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## Effects of Different Management Practices on Milk Hygiene of Goat Farms in Khartoum State, Sudan

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**Abstract:** This study was carried out to evaluate the procedures and management practices and their effect on milk microbiological quality in 15 cross dairy goat farms that distributed in Khartoum State. The areas of study include Kuku, Alhatana, Aldroshab, Alkadrow, Shambat and Ombada. The information were collected through field visits and questionnaire, moreover seventy five raw bulk milk samples were collected from those farms. One duplicate sample per month from each farm were collected and examined for total bacterial counts, coliform counts, yeast and mould counts, milk acidity and freezing point. The questionnaire showed that the dominant breed for crossing was Saanen breed (100%) with blood percentage which vary from 50-90% and it was observed that the well designed housing was dominant in the studied farms and there was a high level of education for the goat owners, since more than 50% awarded a university degree. The laboratory examination of the milk samples revealed that the total bacterial counts were  $762 \times 10^6 \pm 2.14$ ,  $1423 \times 10^6$  and  $702 \times 10^5$  cfu mL<sup>-1</sup> for mean±standard deviation, maximum and minimum values, respectively. The coliform bacteria counts revealed  $636 \times 10^5 \pm 1.66$ ,  $1204 \times 10^6$  and  $652 \times 10^5$  cfu mL<sup>-1</sup>, respectively. Similarly the average yeast and mould counts were  $51 \times 10^5 \pm 3.63$ ,  $160 \times 10^5$  and  $30 \times 10^4$  cfu mL<sup>-1</sup>. Acidity was found to be 0.231±.0026, 0.279 and 0.185%, while the freezing point were  $-0.484 \pm 0.032$ ,  $-0.443$  and  $0.576^\circ\text{C}$ , respectively. The present result also showed that there were significant ( $p < 0.01$ ) positive correlations between total bacterial counts and each of coliform counts ( $r = 0.470$ ) and acidity ( $r = 0.808$ ). Similarly significant positive ( $p < 0.01$ ) correlation between coliform counts and acidity ( $r = 0.613$ ) and significant ( $p < 0.05$ ) correlation between yeast and mould counts and freezing point ( $r = 0.283$ ) were estimated.

**Key words:** Management, goat hygiene, quality, cross dairy goat farms, Sudan

### Introduction

One of the first animals to be domesticated by man was the goat, through the century the goat has remained a popular animal serving the needs of man and goat is known as poor man cow over all the world (Harbans *et al.*, 1982). Goat is one of milk sources that characterized by the economic important, since goat can utilize feed roughages and crops residues by products undesirable for human consumption and convert them into desirable food (Devendra and Meleroy, 1982). Moreover goats are found in all type of environments from arid to humid zones and they do very well in the drier tropics, beside their ability to withstand dehydration and their browsing habit enable them to survive where cattle and sheep can not (Steele, 1996).

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Goat milk has a medical important especially for children who suffer allergy from the milk of cows (Klinger and Rosenthal, 1997; Jandal, 2001). Also goat plays role in the treatment of metabolic diseases, beside its uses to treat intestinal disturbances, mal absorption and renal stone and cardiac diseases (Jandal, 2001). Moreover, when goat milk lactoperoxidase was purified, it was found to have high antifungal and antibacterial activity (Benoy *et al.*, 2000).

Since milk represent highest importance, for human as source of nutrition, it must therefore be protected from contamination or deterioration from sites of production (farms) to the table of the consumer (Giovannini, 1998). Milk is a favorable physical environment for the multiplication of microorganism, which leads at the end to degradation of the quality of milk and milk products or they create some health hazards (IDF, 1994).

