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EFFECT OF HEAT TREATMENT ON KEEPING QUALITY OF CAMEL MILK

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Abstract
This study was conducted to evaluate the microbial load of raw and heat-treated camel milk using LTLT and HTST. Five batches of camel milk samples were examined. The samples were stored at refrigerator (8°C). The total bacterial count in the heat-treated milk ranged from 9.4×10^6 cfu/ml to 2.4×10^7 and 7.6×10^6 to 2.4×10^7 cfu/ml for LTLT and HTST, respectively, compared to raw milk samples (3.02×10^{10} - 3.2×10^{10} cfu/ml). The coliforms count ranged from 4.2×10^5 to 1.4×10^6 and 4.09×10^5 to 1.4×10^6 cfu/ml respectively, while the raw samples revealed 1.1×10^7 - 1.4×10^7 cfu/ml. The results showed low thermoduric bacterial count in the heat-treated milk (6.2×10^5 to 2.03×10^6 and 6.1×10^5 to 2.03×10^6 cfu/ml at LTLT and HTST, respectively) compared with raw milk samples (1.3×10^8 to 1.8×10^8). Also lower values were obtained for both yeast and mould and psychrotrophic bacterial counts in the heat treated milk than in the raw milk samples. Highly significant ($P<0.001$) differences were found in the microbial counts between raw and heat-treated milk during storage. Moreover, the shelf life of heat-treated camel milk was high compared with raw milk samples. It was concluded that heat treatment improves the microbial quality and extends the shelf life of camel milk.

Keywords: heat treatment, camel milk, microbiological loads, acidity, shelf life

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1. INTRODUCTION

There were wide variations in the constituents of camel milk, which were attributed to some factors such as age, number of calving, management, stage of lactation, the sampling technique used and season of the year and feed quality (El-Hag et al., 2003; Parraguez et al., 2003; Shuiep et al., 2008). Healthy functions of camel milk have been highlighted (Hamad et al., 2011). Investigations showed that camel milk is highly contaminated when milked under nomadic conditions (Khedid et al., 2003; Shuiep et al., 2007). Because of its properties, camel milk bacteriology is relevantly different in comparing to milk from other species (Semereab and Molla, 2001; Karimuribo et al., 2005).

Camel husbandry has a significant contribution to national economic in Sudan. However camel milk is being used mainly for family and camel herders' subsistence (El Zubeir and Nour, 2006). Being a major constituent of nomadic diet, healthy camel milk production is considered essential to their health and welfare. However, nomads have shown very little interest to whether food and drink are good to their health, as their concern being only to have enough food (Lues et al., 2003). Karimuribo et al. (2005) stated that the lack of awareness on health risks associated with milk consumption amongst nomadic communities needs to be addressed in order to safeguard their health.

The shelf life of camels milk is longer compared to other milk animals since it contain antibacterial agent such as lysozyme, lactoferrin and immunoglobulin than do bovine or buffalo milk (Kappeler et al., 1999; Wernery et al., 2005; Benkerroum 2008), however raw camel milk may contain some potential pathogens (Yaqoob and Nawaz, 2007; Shuiep et al., 2007; Shuiep et al., 2009). Pasteurized camel milk can last for more than 10 days at 4°C (Wernery, 2008). Hassan et al. (2006) found that pasteurization of camel milk before its fermentation improved the microbial content and increasing the shelf life of the product. However Abdalla and El Zubeir (2006) concluded that for efficient heat treatment, proper handling and strict hygienic measures should be monitored before manufacturing of

dairy products. Similarly Mohamed and El Zubeir (2007) recommended the immediate cooling for milk after milk and application of heat treatment to improve its bacteriological quality. Hassan et al. (2007) reported that camel milk have special properties that it can be looked upon as one of the promising industry in the future by encouraging the investment of camel milk and products. In the present study, the microbial loads and shelf life of camel milk were estimated using low temperature long time (LTLT) and high temperature short time (HTST) pasteurization methods.

2. MATERIALS AND METHODS

2.1. Source of samples

Camel milk samples were obtained from Camel Research Center, University of Khartoum. Milk samples were collected during the period between January to April 2011 in sterile bottles and immediately transferred after milking to dairy microbiology laboratory in Faculty of Animal Production, University of Khartoum. The herd is managed as semi-intensive system.

