±0.8, 10.51±1.10, 3.08±0.35, 4.16±0.42, 18.26±11.93 and 0.63±0.05 respectively. The specific gravity of the raw milk ranged from 1.023-1.031g/cm^3. All milk samples from milk shops, 77.8% from smallholder micro- enterprises and 44.5% from smallholder farmers showed presence of mastitis in the milk. The most important bacteria isolated were E. coli and S. aureus. Milk collected from small micro- enterprise, smallholder farmers and selling point of milk shops were subjected to bacterial infection and does not meet the requirements of international milk quality standard. Therefore, awareness creation and strict quality control is recommended to safeguard public health of the consumers.

Keywords: Dairy cattle; Production; Evaluation; Bacterial; Milk composition; Sebeta

Introduction

On the world about 150 million farm house hold are engaged in milk production and the majority of them is from developing countries where annual growth rate in milk consumption is between 3.3-4 percent in 1995-2005 [36]. In most developing countries, milk is produce by smallholders and contributes to household livelihoods, food security and nutrition (Tedasse *et al.*, 2017).

With almost 60 million cattle, Ethiopia is estimated to be home to the largest livestock population in Africa; however, the productivity of the largely local breed (accounting for over 98%), is said to fall below the Africa average in terms of milk yields. The diverse and wide- range of agro ecological zones and the importance of livestock in livelihood strategies make Ethiopia home to large numbers of livestock [17].

Citation: Umer AA, Bongase SA, Tolemariam T, Bulto AO. Assessment of Milk Quality and Dairy Production Practices in Sebeta Town of Oromia Regional State, Ethiopia. Austin J Vet Sci & Anim Husb. 2023; 10(3): 1124.

Ethiopian national livestock master plan seeks to enhance investments in improved breeds, feeds and health of cattle to increase milk production by over 90% by 2020. The increased supply in dairy as well as meat from the improved cross breeds is expected to meet the demands of the integrated agro industrial parks for both local use and export sector (Shapiro *et al*., 2015).

Dairy sector is a major contributor to economic development mainly among the developing countries used as an engine of growth; it goes increased income, employment, food and foreign exchange earnings as well as better diet (Yilma, *et al*., 2011). The traditional system of milk production in Ethiopia, containing small rural and peri-urban farmers, uses local breeds, which produce about 400-680kg of milk per cow per lactation period [38]. Intensive systems as diverse as state enterprises, small and large private farms use exotic breeds and their crosses, which have the potential to produce 1120-2500 liters over 279-day lactation [4].

Quality is an important issue in production of hygienic products especially for safety of consumers in which both microbial and chemical properties of milks in normal state [7]. Urban and peri-urban smallholder producers are the main suppliers of raw milk to milk processors of different scales in Ethiopia (Haile, 2009).

Microbial contamination in milk may cause milk-borne diseases to humans, while others are known to cause milk spoilage. Many milk-borne epidemics of human diseases are spread through milk contamination. Sources of microbial contamination in milk include primary microbial contamination from the infected or sick lactating animal. The secondary causes of microbial contamination occurs along the milk value chain which may include contamination during milking by milkers, milk handlers, unsanitary utensils and/or milking equipment‟s and water supplies used in sanitary activities. Other secondary sources of microbial contamination occur during milk handling, transportation and storage of milk [14]. In Ethiopia, dairy production is one of the sub-sectors of livestock production that contributes to the livelihood of the owners through important sources of food and income; even though dairying has not been fully exploited and promoted in the country [67].

Milk differs in composition due to different factors like species of animal, variety, individuality, lactation‟s phase, incidence of milking, age, feed, disease, administration of hormones and drugs [25]. The term quality for milk means absence of harmful bacteria, dirt, antibodies, bad flavors, abnormal numbers somatic cell count, chemical analysis to check presence of sufficient amounts of nutrients, removal of fat and other adulterants, verification of hygiene through microbial investigation [25].

Sebeta town known by the intensification of smallholder dairy production, but its production system with the relation to feeding practice, breed type, housing system, husbandry practice and milk quality handled methods are not well recorded. To fill the gap, a cross-sectional study was design to assess dairy production system and evaluation of milk quality, particularly by using information from smallholder farmers and smallholder micro-enterprises dairy producers with the following objectives; To describe a dairy production practices and evaluation of milk quality by evaluate physico-chemical properties and microbial quality of raw milk in the study area

Materials and Methods

Description of the Study Area

The study was conducted at Sebeta town, South West Showa zone. Sebeta town is located 25km far away from the capital city of Ethiopia, Addis Ababa on the ways of main Jimma road. The present Sebeta town consists of nine major Kebele [58]. The map of the study area shown below Figure 1.

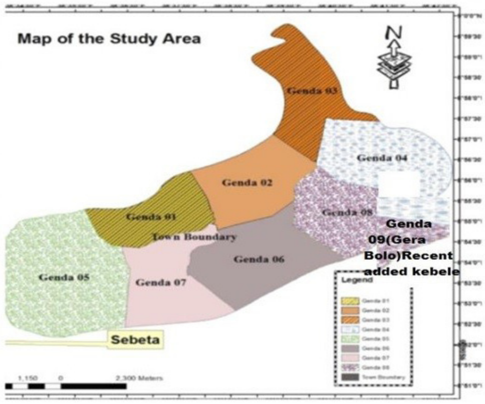

Figure 1: Map of the Sebeta town.

$$n_0 = \frac{Z^2 pq}{e^2}$$

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Figure 2: Determination of population and target Sample size equation.

$$n_0 = \frac{(1.96)^2 * 0.1(1-0.1) = 138.3}{(0.05)^2}$$

$$n = \frac{(138.3 = 87}{\frac{1+(138.3-1)}{230}}$$

Table 1: Proportion of sample taken from each kebeles.

$n_1 = \frac{n * N_1}{N}$	$n_2 = \frac{n * N_2}{N}$	$n_3 = \frac{n * N_3}{N}$

Where n1, n2 and n3: are sample sizes of respondents in each Kebele‟s, N1, N2 an N3: are total number of dairy producers in each Kebele, n=total sample size of respondents in each Kebele. N = is the total number of dairy producers in Sebeta town.

Table 2: Distribution of total population and Sample size determination in sebeta town.

Sebeta town smallholder dairy producers SHF (N= 36) SHMEs (N=51)				
Kebeles	01	05	07	Total
Total population of SHF	33	41	25	99
Target sample size of SHF	12	15	9	36
Total population of SHMEs	39	54	38	131
Target sample size of SHMEs	15	21	15	51

SHF: Smallholder Farmers; SHMEs: Smallholder Micro-Enterprises

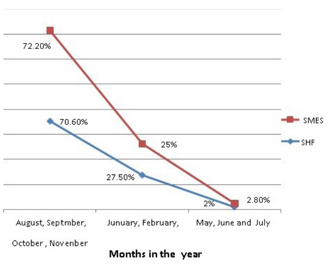

Figure 3: Milk produced in different months of the year in study area.

Table 4: Number and breeds of dairy cows owned, and purpose of milk production.

Respondents		
Variable	SHF (N=36)	SHMEs (N= 51)
Number of dairy cows holder	**N(%)**	**N(%)**
2- 5 cows	8(22.2)	30(58.8)
6-10 cows	14(38.9)	15(29.4)
11-15 cows	7(19.4)	5(9.8)
16-20 cows	2(5.6)	1(2.0)
>20 cows	5(13.9)	- -
Purpose of milk production		
For consumption	5(13.9)	6(11.8)
For market	30(83.3)	45(88.2)
For processing	1(2.8)	_ _
Types of dairy breed		
Pure breed	33(91.7)	48(94.1)
Crossbreed	3(8.3)	3(5.9)
Types of Exotic dairy breed		
Holstein breed	5(13.9)	4(7.8)
Jersey breed		

N: Number of Respondents; SHF: Smallholder Farmers; SHMEs: Smallholder Microenterprises

Table 5: Reason of dairy production, Frequency of milking and milking method.

