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Microbiological and Physicochemical Characteristics of Raw Milk of Animals Grazed Around Sugar Cane Plants in Sudan

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Aims: This study was conducted to study the physicochemical and microbiological characteristics of milk from animals grazed around sugar cane plants in Sudan.
Methodology: A total of 94 samples of milk were collected from area grazed by animals around sugar cane plants as follows: 20 samples from Guneid, 22 samples from Sinnar, 20 samples from Assalaya, 15 samples from Kenana and 17 samples from New Halfa. According to the species of the animals: 14 samples from sheep, 29 samples from goat and the rest of samples (51) from cows. The milk samples were subjected to physicochemical (fat, protein, total solids, solids-non-fat, lactose, density) and microbiological [total viable bacteria count (TVBC) and lactic acid bacteria count] characteristics were determined.
Results: The results showed that physicochemical and microbiological characteristics were significantly (P<0.001) affected by the plant from which samples were collected. The fat (7.44%), protein (3.96%), total solids (17.38%) and solids-non-fat (9.94%) contents were high in milk collected from Assalaya plant, while lactose content (5.17%) and density (0.0339) were high in milk from Guneid plant. TVBC and lactic acid bacteria count (Log 11.78 and Log 8.88 cfu/ml, respectively) were high in milk from Kenana plant. The fat (7.02%), protein (3.88%), total solids

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(16.82%) and solids-non-fat (9.80%) contents were significantly higher in sheep milk, while TVBC (Log 9.31 cfu/ml) and lactic acid bacteria count (Log 6.49 cfu/ml) counts were significantly higher in goat milk, and the lactose content and density were not significantly affected by the species of the animal.

Conclusion: The physicochemical and microbiological characteristics of milk were affected by the plant from around which samples were collected, while the species of the animal affected all physicochemical and microbiological characteristics except lactose and density of milk.

Keywords: Cow; goat; microbiological; physicochemical; sheep; sugar cane plants.

1. INTRODUCTION

Fresh milk is a complete diet because it contains the essential nutrients such as lactose, fat, protein, minerals and vitamins in balanced ratio rather than the other foods, in addition to being a source of macro and micro-nutrients, and a number of active compounds that play a significant role in both nutrition and health protection [1]. Consumption of milk is associated with beneficial health effects beyond its pure nutritional value, with its major constituent being water and the remainder consists largely of fat, protein, lactose, mineral components and other water soluble and fat soluble vitamins [2], in addition to some major elements such as calcium, phosphorus and magnesium, potassium, sodium and chlorine and a wide range of trace elements including zinc, copper, iron, manganese and iodine [3]. Madut et al. [4] reported that most of owners poorly manage their farms because they do not know the basics of farm management and they do not consult professionals to help them in managing their farms, and this results in a poor performance of dairy production. One of the requirements in the production of high quality raw milk is maintaining acceptable bacterial count which meets the official milk quality standards. The presence of bacteria in milk can cause some reduction in the quality and certain bacteria contaminations with their associated enzymes and toxins may even survive pasteurization and create health hazards [5].

Bacterial contamination of raw milk can originate from different sources including air, milking equipment, feed, soil, faeces and grass, and the number and types of microorganisms in milk immediately after milking are affected by animal health, equipment cleanliness, season, feed, milkers, sanitation of milking equipment and storage temperature of collected milk [6,7]. Hempen et al. [8] stated that the equipment used for milking, filtering and storing the milk is an important factor contributing to high contamination. Moreover, livestock drinking water heavily contaminated with enteric bacteria could serve as a common source of exposure to potential pathogens to cattle that could result in infection of large number of animals during a relatively brief period [9]. Bacterial quality of raw milk is important for both industry and consumers since high bacteria count on the farm contribute to poor keeping quality and inferior product [6]. Mohamed and ElZubeir [10] concluded that because of low hygienic quality of milk in Sudan milking should be done under hygienic conditions, followed by immediately cooling and heat treatment to control bacteriological quality; hence milk must be produced, distributed, handled and marketed under the control of milk commission. This study is conducted to investigate the physicochemical and microbiological characteristics of raw milk of animals grazed around five sugar cane plants in the Sudan.

