Milk producers' awareness of milk-borne zoonoses in selected smallholder and commercial dairy farms of Zimbabwe

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Abstract

A cross-sectional questionnaire-based study was conducted to assess milk producers' awareness of milk-borne zoonoses in selected smallholder and commercial dairy farms of Zimbabwe. The questionnaire was designed to obtain information on dairy breeds, milk production, dairy farmers' knowledge and awareness of zoonoses with particular emphasis on milk-borne zoonoses and farmers' behavioural practices that may lead to increased risk of milk-borne zoonoses transmission. A total of 119 dairy farmers were interviewed and 41.5% were aware of milk-borne zoonoses with a significantly ($P<0.01$) higher percentage of commercial dairy farmers (65.0%) being aware compared to smallholder dairy farmers (36.7%). The behavioural practices of dairy farmers observed to increase the risk of milk-borne zoonoses transmission were; consumption of raw milk (68.1%), sale of raw milk to the local public (25.2%), lack of cooling facilities by smallholder farmers (98%), and no routine testing (84.9%) and medical check-ups (89.1%) for milk-borne zoonoses. General hygienic and disease control practices need to be integrated in the milk production process particularly at the smallholder level. Awareness, teaching and training programs for smallholder dairy farmers can improve disease control in animals and reduce the public health risk of milk-borne zoonoses.

Keywords Awareness: Dairy sectors. Milk-borne zoonoses. Milk producers'. Zimbabwe.

Introduction

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 livestock sector, different farm animals naturally carry a wide range of zoonotic pathogens. 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 and coming in contact with infected dairy animals and products, and infected farm environments (Zinsstag et al. 2007). However, most milk-borne zoonoses are mostly acquired through consumption of infected milk. Milk-borne zoonoses are of both public health and economic importance. In addition to causing serious economic losses in dairy cattle production, they pose a major barrier for trade of animals and animal products and this could seriously impair socio-economic progress especially in developing countries in Africa. These countries often have inadequate infrastructure and limited financial resources to control animal diseases. Furthermore, the level of awareness among farmers, of the economic and public health importance of zoonotic diseases in most of these countries is low and this further stifles efforts to control these diseases (Ekuttan, 2005; Munyeme et al. 2010).

Currently in Zimbabwe, there is no documentation of milk producer's awareness of milk-borne zoonoses. Lack of awareness of milk-borne zoonoses can put the lives of milk producers, farm workers and their family members at risk of infection. Considering that most smallholder dairy farmers sell milk to the public and given that consumption of raw milk is a common practice in these communities, this further exposes them to milk-borne zoonoses. Therefore, it is imperative that cattle owners are aware of milk-borne zoonoses that are prevalent in their areas, in addition to the risks they pose and how they are transmitted for them to make informed decisions on their control (Munyeme et al. 2010). The objective of this study was to assess milk producers' awareness of milk-borne zoonoses in selected smallholder and commercial dairy farms of Zimbabwe.

Methodology

Study sites

A convenient sample of smallholder dairy centres and commercial dairy farms in Zimbabwe based on operational capacity when the study commenced and on agro-ecological regions, was selected for the study. Based mainly on rainfall and temperature, Zimbabwe is divided into agro-ecological regions I, IIA, IIB, III, IV and V. The respective mean annual rainfall for regions I to III is over 1 000 mm, 750-1 000 mm and 650-800 mm, respectively. Region IV receives a low rainfall of 450-650 mm that is erratic and subject to periodic mid-season droughts. In region V, rainfall is very erratic and less than 500 mm per annum. The four selected smallholder dairy centers were Dowa-Dewedzo in agro-ecological region IIA, Guruve and Marirangwe in agro-ecological region IIB and Gokwe south in semi-arid agro-ecological region III. Commercial dairy farms covered were from agro-ecological region IIA in and around Harare and these were conveniently selected based on high concentration of active commercial dairy farms. The study covered the period between October 2009 and March 2010.

Data collection and analysis

A cross-sectional study to investigate dairy farmers' awareness and knowledge of zoonoses with particular emphasis on milk-borne zoonoses was conducted between October 2009 and March 1010. The inclusion criterion for dairy farmers was designed to target those who were actively involved in dairy production. Data was collected using an interviewer administered questionnaire. The questionnaire was pre-tested on a few selected farmers in one of the study areas and the easiness of completion of the questionnaire and ambiquity of questions were noted and subsequently revised before a large-scale interview of the farmers.

