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Research article

Comparative assessment on the clean milk production practices of military farm Chattogram and other selected farms of Chattogram district of Bangladesh

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ABSTRACT

Adopting clean milk production practices has great potential for increasing the quality of milk production. Therefore, this study was intended to evaluate the current practice of clean milk production in the commercial dairy farms of the Chattogram region and compared them with the one practiced at Military Farm Chattogram (MFC). Current study therefore, enrolled, 30 commercial dairy farms of different categories were randomly selected along with MFC. The management data of these farms regarding housing, cleanliness, hygienic aspects of milking persons and animals; and methods of milk production were collected from the farms by using a questionnaire. The pooled milk samples were collected to perform the physical, chemical, microbial test, and somatic cell count to determine the milk quality regarding clean milk production practice. Results revealed that the hygienic management was better in MFC than in the other selected farms. The presence of coliform bacteria was nil in the milk samples of MFC, whereas it was found in 50% of the milk samples of category A, B, and C farms. The average Somatic cell count (SCC) of categorized farms were 238400±4262, 509800±17229, 538000±19549 and 520000±15179 in the MFC, category A, B, and C farms, respectively ($p<0.05$). Thus, MFC milk was recorded to be comparativelythe best in all tested parameters regarding clean/hygienic milk production and standard dairy production practices.

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1. INTRODUCTION

Adopting clean milk production procedures has the potential to enhance the quality of milk significantly. As a result of liberalized trade policies advocated in the World Trade Organization (WTO) agreements, globalization of food trade, and technological advancements pose greater awareness of safety concerns, emerging risks, and challenges in food safety.

Milk products are one of the most commonly consumed food categories worldwide. Despite being considered important to the nutrition and health of every age group including those with high vulnerability to health issues such as infants or pensioners, the quality standard of milk and milk products has been a major issue for the dairy sector. To analyze further, the risks of both improper hygiene in milk handling and contaminated dairy products deliberately caused by human. It has also been shown that milk and

dairy products cause the most common foodborne pathogens that affect millions of lives every year (Oliver et al., 2005).

Clean milk can be defined as milk coming from a healthy milch animal possessing normal flavor, devoid of dirt and filth containing permissible limit of bacteria, and essentially free from adulterants, pathogens, various toxins, abnormal residues, pollutants, and metabolites (Rathod et al., 2014). It can also be defined as milk that comes from the udder of healthy animals which has a pleasant smell, is free from dust, dirt, and drug residues, and does not contain harmful microbe, which can affect human health (Pal and Jadhav, 2013). To improve the quality of milk and clean milk production, the government of Bangladesh has a new scheme for hardening infrastructure for quality and clean milk production. The Department of Livestock Services (DLS) also plays an important role.

Milking hygiene has an impact not only on clean milk production which enhances the hygienic quality and shelf-life of the milk but also on the occurrence of infections and risk of spreading zoonotic diseases. The productivity enhancement can be met by adopting improved dairy management practices. Proper cleaning and sanitizing procedures, hygiene of animal house and milking area, care and feeding of milking animal, care in udder and milking utensils, personal hygiene and technique of milking, transportation, and proper preservation after milking are therefore essential for clean milk production which is crucial for the quality of milk. The milk quality is important as it impacts farm profitability, milk processing, human health, keeping quality, etc. Increased somatic cell counts are associated with reduced milk yield. Milk quality has a substantial, adverse impact on milk processing. To the best of my knowledge, very few attempts have been made to study clean milk production practices in the dairy farms in the Chattogram district. Therefore, the study aimed to evaluate and compare the clean milk production practices adopted by Military Farm Chattogram and other selected commercial dairy farms of Chattogram district.

2. MATERIALS AND METHOD

Study area

Military Farm Chattogram (MFC), commercial dairy farms of Chattogram metropolitan area (CMA), and Sikalbaha were selected for the survey (Figure 1).

Figure 1. Study area (●)

Study period

The study was conducted from December 2020 to June 2021 for about 6 months.

Farm selection

To compare the hygienic milk production a total of 30 farms were selected from CMA and Sikalbaha. Among the selected farms, the farms were categorized according to DLS, (2012); small- scale farms as category A (3-25 cows), medium-scale farms as category B (26-50 cows), and large-scale farms as category C (above 50 cows). Ten farms from each category were picked for the study.

Data collection

Data were collected by face-to-face interview and all the farmers were interviewed using a pre-tested questionnaire. All of the participants provided spontaneous responses to all the questions.