Respondents		
Parameters	SHF (N=36) N(%)	SHMEs (N=51) N(%)
Reasons for engagement in dairy production		
income generation	27(75.0)	16(31.4)
Job creation	1(2.8)	33(64.7)
Consumption	8(22.2)	2(3.9)
Method of milking		
Hand milking	36(100.0)	51(100.0)
Frequency of milking per days		
Twice	36(100.0)	51(100.0)

N: Number of Respondents; SHF: Smallholder Farmers; SHMEs: Smallholder Microenterprises

Table 6: Types of house and use of manure in study area.

	Respondents		
Variable	SHF(N=36)	SHMEs(N=51)	Total
	N(%)	N(%)	N(%)
Types of dairy house			
Closed concrete floor	29(80.6)	46(90.2)	75(85.4)
Open muddy floor	- -	2(2.9)	2(1.45)
Both	7(19.4)	3(3.9)	10(11.65)
Use of manure			
For fertilizer	10(27.8)	5(9.8)	15(18.8)
Source of energy by drying	26(72.2)	46(90.2)	72(81.2)
As biogas	- -	- -	- -

N: Number of Respondent; HF: Holder Farmers; SHMEs: Smallholder Microenterprises

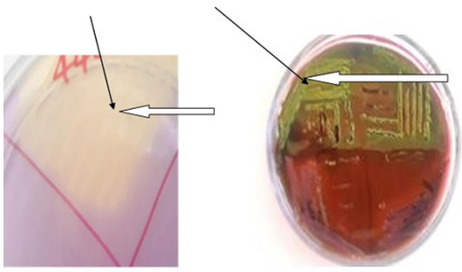

Figure 4: Image for S. aureus (a) and E. coli (b) incubated on media in the lab.

A) Yellow colon shows prevalence *S.aureus.* B) Metallic sheen colon milk shows prevalence E. coli.

Table 7: The main water source used for dairy production in study area.

	Respondents	
Variable	SHF (N=36)	SHMEs (N=51)
	N (%)	N (%)
Source of water		
Well water	4(11.1)	6(11.8)
Tape water	32(88.9)	45(88.2)

N: Number of Respondent; HF: Holder Farmers; SHMEs: Smallholder Microenterprises

The climate of Sebeta is predominantly known by *Wayina Dega-* (mid-altitude) with geographical co-ordinate between a latitude 8°55′N 38°37′E and longitude of 8.917°N 38.617°E and has an altitude of 2,356 meters above sea level (SCEFCCA, 2019). The majority of rainfall in the area is obtain during the Ethiopian rainy season (May, June, July and August) which covers 76.4% of the total annual rainfall. The minimum rain records in the months of September, October, and November with other short rain during March and April. The average annual rainfall varies between 783.6-1422.7mm with mean annual temperature of 12.7°C-24.4°C; this is suitable for dairy production system (SCEFCCA, 2019).

Sampling Technique and Sample Size

Sebeta town has nine major Kebeles and selected purposively based onpotential ofmilk production of the area (SCALM, 2019). Among the nine Kebeles of Sebeta town, 3 representatives Kebeleswere selected purposively based on their dairy cattle population and per households with random sampling technique. Generally, a sample size of 36 smallholder farmers and 51 smallholder microenterprises of dairy producer respondents were proportionally, selected from the three representative kebeles. Accordingly, from the 230 total populations, 131 smallholder microenterprises and 99 smallholder farmers are present in study areas [59].

The study consisted of survey study and laboratory analysis. The survey study focused on dairy production practices by using semi-structural questioner. The interview check lists focused on dairy production practices (feed types, housing, manure handling, water resource, milking times and breeding methods), milk quality characteristic and milk adulteration methods (Fat removing and addition of water). Laboratory analysis focused on milk quality tests like bacterial isolation and identification such as (mastitis, *E. coli*. and *S. aureus*). Chemical composition such as (fat, solid nonfat, protein, lactose, added water and solid) and physical properties such as (density and freezing points) were analyzed by using lactoscan machine. The milk samples were collected from smallholder microenterprises, smallholder farmers and selling point of shops. In the study, 87-target population sizes were used for data collection the dairy producers for responding questionnaires were determined by using equation 1 and 2 of the Cochran formula (1977) with 5% sampling error (95% CI). (https://www.statisticshowto.datasciencecentral.com/wp-content/uploads/2018/01/cochran- 1.jpeg).

Accordingly, 87-target samples size population of (51 smallholder micro-enterprises and 36 smallholder farmers) dairy cattle producers were randomly, taken from the three representative Kebeles of Sebeta town.

Method of Data Collection

Survey Data collection: Both secondary and primary data were collected from the three selected Kebeles. A semi- structured questionnaire was prepared to collect information from

Table 8: Types of feed resources and feeding practice in stud area.

Source of feeds	Respondents		
	Small HF (N=36)	Small HMEs (N=51)	Overall
	N(%)	N(%)	N(%)
Types of feedstuff available for milk production			
Concentrate	25(69.5)	37(72.5)	62(71)
Roughage	11(30.5)	14(27.5)	25(29)
Kind of roughage feeds			
Hay grasses	8(77.8)	49(96.1)	57(86.95)
Crop residue	8(22.2)	- -	8(11.1)
Pasture	--	2(3.9)	2(1.95)
Types of Concentrate feeds			
Brewery (beer byproduct)	26(72.2)	32(62.7)	58(67.45)
Agro-industrial byproducts	10(27.8)	19(37.3)	29(32.55)
Types of Agro-industrial byproducts			
Oil-seed cake	4(11.1)	3(5.9)	7(8.5)
Wheat bran	20(55.6)	9(17.6)	29(36.6)
Flour mill by product	7(19.4)	3(5.9)	10(12.65)
All mixes		36(70.6)	41(42.25)
Concentra feeds provide for a dairy cow per day			
7kg-9kg	24(66.7)	18(35.3)	42(51)
10kg-12kg	12(33.3)	30(58.8)	42(46.05)
>12kg	- -	3(5.9)	3(2.95)
Roughage feeds provide for dairy cow per day			
Adlibtum	36(100.0)	47(92.2)	83(96.1)
Measured quantity	--	4(7.8)	4(3.9)

Table 9: Breeding practice of dairy cows and source of semen in study area.

Variable	Respondents	
	SHF (N=36)	SHMEs (N=51)
	N(%)	N(%)
Methods of mating system cows		
AI only	28(77.8)	43(84.3)
Natural mating only	4(11.1)	2(3.9)
Both	4(11.1)	6(11.8)
Identifies cow's coming to heat		
Farmers	32(88.9)	43(84.3)
AI inseminator technician	1(2.8)	8(15.7)
Natural bull	3(8.3)	- -
Source of bull for natural mating		
Own growth	7(19.4)	3(5.9)
Rental	29(80.6)	46(90.2)
Extension service(DA)	- -	2(3.9)
Source of semen for Artificial insemination		
Government extension	36(100.0)	48(94.1)
Private	- -	3(5.9)
Lactation length cow		
10-moths	16(44.4)	32(62.7)
1- Years	20(55.6)	19(37.3)

N: Number of Respondents; SHF: Smallholder Farmers; SHMEs: Smallholder Microenterprises

smallholder farmers and smallholder micro-enterprises to evaluate dairy production system.

The questionnaire was prepared with some open and close ended questions. Secondary data was collected from record kept by the Sebeta town Livestock and Fishery, Agriculture office as well as through reviewed documents and publications. Primary data was collected through interviews by using questionnaires, field observation and milk samples collected for laboratory work.

