Effects of type of nutrition on the chemical composition of camels milk and urine

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ABSTRACT

Camel milk and urine have high nutritive values and therapeutic properties. The objective of this study was to find out the effect of camel nutrition on milk and urine chemical composition. A total of 30 she camels were selected from 6 herds, 3 from *Elmanagil* area and 3 from *Tambool* area. All camels belong to the Arabian type. The she- camels were in their first to third lactation and in the second to eighth month of lactation. The camel herds in *Elmanagil* area grazed grasses and browsed shrubs and trees of different types, mostly Acacias. Camels in *Tambool* area received concentrate ration (sorghum grains, groundnut cakes and wheat bran), and dry roughages in the form of sorghum stalks and *Abusabien* hay in the pens. Milk and urine samples were collected from each camel and subjected to chemical analyses. The results showed significant differences ($P \leq 0.05$) in milk and urine minerals content between the two areas. The Ca, K and Mg levels in urine were higher than milk, while Na level was higher in milk compared to that in urine. The minerals content in the urine of the camels found in *Elmanagil* area were significantly higher ($P \leq 0.05$) than *Tambool* area. There was significant difference ($P \leq 0.05$) in fat content between the milk of the camels found in the two areas. The fat content was significantly higher in the camel milk produced in *Tambool* area. It is recommended that camels browse on trees to produce high nutritive value milk and urine.

INTRODUCTION

The dairy camel is characterized by clear development of the udder and milk veins and, hence, high milk production and a relatively big abdomen. Camel milk contains a special type of protein immunoglobulins, lactoferrin, lysozyme and lactoperoxidase and the camel urine contains high levels of some minerals, (K, Ca, Mg and Na). The inflammation – inhibiting proteins may explain why, camel milk had been used to cure intestinal diseases. Camel milk also contains a protein with characteristics similar to insulin. This explains that camel milk can help to prevent and treat diabetes.

Investigation of Dutch camel milk has shown that its composition is the same as that of the Middle East and African camel milk. The high content of unsaturated fatty acids of the camel milk may enhance its overall nutritional quality (Konus *et al.,* 2008; Ayadi *et al.,* 2009). Previous findings pointed out that the variation in camel milk composition could be attributed to many factors such as geographical location, measurement procedures, type of sample, feeding condition and breed, in addition to other factors including stage of lactation, milking frequency and parity (Igbal *et al.,* 2001; Riyadh *et al.* 2012; Al Jumah *et al.,* 2011). However seasonal variation and geographical origin were found to be the most effective factors on camel milk constituents (Khaskheli *et al.;* 2005). Konus *et al.* (2008) reported high variability in chemical composition during different lactation stage. Camel milk composition (%) reported over the past 30 years were: ash = 0.79 ± 0.07, lactose = 4.4 ± 0.7, total solids = 11.9, fat = 3.5 ± 0.1 and protein = 3.1 ± 0.5. However, camel milk is much more nutritious than cow milk due to its low lactose and low fat content, and its higher content of iron, potassium, and vitamin C. Vitamin C content in camel milk is generally double that in cow's milk. Camels mainly depend on natural pastures which are deteriorating. Camels prefer browsing, especially on high trees, besides herbs and consume hundreds of plants and prefer plants not demanded by other animals especially, salty feeds due to its high moisture, CP and ash. The camel preference is affected by season. Camels don't compete with other animals for feeds and is the least in feed per kg b.w. among sheep, goats and cattle.

Autumn pastures are usually sufficient and extend through summer; in addition they use crop residues. Camels consume plants not palatable to other species. They selectively graze on tiny and moist plants with high nutritive value, ash and moisture. They continue to graze even when the plants are dehydrated and the camel mouth is adapted to thorny plants. They can depend on pastures and graze 8 – 10 hours / day and up to 12 hours in poor pasture. The objective of this study was to find out the effect of feeding regime of camels on their milk and urine composition.