2. MATERIALS AND METHODS

2.1 Study Area

The study area included five subareas where the sugar cane plants are located, and they are as follows: Guneid area 120 Km south east Khartoum; Sinnar area 250 Km south east Khartoum; Assalaya area 260 Km south Khartoum; Kenana area 280 Km south Khartoum; and New Halfa area 330 Km north east Khartoum

2.2 Sample Collection

A total of 94 samples of milk were collected from sugar cane plants as follows: 20 samples from Guneid, 22 samples from Sinnar, 20 samples from Assalaya, 15 samples from Kenana and 17 samples from New Halfa. According to the species of the animals: 14 samples from sheep, 29 samples from goat and the rest of samples (51) from cows. The samples were aseptically collected in sterile glass bottles and transported to the laboratory in ice box at ≤5℃ and kept in the refrigerator at this temperature till analysis was carried out within 24 hr.

2.3 Physicochemical Analysis

The analysis (fat, protein, lactose, SNF and density) of milk samples was determined using Lactoscan 90 milk analyzer (Aple Industries Service-La Roche Sur Foron, France). Milk samples were mixed gently 4-5 times to avoid any air enclosure in the milk, then 5 ml of the sample were taken in the sample-holder, one at a time and put in the sample holder with the analyzer in the recess position. The starting button was inactivated, the analyzer sucked the milk, the measurements were taken and the result was shown on the digital display. The total solids content was determined by gravimetric method according to AOAC [11].

2.4 Microbiological Examination

Sample dilution was carried out as follows: ten ml from milk were added to 90 ml of sterile 0.1% peptone water at 45^0C in a clean sterile flask, then shacked until a homogenous solution was obtained to make 10^{-1} dilution. One ml from the above-mentioned dilution (10^{-1}) was aseptically transferred to 9 ml sterile distilled water. This procedure was repeated to make serial dilutions of 10^{-2}, 10^{-3}, 10^{-4} ,10^{-5}, 10^{-6}, 10^{-7} and 10^{-8}. TVBC was determined according to Hought by et al. [12] using standard plate count agar, and the plates were incubated at 32ºC for 48 hr. The lactic acid bacteria count was determined using M17 agar medium in anaerobic conditions according to Harrigan and McCance [13], and the plates were incubated at 32ºC for 48 hr.

2.5 Statistical Analysis

Statistical analysis was performed using the Statistical Analysis Systems (SAS, ver. 9). Factorial design (5x3) was used to determine the effect of area around sugar cane plant and animal species on the microbiological and physicochemical characteristics of milk. Mean separation was carried out using Duncan multiple range test ($p<0.05$).

