

Full Length Research Paper

Evaluation of dairy farmers' milking practices and knowledge of milk-transmitted zoonotic diseases in Bishoftu, Ethiopia

Lencho Getechew Kebede* and Seblewongel Ayichew Megersa

School of Veterinary Medicine, Wolaita Sodo University, Ethiopia.

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A cross-sectional study was conducted in Bishoftu town, Ethiopia, from November, 2016 to April, 2017, to assess smallholder urban dairy farmers' milk hygiene practices and awareness on cattle milk-borne zoonoses. Data were collected from a total of 100 randomly selected dairy farmers using structured questionnaire. The results of the study showed that all respondents practiced hand milking, with twice (90%), once (8%) and thrice (2%) milking frequency per day. Most of the respondents (86%) cleaned their barn before milking and 98% used treated pipe water supply for farm activities. Plastic containers were commonly used for storage and transportation of milk. About 26 and 28% of the farmers used individual and common towel for wiping udder after washing, respectively. Most of the farmers (98%) did not practice post-milking dipping of teats. In all the farmers interviewed, respondents' awareness levels of milk-borne zoonoses were 38.89, 33.33, 19.84, 6.35 and 1.6% for tuberculosis, mastitis, anthrax, brucellosis and salmonellosis, respectively. Based on the findings of this study, farmers' awareness level on cattle milk-borne zoonoses was low except for tuberculosis and mastitis. In conclusion, there was little awareness about milk borne diseases and some farmers adhered to some dairy hygiene practices. Therefore, it is imperative to strengthen farmers' awareness, extension services and training programs for smallholders in dairy industry on milking hygiene practices and post-harvest handling of milk, to minimize the likely losses due to rejection of spoiled milk and milk-borne dangers which may occur due to consumption of contaminated milk.

Key words: Bishoftu, farmers' awareness, milk-borne zoonoses, milking hygiene.

INTRODUCTION

Ethiopia has the largest livestock population in Africa. The total cattle population of the country in 2013 was estimated to be about 55.03 million. Out of this total cattle population, the female cattle constitute about 55.38% and the remaining 44.62% are male cattle. From the total

cattle population of the country, 98.71% are local breeds. The remaining are cross and exotic breeds that accounted for about 1.15 and 0.14%, respectively (CSA, 2014). Despite its huge population, the livestock subsector in the country is less productive in general, and

*Corresponding author. E-mail: lenchogetachew29@gmail.com. Tell: 0920413611.

and as compared to its potential, the direct contribution to the national economy is limited (Kedija et al., 2008; Sintayehu et al., 2008). Consequently, the national milk production and overall milk consumption in Ethiopia are very low, when compared with other African countries with lowest livestock population (Zelalem, 2003).

Milk is universally recognized as a complete diet due to its essential components (Benta and Abtamu, 2011). Milk is synthesized in specialized cells of the mammary gland and is virtually sterile when secreted into the alveoli of the udder. Beyond this stage of milk production, microorganisms may contaminate milk at various stages of milking, processing and distribution. The ill health of the cow and its environment, improperly cleaned and sanitized milk handling equipment, and unhygienic workers who milk the cow, and come in contact with milk due to a number of reasons could serve as sources of contamination for the milk. Lack of refrigeration facilities at farm and household level in developing countries of tropical regions, with high ambient temperature implies that raw milk will easily be spoiled during storage and transportation (Godefay and Molla, 2000). Once they enter into milk, microorganisms can multiply and cause changes to its quality. If pathogenic microorganisms are involved, they can cause harm to consumers by causing human illnesses and diseases (Barros et al., 2011). Therefore, milk and milk product handling need special care to reduce spoilage and food borne illness (Ashenafi and Beyene, 1994; Degraaf et al., 1997).

According to Bertu et al. (2010) humans may be infected with milk-borne pathogens through consumption of infected raw or unpasteurized milk and milk products. Although, milk and milk products are minor constituents in most diets, contaminated milk are responsible for up to 90% of all dairy related diseases of humans (De Buyser et al., 2001).

Infections that are naturally transmissible from vertebrate animals to humans and vice-versa are classified as zoonoses (WHO, 2009). It has been estimated that about 61% of human infections are zoonotic (Taylor et al., 2000). In the dairy sector, zoonotic pathogens are normally present in dairy animals, raw milk, milk products, meat and the farm environment but are often difficult to diagnose. These zoonoses can be transmitted to humans in several ways that include consumption of infected raw milk (mostly) and contact with infected dairy animals and products, and infected farm environments (Zinsstag et al., 2007).

