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Original Research

Effect of Food Safety Management Practices on Milk Quality and Subclinical Mastitis in Dairy Cow Farms

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Abstract

The study aimed to investigate the effect of management practices based on the principles of hazard analysis critical control points system application in dairy farms on bulk milk tank quality and the subclinical mastitis prevalence. The study was conducted on two dairy farms located in Dakahlia Governorate, Egypt using observation and questionnaire. Furthermore, cow hygiene scoring, subclinical mastitis prevalence using California Mastitis Testing, and electrical conductivity were evaluated. In addition, the organoleptic, chemical, and microbiological quality of bulk milk tanks were assessed. The results showed that farm I had better adoption of farm management practices (66.20%) than farm II (33.80%). The mean of udder and leg hygiene scores for cows showed no significant variation between both farms. The prevalence of subclinical mastitis in farm I was 0% (0/108), while it reached 6.25% (6/96) in farm II. No evidence of any abnormality during organoleptic examination on both farms. Referring to the chemical analyses, there was a higher significant difference between protein and SNF ($p<0.05$) in farm I than in farm II. However, this was not the case for fat, in which farm II showed a higher significance ($p<0.05$). Furthermore, farm I showed a significantly lower ($p<0.05$) somatic cell count. On the other hand, the total bacterial count (TBC), titratable acidity, and pH had no significant difference in both farms. Finally, these ensure the importance of hygiene management practices for udder health and milk quality.

KEYWORDS
Bulk milk tank, Milk quality, Risk factors, Safety management practices, Subclinical mastitis.

INTRODUCTION

Food safety is described in general as “conditions and practices that preserve the quality of food”. These practices prevent contamination by any food safety hazards and foodborne illnesses (Griffith, 2000). These hazards refer to any physical, biological, or chemical agent, or condition with the potency to cause adverse health effects for consumers (Codex Alimentarius Commission, 2003).

Milk is a complete diet rich in nutrients and has a complicated biochemical composition of variable nutrients. Approximately 87.2% water, 3.7% fat, 3.5% protein, and 6.8 pH for bovine milk makes it an excellent medium for several microbial growth and multiplication when proper conditions exist (Parekh and Subhash, 2008; Bekuma and Galmessa, 2018; Foroutan *et al*., 2019).

variation of milk composition and properties are due to species, breed, breeding and crossbreeding, milk yield, age, genetics, feeding, season and weather conditions, management practices, stage and number of lactation, milking intervals, variations during milking, gestation, heat, udder health, variations during milking, variability from different quarters of the udder, excitement (frightening), administration of drugs and/or hormones (Walker *et al*., 2004; Mehta, 2015).

Various hazards through processing to the consumer, basically influence the quality and safety of the product (Owusu-Kwarteng *et al*., 2020). Milk quality is demonstrated by normal flavor, color, and chemical composition, being free from disease-causing bacteria, harmful toxic substances, sediment, and extraneous substances, having a lower level of titratable acidity, and low in total microbial count (Hemme and Otte, 2010).

The microbiological quality of milk from a healthy animal is theoretically expected to be safe for human consumption. However, once it is secreted from the udder, milk can easily be contaminated by spoilage microorganisms and food-borne pathogens (Muehlhoff *et al*., 2013). In general, sources of contamination of milk at the farm level result from herd hygiene and health status, production environment, milking parlor, milk conserving practices, and mastitis prevalence (Velázquez *et al*., 2019).

Mastitis is one of the major, expensive, and multifactorial disease with a long history of economic loss due to the loss of milk yield, undesirable changes in the milk’s composition, extra treat-

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ment, and control strategies cost especially for subclinical form, extra labor and premature culling of chronically infected cows in dairy production (Halasa *et al*., 2009; Bardhan, 2013). It can be classified as clinical and subclinical, in contrast to visible changes in the acute form of mastitis, no gross abnormalities in the milk or udder in the case of subclinical mastitis (Abebe *et al*., 2016). Most cases of subclinical mastitis and their prevention depend primarily on good farming management practices including a stress-free environment, proper maintenance and operation of milking equipment, and optimal milking procedures (Dipanjali *et al*., 2009). Subclinical mastitis can be inspected indirectly by various, rapid, easy diagnostic methods and yield satisfactory results, consisting of the California mastitis test (CMT), electrical conductivity (EC), and somatic cell count (SCC) (Joshi and Gokhale, 2006; Saber *et al*., 2017).

