Feb 2014. Vol. 4, No. 8 ISSN2305-8269
International Journal of Engineering and Applied Sciences

www.eaas-journal.org

EFFECTS OF REARING CONDITIONS ON THE PROXIMATE COMPOSITION OF LIBYAN MAGHREBI CAMELS' (CAMELUS DROMEDARIUS) MILK

Obaid A. Alwan[1], Amin O .Igwegbe[2] and Ahmad A . Ahmad[3]

[1]Department of Chemistry, High Institute of Technology, El-Zawia, Libya
[2]Department of Food Science and Technology, Faculty of Engineering, University of Maiduguri, Borno State, Nigeria.
[3]Department of Food Science and Technology, Faculty of Agriculture, University of Tripoli, Libya
alwanhas096@gmail.com, amanjide1964@yahoo.com

Abstract

The main objective of this study was to investigate the possible effects of the rearing conditions on the composition of the Libyan Maghrebi Dromedaries milk. Fourteen (14) lactating camels were divided into two homogenous groups (A and B) of seven (7) camels each, and reared under two different conditions. Group A was reared under a good farm condition provided with concentrated feeds and regular drinking water while group B was reared under the normal desert environment with inadequate water supply. Samples for the proximate analysis were collected at the middle of every other month during the period of the experiment and analyzed for various constituents including moisture, fat, protein, lactose, mineral elements and total solids (TS) as well as the pH and titratble acidity (TA). Mean values (%) obtained for fat, protein, lactose, moisture, TS; ash, TA and pH from group A milk were: 3.02±0.14; 3.19±0.06; 5.47±0.13; 87.54±0.23; 12.46±0.13; 0.78±0.02; 0.16±0.04; and 6.57±0.12, respectively, whereas that of the group B milk were: 2.98±0.11; 2.45±0.16; 5.08±0.12; 88.63±0.34; 11.34±0.33; 0.83±0.06; 0.22±0.04 and 6.3±0.08, respectively. The rearing conditions were observed to significantly ($P \leq 0.05$) affect some of the components of the milk from the two groups. It was concluded that variations in camel milk composition could be attributed to many factors including the rearing conditions.

Keywords: camel, milk, proximate analysis, titratable acidity, pH

Introduction

The population of camels in Libya is estimated to be around 250,000 heads and they are all one-humped "dromedary camels"(Wardeh 2004; Alwan and Igwegbe, 2013). Most of the Libyan camel milk are produced traditionally and consumed fresh, as raw milk, or in varying degrees of sourness (Igwegbe et al., 1992). Historically, camel milk, due to its unique composition, has been used as remedy for a number of medical problems (Dickson 1951). For instance, it has been used in different parts of the world including India, Russia, Sudan, Libya, etc., in the treatment of a series of diseases such as dropsy, jaundice, tuberculosis, asthma and leishmaniasis (Abdelgadir, et al,. 1998; Shalash, 1979 and 1984; Shabo and Yagil 2005). Recently, camel milk was also reported to have other potential therapeutic properties, such as anti-carcinogenic (Magjeed, 2005), anti-diabetic (Agrawal, et al., 2007a), anti-hypertensive (Quan et al., 2008) and in the treatment of immunity deficiencies. This last property of the camel milk might be very useful in the treatment of HIV and AIDS cases. In addition to these medicinal properties of the camel milk, it is widely recognized that in absolute terms, the camel produces more milk and for a longer period of time than any other milk-producing animal held under the same conditions (Knoess, 1977; Yagil, 1982; Farah, 1993). Farah (1993) reported that daily milk yield varied from 3.5 litres for camels under desert conditions to 18.0 liters for those on irrigated lands.