Milk produced at smallholder farms in Ethiopia is marketed without any form of pasteurization or quality control measures. According to former reports in Ethiopia, on the total milk production, it is reported that 71 to 97% of milk is consumed through an informal market that is basically characterized by selling of low quality milk and milk products (Stanly, 2012). This implies the need for training in dairy production and processing in the country particularly at smallholders level to enhance the

hygienic quality of the dairy products (Godefay and Molla, 2000).

Currently, a large number of smallholder urban dairy productions are operating in the present study area using improved dairy breeds. However, information on milking hygiene practices and farmers' awareness on cattle milk-borne zoonoses remains scarce. Thus, lack of information could result in public health risks and economic losses affecting the livelihoods of smallholder dairy producers. Hence, an understanding of farmers' knowledge on milking hygiene and cattle milk-borne zoonoses is very important to reduce risk of cattle milk-borne zoonoses transmission.

Therefore the aim of this study was to assess hygienic milking practices and the general handling practices of milk and to evaluate farmers' awareness on cattle milk-borne zoonoses in smallholder urban dairy producers in Bishoftu, Ethiopia.

MATERIALS AND METHODS

Description of the study area

This study was conducted in Bishoftu town which is located at a distance of 45 km South East of Addis Ababa, Ethiopia. The town is located in east Showa zone of Oromia region and it lies 9° North latitude and 40° East longitude at an altitude of 1850 m above sea level in the central high land of Ethiopia. It has an annual rainfall of 866 mm of which 84% is in the long rainy season (June to September) and the remaining in the short rainy season extending from March to May. The dry season extends from October to February. The mean annual maximum minimum temperatures of the area are 26 and 14°C respectively, with mean relative humidity of 61.3%. Mixed farming system followed in the area, crop and livestock production are an intensive type of production. Cattle, small ruminant, poultry and equines are the major livestock species kept with fast growing smallholder dairy production (IPMS, 2005).

Study population

The study was conducted in smallholder dairy farmers in Bishoftu, Oromia Regional State, Ethiopia. The majority of dairy producers in Bishoftu town were market oriented smallholder dairy farmers with average herd size of three cows which are organized under one dairy cooperative called, Ada'a milk and milk products marketing cooperative share company.

Study design

Cross-sectional questionnaire-based study design was used from November 2016 to April 2017 across the smallholder dairy farms in the study area and data collection questionnaire format was developed and used.

Sampling procedure

A random sampling technique was used to select the households for the purpose of this study and a random survey of 100 smallholder urban dairy farmers who were actively involved in dairy production was conducted. A list of households owning dairy farms was obtained from records maintained by Ada'a milk and milk products marketing cooperative share company.

The sample size for collecting the questionnaire data was determined by using formula as indicated by Bartlett et al. (2001). A list of 162 dairy farmers was considered as the sampling frame (N).

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

Where, n = the sample size of the research; N = total number of smallholder in each kebele; e = maximum variability or margin of error 5% (0.05); 1 = the probability of the event occurring.

Therefore, a total of 115 farms were selected at 5% standard error with 95% confidence interval. But depending on willingness and availability of dairy farmers, 100 dairy farms were interviewed in this study.

Data collection

A single-visit-multiple-subject formal survey technique (ILCA, 1990) was used to collect data through face-to-face interviews using a structured and pretested questionnaire using local language. Data obtained from respondents were on demographic characteristics, housing management, sources of farm water, milking system, milking frequency, milking hygienic practices (washing of milkers' hand, milk utensils and udder before milking), and farmers' awareness on cattle milk-borne zoonoses.

Statistical analysis

Microsoft Excel was used for data management and entry. All the collected data were coded and entered into the computer with Excel. The Statistical Package for Social Sciences (SPSS) software version 20 computer program was used for data analysis. Descriptive statistics such as frequencies, distribution and percentages were used to summarize the data. The association of demographic characteristics of the respondents and their milk hygienic practice was analyzed using Chi-square.

RESULTS

Socio demographic characteristics of the respondents

A total of 100 smallholder dairy farmers were interviewed in this cross sectional study in the nine selected kebeles of the Bishoftu town. Females comprised 61% of the respondents while the remaining 39% were males of different age and educational levels. Most of the respondents, 51% (51) belong to the age group of 36-50 years, this indicates that majority of the respondents were in potential productive age. Regarding the educational level, 35 (35%) were illiterate, 31 (31%) attended primary education, 24 (24%) had attended secondary education and 10% had college or university courses. In this study, 93% of the respondents managed their cows intensively and 7% managed their cows semi-intensively. Most of the respondents (86%) rear exotic breed, 13% rear cross breed and the other 1% rear both cross and exotic breeds (Table 1).

