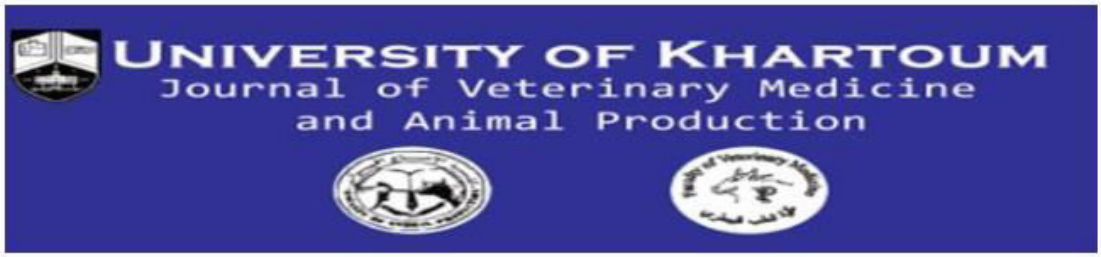
U. of K. J. Vet. Med. Anim. Prod., Vol.6, Issue 2 (2015) p 136-142

ISSN: 243456



Effect of Management System, Parity Orders and Stages of Lactation on Chemical Composition of Camel Milk

Sarra M. B. Mohamed Elhassan[1]; Ibrahim M. M. Dowelmadina[2] and Ibtisam, E. M. El Zubeir[3]

[1]Faculty of Agriculture, Omdurman Islamic University, Sudan, sarrabashir@yahoo.com; [2] Department of Animal Breeding and Genetics, Faculty of Animal Production, University of Gezira, Sudan, Camel2022@gmail.com ; [3]Department of Dairy Production, Faculty of Animal Production, University of Khartoum, P. O. Pox 321, Khartoum, Sudan, Ibtisammohamed@hotmail.com

Abstract

The present study selected the intensive system in Khartoum North (Khartoum State), traditional nomadic system in both Tamboul (Gezira State) and Moya Mountain (Sennar State) for collection of camel milk samples (25, 23 and 21, respectively) during the period from June to July 2013. The study aimed to evaluate the impact of different management systems, parity orders and stages of lactation on the chemical composition of camel milk from different breeds. The samples were examined to determine the percent of fat, solids not fat, total solids, protein, lactose and density of camel milk. The results indicated that both management systems and stages of lactation had impacted significantly ($P \leq 0.05$) the chemical composition of camel milk. Parity order on the other hand did not affected fat, total solids and density of camel milk. Meanwhile the fat, solids not fat, total solids, protein, lactose and density of camel milk decreased with advancement of lactation, i.e from early to late stage of lactation. Milk samples of 4^{th} + 5^{th} parity camels showed the highest fat, solids not fat, total solids, protein, lactose and density compared to other studied parity orders. It was concluded that the chemical composition of camel milk of different breed vary among different management systems and that she-camels grazing in nomadic system utilizing the in rich pasture gave milk with higher compositional content.

Key Words: Camel milk, chemical composition, management systems, stages of lactation, parity orders

المستخلص

أختير فى هذه الدراسة كل من النظام المغلق فى الخرطوم بحرى (ولاية الخرطوم) والنظام الرعوى التقليدى فى كل من تمبول (ولاية الجزيرة) وجبل موية (ولاية سنار) لجمع عينات لبن الإبل (25 و 23 و 21 عينة التوالى). خلال الفترة من يونيو الي يوليو 2013م. هدفت الدراسة لتقيم أثر نظم الإنتاج المختلفة وتأثير كل من فترات الولادة ومراحل الإدرار فى هذه الأنظمة علي التركيب الكيميائى فى لبن الإبل. أختبرت العينات لتحديد قيمة الدهون

والجوامد غير الدهنية والجوامد الكلية والبروتين واللاكتوز والكثافة فى لبن الإبل. أظهرت النتائج فروقات معنوية ($P \leq 0.05$) بين نظم الإنتاج ة ومراحل الإدرار فى التركيب الكيميائى للبن الإبل. لم تلاحظ فروقات معنوية بين فترات الولادة فى الدهون والجوامد الكلية والكثافة فى لبن الأبل. بينما إنخفض متوسط الدهون والجوامد غير الدهنية والجوامد الكلية والبروتين واللاكتوز والكثافة فى لبن الإبل تدريجيا من مرحلة الإدرار الأولي الي مرحلة الإدرار الثالثة. كما سجلت فترة الولادة الرابعة والخامسة أعلي متوسط للدهون والجوامد غير الدهنية والجوامد الكلية والبروتين واللاكتوز والكثافة فى لبن الإبل. أعطت النوق المختلفة التى ترعي فى النظام الرعوى التقليدى فى جبل موية لبن غنى فى التركيب الكيميائى مقارنة بالنظم الآخري.

