The relationship between cattle body care and milk keeping quality

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Abstract: This study was planned to investigate the effect of different manage mental practices on dairy milk quality by examining 160 apparently healthy American Holstein cows. The animals were divided into three groups according to their age and productivity as follow: the animals in the first group (80 cows) were used to examine the effect of the udder and teats cleaning whether accompanied with fore-stripping or not on milk yield and quality. The animals in the second group (60 cows) were used to study the effect of grooming time in relation to cow parity on milk yield and quality. While, the animals in the third group (20 cows) were used to explore the milking frequency on milk yield and quality. Milk has an outstanding nutritional quality, but it is also an excellent medium for bacterial growth and an important source of bacterial infection when consumed without pasteurization. Microbial contamination might generally occur from within the udder, exterior to the udder and from the surface of milk handling and storage equipment. Many bacteria could get an easy access to milk and TBC and SCC are often used as indicator organisms to confirm the bacterial contamination of milk. The higher total bacterial counts and SCC were recorded in poor cow body care. From the obtained results it could be concluded that cattle grooming should be done daily before milking to reduce the total bacterial loads of milk and improve the keeping quality of the product.
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1. Introduction

Cattle are considered the main source of protein of animal origin. The management systems employed for these animals influence their performance, productivity and welfare. Therefore, the selection of the suitable rearing system may play the most important role in reducing stress and achieving their welfare, which in turn increase meat and milk production **(Sainsbury and Sainsbury, 1979).** The quality of raw milk remains an important component in assessing the performance of dairy animals. Generally, the raw milk quality can be detected by the chemical components of milk, such as fat and protein contents that are a result of feeding practices **(Demeyer and Doreau, 1999),** breed, and lactation stage **(Kelsey et al., 2003).** The compromised milk quality and hygiene could affect the population through the spread of milk borne zoonotic diseases such as Tuberculosis, Q-Fever and Brucellosis **(Sharif et al., 2009).**

California Mastitis Test (CMT) is a common test for detection of mastitis in dairy cattle, which is also helpful in identifying the sub-clinical mastitis. CMT is based upon reaction of a reagent with the amount of cellular nuclear protein present in the milk sample **(Badiuzzaman et al., 2015).** The enumeration of Somatic Cell Count is a standard test for diagnosing SCM and also predicts the health and bacteriological status of the mammary gland. The Somatic cells include leucocytes (75%) i.e. neutrophils, macrophages, lymphocytes, erythrocytes and epithelial cells (25%). Leucocytes increase in response to bacterial infection, tissue injury and stress **(Sharma et al., 2011)**.

Increased somatic cell countis an indicator for the development of clinical mastitis in the nearest future **(Vanden-Borne et al., 2011)**. The increased bacterial concentration is more common in un-hygienically milking practices such as compromised udder and hind quarters cleaning, cow nutrition, pre- and post-milking teat disinfection, and clean milk parlor **(Santman-Berends et al., 2016).**

Body care likes skin hygiene, eliminative behavior and other physical and chemical variable actions are important parts of self-maintaining behavioral complex in these farm animals **(Sainsbury, 1986).** The body grooming has an adaptive value in the removal of noxious contaminants as feces, urine, mud and some external parasites **(Hafez and Bouissou, 1975).** The time spent in licking and the

amount of milk produced from cattle were significantly related **(Wood, 1977).**

Regular removal of manure or litter from cattle bodies by grooming does not only help to keep the skin clean but also leads to produce clean milk **(Banerjee, 1982).** To ensure good quality of milk hygienic principles for milk production, milk handling, improvement of management practices (Biosecurity, employee management, housing, bedding, feed delivery, manure removal, stocking density, animal restraint, heat abatement, and fresh cow management), extension programs to the owners and establishing of standers and grades of raw milk should be initiated as it a predictor of animal health, milk production and overall owner satisfaction **(Caraviello et al., 2006).**

Under favorable environmental conditions, the dairy policy in developing countries faced some limitations related to the milk quality: (i) fresh milk quality assessment; (ii) quality of the pooled milk; (iii) the effects of individual cattle management practices on milk quality parameters **(De-Boer, 1981)**. Milk bacterial contamination comes from different sources, including mastitis, external udder surfaces and from the milking plant **(Aberra, 2010).**