3. RESULTS AND DISCUSSION

3.1 Physicochemical Characteristics of Milk from Animals Grazed Around Sugar Cane Plants

The physicochemical characteristics of milk is affected by environmental (stage of lactation, age of animal, season, temperature, nutrition) and genetic (breed, species, individuality) factors. The physicochemical and microbiological characteristics of milk collected from cows, goats and sheep grazing around sugar cane plants are presented in Tables 1, 2 and 3. The average fat content of milk from the three species was significantly ($P<0.001$) higher in milk collected from Assalaya (7.44%) and lower in milk collected from Kenana (3.64%). The fat content of sheep milk was significantly ($P<0.001$) higher (7.02%), followed by goat milk (5.94%) and cow milk (4.06%). The fat content of cow milk ranged between 2.21% in milk from Kenana and 5.29% in milk from Assalaya, while the fat content of goat milk was between 3.26% in New Halfa and 9.48% in Assalaya, and the fat content of sheep milk ranged between 5.20% in Guneid and 9.99% in Assalaya, and the fat content of sheep milk in Kenana and New Halfa was not determined. The fat content of milk in Asslaya was the highest followed by Guneid, and this is due to highest fat content of milk of the three species in Assalaya (5.29% for cow, 9.48% for goat and 9.99% for sheep milks). The mean fat content of cow milk from all sugar cane plants was in agreement with the results reported by Toledo et al. [14] and Czerniewicz et al. [15], and higher than the results of Abou Donia et al. [16]. However, Lingathrai et al. [17], Tola et al. [18] and Menkudale et al. [19] reported higher results. There was a great variation in content of fat from the three species in different plants, with the fat content of cow milk ranging between 2.21% and 5.29%, while goat milk fat was 3.26 - 9.48%, and sheep milk fat was 5.21 – 9.99%. Strzakowska et al. [20] reported that the fat content of goat milk was 3.38-3.85% and Park et al. [21] reported a mean fat content of sheep milk to be 7.9%. The protein content was in the range of 3.45% in Sinnar and 3.96% in Assalaya. The protein content of cow, goat and sheep milks was 3.56%, 3.80% and 3.88%, respectively. The lowest protein content of cow milk was 3.44% in Assalaya, and the highest (3.88%) in Kenana, while the highest protein content of goat milk (4.36%) in Assalaya and the lowest (3.23%) in Guneid, and protein content of sheep milk was high (4.93%) in Assalaya and low (3.59%) in Guneid. Similar results were reported by previous investigators [14,15,16,18]. However, Strzakowska et al. [20] reported lower protein content than that reported in this study, and Park et al. [21] reported higher protein content in sheep milk (6.2%). Lactose content was 5.17% in Assalaya and 4.54% in Sinnar ($P<0.001$). Lactose was 4.84%, 5.01% and 4.96% in cow, goat and sheep milk collected from animals grazed around sugar cane plants, respectively.

The difference between lactose content in cow, goat and sheep milks from each of the five sugar cane plants was not significant, since the content was in the range of 4.48% in sheep's milk in Sinnar and 6.42% in sheep's milk in Asslaya. Previous studies reported similar results [14,15,16,18,20,21] except Lingathirai et al. [17] who reported lower lactose values in cow milk collected from different regions (3.71±0.65%). Total solids content from different plants was significantly affected (P<0.001) being high (17.38%) in milk from Assalaya and low (12.90%) in milk from New Halfa. Cow milk had the lowest total solids content (13.18%), while sheep milk had the highest (16.82%). The highest total solids content was in goats and sheep milks in Assalaya (20.39% and 22.39%, respectively). Czerniewicz et al. [15], Tola et al. [18] and Menkudale et al. [19] reported similar results, while Strzakowska et al. [20] and Wasiksiri et al. [22] reported lower values of total solids content of goat's milk (9.78–12.75%), and Lingathirai et al. [17] reported high total solids content of cow milk (17.11±1.96-19.61±1.11%). Solids-non-fat (SNF) content was higher (P<0.001) in milk from Assalaya (9.94%) and lower (8.79%) in milk from Sinnar. SNF of cow milk was significantly (P<0.05) lower (9.12%) than that of other species. The highest SNF was in sheep milk collected from Assalaya (12.39%). The results reported in this study are in line with those reported by Czerniewicz et al. [15], Park et al. [21] and Menkudale et al. [19], and higher than those reported by Tola et al. [18], Abd Elrahman et al. [23], Strzakowska et al. [20], Tasci [24] and Wasiksiri et al. [22]. The density of milk was higher (P<0.001) in milk from Guneid (1.0339) and lower in milk from Sinnar (1.0303). There was no significant variation in the density of milk from different species although slightly higher density (1.0330) was reported in goat milk. Park et al. [21], Abd Elrahman et al. [23] and Wasiksiri et al. [22] reported similar results, while Strzakowska et al. [20] and Tasci [24] reported lower density than that reported in this study.

