JOURNAL OF AGRICULTURE & SOCIAL SCIENCES
1813–2235/2005/01–2–164–166
http://www.ijabjass.org

Physico-Chemical Quality of Camel Milk

M. KHASKHELI, M.A. ARAIN, S. CHAUDHRY, A.H. SOOMRO, AND T.A. QURESHI†
Departments of Dairy Technology, and †*Pharmacology, Sindh Agriculture University Tandojam–Pakistan*

ABSTRACT

Present study was carried out to investigate the quality of camel milk. A wide variation was observed in the quality of raw camel milk. Specific gravity ranged between 1.014 and 1.017 (1.015±0.001), pH 6.57 and 6.97 (6.77 ± 0.07), and acidity 0.12 and 2.00 (0.18 ±0.01 g per 100 g). Total solids, solids not fat, fat, protein, casein, lactose, ash and chlorides contents ranged between 7.76 and 12.13, 5.56 and 8.29, 1.8 and 5.0, 1.8 and 3.2, 0.78 and 2.76, 2.9 and 4.12, 0.85 to 1.00 0.20 and 0.28 g per 100 g, respectively. While the mean values (g per 100 g) were 9.74 ± 0.49 for TS, 7.12 ± 0.35 for SNF, 2.63 ± 0.40 for fat, 2.54 ± 0.19 for protein, 2.21 ± 0.02 for casein, 3.65 ± 0.16 for lactose, 0.94 ± 0.02 for ash and 0.26± 0.01 for chlorides.

Key Words: Camel; Milk; Quality

INTRODUCTION

In Pakistan 0.8 million heads of camels are reared in the desert areas mostly of Sindh province, Cholistan (Punjab) and hilly areas of Balochistan (Anonymous, 2002).These animals are utilized mainly for transportation and much less for meat and milk. Although the buffalo milk is expected to be the major source of milk for the people of Pakistan, an increasing demand of milk in summer season warrants study of milk from other species like camel. Average milk yield of camel ranged between 3.5 to 35.0 kg per animal per day with an average lactation yield of 4575 to 20675 kg (Sawaya *et al*., 1984). The major portion of this milk is used to feed their young ones, and rest of the milk is consumed by the owner as fresh or when just slightly soured or mixed with buffalo milk and sold to consumers in big cities.

Despite the large camel population in Pakistan, camel milk is not utilized to any significant extent probably due to unawareness of the use, and the market value of camel milk or because of its saltish taste and high acidic nature (Sawaya *et al*., 1984; Abu-Lehia, 1990; El-Bataway, 1991; Abu-Tarboush, 1996). However, it is much more nutritious than that from cow milk because it is low in fat and lactose contents, and higher in potassium, iron and vitamin C (Anonymous, 1996).

Camel's capabilities have been well documented over the centuries and its niche in the history of mankind is assured but studies on yield and composition of camel milk are scarce in Pakistan. Thus it becomes necessary to evaluate quality of camel milk in a significant manor to ensure that this wonderful animal retains a special place in the heart of future generation.

MATERIALS AND METHODS

Milk samples from 30 she camels at various stages of lactation were collected at random from camel-rearing areas around Hyderabad (village Hoosri & Mula Katiar) and Badin (village Sohanro Khaskheli & Thari Nizamani) Districts. Camels were grazed on uncultivated/saline areas where mostly halophillic plants like Atriplex or Acacia etc are grown naturally. Milk samples (500 mL each) were collected in clean and sterilized sample bottles and brought to the laboratory of Dairy Technology, Sindh Agriculture University, Tando Jam for analysis.

Titrable acidity, specific gravity, total solids, casein, ash and chloride contents were determined according to the method of Association of Official Analytical Chemists (AOAC, 1990a,b,c,d,e,f). pH values were determined using pH meter (Model HI, Hanna Instruments, Italy). Fat content of milk was analyzed by Gerber method as described by James (1995). Protein content was estimated according the method of British Standards Institution (BSI, 1990). Lactose and solids not fat contents were determined by difference.

The data were analyzed using computer package SPSS release 7.5, copyright, 1996, SPSS Inc.).

RESULTS AND DISCUSSION

Results presented in Table I revealed the range of specific gravity of camel milk in between 1.014 and 1.017 with an average of 1.015±0.001. These results are not in agreement with result reported by Ahmed (1990). pH values of fresh camel milk (Table I) was observed in between 6.57 and 6.97 with an average of 6.77±0.07. These results were relatively similar to that of reported values (6.5-6.7) by FAO (1982), while higher than those of reported by Ahmed (1990) and Sawaya *et al*. (1984) (*i.e*. 6.53 & 6.49, respectively). It was observed that this variation was greater in between herds as compared to within a herd.