Camel milk is usually opaque-white in colour and has an acceptable taste (Yagil et al, 1980; Alwan and Igwegbe, 2013). The milk normally has a sweet and sharp taste, but sometimes can also have a salty taste due to the type of plants eaten in the desert by the

camels ((Rao et al., 1970; Khaskheli et al, 2005; Alwan and Igwegbe, 2013). The pH and acidity of the milk have been widely reported to range from 0.12-0.14 and 6.36-6.58, respectively (Mal et al, 2006 and 2007). The composition of camel milk had been studied under different conditions (Sohail 1983; Sawaya et al., 1984; Gnan et al., 1986; Abu-Lehia, 1987; Karim and Gooklani, 1987; El-Amin and Wilcox, 1992; Mehaia et al., 1995; Haddadin et al., 2008; Konuspayeva et al., 2009). The mean values of camel milk components (%) reported over the last 30 years were: 3.5±0.1, 3.1±0.5, 4.4±0.7, 0.79±0.07 and 11.9±1.5 for fat, protein, lactose, ash and total solids, respectively (Al-Haj et al., 2010). The camel milk has been adjudged to be different from other ruminant animals' milks, having high mineral contents such as sodium, potassium, iron, copper, zinc and magnesium (Knoess, 1979; Yagil, 1982). The total amount of minerals is generally presented as total ash, its values range between 0.60 to 0.90% (Konuspayeva et al., 2009; Alwan and Igwegbe, 2013). Also, the vitamin C content in the camel milk has been estimated to be two to three folds higher than that of the cow's milk, making the camel milk a good source of this vitamin to the desert inhabitants where fruits and vegetables are lacking (Alwan and Igwegbe, 2013). The wide variations observed in camel's milk composition have always been attributed to many factors such as analytical techniques used, geographical location, feeding regime, size of samples analyzed and breeds, in addition to milking frequency, stage of lactation and parity (FAO, 2001; Iqbal et al., 2001; Ayadi et al., 2009; Konuspayeva et al., 2009; Al-Haj and Al-Kanhal, 2010; Hammadi et al., 2010; Aljumaah et al., 2011). Information regarding the possible effects of the environment and the rearing conditions on the proximate composition of the Libyan Maghrebi camels' milk is very fragmentary and scarce. Therefore, the aim of this study was to investigate the effects of rearing conditions on the composition of the camel milk.

Materials and Methods

The Rearing conditions and Samples collection

Fourteen (14) healthy lactating Libyan Maghrebi dromedaries were randomly selected from a large herd namely Hassan Suleiman Farm, Harsha, Al-Zawia, Libya, for this study. They were divided into two equal homogenous groups (A and B) of seven (7) dams each, and of the same age and parity (the dams used in this experiment were in their first lactation period). The two groups were reared in Al-Zawia area, but under different feeding conditions. Group A was reared on the Hassan Suleiman Farm under very good farm conditions, with concentrated feeds comprising of grains, seeds and hays of alfalfa and oats. Water was also provided to this group on regular basis. Group B were reared under the normal desert conditions in the South of Al-Zawia, under poor feedings of dry and wet shrubs and desert herbs with inadequate supplies of water. The dams in group A were hand milked every morning, whereas those in group B were also hand milked, but three times a week and in the morning hours only. The collection of the milk samples for the proximate analysis commenced one month postpartum and continued on every other month basis from each group for six (6) months of the lactation period. Five (5) litres were taken directly from the pooled fresh milk from each group at the middle of the alternate month, and transported immediately in ice bags to the laboratory for the analysis.

Proximate Analysis

Samples were immediately analyzed in the laboratory for proximate composition moisture, fat, protein and ash contents and for the total solids and titratable acidity in accordance with the procedures outlined by Atherton and Newlander, 1981 and in the AOAC, 2000. Protein was determined through the quantification of the nitrogen content by the standard Micro-Kjeldahl method (AOAC, 2000) and multiplying by a conversion factor of 6.38 to arrive at protein content. Lactose content was determined by subtracting the sum of protein, fat, ash and moisture from 100. The pH was measured by using pH meter (Model WTW410D8120, Welheim, German), while the titratable acidity was determined by titration of the fresh milk with 0.1N NaOH in the presence of phenolphthalein indicator (Atherton and Newlander, 1981).