Table 1. Physicochemical and microbiological (Log cfu/ml) characteristics of milk of animals grazed around sugar cane plants

Parameter	Area around sugar cane plants					SE	*p*
	Sinnar	Guneid	Assalaya	Kenana	New Halfa		
Fat (%)	4.95^{b}	4.69^{b}	7.44^{a}	3.64^{c}	4.02b^{c}	0.948	<0.0001
Protein (%)	3.45^{c}	3.79^{ab}	3.96^{a}	3.70^{b}	3.46^{c}	0.199	0.0008
Lactose (%)	4.54^{b}	5.17^{a}	5.11^{a}	5.10^{a}	4.64^{b}	0.340	<0.0001
Total Solids (%)	13.74^{cb}	14.40^{b}	17.38^{a}	13.18^{cb}	12.90^{c}	1.207	0.0004
Solids-non-fat (%)	8.79^{b}	9.71^{a}	9.94^{a}	9.53^{a}	8.88^{b}	0.508	0.0001
Density (kg/m^{3})	0.0303^{b}	0.0339^{a}	0.0334^{a}	0.0338^{a}	0.0311^{b}	0.0178	0.0005
Total bacterial count	6.75^{d}	7.71^{c}	8.05^{c}	11.78^{a}	11.09^{b}	0.462	<0.0001
Lactic acid bacteria count	3.45^{e}	4.95^{d}	6.03^{c}	8.88^{a}	7.30^{b}	0.366	0.0002

Means in each row bearing similar superscripts are not significantly different (P>0.05)
**** = P<0.001*
SE = Standard error of means
SL = Significance level

Table 2. Physicochemical and microbiological (Log cfu/ml) characteristics of milk of cow's, goat's and sheep's milk

Parameter	Animal species			SE	*p*
	Cow	Goat	Sheep		
Fat (%)	4.06^{c}	5.94^{b}	7.02^{a}	1.224	<0.0001
Protein (%)	3.56^{b}	3.80^{a}	3.88^{a}	0.258	0.0024
Lactose (%)	4.84^{a}	5.01^{a}	4.96^{c}	0.439	0.5923
Total Solids (%)	13.18^{c}	15.60^{b}	16.82^{a}	1.558	0.0003
Solids-non-fat (%)	9.12^{b}	9.65^{a}	9.80^{a}	0.656	0.0146
Density (kg/m^{3})	0.0321^{a}	0.0330^{a}	0.0328^{a}	0.023	0.1901
Total bacterial count	7.84^{c}	9.31^{a}	8.88^{b}	0.597	<0.0001
Lactic acid bacteria count	4.79^{c}	6.49^{a}	5.92^{b}	0.473	0.0005

Means in each row bearing similar superscripts are not significantly different (P>0.05)
**** = P<0.001*
*** = P<0.01*
NS = Not significant
SE = Standard error of means
SL = Significance level

Table 3. Physicochemical and microbiological (Log cfu/ml) characteristics of milk of different species grazed around sugar cane plants (Mean±SD)