A standard structured questionnaire with multiple-choice and open-ended questions was used. Dairy farmers were asked on their general knowledge and awareness of zoonoses, milk-borne zoonoses, their sources of information with regard to these milk-borne zoonoses, transmission modes, risk factors associated with milk-borne infections, milk testing for zoonoses and frequency of testing, medical check-ups for milk-borne zoonoses and recent history of milk-borne zoonoses in their cattle and families.

Data analysis was carried out using SPSS 16.0 for Windows to generate descriptive statistics (frequencies/proportions) related to their awareness and knowledge of zoonoses, their transmission and risk factors with particular emphasis on milk-borne zoonoses. The Chi-square (X^2) test was used to assess differences between the two farming sectors and values of $P < 0.05$ were considered as significant.

Results

Characteristics of respondents

A total of 119 dairy producers were interviewed; 21 (17.6%) commercial and 98 (82.4%) smallholder dairy farmers. Most respondents were males (74.8%) and the majority of the respondents (71.4%) had undergone formal education.

Breeds of dairy animals kept and milk production

A significantly ($P<0.01$) higher percentage of commercial dairy farmers (52.4%) kept a single exotic dairy breed compared to smallholder dairy farmers (10.2%). In contrast, smallholder dairy farmers mostly kept a mixture of the exotic dairy breeds (41.8%) and dairy crosses (33.7%). A relatively small percentage (9.5%) of the commercial dairy farmers kept both dairy cattle and dairy goats.

There was a significant ($P<0.01$) variation in the number of cows milked per day with most smallholder dairy farmers (99%) milking less than 10 lactating cows/day while most commercial dairy farmers (71.5%) milked 20 or more cows/day. Milk production varied significantly ($P<0.01$) between the two sectors with most smallholder dairy farmers (58.2%) producing less than 10 litres of milk/day whereas most (76.2%) commercial dairy farmers produced more than 80 litres of milk daily. Smallholder dairy farmers (89.8%) indicated that a higher milk production was realized during the wet season while most of the commercial dairy farmers (57.1%) indicated no difference in milk production between the wet and dry seasons. Most commercial dairy farmers (90.5%) indicated that milking was done in shelters and parlours and in kraals for smallholder dairy farmers (63.3%). All smallholder dairy farmers practiced

hand milking whereas 57.1% and 42.9% of commercial dairy farmers were machine and hand milking, respectively.

Milk producers' awareness of zoonotic diseases and transmission modes of milk-borne zoonoses

When asked generally on their awareness of cattle zoonoses, 55.9% of dairy farmers were aware with a significantly (P<0.01) higher percentage of commercial dairy farmers being aware compared to smallholder dairy farmers (Table 1). Dairy farmers were generally aware of brucellosis (21.2%), tuberculosis (16.1%) and anthrax (16.1%). Other relevant zoonoses cited were rabies, Rift Valley Fever, salmonellosis and listeriosis. A relatively higher percentage of dairy farmers responded that mastitis (16.1%) was a zoonotic disease (Table 1).

When asked specifically on their awareness of milk-borne zoonoses, only 41.5% were aware with a significantly (P<0.05) higher percentage of commercial dairy farmers being aware compared to smallholder dairy farmers (Table 1). Of those who were aware, 29 (59.2%) were able to name at least one relevant milk-borne zoonotic disease such as brucellosis (20.3%), tuberculosis (16.1%) and salmonellosis (2.5%) (Table 1). Dairy farmers responded that mastitis, anthrax, ticks and diarrhea were milk-borne zoonoses. Most smallholder (87.8%) and commercial dairy farmers (52.4%) ranked themselves as poor to fair on their awareness of milk-borne zoonoses.

Most commercial (76.2%) and smallholder dairy farmers (61.2%) indicated that the most important route of contracting milk-borne zoonoses is through ingestion of infected raw milk (Table 2). Low percentages of commercial (47.6%) and smallholder dairy farmers (43.9%) indicated that they got information on zoonoses from animal health personnel. Most commercial (90.5%) and smallholder dairy farmers (81.6%) indicated that animal health workers are important in raising the awareness on milk-borne zoonoses with human doctors, the media and schools also cited as important.