Hazard Analysis and Critical Control Point System (HACCP) has been specified as a rational and effective method of assuring food safety from principal production to final consumption (Jan *et al*., 2016). Several papers have studied the potential application of HACCP methods to livestock production to ensure the safety and quality of the produced milk (Omer and Abdelgadir, 2014). They investigated the most important critical points associated at the farm level related to animals, environmental health, and management practices on dairy farms (Lievaart *et al*., 2005). The effect of application of such protocols on the production and controlling of diseases related to management practices such as subclinical mastitis found to have noticeable effects on milk quality and the rate of incidence of diseases such as mastitis (Rathod *et al*., 2017). They pointed out the appropriate control limits and gave the recommendation for more implementation of such protocols (Beekhuis-Gibbon *et al*., 2011). Therefore, the major objectives of this study were to investigate if the application of management practices based on the HACCP system in dairy farms may yield a better result than conventional methods. Furthermore, determining the critical points associated with animals, farm environment, and management practices especially milking practices can affect the quality of the bulk milk tank (BMT). and suggest the control limits appropriate protocol for the different critical points based on the recommended international standards.

MATERIALS AND METHODS

Farm description

The study was conducted on two dairy farms located in Dakahlia Governorate, (latitude and longitude coordinates: 31.037933, 31.381523), Egypt. Both dairy farms were intentionally selected based on the management system and willingness of owners to participate in the study which involved 360 and 210 lactating dairy cows (Holstein and crossbreed origin) in the 1st farm (farm I) and 2nd farm (farm II), respectively, the cows were in different ages and parities and were kept on a free-stall barn with a drive-through feed alley. The barn was naturally ventilated and bedded with sand which was renewed every two weeks. All cows received mixed ration and supplemental concentrate. The mixed ration was formulated according to the NRC (2001) nutrient requirement recommendations for high-producing dairy cows.

Produced milk is conserved in cooling bulk tanks on both farms till examined, approved, and received by the quality control department of different dairy factories.

Both farms have herringbone milking parlors with different systems and milking routines. Farm I is based on HACCP quality risk management by the adoption of computerized (conductivity) milking system alert and semi-automated teat scrubber for pre-milking preparation, while farm II depended on a conventional milk jar system using iodine as a pre-dipping followed by drying for pre-milking preparation (this represents the most common system in farms).

On-Farm data collection

The two farms were visited monthly during the period of the spring-summer season in 2021 for a total of five visits per farm. During each visit, BMT was considered for quality assessment (organoleptic and chemical composition evaluation). Total bacterial count (TBC) and SCC were estimated in raw milk in relation to the adopted management practices, and milking practices and used to assess the associated risk factors in the examined dairy farms, the questionnaire was collected to evaluate both dairy farms' hygienic practices during an interview with the responsible persons.

The hygienic score of animals (udder and leg hygiene score assessment)

The hygienic status of lactating cows in the two selected farms was evaluated and scored at each visit. Based on visual hygiene scores, udder (U) and leg (L) hygiene scores were assessed during milking according to criteria described by Reneau *et al*. (2003). The selection of these two points is based on the significant association between udder and leg hygiene scores and subclinical mastitis (Schreiner and Ruegg, 2003). For U scoring, an inspection of both fore, and rear udders, their floor, and teats. However, the area from point of the hock to the floor including the hoof (lower rear legs) was inspected for L scoring. Udder and lower legs of study animals were compared with the model animals depicted in photos on the scoring sheet and given a score based on the following categories: Cows were scored on a 5-point cleanliness scale (1=very clean to 5=very dirty). Scores were recorded and determined by one individual throughout the entire study.