MATERIALS AND METHODS

Experimental animals

A total of 30 she Arabian camels were selected from 6 herds (3 herds from *El Managil* area and 3 herds from *Tumbool* area). The she camels were in their first to third lactation, and they were in the second to the eighth month of lactation.

Feeding of the experimental camels

The camel herds at *Elmanagil* area were grazed on grasses and browsed on trees and shrubs at the time of sample collection, while those at *Tumbool* area received concentrate ration and dry roughage.The pasture in *Elmanagil* area was already grazed at the time of sample collection (February), hence the main sources of feed for the camels were shrubs and trees found in the area. Those trees include *Seyal* (*Acacia tortilis L.*) chemical composition (%) was 17.8, 1,8, 17,5 8.4 and 54,6 for CP, EE, CF, Ash, and NFE, respectively (Lampery *et al.*, 1980), *Laot (Acacia nubica L.)*, 21. 1o,5, 1o, 3,5, and55 for CP, EE, CF. ASH, and NFE, respectively (Mohamed, 2001), *Sidir* 18, 2,15, 9.5, 2,44, 54, and 53 for CP, EE, CF, ASH and NFE, respectively for leaves (Lampery *et al.*, 1980) .

The camels in *Tumbool* area received dry roughages which include sorghum stalks and *Abusabein* hay, and a concentrate ration formulated from sorghum grains (40%), wheat bran (30%) and groundnut cakes (30%).

Sample collection

1. Milk samples

From 5 selected she camels in each herd, milk samples were collected twice a day, in the morning before grazing and in the evening after grazing. A composite milk sample was made by mixing the evening and the morning milk of each she camel and then a sample of 1 litre was taken for each she camel. The collected samples were kept cool in an ice-box.

2. Urine samples

The urine from each she camel was collected in a wide open container and then transferred into a plastic bottle. All urine samples were kept cool in a separate ice-box. The urine samples were 500ml. Both milk and urine samples were frozen in a deep freezer for 3 – 4 days for future analysis

Analysis of milk

1. Mineral content

The milk samples were analysed using atomic absorption spectrophotometer model 210 VEP. This method was used for determination of Ca, Mg, Na and K. Milk proteins were precipitated using trichloroacetic acid according to Roa *et al* (1970). The samples were then filtered and the filtrate was analysed using atomic absorption spectrophotometry.

2. Chemical composition of milk

Milk protein, fats, lactose, total solid, density and solid-not fat were determined using lactoscan apparatus, model 3694. Ash content was determined according to AOAC (2000).

Analysis of urine samples

Urine content of Ca, Mg, Na and K were determined using atomic absorption spectrophotometer (Fernandez and Kahn, 1971).

RESULTS AND DISCUSSION

Mineral content of milk and urine

Table 1 shows mineral content of milk and urine of camels found in *Tamboul* area. There were significant differences (P≤0.05) in mineral content between milk and urine of camels found in *Tambol* area. In general, Ca, K and Mg content in urine were by far higher than those found in milk, while Na content was higher in milk compared with that in urine. This may be attributed to the fact that these minerals were found in abundance in the feeds that include green fodders especially Ca and the K (Abu Sowar, 2005). The amounts used for maintenance and production were very small and hence most of the excess minerals had to be excreted in urine. Na was the only mineral found in higher level in milk than in urine. This may be attributed to the fact that Na is found in small levels in roughages, thus the amount left to be excreted in urine is very low.

Table 1. Mineral content of milk and urine of camels in *Tumbool* area.

Mineral (mg/L)	Milk	Urine	t-value	Significant
Ca	116.8	2332.8	23.7	*
K	349.3	1538.3	10.4	*
Na	198.6	48.2	34.4	*
Mg	87. 8	304.7[a]	9.9	*

* Indicate significant difference at P≤0.05.

