Bacteriological And Chemical Properties Of She Camel Milk In Sharkia Governorate Markets

Selim M.A. and *Abdelfattah M.E.
Zagazig Provincial Lab. (Bacteriological Unit and *Food Hygiene),
Animal Health Research Institute, Egypt

ABSTRACT

Chemical and bacteriological evaluation of 40 raw camel milk samples collected from different markets in Sharkia Governorate over a period of 3 months, were assessed. Variations in the major chemical composition were observed. The mean values of the pH, fat, solid non-fat, protein, ash, total solids, titratable acidity and lactose were 6.47±0.04, 3.55±0.23, 10.33±0.63, 3.01±0.04. 0.93±0.09, 13.75±0.47, 0.16±0.004 and 3.48±0.28%, respectively. Bacteriological analysis of she camel milk revealed that the average aerobic plate count, Enteropathogeic *Escherichia coli* and *Enterococcus faecalis* count were $2.3x10^4$, $0.7x10^3$ and $6.2x10^2$, with an incidence of 100, 30 and 5%, respectively. Because most she camel milk is consumed fresh or when just had been soured, it was refrigerated at 4°C to detect the time of standing until it has a very unpleasant smell and become unacceptable. She camel milk was acceptable for up to 16 days. This explains the necessity to immediately freeze milk if it needs to be kept for a few days. The variations in the chemical composition, as well as, the public health hazard of the isolated organisms were discussed.

INTRODUCTION

"Narrated Anas: 'O Allah's Apostle ! Give us shelter and food. The weather of Madina isn't suitable for us. So he sent them to Al-Harra with some she camels of his and said, 'Drink of their milk'" *(1)*. The above quote is taken from the explanation given for the meanings of Koran. It literally means that in the desert areas man was short of food and that Allah gave the camel as a source of food. In the nomadic folklore the law is taken literally and in various parts of the world camel milk is used only for drinking and isn't sold in case of it is utilized for other purposes *(2)*. It is extremely interesting that, according to Bedouin folklore, when the camel was chosen to be provider of food for man, the animal made an agreement with the prophet Mohammed that its milk would only be used for drinking *(3)*. There are different species of camels belonging to the genus camelus; the one-humped dromedary camel (Camelus dromedarius) and the two-humped bactrian camel (Camel bactrianus) *(4)*. The camel population of Arab Republic of Egypt and Sharkia Governorate about 129496 and 4021, respectively are dromedaries *(5)*.

Food and Agriculture Organization has reported that more than 18 million camels around the world support the survival of millions of people *(6)*.

Economically, single lactating she camel can supply milk for 40 children daily *(7)*. Most camel milk is consumed fresh or when just soured *(8)*. Camels milk is generally opaque white, has faint sweet smell, a sweet but sharp and sometimes it is salty in taste. Furthermore, it is also rich in vitamin C and its level is three times more than that of cow's milk and one and half more than that of human milk *(9)*. Camel milk not only contains all essential nutrients as cow's milk, but also it has therapeutic and antimicrobial agents *(10)*. Therapeutically it is used against dropsy, jaundice, splenic problems, tuberculosis, anemia, constipation as a laxative, treatment of type I diabetes, biliary atresia in a young child and patients with chronic liver hepatitis had improved their liver functions after being treated with camel milk *(3, 11, 12)*.

In fact most of camel milk is consumed in the raw state without any heat treatment or acid fermentation and kept at high ambient temperature coupled with lack of refrigeration facilities during milking and transporting.

Such conditions turned the milk to be unsafe capable of causing food-borne diseases and even spoil fast *(13)*. Pathogenic microorganisms can gain access to milk either by faecal contamination or by direct excretion from the udder into milk. However, there is no available reports documenting any outbreak related to raw camel milk *(14)*. Enteropathogenic *Escherichia coli* organisms has been implicated in human cases of gastroenteritis with symptoms of malaise, vomiting and diarrhea *(15)*.

The presence of Enterococcus in large numbers may at a time constitute a public health hazard and may induce food-poisoning because of their ability to produce extracellular toxic metabolites *(16)*. The information about camel milk chemistry is very limited. Furthermore, there is a limited data on the microbial assessment of raw camel milk. The objective of this work was to study the chemical composition and the bacterial quality of camel milk as well as determination of "how long can camel milk be stored in a refrigerator?"

