East African Scholars Journal of Agriculture and Life Sciences
Abbreviated Key Title: East African Scholars J Agri Life Sci
ISSN 2617-4472 (Print) | ISSN 2617-7277 (Online)
Published By East African Scholars Publisher, Kenya

Volume-7 | Issue-4 | Apr-2024 | DOI:10.36349/easjals.2024.v07i04.001

OPEN ACCESS

Original Research Article

Factors Associated with Chemical Composition of Camel Milk from Different Production Systems in Sudan

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Article History
Received: 19.03.2024
Accepted: 24.04.2024
Published: 27.04.2024

Journal homepage:
http://www.easpublisher.com

Quick Response Code

Abstract: In this study, the impact of different management systems, parity orders, stages of lactation and age of she camels on the chemical composition of milk were evaluated. The study was conducted during August to October 2018 to compare camel milk from three production systems that include the traditional nomadic in Kuma locality (North Darfur State) to the semi-nomadic (Red Valley in Eastern Nile and Hamid Well in Western Omdurman (Khartoum State) and the intensive in El Huda in Western Omdurman (Khartoum State). The milk samples investigated belong to three groups; parity orders, lactation stages and ages; of she-camels. The samples (n=120) were examined to determine the percent of fat, solids not fat, lactose, protein and density in camel milk. The results showed significant (P≤0.05) differences between milk samples obtained from camels reared in different management systems. The semi-nomadic system in Hamid Well area recorded high values for the chemical constituent in comparison to other systems and locations. Stages of lactation of she-camels kept in the intensive production system showed significant effect on the values of SNF, protein, lactose and the density of milk. However non-significant differences were recorded on milk chemical composition depending on parity orders and age of she-camels. In conclusion, the variations of the values of the chemical composition of camel milk from different locations is strongly correlated to the management systems that influenced by the availability of water and feed as well as other factors including lactation stages.

Keywords: Camel milk composition, Production systems, Parity orders, Stage of lactation, Age.

INTRIDUCTION

According to FAOSTAT (2021), the estimation of camels' population during 2019, the Sudan is rated among the highest world size of camel population in the world with population near 5 million heads. Sudan also has about 13% and 15% of the total population of camels in the world and Africa, respectively. However camel milk is not broadly used as cow's milk, although it is an essential commodity for people living in arid and semi-arid zones for its nutritive values (Benmeziane, 2021). Moreover, for the desert people in Asia and Africa, camel is vital to daily life as a source of food and a mean of transportation, and its milk has been used as medicines for diverse ailments since ancient times (Ali *et al.*, 2019a). Camel can produce more milk for a longer period of time in arid zones and harsh environment than any other domestic livestock species (Farah *et al.*, 2007).

The selling of milk is neither practiced nor accepted by camel herders in the traditional systems in Sudan (Musa *et al.*, 2006; Shuiep and El Zubeir, 2012; El Zubeir and Shuiep, 2019) as there are no well-established camel dairy farms (Shuiep and El Zubeir, 2008). Never the less, recently a new trend towards commercialization of camel milk associated with the new semi intensive camel production system has been started in Khartoum as well as other big towns of the country (Shuiep and El Zubeir, 2012). As it seems to be a suitable alternative for supplying urban areas with camel milk. which has a growing market demand, thus raising the monetary value of camel rearing (Shuiep *et al.*, 2014a).

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Dowelmadina *et al.,* (2015) reported that in Sudan, the four camel management systems practiced are the predominant traditional nomadic system, the transhumance or semi-nomadic system, sedentary or semi-sedentary system and the intensive system. The three major production systems of camel in Pakistan including sedentary, transhumant and nomadic. These production systems are mostly affected by the environmental conditions, land consistency, vegetation resources and availability of water (Khaskheli, 2020).