The acidity in terms of lactic acid content (Table I) varied between 0.12 to 0.20 g per 100 g with an average of 0.18±0.01 g per 100 g. These results were in line with those reported by Ahmed (1990) and Elamin and Wilcox (1992) (*i.e.* 0.13 and 0.15%, respectively). It was further observed

that when camel milk was left to stand the lactic acid content did not show any noticeable increase until approximately 8-10 h. This observation was similar to as Hafiz and Hamzawi (1991), but differ from FAO (1982) who reported that when the milk is left to stand for 2-6 h. the lactic acid content rapidly increases from 0.03% after standing 2 h to 0.14% after 6 h.

Results presented in Table II showed a wide variation in the total solids content of camel milk. The values varied between 7.76 to 12.13 g per 100 g with an average of 9.74±0.49 g per 100 g. These results were lower than buffalo milk (14.73 g per 100 g), but in line with the values reported by different workers (Farag & Kebary, 1992; Al-Kanhal, 1993). Ahmed (1990) and FAO (1982) also reported similar fluctuations (84 to 93 g per 100 g) in the moisture content of camel milk which is inversely proportional to TS content. One of the reasons they reported was hot summer, during which the cow camel secretes highly diluted milk with low fat. This could be the natural phenomena by which the camel young ones are supplied with sufficient nutritional value and water for a superb adaptation in a desert environment. Secondly, water content of fodder would also affect water content of milk.

Fat content of camel milk (Table II) ranged between 1.8 to 5.0 g per 100 g and the average 2.63±0.40 g per 100 g. Variation in fat content was observed to be directly/indirectly related to the total solids content of camel milk, *i.e.* as the total solids increased, the fat content also increased and vice versa. These results were very similar to those of reported by (FAO, 1982) according to which, the hydration status of the animal as well as the type of forage eaten would also affect the fat content of the milk.

Table II presents the total Protein content of camel milk within the range of 1.8 and 3.20 g per 100 g with an average percentage of 2.54±0.19. It could be stressed that protein content of the feed as well as water intake had directly affected the protein quality of milk (FAO, 1982). However, relatively similar range (2.0 to 4.2 g per 100 g) of protein was observed by Lapsson (1990) and Knoess (1982). The concentration of casein analyzed (Table II) in the present study revealed the range in between 1.78 and 2.76 g per 100 g with an average of 2.21±0.02 g per 100 g. Similar results were reported by Anonymous (1989).

Lactose content of camel milk (Table II) varied between 2.91 to 4.12 g per 100 g with an average of 3.65±0.16 g per 100 g. The highest lactose content observed in present study was quite similar to that of reported by Ahmed (1990) and Knoess (1982). This wide variation could be due to the fact that camel usually grazed on halophillic plants for example Atriplex, Acacia etc. (FAO, 1982).

Ash content of camel milk (Table II) was observed to vary in between 0.85 to 1.0 g per 100 g and average 0.94±0.02 g per 100 g. These results were higher than those reported by different workers *i.e.* in between 0.75 to 0.83 g per 100 g (Knoess, 1982; Ahmed, 1990; Elamin & Wilcox, 1992). The reason for higher ash content observed could be due to free grazing of camel on bushes or plants grown at saline soil.

Table I. Physical quality of camel milk

Attribute	Minimum	Maximum	Mean	SE
Specific gravity	1.014	1.017	1.015	0.0006
pH values	6.57	6.97	6.77	0.07
Acidity%	0.12	0.20	0.18	0.01

Table II. Chemical quality of camel milk

Components (g per 100 g)	Minimum	Maximum	Mean	SE
Total solids	7.76	12.13	9.74	0.49
Solids not fat	5.56	8.29	7.12	0.35
Fat	1.80	5.00	2.63	0.40
Protein	1.80	3.20	2.54	0.19
Casein	1.78	2.76	2.21	0.02
Lactose	2.91	4.12	3.65	0.16
Ash	0.85	1.00	0.94	0.02
Chlorides	0.20	0.28	0.26	0.01

Data are the average of 30 Camel milk samples and each in duplicate.

Chloride content of camel milk (Table II) in the present study varied between 0.20 and 0.28 g per 100 g and average 0.26±0.01 g per 100 g. These results were in agreement with the results reported by Alkanhal (1993), however, in some occasions, it possessed higher average (Hafiz & Hamzawi, 1991). It could be due to the forages eaten by the she camel (Knoess *et al*., 1986) because they prefer plants of the genera Acacia, Atriplex and Salosa, and salts of these bushes help to meet the physiological requirements of these animals (Knoess, 1976). The results disagreed with the results of Farag and Kebary (1992) who reported the higher (0.31 g per 100 g) chlorides in camel milk.

In general the present study showed a wide variation in the gross composition of camel milk. The results obtained were in agreement with studies of Ahmed (1990) and Lapsson (1990). This variation was concluded to be partly due to the inherited capabilities of the animals and/or attributed due to various seasonal and environmental factors as well as stage of lactation, age and number of calving. In addition, the feed and water quality and quantity available to the animals also play an important role (FAO, 1982).