Sample collection

To check the milk quality and microbiological standard of milk, pooled milk samples from each selected farm were collected. Sterilized falcon tubes were used as sampling containers. Ice boxes were used to transport the samples from the farm to the laboratory. The physical, chemical, and microbial test was performed by the standard procedure.

Bacteriological analysis

Total viable bacterial counts (TVC) and Coliform count (CC) were performed to determine the microbial quality of samples collected from different farms. Different bacteriological media; Plate count agar and MacConkey agar were used (APHA, 1992). Somatic cell counts were performed in the pooled milk samples. The test was performed in Medicine laboratory under the Department of Medicine and Surgery, CVASU. DeLaval cell counter (DCC; DeLaval International AB, Tumba, Sweden) was used for the somatic cell count.

Data analysis

All data were tabulated, processed, and finalized in Microsoft Excel (2007). The final data were then analyzed by using STATA (v.17.0) (Stata Corp, 4905, Lakeway Drive, College Station, Texas 77845, USA) and Kruskal–Wallis test (v.4.3.3).

3. RESULTS AND DISCUSSION

In this study, the use of disinfectant in the milking area was 100%, 80%, 70%, and 60% reported to be practiced by MFC, category A, category B, and category C farms, respectively (Table 1). Cleanliness of the floor is very important for clean milk production this might be due to lower microbial load in the floor. Lower microbial load on the floor readily decreases the contamination of milk after milking. Some other studies supported in favor of the statement, that clean milk production depends mainly on the health status of milch animals, the condition of dairy animal housing, the status of the udder, hygiene of milkers, milking practices, milking containers, feed, fodder and feeding practices, grazing area and storage system for milk (Champak et al., 2017).

In this study, the personal hygiene of the milkmen was evaluated (Table 2). Personal hygiene is considered to be another crucial parameter for clean milk production in dairy farms as the hands of milkers could be a potential source of microbial contamination. Lee et al. (2012) evaluated the occurrence of Staphylococcus aureus isolates in milk and the milking environment. Staph. aureus was isolated (3.3%) from milkers' hands. El-Gedawy et al. (2014) found that, in dairy workers' hand swabs, the isolation rates of Staph. aureus, St. agalactia and Salmonellae were 10%, 2% and 8%. Pandey et al. (2014) explored that the potential sources of contamination were milker hands, milking pails, udder of animals, milk cans, and stored water used for washing equipment. Tahoun et al. (2017) isolated 36.7%, 40.5%, and 22.8% Listeria spp in raw milk, milking equipment, and hand swabs, respectively.

Milk provides an ideal medium for the growth of all kinds of microbes. For this, milk sometimes might not be appropriately safe for public health, especially if contaminated by various micro-organisms that may appear in milk directly, from the mammary gland (secretional contamination) or the environment (post-secretional contamination). Milk contamination can occur at the following levels: animal shed and environment, the animal, milker and milking routine, milking equipment, storage, and transport. In the case of hand milking, the risk of contamination coming from the milker is higher as compared with machine milking (Table 3). Nonga et al. (2015) described milk as a nutritious food that is prone to microbial contamination and many milk-borne epidemics of human are spread through contaminated milk.

The present study demonstrates cleaning the milking utensils can act as one of the major hindrances to clean milk production practices. Dry and hygienic utensils for milking purposes were practiced 100%, 80%, 80%, and 60%, and using separate utensils for milking healthy and sick animals were practiced 100%, 70%, 60%, 60% by MFC, category A, category B, and category C farm, respectively (Table 2). Milking utensils may act as a source of contamination which is also proven by some other studies (Marchand et al., 2012). Marchand et al. (2012)

described that bacteria in milk can adhere and aggregate on stainless steel surfaces, resulting in biofilm formation in milk storage tanks and milk process lines. The growth of biofilms in milk processing environments leads to increased opportunity for microbial contamination of the processed dairy products. Suranindyah et al. (2015) investigated that improving sanitation significantly decreased milk acidity from 0.19% to 0.14% and the number of bacteria in milk. Tegegne and Tesfaye (2017) found that the overall average total bacterial count (TBC) was 4.59 ± 0.118log10 (38,904.51 cfu/ml) and 4.77 ± 0.23 log10 (58,884.37 cfu/ml) for milk samples collected directly from teat during milking and milking buckets at farm level, respectively. Accordingly, the count increased by 0.18 ± 0.23 log10 or 19,979.86 cfu/ml (51.36%) increase from teat to milking buckets. Abdalla et al. (2011) determined the impact of the application of some hygienic practices before milking on milk quality.