Determination of subclinical mastitis with EC and CMT

Each cow entering the milking parlor was subjected to clinical examination by visual inspection, and palpation of the udder, besides that physical examination of the milk secreted from each mammary gland was expressed onto a black plate for detection of gross abnormalities. Furthermore, in farm I, a total of 108 cows was firstly investigated during the milking process at each point for the determination of the prevalence of subclinical mastitis through an automatically computerized digital built-in conductivity meter in parlor milk lines at each point (Fullwood Packo Ltd, United Kingdom) as recommended by kitchen (1981), then in case of EC positive alarm, the CMT screening was applied as described below. While at farm II, 24 cows (96 quarters) in total were screened by CMT according to the guidelines described by Schalm *et al*. (1971) using the Kerba test (Albert Kerbl GmbH Felizenzell 984428 Duchbach, Germany).

Cows were considered positive for subclinical mastitis (SCM) if they had readings of 1, 2 and 3, whereas negative and trace were taken as negative. A cow was considered mastitis positive if at least one of the quarters was CMT positive.

Assessment of BMT quality

Collection of samples

Approximately three samples of 100 mL milk were aseptically collected from each farm, per each visit from the top of cooling tanks after agitation into labeled and sterilized screw-capped plastic cups, then the 1st sample was transported in an ice box on the same day to the laboratory of animal reproduction research institute, Giza for SCC, and the other two samples were transported to the laboratory of food hygiene and control (milk hygiene), Faculty of Veterinary Medicine, Mansoura University to carry out chemical and bacteriological evaluation.

Organoleptic analysis of BMT

Organoleptic analysis was carried out by sensory testing according to Draaiyer *et al*. (2009), and by using the normal senses of smell, sight, and taste to determine the gross milk quality through evaluation of varied organoleptic parameters like flavor, body/texture, color/appearance, taste, and overall acceptability of the milk samples.

Determination of SCC

Somatic cells in BMT samples were counted using Lactoscan SCC compact® (Milkotronic Ltd., Bulgaria) as recommended by the manufacturer's instruction. Briefly, after warming of milk sample to 40°C and thereafter cooling down to 20-25°C, milk was stirred thoroughly with a mini vortex mixer (Four E's Scientific company, China). Then 100 µL of the stirred sample was added into a micro-tube containing Sofia green liquid dye. The tube then was closed and stirred several times, then, 8 µL of milk solution was pipetted into the LACTOCHIP at an angle of approximately 80° to the filling opening in a semicircular shape, and the chip was placed in the lactochip chamber, and reading was taken.

Chemical characteristic evaluation

The milk components of fat, protein, solid not fat (SNF), and milk pH were evaluated using the automatic milk analyzer Lactoscan MCCW (Milkotronic Ltd, Bulgaria) according to the manufacturer's instruction. In addition, the titratable acidity was determined according to Draaiyer *et al.* (2009).

Microbiological analysis

The microbiological quality of BMT was assessed through the determination of TBC per mL of milk according to International Organization for Standardization ISO 4833-2 (ISO, 2013).

Statistical analysis

Descriptive data of two farms, management practices, and the prevalence of subclinical mastitis by CMT and EC were statically analyzed using Microsoft software 2016, while the data for udder and leg hygiene score, and BMT quality assessment and the difference between the two farms were done using SPSS 15 by T-test (Independent Samples).

RESULTS

Farm I showed better evaluation based on the HACCP principles approach for the adoption of farming management practices to control most risk factors and critical points associated with milk production than farm II by 66.19% (47 points from 71) while both farms were the same in the rest of variables by 33.80% (24 points from 71), as shown in Table 1.

Hygiene scores for cows (one and two) in farm I, were high 24±4.47 and 32.00±7.71 (21.13% and 28.15% respectively) compared to farm II 9.20±3.11 and 31.80±6.18 (8.59% and 29.49%). On contrary, the scores (three and four) were lower in farm I, 55.00±6.71 and 2.40±1.67 (48.64% and 2.08%, respectively) than in farm II, 62.40±2.70 and 3.80±1.64 (58.36%, and 3.56%, respectively) and both farms were free of cows with score five with no significant variation for all as illustrated in Table 2.

