Original Article

Assessment of Hygienic Milking Practices and Prevalence of Bovine Mastitis in Small Dairy Farms of Peri-Urban Area of Jaipur

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Abstract

Background: Bovine mastitis is a highly prevalent infectious disease that affects the production and quality of the milk and results in culling of the cattle, leading to severe economic loss. In India, a large number of smallholder urban dairy farmers are in milk production. However, information on their awareness on milk-borne zoonosis and milking hygiene practices remains scarce. **Aim:** The study aimed to evaluate milk hygiene awareness and practices among the small dairy farms in the peri-urban area of Jaipur. **Materials and Methods:** A cross-sectional study was conducted among 30 dairy farms. A total of 80 respondents including the farmers (suppliers), distributors, and customers were surveyed. They were interviewed about their milk hygiene practices and awareness on mastitis using questionnaires and observations. Milk samples were analyzed for somatic cell count. **Results:** The results of the study showed that all respondents practiced hand milking. Only 80% of the respondents washed udder before milking. Tap water was used for washing utensils. Only 2% of the respondents practice postmilking dipping of teats. Nearly 90% of barns were not cleaned properly. **Conclusions:** Hygiene practices are of substandard among the suppliers and the distributors. There is a risk of prevalence of bovine mastitis. This indicates that there is a lack of awareness about the risk associated with bovine mastitis and management. Therefore, there is a need to strengthen farmers' awareness on milking hygiene practices and 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.

Keywords: Bovine mastitis, dairy farmers, food-borne zoonosis, milk distribution system, milking hygiene

Introduction

Transmission of infectious agents from animals to humans occurs by direct contact with the animal or indirectly by ingestion of contaminated food, inhalation, or inoculation of infectious agents such as bacteria and their toxins, viruses, and parasites. Nearly 60% of pathogens that cause diseases in humans are zoonotic diseases of animals that can infect people and over 75% of emerging infectious diseases are zoonotic as well.[1-3] The first-ever comprehensive report on the global burden of food-borne diseases released by the WHO in 2015 stated that when on average globally, 1 in 10 people fall ill every year from eating contaminated food and 420,000 die as a result.[2] To prevent and control the risks, a holistic understanding of the various influencers of inter and intraspecies pathogen transfers in conjunction with animal and human is a requisite. This is possible through One Health (OH) approach of research, which analyzes various dimensions of human, plant, animal health, climate, and environmental factors in an integrated and holistic manner to provide a deep understanding of the health outcomes and impacts.[4-6] Few examples where OH approach has been effective are in the combat of avian influenza (HPAI and H5N1), Ebola, SARS, and Zika Virus.[4-6] Globally with increase in incidence of food-borne diseases disrupting food trade and safety, these zoonotic diseases are ideal candidates for OH approach of disease control.

Bovine mastitis, a food-borne zoonotic disease, causes changes in the milk constituents, significantly reducing milk yield

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and also negative impact on the reproductive system of the cows and buffaloes.[7] It is one of the top most reasons for culling of cows,[8] resulting in economic loss.[9,10] Upholding hygienic practices during milking, maintenance of the cattle, and cleanliness of milking machines are known to reduce the mastitis infection.

India is the largest producer of milk in the world with over 150 million tons of production per day[11] and the State of Rajasthan is the 2nd most producer in the country at an annual production of 16.9 lakhs metric tons of milk.[12] Milk quality has a direct link with hygiene practices from the place of production, to processing, storage, supply, etc., until it reaches the end user. For a proper milk value chain, a systematic approach to quality care is necessary, focusing on each individual link in the production and milk distribution. There is an appreciable gap of the knowledge regarding the awareness to bovine mastitis and the hygiene practices in the state. The current study aims to close this gap by adopting the OH approach in understanding the milk distribution system and the hygienic practices followed by the stakeholders of the distribution system in the peri-urban area.