MATERIAL AND METHODS

Sixty samples of frozen raw camel milk were randomly collected from different markets in Sharkia Governorate over a period of 3 months, March to May, with different commercial packages. Each sample (500 ml) was transported to the laboratory under refrigeration, thawed, pooled as 40 out of them were examined chemically and bacteriologically, while the rest were examined for their pH, flavour and physical changes at a refrigerator at different storage time.

1) Storch's test *(17)*

The examined milk samples were subjected to storch test to prove that they were raw.

2) Chemical analysis

All samples were examined to quantify percentage of total solid, protein content, ash content and acidity *(18)*, fat percentage and pH *(19)*, and lactose *(20)* were determined. The solids non-fat percentage of the examined samples were calculated by subtracting the fat percent from the total solids percent.

3) Bacteriological analysis

Bacteriological examination of camel milk samples carried out by preparation of ten fold serial dilution, total colony count and Enteropathogenic *Escherichia coli* count (EPEC) as well as isolation and identification of *Salmonella (21). Enterococcus faecalis* count was performed as previously described *(22)*. Detection of *Brucella* was done *(23)* using the following tests:

(1) Standard tube agglutination test (SAT).

(2) Rose Bengal plate test (RBPT).

4) Determination of "how long can camel's milk be stored in a refrigerator?" *(3)*

Twenty milk samples were obtained from different markets (frozen milk) and immediately kept in ice while being transferred to the laboratory. The pH was determined using a model 3305 pH meter (England). After thawing of each milk sample the latter was divided into aliquots in sterilized small beakers and placed into a refrigerator (4°C). The milk in one of these beakers was stirred each day before examination of its pH while the milk in other beaker was left untouched, but was examined only for smell, taste, precipitation (cheese formation) and any physical changes. When a rancid smell was obvious, the milk was discarded..

RESULTS

Table 1. Statistical analytical results of chemical examination in examined samples* (n = 40)

Components (%)	Minimum	Maximum	Mean ± SE
pH	6.32	6.59	6.47 ± 0.04
Acidity	0.14	0.17	0.16 ± 0.004
Fat	2.90	4.50	3.55 ± 0.23
Protein	2.90	3.16	3.01 ± 0.04
Lactose	2.50	4.50	3.48 ± 0.28
Ash	0.70	1.20	0.93 ± 0.09
Total solids	12.50	15.00	13.75 ± 0.47
Solid non-fat	8.00	12.00	10.33 ± 0.63

*: All the examined she camel milk samples were raw.
n: number of examined samples

Table 2. Statistical analytical results of bacteriological examination in examined samples* (n=40)

Microorganisms	Positive samples		Min.	Max.	Mean
	No	%			
Total colony count	40	100	1×10^3	4×10^5	2.3×10^4
EPEC	12	30	8 x 10	3×10^3	0.7×10^3
Ent. Faecalis	2	5	4 x 10	1.2×10^3	6.2×10^2

*: Neither Salmonella nor Brucella could be detected in any of the examined she camel samples.

Table 3. pH changes of refrigerated she camel milk samples (n = 20)

Storage time/day	Mean ± SE
0	6.45 ± 0.03
2	6.36 ± 0.04
4*	5.67 ± 0.15
6**	5.27 ± 0.05
7	5.02 ± 0.03
9***	4.23 ± 0.03
16*****	4.19 ± 0.01

*: Smell changes had been started. **: Soured flavour could be detected.
: Camel's milk slowly separated.*: Camel's milk had a very unpleasant smell.