The total number of bacteria from a normal animal may range from few hundreds to few thousands (Murphy and Boor, 2000). Undesirable organism may get into milk either through the body of the animal or some from external sources after the milk has been drawn from the animals, which are ill or carriers of infectious diseases (Murphy and Boor, 2000). Contamination of goat milk usually is in the form of hair, insect part, particles of dust, feed or manure, or bacteria associated with these contaminants plus unclean utensils (Loewenstein and Speck, 1992). However, Droke *et al.* (1993) reported that goat milk escape tuberculosis as they seldom affected. Hence goat milk considered safe as reported by Harbans *et al.* (1982).

The microbiological content of raw milk affects quality, shelf life and safety of the processed milk and other dairy products (Gunasekera *et al.*, 2000). The implementation of hygienic practices at the time of milking is therefore one of the first and most important step in clean milk production (Sinha, 2000). Regular tests and frequent inspections of milking animals coordinated with a definite plan for holding the milk from suspected animal until confirmation tests can be completed are a must (Loewenstein and Speck, 1992). Total bacterial counts which carried out with Standard Plate Count (SPC) gives an indication of total number of aerobic bacteria present in the milk at the time of pick up from the farm (Murphy and Boor, 2000).

Titrate acidity is valuable for measuring the extent of growth of acid producing bacteria in dairy products (Harding, 1999). The acidity of cross Saanen goats averaged  $12.96 \pm 3.64$  °D in Brazil (Chornobai *et al.*, 1999). Abd El Gadir and El Zubeir (2005) found that the acidity and freezing point of milk of crossbred Saanen×Nubian goat under Sudan condition were to range from 0.3 to 0.13% and -0.468 to -0.722°C. Harding (1999) stated that the freezing point of goats is slightly lower than cow's milk. The freezing point of Saanen goat's milk in south eastern of Brazil is found to be -0.575° H (Prata *et al.*, 1998).

The objectives of the present study are aimed to compare the effect of management procedures of the different goat's breeds at dairy goat farms in Khartoum State and evaluation of the hygienic quality of cross goat milk.

## **Materials and Methods**

### *The Farms*

The present study was conducted on farms of cross bred dairy goats that established in Khartoum State, Sudan. This study was done during the period of October 2003-February 2004.

### *Questionnaire and Data Collection*

Field visits and a questionnaire, which was designed for data collection from 15 dairy cross bred goat farms in Khartoum State, were tried. The questionnaire consisted of ten main part that include general information, housing of the farm, herd structure, production performance, level of cross breeding, labours, nutrition, sources of fodder, amount of fodder and water, breeding, kids rearing, milk production, types of records and problems and constrains which faced the farms.

#### *Sources and Numbers of Milk Samples*

A total of 75 raw bulk milk samples were collected from the 15 cross bred dairy goat farms that are located at six areas in Khartoum State. The areas include Kuku, Alhatana, Alkadrow, Ombada, Aldroshab and Shambat. Five bulk tank milk samples were collected from each farm at monthly intervals.

#### *Collection of Milk Samples*

Milk samples were collected in the morning under aseptic conditions in labeled sterilized bottles and kept under refrigerated conditions (kept in ice box at 0-4°C). They were brought to the laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Khartoum for analysis. Each milk sample was examined for total bacterial count, coliform counts, yeast and mould counts, freezing point and acidity.

#### *Microbiological Examinations*

Preparation of the samples, sterilization, serial dilutions, plating and counting were done according to Harrigan and McCance (1976). Plate count agar was used to determine standard plate counts, MacConkey agar medium was used to determine the coliform counts and Yeast extract medium was used to determine yeast and mould counts (Barrow and Feltham, 1993).

#### *Determination of Physicochemical Properties of Goat Milk*

The freezing point was measured by means of a thermistor Cryoscope, FISKE (USA) as described by Harding (1999). The acidity of milk was determined according to Foley *et al.* (1974).

#### *Statistical Analysis*

Social Science Statistical Package (SPSS 9.5) was used for data analysis of the present study. T-test was used for comparison. Also personal correlation's was done between some of the measurements.