Based on clinical examination, it has been found that both farms showed no evidence of mastitis. Regarding subclinical mastitis determination, the EC in the farm I revealed an alarm for 2 animals (1.85%) and by applying the CMT screening test negative results (0-200.000 total cell count) were obtained. While in farm II, the EC was not performed, and the detection of subclinical mastitis depended only on CMT. The results reported positive quarters by 6.25% ranging from scale 1 (weak positive which represents 500.000–1.500.000 SCC) to strong positive (over 5000000) as shown in Table 3.

The sensory and visual inspection of BMT for both farms were the same. The milk showed no evidence of abnormal odor, color (reddish color) or flavor (salty flavor), no excessive foaming, no floating debris or impurities, and no large clots

Table 4 illustrated the evaluation of BMT chemical properties (fat, protein, SNF, titratable acidity, and pH). The obtained results demonstrated a significant variation ($p<0.05$) of BMT fat, protein, and SNF parameters between the two farms. Percentage of BMT fat, protein, and SNF parameters were 3.61±0.21, 3.22±0.06, and 8.92±0.06, respectively for farm, I while, for farm II was 4.18±0.40, 2.98±0.26, 8.22±0.48, respectively. These results complied with Egyptian Standards (2005) for fat and SNF in both farms (not less than 3%, 8.25%). Also, the protein amount in BMT of farm I follow the Egyptian Standards (not less than 3.2%), meanwhile, the results for farm II were below the normal range.

Analyses of titratable acidity were 0.16±0.019 and 0.15±0.02 in farm I, and farm II, respectively. These results met the normal standard as mentioned by (Schmidt *et al*., 1996) which ranged from (0.14 to 0.17%). While pH value of BMT was 6.45±0.26 and 6.57±0.24 in the farm I and farm II, respectively. slightly below the normal range (6.6 to 6.8) in both farms. There was no significant variation in the mean value of two parameters (titratable acidity and pH) between the BMT of the two farms ($p=0.928$, 0.502) (Table 4).

Total bacterial count in the BMT of the two farms were ($3.60\times10^4\pm3.44\times10^4$ and $1.06\times10^5\pm3.27\times10^4$) in farm I and farm II, respectively., both farms were within the normal range. It was very lower in farm I than farm II with no significant variation at $p= 0.656$ (Table 4).

Somatic cell count of the BMT was 53.33±33.81and 152.93±67.92 in farm I and farm II, respectively. There was a significant variation ($p=0.016$) in farm I than in farm II (Table 4).

DISCUSSION

The evaluation of the applicability of quality control programs like good farming practice and HACCP on dairy farms revealed that the HACCP-based approach would yield the best results in the context of animal health, animal welfare, and food safety (Lievaart et.al, 2005).

As described in Table 1, it was possible to realize that farm I was more likely to adopt more milking management practices based on HACCP approaches than farm II adapted conventional methods

The optimal cow cleanliness is a major indicator of welfare (Ellis *et al*., 2007), considered one of the critical points influencing microbial contamination of milk (Bava *et al*., 2011), subclinical intramammary infection rate and SCC (Schreiner and Ruegg, 2003). Indirect screening tests such as CMT and EC could be used as reli

Table 1. Descriptive difference in of farm management practices applied by the two examined farms