The camel milk constitutes of 2.5-4.5% protein, 2.9-5.5% fat, 8.9-14.3% SNF, 2.9-5.8% lactose, 0.35-0.95% ash, 86.3-88.5%) water and 1.03 g/cm^3 mean specific gravity (Ali *et al.,* 2019b). In Sudan, the camel milk from traditional nomadic systems was significantly ($P<0.05$) rich in its compositional content compared to those obtained from semi-intensive systems; 4.50±0.04% vs. 3.47±0.04% protein, 6.62±0.09% vs. 4.20 ±0.09% fat, 6.00 0.06% vs. 4.75±0.06% lactose, 11.40±0.11% vs. 8.91±0.11% SNF and 1.044 g/cm^3 and 1.031 g/cm^3 density (Yousof and El Zubeir, 2020).

The variations reported for the compositional content in camel milk could be due to many intrinsic and extrinsic factors. Different studies concentrated on the production and management systems as the main contribution factors for the camel milk composition. Shuiep *et al.,* (2008) found highly significant ($P\leq0.01$) differences in fat and lactose content of milk from camels kept in the traditional and semi-intensive production systems in Khartoum State, Sudan. Dowelmadina *et al.,* (2014) reported that the highest values of milk fat, protein, lactose, TS and SNF were recorded for the camel in traditional nomadic system in Butana area followed by those obtained from the semi intensive system. Mohamed Elhassan *et al*., (2015) and Mohamed and El Zubeir (2020) concluded that the management system has significant impact in camel milk composition.

Riyadh *et al.,* (2012) reported that the highest significant percentages of protein, lactose and SNF and the lowest fat were recorded in the milk of camels kept in semi-nomadic system in comparison to the settled system in Saudi Arabia. Similarly, Mostafa *et al.,* (2017) indicated that the fat, protein, lactose, total solids and solids not-fat contents showed significant variations in the milk of Maghrebi she-camel in different management in Egypt.

Variations were also observed in camel milk composition during different stages of lactation and parity orders (El-Amin *et al.,* 2006; Babiker and El Zubeir, 2014; Dowelmadina *et al*., 2014; Mohamed Elhassan *et al.,* 2015; Idrees *et al.,* 2016; Mohamed and El Zubeir, 2020) in Sudan and nearby regions; Riyadh *et al.,* (2012) in Saudi Arabia and Mostafa *et al.,* (2017) in Egypt as well as in Kazakhstan (Konuspayeva *et al*., 2010). Moreover, Alwan and Zwaik (2014) reported that the variations in milk chemical composition of Libyan Maghrebi camels may be attributed to some factors such as age, number of calving, management, stage of lactation, sampling technique used and feed quality. Also, Babiker and El Zubeir (2014) reported that the variation of camel milk to be due to the differences in the management systems, parity numbers and stage of lactation for she-camels kept in Khartoum State. Moreover, Mohammed and El Zubeir, 2023) concluded that the important factors such as parity number and age of she-camels, in addition to the seasons and pasture content resulted in the variations in camel milk chemical composition. Therefore, this study was done with the objective of evaluating the influence of parity orders, stages of lactation and age of she-camel raised in different management systems and locations on the chemical composition of milk.

MATERIALS AND METHODS

Study Sites

This study was conducted to evaluate camel milk samples that were collected from 120 healthy she-camels (*Camelus dromedarius*) during August to November 2018. The study aimed to evaluate the effect of different management systems, parity orders, lactation stage and age of she-camels on the chemical composition of milk. The camels investigated include four locations; Kuma in North Darfur, Green Valley in Eastern Nile, Hamid Well and El Huda in West Omdurman (Khartoum State) as shown in Plate 1.

Description of Study Sites

Three different management systems; traditional nomadic (Kuma in North Darfur), semi-nomadic (Green Valley in Eastern Nile and Hamid Well in Western Omdurman) and the intensive (El Huda in Western Omdurman) were included in this study (Plate 1).

Camels in traditional nomadic system always browse the natural trees and graze the grass land without any supplementary feeding (Plate 2). In the semi-nomadic system, the camels browse at pasture during the day light and then go back at night to pens in most of year (Plate 3 and 4). However, the camels in the intensive system are kept in pens all year round (Plate 5), and provided with a daily ration that consists of a mixture of groundnut cake and *Sorghum bicolor* (locally known as *Feterita* and *Abu 70*). The water interval is restricted in both nomadic and semi-nomadic production systems, while it was continuously offered in the intensive production systems. All camels in the three management systems were hand milked 2 - 3 times a day.