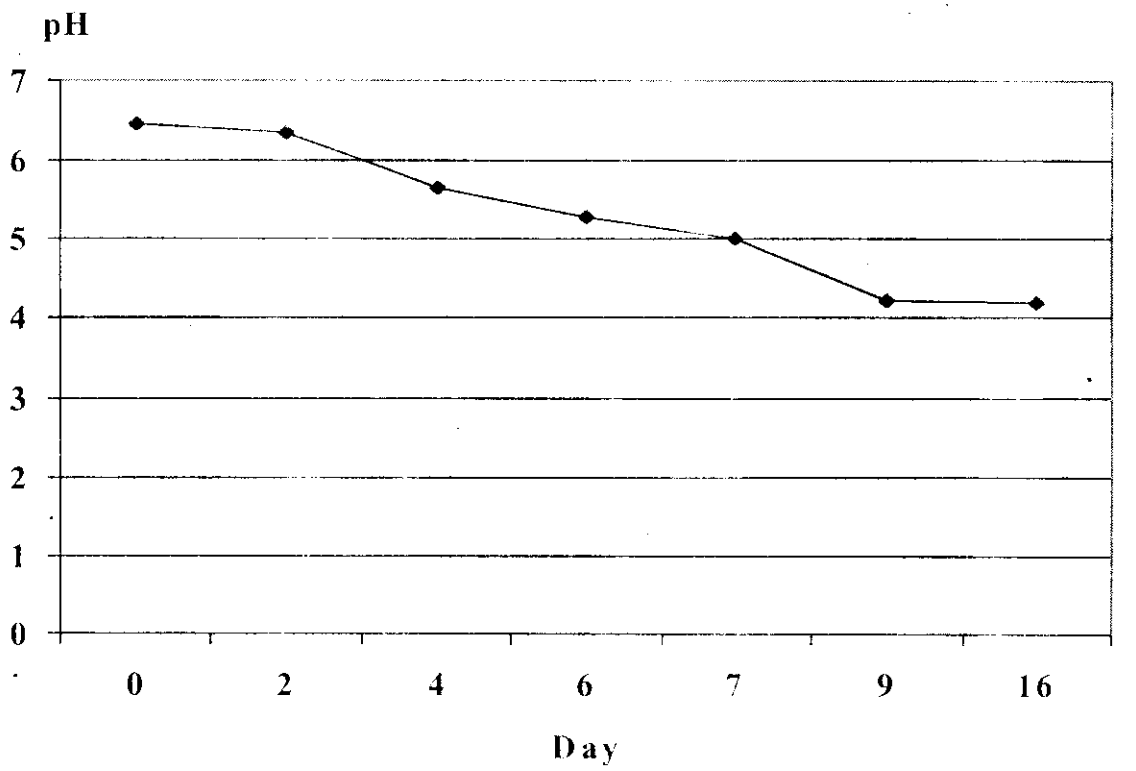

Fig. 1. pH changes of refrigerated she camel's milk

DISCUSSION

The summarized results given in Table 1 revealed that the pH of the examined marketed camel milk samples had a mean value of 6.47 ± 0.04 with a minimum of 6.32 and a maximum of 6.59. Similar result was recorded (3), however several investigators *(13, 24)* cited higher values.

The camel milk's is more acidic than fresh cow's milk. Freshly drawn milk is considered as being distinctly acid and is known as the "apparent acidity of milk". The acid which is formed by bacterial conversion of lactose to lactic acid is considered as "real acidity of milk" *(3)*.

On the other hand, the titratable acidity of the examined samples fluctuated between 0.14% and 0.17% with a mean value of 0.16 ± 0.004%. Nearly similar *(25)*, but higher values were recorded *(4, 26)*. The acidity of camel's milk rapidly increased when it was left to stand *(27)*. Acidity in milk mainly reflects temperature of milk after collection, husbandry techniques and marketing practices *(25)*.

The fat percentage was ranged from 2.90 to 4.50% with a mean value of 3.55 + 0.23%. Similar *(4, 13, 26)*, higher *(28, 29)* and lower *(25)* percentage of fat in she camel's milk were previously recorded. The mean values of protein and lactose contents were 3.01 ± 0.04 and 3.48 ± 0.28% with a minimum of 2.90 and 2.50% and a maximum of 3.16 and 4.50%, respectively. Protein contents in the present study are lowered than that reported by several investigators *(13, 26, 29)*. However higher values also cited *(4, 25)*. Lactose percentage is lowered than that previously reported *(4, 25, 26, 29)*.