CCP	Control measure/corrective action	V	Application of control measure/corrective action			The best application
			Evaluation variable	Farm I	Farm II	
	Follow up to date records promptly.	v1	Follow up to date records promptly	yes		Both farm
	Check animal and replace any lost tags.	v2	system of records	Automatic, computerized using different dairy programs Manually in paper records	Manually in paper records.	Farm I
		v3	cow identification	Automatic system using electronic ear tag.	Plastic ear tags.	Farm I
		v4	No of milking animals	360	210	Farm I
		v5	Breed Records Register / breed	Dairy comb program / Holstein and crossbreeds.	Paper records / Holstein and crossbreeds.	Farm I
Animal traceability		v6	Cattle History - Pedigree - Production traits records	yes		Both farm
		v7	Mean age of milking cows/year	4 - >6	6 ≤	Farm I
		v8	Milk yield of farm / kg /day	11000 Kg	5800 Kg	Farm I
		v9	Parity	3- 3.5	4	Farm I
		v10	working Team	Veterinarian, 2 agronomists, technical director, administrative manager, dairy, breeding, animal feeding workers).	Full time agronomist, 2 educated supervisor, dairy, breeding, animal feeding workers	Farm I
		v11	Well educated, experienced and trained workers	Yes	No	Farm I
		v12	Rate culling	≤ 5%	≥7%	Farm I
		v13	Culling causes	Financial issues.	Health problems and financial issues	Farm I
	Supplying balanced ration.	v14	Nutrition system	Totally Mixed Rations		Both farm
	Number and methods of feed preparation and serving	v15	Preparation and serving rate /day	4-5 times/day	3 times	Farm I
	Use feed according to manufacturers' instructions.	v16	serving methods	Served by mixer wagon free of rust, metal particles, strange bodies, bad smell, mold etc.)		Both farm
	Store properly.	v17	Ration replacement rate/day	Twice	Once	Farm I
Water and feeding systems		v18	feeding troughs made of	Concrete	Ceramics	Farm I
	For water and feed troughs: Ensure that they are clean, no waste, rust, metal particles, strange bodies, bad smell, mold, material they made from … etc.).	v19	Optimal feeding troughs	yes	No (Sharp angles, with multiple thin cracks)	Farm I
		v20	Regular cleaning of feeding troughs	Yes	No	Farm I
		v21	water troughs made of	steel	Concrete covered by ceramics.	Farm I
		v22	Number and size of water troughs	Multiple, small size.	Low numbers, large size.	Farm I
		v23	source water supply	Fresh clean tap water		Both farm
	Avoid over stocking	v24	Type of animal yard	Open yard		Both farm
	Optimal floor yard and bedding material. Cleaning/disinfection	v25	area assigned to each cow (m^2)/ cow	More than 30 m^2 (32 m^2)	25- 30 m^2 (25 m^2)	Farm I
	Proper housing and ventilation	v26	Shadow area assigned to each cow (m^2)/cow	8 m^2	6 m^2	Farm I
Animals housing-clean livestock - pathway to milking parlor -waiting area	Avoid animal waste build up.	v27	Ventilation	Optimal (air fans – sprinkle shower system).	Good (air fans system).	Farm I
	Vermin-insect control.	v28	Floor yard	For animal husbandry: concrete / for bedding: concrete floors with sand bedding		Both farm
	Organization of animal easy movement.	v29	Waste management rate	Optimal (3 times/day and increase in demand by scrubbing using tractor in central way).	manually according to responsible worker's vision.	Farm I
	Appropriate waiting conditions with no excessive time	v30	Vermin - insect control	yes		Both farm
		v31	Pathway between the milking parlor and animal yard	Straight – cleaned with long distance.		Both farm
		v32	Waiting area	Optimal, supported by water spraying cleaning system for animals and drying by storm fans.	No additional supporting system.	Farm I
		v33	Animals Overstocking in milking parlor	Excellent (crowded, organized, easy movement in short time).	Good (not crowded, need manual interfering, taking long time).	Farm I