Laboratory Diagnosis

Bacterial isolation: Twenty-one pooled and bulk samples of milk were collected from selling points of shops (1bulk milk sample from each of the 3 Kebeles), SHMEs (3 pooled milk sample from each of the 3 Kebeles) and smallholder farmers (3 pooled milk samples from each of the 3 Kebeles) and taken to investigation center by using a sterile sampling bottle of 50ml capacity. Immediately after the samples were taken from the delivery place, it was placed in the icebox and transported to Sebeta National animal health diagnosis investigation center (NAHDIC) for bacterial analysis.

I. The twenty-one pooled milk samples taken from milk shops, SHMEs and SHF were screened by Californian Mastitis Test (CMT) to identify prevalence of Subclinical Mastitis. The positive milk samples were analyzed for milk quality and isolation of milk born bacteria that cause mastitis. The pooled milk sample collected was examined for specific milk born pathogenic bacterial presence (like *E. coli* and S. *aureus*) in replicates following the standard techniques recommended by the International Organization for Standardization (ISO) via culturing on bacteriological media and testing using a series of biochemical test **California Mastitis Test (CMT):** The California Mastitis Test (CMT) was performed according to the manufacturer‟s instruction.

II. Escherichia coli: Identification of E. coli was carried out according to the protocol of ISO- 16654: 2001 standard. The samples were collected under strict aseptic procedures and transported in ice box to Sebeta National Animal Health Diagnosis Center (NAHDIC), stored at +4°C until processed. For isolation and identification, milk was cultured primarily on MacConkey agar and incubated aerobically at 37°C for 24 hours. A single, isolated colony was picked and sub-cultured on Eosin Methylene Blue (EMB) agar for formation of metallic sheen.

III. Staphylococcus aureus: Initial culturing was made by streaking 50µl of each milk sample on Tryptic Soy Agar (TSA) with a 5% horse blood. Plates were incubated at 37°C for 24 hours. *Staphylococcus* isolation and identification at the species level was conducted according to ISO-6888-3 using biochemical characteristics. Pathogens isolates was identified by MacConkey agar, hemolytic patterns, and growth on blood agar and Mannitol salt agar and biochemical tests (Kumar *et al*., 2011). Finally, identification of *S. aureus* was conducted using Gram staining. Yellow colonies formation with yellow zones after 24 hours of incubation at 37°C on Mannitol Salt Agar and clotted when mixed with 0.5 ml of horse plasma and incubated at 37°C for 24 hours.

Table 10: Calves colostrum feeding and management methods.

Variable	Respondents		
	SHF(N=36)	SHMEs(N=51)	Overall
	N(%)	N(%)	N(%)
Colostrum feeding methods			
In bucket	36(100.0)	51(100.0)	87(100.0)
Suckling dam	- -	- -	- -
Days of Colostrum feeding			
Three days	- -	3(5.9)	3(5.9)
5 days	28(77.8)	34(66.7)	31(72.25)
7 days	8(22.2)	4(27.4)	22(24.8)
Fate of male calve born			
Sold as veal	34(94.4)	50(98.0)	84(96.2)
Growth for natural mating	2(5.6)	1(2.0)	3(3.8)
5 days of birth	4(11.1)	18(35.29)	22(46.39)
7 days of birth	30(83.3)	30(58.12)	60(70.71)
10 days of birth	2(5.5)	3(5.89)	5(11.49)

N: Number of Respondents; SHF: Smallholder Farmers; SHMEs: Smallholder Microenterprises

Table 11: Amounts of milk produced per day as perceived by respondents of the study area.

Variable	Respondents	
	SHF (N=36)	SHMES (N=51)
	N(%)	N(%)
Milk in liters per day		
2-5 liters	1(2.8)	2-5 liters
6-9 liters	18 (50)	14(27.5)
10-13 liters	14(38.9)	21(41.2)
14-17 liters	2(5.6)	5(9.8)
18 and above liters	1(2.8)	3(5.9)

N: Number of Respondents; SHF: Smallholder Farmers; SHMEs: Smallholder Microenterprises

Table 12: Constraints of dairy production in the study area.

Parameters	Respondents		
	SHF(N=36)	SHMEs (N=51)	Overall
	N(%)	N(%)	N(%)
Types of constraints			
Technical	34(94.4)	44(86.3)	78(90.35)
Non-technical	2(5.6)	7(13.7)	9(9.65)
The main technical constraint			
Low feed availability	25(69.4)	37(72.5)	62(70.95)
High feed cost	6(16.7)	4(7.8)	10(12.25)
Disease	2(5.6)	4(7.8)	6(6.7)
Shortage of land	1(2.8)	7(13.7)	8(8.25)
Dairy breed	2(5.6)	1(2.0)	3(3.8)

N: Number of Respondent; HF: Holder Farmers; SHMEs: Smallholder Microenterprises

Table 13: Experience of dairy farmers on milk quality and handling system.

Parameters	Respondents	
	SHF (N=36)	SHMEs (N= 51)
Milk Quality detection	N(%)	N(%)
Odor/smelling	14(38.9)	37(72.5)
Color	22(61.1)	30(58.8)
Source of milk adulteration		
Addition of water	14(38.9)	21(41.2)
Addition of flour	22(61.1	30(58.8)
Experience of washing equipment before milking		
Yes	36(100)	51(100)
No	--	--
Type of Water used for wash equipment's before milking		
Cold	17(47.2)	24(47.1)
Hot	19(52.8)	27(52.9)
Experience of washing udder before milking		
Yes	21(58.3)	49(96.1)
No	15(41.7)	2(3.9)
Experience of Dipping teat in sanitizer after milking		
Yes	1(2.8)	9(17.6)
No	35(97.2)	42(82.4)

N: Numbers of Respondents

Analysis of Milk Chemical Composition and Density: Twenty-one bulk and pooled milk samples collected were immediately, taken from the delivery place, put in to the icebox and transported to Sebeta agro-industry (Mama Milk) plc. for analysis of chemical and physical properties. Chemical properties of milk samples analyzed include percent fat content, solid, protein, Solid Nonfat (SNF), lactose and added water to milk and specific gravity (density) and freezing points of milk were determined with calibrated milk analyzer of lactoscan machine.

Table 14: Experience of dairy farmers on milk quality and handling systems.

Parameters	Respondents	
	SHF (n=36)	SHMEs (N= 51)
Frequency of cleaning house per week		
Daily	29(80.6)	43(84.3)
Four times	6(16.7)	- -
Three times	1(2.8)	8(15.7)
Constraints of clean milk production		
Lack of awareness	15(41.7)	16(31.4)
Lack of clean water	3(8.3)	13(25.5)
Lack of clean environment	8(50.0)	22(43.1)
The main reason for milk adulteration		
For processing	- -	5(9.8)
For preservation	- -	3(5.9)
For economic gain	36(100.0)	43(84.3)

N: Number of Respondents

Table 15: Prevalence of mastitis in study area.

Collection Centers	No. of Sample Examined	Positive Samples N (%)
Smallholder micro-enterprise	9	7(77.8)
Smallholder Farmers	9	4(44.5)
Milk of selling points of Shops	3	3(100.0)

Table 16: Prevalence S. aureus and E. coli from milk samples collected in the study area.

Bacterial Isolated	Source of sample				
	Number of Positive Sample	Smallholder Farmers N (%)	Small Micro-Enterprise N (%)	Milk Shops N (%)	Overall N (%)
E. coli	7	4(44.44)	3(11.11)	- -	7(27.78)
S. aureus	3	1(11.11)	1(11.11)	1(33.33)	3(18.52)

No. p: Number of Positive Sample; SHF: Smallholder Farmers; SHMEs: Smallholder Micro- Enterprises; N(%): Number in Percent; S: Staphylococcus

Table 17: Mean value ± SE for chemical composition and sample collected.