Materials and Methods

The cross-sectional study was conducted in Vatika, a peri-urban area, 20 km from Jaipur, the capital of state of Rajasthan. The study was conducted in 5 months from January to May 2017. Study participants included milk suppliers from the small dairy farms, distributors, and consumers. A total of 80 respondents were included in the survey, which included 30 suppliers, 10 distributors, and 40 consumers, who were interviewed and observed for hygienic practices related to milking and handling of milk. These interviews and observations were conducted on a predesigned and a pretested questionnaire and checklist. The respondents were selected based on snowball method of sampling.

Clinical Testing for Mastitis (CMT) was used to test the presence of the infection. From each farm, one lactating cow and one buffalo were randomly selected and clinically observed for the manifestation of general clinical signs related to udder, teats, and presence of any gross abnormalities. The udder was first examined visually for any visible injuries and infection. Grades of the CMT were evaluated as shown in Table 1.

The collected quantitative data were analyzed using SPSS version 21. All data forms underwent scrutiny for logical inconsistencies, skip patterns, and missing values. The percentages and their 95% confidence intervals were presented.

Ethical clearance

Ethical clearance for the study was obtained from the Institute Review Board of IIHMR. Consent was obtained in written format from the respondents before participating in the survey.

Results

Four types of milk distribution system were identified in the peri-urban area [Figure 1]. Three involved intermediaries such

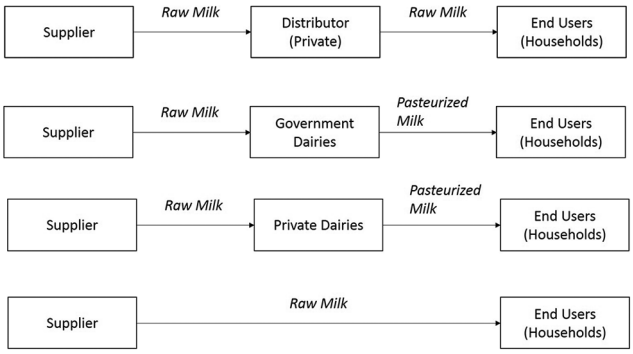

Figure 1: Milk distribution system of the Peri-urban area, Vatika

as distributors, government dairies, and private dairies, whereas one had suppliers selling milk directly to consumers. During survey, the suppliers were questioned regarding availability of clean water and frequency of cleaning barn in addition to other hygiene practices. They were simultaneously observed by the researcher if the practices were actually followed. Out of 30 suppliers, 24 (80%) reported that they washed udder before milking, whereas the observation made by the researcher reported that only 7 (23%) of them actually washed udder before milking [Table 2].

It was also found that 2 (7%) out of 30 suppliers were practicing teat dipping and only 10% of the cows were having clean teat. Tap water was used for washing milking utensils and storage cans. Mostly aluminum utensils (88%) were used, whereas the rest were steel utensils (13%). There was 100% availability of electricity at all the dairy farms. There was no cooling facility available in the farms. Hand milking system was in practice. Every supplier responded that they cleaned the barn twice every day and vessels were washed frequently. However, it was observed that only 37% of the suppliers had clean vessels at any given time. There were traces of animal urine (53%), manure (63%), and dirt and hairs (97%) present in the sheds [Table 3].

Hygiene practices of the distributers were also evaluated based on observation [Table 4]. Motorcycle (60%) was the most commonly used mode of transportation. Nearly 60% of distributors use steel containers for supplying, out of which 10% were having tap system. The rest served milk from the top of the utensil (70%). It was observed that they do not wash their pouring utensil every time they serve.

Every consumer reported that they drink milk after boiling and nearly 70% stored milk in the refrigerator [Table 5]. 40% of the consumers had faced curdling of milk sometimes, 8% frequently, and 52% had never faced any curdling of milk. They perceived that boiling milk removed all infections.