Table 1. Continue

Milking hygiene	Milking machines hygiene, liner quality, segregation/ cluster disinfection and water stripping.	v34	Milking parlor shape.	Herring bone		Both farm
	Washing, drying, fore milking, pre-dipping.	v35	Milking parlor Floor	Concrete supported by clean rubber mats.	Concrete.	Farm I
	Post milking teat disinfection.	v36	No of milking point/parlor	18	16	Farm I
		v37	No of cows/each point/day	60	38	Farm I
		v38	Type of milking techniques	Computerized with (automatic identification, electrical conductivity, take off, back flush system).	Manual conventional system	Farm I
		v39	Milking at fixed time	yes		Both farm
		v40	Frequency of milking for each cow/day	3 time/day		Both farm
		v41	No of workers/parlor	2 + 1 (supervisor)	4 + 1 (supervisor)	Farm I
		v42	Hand washing	yes		Both farm
		v43	Wearing clean clothes, gloves, boots	yes		Both farm
		v44	Milking operation consumed time/min	From 9-10	From 13-14	Farm I
		v45	Pre milking preparation time/sec/cow	30 + 40 delay	90	Farm I
		v46	Discard first milk flow	yes		Both farm
		v47	Examination for detection of mastitis/ subclinical mastitis	Yes (per session).	Yes (once per week).	Farm I
		v48	Methods of examination	Clinical investigation and electrical conductivity.	Clinical investigation and CMT.	Farm I
		v49	Pre milking preparation of udder and teats	yes		Both farm
		v50	The method of pre milking preparation of udder and teats	Teat scrubber (cholorine dioxide) all in one.	Manual washing - drying with tissue - iodine dipping.	Farm I
		v51	Attached Time consumed per milking operation / min	3 min and 10 sec (computerized).	5 min	Farm I
		v52	Post milking treatment of udder and teats	yes		Both farm
		v53	The method of post milking treatment of udder and teats	Iodine dipping or chlorexidin using teat cup.	Iodine dipping (manual prepared) using teat cup.	Farm I
Milking hygiene		v54	Back flushing / point	Yes	No	Farm I
		v55	The disinfection products used	Disinfection through back flush installation by Circo flush PE 15 n (GEA).	Not available.	Farm I
		v56	Streamed floor with clean water after milking	yes		Both farm
		v57	Milking time of sick cows	At the end milking, separate the drown out milk away from the collecting tank.		Both farm
		v58	Following the manufacturer's guidelines strictly for milking machines	Yes		Both farm
Receiving and storing of milk	Keep milk preserved in low temperature.	v59	Rapid cooling system	Yes	No	Farm I
	Keep tank temperature as low as possible.	v60	The temperature at which milk is being cooled before arrived to cooling tanks.	Milk cooled suddenly to 3-4 ºC.	Not available.	Farm I
	Periodical analysis of milk for quality assessment, bacteriological and chemical composition … etc.	v61	Cooling tanks No	2	1	Farm I
		v62	Storing temperature of cooling tank	3.5 ºC/tank (during milking operation). 2.1 ºC/tank (full loaded).	13 ºc (during milking operation).	Farm I
		v63	Technique of CIP (cleaning in place) system	cold water - warm water (85ºC) + alkaline detergent - warm water (85ºC) + acidic detergent “)- cold water for rinsing - cold water + sanitizer “ (GEA)	cold water- warm water (90ºC) + alkaline detergent (NaOH industrial brand) - warm water (90ºC) + acidic detergent (Nitric acid 0.5% industrial brand)-rinsing without sanitizer	Farm I

Table 1. Continue

v64	detergents type	Liquid.	Powder (nitric acid and NaOH) 0.5%.	Farm I
v65	Rate of parlor cleaning by alkaline detergents	One time/each milking session.		Both farm
v66	Rate of cleaning parlor by acidic detergent	Three times/week.		Both farm
v67	Source of cleaning water	Clean fresh tap water		Both farm
v68	Technique of cleaning and sanitation	Washing by cold water then warm water with detergent then rinse with cold water then cold water with sanitizer (Automatic dosing).	Washing by cold water then warm water with detergent then rinse with cold water (Manually).	Farm I
v69	Frequency of tank cleaning	Automatic after each evacuation		Both farm
v70	Type of disinfectants used in farm	"GEA" several disinfectants for (pre and post) dipping, alkaline+ Acidic detergent for cleaning (milking installations, parlors and backflush system)	NaoH as Alkaline detergent for cleaning. Nitric acid as acidic detergent for cleaning. Iodine for (pre and post) dipping	Farm I
v71	Additional preparation in Farm	quality assessment portable tools	Not available.	Farm I