CONCLUSION

In view of the observed results of the physico-chemical properties of the camel milk, it could be concluded that camel cow produces nutritious milk for human consumption. The result could contribute to the overall knowledge of camel as food source, but much still needs to be learned if efficient improvement programmes are to be initiated. For example, if camels are reared under same environment as buffalo, there is no doubt it will produce milk of high quality.

REFERENCES

Abu–Lehia, I.H., 1990. The variable contents of lactose and chloride in camel milk. *Egyptian J. Dairy Sci.,* 18: 303–14

Abu–Tarboush, H.M., 1996. Comparison of associative growth and proteolytic activity of yoghurt starters in whole milk from camels and cows. *J. Dairy Sci.,* 79: 366–77

Ahmed, M.M., 1990. The analysis and quality of camel milk. Index of the thesis accepted for higher degrees by the Universities of Great *Britain and Ireland and the councils for National Academic Awards.* 38: 1356

AL–Kanhal, H.A., 1993. Goat and camel milk composition and freezing point. *Egyptian J. Dairy Sci.,* 21: 233–44

Anonymous, 1989. To develop suitable management practices for rearing camel. *Annual Report of Indian National Research Centre on Camel.* 42–54

Anonymous, 1996. *The A–Z of Camels.* SPRC. Arab net–A–Z of the Arabian camel.htm.

Anonymous, 2002. *Economic Survey*, Finance Division Government of Pakistan, Economic Advisors wing. Islamabad.

AOAC, 1990a. Acidity of milk (Titrimetric method). *In: Official Methods of Analysis*, No. 947.05. Association of Official Analytical Chemists Inc. Virginia, USA.

AOAC, 1990b. Specific gravity of milk (pycnometer method). *In: Official Methods of Analysis,* No.925.22. Association of Official Analytical Chemists Inc. Virginia, USA.

AOAC, 1990c. Solids (Total) in milk. *In: Official Methods of Analysis*, No.925.23.Association of Official Analytical Chemists Inc. Virginia, USA.

AOAC, 1990d. Casein in milk. *In: Official Methods of Analysis*, No. 927.03. Association of Official Analytical Chemists Inc: Virginia, USA.

AOAC, 1990e. Ash of milk (Gravimetric method). *In: Official Methods of Analysis.* No. 945.46. Association of Official Analytical Chemists Inc: Virginia, USA

AOAC, 1990f. Chlorides in milk. *In: Official Methods of Analysis*, No.935.43. Association of Official Analytical Chemists Inc: Virginia, USA.

BSI, 1990. Determination of the nitrogen content of liquid milk. *In: Methods for Chemical Analysis of Liquid Milk and Cream.* BSI. 1741, British Standards Institution, London, U.K.

Elamin, F.M. and C.J. Wilcox, 1992. Our Industry Today. Milk Composition of Majaheim Camels. *J. Dairy Sci.,* 75: 3155–7

El–Batawy, M.A., 1991. Some factors affecting the clotting activity of adult camel rennet. *Eygptian J. Dairy Sci.,* 19: 117–30

FAO, 1982. FAO Animal Production and Health Papers. *Camels and Camel Milk.* Food Agriculture Organization of the United Nations, Rome.

Farag, S.I. and K.M.K. Kebary, 1992. Chemical composition and physical properties of camels milk and milk fat. *Proceed. 5th Egyptian Conference for Dairy Science and Technology.* pp. 57–67

Hafiz, E.H. and L.F. Hamzawi, 1991. Comparative study of some compositional, physical and technological properties of Egyptian cow, goat and camel milk. *Annals of Agricultural Science Moshtohor*., 29–2, pp. 835–45

James, C.S., 1995. *Determination of the Fat Content of Dairy Products by the Gerber Method.* Analytical Chemistry of Food. Blackie Academic and Professional, an imprint of Chapman and Hall, Glagow, U.K. pp. 93–5

Knoess, K.H., 1976. *Assignment Report on Animal Production in Middle Awash Valley.* FAO Rome.

Knoess, K.H., 1982. Milk production of the dromedary. *Pakistan Vet. J.*, 2: 91–8

Knoess, K.H., A.J. Makhdum, M. Rafiq and M. Hafez, 1986. Milk production potential of the dromedary with special reference to the province of Punjab, Pakistan. *Animal Breed. Abstract.*, 54: 884

Lapsson, R.M., 1990. *Cheese Making Properties of Camel Milk Food Laboratory News.* No.22: 22–5

Sawaya, W.N., J.K. Khalil, A.A.L. Shalhat and H.A.L. Mohammad, 1984. Chemical composition and nutritional quality of camel milk. *J. food Sci.,* 49: 744

(Received 10 December 2004; Accepted 01 March 2005)