## **Results**

#### *Management Procedures and Practices in Dairy Cross Goat Farms*

The present study was done to assess the hygiene and quality of raw milk produce by 15 cross dairy goat farms in Khartoum State. General information and procedures of management practices in those farms were collected through the filed visits and questionnaire.

#### *General Information*

The educational levels of the owner of those farms were found as follows: 13.3% primary, 33.3% secondary, 46.7% university and 6.7% post graduate as shown in Table 1. There was a non significant positive correlation between education level with each of coliform counts ( $r = 0.024$ ), yeast and mould counts ( $r = 0.525$ ) and acidity ( $r = 0.093$ ) as shown in Table 3.

#### *Comparison of Management Practices and Procedures in Cross Dairy Goat Farms*

The filed visits and questionnaire conducted during the present study revealed that a well housing design was among 60% of farms compared to 40% of the random traditional housing (Table 1). The dominant breed of goat in the studied farms was Saanen. It was found either as pure cross of Saanen (33.3%) or mixed with Damascus (60%) and Damascus and Anglo Nubian (6.7%). The labours running the farm showed significant variations ( $p < 0.05$ ) and they were either the owner them selves (53.3%) or rent labours (46.7%) as shown in Table 1. The type of breeding was either natural (66.5%) or artificial breeding (33.5%). Most of the farms obtained their fodder from market (86.6%), while only

13.4% were found to cultivate the fodder in their farms (Table 1). Moreover 79.9% of the farms used nutritional program through out the year and only 20.1% used different regime due to the seasonal variations. Twice a day milking was found as the common practice of milking (73.2%) compared to once a day milking (26.8%) as shown in the Table 2. The same table showed that gradual drying of the milking goat (79.9%) was more than the sudden drying (20.1%) of the milking animal. The absence of records and mastitis infection (66.5%) were higher in the studied dairy goat farms (Table 2).

The result of the effect of housing on milk quality showed that there is a non significant positive correlation between housing system and total bacterial counts ( $r = 0.215$ ). Similarly non significant negative correlations were found for the housing system and each of coliform counts ( $r = -0.278$ ), yeast and mould counts ( $r = -0.181$ ), freezing point ( $r = -0.004$ ) and acidity ( $r = -0.049$ ). Also non significant positive correlations between mastitis infection and each of type of cross breed ( $r = 0.411$ ) freezing point ( $r = 0.169$ ) and yeast and mould counts ( $r = 0.019$ ) were obtained. Non significant negative correlations were obtained when comparing mastitis infection with each of total bacterial counts ( $r = -0.057$ ), coliform counts ( $r = -0.278$ ) and acidity ( $r = -0.326$ ) as shown in Table 3.

**Table 1: General information on cross dairy farms in Khartoum State**

Measurement	Number	Significant level
Education level		
Primary	1 (13.3%)	
Secondary	5 (33.3%)	
University	7 (46.7%)	
Post graduate	1 (6.7%)	
Housing system:		0.613 <sup>ns</sup>
designed	6 (40.0%)	
well designed	9 (60.0%)	
Type of cross breed:		0.144 <sup>ns</sup>
Saanen	5 (33.3%)	
Saanen-damascus	9 (60%)	
Saanen-damascus-Ang	1 (6.7%)	
Labours:		0.294 <sup>ns</sup>
Rent labour	7 (46.7%)	
Owner labour	8 (53.3%)	
Type of breeding:		0.049*
Seasonal breeding	10 (66.5%)	
Organize breeding	5 (33.5%)	
Nutrition:	0.105 <sup>ns</sup>	
Source of fodder		
Market	13 (86.6%)	
Farm product	2 (13.4%)	