Dairy cattle housing characteristics

In the study area, all the respondents (100%) use separate house for keeping the animals and most of the cows (93%) were housed in concrete type floor barn and 6% were in muddy soil floor and only 1% are in wooden floor. Regarding barn cleaning, most of the respondents (41%) clean the barn twice a day, 27% clean once a day, 20% clean thrice a day and 12% clean more than thrice a day (Table 2).

Milking hygienic practices

Results of this study showed that milking is done by hand (100%), with milking frequency of twice (90%), once (8%) and thrice (2%) a day. All respondents milk their animal in barn, most of the respondents (86%) clean their barn before milking, while 14% do not clean their barn before milking, and 98% of the dairy farmers had access to pipe water supply and 2% use ground water.

In this study, most of the farmers (76%) reported that they washed their hands with water only and it was noted that only 24% used water and soap for washing their hands. Most of respondents (49%) use warm water for udder and teat washing, 46% uses cold water and 4% cooled water and detergent and only 1% wash udder and teats with warm water and soap. About 26% of the respondent's use individual towels and 28% use common towels for wiping udder after washing, whereas, the rest 44% do not use towels for drying. Most of the respondents (61%) do not use teat lubricant and it was noted that only 39% use it. 98% farmers did not practice teat dipping, only 2% practice teat dipping (Table 3).

Milking equipment and milk handling practice

In this study, most of the respondents (95%) use plastic containers for collecting milk and only 5% use stainless steel for collecting and transporting milk. All respondents clean milk handling containers; however, 39% wash containers with cold water, 40% wash containers with soap and cold water and only 21% wash containers with hot water and soap. Majority of the respondents (58%) do not remove foremilk during milking and 41% of the respondents remove foremilk. Concerning milk filtering to storage containers, most of the respondents (75%) do not practice milk filtering, only 25% practice milk filtering into containers. Concerning milk storage, 96% of the respondents store milk as milked, only 4% store their milk in refrigerator. Most of the respondents (88%) deliver milk to other users immediately after milking and 12% of respondent's delivery milk within one hour after milking (Table 4).

Farmers' awareness of cattle milk-borne zoonoses

Almost all of the respondents (99%) consume milk and

Table 1. Socio demographic characteristics of the respondents.

Parameter	Category	Frequency	Percentage
Sex	Female	61	61
	Male	39	39
Age	18-35 yrs	17	17
	36-50 yrs	51	51
	>50 yrs	32	32
Occupation	Self –employ	21	21
	Farmer	71	71
	Government	2	2
Education	Illiterate	35	35
	Primary education	31	31
	Secondary education	24	24
	Diploma and above	10	10
Farm type	Intensive	93	93
	Semi intensive	7	7
Breed	Cross breed	13	13
	Exotic	86	86
	Cross and exotic	1	1

Table 2. Housing characteristics of the farms.

Parameter	Category	Frequency	Percentage
Housing	Separate house	100	100
Floor type	Concrete	93	93
	Wooden	1	1
	Muddy soil	6	6
Barn cleaning	Once a day	27	27
	Twice a day	41	41
	Thrice a day	20	20
	> thrice a day	12	12

only 1% do not. Most of the respondents (57.5%) consume milk after boiling it, 23.4% consume raw milk as milked and 19.1% consume milk after processing (yogurt). Most of the respondents (62%) discards milk of sick animals, 27.6% gave milk sick animals to their pets, 7.8% use the milk of sick animals after processing it and 2.6% gave milk of sick animals to their calves. Most of the respondents (64.9%) discards milk of drug treated animals, 26.32% gave milk of drug treated animals to their pets, 5.3% use the milk of drug treated animals after processing it and 3.5% gave milk of drug treated animals to their calves.

With regards to farmers' knowledge on milk-borne

zoonoses, they were aware of tuberculosis (38.89%), mastitis (33.33%), anthrax (19.84%), brucellosis (6.35%) and salmonellosis (1.6%). Most of the respondents (91%) have not suffered from any milk borne illness before, whereas 9% of the respondents have suffered from milk borne illness in the past. Most respondents (93%) reported that disease from human being are not transmitted to animals, only 7% stated that human disease can be transmitted to animals (Table 5).

Prevention practice of the farmers

In this study, most of respondent (39%) boil milk before

Table 3. Milking methods and hygienic milking practices followed by farmers.