Mineral analyses

For the determination of mineral elements the ash was dissolved in 5ml concentrated HCl (sp. gr. 1.73g/200C, 35.0 – 37.5%; May and Baker Ltd., Bagenmam, England) and made up to the mark of 50ml volumetric flasks with distilled water (Igwegbe et al., 2013). The final diluted solution for calcium and magnesium determination contained 1% lanthanum to overcome phosphate interference. All

the minerals except phosphorus were determined with an Atomic Absorption Spectrophotometer, AAS (Pye Unicam SP9 AAS).

Statistical Analysis

Statistical analysis of the data obtained in this study was carried out by the calculation of the means and standard deviations. The test for significance between means of the two experimental groups was determined through T-tests at 5% levels of significance (Montgomery, 1976).

Results and Discussion

Dromedaries are natural browsers and thrive on rough sparse pasture where other domesticated animals would virtually starve to death and are able to produce milk. This characteristic makes the lactating camel a very valuable animal for the nutrition of nomads' families in such harsh environment. The major chemical components of milk samples of the two groups of Libyan Maghrebi lactating camels investigated in this study are presented in Table 1, as means of triplicate analysis. The data obtained in this study showed a wide range of variations between the chemical composition of the milk obtained from the two experimental groups (A and B). Statistically, significant differences ($P \leq 0.05$) were observed between Group A and B in the mean values of percent moisture, protein, lactose, ash and total solids (TS) (Table 1). A gradual increase was observed in the titratable acidity of the farmed reared camel milk (group A) whereas that of group B remained almost constant, though higher than that of group A, as the lactation period progressed. The increase in the titratable acidity of the farm-reared camel milk could be as results of the direct effects of both quantity and type of feeds available to the dams. This is very important to note in planning the end use for the camel milk in dairy processing. One of the important factors that affect the composition of camel milk is the amount of water available to the dams. In this study, the moisture contents of the desert-reared dams were significantly higher ($P<0.05$) than that of the farm-reared (Table 1). This observation is completely in agreement with that of other researchers (Yagil and Etzion, 1980; Abu- Lehia, 1987; Alshaikh, 1994; Wilson, 1998; Aljumaah et al., 2011). Yagil and Etzion (1980) observed that when water was freely accessible to camel, the water content of the milk was 86%, and when drinking water was restricted, the water content of the milk rose to 91%. The present study also shows that the lactating camel loses water to the milk in times of drought. This could be as a result of natural adaptation in order to provide the necessary fluid to prevent dehydration of the camel calf. Wilson (1998) also observed that the high content of water in the camel milk is an important factor for herders living in the arid zone. The mean values of protein, lactose and TS, 3.19±0.06; 5.47±0.13 and 12.46±0.13%, respectively, recorded from farm-reared dams, were significantly higher ($P \leq 0.05$) than the same components recorded from the desert-reared dams 2.45±0.16; 5.08±0.12 and 11.34±0.33%, respectively (Table 1); whereas no significant difference ($P \geq 0.05$) was observed between the pH, fat and ash contents of the milk from the two groups (Table 1). The differences were due to the direct effects of the feeding regime, availability of drinking water, in addition to some individual factors including genetics.

Table 1: Comparison of Chemical Composition of Farm-reared and Desert-reared Libyan Maghrebi Camels' Milk

	Group A[1] / Month			Overall	Group B[2] / Month			Overall
Parameter	**1st**	**2nd**	**3rd**	**Means[3]**	**1st**	**2nd**	**3rd**	**Means[3]**
pH	6.40	6.60	6.70	6.57±0.12[a]	6.40	6.20	6.30	6.30±0.08[a]
Acidity	0.13	0.14	0.21	0.16±0.04[a]	0.25	0.16	0.26	0.22±0.04[b]
water%	87.68	87.43	87.50	87.54±0.23[a]	89.02	88.50	88.38	88.63±0.34[b]
Fat %	3.00	2.90	3.17	3.02±0.14[a]	2.93	3.10	2.90	2.98±0.11[a]

Protein%	3.14	3.26	3.18	3.19±0.06[a]	2.32	2.41	2.63	2.45±0.16[b]
Lactose%	5.42	5.61	5.37	5.47±0.13[a]	4.96	5.08	5.20	5.08±0.12[b]
Ash%	0.76	0.80	0.78	0.78±0.02	0.77	0.83	0.89	0.83±0.06
TS %	12.32	12.57	12.50	12.46±0.13[a]	10.98[b]	11.42	11.62 [b]	11.34±0.33[b]