\* = Significant at  $p < 0.05$ , ns = Non significant

**Table 2: Management practices in cross dairy farms in Khartoum State**

Measurements	Number	Significant level
Seasonal nutrition		
Different	3 (20.1%)	
No-different	12 (79.9%)	
Milking:		0.93 <sup>ns</sup>
Milking/day		
Once/daily	4 (26.8%)	
Twice/daily	11 (73.2%)	
Method of drying:		
Gradually	12 (79.9%)	
Suddenly	3 (20.1%)	
Farms records:		0.099 <sup>ns</sup>
Present of record	5 (33.5%)	
Absence of record	10 (66.5%)	
Mastitis infection:		0.205 <sup>ns</sup>
Infection	5 (33.5%)	
No-Infection	10 (66.5%)	0.205 <sup>ns</sup>

ns = Non significant

Table 3: Correlation between some milk quality measurement

	Owner education	Types of housing	Types of breed	Mastitis infection	Total bacteria counts	Coliform counts	Yeast and mould	Freezing point	Acidity
Owner education	1.000	0.034	-0.125	-0.410	-0.102	0.024	0.525	-0.129	0.093
Types of housing	0.034	1.000	0.332	0.000	0.215	-0.278	-0.181	-0.004	-0.049
Types of breed	-0.125	0.332	1.000	0.411	-0.247	-0.144	0.294	0.204	-0.385
Mastitis infection	-0.410	0.000	0.411	1.000	-0.057	-0.278	0.019	0.169	-0.326
Total bacteria counts	-0.102	0.215	-0.247	-0.057	1.000	0.470**	-0.259*	-0.677**	0.801**
Coliform counts	0.024	-0.278	-0.144	-0.278	0.470**	1.000	-0.283*	-0.494**	0.613**
Yeast and mould	0.525	-0.181	0.294	0.019	-0.259*	-0.283*	1.000	0.283*	-0.392**
Freezing point	-0.129	-0.004	0.204	0.169	-0.677**	-0.494**	0.283*	1.000	-0.808**
Acidity	0.093	-0.049	-0.385	-0.326	0.801**	0.613**	-0.392**	-0.808**	1.000

\*Correlation is significant at the (p<0.01) level, correlation is significant at the (p<0.05) level

Table 4: Level of the hygienic quality of cross dairy goats milk

Measurement	Maximum	Minimum	Mean	*SD
Bacterial counts (cfu mL <sup>-1</sup> )	1423×10 <sup>6</sup>	702×10 <sup>5</sup>	762×10 <sup>6</sup>	2.14
Coliform count (cfu mL <sup>-1</sup> )	1204×10 <sup>6</sup>	636×10 <sup>5</sup>	652×10 <sup>6</sup>	1.66
Yeas and mould (cfu mL <sup>-1</sup> )	160×10 <sup>5</sup>	30×10 <sup>4</sup>	51×10 <sup>5</sup>	3.63
Freezing point (°C)	-0.443	-0.575	-0.484	0.032
Milk acidity (%)	0.279	0.185	0.231	0.026

\*SD = Standard Deviation

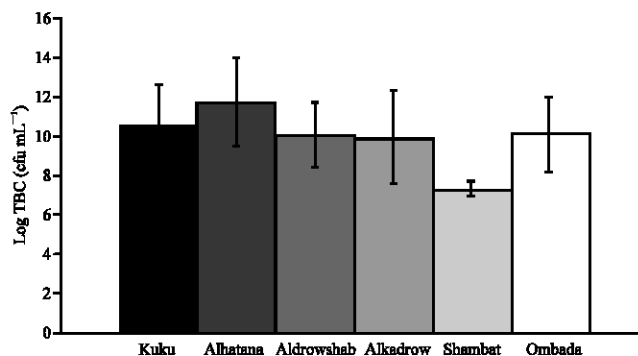


Fig. 1: The average log total bacterial counts of milk of cross dairy goats in the different areas of Khartoum State

### *Microbiological Examination of Cross Bred Dairy Goat Milk*

#### *Total Bacterial Counts*

The average total bacterial count of cross dairy goat milk was  $762 \times 10^6 \pm 2.14$  cfu mL<sup>-1</sup>, the maximum was  $1423 \times 10^6$  cfu mL<sup>-1</sup> and the minimum was  $702 \times 10^5$  cfu mL<sup>-1</sup> (Table 4). There were variations of the average log total bacterial counts of cross dairy goat in the different areas in Khartoum State as shown in Fig. 1.