Table1. Hygienic practices and management of milking animal

Variables	**Category**	**Percent**
Management of the milking area		
Keep milking area clean, disinfected, and free from flies and insects	MFC	100
	A	80
	B	70
	C	60
Clean animal shed 15 min. before milking	MFC	100
	A	40
	B	20
	C	30
Care of milking animal		
Regular examination of milking animals by veterinary doctor	MFC	100
	A	30
	B	30
	C	20
Deworming of milking animals regularly	MFC	100
	A	90
	B	60
	C	40
Vaccinate milking animals regularly	MFC	100
	A	70
	B	60
	C	60
Wash and clean animals everyday	MFC	100
	A	90
	B	80
	C	80
Cleaning of animals before milking		
Cleaning udder and teats of cows before milking	MFC	100
	A	100
	B	100
	C	90
Washing hind quarters or back of cows before milking	MFC	100
	A	30
	B	20
	C	10
Washing entire animal	MFC	100
	A	50
	B	30

	C	20

[MFC=Military Farm Chattogram, f=Frequency, Category A=Small scale farm (3-25cows), Category B = Medium scale farm (26-50 cows), Category C =Large scale farm (≥51 cows).]

Table 2. Hygiene of dairy farmers and Cleaning of the milking utensils

Variables	**Category**	**Percent**
Personal hygiene of dairy farmers		
Washing hands before milking	MFC	100
	A	100
	B	100
	C	100
Changing/Wearing the clean dress before milking	MFC	100
	A	30
	B	20
	C	100
Trimming of nails regularly	MFC	100
	A	40
	B	30
	C	30
Always stop milk handling while showing disease symptoms	MFC	100
	A	80
	B	60
	C	50
Cleaning of the milking utensils		
Using clean, dry, and hygienic utensils for milking	MFC	100
	A	80
	B	80
	C	60
Using separate utensils for milking healthy and sick animal	MFC	100
	A	70
	B	60
	C	60
Do not use rusted cans for milk collection	MFC	100
	A	100
	B	80
	C	80

[MFC=Military Farm Chattogram, f= Frequency, Category A=Small scale farm (3-25cows), Category B= Medium scale farm (26-50 cows), Category C =Large scale farm (≥51 cows).]

The average TVC of categorized farms were 3455100, 4150300, 4241867, and 4165733 cfu/ml in the MFC, Category A, Category B, and Category C farms, respectively (Figure 2) (Table 4). Among the selected farms, MFC recorded with lower TVC, this might be due to their comparatively better hygienic management of the milking shed, milking utensils, and milking personnel. The reason for the high bacteria counts in raw milk is well-known as a good growth medium that supports the growth of several microorganisms because of its high water content, nearly neutral pH, and variety of available essential nutrients that renders it one of the best media for microbial growth and multiplication (Soomro et al., 2002). The most frequent cause of high bacterial load is normally a result of poor cleaning of the milking system. The bacterial count may be high due to milking dirty udders, maintaining an unclean milking and housing environment, and failing to rapidly cool milk to less than 40°F. Aaku et al. (2004) and Arenas et al. (2004) have found 5.5×10^6cfu/ml and 10^6 to 10^7 cfu/ml of the total

number of microorganisms in pooled raw milk, respectively, which were comparatively higher than this experiment. Hossain et al. (2011) experimented in India and found that the bacterial count in raw milk ranged from 1.75×10^6 to 1.22×10^8cfu/ml and Banik et al. (2014) found a high bacterial load in raw milk samples which ranged from 1.3×10^7 to 5.2×10^8cfu/ml.

Table 3. Udder management, the pattern of milking, and post-milking care

Variables	Category	Percent
Udder management		
Examine udder, teat, or milk regularly by veterinary doctor	MFC	100
	A	0
	B	0
	C	0
Wash udder for removal of mud and dung	MFC	100
	A	70
	B	60
	C	60
Wipe the udder with a dry cloth after udder washing	MFC	100
	A	30
	B	20
	C	10
Use of $KMnO_4$ in water for cleaning of udder and teats	MFC	100
	A	10
	B	0
	C	0
The pattern of milking the animals		
Milking the healthy animals first	MFC	100
	A	40
	B	20
	C	20
Randomly	MFC	0
	A	60
	B	80
	C	80
Post-milking care		
Passing the milk from a sieve or muslin cloth to remove the dirt	MFC	100
	A	90
	B	70
	C	70
Keep the animal in a standing position for 15min. after milking	MFC	100
	A	50
	B	50
	C	40

[MFC=Military Farm Chattogram, f=Frequency, Category A=Small scale farm(3-25cows), Category B = Medium scale farm (26-50 cows), Category C =Large scale farm (≥51 cows).]