2.2. Heat treatment of milk samples

Five batches of raw camel milk samples (1 liter/ batch) were used in this study. Each batch was divided into three portions. One portion was kept as a control (raw milk) and the rest were individually heated. The samples were heat treated in glass containers, using water bath. Heat treatment involved two time temperature combinations: 63°C for 30 min (Low temperature long time, LTLT) and 72°C for 15 sec (High temperature short time, HTST). Then the samples were cooled immediately and stored at refrigeration temperature.

2.3. Analysis of camel milk samples

The microbiological examinations were carried out at day 1, 5, 9, 13 and 17. The acidity and clot on boiling test were done daily to assess the shelf life of milk. Titratable acidity and colt on boiling test were done according to AOAC (1990). The camel milk samples (raw and heat treated milk) were examined for total bacterial count (TBC), coliform count, psychrotrophic bacterial count, thermophilic bacterial count, thermoduric bacterial count and yeast and moulds counts according to Marshall (1992). Plate count agar (Scharlau, 01- 161) was used to determine the total bacterial, psychrotrpic, thermophilic and thermoduric bacterial counts. Potato dextrose agar (Scharlau, 01- 483) was used to determine the total yeast and mould counts. Eosine methylene blue agar (EMB) (Himedia, M317-500G) was used for differential isolation of coliform bacterial count. All media were obtained in dehydrated form and were prepared according to the manufacturer's instructions. Sterilization was done according to Marshall (1992). Preparation of serial dilution, culturing method, incubation and counting of the developed colonies (cfu/ ml) were also done according to Marshall (1992).

2.4. Statistical Analysis

The analysis of the data was conducted using a completely randomize design. The analysis of variance and the significant differences between means were determined using Duncan Multiple range test using SPSS version 13.

3. RESULTS AND DISCUSSION

The results revealed low total bacterial count in the heat-treated milk (9.4×10^6 cfu/ml to 2.4×10^7 and 7.6×10^6 to 2.4×10^7 cfu/ml when using LTLT and HTST respectively) compared to raw milk samples (3.02×10^{10} to 3.2×10^{10} cfu/ml (Table 1). The total bacteria count of raw camel milk samples was higher than that reported by Semereab and Molla, 2001; Shuiep et al., 2007). The high total counts indicate low quality of some raw camel milk, which may be due to milking procedures (Shuiep et al., 2007). Measurement of bacterial number in milk is of interest, because they are indicators of poor milk hygiene (Harding, 1999).

Table 1: Variations of total bacterial count of raw and heat treated camel milk during storage

Storage days	Treatments			Standard error
	Raw milk	LTLT heated milk	HTST heated milk	
1	3.02×10^{10a}	9.4×10^{6a}	7.6×10^{6a}	1.7×10^{6}
5	3.2×10^{10b}	1.2×10^{7b}	1.2×10^{7b}	1.7×10^{6}
9		1.6×10^{7c}	1.5×10^{7c}	1.7×10^{6}
13		1.9×10^{7c}	2.07×10^{7c}	1.7×10^{6}
17		2.4×10^{7c}	2.4×10^{7c}	1.7×10^{6}

In this and the following tables: LTLT = Low Temperature Long Time (63°C for 30 minutes); HTST = High Temperature Short Time (72°C for 15 seconds). The same superscript letter in the same column indicate non significant differences ($P< 0.05$)

Table 2: Variations of coliform count of raw and heat treated camel milk during storage

Storage days	Treatments			Standard error
	Raw milk	LTLT heat treated milk	HTST heat treated milk	
1	1.1×10^{7a}	4.2×10^{5a}	4.09×10^{5a}	1.1×10^{5}
5	1.4×10^{7b}	7.2×10^{5b}	7.09×10^{5a}	1.1×10^{5}
9		9.1×10^{5c}	8.7×10^{5c}	1.1×10^{5}
13		1.1×10^{6d}	1.2×10^{6d}	1.1×10^{5}
17		1.4×10^{6e}	1.4×10^{6e}	1.1×10^{5}

Table 3: Variations of yeast and moulds counts of raw and heat treated camel milk during storage

Storage days	Treatments			Standard error
	Raw milk	LTLT heat treated milk	HTST heat treated milk	
1	5.08×10^{5a}	1.1×10^{4a}	1.3×10^{4a}	7.1×10^{3}
5	6.2×10^{5b}	1.8×10^{4b}	2.3×10^{4b}	7.1×10^{3}
9		2.3×10^{4c}	3.4×10^{4c}	7.1×10^{3}
13		4.9×10^{4d}	5.7×10^{4d}	7.1×10^{3}
17		7.1×10^{4e}	7.06×10^{4e}	7.1×10^{3}