CCP: critical control point; V: variable; CMT: California mastitis test

Table 2. Udder and leg hygiene score of both examined farms

Visit number	Total No. of examined animals/visit		Score number and description*									
			1		2		3		4		5	
	Farm I	Farm II	Completely free of dirt (%)		Very little dirt (%)		Slightly dirty (%)		Mostly covered by dirt (%)		Completely dirty with caked – on dirt (%)	
			Farm I	Farm II	Farm I	Farm II	Farm I	Farm II	Farm I	Farm II	Farm I	Farm II
1	108	96	22 (20.37)	7 (7.29)	34 (31.48)	24 (25.00)	50 (46.30)	62 (64.58)	2 (1.85)	3 (3.13)	0 (0)	0 (0)
2	126	104	25 (19.84)	12 (11.54)	32 (25.40)	28 (26.92)	64 (50.79)	58(55.77)	5 (3.97)	6 (5.77)	0 (0)	0 (0)
3	99	112	23 (23.23)	13 (11.61)	19 (19.19)	32 (28.57)	56 (56.57)	65 (58.04)	1 (1.01)	2 (1.79)	0 (0)	0 (0)
4	126	112	31 (24.60)	8 (7.14)	36 (28.57)	35 (31.25)	58 (46.03)	64 (57.14)	1(0.79)	5 (4.46)	0 (0)	0 (0)
5	108	112	19 (17.59)	6 (5.36)	39 (36.11)	40 (35.71)	47 (43.52)	63 (56.25)	3 (2.78)	3 (2.68)	0 (0)	0 (0)
Mean value (%)			21.13	8.59	28.15	29.49	48.64	58.36	2.08	3.56	0	0
Mean±SD			24±4.47	9.20±3.11	32.00±7.71	31.80±6.18	55.00±6.71	62.40±2.70	2.40±1.67	3.80±1.64	0.00±0.00	0.00±0.00
P value			0.673		0.842		0.085		0.871		**	

*According to Reneau *et al*. (2003), ** t cannot be computed because the standard deviations of both groups are 0

Table 3. Detection of subclinical mastitis by electrical conductivity and/or California mastitis test

	Number of examined animals (quarter)	No. of positive samples examined by electrical conductivity/ animal	(California mastitis test/quarter) Score*					Total positive (%)
			None	Trace	1	2	3	
Farm I	108 (432)	2	8					0 (0%)
Farm II	24 (96)	-	5	13	3	2	1	6 (6.25%)

*According to Schalm *et al*. (1971)

able tests to monitor udder health and hygienic status in general as stated by Saber *et al.* (2017).

In farm II, 6.25% of examined dairy cattle turned out positive in the CMT testing process range from scale 1 (weak positive) to strong positive as shown in Table 4, and compared with the cleanliness and hygienic score of the farm, it was found that mean value percentage for the hygienic condition of udder and legs was low (8.59%), in contrast in farm I, cow screened by CMT turned out negative with high hygienic score condition for udder and legs (21.13%), The result obtained in this study was similar to Reneau et. Al. (2003) and Lamsal (2018) indicating dirty cows had a higher prevalence of subclinical mastitis and clean cows have less.

It was found that the common predisposing factors of milk contamination are related to cows, milking environment, milking equipment, milking personnel, water, and transportation (Mbabazi 2005). The major key sources of milk contamination are soiled animals (especially teats and udder) by feces, bacterial infection due to poor milking practices, poor personnel hygiene, bedding materials, insects, inadequate cleaning and disinfection for milking equipment (including bulk milk tanks), inadequate teats disinfection pre milking and post milking, failure to detect any abnormality in milk as blood; clots; foreign bodies, failure to detect subclinical mastitis, poor storage conditions (Bekuma and Galmessa, 2018). Soiled animals with feces, contaminated floors, wet bedding, poor ventilation, high stocking density, and hot and humid climate can promote growth have a deceive effect on udder health and increase exposure to mastitis pathogens resulting in higher occurrence of mastitis (Cheng and Han, 2020).