Behavioural practices of dairy producers which could expose them and the public to milk-borne zoonoses

A significantly (P<0.01) higher percentage of smallholder dairy farmers (79.6%) indicated that part of the milk they produce is used for household consumption compared to commercial dairy farmers (38.1%) (Table 3). Overall, most farmers (72.3%) indicated that they sell their milk to processors with a relatively low percentage (25.2%) selling to the public (Table 3). Public milk sales were to individual households, clinics or schools with a relatively high percentage (45.4%) of the farmers selling milk to 5 or more people daily (Table 3). Despite most (89.1%) of smallholder dairy farmers selling raw milk, a significantly (P<0.01) lower percentage (2%) of them did have cooling facilities compared to commercial dairy farmers (71.4%). Most farmers (68.1%) indicated that they consume raw milk and 35.3% of them indicated that they were certain that the milk they sell to the public in their local areas was consumed raw. A low percentage of the dairy farmers indicated that they routinely test for milk-borne zoonoses in milk (15.1%) and routinely go for medical-checkups (10.9%) (Table 3). However, most farmers (84.9%) indicated that they dispose off milk from sick cows (Table 3).

Table 1 Milk producers' awareness of zoonotic diseases

Variables	Farmer category		
	Smallholder dairy (%)	Commercial dairy (%)	Total (%)
General cattle zoonoses	50 (51.0)[b]	16 (80.0)[a]	66 (55.9)
Named zoonoses			
Brucellosis	17 (17.3)[b]	8 (40.0)[a]	25 (21.2)
Tuberculosis	14 (14.3)[a]	5 (25.0)[a]	19 (16.1)
Anthrax	12 (12.2)[b]	7 (35.0)[a]	19 (16.1)
Rabies	2 (2.0)[a]	2 (10.0)[a]	4 (3.4)
Salmonellosis	3 (3.1)[a]	1 (5.0)[a]	4 (3.4)
Rift Valley Fever	0 (0)[a]	2 (10.0)[a]	2 (1.7)
Listeriosis	1 (1.0)[a]	0 (0)[a]	1 (0.8)
Mastitis	15 (15.3)[a]	4 (20.0)[a]	19 (16.1)
Milk-borne zoonoses	36 (36.7)[b]	13 (65.0)[a]	49 (41.5)
Named zoonoses			
Brucellosis	16 (16.3)[b]	8 (40.0)[a]	24 (20.3)
Tuberculosis	15 (15.3)[a]	4 (20.0)[a]	19 (16.1)
Salmonellosis	2 (2.0)[a]	1 (5.0)[a]	3 (2.5)
Anthrax	2 (2.0)[a]	0 (0)[a]	2 (1.7)
Mastitis	12 (12.2)[a]	5 (25.0)[a]	17(14.4)
Diarrhoea	4 (4.1)[a]	0 (0)[a]	4 (3.4)
Ticks	1 (1.0)[a]	0 (0)[a]	1 (0.8)

Variables within rows with different superscripts are significantly different ($P<0.05$)

Table 2 Possible transmission modes of milk-borne zoonoses

	Farmer category		
	Smallholder dairy (%)	Commercial dairy (%)	Total (%)
Variable(s)			
Ingestion of infected raw milk	60 (61.2)[a]	16 (76.2)[a]	76 (63.9)
Ingestion of infected meat	35 (35.7)[a]	12 (57.1)[a]	47 (39.5)
Contact with infected animals/products	5 (5.14)[a]	5 (23.8)[b]	10 (8.4)
Bites from flies	4 (4.1)[a]	1 (4.8)[a]	5 (4.2)
Contaminated air (aerosols)	0 (0)[a]	3 (14.3)[b]	3 (2.5)
Feacal/oral route	6 (6.1)[a]	4 (19.0)[a]	10 (8.4)
Occupational hazard	3 (3.1)[a]	6 (28.6)[b]	9 (7.6)

Variables within rows with different superscripts are significantly different ($P<0.05$)

Table 3 Behavioural practices of milk producers which could expose them and the public to milk-borne zoonoses

Variable (s)	Farmer category		
	Smallholder dairy (%)	Commercial dairy (%)	Total (%)
Milk usage			
Household	78 (79.6)[a]	8 (38.1)[b]	86 (72.3)
Sale to public	23 (23.5)[a]	7 (33.3)[a]	30 (25.2)
Sale to processors	73 (74.5)[a]	13 (61.9)[a]	86 (72.3)
Category of people buying milk			
< 5	33 (33.7)[a]	7 (33.3)[a]	40 (33.6)
≥ 5	43 (43.9)[a]	11 (52.4)[a]	54 (45.4)
Type of milk sold			
Raw	88 (89.8)[a]	18 (85.7)[a]	106 (89.1)
Sour	17 (17.3)[a]	2 (9.5)[a]	19 (16.0)
Presence of cooling facilities	2 (2.0)[a]	15 (71.4)[b]	17 (14.3)
Consumption of raw milk			
Dairy farmers	69 (70.4)[a]	12 (57.1)[a]	81 (68.1)
Public	37 (37.8)[a]	5 (23.8)[a]	42 (35.3)
Test for milk-borne zoonoses	12 (12.4)[a]	6 (28.6)[a]	18 (15.1)
Medical check-ups	9 (9.2)[a]	4 (19.0)[a]	13 (10.9)
Dispose-off milk from sick cows	83 (84.7)[a]	18 (85.7)[a]	101 (84.9)