Collection of Milk Samples

Raw camel milk samples (n= 120) were collected into clean bottles (500 ml) that were labeled and stored in an ice box before they were transported to the laboratory of the Department of Dairy Production,

Faculty of Animal Production, University of Khartoum to conduct the analysis.

Chemical Analysis of Camel Milk

Chemical analysis of camel milk samples was determined by using Lacto-Scan Milk Analyzer (Milkotronic LTD, Europe) according to the manufacturer's instructions, to determine fat, SNF, density, protein and lactose content of milk samples.

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 shows the specified result. This measurement was repeated three times for each sample.

Statistical Analysis of the Data

The data obtained were arranged as the following:

1. Management systems, the traditional nomadic (Darfur), semi-nomadic (Green Valley and Hamid Well) and intensive system (El Huda).
2. Parity orders are grouped into 3 (1^{st} and 2^{nd}, 3^{rd} and 4^{th} and more than 4 parities).
3. Stage of lactation (grouped into: early, mid and late stage).
4. Age (grouped into: young, mid and old she-camels/year).

Each factor was replicated three times for the analysis. For the statistical analysis of the data, 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 (SPSS. 2013) was used.

RESULTS AND DISCUSSION

Influence of Production Systems on Camel Milk Composition

The average chemical compositional (fat, SNF, density, protein and lactose) values in camel milk in all production systems ranged between 4.34-6.49%, 9.11-9.89%, 1.031-1.033 g/cm^3, 3.55-3.90% and 4.83-5.24%, respectively (Table 1). These values were harmonized with the results of Babiker and El Zubeir (2014) who reported that the contents of fat, SNF, density, protein and lactose in camel milk in three production systems were in a range of 1.05-6.55%, 6.15-11.36%, 1.023-1.038, 2.28-4.58% and 3.18-6.02%, respectively. The results obtained by Mohamed and El Zubeir (2020) revealed that the effect of management systems on the camel milk composition was highly significant ($P<0.001$) and the highest values of total solids, fat, protein, lactose and density were recorded for the milk samples collected from camels that kept in the semi-closed farm and the natural browsing range production system (14.47% vs. 14.89%, 5.07% vs. 5.59%, 3.67% vs. 3.65%, 5.01% vs. 4.90% and 1.033 mg/cm3 vs. 1.032 mg/cm3, respectively). Lower overall means were obtained for the total solids (12.98±12.84%) and lactose (4.77±4.69%) content of camel milk samples collected from transhumance nomadic production system in Shandi area, Sudan (Mohammed and El Zubeir, 2023). The fat and protein content in camel milk were affected significantly ($P\leq0.05$) by the variations of the production systems (Table 1). Similarly previous reports showed variation of fat and protein in camel milk due to the management systems (Bakheit *et al.*, 2008; Shuiep *et al.*, 2008; Riyadh *et al.*, 2012; Babiker and El Zubeir, 2014; Dowelmadina *et al.*, 2014; Shuiep *et al.*, 2014b; Mohamed Elhassan *et al.*, 2015). However non-significant differences were recorded between the studied production systems regarding the SNF, density and lactose content in camel milk (Table 1). Similar results were obtained by Elbashir and Elhassan (2018) who found no significant effect of management systems during different seasons at Butana area on SNF and lactose contents. Babiker and El Zubeir (2014) also reported that the management systems were not affecting the value of density in camel milk. On the other hand, the milk obtained from camels reared in the semi-nomadic system at Wad Hamid area recorded high values of fat, SNF, protein and lactose than that of intensive, nomadic and semi-nomadic systems at East Nile (Table 1). These findings agreed with those reported by Riyadh *et al.*, (2012) who found that the camel milk collected from the semi-nomadic system recorded high percentages of SNF, protein and lactose in comparison with those obtained from the settled and nomadic systems. Also, Babiker and El Zubeir (2014) found higher milk fat, SNF, protein and lactose in the camels reared in semi-intensive system than that kept either intensive or grazing and supplement systems. The production of camel milk as organic food from natural grazing system was suggested before (Yousof and El Zubeir, 2020).

