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The Hygienic Quality of Raw Milk Produced by Some Dairy Farms in Khartoum State, Sudan

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Abstract: This study evaluate the quality of raw milk produced by the big 60 dairy farms at different locations in Khartoum State, 120 milk samples were collected from the selected dairy farms and tested during summer and winter seasons. Laboratory pasteurization counts, coliforms counts, Enterobacteriaceae counts and total bacterial counts of raw milk were estimated. Enumeration, isolation and identification of *S. aureus*, *E. coli* and *Salmonella* spp. were also estimated. Higher total bacterial counts were estimated during the present study for both milk samples collected during summer and winter season (5.3×10^{10} and 7.5×10^{7} cfu mL^{-1}, respectively). Similarly the laboratory pasteurization count of milk samples collected during summer were higher than those collected during winter season (6.0×10^{3}-3.1×10^{9} and zero to 5.3×10^{7} cfu mL^{-1}, respectively). Highly significant variations ($p<0.001$) were reported for the milk samples collected from dairy farms in different season and cities of Khartoum State for all microbiological quality tests that carried out.

Key words: Quality, raw milk, dairy farms, Khartoum State, Sudan

INTRODUCTION

The use of milk products as human food has got a very long history (Teuvo, 2000). Milk in addition to be a nutritious media, presents a favourable physical environment for multiplication of microorganism (Mohamed and El Zubeir, 2007), Yagoub *et al.* (2005) stated that milk is good medium for bacteria including pathogenic organisms and if it is produced and processed under unhygienic conditions; frequently outbreaks of diseases may result. Thus milk can transmit diseases of microbial origin to the people from sick animals and/or people carrying certain diseases and contaminating the milk with pathogenic bacteria during its handling (Teuvo, 2000).

The health and hygiene of the cow, the environment in which the cow housed and milked and hygiene during milking and storage equipment, all influence microbial numbers in raw milk (Murphy and Boor, 2000).

Abdalla and El Zubeir (2007) reported that introduction of hygienic principles for milk production and handling, improvement of the management practices, extension programs to the owners and establishing of standards and grades of raw milk should be initiated to ensure good quality milk Similarly Reed and Grivettit (2000) reported that on-farm programs similar to hazards analysis critical control point, which target pathogen reduction and screening, can provide assurance to processors and consumers that on-farm safety is a high priority.

In Sudan most of important milk producing areas have no rigid systems of inspection on the farms and are not complying with sanitary standards, subsequently most of the products of these farms are sold through venders and groceries. Thus, there is a need for up-to-date sound information based on

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scientific data on the quality, health and safety measures of milk. Hence this study was conducted to evaluate the hygienic quality of raw milk produced by some big dairy cow's farms in Khartoum State.

MATERIALS AND METHODS

Source and Collection of Milk Samples

A total of 120 raw bulk milk samples were collected from 60 dairy farms in Khartoum State, during summer and winter seasons (August 2003-January 2004). Raw bulk milk samples (100 mL each) were collected in the afternoon under aseptic conditions in clean sterile bottles. They were kept in an ice box, then brought to the laboratory for analysis which were carried out immediately.

Examination of Milk Samples

The samples were enumerated for total bacterial counts, Enterobacteriacae counts, laboratory pasteurization counts, *Staphylococcus aureus* and *Staphylococcus* spp. counts, coliforms counts, *Escherichia coli* counts and *Salmonella* spp. Counts using the suitable selective and differential media. Preparation of the media, sterilization, isolation and identification of the isolates was done (Barrow and Feltham, 1993). Seial dilution was done as described by Richardson (1985).

RESULTS AND DISCUSSION

Higher total bacterial counts were estimated during the present study (2.6×10^{10} cfu mL^{-1}) as shown in Table 1 and 2. Also highly significant differences ($p<0.001$) in total bacterial count were observed for the samples collected during summer than those collected during winter season (5.3×10^{10} vs. 7.5×10^{7} cfu mL^{-1}). These results were agreed with those reported by Mohamed and El Zubeir (2007). However both results were very high compared to the acceptable level of raw milk. The high bacterial count of the farms which exceeded the international standard for raw milk, indicated that the hygienic and sanitary control measures and the health supervision applied in those farms were

Table 1: Microbial contents of raw milk of some dairy farms in Khartoum State during summer and winter seasons

	Summer			Winter			Total		
Measurement	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Standard plate count	5.3×10^{10}	3.3×10^{11}	7.7×10^{5}	7.5×10^{7}	1.4×10^{9}	4.0×10^{5}	2.6×10^{10}	3.3×10^{11}	4.0×10^{5}
Laboratory pasteurization count	4.7×10^{8}	3.1×10^{9}	6.0×10^{3}	2.1×10^{6}	5.3×10^{7}	0	2.4×10^{8}	3.1×10^{9}	0
Staphylococcus count	1.7×10^{8}	2.1×10^{9}	0	1.6×10^{5}	3.2×10^{6}	0	8.6×10^{7}	2.1×10^{9}	0
Enterobacteriaceae count	2.4×10^{9}	1.5×10^{10}	0	8.4×10^{5}	9.9×10^{6}	0	1.2×10^{9}	1.5×10^{10}	0
Coliforms counts	2.4×10^{9}	1.5×10^{10}	0	7.8×10^{5}	1.1×10^{7}	0	1.2×10^{9}	1.5×10^{10}	0

Max. = Maximum; Min. = Minimum

Table 2: Microbial content of raw milk of the dairy farms of the three cities of Khartoum State