The results recorded in Table 1 revealed that, the mean values of solids non-fat, ash and

total solids of the examined market camel samples were 10.33 ± 0.63, 0.93 ± 0.09 and 13.75 ± 0.47% with a minimum of 8.00, 0.70 and 12.50% and a maximum of 12.00, 1.20 and 15.00%, respectively. The previously mentioned results are higher than that recorded in several research work ***(4, 13, 25, 26, 29)***. The general composition of camel's milk varies in various parts of the world with a range of 3.5 to 4.5% protein, 3.4 to 5.6%; lactose, 3.07 to 5.50% fat, 0.7 to 0.95% ash and 12.1 to 15% TS ***(30)***. The wide variation in the constituents of camel's milk may be attributed to several factors such as age, the number of calvings, nutrition, management, the stage of lactation, sampling technique used and the methods used for determination of such constituents ***(26, 29)***.

Regarding to bacteriological analysis of market camel milk samples represented in Table 2 as the aerobic plate count was ranged from $1x10^3$ to $4x10^5$ with an average of $2.3x10^4$ with an incidence of 100%. Similar results were reported ***(13, 26)***. Enteropathogenic *Escherchia coli* and *Enterococcus faecalis* could be detected in 30% and 5% of examined samples with a mean ,count of $0.7x10^3$ and $6.2x10^2$ and a minimum of 8x10 and 4x10 and a maximum of $3x10^3$ and $1.2x10^3$, respectively. Nearly similar results were recorded ***(26, 31)***. The public health hazard of *E. coli* organisms had been emphasized by several investigators as they had been implicated in human cases of gastroenteritis, epidemic diarrhea in infants, sporadic diarrhea in children as well as food-poisoning ***(32)***. The presence of *Enterococcus faecalis* in milk reflected the faulty condition under which milk was produced and handles, unsanitary condition of production and faecal contamination. Also, these organisms are implicated in food-poisoning ***(31)***. These microorganisms may contaminate milk from various sources including air, dust, udder, as well as hands of milkers ***(26)***.

Neither *Salmonella* nor *Brucella* could be detected in any of the examined samples. The negative isolation of certain pathogenic microorganism was due to therapeutic and antimicrobial activities of camel components ***(10, 33)***. On the other hand, there were no available reports documented any outbreak related to raw camel milk consumption ***(14)***. When camel's milk was described for treatment of liver cirrhosis, therapeutically it can fight many diseases, it could be consumed fresh and when just soured and there is no available reports about any outbreak related to raw camel's milk consumption. We were confronted by the question "How long can camel's milk be stored in a refrigerator?". The results achieved from Table 3 revealed that the refrigerated unstirred camel's milk slowly separated with 9 days, but didn't coagulated. After 16 days of standing, although the milk returned to its original form when shaken, it had a very unpleasant smell and had to be discarded. The pH of refrigerated stirred milk is depicted in Table 3 and Fig. 1. Day zero is the day of collection. In the first 2 days, between 6^{th} and 7^{th} day and between 9^{th} and 16^{th} day there were no rapid decline in the pH. On the other hand, a gradual decline in pH continued from 2^{nd} day to 6^{th} day and from 7^{th} to 9^{th} day. After 4 days although the taste of the milk was good, there were a little changes in the smell. Camel milk turned soured within 6 days of storage in the fridge. After 16 day, it had been discarded because of the pungent odour and unpleasant smell, formed.

On contrary, camel's milk showed an outstanding pH stability, after 45 days a gradual "musty" taste developed but it was still drinkable at 60 days and after 90 days it had to be discarded because of unpleasant odour and smell ***(3)***. Our explanation could be attributed to differences in hygienic quality of the market camel milk samples in the present findings and the farm ones in the literature or due to high price of camel's milk in comparison to bovine and buffaloe's milk, cow's or buffaloe's milk can be used for adulteration of camel's milk ***(13)***.

It can concluded that camel's milk contains all essential nutrients. Although the bovine species is the major source of milk nutrients for people of Egypt, an increasing supply of camel milk for human consumption

warrants study of camel's milk composition and quality. Extensive studies are needed to establish Egyptian standard of chemical parameters for camel's milk. The animal who was designated by Allah to supply milk for drinking, not only provides milk, but it has an exceptional storage capability. But as the raw milk is an ideal medium for the growth of microorganisms and to protect the consumers against infection, the heat treatment of milk to destroy microorganisms which may be entered must be taken in consideration.