Introduction

Camel milk is the main valuable food resource for the nomads in Sudan (Musa *et al.*, 2006). It is usually drunk fresh or when turned sour (Bakheit *et al.*, 2008 and Suliman and El Zubeir, 2014).

Camel milk composition showed wide variations in the different management systems in Sudan with some contradictory data (Bakheit *et al.*, 2008; Shuiep *et al.*, 2008; Babiker and El Zubair, 2014; Dowelmadina *et al.*, 2014 and Shuiep *et al.*, 2014) and Saudi Arabia (Riyadh *et al.*, 2012). Moreover parity order and /or calving number had contributed to the variation of camel milk (El-Amin *et al.*, 2006; Zeleke, 2007; Riyadh *et al.*, 2012 and Dowelmadina *et al.*, 2014). The highest percentage of milk fat, protein, lactose and SNF were recorded for the samples of camel in the semi-intensive farming system at the early lactation stage and in the 5th parity (Babiker and El Zubeir, 2014). Variation in the breeds of camel was also reported to affect the composition of camel milk (Haddadin *et al.*, 2008; Riyadh *et al.*, 2012 and Dowelmadina *et al.*, 2014). Some authors also highlighted the effect of feeding conditions on camel milk contents (Khaskheli *et al.*, 2005; Bakheit *et al.*, 2008; Konuspayeva *et al.*, 2009; Dowelmadina *et al.*, 2014 and Shuiep *et al.*, 2014).

This study was aimed to assess the impact of management systems, breed, parity order and stage of lactation on the chemical composition of camel milk in Sudan.

Materials and methods

Source of samples

This study was carried out during the period of June to July 2013. Camel milk samples were collected from Tamboul in Butana area (Gezira State); Khartoum North (Khartoum State) and Moya Mountain (Sennar State).

Milk samples (69) were collected from healthy she camels that reared in intensive system at Khartoum North (n= 25), traditional nomadic at each Tamboul (n= 21) and Moya Mountain (n= 23) as sgown in Table 1. All camels in the two management systems were hand milked three times a day.

Table 1: Milk samples per Parity number

Production system, Location, Breed	Parity Number					Total
	1st	2nd	3rd	4th	5th	
Semi Intensive, Khartoum, Kenani	7	6	7	3	2	25
Traditional nomadic, Tamboul, Lahawi	0	5	6	5	5	21
Traditional nomadic, Moya Mountain, Nefidia	1	5	7	9	1	23

Raw camel milk samples were collected in sterile bottles (50 ml in size). Each sample was immediately labeled, stored in an ice box and transferred to the

laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Khartoum for analysis.

Milk samples chemical analysis

Chemical analysis of camel milk samples were determined by using Lacto-Scan Milk Analyzer (Milkotronic LTD, Europe) according to the manufacturer's instructions, to determine fat, SNF, protein, lactose and density. Meanwhile the total solids were determined by calculation of (Fat + SNF). Twenty five ml of the sample were taken in the sample holder after mixed gently 4-5 times. The sample holder was put in the analyzer in the recess position and the analyzer sucks the milk and makes the measurement. When the measurement was finished, the sample returns in the sample- holder and the digital indicator showed the specified result. This measurement was repeated three times for each sample.

Statistical analysis

Management systems and breeds were divided in three treatments for analysis, as: i) intensive system/ Kenani breed at Khartoum North; ii) nomadic system/ Nefidia breed at Moya Mountain and iii) nomadic system/ Lahawi breed at Tamboul area.

The parity numbers were divided into three parity groups for analysis, as followed: (first and second parity group, third parity group and fourth and fifth parity group).