Parameter	Category	Frequency	Percentage
Milking area	In barn	100	100
Cleaning milking area	Yes	86	86
	No	14	14
Milking frequency	Once a day	8	8
	Twice a day	90	90
	Thrice a day	2	2
Source water	Pipe water	98	98
	Well water	2	2
Hand washing before Milking	Wash with water	76	76
	Wash with water and Soap	24	24
Washing udder and teats	Cold water	46	46
	Warm water	49	49
	Cold water with soap	4	4
	Warm water with soap	1	1
Use of towel	Individual towel	26	26
	Common towel	28	28
	No use of towel	46	46
Using of lubricant	Yes	39	39
	No	61	61
Teat dipping	Yes	2	2
	No	98	98

use as disease prevention method, 25% stated that keeping hygiene prevent disease transmission, 24% had no idea on disease prevention methods, 19% reported treating of sick animals, 15% stated vaccination of animals and the other 2% stated the use of artificial insemination prevent disease transmission. The study showed that there was no practice of medical examination of farm workers, particularly milkers for prevention of contamination of milk by diseases carried by man.

In this study, half of the respondents (50%) were trained only on hygienic milking and all (100%) did not acquire training on cattle milk borne zoonoses. In this study, most of the respondent (67%) got veterinary professionals service at farm on phone call, while the rest 33% do not have veterinary professionals that follow their animal health (Table 6).

Association of age with hygienic milking practice

Among hygienic milking practices use of PPE, source of water used, washing udder, removing foremilk and

milking equipment were significantly ($p < 0.05$) associated with age of the respondents (Table 7).

Association of sex with hygienic milking practice

Among hygienic milking practices, washing animals, drying udder, cleaning milking utensils, removing foremilk and use of towel were significantly ($p < 0.05$) associated with sex of the respondents (Table 8).

Association of education with hygienic milking practice

Among hygienic milking practices, washing animals, source of water, cleaning milking utensils, milking equipments and milk storage were significantly ($p < 0.05$) associated with educations of the respondents (Table 9).

DISCUSSION

This study aimed to assess the hygienic milking practices

Table 4. Milking equipment and milk handling practice.

Parameter	Category	Frequency	Percentage
Milk containers	Plastic	95	95
	Stainless steel	5	5
Milk utensils cleaning	Cooled water	39	39
	Soap and cold water	40	40
	Soap and hot water	21	21
Removing foremilk	Yes	42	42
	No	58	58
Filtering milk	Yes	25	25
	No	75	75
Milk storage	In refrigerator	4	4
	As milked	96	96
Time to reach collectors	Immediately after milking	88	88
	within one hour	12	12

and awareness of milk-borne zoonoses among smallholder dairy farmers. The results of the present study showed that majority of the respondents (69%) in the study area who were engaged in milk production were females than males which is similar to Bereda et al. (2012) report in Ezha district of the Gurage zone, that dairying offers more opportunities for females to be closely involved in the daily management than males. In contrast with the present findings, Azage (2004) and Yitaye et al. (2008) reported that in Addis Ababa and northwest Ethiopia, there were more male-headed households. The present study showed that majority of the participants handling milk were females, it may be because men work in the field and attitude of the society towards dairy farms. The sex of the respondents had significant level of variation with hygienic milking practice ($P < 0.05$).

The present study indicated that most of the respondent's educational levels were found between illiterate and primary school. This is in agreement with report from Illu Aba Bora Zone, Southwest Ethiopia (Bereda et al., 2014), where the educational level attained by majority of the household heads falls between illiterate and primary school. In this study, the educational level of the respondents had significant level of variation ($P < 0.05$) with hygienic milking practice. This indicates that more intervention is needed to make farmers to be aware, in order to improve their hygienic dairy production and husbandry practices.

In this study, most of the respondents (51%) were in the productive ages which agreed with Teshager et al. (2013) report in Illu Aba Bora Zone. In this study, the age

of the respondents had significant level of variation of hygienic milking practice ($P < 0.05$).

The survey result showed that, all the respondents (100%) use separate house for keeping the animals and most of the cows (93%) were housed in concrete type floor barn. In agreement with the present findings, Bruktawit (2016) reported that in Addis Ababa, majority of the respondents used barn floor made of concrete. As observed in the current study, 98% of the respondents used pipe water as main water sources for cleaning the udder or teats, wash their hands and milking equipment, and the other 2% use well water source for cleaning and washing purpose. Similarly, Bruktawit (2016) reported that in Addis Ababa, 98.9% of the respondents use pipe water and the other 1.1% use well water. According to Zelalem (2009), when water from non-tape sources is used for cleaning purpose, it is important that producers should at least filter and heat treat it before use because the quality of water determines the amount of bacterial counts.