A significant (p<0.05) correlation was estimated for the total bacterial counts when it was compared with yeast and mould counts (r = -0.259). Moreover highly significant (p<0.01) correlations were estimated for the total bacterial counts with each of coliform counts (r = 0.470), freezing point (r = -0.677) and acidity (r = 0.801) as shown in Table 3.

#### *Coliform Counts*

The average coliform count of cross dairy goat milk was  $652 \times 10^6 \pm 1.66$  cfu mL<sup>-1</sup>, the maximum was  $1204 \times 10^6$  cfu mL<sup>-1</sup> and the minimum was  $636 \times 10^5$  cfu mL<sup>-1</sup> (Table 4). Variations of the average log coliform counts in cross dairy goat farms in the different areas in Khartoum State were shown in Fig. 2.

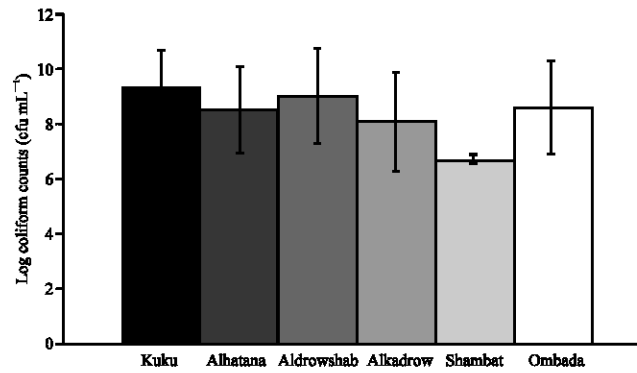


Fig. 2: The average log coliform counts of cross goats milk from different areas of Khartoum State

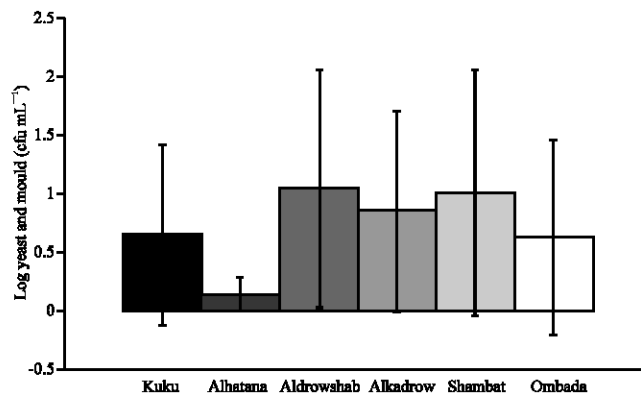


Fig. 3: The average log yeast and mould counts of cross goats milk from different areas of Khartoum State

A non significant positive correlation was estimated for the coliform counts and education level ( $r = 0.024$ ). However highly significant ( $p < 0.01$ ) positive correlation was estimated for the coliform counts when compared with acidity ( $r = 0.613$ ) and negative correlation with freezing point ( $r = -0.494$ ) as shown in Table 3. Also significant ( $p < 0.01$ ) negative correlation was found for coliform counts and yeast and mould counts ( $r = -0.283$ ).

#### Yeast and Mould Counts

The average of yeast and mould count of cross dairy bred goat was  $51 \times 10^5 \pm 3.63$  cfu mL<sup>-1</sup>, the maximum was  $160 \times 10^5$  and the minimum was  $30 \times 10^4$  (Table 4). Higher variations between the farms for average log yeast and mould counts in milk of cross dairy goat farms in the different areas of Khartoum State were recorded (Fig. 3).

There is a positive correlation between yeast and mould counts with education level ( $r = 0.525$ ). Significant ( $p < 0.05$ ) positive correlation was estimated for the yeast and mould counts when compared with freezing point ( $r = 0.283$ ) as shown in Table 3. Moreover highly significant ( $p < 0.01$ ) negative correlation was found when yeast and mould counts were compared to acidity of the cross goat milk ( $r = -0.392$ ).