The stages of lactation were divided into three stages for analysis, as followed: (early stage: contain the data collected during lactation period of first to fourth (1-4 months); medium stage: contain the data collected during lactation period of fifth to eighth (5-8 months) and the late stage: contain the data collected during lactation period of ninth and more (≥9) months.

ANOVA tables were computed with general linear model (univariate) and the means were separated using Duncan Multiple Range Test (DMRT). IPM SPSS software version 22; SPSS Inc., Chicago, USA (2013) was used.

Results

The results in Table 2 showed that camel milk composition recorded significant ($P \leq 0.05$) differences between the management systems and breeds. The camels in the traditional nomadic system in Moya Mountain recorded the highest means of fat (4.63 %), SNF (9.35 %), TS (14.24 %), protein (3.65 %), lactose (4.98 %) and density (1.033 gm/cm^3) in comparison with the other two systems. Whereas the least camel milk fat (3.20 %), SNF (8.04 %), TS (11.23 %), protein (3.11 %), lactose (4.29 %) and density (1.028 gm/cm^3) were recorded in traditional nomadic system in Tamboul.

The data in Table 2 revealed highly significant ($P \leq 0.05$) differences in the contents of solids not fat, protein and lactose of camel milk as affected by the parity orders. However non significant ($P \leq 0.05$) differences between the camels in different parity orders were observed in the contents of milk fat, total solids and density. The density of milk samples from she camels in the different parity orders recorded fixed mean value (1.03± 0.4 gm cm^3). Meanwhile the milk samples from she camels in the fourth + fifth parities showed highest mean percent of fat (4.3), solids not fat (8.9), total solids (13.1), protein (3.4) and lactose (4.7).

Means in Table 4 showed significant ($P \leq 0.05$) differences for fat, solids not fat, total solids, protein,

lactose and density of camel milk as affected by different stages of lactation in the different management systems. All chemical composition (fat, solids not fat, total solids, protein and lactose) and density of camel milk were decreased from the early to the late stage of lactation.

Table 2: Effect of management systems and breed on the chemical composition of camel milk

Management System/ Breed	Mean ± S.E. of chemical composition					
	Fat (%)	SNF (%)	TS (%)	Protein (%)	Lactose (%)	Density (gm/cm^3)
Intensive / Kenani	4.50 ^{a} ±0.18	8.46 ^{b} ±0.1	13.01 ^{b} ±0.28	3.31 ^{b} ± 0.04	4.48 ^{b} ± 0.05	1.029 ^{b} ± 0.4
Nomadic / Nefidia	4.63 ^{a} ±0.21	9.35 ^{a} ±0.11	14.24 ^{a} ±0.33	3.65 ^{a} ± 0.04	4.98 ^{a} ± 0.06	1.033 ^{a} ± 0.5
Nomadic / Lahawi	3.20 ^{b} ±0.21	8.04 ^{c} ±0.11	11.23 ^{c} ±0.32	3.11 ^{c} ±0.04	4.29 ^{c} ±0.06	1.028 ^{c} ±0.5

Means followed by the same superscripts letter(s) in the same column are not significantly different at ($P \leq 0.05$).
SNF = Solids not fat.
TS = Total solids

Table 3: Effect of parity orders on the chemical composition of camel milk

Parity order	Mean ± S.E. of chemical composition					
	Fat (%)	Solids not fat (%)	Total solids (%)	Protein (%)	Lactose (%)	Density (gm cm^3)
First + Second	4.2 ^{a} ± 0.2	8.7 ^{ab} ± 0.1	12.9 ^{a} ± 0.3	3.3 ^{ab} ± 0.04	4.6 ^{ab} ± 0.05	1.03 ^{a} ± 0.4
Third	3.9 ^{a} ± 0.2	8.5 ^{b} ± 0.1	12.7 ^{a} ± 0.3	3.2 ^{b} ± 0.04	4.5 ^{b} ± 0.05	1.03 ^{a} ± 0.4
Fourth + Fifth	4.3 ^{a} ± 0.2	8.9 ^{a} ± 0.1	13.1 ^{a} ± 0.2	3.4 ^{a} ± 0.03	4.7 ^{a} ± 0.04	1.03 ^{a} ± 0.4

Means followed by the same superscripts letter(s) in the same column are not significantly different at ($P \leq 0.05$).