Influence of Parity Orders on Camel Milk Composition

The values of chemical composition in camel milk obtained from all studied locations and production systems were not affected significantly ($P>0.05$) by the three classes of parity orders first to second, third to fourth and fifth or more parities. As the values of these parameters were closely related within the different parity orders classes, except for fat content that revealed slightly different values (Table 2). These finding agreed with those obtained by El-Amin *et al.*, (2006) who mentioned that no significant variations were observed on fat and protein content of milk depending on the different parity orders for camels reared at Khartoum State. Results of Dowelmadina *et al.*, (2014) also showed non-significant differences of fat, SNF, density, protein and lactose content between the camels kept in the semi intensive system during the first four parities. Moreover, other previous studies (Riyadh *et al.*, 2012; Babiker and El Zubeir, 2014; Mohamed Elhassan *et al.*, 2015) also

reported that fat and density in camel milk were not affected significantly by the different parity orders of she camels. The milk samples from she camels at the second parity revealed 14.44% total solids, 5.25% fat, 3.60% protein, 4.88% lactose and 1.032 mg/cm^3 density compared to those found for she camels at the third parity that 13.46% total solids, 4.69% fat, 3.46% protein, 4.69% lactose and 1.031 mg/cm^3 density (Mohamed and El Zubeir, 2020). However, Riyadh *et al.,* (2012) indicated that the protein and lactose content were affected by variation of the parity orders and that the highest level of lactose content (5.3%) was observed in the milk of camels at their first parity. Mohammed and El Zubeir (2023) estimated highly significant (P<0.01) positive correlations when comparing the parity number of the she camel with total solids (r= 0.293), protein (r= 0.241) and density (r= 0.345) and negative correlation with lactose (r= - 0.364) content of milk.

Influence of Lactation Stages on Camel Milk Composition

Lactation stages of she-camels browsing in Darfur, Red Valley and Wad Hamid areas were not affecting significantly the camel milk components (Table 3). Also, the results obtained by El-Amin *et al.,* (2006) showed non significant variations between lactation stages on fat, protein and lactose in camel milk. However, Idrees *et al.,* (2016) reported that the stages of lactation were significantly (P<0.01) influenced total solids and fat content in camel milk, but similar to the present result no variation on protein and lactose were observed. On the other hand, the lactation stages were significantly affecting the values of SNF, density, protein and lactose of milk content of she-camel kept in El Huda area (Table 3). The results agreed with those reported by Konuspayeva *et al.,* (2010); Riyadh *et al.,* (2012); Babiker and El Zubeir (2014); Mohamed Elhassan *et al.*, (2015). The reason might be because of the concentrate offered for she camel kept in this production system (intensive). The mean values in camel milk protein, lactose, TS and SNF were significantly higher during the first stage of lactation, while the mean for fat level was significantly high during the third stage of lactation (Dowelmadina *et al.,* (2014). Moreover, in south east of Algeria, the highest density, fat and TS values in camel milk were found during the first stage of lactation, while the ash was the lowest. However, the protein and lactose content did not change with advancing lactation (Hadef *et al.*, 2015).

Influence of She-Camel Age/Year on Camel Milk Properties

Age of she-camel grazed in different locations were not affecting significantly (P>0.05) the values of milk chemical composition (Table 4). However, Mohammed and El Zubeir (2023) found that the age of the she camels has highly significant correlations when compared with total solids, protein, lactose and density of milk. Never the less, the results indicated that fat content was slightly higher in camel of older ages. This result disagreed with those obtained by Alwan and Zwaik (2014) who reported that the animal age was among the factors that affecting the chemical composition in camel milk. Also, Swelum *et al.,* (2021) reported that the age of camels is one of the factors that affecting the milk composition more significantly.