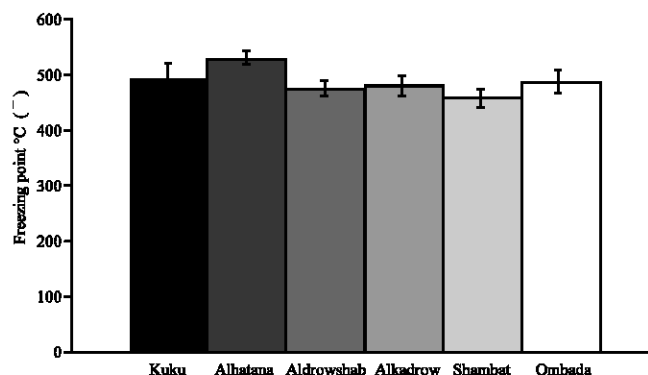


Fig. 4: The average freezing point of cross goats milk from different areas of Khartoum State

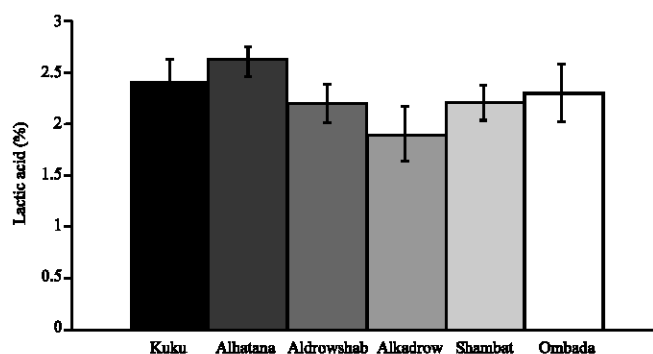


Fig. 5: The average lactic acid% of cross goats milk from different areas of Khartoum State

### *Physio-chemical Properties of Milk*

#### *Freezing Point*

The average of freezing point of milk of cross dairy goat was found to be  $-0.484 \pm 0.032^{\circ}\text{C}$ , the maximum freezing point was  $-0.443^{\circ}\text{C}$  and the minimum freezing point was  $-0.575^{\circ}\text{C}$  (Table 4). The average freezing point of milk of cross dairy goat farms in the different areas of Khartoum State revealed more or less similar values (Fig. 4).

A positive correlation was estimated for the freezing point with mastitis infection ( $r = 0.169$ ). Significant ( $p < 0.05$ ) positive correlation was estimated for the freezing point and yeast and mould counts ( $r = 0.283$ ) as shown in Table 3. Moreover the same table revealed highly significant ( $p < 0.01$ ) negative correlation between freezing point and acidity of milk ( $r = -0.808$ ).

#### *Milk Acidity*

The average of milk acidity of cross dairy goat (lactic acid%) was  $0.231 \pm 0.026\%$ , the maximum was  $0.279\%$  and the minimum was  $0.185\%$  (Table 4). The average of milk acidity in the different areas of Khartoum State revealed higher variations (Fig. 5).

There is a positive correlation for the milk acidity with education level ( $r = 0.093$ ). Moreover highly significant ( $p < 0.01$ ) correlations were estimated for the milk acidity with each of total bacterial counts ( $r = 0.801$ ), coliform counts ( $r = 0.613$ ), yeast and mould counts ( $r = -0.392$ ) and freezing point ( $r = -0.808$ ) as shown in Table 3.



## **Discussion**

The present study was done to evaluate the procedure and management practices and their effect on microbiological quality of raw milk produced by cross dairy goat farms in Khartoum State.