Ahmed and El Zubeir stressed on both the importance of quality control programs to regulate milk supply and on the training and education as means of increasing the awareness of stockholders and people from dairy industry. The results also showed low coliforms count in the LTLT and HTST- treated milk, ranging from 4.2×10^{5} to 1.4×10^{6} and 4.09×10^{5} to 1.4×10^{6} cfu/ml respectively, while in the raw samples the range was 1.1×10^{7} - 1.4×10^{7} cfu/ml (Table 2). The coliform bacterial count of raw camel milk samples was higher than that reported previously. Benkerroum et al. (2003) mentioned that coliform bacteria were not detected in 1 ml of some camel milk samples. Moreover Semereab and Molla (2001) found that coliform count in more than half of camel milk samples was less than 10 cfu/ml. Khedid et al. (2003) reported that coliforms were the most abundant microorganisms in camel milk and they ranged from less than 1 cfu/ml to 8×10^{4} cfu/ml. Shuiep et al. (2007) reported the mean coliform bacterial count of camel milk samples collected from Khartoum State was found to be 1.70×10^{7} cfu/ml. High coliform count may be due to contamination with feacal material, improper sanitation, and/ or mastitis infection (Murphy and Boor, 2000). The yeast and moulds count of raw camel milk samples (Table 3) were higher than that reported by Shuiep et al. (2007). He took the samples directly from the udders after application of alcohols as disinfections. Njage et al. (2011) reported the presence of yeast throughout the distribution and processing of raw milk and it was low in samples collected from camel milk (300 cfu/ ml) compared to those collected from market (5.0±1.5 log cfu/ml).

The results of psychrotrophic bacteria (Table 4) were high, that might have been due to storage

conditions. The results revealed low thermoduric bacterial count in the heat-treated milk (6.2×10^5 to 2.03×10^6 and 6.1×10^5 to 2.03×10^6 cfu/ml at LTLT and HTST, respectively) compared with raw milk samples (1.3×10^8 to 1.8×10^8) as shown in Table 5.

There a was a decrease in the means values of microbial measurements (total bacteria, coliforms, total yeast and mould, psychrotrophic bacteria, and thermoduric bacteria) after heat treatment of camel milk samples. El Zubeir et al. (2008) found lower microbial loads when ccomparing raw and pasteurized milk of the Western Cape, South Africa. These results were in agreement with the objectives of pasteurization (IDF, 1994). Moreover the procedure of heat treatment is known to improve the quality of dairy product by killing the pathogenic microorganisms and increasing the shelf life (Harding, 1999). Moreover the microbial content revealed that the count for total bacterial, coliforms, total yeast and mould, psychrotrophic bacteria, and thermoduric bacteria showed minimum values at the beginning of the storage period, and then increased slightly until the end of storage period. The slight increase might be due to the presence of antimicrobial factors in the camel's milk (El Agamy et al., 1992).

The acidity at day1 revealed mean of 0.16%±0.002 for both raw and heat treated camel milk samples. Then the results indicated gradual increase of acidity which was continued till end of shelf life of camel milk (raw and heat treated samples). Moreover, sharp increase were observed in raw milk samples up to the end of the shelf life (day 7) compared to the heat treated samples, which showed extended shelf life for up to 20 days. Moreover the results of acidity were significantly ($P< 0.001$) affected by storage conditions (Table 6). This might be due to fermentation of lactose, which was converted to lactic acid (Harding, 1999). Higher level of camel milk acidity was found during the present study than that reported by Shuiep et al. (2007. This might be due to the prolong storage of the samples or their contamination by microorganisms (Hassan et al. (2006)). As most of camel owners practiced less hygiene during milking and storage of their milk (Shuiep et al., 2007). The increase in lactic acid (acidity) level was gradually at the beginning of storage period (Table 6). The rate of increase in the acidity levels observed to be slow at the beginning and this might be due to the presence of the antimicrobial agents in the camel milk (El Agamy et al., 1992; Wernery et al., 2002).