[1]Group A = Lactating camels reared under good farm conditions
[2]Group B = Lactating camels reared under normal desert conditions
[3] In any row, overall means bearing different superscripts are significantly different (P≤0.05)

The results of the mineral analysis of the milk samples (mg/100g) from the two groups of the lactating camels investigated in this study are presented in Table 2. These results indicated gradual increase in the level of all the mineral components as the lactation period progresses, especially in the desert-reared dams (group B). The comparison between the overall means of the two groups showed a significant difference (P≤0.05) in the concentrations of Cu, Ca, Mg, P, Na, and K between the milk samples from the two groups (Table 2). This could be as a result of the hyper-accumulation of the minerals in the desert plants. Igwegbe et al 2013 observed that soils in the arid areas are generally characterized by high contents of carbonate, low concentration of organic matter, low cation exchange capacity, and basic pH value which result in uptake and accumulation of mineral elements in growing plants in the arid areas; the minerals are subsequently taken up by the grazing animals and bio-concentrated in their tissues, including milk, as confirmed by the present study (Table 2). On the other hand, the high concentrations of phosphorus and magnesium in the milk of the farm-reared dams can be seen as a confirmation of the role and importance of good feeding conditions to particularly the lactating animals as good nutrition not only affects the quantity of milk produced by the lactating dam but also the quality of the yield. The total content of minerals in milk is usually expressed as the total ash; this amount varies from 0.60 to 0.90% in Dromedary camel milk (Konuspayeva et al., 2009). Moreover, the results obtained in this study are comparable and are also in agreement with those of the similar studies in various parts of the world, including those of Abu-lehia 1987; Ahmed 1988; Yasin 1957; FAO, 2001; Farah 1992; Zhang et al., 2005; Zeleke 2007; Haddadin et al., 2008; Konuspayeva et al., 2009; Al-haj and Al-kanhal, 2010. The results of these studies attributed variations in the composition of camels' milk to many factors such as analytical techniques used, geographical location, feeding regime, size of samples and breed of the dams, in addition to milking frequency, stage of lactation and parity.

Table 2: Comparison of Mineral Composition of Farm-reared and Desert-reared Libyan Maghrebi Camels' Milk

	Group A[1] / Month			Overall Means[3]	Group B[2] / Month			Overall Means[3]
Mineral	1st	2nd	3rd		1st	2nd	3rd	
Cu	0.11	0.14	0.16	0.14±0.02[a]	0.05	0.06	0.62	0.24±0.27[b]
Fe	0.23	0.26	0.28	0.26±0.02	0.23	0.30	0.31	0.28±0.04
Mn	0.011	0.010	0.021	0.01±005	0.031	0.022	0.020	0.024±0.004
Zn	0.44	0.42	0.39	0.42±0.021[a]	0.51	0.63	0.61	0.58±0.052[b]
Ca	84.34	85.29	87.45	85.69±1.30[a]	120[b]	115	115	114±5.35[b]
Mg	11.04	10.00	12.10	11.05±0.57[a]	6.84	7.57	7.57	7.30±0.32[b]
P	97.40	81.05	88.60	89.02±6.68[a]	63.58	62.70	62.70	65.15±2.87[b]

Na	43.10	31.20	55.12	43.14±9.77[a]	67.77	70.40	70.40	69.26±1.10[b]
K	152.35	135.83	156.11	148.10±8.80[a]	145.12[b]	156.35	156.35	154.57±5.5[b]

[1]Group A = Lactating camels reared under good farm conditions
[2]Group B = Lactating camels reared under normal desert conditions
[3]In any row, overall means bearing different superscripts are significantly different ($P \leq 0.05$)

Conclusion

The results of this research have indicated that the rearing conditions of the Libyan Maghrebi dromedaries significantly affect the proximate composition and the mineral components of the milk. And that the amount of water in the camel's fresh milk is significantly increased when drinking water is restricted, while total solids are significantly lowered. It is suggested that further work should be carried out trying to determine the extent of the variations up to the end of the lactation period.