Table 2 shows mineral content of milk and urine of camels in *Elmanagil* area. The data showed significant differences (P≤ 0.05) in the minerals content between milk and urine of camels found in the area. The levels of Ca, K and Mg in urine were higher than those found in milk, while the level of Na in milk was higher than that in urine. The results in *Elmanagil* area followed the same trend of those of *Tambol* area. However, the levels of the different minerals were higher in case of *Elmanagil* than of *Tumbool* area. This may be attributed to type of feed.

Table 2. Mineral content of milk and urine of camels in *Elmanagil* area.

Mineral(mg/L)	Milk	Urine	t-value	Significant
Ca	149.4 [b]	3139.1 [a]	17.1	*
K	395.8 [b]	2684.5 [a]	26.9	*
Na	249.3 [a]	159.4 [b]	18.9	*
Mg	145.5 [b]	743.6 [a]	4.3	*

* Indicate significant at P≤0.05.

Mineral content of milk

Table 3 shows mineral content of milk of camels in *Elmanagil* and *Tumbool* areas. Significant differences were found in mineral content in the camel milk produced in the two areas. The levels of all minerals were significantly higher in the milk of the camels found in *Elmanagil* area compared to the milk produced in *Tumbool* area. This may be attributed to differences in feed type that each camels group consumed. The fresh forages in the form of growing tips and leaves of Acacia trees had a higher content of minerals (*Elmanagil* area) compared to dry roughages and concentrates (*Tumbool* area). Mehaia *et al.* (1995) suggested that feeding is one of the factors leading to variation in mineral content. Khaskheli *et al*. (2005) reported that camel milk is rich in Cl due to the forage eaten by camels such as Acacia, which according to Yagil (1982) contains a high salt content. The Ca content (116 – 148 mg/L) found in this study was similar to that reported by Alhaj *et al*, (2007), while K, Na and Mg content were higher than reported by the same author. These variations may be attributed to feeding, breed differences (Elamin and Wilcox, 1992), water intake (Haddadin *et al*., 2008), or even to analytical procedure (Mehaia *et al*., 1995). K content of dromedary camel milk was substantially higher than that reported for bovine milk, while Ca and Mg content of dromedary camel milk were close to that in bovine milk (Sawaya *et al*., 1984).

Table 3. Minerals content of milk of camels in Elmanagil and Tumbool areas.

Mineral (mg/L)	*Elmanagil*	*Tambool*	t-value	Significant
Ca	149.4	116.8	8.9	*
K	395.8	349.3	6.5	*
Na	249.8	198.6	9.4	*
Mg	145.5	87.8	17.1	*

* Indicate significant at P≤0.05.

Mineral content of urine in *Tumbool* and *Elmanagil* area

Table 4 shows mineral content of urine of camels found in *Elmanagil* and *Tumbool* areas. There were significant differences (P≤0.05) in minerals content of urine between the camels in *Elmanagil* area and those in *Tumbool* area. The urine samples from the camels in *Elmanagil* area contain significantly higher levels of Ca, K, Na and Mg than the urine sample collected from camels in *Tumbool* area. Nevertheless, all urine samples from both areas contain high levels of Ca and K, but low levels of Na and Mg.The way of feeding (grazing *vs* browsing) affects the level of different minerals in urine.

Table 4. Mineral content of urine of camels in *Elmanagil* and *Tumbool* areas.

Mineral(Mg/L)	*Elmanagil*	*Tumbool*	t-value	Significant
Ca	3139.0	2332.8	4.0	*
K	2684.5	1538.3	8.2	*
Na	159.4	48.2	31.3	*
Mg	743.6	304.7	3.1	*

* Indicate significant difference at P≤0.05.

