DAIRY CATTLE PRODUCTION, PROCESSING AND HANDLING OF MILK AND MILK PRODUCTS IN ENEMAY DISTRICT, AMHARA, ETHIOPIA

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✉*Supporting Information*

ABSTRACT: The objective of the study was to assess dairy cattle production systems, processing and handling systems of cow milk and milk products in the highlands of Ethiopia. The study was conducted from 2017 to 2018 in Enemay district, Amhara, Ethiopia. The sample kebeles and household for the study were selected based on stratification and purposive sampling techniques. Three rural and two urban and pre urban kebeles were selected. From each kebele 30 households (total of 150 households) were selected randomly from those have at least two lactating cows. Dairy cooperatives and private farms were included during the study. Descriptive statistics was employed for data analysis using Statistical Procedures for Social Sciences (SPSS) version 20.0. Dairy cattle production systems that identified in the study areas were rural smallholder or mixed crop- livestock production which accounts 98% and the rest 2% were urban and pre urban system. Out of the total milk produced per households per day 0.42±1.8 liters was used for traditional milk processing. The study also revealed that 40.2% of the respondents were process milk into different milk products. The three most prioritized milk and milk products in the area were butter, ghee and whole milk with their ascending ranking order. The finding revealed that most of respondents (89.4 %) did not use udder washing before milking. The majority of the respondents were practiced washing of their hands (73.6%) and milk utensils (90.6%) before milking. There should be training for farmers and dairy cooperatives about milking hygienic practices, feeding and health care managements for their dairy cattle animals. The study is also recommend that improved and appropriate milk processing technologies like churner and cram separator should be accessible in place to improve milk processing for sustainable dairy production.

Keywords: Dairy cattle production, East Gojjam, Enemay, Milk handling, Milk processing

INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa (CSA, 2017). The varied and extensive agro-ecological zones and the importance of livestock in livelihood strategies make Ethiopia home to large numbers of livestock. Indeed, Ethiopia has the largest livestock inventory in Africa, 59,486,667 cattle, 30,697,942 sheep and 30,200, 226 goats, 8,439, 220 donkeys, 409, 877 mules, 2,158, 176 horses and 59,495, 026 chickens (CSA, 2017). Out of this total cattle population, the female cattle constitute about 55.5 percent and the remaining 44.5 percent are male cattle. Eighty-three percent of all milk produced in Ethiopia comes from cattle with the remainder coming from goats and camels (MoARD, 2007).

Dairy sector is a major contributor to economic development especially among the developing countries. As an engine of growth, it provides increased income, employment, food and foreign exchange earnings as well as better nutrition (Yilma et al., 2011). As income increases with economic development, the share of animal products in total food budget increases faster than that of cereals. This occurs because of the relatively high-income elasticity of demand for animal products (Yigrem et al., 2008). According to CSA, 2017 the estimate of total cow milk production for the rural sedentary areas of the country is about 3.1 billion liters. The average lactation period per cow is estimated to be about six months, and average milk yield per cow per day is about 1.37 liters.

Despite its huge number, the livestock sub-sector in Ethiopia is less productive in general, and compared to its potential, the direct contribution to the national economy is limited. The poor genetic potential for productive traits, in combination with the sub-standard feeding, health care and management practices that animals are exposed to are the main contributors to the low productivity (Zegeye, 2003). Milk and milk products play an important role in human nutrition throughout the world. Milk is also highly perishable and can easily be adulterated whilst the quality of the milk is highly dependent on farm management. The safety of dairy products with respect to food-borne diseases is a great concern around the world. This is especially true in developing countries where production of milk and various dairy products take place under rather unsanitary conditions and poor production practices (Mogesse, 1990; Zelalem and Faye, 2006)

Dairy products are manufactured and consumed in many parts of the country. Fresh whole milk, butter, Arera (defatted sour milk), whole sour milk (*Ergo*), and Ayib (a traditional cottage cheese) are the major dairy products produced and consumed in many parts of the Ethiopia (Fekadu, 1994; Tola, 2002; Fita, 2004, Eyassu and Asaminew, 2014 and Belay and Janssens, 2014). Many of these products are produced using artisanal technologies on-farm and the types and processing steps of these dairy products can vary considerably from one area to the other. So, identification and understanding of dairy products, handling and processing methods are essential in order to devise appropriate development interventions that would result in improved production and quality of dairy products.