All chemical composition values in camel milk recorded in this study ranged between 3.63-7.60%, 8.36-10.51%, 3.27-4.15% and 4.37-5.54% for fat, SNF, protein and lactose according to all factors tested. Babiker and El Zubeir (2014) also reported that camel milk composition in different management systems in Sudan ranged between 1.05-6.55% for fat, 6.15-11.36% for SNF, 2.28-4.58% for protein and 3.18-6.02% for lactose. Al Salihi *et al.,* (2017) found that the percentages of total fat, SNF, protein and lactose revealed 4.1343±2.88%, 9.428±2.8833%, 3.576±1.1087% and 5.3406±1.6513%, respectively for Iraqi dromedary camel's milk.

The obtained average value of density reported during this study (1.029-1.035 mg/cm^3) supported Babiker and El Zubeir (2014) who obtained 1.023-1.038 mg/cm^3 for density in camel milk. Also Hessian (2013) found that the density in camel milk was 1.029±0.00 g/cm^3. The overall mean reported for the density was 1.035±1.030 gm/cm^3 in camel milk samples collected from Nile State in Sudan (Mohammed and El Zubeir, 2023). The density in camel milk ranges from 1.026-1.035, which was lower than those of the cows' milk (Gul *et al.*, 2015).

In this study all camel milk samples tested showed high variations in chemical composition depending on production systems (Table 1), and to less extend by the variation of parity orders (Table 2), stages of lactation (Table 3) and age of she camels (Table 4). Some of these findings were in line with those reported by El Amin *et al.* (2006); Nabag *et al.,* (2006); Bakheit *et al.*, (2008); Shuiep *et al.*, (2008); Riyadh *et al.* (2012); Babiker and El Zubeir (2014); Dowelmadina *et al.,* (2014); Shuiep *et al.,* (2014b); Mohamed Elhassan *et al.* (2015); Mostafa *et al.,* (2017); Mohamed and El Zubeir (2020) and Mohammed and El Zubeir (2023). They showed that the chemical composition showed high variations according to production systems, parity orders, stages of lactation and age. Also, the chemical composition estimated for camel milk could also be affected by other factors (e.g., breeds, geographical location, feeding habits and calving number (Al Salihi *et al.*, 2017). The effects of feed, breed, age, and lactation stage on milk composition are more significant for camel and that the region and season are significantly changing the ratio of compounds in camel's milk (Swelum *et al.*, 2021).

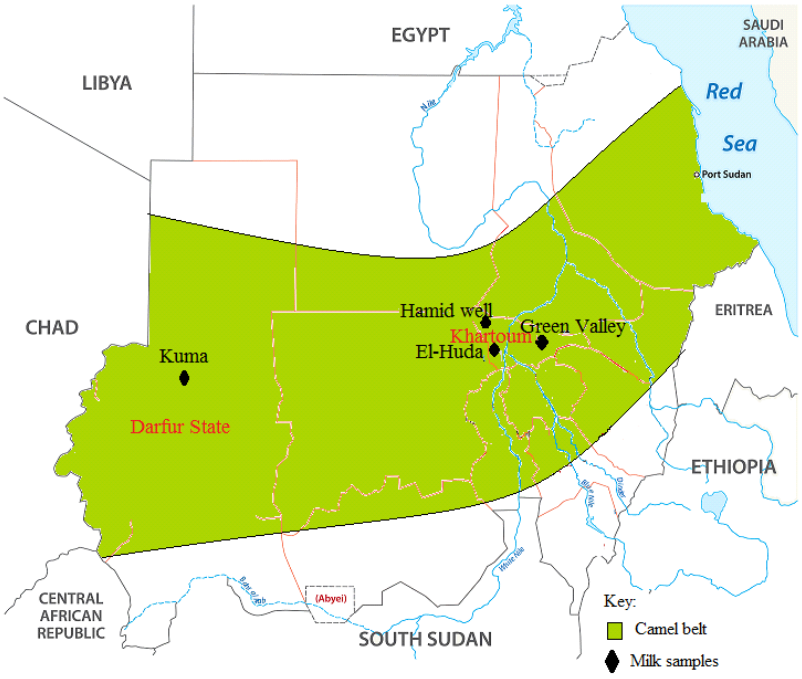

Plate 1: Study sites from which camel milk samples were collected

Plate 2: Some of camels in Al Koma area (North Darfur State) browsing the natural pasture