REFERENCES

1. ***Khan M.M. (1974):*** Sahih Al-Bukhari. The translation of meanings. Vol. II., Ch. 5, pp. 398-399. Al-Madina, Islamic University.
2. ***Yagil R. (1982):*** Camels and camel milk. In: F.A.O. Animal Production and Health paper, pp. 69. F.A.O., Rome, Italy.
3. **Yagil R., Saran A. and Etzion Z. (1984):** Camels' milk: For drinking only? Comp. Biochem. Physiol. A., A78 (2): 263-266.
4. ***Sawaya W.N. Khalil J.K., Al-Shalhat A. and Al-Mohammad H. (1984):*** Chemical composition and nutritional quality of camel milk. J. Food Sci., 49: 744-747.
5. ***Ministry of Agriculture (MA) (2004):*** Department of Agricultural Economic and Statistics. Min. Agric., Cairo Egypt.
6. ***Food Agriculture Organization (1992):*** Animal Health Yearbook. Food and Agriculture Organization. Rome, Italy.
7. ***Mehaia M.A. (2006):*** Components, characteristics and processing of camel milk: A review and future prospect proceedings of the international scientific conference on camels. 1637-1697.
8. ***Knoess K.H. (1982):*** Milk production of the dromedary. Pakistan Vet. J., 2 (2): 91-98.
9. ***Yagil R. and Etzion Z. (1980):*** The effect of drought conditions on the quality of camels' milk. J. Dairy Res., 47: 159-166.
10. ***Elagamy E., Ruppanner R., Ismail A., Champagne C. and Assaf R. (1992):*** Antibacterial and antiviral activity of camel milk protective proteins. J. Dairy Res., 59: 169-175.
11. ***Sharmanov T.S., Kadyrova R.K., Shlygina O.E. and Zhaksylykova R. (1978):*** Changes in the indicators of radioactive isotope studies of the liver of patients with chronic hepatitis during treatment with whole camel's and mare's milk. Voprospy Pitaniya, 1: 9:13.
12. ***Agarwal R.P., Swami S.C., Beniwal R., Kochar D.K., Sahani M.S., Tuteja F.C. and Ghouri S.K. (2003):*** Effect on camel milk on glycemic control, risk factors and diabetes quality of life in type I diabetes: A randomised prospective controlled study. J. Camel Practice and Res., 10: 45-50.
13. ***Abeer A.A., Ibrahim A.K. and Adel S.A. (2006):*** Molecular assessment of camel milk adulteration with special reference to chemical and microbiological features. J. Egypt. Vet. Med. Assoc., 66 (3): 7-23.
14. ***Benkerroum N., Boughdadi A., Bennani N. And Hidane K. (2003):*** Microbiological quality assessment of Moroccan camel milk and identification of predominating lactic acid bacteria. World J. Microbiol. Biotechnol., 14: 645-648.
15. ***Adams M.S. and Moss M.O. (2000):*** Food Microbiology. 2nd Ed., Royal Society of Chemistry. Thomas Graham House, Science Park, Milton Road Cambridge CB40WF, UK.
16. ***Roushdy I.M., Ehrmann M.A. and Vogel R.F. (1998):*** Molecular identification and characterization of halo-tolerant lactic acid bacteria isolated from soft pickled Damietta cheese. Adv. Food Sci., 20 (1/2): 40-45.
17. ***Mohamed E.A. (1999):*** Lipolytic psychrotrophs in milk. M.V.Sc., Thesis, Fac. of vet.. Med., Zagazig Univ., Egypt.
18. ***A.O.C.A. (1990):*** Official Methods of Analysis, Association of Official Agricultural Chemist, Inc., 15th ed., Virginia, USA.
19. ***A.P.H.A. (1985):*** Standard methods for examination of dairy products. 15th ed.,

American Public Health Association, Washington, D.C., USA.