MATERIALS AND METHODS

Study area description

Enemay district is found in east Gojjam zone, Amhara region, Ethiopia and which is located 265 km northeast of Addis Ababa, capital city of Ethiopia. The district is geographically located 10^0 39' 59.99" N latitude and 38^0 00' 0.00" E longitudes. The district has an average altitude of 2541 m a.s.l. (WAO, 2016). The district consists of 27 rural and 7 urban Kebeles (WAO, 2016). Agro ecologically, the district is classified as 88% of *"Weinadega"*(midland), 7% of *"Dega" (*highland), 5% of *"Kola"* (lowland). The mean annual rainfall is 1100 mm ranging from 997 mm to 1203 mm. It is unimodal, falling during *"Kiremt"* (June-September), however, there is small rain falling between April and May (*"Belge"*). The mean annual temperature is 18.5°C and the range is from mean minimum of 10 °C to mean maximum 27°C (WAO, 2016).

Sampling Techniques and Methods

District was selected purposively based on cattle population, potential of milk production, and access of the road. Secondly, *kebele* was selected based on stratification methods and 3 rural and 2 urban *kebeles* were selected. Bichena and Yetemen were purposely selected and classified as urban and peri-urban dairy production systems. According to this study farms located at a distance greater than five kilometers from the main town of the district was considered as peri-urban farms. From the total 26 rural kebeles 3 kebeles were selected purposively based on agro ecology. From each *kebele* 30 households were selected randomly from those have lactating cow. During the study dairy cooperatives and private farms that found in the selected kebeles were included.

A rapid survey with veterinarian, animal production expert in the district and focused group discussion was made with key informants after designing check lists of issues to be covered. Semi structured questionnaire was prepared in a way it can address the aim of the research. Questionnaire having open-ended and closed-ended were developed with main focus on dairy cattle production system, milk handling, processing techniques and types of dairy products that has to be manufactured and consumed in the area. In addition to this, field observation was made to enrich the collected data. Descriptive statistics was employed for data analysis using Statistical Procedures for Social Sciences (SPSS) version 20.0 (SPSS, 2011).

RESULTS AND DISCUSSION

Socio economic characteristics of household

Sex, family size and education background of the respondents in the two farming systems are presented in Table 1. The overall mean family size in the study area was 5.6 ± 2.45. The current findings are similar with results reported by Belay and Janssens (2014) on average family size of households in Jimma town that was 6.02±2.52. The survey also revealed that the majority of the households in the study area were headed by males which accounted 97% and the remaining proportion of the households was headed by females. Female headed household in this particular study would indicate either the husband has died or they are divorce. Similarly, Kassa and Dekamo (2016) reported that in southern Ethiopia out of the total interviewed respondents (N = 140), 95% were male and the rest (5%) were female household members of different age and educational status. The study also revealed that the majority of religion of HH (87.42%) was Orthodox and the rest were Muslim and protestant 11.52% and 1.06%, respectively. Similarly Kassa and Dekamo (2016) reported that regarding the religion of the respondents, the majorities (65.7%) were orthodox followers, 30.1% were protestant, 3.5% were Muslim and 0.7% was catholic followers in the southern parts of Ethiopia. The majorities (67.4%) of the household heads in Enemay districts were illiterates and the remaining proportions (32.6%) were literate, who can read and write.

Dairy Cattle Production Systems

Based on this finding the production system that identified in the study areas were rural smallholder or mixed crop- livestock production (98%) and the rest 2% were urban and pre urban system. Rural smallholder production system is characterized by land scarcity and the major livestock feed resources include grazing on marginal lands,

crop aftermath and crop residues. Which is in line with the finding of Kassa and Dekamo (2016) those reported that in Kaffa and Sheka Zones, Southern Ethiopia the major production system were mixed crop livestock production system in which cereal crops predominantly produced in the study areas were maize, barley, wheat, vetch, bean, pea, teff and chickpea which used for livestock feed resources as a crop residues. The smallholder farmers in this system predominantly raise indigenous zebu cattle breeds and farming is subsistence in nature. In the mixed crop-livestock production system, milk produced is retained for home consumption and seldom for sale.