Table 4: Effect of stages of lactation on the chemical composition of camel milk

Stage of lactation (months)	Mean ± S.E. of chemical composition					
	Fat (%)	SNF (%)	TS (%)	Protein (%)	Lactose (%)	Density (gm cm^3)
Early stage (1 – 4 months)	4.4 ^{a} ± 0.2	8.9 ^{a} ± 0.1	13.6 ^{a} ± 0.3	3.5 ^{a} ± 0.04	4.7 ^{a} ± 0.05	1.03 ^{a} ± 0.4
Mid stage (5 – 8 months)	4.3 ^{a} ± 0.2	8.9 ^{a} ± 0.1	13.2 ^{a} ± 0.3	3.5 ^{a} ± 0.04	4.7 ^{a} ± 0.05	1.03 ^{a} ± 0.4
Late stage (≥ 9 months)	3.7 ^{b} ± 0.2	8.1 ^{b} ± 0.1	11.8 ^{b} ± 0.3	3.1 ^{b} ± 0.04	4.3 ^{b} ± 0.06	1.02 ^{b} ± 0.5

Means followed by the same superscripts letter(s) in the same column are not significantly different at ($P \leq 0.05$)

Discussion

In this study significant ($P \leq 0.05$) differences were obtained in the milk composition of camels due to variations of the management systems and breeds (Table 1), parity orders (Table 2) and stages of lactation (Table 3). Similarly previous reports showed variations of camel milk from different production systems (Bakheit *et al.*, 2008; Shuiep *et al.,* 2008; Riyadh *et al.,* 2012; Babiker and El Zubair, 2014; Dowelmadina *et al.*, 2014 and Shuiep *et al.*,

2014). The variations of camel breeds were also found to affect milk composition (Haddadin *et al.*, 2008; Riyadh *et al.*, 2012 and Dowelmadina *et al.*, 2014). Moreover the geographical locations, stage of lactation, age, analytical measurement procedures and feeding conditions (Khaskheli *et al.*, 2005; Bakheit *et al.*, 2008 and Konuspayeva *et al.*, 2009), parity number, and calving number (El-Amin *et al.*, 2006; Zeleke, 2007; Riyadh *et al.*, 2012 and Dowelmadina *et al.*, 2014) were influencing camel milk composition.

Variations in the chemical composition of camel milk also could be related to breeds studied in Table 1. The Nefidia camel's milk showed the highest content of solids not fat, total solids, protein and lactose than the other breeds. These results agreed with those of Babiker and El Zubeir (2014) who found similarities between camel milk components of Kenani and Anafi but reported differences in these components between these two camel breeds. Also Dowelmadina *et al.* (2014) mentioned that Nefidia camel's milk had the highest content of solids not fat, total solids, protein and lactose than the breeds of Kenana and Butana. Khaskheli *et al.* (2005 and Konuspayeva *et al.* (2009) also reported that camel milk components were significantly affected by breed of lactating camels.

The higher milk constituent were obtained in milk samples from the nomadic system in Moya Mountain could be attributed to the fact that camels are grazing on different plants grown beside and/or around irrigation canals of agricultural schemes (Gizera, Kenana and Asalaia) in addition to the continuous availability of water (Dowelmadina *et al.*, 2014). This finding agreed with Shuiep *et al.* (2008) who concluded that availability of quality feed coupled with continuous water supply strongly influenced chemical composition of camel milk. Moreover, the evidences in ruminants demonstrated that composition of milk is strongly influenced by feeding conditions (Sampelayo *et al.*, 1998). However Riyadh *et al.* (2012) mentioned that the semi nomadic system is significantly best than the settled and nomadic systems in camel milk composition in Saudi Arabia. Also the geographical origin was reported to be one of the effective factors that influenced the composition of camel milk (Konuspayeva *et al.*, 2009).

The content of the milk fat of camels was affected by management systems and breed, parity orders and stage of lactation (Tables 1, 2 and 3). Konuspayeva *et al.* (2008) reported that the fat content of dromedary camel milk is between 1.2 to 6.4%. However the average of fat content (4.2%) in camel milk is more than the average reported by Babiker and El Zubeir (2014) who found that the fat content (3.7%) of camel milk were affected by management systems, parity numbers and stage of lactation. Yagil and Etzion (1980) reported that fat content of camel milk was decreased from 4.3 to 1.1% due to the increase in water content of milk produced by thirsty camels.