Nutrient	Respondents				
	SMEs (N=9)	SHF (N=9)	Milk Shop (N=3)	Over All Mean	
Mean±SE	Mean±SE	Mean±SE	Mean±SE	p-value	
Fat	2.81±0.13^b	3.48±0.46^a	1.37±0.25^b	2.56±0.28	0.015
SNF	8.24±0.26^b	9.05±0.78^a	6.6±1.44^b	7.96±0.83	0.17
Total solid	11.05±0.39	12.53±1.24	7.97±1.69	10.51±1.10	0.07
Protein	3.16±0.11^b	3.47±0.32^a	2.62±0.63^b	3.08±0.35	0.27
Lactose	4.35±0.13^b	4.74±0.41^a	3.39±0.71^b	4.16±0.42	0.13
Added Water	5.43±2.61^b	8.25 ±3.65^b	41.09±29.53^a	18.26±11.93	0.034
Solid	0.66±0.016^b	0.49±0.10^b	0.75±0.04^a	0.63±0.05	0.016

Mean within the same row that different as superscripts are significantly different at (p<0.05). SE=Standard Error of mean, SNF= Solid Not Fat, SHMEs: Small-Holder Micro-Enterprises; SHF: Smallholder Farmers; N: Number of Sample; Added Water: is a not water content. The water added by producer or by milk sale men. Solid: is not total solid (only solid part).

Table 17: Specific gravity and Freezing points of milk sample from study area.

Sampling Source	N	Specific GravityMean ±SE	Freezing PointMean ±SE
SHMEs	**9**	**29.31±0.92^b**	**- 0.51±0.02^b**
SHF	9	31.34±2.91^b	-0.55±0.06^b
Milk Shop	3	2 3.38±4.89^a	-0.31±0.15^a
Over all means	21	28.01±2.90	-0.46±0.08
Significance		0.234	0.082

Mean within the same column having different as superscripts are significantly different at (p<0.05). SE=Standard Error of mean, SHMEs: Smallholder Micro-Enterprises; SHF: Small Holder Farmers; N: Number of Sample.

Data Analysis

Data collected from study area was entered into excel spread sheet and analyzed by using statistical package for the social science (SPSS, 2011, version 20). Descriptive statistics such as mean, percentage and standard error were used to present the result.

Results and Discussion

Demographic Characteristics of the Respondents

The information on socio-economic demographic characteristics of the respondents in the study areas are summarize in Table 3. Male respondents were dominant at both smallholder farmers and micro-enterprises (71.25%). This result is similar with Haile (2015) who reported that the overall mean male and female households were 97% and 3% respectively in AdeaBerga in West Shewa Zone and Wondatir (2010) who reported 86.7% of respondents were male dairy farmers in the Highland (Debre Birhan, Sebeta and Jimma) system. In Ethiopia, male are the household leaders who participate in most of the trainings and meeting including response to existing questions.

The marital status of dairy producers indicated that (86.1%) smallholder farmers and (56.9%) smallholder micro enterprises were married in Table 3. The study result is an indicated that dairy production might have positive effect on households‟ livelihood; because of milk related work is generating enough income for the family besides the home consumption.

The mean age group (37.3%) of smallholder microenterprises dairy producers were having between 26-33 years indicates that the dairy producers are at the productive age and provided employment to the youth. Similarly, majority of the smallholder dairy producers were at age group of 50 and above (44.4%), which could be due to the fact that dairy required a higher investment and it can take longer time to accumulate wealth before being engaged in dairy business. Present result is similar with Aleganesh *et al.* (2019) who reported productive age group was dominants for dairy production in central highlands of Jimma.

Education is entry point for enabling of community and tool for sustainably improves dairy production through knowledge, attitude and skill. From both smallholders, the majority of the respondents have passed through secondary school about (60%) and diplomas level counts about (23.85%). This finding indicated more numbers of respondents were educated and that contributed for the development of dairy production. Education makes easy adoption of new technologies; production of quality milk and food safety practices would be possible.

Dairy Cattle Production System

In the study area, based on own observation and interview results of respondents, two main dairy cattle production systems were identified; namely peri-urban and urban. The present study is more or less similar with Ayza*et al.* (2013) who reported two major dairy cattle production systems: peri-urban and urban dairy production system in Boditti town and reports at national level by Tegegne *et al.* (2013).

In this study, peri-urban production system was comprised of majority of smallholder farmers. (Over 80%) of milk is produced, mainly for marketing, whereas (13.9%) consumption and (2.8%) processing at smallholder farmers. This difference shows that the main objectives of milk production of smallholder farmers were not only for sale, but also used for house consumption and small amount is processed to yoghurt and cheeses. It was found that pure exotic breeds mainly form (86.1%) Holstein Friesian dairy cows are dominating with (13.9%) Jersey in Table 4 implying they are mainly targeting towards a commercial dairy production but limited with small number of cows. The main feed resources are agro-industrial by- products, purchased roughage and in addition, they use crop residue and pasture land. This result is similar with Anteneh *et al*. (2010) who reported the main feed resources are agro- industrial by-products and crop residue.

In this study, urban dairy production system was comprised of the majority of both smallholder farmers and smallholder micro-enterprises production system. Both dairy producers located mainly in Sebeta town. This result was similar with Tegegne *et al*. (2013) who reported urban dairy production system characterized by fresh fluid market orientation central highlands of Ethiopia.

The urban dairy productions system identified in study area were characterized by dominance of purebred which are restricted in closed housing and managed by zero grazing, fed from purchased hay. The major feed resources: include industrial by products like brewery, purchased hay and agro-industrial by products indicated in Table 4.

As indicated in Table 5, this finding is similar with the milking frequency of practiced in many parts of the country by Sintayehu *et al*. (2008) who reported 96.3% of households milked their cows twice per day in Shashemene-Dilla areas. On the other hand, Tegegne *et al* (2013) reported that hand milking is the sole milking method and milking frequency was twice per day across all the production systems in Ethiopia. The difference between the various studies could be attributed time of study and range of data collected by the researchers.

Housing systems and Uses of manure

Housing of dairy cattle is important for protection of the animals from adverse climatic conditions and to confine or control the animals. This study was more or less in agreement with Fekadeand Mekasha (2012) who reported 100% and 86.5% small and medium urban respondents keep their dairy animals within closed and attached housing type in Adama milk shade. In study areas, about (81.2%) dairy farmers used manure for energy by drying in the sun and also as sources of income generation by selling to other costumers for making injera (local bread).

Water resources used for Dairy production

The main sources of water in the present study area were tape water and well water. Majority of both smallholder respondents (88%) used tape water as source of water for dairy cattle in Table 7. About (11%) of both smallholders used water from well for their dairy cattle production. Respondents indicated that frequency of watering their animals by most of smallholders was three times in a day and all time after feeding. Present study result is similar with Shimeles (2016) who reported (98.9%) the main source of water is tape water in Addis Ababa (Bole sub-city, Nifas silk and Akaki).

Feed Resources for Dairy Cattle Production in Study Areas

Animal feeds are the major input for any animals‟ production activities. The major feed sources for dairy cattle in the study area include roughage feed (hay grasses and crop residue) and concentrate feed (brewery grain and agro-industrial byproducts) indicated in Table 8.

This variation could be due to the fact that some smallholder farmers having their own land for pasture cultivation. The other major feed sources for dairy cattle production were industrial byproducts (Meta brewery grain) as well as some agro-industrial by products (corn flour, wheat barn and oil seed cake) at both categories of the respondents. In study areas, the use of industrial byproducts from Meta brewery grain is very common due to availability of Meta berry byproducts in the area and its suitability for milk production. This result was in line with Galmessa *et al.* (2013) who reported in Jimma area, natural pasture has little importance as the system is almost zero grazing (peri-urban production) and Ayza *et al*. (2013) reported 86.8% of dairy producers in the urban production system use purchased feed Boditi.