Milk processing and handling
In the study area the total annual cow milk produced was estimated to be about 2000 thousand liters from 150 households and dairy cooperatives those having more than 2 indigenous (zebu) and cross breed lactating cows. In the study area, out of the total milk produced per farm per day 0.42±1.8 liters was used for traditional milk processing. The finding also revealed that 40.2% of the respondents were process milk into different milk products. This result is lower than the findings of Debrah and Berhanu (1991), Sintayehu et al. (2008) and Belay and Janssens (2014) who reported that 50.6%, 54.5% and 46.3% of respondents in different parts of Ethiopia process their milk into different milk products, respectively. The major products of the traditional milk processing were naturally fermented milk, butter, whey, cheese and ghee (Table 2).

Cleaning the udder of cows before milking is important since it could have direct contact with the ground, urine, dung and feed refusals while resting. The finding revealed that the majority of respondents (89.4 %) did not use udder washing before milking but lack of washing udder before milking can impart possible contaminants into the milk. Contrary to the current finding, Negash (2012) reported that 82.5% of households in Hawassa city are practicing milking by washing udder. It also disagree with the report of Gezu and Kebede (2015) who reported that all respondents (100%) practices udder washing before milking in urban and peri urban area of Hadya Zone, Southern Ethiopia. Production of milk of good hygienic quality for consumers requires good hygienic practices (clean milking utensils, washing milker's hands, washing the udder and use of individual towels) during milking and handling, before delivery to consumers or processors (Getachew, 2003). In the study area, the majority of the respondents practiced washing of their milk utensils (90.6%) and milker's hands (73.6%) before milking. This is in line with results of Abebe et al. (2013) that reported the majority of the respondents practiced washing of their milk utensils (87.5%) and milker's hands (71.6%) before milking in Ezha district of the Gurage zone, Southern Ethiopia. This finding revealed that containers used for milking and traditional milk processing were used 62.7%, 30.3% and 7% plastic material, gourd and stainless steel, respectively. The current result in line with results of Gezu and Kebede (2015) who reported all respondents (100%) used clay pot, Gourd, Plastic material and Stainless steel as handling and traditional milk processing materials in Hosanna Town, Hadya Zone, Southern parts of Ethiopia. It also similar with the report Gezu and Kebede (2015) who revealed that the milking material used in the Dangila zone western part of Amhara region were gourd, plastic material and stainless steel.

Milk and milk products
In Enemay district milk is consumed either in its raw state or after processing to various products (Table 2). The common dairy products that have to be consumed in the area were fresh whole milk, naturally fermented sour milk, butter, whey, ghee and cheese. Which is in line with reports of Eyassu and Asaminew (2014) and Gezu and Kebede (2015) that they revealed fresh whole milk, Ergo (naturally fermented sour milk), Arera (defatted sour milk), butter, ghee, Ayib (a traditional cottage cheese), Metata Ayib (a traditional fermented cottage cheese) and Zure are the common dairy products produced and consumed in different part of Ethiopia. From these products, the three most prioritized milk and milk products in the area were butter, ghee and whole milk with their ascending ranking order. The naturally fermented sour milk and whey were used as rarely consumed in the area. In rural and urban and pre urban strata milk and milk products consuming pattern of households were not similar. In rural area of Enemay district butter, ghee and whole milk were ranked 1st, 2nd and 3rd, respectively whereas in urban and pre urban kebeles whole milk, butter and ghee were ranked 1st, 2nd and 3rd, respectively. The results of the current study are in contrast with the report of Debrah and Berhanu (1999) who indicated butter and cheese were not sold by intra-urban producers in Addis Ababa.

Table 1 - Socio-economic characteristics of households in Enemay district			
Descriptor		**Rural kebeles**	**Urban and pre urban kebeles**	**Overall**
		N=90; Mean± SD	N= 60; Mean ± SD	N= 150; Mean ± SD
Family size		5.7± 2.51	5.6 ± 2.44	5.6 ± 2.45
Sex of household (%)	Male	100	95.6	97
	Female	_	4.4	3
Educational level	Illiterate	62.2	70	67.4
	literate	37.8	30	32.6
The religion of HH heads	Muslim	1033	12.7	11.52
	Orthodox	88.55	86. 3	87.42
	Protestant	1.12	1	1.06