Variables within rows with different superscripts are significantly different ($P<0.05$)

Discussion

The results of the present study showed that commercial dairy farmers were generally more aware of cattle zoonoses compared to smallholder dairy farmers and the same trend was observed with regard to milk-borne zoonoses. The low level of smallholder dairy farmers' awareness could be attributed to remoteness, poor extension and accessibility to public and private veterinary services as supported by a low percentage of them indicating that they get information on zoonoses from animal health personnel. Another reason could be due to historically predominant emphasis on disease surveillance in commercial farms compared to communal and small-scale farming areas. Remoteness, lack of health facilities, poor extension services, low training status on rearing and handling animals and low literacy rate have been reported as major contributors to low level of awareness among smallholder dairy farmers from other African countries (Ameni and Erkihum, 2007; Jergefa et al. 2009; Munyeme et al. 2010). Furthermore, many African communities associate diseases shared between livestock and humans with misbehaviour or witchcraft (Edginton et al. 2002; Marcotty et al. 2009) and all these practices are due to little information or lack of knowledge about milk quality at farm-level and on different aspects of dairy husbandry issues (Hooton et al. 2004; Marcotty et al. 2009).

Milk-borne zoonoses awareness was low in both sectors and despite that some dairy farmers were aware, they failed to name them. Similar observations were noted in Kenya (Ekuttan, 2005) where dairy farmers were generally aware of zoonoses but lacked knowledge on specific milk-borne zoonoses. However, both commercial and smallholder dairy farmers in the survey area were particularly aware of brucellosis, tuberculosis, anthrax and rabies. In Tanzania; brucellosis, anthrax, tuberculosis and rabies were also reported to be the top four zoonoses known by smallholder dairy farmers (John et al. 2008). Awareness on anthrax and rabies observed in this study could be attributed to periodic vaccination campaigns that are launched annually by the Department of Veterinary Services in small-scale, communal and commercial farming areas. Farmers are well informed about these diseases and the need to vaccinate their animals. Hence, highly fatal zoonoses like rabies and anthrax overshadow other zoonoses that rarely cause death. Similar studies on pet zoonoses in the country showed that a high proportion of pet owners were well informed on rabies as a zoonosis but a relatively smaller proportion of them were aware of other pet zoonoses (Pfukenyi et al. 2010). Awareness on brucellosis, particularly with regard to commercial dairy farmers could be attributed to its importance as a cause of production losses in terms of calf losses and decreased milk production by aborting cows. In addition, as a result of the gradual increase of the national prevalence of brucellosis, compulsory calf-hood vaccination using *Brucella abortus* S19 vaccine and stamping out policy has been enforced to control the disease in commercial dairy herds (Madsen, 1989). This is likely to have increased the awareness of brucellosis in that sector.

Ingestion of infected raw unpasturized milk was cited as the most possible way of contracting milk-borne zoonoses and this agrees with earlier observations (Chahota et al. 2003). However, as reported earlier (Ameni and Erkihum, 2007) the awareness of other possible ways of contracting milk-borne zoonoses such as ingestion of infected meat and regular contact with infected animals and afterbirths was low. Despite being aware of the most possible way of contracting milk-borne zoonoses, dairy farmers consume raw milk at household level and sell raw milk to the local public and this concurs with a previous report (Khan and Usmani, 2005).

In spite of selling raw milk to the local public, smallholder dairy farmers lacked cooling facilities and similar observations have been reported elsewhere (Grimaud et al. 2007; Millogo et

al. 2008). Cooling milk after milking reduces the risk for the growth of both pathogenic and spoilage bacteria (Quinn et al. 2002). Where milk is produced under poor hygienic conditions and is not cooled, the main contaminants such as lactic acid producers which cause rapid souring. Lactic acid has an inhibitory effect on pathogenic bacteria but however, this cannot be relied upon to provide a safe milk product (Nangamso, 2006). Therefore, since cooling requires electricity which is currently limited in Zimbabwe, it may also be important to investigate other possibilities such as the lactoperoxidase system to prevent bacterial growth (Kussendrager and Hooijdonk, 2000).