Plant	Parameter	Cow	Goat	Sheep
Sinnar	Fat (%)	3.24±0.543	5.31±1.98	8.01±2.25
	Protein (%)	3.38±0.148	3.23±0.167	3.79±0.139
	Lactose (%)	4.67±0.216	4.35±0.196	4.48±1.56
	Total Solids (%)	11.95±0.622	13.52±2.15	17.53±2.45
	Solids-non-fat (%)	8.72±`0.400	8.21±0.385	9.52±0.26
	Density(kg/m^3)	0.0310±0.002	0.0279±0.002	0.0312±0.009
	Total bacterial count	6.04±0.78	6.51±1.38	8.41±1.71
	Lactic acid bacteria count	3.81±0.15	3.23±0.16	3.79±0.14
Guneid	Fat (%)	4.91±0.829	3.67±1.47	5.20±3.13
	Protein (%)	3.79±0.117	4.03±0.624	3.59±0.398
	Lactose (%)	5.16±0.140	5.53±0.798	4.87±0.421
	Total Solids (%)	14.62±1.019	14.05±2.44	14.38±3.87
	Solids-non-fat (%)	9.71±0.276	10.38±1.54	9.17±0.897
	Density(kg/m^3)	0.0337±0.009	0.0373±0.005	0.0315±0.002
	Total bacterial count	6.74±1.31	10.12±1.64	7.15±1.52
	Lactic acid bacteria count	4.07±1.19	6.74±1.06	4.78±1.32
Assalaya	Fat (%)	5.29±2.86	9.48±3.75	9.99±4.95
	Protein (%)	3.44±0.194	4.36±1.17	4.93±1.28
	Lactose (%)	4.64±0.411	5.37±1.84	6.42±1.461
	Total Solids (%)	13.97±2.44	20.39±5.75	22.39±0.038
	Solids-non-fat (%)	8.67±0.696	10.90±3.00	12.39±3.09
	Density (kg/m^3)	0.030±0.004	0.0356±0.010	0.0409±0.009
	Total bacterial count	8.41±0.56	7.48±0.55	8.51±0.98
	Lactic acid bacteria count	6.28±0.96	5.39±0.97	7.28±0.59
Kenana	Fat (%)	2.21±1.11	4.89±2.32	-
	Protein (%)	3.88±0.243	3.54±0.196	-
	Lactose (%)	5.45±0.301	4.80±0.339	-
	Total Solids (%)	12.31±1.59	13.93±2.10	-
	Solids-non-fat (%)	10.10±0.596	9.04±0.568	-
	Density (kg/m^3)	0.037±0.002	0.0312±0.003	-
	Total bacterial count	11.67±0.94	11.88±0.70	-
	Lactic acid bacteria count	8.52±0.50	9.19±0.67	-
New Halfa	Fat (%)	4.12±0.440	3.26±0.082	-
	Protein (%)	3.46±0.047	3.44±0.217	-
	Lactose (%)	4.62±0.378	4.76±0.309	-
	Total Solids (%)	13.00±0.393	12.13±0.489	-
	Solids-non-fat (%)	8.88±0.131	8.87±0.569	-
	Density (kg/m^3)	0.0311±0.000	0.0316±0.002	-
	Total bacterial count	11.05±0.72	11.39±0.69	-
	Lactic acid bacteria count	7.26±0.76	7.61±0.69	-

3.2 Microbiological Characteristics of Milk from Animals Grazed Around Sugar Cane Plants

TVBC was significantly (P<0.001) higher in milk collected from Kenana (Log 11.78 cfu/ml), and goat milk had significantly (P<0.001) higher TVBC (Log 9.31 cfu/ml). The highest TVBC was in cow and goat milks from Kenana (Log 11.67±0.94 and 11.88±0.70 cfu/ml, respectively) and the lowest count was in cow and goat milk from Sinnar (Log 6.04±0.78 and 6.51±1.38 cfu/ml respectively). The results of this study are slightly higher than those reported by Funk et al. [25] who reported aerobic mesophilic bacteria and LAB counts of raw milk from the Northwestern Frontier region of Rio Grande do Sul, Brazil to be Log 6.16±0.59 – 6.51±1.05 cfu/ml and Log 5.93±0.76 – 5.98±1.52 cfu/ml, respectively. Beldjil et al. [26] reported total aerobic mesophilic flora count of 90.2x10^3 – 117x10^3 cfu/ml in ewe milk collected from different western Algeria farms. Similar results of total bacteria count were reported by Bruktawit [27]. Ali [28] reported that the total viable bacteria count of raw cow milk collected from different sources in Shendi area, Sudan was as follows: dairy farms Log 8.01±1.39 cfu/ml, milk vending shops Log 7.99± 1.21 cfu/ml, pickup trucks Log 7.92 ± 1.06 cfu/ml and milkers on donkey cart Log 8.09 ±1.11 cfu/ml. The lactic acid bacteria count (LABC) was lowest (P<0.001) in milk from Sinnar (Log 3.45