Milk Chemical composition

Table 5 showed significant difference (P≤0.05) in fat content of milk of camels raised in *Elmanagil* and those in *Tumbool* areas. The fat content was significantly higher in camel's milk produced in *Tumbool* area. This may be attributed to the types of feed eaten in the two areas. The consumption of dry roughages and concentrate led to production of more fat (Elemam, 2000). The level of fat reported in this study agree with those reported by Khanna (1986), Bakht and Igbal (2001), Sawaya (1984), and Abu Lehia (1987), but is less than that reported by Sohail (1983), Ibrahim (1990), and Karim and Gooklani (1987).On the other hand, protein, lactose, ash and solid- not fat showed no significant differences between the milk produced in *Elmangail* area and that produced in *Tumbool* area. However, the different milk constituents were higher in camel milk produced in *Tumbool* area. The levels of these constituents seem not to be affected by the types of feeds that camels received. The protein content was not significantly different (P>0.05) in the camel's milk produced in *Tumbool* and *Elmanagil* area. The level of protein reported in this study was similar to that reported by Sawaya *et al.* (1984) and Meredove (1989), and higher than that reported by Knoess *et al.* (1986), Karim and Gooblani (1987) Abu Lehia (1987) and Elamin and Wilcox (1992), but lower than that reported by

Sohail (1983) and Ibrahim (1990). Lactose content was not significantly different (P>0.05) between the milk produced in *Elmanagil* and *Tumbool* area. Lactose level in this study agreed with that reported by Karim and Gooblani (1987), Elamin and Wilcox (1992),but less than that reported by Schwartz (1992), Knoess *et al.* (1986), Merdove (1989), and higher than that reported by Ibrahim (1990). The total solids content was not significantly different in the camels milk produced in *Tumbool* and *Elmanagil* area. However, it was less than that reported in the literature by many authors (Khanna, 1993; Meredove, 1989; Igbal, 2001).

Table 5. Chemical composition of milk of camels in *Elmanagil* and *Tumbool* areas.

Chemical constituents (%)	*Elmanagil*	*Tumbool*	t-value (±)	Significant
Moisture	90.8	90.4	1.8	NS
Protein	3.2	3.3	4.0	NS
Lactose	4.3	4.5	4.0	NS
Total solids	9.2	9.6	3.1	NS
Fat	3.5b	5.1	4.9	*
Ash	0.58	0.6	1.4	NS
Solid - not fat	8.2	8.5	6.5	NS
Density(g/cm^3)	1.028	1.032	1.6	NS

*and NS indicate significance at P≤0.05 and not significant, respectively.

Correlation between milk and urine mineral content in *Tumbool* area

Table 6 shows the correlation between the milk and urine mineral content collected from camels found in *Tambool* area. The data showed a negative and weak correlation between K and Na contents in milk and urine, however, there was a positive but very weak correlation with respect to Ca content. The Mg content in milk and in urine showed a positive and moderate correlation.

Table 6. Correlation between milk and urine mineral content of camel in *Tumbool* area.

Minerals	Milk	Urine	Correlation coefficient	
Ca	116.8	2332.8	0.03	Very weak
K	395.9	1538.3	– 0.31	– ve weak
Na	198.6	48.2	– 0.27	– ve weak
Mg	87.8	304.7	0.60	+ moderate

Correlation between milk and urine mineral content in *Elmanagil* area

Table 7 shows the correlation between milk and urine mineral content of camels found in *Elmanagil* area. The correlation coefficients showed a negative and weak correlation in Ca content, very weak correlation in K content, negative but strong correlation in Na content, and negative moderate correlation with respect to Mg content.

Table 7. Correlation between milk and urine mineral content of camels in *Elmanagil* area.

Minerals	Milk	Urine	Correlation coefficient	
Ca	149.4	3139.1	– 0.15	ve and very weak
K	349.3	2684.5	0.009	Very weak or no relationship
Na	249.6	159.4	– 0.73	ve and strong
Mg	145.5	743.6	– 0.56	ve and moderate

Conclusion

The levels of minerals found in the milk and urine were higher for camel in *Elmanagil* area where they grazed and browsed on trees.The chemical composition of milk was similar in both areas except for fat content which was higher in *Tambool* area

REFERENCES

Abu-lehia, H. 1987. Composition of camel milk. Milchwissen Schaft 42 (6): 368-371.