Except when the Department of Veterinary Services does its routine testing, farmers themselves do not commonly test for milk-borne zoonoses. Similar observations have been reported in Nigeria where routine testing of zoonoses is not regularly done thus, exposing their prisoners who herd animals to serious public health implications (Junaidu et al. 2008). Due to lack of efficient zoonosis surveillance and food safety the risk for zoonoses transmission is increasing, particularly in resource-limited countries (Acha and Szyfres, 2003; Zinsstag et al. 2007; Marcotty et al. 2009). Furthermore, as observed by Junaidu et al. (2008), routine medical check-up for zoonoses by dairy farmers, farm workers and their families is not a common practice and when they fall sick, zoonotic diseases are unlikely to be considered among the differential diagnoses.

Milk production practices such as lack of appropriate milking places and milking techniques influence the level of milk contamination at farm level (Grimaud et al. 2007). As observed in other studies (Hidayet and Mehmet 2004; Millogo et al. 2008) all smallholder dairy farmers studied practiced hand milking with a relatively higher percentage of them milking cows in open kraals, which constitutes one of the direct methods of milk contamination. Higher microorganisms have been reported in milk from hand milked compared to machine milked cows (Filipoviet and Kokaj, 2009). Some of these microorganisms contaminating milk may include those that are potentially zoonotic such as *Salmonella* spp. Thus the milking practices used in smallholder dairies constitute an important risk factor for exposure to zoonotic pathogens.

Although no outbreaks of food poisoning associated with raw milk have been recorded in Zimbabwe, the reporting of such illness in rural areas is low. However, large amounts of *E. coli, S. aureus, Candida albicans* and other health hazard microbes have been reported in raw milk, cultured pasteurized milk and naturally soured raw milk from three smallholder dairies in Zimbabwe (Gran et al. 2003; Mhone, 2010) and this emphasizes the need for improved hygiene practices at all levels in this dairy sector. Therefore consumption of such contaminated milk and milk products constitutes a public health risk in smallholder communities in Zimbabwe, especially in the most vulnerable groups such as young children, the elderly and people living with HIV /AIDS, which is prevalent in the region. *Mycobacterium bovis*, *Brucella abortus*, *Bacillus cereus* and *Campylobacter* spp. are other pathogenic microorganisms found in milk and milk products in sub-Saharan Africa (Bonsu et al. 2000; Weinhaupl et al. 2000). It would be of interest to investigate the presence of these microorganisms in milk and milk products in smallholder dairies in Zimbabwe.

Without information on milk-borne zoonoses, dairy farmers are neither informed nor motivated to take the simple precautions necessary to protect themselves, their families, workers and the public. From this study over 80% of dairy farmers indicated that animal health workers are important in raising the awareness on milk-borne zoonoses. Hence, veterinarians are a crucial link in keeping dairy farmers fully informed of ways to reduce the risk of zoonotic transmission.

In addition, proper disposal of infected milk or dairy products, aborted materials and use of hygienic procedures during milking and milk storage are extremely important steps in successful control of zoonotic pathogens (Al-Majali et al. 2009). These general hygienic practices and zoonotic diseases controlo programmes need to be integrated in the milk production process particularly at the smallholder level in order to prevent transmission from animals and animal products since most are maintained in the animal reservoirs (Zinsstag et al. 2007). While successful control of the milk-borne zoonoses rests with multi-stakeholder involvement (Brook and McLachlan, 2006), farmers play a critical role in the implementation phase whose success hinges on farmers' level of awareness of the importance of such diseases. Therefore, results of this study appear to imply that by improving the level of awareness for zoonoses, teaching and training of dairy farmers, especially from smallholder sectors in Zimbabwe and other resource-limited countries in tropical and sub-tropical regions could bring about improved animal health, productivity and food safety.

In conclusion, this study established that the level of awareness to milk-borne zoonoses is lower in smallholder compared to commercial farms. Smallholder farmers are mostly not aware of the risk of contracting zoonotic pathogens from consuming raw milk. Thus, educating these farmers on the methods to control milk-borne zoonoses in animals and to minimize human exposure from animals and animal products will reduce their incidence in smallholder dairy farms.

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