Generally, concentrate feed is significantly vital for milk production and provided by calculation by its cost effectiveness, while feeding roughage was (adlibtum) without considering the quality and quantity. This finding is similar with Ayalew and Abateneh, (2018) who reported urban dairy production system common feed practiced in Dessie town and Mohammed *et al.* (2004) reported the urban and peri-urban milk production system feeding industrial byproducts and agro-industrial byproduct (like corn flour) in the central highland of Ethiopia.

Breeding Practices and Reproductive Performance

Both Artificial Insemination (AI) and natural services were used to breeding the dairy cows (Table 9).

Calf Management System and Colostrum Feeding

Respondents from Both smallholder farmers and smallholder microenterprises didn't allow suckling for calve before and after milking. Both smallholder dairy cattle producers practiced calf feeding by hand starting from the first day to five days drenched colostrum by bottle. After five days, calves practiced freely in bucket feeding (Table 10). This study indicated that the dairy farmers in the study area have prioritized for fluid milk marketing than feeding a calf.

This result shows that, urban producers follow early weaning practices with the intention of profit maximizations from sale of milk. This result is similar with Sintayehu et al., (2008) who reported Colostrum feeding for early weaning calves in the urban system lasted for 4 to 7 day in shashemane and Addis Ababa. Generally, colostrum feeding is the important management issue in determining calf health and survival. All calves must receive sufficient colostrum immediately after birth to support their growth and improve their welfare.

Milk Production Potential of Dairy Cows

Milk yield potential of cows at study area: As shown in Table 11, this variation is due to handling method and uses of superior milk production potential bred. The study area had relatively better access to basic input likes concentrate feeds, AI, veterinary service and handling methods. This study is similar with Saba (2015) who reported 11 litter/cows per days and Alemu (2019) with 11.6 and 10.8 liters per day per cow in Bishoftu and Akaki towns respectively, in peri-urban and urban dairy production systems.

Seasonal distribution of milk yield in study area: According to the current study result, the highest milk productions were reported by both respondents between August and December indicated in Figure 3). The respondent dairy farmers indicated that milk productions were dependent on availability of green pasture of grasses and the season of the month in a year. The most of favorable temperature for peak milk production is mid-summer due to abundance of grasses which is commonly the farmers are feeding their animals in zero grazing. Majority of the smallholder farmers (70.6%) and smallholder microenterprises (72.2%), the both smallholder getting the highest amounts of milk recorded in between August and December, while the lowest milk yield was recorded in between January and July, because both smallholders‟ producers are preserving the grasses as hay. So that would be indicated that shortage of free accesses of grasses for the animals. Even if there were availability of purchased concentrate from agro-industrial by products with high cost in study areas, yet season had greater influence in relation to forage availability. This result is in agreements with Ayalew (2017) who reported that breed and season affect milk yield in south wollo zone, Ahmara Region.

Constraints of Dairy Production in Study Area: Dairy productions in the studied areas were constrained by different problems: mostly, by technical constraint including low feed availability, high feed cost, disease, shortage of land and dairy breed (access of improved gene) in Table 12. The present finding is similar with Galmessa and Fita (2018) who reported the primary constraints to increased milk production under all dairy production systems are inadequate feed resources and the ever-increasing feed prices.

Evaluation of Milk Quality and Milk Handling System

Milk handling and hygienic practices: As indicated in Table 13, 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. 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.

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.

As indicated Table 14, all respondents had the culture of cleaning dairy cows shade/house for hygienic quality of milk and subsequent public health safety issues. The most limiting factor forquality milk productions is lack of awareness and lack of clean environment (over 31% and 43%) respectively reported from both smallholders. This results 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, 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.

Evaluation of Milk Sample for Microbial and Chemical Composition

Identification of Mastitis: From 21 pooled milk samples collected, (100.0%) of from the selling points of milk shops, (77.5%) smallholder micro-enterprises and (44.5%) smallholder farmers were positive for mastitis test with California Mastitis Test (CMT) indicated in Table 15. The result that positive for mastitis milk sample collected from selling points of shops was higher than that of milk sample collected from smallholder farmers and smallholder microenterprises. The variation between them might be due to the unhealthy cow, feed relating, possibility of contamination by adulterants along supply chain as well as low awareness of milk handling stem. The fact that all samples at selling point of milk shops being positive for mastitis could be associated with lack of hygienic, addition of powder material, milking equipment, milk storage, cows being not regular checked for mastitis. Such situations can cause ill effect on human health status specially, for milk consumer and newborns, cause food safety issue and not only in study areas but also along the milk supply chain. The positive result for mastitis in milk sample collected from smallholder micro-enterprises higher than that of smallholder farmers. The difference might be due to unhealthy cow, feed related and hygienic condition. The Present study is similar with (Yilma, 2010) who reported mastitis infections result in large numbers of bacteria in milk that caused by *S. aureus* which constitute a health hazard to consumer.

Generally, infection such as mastitis (inflammation of udder) observed in milk sample in the present study that changes the milk content such as reduction of fat and main protein (casein) content of milk and thus need training(awareness creation) for milk producers and sellers about milk handling, caustic agents for mastitis and control practice of adulteration.

Identification of Eschertial coli and Staphylococcus aureus from milk samples

The result of E. coli and S. aureus isolated and identified from milk sample collected from smallholder farmers, smallholder microenterprises and selling points of shops are indicated in Table 16. From the current 21-pooled milk samples were examined, overall (27.78%) were found to be positive for E. coli. Milk samples collected from smallholder micro-enterprises was (44.44%) higher than that of milk sample collected from smallholder farmers (11.11%) and selling points of shops. However, E. coli was not found in milk sample collected from selling point of milk shops. Therefore, among the three milk collection centers, highest (P<0.05) contamination of E. coli (44.44%) was observed at smallholder micro-enterprise. The variation might be due to unhygienic milking practices, contaminated feed, contamination from udder of animals through environment (uncleanliness milking areas, type of feeding and utensils).The current study result is similar with Fatine *et al*. (2012) who reported adulterated milk exercised during milking like unhygienic condition, cleanliness of milking utensils, condition of storage, as well as cleanliness of the udder of the individual animal. The laboratory result agrees with survey study interviewed the most of smallholder micro- enterprises were used industrials byproducts feed like meta juice(brewery grain) as main feed to produce milk, it might be the reason for high percent of prevalence of E. coli in milk sample collected from smallholder microenterprises.

Among 21- pooled milk samples examined, overall (18.52%) were positive for S. aureus. This indicates from the total sample, (11.11%, 11.11% and 33.33%) from smallholder micro- enterprises, smallholder farmers and selling point of shops respectively, positive for *S. aureus* and that is the potential for rejection at commercial processing units. The occurrence of milk born pathogenic in milk could be hazardous for consumers. This result is similar with Abunna *et al*. (2013); Mekuria*et al*. (2013) reported about 21.13% and 16.2% *S. aureus* prevalence, respectively in Addis Ababa milk shed and also Addis *et al*. (2011) who reported milk collected from farms (19.6%) *S. aureus*in Debrezeit.

The study has indicated relatively the similar contamination rate of *S. aureus* at smallholder farmers and smallholder microenterprises. In generally, the variation of bacterial load in raw milk might be due to many factors such as unhealthy animals and unhygienic condition like uncleanliness of milk sheds, types of feed, unclean condition of milkers and adulteration practice that cause food poising and affect gastrointestinal of consumers. However, during survey study all of smallholders practiced washing of dairy equipment with hot water before milking, while some of smallholder microenterprises used cold water for washing of udder before milking.