Plate 3: Camel browsing weeds and shrubs grown in Eastern Nile, Khartoum State

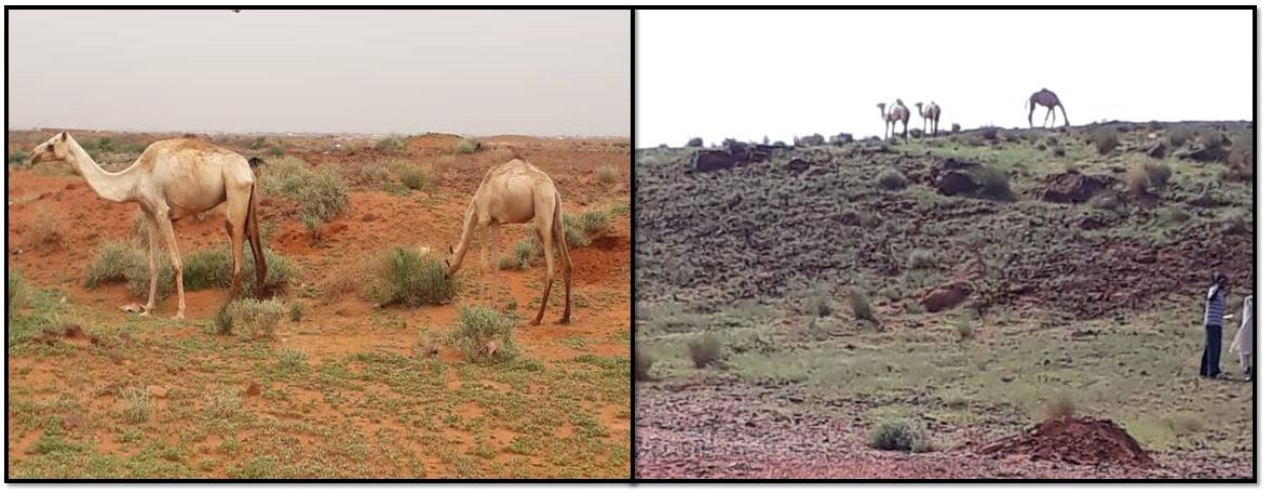

Plate 4: Camels utilizing at natural pasture in semi-nomadic system, Hamid Well area at West Omdurman (Khartoum State)

Plate 5: Camels rearing in the intensive system production System (Khartoum State)

Table 1: Effect of production system in different locations on chemical composition of camel milk

Production system	Location	Milk chemical composition (%)				Density gm/cm^3
		Fat	SNF	Lactose	Protein	
Nomadic	Darfur	4.34±0.7^b	9.36±0.4^a	4.99±0.2^a	3.65±0.2^b	1.033±1.3^a
Semi-nomadic	Green Valley	4.41±0.8^b	9.11±0.6^a	4.83±0.3^a	3.55±0.2^b	1.032±2.1^a
Semi-nomadic	Wad Hamid	6.49±1.6^a	9.89±0.9^a	5.24±0.4^a	3.90±0.4^a	1.031±7.9^a
Intensive	El Huda	6.07±1.3^a	9.51±0.7^a	4.93±0.5^a	3.75±0.3^{ab}	1.032±2.3^a
Statistics	LSD	1.06	0.59	0.34	0.24	3.90
	CV (%)	21.80	6.84	7.48	7.13	13.39
	Error df	36	36	36	36	36
	F value	9.221	2.521	2.163	3.146	0.218
	P value	0.001	0.073	0.109	0.037	0.883

Means within columns which followed by similar letters are not significantly different at 0.05 level of probability according to DMRT.