Results of this study showed that milking is done by hand (100%), with milking frequency of twice (90%), once (8%) and thrice (2%) a day. In agreement with these findings, Milligo et al. (2008) reported that all smallholder farmers in peri urban areas in Burkina Faso practiced hand milking. The findings of Zelalem (1999) showed that in Holetta, Selale and Debre Zeit, 83.3, 93.3 and 96.7% of crossbred cows are milked twice a day, respectively. Yitaye et al. (2007) reported that 83.8% of the farmers in northern Ethiopia milked their cows twice a day. Once and thrice per day milking frequency was also reported by Sintayehu et al. (2008) in other urban dairy farms in

Table 5. Farmers' awareness of cattle milk-borne zoonoses at urban dairy farms.

Parameter	Category	Frequency	Percentage
Milk consumption	Yes	99	99
	No	1	1
Milk consumption ways	Raw	39	23.35
	Boiled	96	57.485
	Processing	32	19.16
Milk of sick animals	Discarded	72	62
	Given to pet	32	27.6
	Given to calves	3	2.6
	Using it after Processing	9	7.8
Milk of drug treated animals	Discarded	74	64.9
	Given to pet	30	26.32
	Given to calves	4	3.5
	Using it after Processing	6	5.3
Disease transmit from milk	Yes	20	20
	No	80	80
Named milk-borne zoonoses	TB	49	38.89
	Anthrax	25	19.84
	Mastitis	42	33.33
	Salmonellosis	2	1.59
	Brucellosis	8	6.349
Human disease transmit animals	Yes	7	7
	No	93	93

Table 6. Prevention practice of the farmers

Parameter	Category	Frequency	Percentage
Prevention methods	No idea	24	24
	Boiling milk	39	39
	Keeping hygiene	25	25
	Treating sick Animals	19	19
	Vaccination	15	15
	Using AI	2	2
Vaccination	Yes	96	96
	No	4	4
Training on hygiene	Yes	50	50
	No	50	50
Vet. Professionals	Yes	67	67
	No	33	33

Ethiopia.

The production of milk of good hygienic quality for consumers requires good hygienic practices, such as clean milking utensils, washing of milker's hands, cleaning udder and use of individual towels during milking and handling, before delivery to consumers or processors

(Getachew, 2003). In this study, most of respondents (76%) washed their hands with water only and 24% of them used water and soap for washing their hands. Most of the respondents (49%) use warm water for udder and teat washing, 46% use cold water and 4% cooled water and detergent and only 1% wash udder and teats with

Table 6. Association of age with hygienic milking practice.

Parameter	Category	Age			X ²	p-Value
		18-35 years	36-50 years	>50 years		
Use of PPE	Yes	16	22	13	15.287	0.000
	No	1	29	19		
Source of water	Pipe water	15	51	32	9.964	0.007
	Well water	2	0	0		
Washing udder	Cold water	6	21	19	14.424	0.025
	Warm water	8	29	12		
	Cold water with soap	3	0	1		
	Warm water with soap	0	1	0		
Removing foremilk	Yes	13	19	10	10.282	0.006
	No	4	32	22		
Milking equipment	Plastic	14	49	32	7.534	0.023
	Stainless steel	3	2	0		

Table 7. Association of sex with hygienic milking practice

Parameter	Category	Sex		X ²	p-value
		Female	Male		
Washing animals	Yes	11	15	5.16	0.023
	No	50	24		
Drying udder	Yes	23	27	9.458	0.002
	No	38	12		
Removing foremilk	Yes	19	23	7.562	0.006
	No	42	16		
Use of towel	Individual towel	12	14	8.234	0.016
	Common towel	14	14		
	No use of towel	35	11		

warm water and soap. Consistent with this study, Duguma and Geert (2015) reported that majority (96.3%) of the farmers in Jimma practiced hygienic milking, such as washing of hand, milk containers and udder before milking.

In this study, 26 and 28% of the farmers used individual and common towels for wiping udder after washing, respectively. This is in agreement with the findings of Zelalem and Faye (2006) who reported that in the central highlands of Ethiopia, small and large scale dairy producers used common towel for drying udder. Duguma and Geert (2015) reported that only 13% of the farmers in Jimma town, southwestern Ethiopia, used individual towel and this is lower than the present findings (26%). The use of common towel may result in transmission of diseases, particularly mastitis. The high percent of using individual towel might be due to more awareness and modern

dairy farms being in this study area.