Generally, milk is an ideal environment for growth of microorganism like bacteria to reproduce, especially in warm conditions. Microorganisms may cause souring of the milk and hence rejection by the consumer or the milk sample collected for examination of prevalence of *S. aureus*.

Chemical Composition of Milk Samples Collected at Study Area

Avery important aspect of raw milk quality is its composition as well known that milk composition is influenced by many factors such as breed, age, parity, stage of lactation, feeding, health, milking technique and the milker [26]. According to Ethiopian Standards authority Agency recommended composition of milk, ESA (Ref No ES 3460:2009) and the specification of all nutrients of milk by Abebe (2015) from Ethiopian Meat and Dairy Industry Development Institute.

All chemical compositions of milk have shown significantly different values among the collections sites as shown in Table 17 below. The fat contents of milk collected from smallholder micro-enterprises, smallholder farmers and selling points of shops were 2.81±0.13, 3.47±0.46 and 1.37±0.25 respectively and the differences were significant at (P<0.05). The overall mean value of milk fat (2.56%) in the current study areas were lower than that (3.50%) indicated in the Quality Standard Authority of Ethiopian (ES, 2009) reported by Eshetu *et al*. (2019) and Abebe (2015). In the current study, the mean fat contents of milk sample collected from smallholder farmers was higher than milk sample that collected from smallholder micro-enterprise and selling points of shop. The wide range of variation in fat percent content of milk might be due to possible adulteration of milk by fat removal and/or addition of water to increase milk volume and to gain additional income. This result strengths the response of farmers during survey study, which revealed that the main milk adulteration activities were practiced by removing fat from fresh milk. Especially, the lowest fat content from the milk sample collected from selling milk shops indicated double adulteration by addition of water and fat removed from fresh milk after arrival at shops.

The Food and Drug Administration (FDA) and Milk Ordinance and Code of USA recommended that acceptable milk fat contents require not less than 3.25% milk fat for fluid milk by (Eshetu *et al*., 2019). A study made by Alganesh *et al.* (2019) has shown that adulteration of milk and milk products increased along the value chain from producers to whole seller or consumption site.

The overall Solid Nonfat (SNF) of milk samples in the study areas was (7.96%). According to Food and Drug Administration (FDA) as well as European Union (EU) quality standards, a minimum Solid Not Fat (SNF) content of completely fresh milk is (8.25%). Therefore, the mean SNF content of milk sample collected from smallholder micro-enterprises and smallholder farmers at acceptable level; while milk collected from selling points of shops had lower than recommended value. The difference in values among the source of sample collected might be due to adulteration activities like removing of fat that decrease SNF contents of milk.

Total solids are one of the parameter used for the quality of milk and the total addition of (fat and solid nonfat). Among the milk samples the total solids content of milk obtained from selling points of shops (7.97%) lower compared to that of milk samples obtained from the smallholder farmers (12.53%) and smallholder micro-enterprises (11.05%) respectively. The overall mean total solids content in the present study (10.51%) was lower than with Ayshim *et al*. (2015) who reported total solid (13.48 %) of crossbred dairy cows in Western Amhara Region. The overall mean total solid of milk samples in the study areas were (10.51%) and this value is lower to Ethiopian standards (ES, 2009) for total solid content of fresh cows "milk should not be less than (12.8%) by Haftu and Degnet and (2018) and European Union (EU) quality standards not less than (12.5%) by Raff (2011). In view of that, the total solid content obtained from the smallholder microenterprises milk producers and selling points of shops were below the quality standard due to adulteration practices.

The protein contents of milk samples collected from smallholder micro-enterprises, smallholder farmers and selling points of shops were (3.16±0.11, 3.47±0.32 and 2.62±0.63) respectively. The average protein content of milk as observed in the current study was (3.08%) and this value is close to Ethiopian standards (ES, 2009) for protein content of fresh cows" milk should not be less than (3.20%) except the lower values recorded from selling shops. According to ISO (2013), protein percent is not less than 3.5% of milk protein. Therefore, the average protein content observed from all sources of milk sampling was below this recommended standard. Milk sample collected from selling points of milk shops lower than smallholder micro-enterprises and smallholder farmers. This might be due to adulteration practiced after arrived shops, these activity cause frauds food quality issue. This finding is close to the acceptable level of protein percent when compared with FAO (2008) milk and milk product training manual. The present study similar with Alganesh (2016) who reported the overall mean protein in milk samples from Ejere, Walmera, Selale and Debre Birhan was 3.10 %.

The lactose percent contents of milk collected from smallholder micro-enterprises, smallholder farmers and selling points of shops were 4.35±0.13, 4.74±0.41 and 3.39±0.71) respectively (Table 17). This result is significant difference at ($p<0.05$). The overall lactose percentage of milk samples in the study areas were (4.16%). These finding is similar with EU and FDA who set that fresh whole milk lactose content should not be less than 4.2% [62]. However, the lactose content (3.39%) of milk sample collected from selling points of shops is lower than that smallholder micro-enterprises and smallholder farmers. These might be due to considerably affected by the extraneous addition of water and adulteration is practiced we progress from production to consumption areas of the milk supply chain.

The added water percent (not water content, only added water) contents of milk collected from smallholder micro-enterprises, smallholder farmers and selling points of shops were 5.43±2.61, 8.25±3.65 and 41.09±29.53, respectively. The conclusion from this result is more diluted milk by addition of water is significant. The overall mean added water percentage of milk sample in the study areas was (18.26±11.93) percentage. Accordingly, added water to milk sample collected from smallholder micro-enterprises and smallholder farmers were lower than of selling points of milk shops: these indicated addition of much water to milk significantly seen as far from production areas. Present result higher than Genzebu *et al*. (2016) who reported overall mean value of added water 2.80±3.6 in Bishoftu and Akaki towns of urban milk production.

Generally, addition of water to milk caused big problem where we have unfaithful farm workers, milk transporters and greedy milk sales persons. Many of urban residences and a few farmers also full sufferer of this illegal practice. This finding showed the reason of adding water to increase the quantity of milk to gain more income, this result makes sure the reason of adulteration observed during survey study in this study areas.

The solid percent (dried powder left after all the water is removed from liquid milk) contents of milk collected from smallholder micro-enterprises, smallholder farmers and selling points of shops were 0.66±0.016, 0.49±0.1, and 0.75±0.04 respectively, indicate in Table 17. The overall mean of solids content of the current study was (0.63%) lower. The variations of this study are might be due to lactation stage, fat removed and type of feed consumed. The solid of milk contents refers to all non-water components (whether fat or not) of including fat, proteins, vitamins, lactose and minerals. However, in these work the only solid part was examine to identify solid parts of milk was either removed or added. In generally, the difference in milk composition was described in this research among different milk collection centers with in Sebeta town, might be due to many factors including stage of lactation, type of feed, fat removed, addition of powder and water.

Physical Properties of Milk: Density and Freezing points of Milk

The specific gravity recorded in study areas ranged from 1.023g/cm^3-1.031 g/cm^3 indicated in Table 18. This result is more or less similar with Haile (2015) who reported specific gravity range 1.022g/cm^3-1.031 g/cm^3 in AdeaBerga districts, but higher than report of Mebratu (2015) overall density 1.023g/cm^3 in Addis Ababa.