Solids not fat in camel milk were affected by management systems and breed, parity orders and stages of lactation in this study (Tables 1, 2 and 3). These results supported the results of Babiker and El Zubeir (2014) who found that solids not fat in camel milk were affected by management systems, parity numbers and stage of lactation. Although the locations of the investigation is different from those included in this study. Moreover the total solids in camel milk obtained from camel in the different management systems, parity orders and stages of

lactation (Tables 1, 2 and 3) were in agreement with those reported by Konuspayeva *et al.* (2009).

The fat, solids not fat and total solids content of camel milk samples were lower in the she camels at early compared to those from she camels late stage of lactation (Table 3), this may be due to the increase in the water content of milk during the last stage of lactation (Riyadh *et al.*, 2012; Dowelmadina *et al.*, 2014). These results confirmed those of Gaili *et al.* (2000); Zeleke (2007) who demonstrated that total solids of camel milk decreased from 11.7% in the first stage of lactation to 10.1% at the end of lactation and that fat content of camel milk was gradually decreased with the progress of the stage of lactation.

The present results revealed significant ($P<0.05$) differences in protein content of milk samples collected from camel in the different management systems and breed, parity orders and stages of lactation. The higher protein content in camel in the nomadic system in Moya Mountain could be attributed to the feeding of rich protein diet. These finding agreed with those of Parraguez *et al.* (2003) and Shuiep *et al.* (2008). They reported that rich diet provided to camel resulted in production of milk rich in protein content. These results were also in agreement with Konuspayeva *et al.* (2009). Similarly the average of protein found in during this study is similar to the result of Babiker and El Zubeir (2014).

Results in Tables 1, 2 and 3 showed that the higher lactose content of milk was obtained from she camels reared in different management systems and they were in different parity orders and stages of lactation. These results agreed with Konuspayeva *et al.* (2009). The average lactose content of camel milk samples found in this study, agreed with Babiker and El Zubeir (2014) who obtained 4.6%. Haddadin *et al.* (2008) concluded that lactose content of camel milk is the least variable component.

This study found the chemical composition (fat, solid not fat, total solids, protein and lactose) of camel milk decreased from the early stage to the late stage of lactation. These findings agreed with Babiker and El Zubier (2014) who found that the chemical composition (fat, solid not fat, total solids, protein and lactose) of camel milk decreased from the first stage (1– 3 months) to third stage (≥ 9 months) of lactation. Also Riyadh *et al.* (2012) found that the solids not fat, protein and lactose in camel milk decreased from the first stage to third stage of lactation in Saudi Arabia.

The average of milk density obtained from camels in different management systems, parity orders and stages of lactation agreed with Babiker and El Zubier (2014); Dowelmadina *et al.* (2014) and Shuiep *et al.* (2014) who reported that the average of milk density in she camels kept in different management systems with different parity orders and stages of lactation was ranged between 1.02 to 1.03 mg/cm^3.

In conclusion, the present study confirmed that the chemical composition of camel milk of different breed vary among different management systems, parity orders and stages of lactation. Moreover she-camels graze in nomadic system with rich pasture with continuous availability of water gave milk with higher compositional contents.

References

Babiker, W.I.A. and El Zubeir, I.E.M. (2014). Impact of husbandry, stages of lactation and parity number on milk yield and chemical composition of dromedary camel milk. Emirate Journal of Food and Agriculture, 26 (4): 333-341.

Bakhiet, S.A.; Abu-Nikheila, A.M.; Kijora, C. and Faye, B. (2008). The impact of farming system on Sudanese camel milk production. Program and

Extended Abstracts WBC/ICAR 2008 Satellite Meeting on Camelid Reproduction. Emirates Industries for Camel Milk and Products (Camelicious^{TM}) Dubai, United Arab Emirates. Pp 88-90.

Dowelmadina, I.M.M.; El Zubeir, I.E.M.; Salim, A.D.A. and Arabi, O.H.M.H. (2014). Influence of some factors on composition of dromedary camel milk in Sudan. Global Journal of Animal Scientific Research, 2(2): 120-129.