Milk is secreted into the alveoli of udder in a sterile fluid. The microbial contamination may be occurred from three main sources; inside the udder (in case of diseased cows), outside the udder (e.g. feces, bedding, soil and environmental mastitis), from the surface of milk handling (insufficiently cleaned milking equipment) and storage equipment. Beside other sources, the microbes are mainly transferred from the farm environment to milk via dirtsattached to the exterior of teats. These microorganisms can enter the teat canal causing mastitis **(Vissers and Driehuis, 2008).** Somatic cell concentration or density in the milk is an importantindicator for detecting mastitis incidence and milk quality in the dairy industry **(Byeongyeon et al., 2017).**

The variances of cow milk chemical parameters were linked to the genetic type of cows, the lactation stage, and the conversion of net energy of feed concentrates into milk. Lack of hygiene and inadequate milking conditions (hands, udder, and teat washing, type of bucket used, dirtiness of cows) leads to poor milk quality **(Srairi, 2008).** So, the objectives of this study were planned to investigatethe effect of different managemental practices on dairy milk quality by monitoring some milk parameters as total bacterial count and somatic cell count to suggesting the best managemental practices for producing a high milk quality.

2. Materials and Methods

This work was carried out in Al-Kurashyia and Shebshier dairy farm, Production Sector, Agricultural Research Institute at Tanta Governorate on 160apparently healthy American Holstein cows. Their age ranged from 2.5-6 years. The animals were divided into three groups according to their age and productivity as follow; the animals in the first group (80cows) were used to examine the effect of the udder and teats cleaning in relation to fore stripping or not on milk yield and quality. The animals in the second group (60cows) were used to study the effect of grooming time in relation to cow parity on milk yield and quality. While, the animals in the third group (20 cows) were used to explore the milking frequency on milk yield and quality.

Animal management: the animals were housed free in pens bounded by steel tube fences. The animals in each group could see the animals in other pens. Each pen was partially covered with shed for protection from sunshine and rain. The feed was provided through feeding troughs and water was available at all times through rectangular troughs. Cows were milked at 5.00 a.m. and 5.00 p.m. in case of two times/day and at 4.00, and 12 a.m. and 8.00 p.m.in case of three times/day. All cows were individually identified by plastic large yellow ear tags. Milk yield (MY) was recorded for each cow.

Milk sampling: The milk samples were taken according to **(Khalaf-Allah and Abdel-Aal, 1997).** About 10 mL of milk was taken from each cow in a well labeled sterile test tube. Samples were immediately transferred to the laboratory under refrigerated conditions (4±2°C) within 1-3 h of collection and analyzed immediately upon arrivalfor determination of total bacterial count.

Total bacterial count (TBC) was examined according to **Roberts and Greenwood (2003):** Sterile and cotton plugged test tubes (each contained 9mL sterile saline in addition of one mL milk) were prepared. After thorough mixing of milk sample, 1 mL is transferred to the first tube to make a dilution of 1/10 from which 10^{th}fold serial dilutions were prepared up to 10^6. After thorough mixing, one mL from each serial dilution was carefully transferred to a sterile petri-dish, duplicate plates, for each dilution, were plated using a separated pippete. About 10 mL of sterile nutrient agar previously melted and cooled at 45°C was aseptically transferred into sterile petri-dishes, then one mL from previously prepared dilutions were added and thoroughly mixed in a horizontal position. After solidification, they well inoculated and were incubated in an inverted position at 37°C and for 48 hrs. The plates (30-300 colonies) were counted and reported as total colony count/mL.

Somatic Cell Count (SCC): The milk samples were analyzed for SCC using Electronic Fluorescence Based Cell Counting (Fossomatic 5000, A/S N. Foss), according to **Koskinen et al. (2009).**

California Mastitis Test (CMT): the milk from the four teats of each cow was drawn into the four chambers on CMT paddle separately. California Mastitis Test (CMT): 2mL of mastitis test reagent (NICETM) mixed with 2mL of milk sample, collected in each chamber of paddle and then mixed thoroughly by a clockwise, anticlockwise, forward and backward movement and results were read within 30Sec and recorded.