Abu Sowar, A.O. 2005. Forage Production in Sudan. Univesity of Khartoum Press, Sudan.

Alhaj, O.A., A. Kanekanian and A. Peters. 2007. Investigation on proteins profile of commercially available milk –based probiotics health drinks using fast protein liquid chromatography (FPLC). British Food Journal 109: 469-480

Aljumah, R.S., F.F. Almutairi, M.A. Ayadi, M.A. Alshaikh, A.M. Aljumaah and M.F. Hussein. 2011. Factors affecting the prevalence of subclinical mastitis in lactating dromedary camels in Riyadh region, Saudi Arabia. Tropical Aminal Health Proceeding.

A.O.A.C. 2000. Official Methods of Analysis, 17 Ed., Association of Official Analytic Chemists.

Ayadi, M., M. Hammadi, T. Khorchani, A. Barmat, M. Atigui and G. Gaja. 2009. Effect of milking interval and cisternal udder evaluation in Tunisian Maghrebi dairy camels (*Camelus dromedarius* L.). Journal of Dairy Science 91:1452-1459.

Bakht B. and A. Igbal. 2001. Production and composition of camel milk, Review. Pakistan Journal of Agricultural Science. 38: 3-4.

El-Amin, F.M. and C.J. Wilcox. 1992. Milk composition of majaheem camels. Journal of Dairy Science 75: 3153-3157.

Elemam, M.E. 2000. Ruminant Nutrition, University of Gezira Press, Wad Medani, Sudan.

Fernandez, F.J. and H.L. Kahn. 1971. Clinical Methods for Atomic Absorption Spectroscopy. Clinical Chemistry Newsletter. 3, 24.

Haddadin, M.S.Y., S.I. Gammoh and R.K. Robinson. 2008. Seasonal variations in the chemical composition of camel milk in Jordan. Journal of Dairy Research 75:8-12.

Ibrahim, A. 1990. Potentialities for milk Production from Sudanese she- camels in feedlot system. In: Proceeding of the international conference of camel Production and Improvement 10-13 December, Tobruk, Libya.

Igbal, A.R., A. Gill and A. Uounas. 2001. Milk composition of Pakistani camel (*Camelus dromedarius*) kept under station, farmers conditions. Emirates Journal of Agricultural Science 13:7-10.

Karim, C.A. and I. Gooklani. 1987. Studies on the gross components of camel milk in Turkman Sahara. Journal of Veterinary Faculty. Tehran, Iran 42(1):62-67.

Khanna, N.O. 1986. Camel as a milk animal. Indian Farming 36(5): 39-40.

Khaskheli, M.M., A. Arain, S. Chaudhary, A. H. Soomro and T.A. Qureshi. 2005. Physico-chemical quality of camel milk. Journal of Agric- Social. Science 1: 164 – 166.

Knoess, K.H., A.I. Makhudum, M. Rafia and M. Hafeez. 1986. Milk production potential of the dromedary with special reference to the Province of Punjab. Pakistan World Animal Reviews 57: 11-21.

Konus, P. G.B. Faye and G. Losseau. 2008. The composition of camel milk. A meta analysis of the literature data. Journal of Food Composition Analysis 22: 95-101.

Lampery, H.F., D.J. Herllock and C.R. Filed. 1980. Report on the State of Knowledge in East Africa in 1980 pp 33-55 In: H.N. Lehouerou (ed). Browse in Africa, Addis Ababa,Ethiopia.

Mehaia, M.A., M.A. Hablas, K.M. Abed-Rahman and S.A. El-Mougy. 1995. Milk composition of *Majaheim*, *Wadah* and *Hamra* camels in Saudi Arabia. Food Chemistry 52: 115-122.