Acknowledgements:

We are very grateful to the Managements of the High Institute of Technology, Al-Zawia, Libya and the Departments of Food Science and Technology, Faculty of Engineering, University of Maiduguri, Nigeria, and Faculty of Agriculture, University of Tripoli, Libya, for providing the facilities and the enabling environments to carry out this study.

Reference

1. Abdelgadir,W.S., Ahmed, T.K.and Dirar, H.A. (1998). The traditional fermented milk products of the Sudan. Intnl. J. Food Microbiol., 44: 1 - 13.
2. Abu-lehia, I.H. (1987). Composition of camel milk. Milchwissenschaft, 42(3): 68 – 71.
3. Agrawal, R.P., Budania, S., Sharma, P., Gupta, R. And Kochar, D.K. (2007a). Zero revalence of diabetes in camel milk consuming Raica community of Northwest Rajasthan, India. Diabetes Res. Clin. Pract., 76: 290 - 296.
4. Ahmed, M.M. (1988). The analysis and quality of camel milk. Higher Degree Thesis, University of Reading, Reading, UK.
5. Al haj, O.A. and Al Kanhal, H.A. (2010). Compositional, technological and nutritional aspects of dromedary camel milk: a review, Intnl. Dairy J., 10: 10 – 16.
6. Aljumaah, R.S., Almutairi, F.F., Ayadi, M.A., Alshaikh, A.M. and Hussein, M.F. (2011). Factors influencing the prevalence of subclinical mastitis in lactating dromedary camels in Riyadh region, Saudi Arabia . Trop. Anim. Health Prod., 43(8):1605-1610.
7. Alshaikh, M, A and Salah, M, S. (1994). Effects of milking interval on secretion rate and composition of camel milk in late lactation. J. Dairy Res., 61: 451 – 456.
8. Alwan, A.O and Igwgebe, A.O. (2013). Physico-Chemical Properties of Stirred-Curd Cheddar Cheese Manufactured from Farm-reared Camel and Cow's Milk: A Comparative Study. Accepted for Publication in Scottish J. Art Sci. Studies, 2014.
9. AOAC. (2000). Official Methods of Analysis. 17th Edition. Gaithersburg, Maryland, USA.
10. Atherton, H.V. and Newlander, J.A. (1981). Chemistry and Testing of Dairy Products. 4th Ed., Avi Pub. Co., Inc., Westport, Conn.
11. Ayadi, M., Hammadi, T. Khorchani, A. Barmat, M.A. and Caja, G. (2009). Effect of milking interval and cisternal udder evaluation in Tunisian Maghrebi dairy dromedaries (Camelus dromedaries . L) J. Dairy Sci., 92: 1452 – 1459.
12. Dickson, H.R.P. (1951). The Arab of the Desert. London, George Allen & Unwin Ltd. Pp: 409–446.
13. Dilanyan, S.H. (1959). Utilisation of mares, ewes, camels and yaks milk in the USSR. Report Int. Comm. Dairying in warm countries. Dairy Fed. Brussels.
14. Elamin, F.M., Wilcox, C.J., 1992. Milk composition of Majaheim camels. Journal ofFaculty of Agriculture, Tehran, Iran, 42(1): 13 - 17.
15. Farah, Z., Rettenmayer, R. and Atkins, D. (1992). Vitamin content of camel milk. Intnl. J. Vitamin Nutr. Res. 62: 30-33
16. Farah, Z. 1993. Composition and characteristics of camel milk. 1. Dairy Res. 60: 603-626.