cfu/ml) and highest in milk from Kenana (Log 8.88 cfu/ml), and goat milk had the lowest LABC (Log 6.49 cfu/ml). The lowest LABC was found in cow, goat and sheep milks from Sinnar (Log 3.81±0.15, 3.23±0.16 and 3.79±0.14 respectively). Beldjil et al. [26] reported that LAB count of ewe milk collected from different farms in western Algeria ranged from $21.4x10^3$ cfu/ml to $110x10^3$ cfu/ml. In a healthy cow, when milk leaves the udder it normally contains less than 100 total bacteria count per ml, and becomes contaminated from the exterior of the udder and teats which can contribute microorganisms normally associated with the skin of the animal as well as those derived from the environment [17,29]. The results of this investigation are in agreement with those reported by Tasci [24] and in disagreement with the results of Muehlherr et al. [29], Tola et al. [18] and Abd Elrahman et al. [23] for goat and sheep milk.

4. CONCLUSION

Physicochemical and microbiological characteristics of milk collected from animals grazed around sugar cane plants were significantly affected by the plant regardless of the species of animal, probably due to the fact that sheep milk was not collected from Kenana and New Halfa plants. Sheep milk was found to be higher in fat, protein, total solids, solids-non-fat contents and density compared to other animals, while goat milk was contaminated with bacteria (both total and lactic acid bacteria).

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Elsheikh NAH, Rahamtalla SA, Abdalla MOM. Chemical composition of raw milk produced and distributed in Khartoum state, Sudan. Asian Journal of Agriculture and Food Sciences.2016;3(1):34-39.
2. Mattila ST, Mylarinena D, Crittendena R, Mogensenb G, Fondence R, Saarela M. Technological challenges for future probiotic food. International Dairy Journal. 2002;12:173-182.
3. Farid SM, Enani MA, Wajid SA. Determination of trace elements in cow's milk in Saudi Arabia. Journal of King Abdulaziz University Engineering Sciences. 2004;15(2):131-140.
4. Madut NA, Abdel Gadir AE, El JaliiI IM. Host determinants of bovine mastitis in semi-intensive production system of Khartoum state, Sudan, Journal of Cell and Animal Biology. 2009;3(5):071-077.
5. Oliver SP, Jayarao BM, Almeida RA. Foodborne pathogens in milk and the dairy farm environment: Food safety and public health implications. Foodborne Pathogens and Disease. 2005;2(2):115–129.
6. Elmagli AAO, ElZubeir IEM. Study on the hygienic quality of pasteurized milk in Khartoum state (Sudan). Research Journal of Animal Veterinary Science. 2006;1(1)12-17.
7. Rahamtalla SA, Elsheikh NAH, Abdalla MOM. Microbiological quality of raw milk produced and distributed in Khartoum state, Sudan. ARPN Journal of Agricultural and Biological Science. 2016;11(1):24-29.
8. Hempen M, Unger F, Munstermann S, Seck MT, Niamy V. The Hygienic status of raw and sour milk from smallholder dairy farms and local markets and potential risk for public health in the Gambia, Senegal and Guinea, Animal Health Research Working Paper 3: International Trypanotolerance Center, Gambia; 2004. Available:http://www.itc.gm/downloads/animalhealthworkingpaperno3.pdf.
9. El Emam IA, El Jalii IM. Bacterial contamination of drinking water in selected dairy farms in Sudan. Scientific Journal of King Faisal University (Basic and Applied Sciences. 2010;11(1):153-160.
10. Mohamed NI, ElZubier IEM. Evaluation of the hygienic quality of market milk of Khartoum State (Sudan). International Journal of Dairy Sciences. 2007;2(1):33-41.
11. AOAC. Official Methods of Analysis of AOAC International. 17th edition. Gaithersburg, MD: AOAC International, USA; 2000. Official Methods 920.124, 926.08, 955.30, 2001.14.
12. Houghtby AG, Maturin LJ, Koenig KE. Microbiological count methods. In: Standard Methods of the Examination of Dairy Products. 16th edition. Marshal RT, (edt.). Washington, D.C.: American Public Health Association, USA. 1992;213-246.
13. Harrigan WF, McCane ME. Laboratory Methods in Food and Dairy Microbiology. London, UK; 1976. Academic Press.
14. Toledo P, Andr!en A, Bjorck L. Composition of raw milk from sustainable