The field visits and the questionnaire showed that in some cross dairy goat farms milkiers' practiced bad habits during milking process such as talking, singing, snuffing and introducing of hands into the milk as mean for udder massage. Those habits could lead to contamination of milk as represent by the high bacterial counts (Table 4). Also those bad management practices might be due to lower labours skills in hygienic principles for milk production and handling. Moreover the differences in the education levels between the owners of these farms might be the reason for those management and practices which led to increase number of bacterial colony especially coliforms bacteria. As the enhance growth of bacteria in the milk result in degradation of milk quality (IDF, 1994).

The influence of health problem showed increase in the reading of freezing point especially in the farms, which has mastitis infection. This might be due to the fact that increased bacteria will lead to decrease the freezing point of the milk (Marshall and Richardson, 1992).

The influence of housing system on milk quality revealed an increase in the number of bacterial colony especially in the random designed housing. The lack of environmental sanitation during milking was found to lead to contamination of milk (Murphy and Boor, 2000). Moreover, Dirar (1975) reported that under tropical condition like Sudan, the high temperature enhances the growth and multiplication of bacteria.

The laboratory examination for milk samples during the present study showed that the average total bacterial count of milk ( $762 \times 10^6 \pm 21.4$  cfu mL<sup>-1</sup>) was higher than that reported by Muehlherr *et al.* (2001) who reported log 4.69 cfu mL<sup>-1</sup> for bulk milk tank samples of dairy goat farms. Similarly, it was higher than Foschino *et al.* (2002) who found  $5.0 \times 10^4$  cfu mL<sup>-1</sup> for bulk milk tank samples from dairy goat farms.

The total bacterial count in the present study was high for tropical grading as reported by Chandra and Hedrick (1979). They stated that the milk was graded as good when it has total bacteria count (TBC) of  $500 \times 10^5$  cfu mL<sup>-1</sup> or less, satisfactory when it ranged between  $50 \times 10^5$  and  $50 \times 10^6$  cfu mL<sup>-1</sup> and bad when TBC was more than  $50 \times 10^6$  cfu mL<sup>-1</sup>.

The average of the coliform counts in the present study ( $636 \times 10^5 \pm 16.6$  cfu mL<sup>-1</sup>) was higher than that reported by Foschino *et al.* (2002) for bulk milk tank samples from dairy goat farms ( $91 \times 10^2$  cfu mL<sup>-1</sup>). This milk is considered to lack sanitation during milking according to Murphy and Boor (2000) who reported that the coliforms counts above 50 cfu mL<sup>-1</sup> indicated poor milking hygiene.

The average of yeast and mould counts in the present study ( $51 \times 10^5 \pm 36.3$  cfu mL<sup>-1</sup>) was smaller than that reported by Foschino *et al.* (2002). Since they reported  $2.5 \times 10^2$  cfu mL<sup>-1</sup> for bulk milk tank samples from dairy goat farms.

The freezing point obtained during the present study ( $-0.484 \pm 0.032^\circ\text{C}$ ) was more or less similar to those reported by Prata *et al.* (1998) and Abd El Gadir and El Zubeir (2005). They reported  $-0.574$  and  $-0.561^\circ\text{C}$ , respectively.

The average acidity (lactic acid%) in the present study (0.231%) was more or less similar to those reported by Chornobi *et al.* (1999) for cross Saanen. They found the acidity was 12.96° D and 0.203%, respectively. This might indicate that milk produced by the studied farms is not adulterated by addition of water.

The present study concluded that the management practices influence the quality of milk. However, some conditions like Sudan local environmental conditions, which affect milk quality, must be eliminating by implementation of good management practices. Hence it is recommended that improvement of milk hygiene by introduction of simple hygienic principles for milk production and handling. Also improvement of the management practices and extension programs to the owners and

establishing of standards and grades of raw milk to ensure good quality should be initiated. Establishment and encouragement of specialized farms of dairy goat in order to ensure food security especially in rural areas will fill the gap of domestic production of milk supply. Future research is needed to estimate and evaluate the keeping quality and nutritional aspects of goat milk.

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