The normal density of raw milk depends on its composition and temperature can usually found in the range of 1.026g/cm^3-1.032 g/cm^3 at 20°C [27]. Whereas samples of milk from herds should have reading the average milk, but wrong feeding might result in low readings. According to current result, the most of the milk samples collected from smallholder micro-enterprises and smallholder farmers were within normal range for specific gravity. However, samples collected from milk selling shops were not in the normal range of specific gravity. These variations might be due to the different sources of milk in the mixed, adulterated with water and removal of fat. In general, addition of water and removal of fat decreases the density of milk, while addition of solids increases the density of milk. The density measurement of milk quickly indicates nonconformities from the normal milk composition due addition of water. A similar result was also reported by Teklemichael *et al*. (2015) where specific gravity of milk samples collected from milk wholesalers were significantly lower (P<0.05) than that obtained from dairy farms in Dire Dawa Town, Eastern Ethiopia.

The overall mean freezing point content of the current study was (-0.46±0.08). When compared with FAO (2008) who reported standards freezing points (-0.521) in Ethiopia, the study result was below quality Standard Authority of Ethiopia recommended. These result is higher than that of Genzebu *et al.* (2016) who reported freezing point of milk in Bishoftu (-0.54±0.03) and Akaki (-0.56±0.02). As indicated in Table 18, milk sample collected from smallholder micro-enterprises and smallholder farmers were in the range of acceptable level. While milk sample collected from selling points of shops below normal acceptance level of freezing point. The variation of these result among sample collected in study areas were due to adulteration of milk by addition of water as well as removal of fat for the reason of economic gain.

Generalization, the overall milk obtained from selling shops had the lowest quality in terms of both chemical composition as well as bacteriological quality compared to the smallholder farmers and smallholder micro-enterprises.

Conclusion and Reccommedation

The study was conducted in Sebeta town, South West Showa Zone with the general objectives to describe dairy production system and evaluation of milk quality. The present study has identified two production systems; namely, peri-urban and urban dairy production systems. In study area, purebred dairy cattle are dominant when compared to local breeds and crossbred. Dairy production was the main source of income for smallholder farmers (975%) 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. Tape water was the main sources of water for the dairy animals in study areas. Most of dairy cattle owners have constructed separate sheds/barns with concrete floor for their dairy cattle. AI was the most common methods for cattle breeding. All smallholders have practiced hand milking as the only methods of milking but they had practice of washing their hand prior to milking. The average daily milk yield from pure bred and crossbred was 11.5 liters per day per cow. The current study result showed the highest milk production was possible during August to December from both categories of respondents in study areas. Therefore, the current study presented that milk production has relation with green harvest during wet season. The main constraints of

✓ 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.

✓ Milk samples collected from all sampling points were indicative of bacterial contamination, 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

1. Abebe Bereda. Milk Quality for Consumers‟ Safety. Ethiopian Meat and Dairy Industry, Development Institute: Proceedings. 2015; 5: 284-291.
2. Abunna F, Fufa G, Megersa B, Regassa A. Bovine mastitis: prevalence, risk factors and bacterial isolation smallholder dairy farms in Addis Ababa city. Ethiopia Glob. 2013; 10: 647–52.
3. Addis M, Pal M, Kyule M. Isolation and identification of Staphylococcus species from raw bovine milk in Debrezeit. Ethiop Vet Rese. 2011; 4: 45–9.
4. Ahmed MM, Jabbar M, Ehui S. Household-level economic and nutritional impacts of market-oriented dairy production in the Ethiopian highlands. Food and Nutrition Bulletin. 2000; 21: 460-465.
5. Alemu MM. Urban and peri-urban dairy cattle production in Ethiopia: a review. Online J Anim Feed Res. 2019; 9: 173-7.
6. Alganesh T, Tesfa K, Yetnayet B, Taye T, Fekadu. Assessment of butter adulteration practices and associated food safety issues along the supply chain in central highlands and south west mid lands of Ethiopia; 2019.
7. AOAC. Official methods of analysis of the AOAC. 15th ed; 1990 Methods 932.06, 925.09. Asrat A, Feleke A, Ermias B. Characterization of dairy cattle production systems in and around WolaitaSodo town, Southern Ethiopia. Schj Agric Sci. 2016; 6: 62-70.
8. Ayalew H, Abatenhe A. Dairy cattle production, processing and handling of milk and milk products in Enemay District, east Gojjam, Amhara, Ethiopia. J Adv Dairy Res. 2018; 06: 2.
9. Ayalew M. Assessment and monitoring of traditional milking and milk product handling, processing and marketing in Dessie-ZurieaWoreda and Dessie Town, south Wollo zone, Amhara, Ethiopia; 2017 ([doctoral dissertation]. Bahir Dar University).
10. Barbano DM, Ma Y, Santos MV. Influence of raw milk quality on fluid milk shelf life. J Dairy Sci. 2006; 89: E15-9.
11. Bekele A, Fekadu B, Mitiku E. Chemical composition and microbial quality of cow milk in urban and peri urban area of Dangila town, Western Amhara Region. Ethiopia. Glob J Dairy Farming Milk Prod. 2014; 3: 081-5.
12. Beyene B, Hundie D, Gobena G. Assessment on dairy production system and its constraints in HoroguduruWollega Zone, Western Ethiopia. Sci Technol Arts Res J. 2015; 4: 215-21.
13. Bille PG, Haradoeb BR, Shigwedha N. Evaluation of chemical and bacteriological quality of raw milk from Neudamm dairy farm in Namibia. Afr J Food Agric Nutr Dev. 2009; 9.
14. Chala Adugna, Yosef T, Mitiku E. Dairy Cattle Production Practice, Microbial milk quality, and Marketing of milk and milk product in Eastern Wolega zone of Sibu Sire District. Ethiopia. 2017; 27-31.
15. Cochran WG. Sampling techniques. 3rd ed. New York: John Wiley & Sons; 1977.
16. CSA (Central Statistical Agency). Agricultural sample survey. Federal Democratic Republic of Ethiopia Central Statistical Agency. Private peasant holdings. Stat Bull. 2017; 570.

17. CSA (Central Statistical Authority). Agricultural sample survey and livestock characteristics (private peasant holdings), Ethiopia. Stat Bull. 2018; 587.

18. Dehinenet G, Mekonnen H, Ashenafi M, Emmanuelle G. 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. 2013; 4: 84-90.

19. Drewnowski A. The contribution of milk and milk products to micronutrient density andaffordability of the US diet. J Am Coll Nutr. 2011; 30: 422S-8S.

20. Dugdill BT. Training Program for the Small-scale Dairy Sector in Kenya; 2001 (FAO. TCP/KEN/6611).Discussion paper 3.3.

21. Duguma B, Janssens GPJ. Assessment of feed resources, feeding practices and coping strategies to feed scarcity by smallholder urban dairy producers in Jimma town, Ethiopia. SpringerPlus. 2016; 5: 717.

22. Elmoslemany AM, Keefe GP, Dohoo IR, Wichtel JJ, Stryhn H, et al. The association between bulk tank milk analysis for raw milk quality andon- farm management practices. Prev Vet Med. 2010; 95: 32-40.

23. Abd El-Salam MHA, El-Shibiny S. A comprehensive review on the composition and properties of buffalo milk. Dairy Science & Technol. 2011; 91: 663-99.

24. Dehinenet G, Mekonnen H, Ashenafi M, Emmanuelle G. Determinants of raw milk quality under a smallholder production system in selected areas of Amhara and Oromia National Regional States, Ethiopia. Agric Biol JN Am. 2013; 4.

25. Fahmid S, Sajjad A, Khan M, Jamil N, Ali J. Determination of chemical composition of milk marketed in Quetta, Pakistan. Int J Adv Res Biol Sci. 2016; 3: 98-103.

26. FAO. Characteristic and composition of hygienic and quality Milk production manual in Kenya and Ethiopia, Rome, Italy; 2008.

27. FAO. Gender assessment of dairy value chains: evidence from Ethiopia. Rome, Italy: Food and Agriculture Organization. Rome, Italy; 2017. Hygienic and Quality Milk Production Training Manual I and II dairy extension.