	Khartoum			Khartoum North			Omdurman		
Measurement	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Standard plate count	7.9×10^{10}	3.3×10^{11}	4.0×10^{5}	1.4×10^{8}	1.4×10^{9}	1.8×10^{6}	3.8×10^{8}	5.2×10^{9}	5.0×10^{5}
Laboratory pasteurization count	6.9×10^{8}	3.1×10^{9}	4.0×10^{4}	2.0×10^{6}	1.2×10^{7}	0	2.3×10^{7}	4.8×10^{8}	0
Staphylococcus count	2.3×10^{8}	2.1×10^{9}	2.0×10^{3}	2.3×10^{7}	1.1×10^{9}	0	3.9×10^{5}	3.2×10^{6}	0
Enterobacteriaceae count	3.6×10^{9}	1.5×10^{10}	0	1.1×10^{6}	9.9×10^{6}	0	5.0×10^{6}	8.3×10^{7}	0
Coliforms counts	3.6×10^{9}	1.5×10^{10}	0	9.2×10^{5}	1.1×10^{7}	0	1.5×10^{7}	4.9×10^{8}	0

Max. = Maximum; Min. = Minimum

not satisfactory. This might be due to either the milk producing animals and/or milkers hygiene are weak or completely lacking (El Zubeir *et al*., 2006). The higher bacterial counts are expected under tropical condition like Sudan due to the fact that high temperature enhances growth and multiplication of bacteria (Mohamed and El Zubeir, 2007). However, all farms under study except Arab Dairy farm were found not to use hot water so insufficient cleaning of equipment might be the cause of this high counts. This was the same as reported by Murphy and Boor (2000) who found that ineffective cleaning, insufficient hot water temperatures and/or the absence of sanitizers tends to select for faster growing of less heat resistant organisms. Poor bacteriological quality was also observed by Godefay and Molla (2000), Adesiyun (1994) and Mohamed and El Zubeir (2007) in Ethobia, Trindad and Sudan, respectively.

The milk samples were found positive for the presence of coliforms bacteria and Enterobacteriaceae, which were an indication of lack of sanitary measures during production and handling of milk. Murphy and Boor (2000) stated that coliforms may enter the milk supply as a consequence of milking soiled cows or of dropping equipment into manure during milking. As the counts of coliforms in raw milk were 1.2×10^{9} cfu mL^{-1} (Table 1). Higher significant differences ($p<0.001$) were found between seasons and cities. These might be due to contamination from outside or around milking area. This supported Godefay and Molla (2000). Similarly the findings supported El Zubeir *et al*. (2006) who reported that Enterobacteriaceae occur in the environment of animals, their skin and udder and they gain access to milk from several of these sources. The seasonal variation was also observed during the present work for the isolation of *Escherichia coli*. Since *Escherichia coli* was isolated during winter season only (Table 1). These bacteria might originate from contamination due to mismanagement practices such as poor milking system, absence of equipment maintanance or poor environmental conditions upon milking (Adam, 1997) or from udder infection (Mohamed *et al*., 1997; El Zubeir *et al*., 2006). Moreover, Adam (1997) reported that the presence of *Escherichia coli* in faeces and that it might be recovered from water, dust in the air and milk or urine.

During the present study a number of potentially pathogenic bacteria (*Staphylococcus aureus*, *Escherichia coli* and *Salmonella* spp.) were isolated from bulk milk (Table 1 and 2). It is well known that poor milk hygiene reflects risk to public health. Since a lot of diseases and conditions might originated from milk sources (Adam, 1997). Also the high incidence of *S. aureus* might be attributed to udder infection as it is the first microorganism's incremented in mastitis. This is in accordance with the findings of Mohamed *et al*. (1993 and 1997) who reported that *S. aureus was* isolated as the predominant cause of mastitis in Khartoum State. Bystron *et al*. (2001) found that 66% of *S. aureus* strains isolated from raw milk have the ability to produce entrotoxins because of the stability of staphylococcus entrotoxins.

The result revealed that the laboratory pasteurization count of milk samples collected during summer were higher than those collected during winter season that range from 6.0×10^{3}-3.1×10^{9} and zero to 5.3×10^{7} cfu mL^{-1}, respectively (Table 1). However, highly significant differences ($p<0.001$) were found between seasons and cities (Table 2). These findings were disagreed with those reported by Sutherland and Murdoch (1994) They reported that as might be due to bedding materials on which cows are housed in winter. High incidences and values of laboratory pasteurization count found during this study might be due to contamination of feed and equipment by soil.

The result obtained during the present work revealed that there was only one case of *Salmonella* spp. during summer season in milk sample collected from Khartoum (Table 2). This might be due to direct or indirect (for example via udders, hide, etc.) faecal contamination. Contamination may also occur during milking and subsequent practices such as poor hygiene (IDF, 1994). Reed and Grivettit (2000) found that resistant salmonella was linked directly to product made from raw milk. The lack of knowledge about clean milk production, use of unclean milking equipment and lack of potable water for cleaning purpose were some of the factors which contributed to the poor hygienic quality of raw cow's milk at farms and at collection centers, in and around Addis Ababa (Godefay and

Molla, 2000). On the other hands Sischo (1996) reported that ultimately, the milk testing programs should become a component of the quality process that is centered on the farm and that measures the success of the industry in producing high quality milk rather than being a regulatory program.

The present study concluded that health hazards that might arise from contaminated milk Hence quality control programs are urgently needed. Training and education is also essential for all persons concerned with milk production and processing.

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