Table 4: Variations of psychotropic bacterial count of the raw and heat treated camel milk during storage period

Storage days	Treatments			Standard error
	Raw milk	LTLT heat treated milk	HTST heat treated milk	
1	1.7×10^{8a}	6.7×10^{5a}	7.7×10^{5a}	1.3×10^6
5	2.05×10^{8b}	1.1×10^{6b}	1.1×10^{6b}	1.3×10^6
9		1.4×10^{6c}	1.4×10^{6c}	1.3×10^6
13		1.8×10^{6c}	1.9×10^{6c}	1.3×10^6
17		1.9×10^{6c}	2.07×10^{6c}	1.3×10^6

Table 5: Variations of thermoduric bacterial count of raw and heat treated camel milk during storage

Storage days	Treatments			Standard error
	Raw milk	LTLT Heat treated milk	HTST heat treated milk	
1	1.3×10^{8a}	6.2×10^{5a}	6.1×10^{5a}	1.0×10^7
5	1.8×10^{8b}	8.3×10^{5b}	8.3×10^{5b}	1.0×10^7
9		1.3×10^{6c}	1.4×10^{6c}	1.0×10^7
13		1.7×10^{6c}	1.7×10^{6c}	1.0×10^7
17		2.03×10^{6c}	2.03×10^{6c}	1.0×10^7

Table 6: Variations of titrable acidity (lactic acid%) of raw and heat treated camel milk during storage period

Storage period/days	Raw milk	Heat treatment	
		LTLT heat treated milk	HTST heat treated milk
1	0.160±0.002[b]	0.162±0.002[a]	0.160±0.002[a]
2	0.170±0.002[b]	0.170±0.002[b]	0.168±0.002[b]
3	0.180±0.002[c]	0.172±0.002[c]	0.170±0.002[c]
4	0.192±0.002[d]	0.176±0.002[d]	0.172±0.002[d]
5	0.208±0.002[d]	0.178±0.002[d]	0.178±0.002[d]
6	0.224±0.002[e]	0.180±0.002[d]	0.178±0.002[d]
7	0.224±0.005[e]	0.180±0.002[e]	0.180±0.002[e]
8	-	0.182±0.002[e]	0.180±0.002[e]
9	-	0.188±0.002[e]	0.186±0.002[e]
10	-	0.188±0.002[f]	0.188±0.002[f]
11	-	0.182±0.002[f]	0.192±0.002[f]
12	-	0.198±0.002[f]	0.194±0.002[f]
13	-	0.198±0.002[g]	0.198±0.002[g]
14	-	0.200±0.002[g]	0.202±0.002[g]
15	-	0.206±0.002[h]	0.208±0.002[h]
16	-	0.210±0.002[h]	0.212±0.002[h]
17	-	0.214±0.002[i]	0.216±0.002[i]
18	-	0.220±0.002[j]	0.222±0.002[j]
19	-	0.228±0.002[k]	0.228±0.002[k]
20	-	0.230±0.004[l]	0.230±0.004[l]

The two methods of heat treatment of camel milk samples were found to have a high keeping quality, since the shelf life of the heated samples extended up to 20 days under refrigeration temperature compared to a shelf life of raw camel milk samples that showed a shelf life of 7 days at refrigeration temperature. The long shelf life of the two products (raw and heat treated) might be due to the presence of antimicrobial and antibacterial agents in the camel's milk (El Agamy et al., 1992; Wernery et al., 2005). The heat treated milk showed longer shelf life compared raw milk.

Moreover, pasteurization of the milk had an effect on the keeping quality of the product, since the heat treatment is used to kill the pathogens and the thermoduric organisms in raw milk if refrigeration is poor might restrict the shelf life of pasteurized milk (Harding, 1999).

The non complete destruction of organisms after heat treatment supported Hassan et al. (2006). This might be because presence protective factors in camel milk (El Agamy et al., 1992; Wernery et al., 2005). Moreover non significant variations between two procedures of heat treatments for the measurements supported by Attia et al. (2001) that more heat and time are required for pasteurization of camel milk.

The present study concluded that heat treatments improve the microbial quality of camel milk and extended its shelf life. Camel milk has longer shelf life compared to other livestock's. Hence the present study recommends the use of heat treated for camel milk by establishment of collection centers and mobile dairy factories for processing of pasteurized camel milk in the area of the production to improve the traditional productions. Also it is necessary to increase the awareness on health risks associated with consumption of raw camel's milk. Further research is needed to promote heating degree without affecting the nutritional values of camel milk to guarantee the elimination of all pathogenic and spoilage bacteria or make it at minimum levels, since the camel milk is more heat resistant.