17. Haddadin, M.S., Gammoh, S. I. and Robinson, R.K. (2008). Seasonal variations in the chemical composition of camel milk in Jordan. J. Dairy Res., 75: 8 - 12.
18. Hammadi, M., Atigui, M., Ayadi, A., Barmat, A., Belgacem, G. K and Khorchani, T. (2010). Training period and short time yield and milk composition in Tunisian Maghrebi camels (Camelus dromedaries . L) . J. Camel Pract. Res., 17: 1 – 7.
19. Igwegbe, A.O., Gnan, S.O., Mohammed, M.O. Shareha, A.M. (1992a). A comparative study on the fermentability of camel and cow's milk by lactic acid cultures. Proceedings of the Conferences, Pp 153 – 158.
20. Igwegbe, A.O., Agukwe, C.H. and Negbenebor, C.A. (2013). A Survey of Heavy Metal (Lead, Cadmium and Copper) Contents of Selected Fruit and Vegetable Crops from Borno State of Nigeria. Intnl. J. Engr. Sci., 2(1):1 - 5
21. Iqbal, A., Gill, R.M. and Younas, M. (2001). Milk composition of Pakistani camel (Camelus dromedaries) Kept under station / farmer's condition . Emir. J. Agric. Sci., 13:7-10.
22. Konuspayeva, G., Faye, B., and Loiseau, G. (2009). The composition of camel milk: a meta- analysis of the literature data. J. Food Comp. Analysis, 22: 95 - 101.
23. Magjeed, N. A. (2005). Corrective effect of milk camel on some cancer biomarkers in blood of rats intoxicated with aflatoxin B1. J. Saudi Chem. Society, 9: 253 – 263.
24. Mal G., Suchitra, S.D., Jain,V.K. and Sahani, M.S. (2006a). Therapeutic value of camel milk as a nutritional supplement for multiple drug resistant (MDR) tuberculosis patients. Israel J. Vet. Med., 61(3-4): 88-94.
25. Mal, G., Suchitra, S.D. and Sahani, M.S. (2006b). Milk production potential and keeping quality of camel milk. Journal of Camel Practice and Research 13(2): 175-178.
26. Mehaia, M.A., Hablas, M.A., Abdel-Rahman, K.M. and El-Mougy, S.A. (1995). Milk composition of Majaheim, Wadah and Hamra Camels in Saudi Arabia. Food Chem. 52: 115 – 122.
27. Quan, S., Tsuda, H. and Miyamoto, T. (2008). Angiotensin I-converting enzyme inhibitory peptides in skim milk fermented with Lactobacillus helveticus 130B4 from camel milk in Inner Mongolia, China. J. Sci. Food Agric., 88: 2688 - 2692.
28. Rao, M.B., Gupta, R.C. and Dastur, N.N. (1970). Camel milk and milk products. Indian J. of Dairy Sci. 23 (2), 71-78
29. 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.
30. Shabo, Y., Yagil, R. (2005). Behavioral improvement of autistic children following drinking camel milk. In: Treating Persons with Brain Damage. 4th National Conference. Tel Aviv, Israel.
31. Shalash, M. R. (1984). The production and utilization of camel milk. InW. R. Cockrill (Ed.), The Camelid: An all-purpose animal (pp. 196 208). Uppsala, Sweden: Scandinavian Institute of African Studies.
32. Sohail, M.A. (1983). The role of the Arabian camel (Camelus dromedarius) in animal production. World. Rev. Anim. Prod. 19(3): 38-40.
33. Wardeh, M.F. (2004). Classification of the Dromedary Camels. J. Camel Sci., 1 – 7.
34. Wilson, R.T. (1998). Camels. CTA Series, Mac Millan Educational Press Ltd., London, UK. Pp:120–124.,
35. Yasin, S, A and Wahid, A 1957 . Pakistan camels: a preliminary survey. Agric. Pakistan,8, 289 – 92 .
36. Yagil, R. and Etzion, Z. (1980). Effect of drought condition on the quality of camel milk. J. of Dairy Res. 47 (2), 159-166
37. Zeleke, M.Z. (2007). Major non-genetic factors affecting milk yield and milk composition of traditionally managed camels (Camelus dromedarius) in Eastern Ethiopia. Proceedings of the International Camel Conference, February 16-17, 2007, Bikaner, India, pp: 168-170.
38. Zhang, H., Hao, J., Zhao, D., Liu, H. and Guo, M. (2005). Changes in chemical composition of Alxa Bactrian camel milk during lactation . J. Dairy Sci., 88: 3402 – 3410