Meredove, B. 1989. One – humped camels in Amiir. Genetic Resources of the USSR. Journal of Animal Production and Health 65: 351-5331 .

Mohamed, A. 2001. Evaluation of some range plants for goats in Rahad area, Butana plain, Sudan. M.Sc. Thesis, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.

Riyadh, A., E. Faris, S. Elsauaed, A. Al Sheikh, S. Ahmed and A. Moez. 2012. Effects of production system, breed, parity and stage of lactation on milk composition of dromedary camels in Saudi Arabia. Journal of Animal and Veterinary Advances 11(1): 141-147.

Roa,M.B, R.C .Gupta and N.N. Dastor, (1970).Camel milk and milk production. Indian Journal of Dairy Science,23:71-78

Sawaya, W.V., J.K. Khali, A.A.L. Shalhat and H.A.L. Mohammad. 1984. Chemical composition and nutritional quality of camel milk. Journal of Food Science 49(3): 744-747.

Schwartz, H.J.,1992. Productive, Performance and Productivity of Dromedaris (*Camelus dromedarius*). Animal Research and Development 35:85-98.

Sohail, M.A. 1983. The role of the Arabian camel (*Camelus dromedarius*) in animal Production. World Reviews of Animal Production 19(3): 38-40.

Yagil, R. 1982. Camels and camel milk. Animal Production and Health Report. : FAO Italy. Rome.

أثر تغذية الإبل على التركيب الكيميائي لألبانها وأبوالها

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الخلاصة

إشتهرت منتجات الإبل وخاصة اللبن والبول بقيمتها الغذائية العالية وخصائصها العلاجية. الهدف من هذا البحث هو تقييم تأثير تغذية الإبل على التركيب الكيميائي ومحتوى المعادن في ألبانها وأبوالها. تم إختيار 30 ناقة من 6 قطعان من الإبل، ثلاثة من منطقة المناقل والثلاثة الأخرى من منطقة تمبول .جميع النوق تنتمي لنوع الإبل العربية. يتراوح موسم الإدرار لها ما بين الأول والثالث بينما تتراوح فترة الحليب ما بين الشهر الثاني والثامن. إعتمدت النوق الموجودة في منطقة المناقل في تغذيتها على المرعى الطبيعي وما به من نباتات وشجيرات واشجار مختلفه معظمها من نوع الاكاشيا، في أثناء فترة جمع العينات، بينما إعتمدت النوق الموجودة في منطقة تمبول على أعلاف مركزة عاديه تحتوي على (حبوب الذرة والامبازات ونخالة القمح) وأعلاف خشنة (قصب ذرة وتبن ابو سبعين) قدمت لها داخل الحظائر. تم جمع عينات من اللبن والبول من كل النوق وتم تحليلها كيميائياً. أظهرت النتائج أن هنالك فروق معنوية ($P<0.05$) في محتوى المعادن في البول واللبن بين المنطقتين. كما وجد أن مستوى Mg, K, Ca أعلى بكثير في البول منه في اللبن. بينما كان مستوى Na أعلى في اللبن. كما أظهرت النتائج أن هنالك فروق معنوية ($P<0.05$) في محتوى المعادن في البول بين المنطقتين وكان مستوى المعادن المختلفة في بول الإبل أعلى في منطقة المناقل مقارنة بمنطقة تمبول. كما أظهرت النتائج ان هنالك فروق معنوية ($P<0.05$) في محتوى الدهن في االلبن بين المنطقتين. حيث كانت نسبة الدهن أعلى في لبن الإبل المنتج في منطقة تمبول. توصي هذه الدراسه في حالة الحاجة إلى مستويات عالية من العناصر المعدنية (Ca, K, Na, Mg) في ألبان وأبوال الإبل يفضل أن تعتمد الإبل في تغذيتها على المرعى الطبيعي والأشجار.