20. ***Hill R.H. (1915):*** Note on the use of colloidal iron in the determination of lactose in milk. J. Biol. Chem., 20 (3): 175-177. http:/www.jbc.org.
21. ***A.P.H.A. (1992):*** Standard methods for examination of dairy products. 16th ed., American Public Health Association, Washington, D.C., USA.
22. ***Efthymiou C.J. and Joseph S.W. (1974):*** Development of selective enterococcus medium based on manganese ion deficiency, sodium azide and alkaline pH. Appl. Microbiol., 28: 411-416.
23. ***Hamdy M.E. and Amin A.S. (2002):*** Detection of Brucella species in the milk of infected cattle, sheep, goats and camels by PCR. Vet. J., 163 (3): 299-305.
24. ***Shalash M.R. (1979):*** Utilization of camel meat and milk in human nourishment. In Camels, pp. 285-306. I.F.S. Symp., I.F.S. Sweden.
25. ***Elamin F.M. and Wilcox C.J. (1992):*** Milk composition of Majahelm camels. J. Dairy Sci., 75: 3155-3157.
26. ***Sabah I.M., Ahmed A.H., Nagah M.S. and Yahya H.M. (2000):*** Quality evaluation of camels' milk in New Valley Governorate. Egypt. J. Agric. Res., 78 (1): 241-249.
27. ***Ohri S.P. and Joshi B.K. (1961):*** Composition of camel milk. Ind. Vet. J., 38: 514-516.
28. ***Gorban A.M. and Izzeldin O.M. (2001):*** Fatty acids and lipids of camel milk and colostrum. Int. J. Food Sci. Nutr., 52 (3): 283-287.
29. ***Zhang H., Yao J., Zhao D., Liu H., Li J. and Guo M. (2005):*** Changes in chemical composition of Alxa Bactrian camel during lactation. J. Dairy Sci., 88: 3402-3410.
30. ***Gnan S.O. and Sheriha A.M. (1986):*** Composition of Libyan camel's milk. Aust. J. Dairy Technol., 41: 33-35.
31. ***Amer A.A., Ahlam E. and Abou El-Lail M. (2005):*** Some enteropathogens in camel milk. 4th Int. Sci. Conf., Mansoura, 1383-1391.
32. ***DeBuyser M.L., Dufour B., Maire M. and Lafarge V. (2001):*** Implication of milk and milk products in food-borne diseases in France. Int. J. Food Microbiol., 20; 67 (1/2): 1-17.
33. ***Barbour E.K., Nabbut N.H., Frerichs W.M. and Al-Nakhlic H.M. (1984):*** Inhibition of pathogenic bacteria by camel milk relation to whey lysozyme and stage of action. J. Food Protec., 47: 838-840.

الملخص العربى

الخواص البكتريولوجية والكيميائية للبن النوق فى أسواق محافظة الشرقية

مختار عبد الحكيم عبد العزيز سليم- محمد السيد عبد الفتاح*

معهد بحوث صحة الحيوان بالزقازيق (وحدة البكتريولوجى ووحدة صحة الأغذية*)

معهد بحوث صحة الحيوان – مصر

أجريت الدراسة الكيميائية والبكتريولوجية على عدد ٤٠ عينة من لبن الجمال جمعت من أسواق محافظة الشرقية خلال ٣ شهور (مارس – مايو). أوضحت النتائج الكيميائية ان متوسط نسب الأيون الأيدروجينى ، الدهون،الجوامد اللادهنية، البروتين، الرماد، الجوامد الكلية، الحموضة واللاكتوز كانت: ٦,٤٧، ٣,٥٥، ١٠,٣٣، ٣,٠١، ٠,٩٣، ١٣,٧٥، ٠,١٦، ٣,٤٨ جرام لكل مائة جرام على التوالى.

تبين من الفحص البكتريولوجى أن متوسط العدد الكلى للميكروبات الهوائية، الإيشريشيا القولونية، المكور السبحى من النوع فيكالى قد بلغ $٢,٣\times١٠^{٤}$، $٠,٧\times١٠^{٣}$، $٦,٢\times١٠^{٢}$ على التوالى بنسب ١٠٠، ٣٠، ٥٪ على التوالى.

ونظرا لأن معظم لبن الجمال قد يستهلك طازجاً أو بمجرد أن يصبح حريف أو لاذع طعماً فقد أجريت تجربة على لبن الجمال المتداول فى أسواق محافظة الشرقية لمعرفة الى أى مدى يظل مقبولا طعما ورائحة أثناء حفظه فى درجة حرارة الثلاجة. وقد ثبت أن حفظه فى درجة حرارة الثلاجة ضرورى لكى يظل مقبولا لمدة ١٦ يوما. وقد تم مناقشة النتائج من الناحيتين الصحية والاقتصادية.