The somatic cell count of cows and buffalos, which depicts the presence of mastitis, was detected by the California Mastitis Test [Table 6]. According to the results, 63% showed CMT 1 in cows, which means that they are having risk of mastitis and somatic cell count was 500,000–1,000,000. 30% showed CMT

Table 1: Grading of California mastitis testing

Results	Criteria
CMT (−) - (0-200,000)	Liquid mixture without gel
CMT 0 - (>200,000-500,000)	Light gel visible by transparencies, will disappear after 10 s
CMT 1 - (500,000-1,000,000)	Visible light gel by transparencies, persistent
CMT 2 - (1,000,000-5,000,000)	Visible gel adhesion to the cup - vacuous filament
CMT 3 - (>5,000,000)	Strong gel like the egg white

CMT: California mastitis test

Table 2: Hygiene practice before milking (*n*=30)

	Supplier response	Observation by researcher
Hygiene practice	Yes (%)	Yes (%)
Washing udder before milking	24 (80)	7 (23)
Cleaning barn twice every day	30 (100)	4 (13)
Availability of clean water	18 (60)	4 (13)

Table 3: Hygiene practices related to shed and animals (*n*=30)

Hygiene practise	Observation	*n* (%)
Barn cleanliness		
Floor	Cleaned	9 (3)
Urine	Present	16 (53)
Manure	Present	19 (63)
Uterine discharge	Present	0
Dirt	Present	29 (97)
Hairs	Present	29 (97)
Milking animal related		
Body	Clean	18 (60)
Teats clean	Clean	3 (10)
Feeding of animal	Proper diet	24 (80)
Shed	Stable	29 (97)
Ventilation of sheds	Available	30 (100)
Milk related		
Proper transport	Yes	25 (83)
Milking inside shed	Yes	100 (100)

2 in cows, which shows a high risk of mastitis. In buffalos, 50% showed CMT 1 and 21.4% showed CMT 2. CMT 1 and CMT2 indicate high risks of mastitis.

Discussion

The aim of this study was to assess the knowledge and practices among the small dairy farmers in peri-urban area Vatika of Jaipur. Hygiene practices adopted during milk production, processing, and distribution are known not only to affect the quality of raw milk[13,14] but also to have a direct link to both human and animal health. They have economic implications also. Unhygienic or unclean milking utensils affect the quality of the milk.[14] The hygienic conditions are affected according to the distribution system, type of stakeholders, adapted practices, level of awareness, and availability of resources. In the study area, two distribution patterns could be differentiated: one that involves intermediaries and another that involves direct interaction between suppliers and end users. Hence the responsibility of maintaining the quality of milk and ensuring

Table 4: Hygiene practices of distributors

Response	*n* (%)
Transportation for distribution	
Motorcycle	6 (60)
Jeep	4 (40)
Milk distribution	
Households	8 (80)
Milking factories	2 (20)
Cooling procedure	
Yes	0
Utensil used for distribution	
Steel	6 (60)
Aluminium	4 (40)
Pouring of milk through	
Tap	1 (10)
Top of utensil	7 (70)
Do not serve to households	2 (20)
Cleaning of pouring utensil every time before serving milk	
Yes	2 (20)
Do not serve to households	2 (20)

Table 5: Hygiene practices of consumers (*n*=40)

Variable	*n* (%)
Consumption of raw milk	
Yes	0
Storage of milk	
Refrigerator	28 (70)
Room temperature	12 (30)
Curdling of milk	
Sometimes	16 (40)
Frequently	3 (8)
Never	21 (52)
Affected by diarrhoea after drinking of milk	
Yes	7 (18)
No	33 (82)
Milk consumption from other source	
Yes	9 (22)
No	31 (78)

Table 6: Somatic cell count of cows and buffaloes

Somatic cell count grade	Frequency of occurrence, frequency (%)	
	Cows	Buffaloes
CMT 0	2 (7)	8 (29)
CMT 1	19 (63)	14 (50)
CMT 2	9 (30)	6 (21)

CMT: California mastitis test

adoption of hygienic practices while handling milk depends on both the suppliers and intermediaries.

Most of the dairy farmers in the studied peri-urban area were supported by their families, especially by their wives in taking care of the animals. Having efficient milk hygiene practices is important for reducing the transmission of bacteria from animals to humans and preventing malnutrition and transmission of communicable diseases of men through milk. This requires safe hygiene practices such as keeping the milkers' hands and clothes clean, having clean milking utensils and milk storage equipment, and cooling milk immediately after milking preferably to 4°C. In the current study, the hygiene practices followed under small dairy farms were found to be of substandard quality. Such substandard leads to decrease in the quality of the milk and milk products.[15-17]

The sanitation of the milking area is another important factor for the production of good quality of milk.[18] If the milking area is not clean and infested with flies, they may fall in milk and spoil it. When the animal urinates or defecates during milking, it may fall in the milk causing contamination. The current study observed that the floors in most of the milking area were not clean. More than 90% had hair and dirt on the floor and nearly 50%–60% of the sheds had hair and feces lying around. This was in spite of the dairy farmers reporting cleaning the floor twice every day. The dirt from the soil, feces, etc., may attach themselves to the teats and cause bovine mastitis.