Statistical analysis: The SPSS pocket program for windows was used for the statistical analysis. Values of different parameters were expressed as the Mean±Standard Error (±SE).

3. Results and Discussion

Data in Table.1 revealed that, there was a significant and considerable interaction between the occurrence of fore-stripping (milking whether accompanied with fore-stripping) or not and the method of udder and teat cleaning which had great influences on the milk yield (MY), somatic cell count (SCC), total bacterial count (TBC) and California mastitis test (CMT). The udder and teats wiping, had a significantly higher level of MY and lower levels of SCC, TBC and CMT in cows which fore-stripping was practiced as the first step of milking. However, udder and teat washing with water only had a lower SCC level in cows where fore-stripping was performed after washing. This difference was increased in the case of using water with a disinfectant in comparing with those in cows washed with water only. These findings are in agreement with that recorded by **Dzidic et al. (2004)** who found that the teats cleaning mechanism used in the automatic milking system, either with warm or cold water was suitable to induce milk ejection in cows before the start of milking. Similar distribution of particular methods of udder preparation for milking, which occurred in the investigated herds in spite of random selection, confirms the fact that producers do not have a definite opinion on the optimum method of udder and teat preparation for milking. Likewise, in the present study, similar effects of the individual methods of cleaning the udder and teats were recently shown in Germany **(Fadlelmoula et al., 2008)**, Poland **(Skrzypek, 2002)** and Chile **(Tadich et al., 2003)**.

Moreover, **Rasmussen and Frimmer (1995)** found that the application of disinfectants in the admissible concentration of the cleaning of teats before milking had no direct effect on the microbiological load of milk. **Peeler et al. (2000), Rasmussen (2000) and Barrett (2002)** indicated that although fore-stripping is potentially a very effective method of lowering the SCC in bulk tank milk, at the same time this procedure may increase the frequency of intra-mammary infections due to the close contact of the milker's hand with the teat. **Smith and Hogan (1993)** claimed that the milker's hands have to be both dirty and wet for the infection to spread in this way.

Table (1): The effect of the udder and teats cleaning in a relation to the fore-strippingon milk yield (MY) and its quality of Holstein cows.

	Method of udder and teat cleaning before milking							
	CDTO		**CWTDDT**		**CWDT**		**CWDDT**	
FS	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
MY (Kg)	**17.1± 0.002^{b}**	**15.8± 0.003^{c}**	**18.1± 0.001^{a}**	**15.9± 0.002^{c}**	**17.4± 0.003^{b}**	**15.1± 0.002^{d}**	**18.2± 0.001^{a}**	**15.3± 0.002^{d}**
TBC (x 10^{3}/ml)	**10.60± 0.003^{d}**	**10.88± 0.003^{c}**	**10.90± 0.002^{b}**	**11.33± 0.001^{a}**	**10.73± 0.003^{c}**	**10.96± 0.004^{b}**	**10.35± 0.002^{d}**	**11. 55± 0.003^{a}**
SCC (x 10^{3}/ml)	**140± 0.004^{c}**	**160± 0.002^{a}**	**130± 0.003^{d}**	**145± 0.002^{c}**	**150± 0.001^{b}**	**170± 0.002^{a}**	**135± 0.003^{d}**	**155± 0.002^{b}**
CMT (%)	**0.33± 0.001^{c}**	**0. 40± 0.002^{b}**	**0.15± 0.003^{d}**	**0.35± 0.001^{b}**	**0.20± 0.003^{c}**	**0.54± 0.001^{a}**	**0.01± 0.001^{d}**	**0.44± 0.002^{a}**

*Means which superscript with different small letters (a,b,c…) differ significantly at (P<0.05)

**CDTO: Dry towel; CWDDT: Water with a disinfectant, dry towel; CWDT: Clean water, dry towel; CWTDDT: Wet towel with a disinfectant, dry towel; FS: Fore-stripping is performed before udder and teat cleaning or not.