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4. REFERENCES

[1] Abdalla, W.M., I.E.M. El Zubeir, Microbial hazards associated with fermented milk (Roub and Mish) processing in Sudan. International Journal of Dairy Science, 2006, 1 (1), 21-26. http://scialert.net/abstract/?doi= ijds.2006.21.26

[2] Attia, H., N. Kherouatou, A. Dhouib, Dromedary milk lactic acid fermentation: microbiological and rheological characteristics. J. Ind. Microbiol. Biotechnol., 2001, 26, 263-270. http://www.springerlink.com/content/k0ryl98bxc0ngdu9/

[3] AOAC, Official Methods of Analysis 15th ed. Association of Official Analytical Chemists. Washington, D. C., U. S. A., 1990.http://www.aoac.org/News/OMA_18_rev_4.htm

[4] Benkerroum, N., Antimicrobial activity of lysozyme with special relevance to milk. Afr. J. Biotechnol., 2008, 7, 4856-4867.

[5] Benkerroum, N., A. Boughdadi, N. Bennani, K. Hidane, Microbiological quality assessment of Moroccan camel's milk and identification of predominating lactic acid bacteria. World J. Microbiol. Biotechnol., 2003, 19, 645-648. http://www.scribd.com/doc/77481888/Full-Text

[6] El Agamy, E.S.I., R. Ruppanner, A. Ismail, C.P. Champagne, R. Assaf, Antibacterial and antiviral activity of camel milk protective protein. Journal of Dairy Research, 1992, 59, 169- 175.

[7] El-Hag, F.M., S.A. Sabiel, A.M. Abu Nikhaila, M.E., M.M. Ahmed, Camels *(Camelus dromedaries*) under pastoral system in North Kordofan, Sudan: Seasonal and parity effect on camel milk yield and composition. Nomadic People, 2003, 6, 24-32.http://www.questia.com/googleScholar. qst? docId=5002547907

[8] El Zubeir, I.E.M., M.I.A. Ahmed, The hygienic quality of raw milk produced by some dairy farms in Khartoum State, Sudan. Research Journal of Microbiology, 2007, 2(12), 988-991. http://docsdrive.com/pdfs/academicjournals/jm/2007/988-991.pdf

[9] El Zubeir I.E.M., V. Gabriechise, Q. Johnson, Comparison of chemical composition and microbial profile of raw and pasteurized milk of the Western Cape, South Africa. International Journal of Dairy Sciences, 2008, 3(3), 137-143. http://scialert.net/qredirect.php?doi=ijds.2008.137.143&linkid=pdf

[10] El Zubeir, I.E.M., E. M. Nour, Studies on some camel management practices and constraints in pre-urban areas of Khartoum State, Sudan. International Journal of Dairy Science, 2006, 1(2), 104- 112. http://scialert.net/qredirect.php?doi=ijds.2006.104.112&linkid=pdf

[11] Hamad, E.M., E.A. Abdel-Rahim, E.A. Romeih, Beneficial effect of camel milk on liver and kidneys function in diabetic sprague-dawley rats. International Journal of Dairy Science, 2011, 6, 190-197. http://scialert.net/qredirect.php?doi=ijds.2011.190.197&linkid=pdf

[12] Hassan, R.A., I.E.M. El Zubeir, S.A. Babiker, Microbiology of camel fermented milk (*Gariss*) in Sudan. Res. J. Microbiol., 2006, 1:160-165.http://scialert.net/ abstract/ ?doi= jm.2006.160.165

[13] Hassan, R.A., I.E.M. El Zubeir, S.A. Babiker, Effect of pasteurization of raw camel milk and storage temperature on the chemical composition of fermented camel milk International Journal of Dairy Science, 2007, 2(2), 166-171. http://scialert.net/qredirect.php?doi=ijds.2007.166.171&linkid=pdf

[14] Harding, F., Milk Quality. First edition,. Aspen Publishers, Inc. Gaithersburg, Mary land, 1999.

[15] IDF, Recommendations for the Hygienic Manufacture of Milk and Milk Based Products. International Dairy Federation, Document No. 292. Brussels, Belgium, 1994.

[16] Kappeler S., Z. Farah, Z. Puhan, Alternative splicing of lactoferrin mRNA from lactating mammary gland of the camel (*Camelus dromedaries)*. J. Dairy Sci., 1999, 82, 2084-2093. http://www.sciencedirect.com/science/article/pii/S0022030299754500.

[17] Karimuribo, E.D. L.J. Kusiluka, R.H. Mdegela, A.M. Kapaga, D.M. Kambarage, Studies on mastitis, milk quality and health risks associated with consumption of milk from pastoral herds in Dodam and Morgoro regions, Tanzania. J. Vet. Sci., 2005, 6(3), 213-221.

[18] Khedid, K., M. Faid, M. Soulaimani, Microbiological characterization of one humped camel milk in Morocco. Journal of Camel Practice and Research, 2003, 10 (2), 169-172.