The study indicated that hand milking was done by the small dairy farmers. Hand milking is prone to high risks of transferring bacteria from the milker to the milk itself.[19] In addition, as they are in close contact with the animal, there is a greater chance of transmission of the disease from the animals to humans. Wet milking should not be done as the water in their hands and teats may wash the organisms on the teats and udder into milk. In the current study, though the milkers were found to have clean hands, it was observed that at times, they were negligent enough not to dry their hands. Earlier studies have shown that when hygienic practices are followed, the risk of contamination was significantly reduced.[20]

Poorly cleaned milking equipment with milk drops on the surface of the cans can be a source of many microorganisms.[21] The distributers and the suppliers were cleaning the storing can, but were not cleaning the top of the pouring vessel. There were droplets of milk on the top.

Water serves as primary sources of microorganism's contamination[22] and hence should be clean before use. All the suppliers and distributors used tap water and no purification steps were adopted. Milk contains mostly water (>80%) and has a shorter storage life. Cooling the milk immediately to 4°C, pasteurizing the milk, and transporting in insulated trucks stop spoilage of milk by curdling.[23] During transportation of milk, the bacterial load of milk increases, and if the transportation equipment is not appropriate, the bacterial counts increase causing spoilage before the milk reaches its destination.[23] It was observed that the milk was distributed in motorbike and jeep. Furthermore, the storage and transport cans were not double walled or cooled. More than 40% of the consumers had faced curdling of the milk. Lack of clean water in washing utensils might be a probable reason.

Udder cleanliness is another important hygienic parameter to be followed. Washing the udder before milking removes dirt, but does not remove the microorganisms from the skin. Only 7 out of 30 dairy farms had the practice of washing udders before milking. Only 10% of animals had clean teats. Negligible suppliers were following the practice of teat dipping (2 out of 30) and the rest assume allowing the calf to suckle before milking is sufficient to clean the teats. CMT is the most commonly used efficient indicator for udder health status and presence of mastitis.[24] In general, count of somatic cells above 200,000 cells/ml milk per cow is known to increase the risk for mastitis,[25] and its somatic cell count below 100,000 cells/ml milk is an indication of healthy udder.[26] An elevated somatic cell count in milk has a negative influence on the quality of raw milk. They may have shorter shelf life and gain a rancid flavor. Most of the cows and buffaloes tested for CMT had high somatic cell count and hence high risk for mastitis.

Conclusions

The overall study shows a low awareness of milk-borne pathogens and hygienic practices among the stakeholders. This could likely engender dairy production and may compromise quality and safety of the milk being traded. It has been proven by earlier authors that though the occurrence of inflammation in the udder may not be entirely preventable, their frequency of occurrence and the intensity of the infection can be significantly reduced in all animals through better management. Some of the methods include proper milking methods, hygienic maintenance of milking equipment and environment, good udder health maintenance, culling chronically infected cows, appropriate mastitis therapy, and dry cow management.[27,28] Milk quality is affected by contaminants that are introduced due to improper management of milk and milk product any time in the milk distribution chain, from milking until finally reaching the consumers. This necessitates that hygienic conditions of cow's milk should be maintained by all stakeholders of the distribution system to eliminate harmful microorganisms from the milk. To address the lack of awareness among the stakeholders regarding bovine mastitis and its management, they need to be systematically trained in managing the animals and maintaining the quality of milk and its products. The consumers who are in the receiving end of the value chain should also be encouraged to demand for quality in the milk supplied to them and self-trained to follow hygienic practices of handling milk.

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Conflicts of interest

There are no conflicts of interest.

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