The results in Table 2, showed that, the interaction between grooming time and parity had a significant MT and a considerable effect on MY, SCC, TBC and CMT. The milk yield was increased in MT and LGT cow, while TBC, SCC and CMT were reduced by LGT. **Ingalls (1998)** mentioned that the decreased level of total bacterial counts with increasing grooming indicates that the grooming has cleaning effect on udder and the region around, and consequently the milk produced will be of better

quality. The manual massage of the udder before milking was associated with a lower SCC according to **Bruckmaier and Blum (1998)**; moreover, this routine should be performed obligatorily before each milking, as it is the most important stimulus causing the release of sufficient amounts of oxytocin from the pituitary gland and the ejection of milk from the glandular tissue to the udder cistern. Those authors also reported that manual udder massage is a much greater stimulus for the oxytocin releasing than practicing the mechanical massage. The omission of manual udder massage leads to severe disturbances in the course of milking, resulting in an increased frequency of mechanical damage of the udder, and in consequence to its infection (**Bruckmaier and Blum, 1998**; **Rasmussen, 2000**). A higher frequency of SCC and CMT was found among individuals with higher parity **(Haftu et al., 2012)**.

Table (2): The effect of interaction between grooming time and parity on milk yield (MY) and itsquality of Holstein cows.

	Grooming					
	LGT		MGT		SGT	
Parity	M	MT	M	MT	M	MT
MY (Kg)	11.1± 0.001^{b}	19.9± 0.002^{a}	10.4± 0.003^{c}	19.1± 0.002^{a}	9.25± 0.001^{c}	18.3± 0.002^{b}
TBC (x 10^3/ml)	10.20± 0.003^{c}	10.38± 0.003^{c}	10.80± 0.002^{b}	11.53± 0.001^{a}	10.73± 0.003b	11.96± 0.004^{a}
SCC (x 10^3/ml)	120± 0.004^{c}	140 ± 0.002^{b}	130± 0.003^{c}	145± 0.002^{a}	135± 0.001b	170± 0.002^{a}
CMT (%)	0.22± 0.001^{c}	0. 30± 0.002^{b}	0.28± 0.003^{c}	0.35± 0.001^{a}	0.33 ± 0.003b	0.44± 0.001^{a}

*Means which superscript with different small letters (a,b,c…) differ significantly at (P<0.05)
**LGT: Long Grooming Time, MGT: Medium Grooming Time, SGT: Short Grooming Time, M: Monoparous, MT: Multiparous, MY: Milk Yield, TBC: Total Bacterial Count, SCC: Somatic Cell Count, CMT: California Mastitis Test.

The frequency of milking had a significant and considerable effect on MY, SCC, TBC and CMT as shown in table 3. As, in case of three times milking/day had a higher MY and TBC with a lower SCC and CMT than those in two times milking/day. A cow producing 80 or 90 Ibs/day when milked two times, its productivity will be approximately increased 8.0 Ibs/daywhen she is milked 3 times/day **(Erdman and Varner, 1995)**. A positive influence of a greater number of milkings/day on milk secretion was found to be associated with the changing from twice to three milkings/day **(Alabiso et al., 2006).** According to several authors, frequent milking can increase milk yields in cows **(Bar-Peled et al., 1995; Wall and McFadden, 2008)**, which is a phenomenon that can be attributed to increased differentiation, proliferation, and activity of mammary cells **(Hale et al., 2003)** as well as increased concentrations of multiple hormones, including prolactin **(Bar-Peled et al., 1995)**, considering as a candidate systemic regulator of the effects of frequent milking on milk yield **(Dahl et al., 2004). Smith et al. (2002)** recorded that an overall decreased in SCC when cows milked three times in comparison with two times daily. In conclusion, cattle grooming plays an important role in reduction of the total somatic cell count and bacterial loads of milk resulting in a high keeping quality product.

Table (3): The effect of milking frequency on milk yield (MY) and its quality of Holstein cows.

	Milking times per day	
	Twice/ Day	Thrice/Day
MY (Kg)	16.10±0.001^{a}	19.80±0.002^{b}
TBC (x10^3/mL)	10.20±0.003^{a}	9.38±0.002^{b}
SCC (x 10^3/mL)	145±0.004^{a}	130±0.002^{b}
CMT (%)	0.33±0.001^{a}	0. 12±0.002^{b}

*Means which superscript with different small letters (a,b,c…) differ significantly at (P<0.05)

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