Eisa, M.O. and Mustafa, A.B. (2011). Production systems and dairy production of Sudan camel (*Camelus dromedarius*): A review. Middle-East Journal of Scientific Research, 7 (2): 132- 135.

El-Amin, E.B.; El Owni, O.A.O. and El Zubier, I.E.M. (2006). Effect of Parity Number, Lactation Stage and Season on Camel Milk Composition in Khartoum State, Sudan. Part IV: 2173-2183. Qassim University, Saudia Arabia, 9-11.

Elnour, A.A.H.M. and Bakheit, S.A. (2012). The Effect of Parity Number on Some Mineral Level Rations in Camel's Milk. A Case Study: North Kordofan State, Sudan. 3rd ISOCARD International Conference. Sultanate of Oman 29th January-1st February 2012, 3:220-221.

El Zubier, I.E.M. and Nour, E.M. (2006). Studies on some camel management practices in pre-urban areas of Khartoum State, Sudan. International J. Dairy Sci., 1: 104-112.

Gaili, E.S.E.; Al-Fknah, M.M. and Sadek, M.H. (2000). Comparative of three types of Saudi camels (*Camelus dromedarius*). Journal of Camelid Practice and Research, 7: 73-76.

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

HCENR (2009). Higher Council for Environment and Natural Resource. Sudan's 4th National report to the convention on biological diversity. Khartoum, Sudan.

Khaskheli, M.; Arain, M.A.; Chaudhry, S.; Soomro, A.H. and Qureshi, T.A. (2005). Physico-chemical quality of camel milk. Journal of Agriculture and Social Sciences, 2: 164-166.

Konuspayeva, G.; Lemarie, E.; Faye, B.; Loiseau, G. and Montet, D. (2008). Fatty acid and cholesterol composition of camel's (*Camelus bactrianus*, *Camelus dromedaries* and hybrids) milk in Kazakhstan. Dairy Science and Technology, 88: 327-340.

Konuspayeva, G.; Faye, B. and Loiseau, G. (2009). The composition of camel milk: A meta-analysis of the literature data. Journal of Food Composition and Analysis, 22: 95- 101.

Parraguez,V.H.; Thenot, M.; Latorre, E.; Ferrando, G. and Raggi, L.A. (2003). Milk composition in alpaca (*Lama pacos*): Comparative study in two regions of Chile. Archivos de Zootecnia, 52: 431-439.

Riyadh, S.A.; Faris, F.A.; Elsyed, I.; Mohammed, A.A.; Ahmed, S. and Moez, A. (2012). Effect of production system, breed, parity, and stage of lactation on milk composition of dromedary camels of Saudi Arabia. Journal of Animal and Veterinary Advances, 11: 141-147.

Sampelayo, M.R.; Perez, L.; Boza, J. and Amigo, L. (1998). Forage of different physical forms in the diets of lactating Granadina goats: Nutrient digestibility and milk production and composition. Journal of Dairy Science, 81: 492-498.

Shuiep, E.S.; El Zubeir, I.E.M.; El Owni, O.AO. and Musa, H.H. (2008). Influence of season and management on composition of raw camel (*Camelus dromedarius*) milk in Khartoum State, Sudan. Tropical and Subtropical Agro ecosystem, 8: 101 – 106.

Shuiep, E.S.; El Zubeir, I.E.M. and Yousif, I.A. (2014). Compositional quality of camel milk and some husbandry practices associated with camel milk production in two production systems in Sudan. SUST Journal of Agriculture Veterinary Sciences, 15: 10-18.

Suliman, E.S.K. and El Zubeir, I.E.M. (2014). A survey of the processing and chemical composition of gariss produced by nomadic camel women herders in Al Gaderif state. Jordan Journal of Biological Sciences, 7(2): 95-100.

Yagil, R. and Etzion, Z. (1980). Effect of drought condition on the quality of camel milk. Journal of Dairy Research, 47: 159-166.

Zeleke, Z M. (2007). Non-genetic factors affecting milk yield and milk composition of traditionally managed camels (*Camelus dromedarius*) in eastern Ethiopia. Livestock Research for Rural Development, 19 (6). Available at www.irrd.org/irrd19/6/zeleke19085.htm