[19] Lues, J.F.R., P. Venter, W.H. Vander, Enumeration of potential microbiological hazard in milk from a marginal urban settlement in central South Africa. Journal of Food Microbiology, 2003, 20 (3), 321-329.

[20] Marshall, R.T., Standard Methods for Examination for Dairy Products. 16th Edn., American Public Health Association (APHA), Washington, DC., USA, 1992.

[21] Mohamed, N.N.I., I.E.M. El Zubeir, Evaluation of the hygienic quality of market milk of Khartoum State (Sudan). International Journal of Dairy Science, 2007, 2(1), 33-41. http://scialert.net/qredirect.php?doi=ijds.2007.33.41&linkid=pdf

[22] Murphy, S.C., K.J. Boor, Trouble-shooting sources and causes of high bacterial count in raw milk. Dairy Food Environ. Sanit., 2000, 20, 606-611.

[23] Njage, P.M.K., S. Dolci, C. Jans, J. Wangoh, C. Lacroix, L. Meile, Characterization of yeasts

associated with camel milk using phenotypic and molecular identification techniques. Research J. Microbiology, 2011, 6, 678-692. http://scialert.net/qredirect.php?doi=jm.2011.678.692&linkid=pdf

[24] Parraguez, V.H., M. Thenot, E. Latorre, G. Ferrando, L.A. Raggi, Mil composition in alpaca (*Lama pacos*): Comparative study in two regions of Chile. Archivos de Zootecnnia, 2003, 52, 431-439. http://www.uco.es/organiza/servicios/publica/az/articulos/2003/200/pdf/02Parraguez.pd.f.

[25] Semereab T., B. Molla, Bacteriological quality of raw milk of camel (*Camelus dromedarius*) in Afar region (Ethiopia). J. Camel Pract. Res., 2001, 8, 51-54.

[26] Shuiep E.S., I.E.M. El-Zubeir, O.A.O. El Owni, H.H. Musa, Assessment of hygienic quality of camel (*Camelus dormedarius*) milk in Khartoum State, Sudan. Bull. Anim. Hlth. Prod. Afr., 2007, 55, 112-117.http://www.ajol.info/index.php/bahpa/article /view/32797.

[27] Shuiep E.S., I.E.M. El-Zubeir, O.A.O. El Owni, H.H. Musa, Influence of season and management on composition of raw camel milk (*Camelus dromedarius*) milk in Khartoum State, Sudan. Trop. Sup Trop. Agro-Ecosyst., 2008, 8, 101-106. http://redalyc.uaemex.mx/redalyc/pdf/939/93980109.pdf

[28] Shuiep, E.S., T. Kanbar, N. Eissa, J. Alber, C. Lammler, M. Zschock, I.E.M. El Zubeir, R. Weiss, Phenotypic and genotypic characterization of *Staphylococcus aureus* isolated from raw camel milk samples. Research in Veterinary Science, 2009, 86: 211–215.http://www.sciencedirect.com/science/article/pii/S0034528808001641

[29] Wernery U., Camel milk-new observations. Proceedings of the International Camel Conference Recent Trends in Camel Research and Future Strategies for Saving Camels, July 12-13, 2008, Rajasthan, India

[30] Wernery, U., M. Ali, J. Kinne, A. A. Abraham, Copper deficiency: A predisposing factor to septicaemia in dromedary calves. J. Camel Pract. Res., 2002, 9, 59-66.

[31] Wernery U., B. Johnson, A. Abrahm, The effect of short-term heat treatment on vitamin C concentrations in camel milk. Milchwissenschaft, 2005, 60, 266-267.http://cat.inist.fr/?aModele=afficheN &cpsidt=16909346.

[32] Yaqoob, M., H. Nawaz, Potential of Pakistani camel for dairy and other uses. A review article. Animal Science Journal, 2007, 78, 467-475. http://onlinelibrary.wiley.com/doi/10.1111/j.1740-0929.2007.00464.x/abstract;jsessionid=7BE7E7AFB4C91DCFDFC4A03AD116BA8E.d03t01?userIsAuthenticated=false&deniedAccessCustomisedMessage=

[33] Younan, M., Z. Ali, S. Bornstein, W. Muller, Application of California Mastitis Test in intramammary *Streptococcus agalactiae* and *Staphylococcus aureus* inactions of camels (*Camilus dromedaruis)* in Kenya. Prev. Vet. Med., 2001, 51, 307-216.http://www.sciencedirect.com/science/article/pii/S0167587701002288.