production systems. International Dairy Journal. 2002;12:75–80.
15. Czerniewicz M, Kieczewska K, Kruk A. Comparison of some physic-chemical properties of milk from Holstein-Friesian and Jersey cows. Polish Journal of Food and Nutrition Science. 2006;15(56):61-64.
16. Abou Donia MA, Abou-Arab AAK, Enb A, El-Senaity MH, Abd-Rabou NS. Chemical composition of raw milk and the accumulation of pesticide residues in milk products. Global Veterinaria. 2010;4(1):6-14.
17. Lingathurai S, Vellathurai P, Vendan SE, Prem Anand AA. A comparative study on the microbiological and chemical composition of cow milk from different locations in Madurai, Tamil Nadu. Indian Journal of Science and Technology. 2009;2(2):51-54.
18. Tola A, Ofodiele LN, Beyene F. Microbial quality and chemical composition of raw whole milk from Herro cattle in East Woolega, Ethiopia. Ethiopian Journal of Education and Sciences. 2007;3(1):1-10.
19. Menkudale GV, Wadekar SB, Landge SN. Physico-chemical quality of raw milk marketed in Latur town. Hi-Tech Research Analysis. 2011;1(1):37-41.
20. Strzałkowska N, Jóźwik A, Bagnicka E, Krzyżewski J, Horbańczuk K, Pyzel B, Horbańczuk JO. Chemical composition, physical traits and fatty acid profile of goat milk as related to the stage of lactation. Animal Science Papers and Reports. 2009;27(4):311-320.
21. Park YW, Ju´arez M, Ramosc M, Haenlein GFW. Physico-chemical characteristics of goat and sheep milk. Small Ruminant Research. 2007;68:88–113.
22. Wasiksiri S, Chethanond U, Pongprayoon S, Srimai S, Nasae B. Quality aspects of raw goat milk in lower southern Thailand. Songklanakarin Journal of Science and Technology. 2010;32(2):109-113.
23. Abd Elrahman MAS, Said Ahmad AMM, ElZubeir IEM, ElOwni OAO, Ahmed MKA. Microbiological and physicochemical properties of raw milk used for processing pasteurized milk in Blue Nile Dairy Company (Sudan). Australian Journal of Basic and Applied Sciences. 2009;3(4): 3433-3437.
24. Tasci F. Microbiological and chemical properties of raw milk consumed in Burdur. Journal of Animal and Veterinary Advances. 2011;10(5):635-641.
25. Funk GD, Hermanns G, Vicenzi R, Schmidt JT, Richards NSPS, de Silva WP, Fiorentini AM. Microbiological and physicochemical characterization of the raw milk and the colonial type cheese from the Northwestern Frontier region of Rio Grande do Sul, Brazil. Rev. Inst. Adolfo. Lutz. 2015;74(3):247-57
26. Beldjil AAF, Benlahcen K, Guesses B, Aggad H, Kihal M. Evaluation of microbiological and sanitary quality of ewe's raw milk in Western of Algeria and detection of antibiotic residue by Delvotest. Advances in Environmental Biology. 2013;7(6):1027-1033.
27. Bruktawit S. Physicochemical properties and microbial quality of cow milk collected from selected subcity of Addis Ababa, Ethiopia. M.Sc. thesis, Addis Ababa University, Ethiopia; 2016.
28. Ali MAMI. Bacterial contamination of raw milk in Shendi area. M.Sc. Thesis, University of Shendi, Sudan; 2016.
29. Muehlherr JE, Zweifel C, Corti S, Blanco JE, Stephan R. Microbiological quality of raw goat's and ewe's bulk-tank milk in Switzerland. Journal of Dairy Science. 2003;86:3849-3856.

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