Table 4. Total viable count of the collected milk

Type of Farms	TVC (cfu/ml) Mean±SD	P-value
MFC	3455100[b]±19554	<0.04
Category A	4150300[a]±50585	
Category B	4241867[a]±51369	
Category C	4165733[a]±61712	

[Different superscripts (a,b) in the same column differ significantly. (P<0.05)]

Figure 2. Total viable bacteria on plate count agar

The presence of coliform bacteria was nil in the milk samples of MFC, whereas 50% negative and 50% positive coliform bacteria were present in the milk samples of category A, category B, and category C farms, respectively (Figure 3) (Table 5). The presence of a nil percentage of coliform bacteria is an excellent indication of clean milk production practice indices of MFC. Coliform count in milk is a good indicator of fecal contamination of milk. MFC showed a lower coliform count which indicates proper sanitary management. Sraïri et al. (2006) found that the coliform count of raw milk was less than 30 to 2.08×10^7scfu/ml. The higher coliform count indicates poor sanitary practices of dairy farms and processing units. It may result from irregular bathing of animals, feeding system of animals in low land, muddy cow yards, unsanitary milking utensils, contamination of body surface by feces, poor personnel hygiene, etc. (Khaton et al., 2014). Godefay and Molla (2000) and Uddin et al. (2011) found coliform counts above 1×10^4cfu/ml.

The average Somatic cell counts of categorized farms were 238400±4262, 509800±17229, 538000±19549 and 520000±15179 in the MFC, category A, category B, and category C farms, respectively (Table 6). Somatic cell count (SCC) is widely used for evaluating milk quality. An increased SCC results either from an inflammatory process due to the presence of an intramammary infection or, under non-pathological conditions, from physiological processes such as estrus or advanced stage of lactation (Raynal-Ljutovac et al., 2007). An increase in SCC causes a decrease in milk yield and affects milk composition, which leads to reduced cheese-making potential (Barbano et al., 1991).

Table 5. Presence/absence of coliform bacteria in the collected milk

	MFC	Category A	Category B	Category C
Presence of coliform bacteria	-	-	-	+
	-	-	+	-
	-	+	+	-
	-	-	+	+
	-	+	-	+
	-	-	+	+
	-	+	-	-
	-	-	-	-
	-	+	-	-
	-	+	+	+

[(-)= nil, (+)=present)]

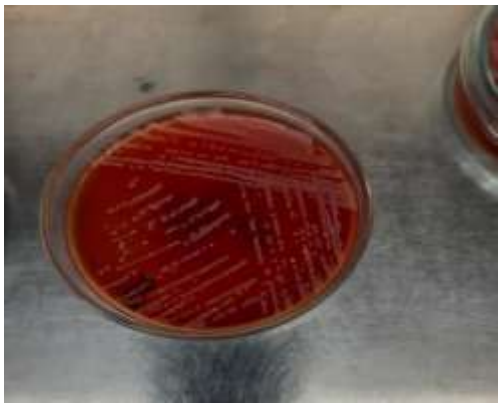

Figure 3. Coliform bacteria on MacConkey agar

Table 6. Somatic cell count of the collected milk [Different superscripts (a,b) in the same column differ significantly. ($p<0.001$)]

Type of Farms	SCC (Mean±SD)	P-value
MFC	238400^{b}±4262	0.000
Category A	509800^{a}±17229	
Category B	538000^{a}±19549	
Category C	520000^{a}±15179	

4. CONCLUSION

Among the selected farms MFC adopts comparatively proper hygienic management of the milking shed and cleaning of milking animals. These hygienic practices might have attributed in clean milk production on their farms in terms of good microbial quality and lower somatic cell count. Cleaning the milking shed and milch animals is required for clean milk production. Efforts should be made for intensive training programs, group discussions, demonstrations, tours, field visits, awareness programs, etc., for quality milk production. A broad range of resources should be developed to support these steps, including farmer's short course training, farm guidelines, mastitis action plans, mastitis focus reports, and milk quality awards.

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