The availability of more than 20% of cows with udder hygiene scores 3 and 4 was an indicator of increased risk of mastitis in the herd and obtaining low-quality milk. Somatic cell count in milk

Table 4. Chemical (fat, protein, SNF, pH and titratable acidity) and microbiological (TBC and SCC) properties of bulk milk tank of both examined farms (mean ±SD)

	Farm	No. of sample	Mean±SD	P value
Fat (%)	Farm I	15	3.61±0.21	0.034
	Farm II	15	4.18±0.39	
Protein (%)	Farm I	15	3.22±0.06	0.001
	Farm II	15	2.98±0.26	
SNF (%)	Farm I	15	8.92±0.06	0
	Farm II	15	8.23±0.48	
pH	Farm I	15	6.45±0.26	0.502
	Farm II	15	6.57±0.24	
Titratable acidity	Farm I	15	0.16±0.02	0.928
	Farm II	15	0.15±0.02	
TBC (CFU/ml)	Farm I	15	$3.60\times10^4\pm3.44\times10^4$	0.656
	Farm II	15	$1.06\times10^5\pm3.27\times10^4$	
SCC ($\times10^3$)	Farm I	15	53.33±33.81	0.016
	Farm II	15	152.93±67.92	

SNF: Solid nonfat; TBC: Total bacterial count; CFU: Colony forming unit; SCC: Somatic cell count

depended largely on the maintenance of bedding and the farm hygiene rather than the farm capacity and the rearing technology (Mitev *et al*., 2013)

In this study, significant differences in the mean value of milk composition were found between the two farms. Most of the analyzed milk samples met the required Egyptian standards for chemical composition: fat, and SNF percentage in both farms while protein percentage was found to be below Egyptian standards in farm II and contrast farm I, although the use of similar breeds of cattle and similar feed management strategies. These findings are not similar to those reported by Migose *et al.* (2018) and Nyokabi *et al.* (2021) who suggested that farming practices could affect composition besides breeds and feed management strategies.

Titratable acidity is defined as a measure of freshness and bacterial activity in milk. When the milk is left for a while, the bacteria will proliferate by utilizing lactose to convert it to lactic acid, thereby increasing the acidity and decreasing the pH value. This acidity is said to be developed or real titratable acidity (O'Connor, 1994; Vishweshwar *et al*., 2005). In this study titratable acidity was within the normal standard for both farms while pH was slightly lower than normal ranges (6.6–6.8) in both farms, there was no significant difference between the two farms as shown in Table 4. Milk composition is influenced by factors that are specific to a cow and its environment. These factors are breed, age, health status, stage of lactation, diet; intensity of management; milking interval; and ambient environmental temperature and seasonality, which influences feed availability (Chen *et al*., 2014; Schwendel *et al*., 2015; Swathi and Kauser, 2015).

In the current study, it was found that the mean value of SCC was significantly lower in farm I ($53.33\pm33.81\times10^3$) than farm II ($152.93\pm67.92\times10^3$). The results obtained agree with other reports (Elmoslemany *et al*., 2009; Daneluz *et al*., 2020; Mihajlović *et al*., 2022), which refer to these managements as essential to milk microbial count. As the number of management practices with the implementation of corrective and preventive measures increases, the reduction of SCC and TBC and therefore significant improvement of milk quality will be achieved.

CONCLUSION

Improving milk quality at all stages of the food chain is a very important point in food safety. The start point of milk quality improvement is the dairy farm level, therefore, following and implementation of appropriate milking management practices from producer to the consumer pathing through distributer are necessary. Furthermore, maintaining the hygiene level and sanitary quality of raw bovine milk will support maintaining TBC and SCC at a low level. Additionally, the raw milk must be continuously monitored to maintain the required milk quality standard and ensure good animal health, profitability, and food safety.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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