28. FAO, TCP/KEN/6611. Milk testing and quality control. Training Programme for Small Scale Dairy Sector and Dairy Training Institute Naivasha. 2017; 2: 4-18.

29. Fatine H, Abdelmoula E, Doha B, Hinde H. Bacterial Quality of Informal marketed raw milk Kenitra City, Morocco. Park. J Nurtr. 2012; 11: 662-9.

30. Faye B, Konuspayeva G. The sustainability challenge to the dairy sector–The growing importance of non-cattle milk production worldwide. Int Dairy J. 2012; 24: 50-6.

31. Fekade N, Mekasha Y. Evaluation of urban and peri-urban dairy production SystemsinAdama milk shed east Shoa zone Oromia National Regional state Ethiopia; 2012.

32. Food US. Drug Administration (FDA). Production record of health functional food and analysis result of that inFDA. Retrieved from FDA. 2011; 2008.

33. Fiseha KTD. Dairy production and marketing systems in kaffa and Sheka Zones, Southern Ethiopia. Age. 21: 31-40.

34. Gadaga TH, Nyanga LK, Mutukumira AN. The occurrence, growth and control of pathogens in African fermented foods. 2004.

35. Haftu KS, Degnet HM. Determination of adulteration and chemical composition of raw milk sold in Hossana town, South Ethiopia; 2018.

36. Hemme T, Otte J. Status and prospects for smallholder milk production: a global perspective. Food and Agriculture Organization of the United Nations (FAO); 2010.

37. Herikstad H, Motarjemi Y, Tauxe RV. Salmonella surveillance: survey of public health serotyping. Epidemiol Infect. 2002; 129: 18.

38. Holloway GJ. How to make a milk market: A case study from the Ethiopian Highlands. ILRI (aka ILCA and ILRAD). 2000; 28.

39. Hu W, Murphy MR, Constable PD, Block E. Dietary cation-anion difference effects on performance and acid-base status of dairy cows postpartum. J Dairy Sci. 2007; 90: 3367-75.

40. Hussen K, Tegegne A, Kurtu MY, Gebremedhin B. Traditional cow an camel milk production and marketing in agro-pastoral and mixed crop-livestock systems:the case of Mieso District, Oromia regional state, Ethiopia (No. 13). ILRI (aka ILCA and ILRAD). 2008.

41. ISO. Sample collection culturing on bacteriological media and testing using a series of biochemical. Int Stand Organ. 2001: ISO-16654.

42. Kamthania M, Saxena J, Saxena K, Sharma DK. Milk adulteration: methods of detection &Remedial measures. Int J Eng Tech Res. 2014; 1: 15-20.

43. Kassa T, Dekamo F. Dairy production and marketing systems in Kaffa and Sheka Zones, Southern Ethiopia. J Mark Cons Res. 2016; 27: 242-56.

44. Kurwijila LR. Hygienic milk handling, processing and marketing: guide for training and certification of small-scale milk traders in eastern Africa. Lactoperoxidase method preserving raw milk in areas without cooling facilities. Afr J Food Agric Nutr Dev. 2006; 7: 1.

45. Mebratu A. Evaluation of the chemical and microbial properties of domestic commercial pasteurized milk available in Addis Ababa, Ethiopia; 2015 ([doctoral dissertation]. Addis Ababa University). 2015.

46. Mekuria AD, Asrat YW, Tefera G. Identification and antimicrobial susceptibility of Staphylococcus aureus isolated from milk samples of dairy cows and nasal swabs of farm workers in selected dairy farms around Addis Ababa, Ethiopia. Afr J Microbiol. 2013; 7: 3501-10.

47. Mitiku E, Mekdes S, Yesihak YM. Milk production, marketing practices and qualities along milk supply chains of Haramaya District, Ethiopia. Afr J Agric Res. 2019; 14: 1990-2005.

48. Pandey R, Verma MR. Sample allocation in different strata, impact evaluation of developmental program. Rev Mar Estat. 2008; 24: 103-12.

49. Perera P, Munasinghe H, Marapana RAUJ. Quality assessment dairy products in Sri Lankan market. J Food Qual. 2019; 2019.

50. Powell JM, MacLeod M, Vellinga TV, Opio C, Falcucci A, et al. Feed–milk–manure nitrogen relation dairy production systems. Livest Sci. 2013; 152: 261-72.

51. Raff H. Market implications of changing fat content of milk and dairy products, fat content and composition; 2011.

52. Rao PS, Reddy BR. An overview of dairy Industry in India. Productivity. 2014; 55: 43.

53. Rizani H, Cabeli P, Jashari B, Shala S, Rizani M, et al. Determination of aerobic mesophilic bacteria and coliforms in raw milk in the region of Kosovo. Albanian J Agric Sci. 2018; 17: 37-4.

54. Santos MV, Ma Y, Barbano DM. Effect of somatic cell count on proteolysis and lipolysis in pasteurized fluid milk during shelf-life storage. J Dairy Sci. 2003; 86: 2491-503.

55. Sarkar U, Gupta AK, Sarkar V, Mohanty TK, Raina VS, et al. Factors affecting milk yield and milk composition in dairy animals. J Dairying Foods Home Sci. 2006; 25: 129-32.

56. Limit Compainy SA-IP. The plan collects milk from nearby smallholder dairy farmers and small micro enterprise processing in to different products; 2019.

57. Sebeta city administration environment, forest and climatic change authority. Environment and weather condition study in Sebeta and its surrounding. 2019.

58. Sebeta City Administration and Land Managements. Demography of population and location of the town. 2019.

59. Sebeta Town Livestock and Fisher, agriculture office. Dairy cattle population distribution in kebeles. 2019.

60. Shimeles B. Physicochemical Properties and Microbial Quality of Cow Milk Collected from Selected Sub city of Addis Ababa, Ethiopia (Doctoral dissertation. Addis Ababa university. 2016.

61. Soomro AA, Khaskheli M, Memon MA, Barham GS, Haq IU, et al. Study on adulteration and composition of milk sold in Badin. Int J Res Appl Nat Soc. 2014; 2: 57-70.

62. Tamine AY. Milk processing and quality management. United Kingdom: Society of Dairy Technology; 2009.

63. Tekliye M, Gizaw M. Handling practices, evaluation, adulteration and microbial quality of raw cow milk around Bahir Dar, Ethiopia; 2017.

64. Teklemichael T, Ameha K, Eyassu S. Physicochemical properties of cow milk produced and marketed in Dire Dawa town, Eastern Ethiopia. Food Sci Qual Manag. 2015; 42: 56-61.

65. Verdi RJ, Barbano DM. Preliminary investigation of the properties of somatic cell proteases. J Dairy Sci. 1988; 71: 534-8.

66. Wondatir Z. Livestock production systems in relation with feed availability in the highlands and central rift valley of Ethiopia; 2010.

67. Yigrem S, Beyene F, Tegegne A, Gebremedhin B. Dairy production, processing and marketing systems of Shashemene–Dilla area, South Ethiopia. Improving Productivity and Market Success (IPMS) of Ethiopian farmers‟ project. International Livestock Research Institute (ILRI). Addis Ababa, Ethiopia; 2008.

68. Zelalem Y, Guernebleich E, Sebsibe A. A review of the Ethiopian dairy sector. Addis Ababa: Food and Agriculture Organization of the United Nations, Sub Regional Office for Eastern Africa (FAO/ Society for Endocrinology). Fombad R, editor. 2011; 81.

69. Zelalem Y, Guernebleich E, Sebsibe A, Fombad R. A review of the Ethiopian dairy sector. Addis Ababa, Ethiopia: Food and Agriculture Organization Sub Regional Office for Eastern Africa (FAO/ Society for Endocrinology); 2011; 10.