Table 2 - Milk and processed milk products in Enemay district

Milk and Milk products	Urban and pre urban kebeles (HH=60)						Rural Kebles (HH=90)						Overall (HH=150)		
	Number of HH ranking						Number of HH ranking								
	1st	2nd	3 rd	Total N	Index	Rank	1st	2nd	3 rd	Total N	Index	Rank	Total N	Index	Rank
Whole milk	35	15	9	144	0.30	1	8	15	25	79	0.13	3	223	0.20	3
Butter	22	14	20	114	0.24	2	47	36	6	219	0.35	1	333	0.30	1
Whey	-	33	9	75	0.16	4	-	3	-	6	0.01	6	81	0.07	6
Ghee	19	10	23	100	0.21	3	43	19	28	195	0.31	2	295	0.27	2
Sour milk (Ergo)	-	7	9	23	0.05	6	6	13	17	61	0.10	5	84	0.08	5
Cheese	-	11	5	27	0.06	5	3	18	24	69	0.11	4	96	0.09	4
Total	483						629						1112		

Index= [(3 for rank 1) + (2 for rank 2) + (1 for rank 3)] divided by sum of all weighed reasons mentioned by respondent

Table 3 - The major constrains of dairy production in the study areas

Constraints of dairy production	Urban and pre urban (HHN=60)						Rural (HHN=90)					
	1st	2nd	3 rd	Total N	Index	Rank	1st	2nd	3 rd	Total N	Index	Rank
Feed related problems	30	7	12	116	0.23	1	30	37	14	174	0.23	1
AI service problems	-	4	4	12	0.020	8	13	19	8	140	0.18	2
Market problems	-	1	2	4	0.01	9	5	2	-	19	0.025	8
Lack of improved dairy cow	10	9	11	59	0.09	5	13	20	3	82	0.11	4
Health problem	22	17	10	110	0.16	3	23	13	17	112	0.15	3
Lack of access of credit	-	6	2	14	0.021	7	13	20	9	88	0.12	5
Lack of shelter	49	1	3	151	0.17	2	2	-	-	6	0.01	9
Lack of extension service	2	28	5	67	0.10	4	11	22	-	77	0.10	6
Water scarcity	2	14	11	45	0.07	6	7	6	22	55	0.07	7
Total	578						753					

Index= [(3 for rank 1) + (2 for rank 2) + (1 for rank 3)] divided by sum of all weighed reasons mentioned by respondent

Constraints of dairy cattle production

As indicated the table below the majority of respondents in both stratification of the study area feed shortage was ranked first, as the first most significant problem responsible for low productivity yield and low milk of dairy cows. This is in line with the finding of Fayo 2006; Derese (2008); Bekele et al. (2015) and Gezu and Kebede (2015) those reported that feed shortage as the most important constraint that donated to the low production and productivity of dairy cattle in different place of Ethiopia. The reason for this might be due to changing of rangelands to crop cultivation land and the crop residues utilization and treatment habits are low. The current finding revealed that the second and the third major constraints of dairy production in rural areas were AI service problem and health problems, respectively where as in urban areas lack of shelter and health problems were ranked second and third respectively. Which were similar with the finding of Gezu and Kebede (2015) who reported that disease problems is the top third constraint of dairy production in urban and pre urban area of hossan, Ethiopia.

CONCLUSION AND RECOMMENDATION

The current study can be concluded that rural smallholder or mixed crop- livestock production and urban and pre urban dairy production system were identified but the major were the first production system. Majority of respondents were not practiced udder washing and teat sanitizing before milking. Milk processing and handling methods were found traditional type. The milk and milk products which are common used in the study area were butter, ghee and whole milk. The major dairy cattle production constraints in the area were feed scarcity in quantity and quality, health problems and access and effectiveness of artificial insemination for their dairy cow. There should be training for farmers and dairy cooperatives about milking hygienic practices, feeding and health care managements for their dairy cattle animals. The study also suggests that improved and appropriate milk processing technologies like churner and cram separator should be accessible in place to improve milk processing for sustainable dairy production.

DECLARATIONS

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Author's contribution
All authors are contributed equally to this work from starting proposal writing up to preparation of manuscript.

Competing Interests
The authors declare that they have no conflict of interest with respect to the research, authorship or publications of this manuscript.

Acknowledgements
The authors would like to thank Beauro of agriculture of Enemay district for providing different facilities and information for this work. We are also thankful to dairy cattle farmers and dairy cooperatives in Enemay district for providing the required information without hesitation.

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