As shown in this survey, most respondents (61%) do not use teat lubricant and it was noted that only 39% used it. In this study, 98% farmers did not practice teat dipping, only 2% practice teat dipping. In contrast to the present findings, Benta and Abtamu (2011) reported that 10% of the farmers in Wolayta Sodo used teat dip solutions after milking and this is higher than the present findings (2%). This might be due to the fact that farmers in the study area lack awareness on teat dipping practices.

In this study, most of the respondents (95%) use plastic containers for collecting milk and only 5% use stainless steel for collecting and transporting milk. In agreement with this study, Duguma and Geert (2015) reported that about 92.6 and 3.7% of the farmers in Jimma collected milk using plastic buckets and stainless steel cans,

Table 8. Association of education with hygienic milking practice.

Parameter	Category	Education				χ^2	p- value
		Illiterate	Primary education	secondary education	Diploma and above		
Washing animals	Yes	4	10	6	6	10.514	0.015
	No	31	21	18	4		
Source water	Pipe water	35	31	24	8	18.367	0.000
	Well water	0	0	0	2		
Cleaning milking utensils	Cooled water	19	9	6	5	13.578	0.035
	Cold water and Soap	11	17	8	4		
	Hot and water soap	5	5	10	1		
Milking equipment	Plastic	34	31	23	7	15.163	0.002
	Stainless steel	1	0	1	3		
Milk storage	In Refrigerator	0	1	1	2	8.175	0.043
	As milked	35	30	23	8		
Human disease transmit to animals	Yes	1	2	0	4	19.472	0.000
	No	34	29	24	6		

respectively. All respondents clean milk handling containers before and after use. In the present study, 95% the farmers did not practice milk cooling after milking, because of lack of facilities for cooling milk, which is a serious problem to hygienic milk production. Contrary to the present findings, Benta and Abtamu (2011) reported that 50% of the farmers in Wolayta Sodo cooled milk immediately after milking. This is might be because, farmers in the study area lack facility for cooling and storing of milk. Quinn et al. (2002) reported that cooling milk after milking reduces risk of the growth of both pathogenic and spoilage bacteria.

In this study, most of the respondents (57.5%) consume milk after boiling it, 23.4% consume raw milk as milked and 19.1% consume milk after processing (yogurt). Contrary to the results of the present study, Duguma and Geert (2015) reported that most (92.6%) of the farmers in Jimma boil milk before consumption, 3.7% also indicated that they consume raw milk, Zelalem and Faye (2006) reported that 45% of the respondents did not boil milk before consumption. This might be due to habitual practice of famers that they prefer taste of milk boiled.

With regards to farmers' knowledge about milk-borne zoonoses, they were aware of tuberculosis (38.89%), mastitis (33.33%), anthrax (19.84%), brucellosis (6.35%), and salmonellosis (1.6%). The results of the current study revealed that majority (38.89%) of the farmers were more aware of bovine tuberculosis than other milk-born zoonoses due to its frequent occurrence in the study area.

In agreement with this study, the findings by Stanly (2012) showed that farmers were more knowledgeable about tuberculosis as compared to brucellosis (74.3 vs.

2.9%) in north Malawi. Girma et al. (2012) reported that in Addis Ababa, 88.54 and 49.48% of the respondents were aware of bovine tuberculosis and brucellosis, respectively. In the present study, farmers lacked awareness on anthrax (80.16%), brucellosis (93.65%), mastitis (66.67%), tuberculosis (61.11%) and salmonellosis (98.4%) as milk-borne zoonoses. Similar observations were made by Ekuttan (2005) who showed in Kenya that dairy farmers lacked knowledge on specific milk-borne zoonoses.

The results of the present study revealed that respondents had low level of awareness on milk-borne zoonoses, except mastitis and tuberculosis, which are commonly available in the study area. This is in agreement with the findings of Belay et al. (2012) and Jergefa et al. (2009) in Ethiopia, and Munyeme et al. (2010) in Zimbabwe.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ABBREVIATIONS: **CSA**, Central Statistics Authority; **CAC**, Codex Alimentarius Commission; **FSA**, Food Standards Agency; **NMSA**, National Meteorological Services Agency; **IMPS**, improving productivity and market success; **ILCA**, International Livestock Centre for Africa; **SPSS**, Statistical Package for Social Sciences.

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