Table 2: Effect of parity number on chemical composition of camel milk

Production system (Location)	Parity order		Chemical composition of camel milk (%)				Density (gm/cm^3)
			Fat	SNF	Lactose	Protein	
Nomadic (Darfur)	First	1 - 2	4.53^a	9.35^a	4.98^a	3.65^a	1.033^a
	Second	3 - 4	4.20^a	9.24^a	4.93^a	3.60^a	1.032^a
	Third	> 4	4.35^a	9.58^a	5.11^a	3.73^a	1.034^a
Statistics	SE±		0.34	0.30	0.16	0.12	1.13
	CV (%)		15.54	6.47	6.34	6.52	6.87
Semi-nomadic (Green Valley)	First	1 - 2	4.62^a	9.06^a	4.82^a	3.54^a	1.031^a
	Second	3 - 4	4.43^a	9.25^a	4.88^a	3.61^a	1.032^a
	Third	> 4	3.78^a	8.84^a	4.72^a	3.44^a	1.031^a
Statistics	SE±		0.31	0.37	0.19	0.15	1.31
	CV (%)		0.15	8.13	7.97	8.26	8.32
Semi-nomadic (Wad Hamid)	First	1 - 2	5.60^a	9.52^a	5.05^a	3.74^a	1.033^a
	Second	3 - 4	5.31^a	9.54^a	5.07^a	3.74^a	1.033^a
	Third	> 4	6.70^a	9.71^a	5.12^a	3.83^a	1.033^a
Statistics	SE±		0.76	0.55	0.28	0.22	1.73
	CV (%)		25.76	11.50	11.05	11.89	10.55
Intensive (El Huda)	First	1 - 3	6.78^a	9.89^a	5.22^a	3.90^a	1.033^a
	Second	4 - 5	7.04^a	9.89^a	4.95^a	3.91^a	1.033^a
	Third	> 5	7.06^a	9.62^a	5.15^a	3.81^a	1.032^a
Statistics	SE±		0.62	0.37	0.29	0.15	1.37
	CV (%)		18.00	7.57	11.38	23.68	8.27

Means within columns which followed by similar letters are not significantly different at 0.05 level of probability according to DMRT.

Table 3: Effect of lactation stages/month on chemical composition of camel milk

Production system (Location)	**Stage of lactation**		**Chemical composition of camel milk (%)**				**Density (gm/cm^3)**
			Fat	**SNF**	**Lactose**	**Protein**	
Nomadic (Darfur)	Early	1 - 4	4.07^a	9.42^a	5.03^a	3.66^a	1.033^a
	Mid	5 - 8	4.08^a	9.40^a	5.02^a	3.65^a	1.033^a
	Late	> 8	4.55^a	9.53^a	5.08^a	3.72^a	1.033^a
Statistics	SE±		0.41	0.13	0.41	0.06	0.38
	CV (%)		19.16	2.76	2.51	2.98	2.26
Semi-nomadic (Green Valley)	Early	1 - 4	4.72^a	8.90^a	4.74^a	3.49^a	1.031^a
	Mid	5 - 7	4.23^a	8.36^a	4.45^a	3.27^a	1.029^a
	Late	> 7	5.61^a	8.80^a	4.66^a	3.47^a	1.029^a
Statistics	SE±		0.72	0.25	0.12	0.11	0.65
	CV (%)		29.78	5.78	5.27	6.36	4.38
Semi-nomadic (Wad Hamid)	Early	1 - 5	5.79^a	9.38^a	4.97^a	3.69^a	1.032^a
	Mid	6 - 10	6.12^a	9.80^a	5.18^a	3.86^a	1.033^a
	Late	> 10	4.97^a	9.38^a	4.99^a	3.67^a	1.032^a
Statistics	SE±		0.81	0.51	0.26	0.21	1.60
	CV (%)		28.92	10.78	10.31	11.19	9.83
Intensive (El Huda)	Early	2 - 4	7.41^a	10.51^a	5.54^a	4.15^a	1.035^a
	Mid	5 - 7	6.24^a	9.54^{ab}	5.08^{ab}	3.76^{ab}	1.032^{ab}
	Late	> 7	6.81^a	9.26^b	4.37^b	3.67^b	1.031^b
Statistics	SE±		0.66	0.31	0.28	0.13	0.99
	CV (%)		19.29	6.35	11.37	6.55	6.04

Means within columns which followed by similar letters are not significantly different at 0.05 level of probability according to DMRT.

Table 4: Effect of age/year on chemical composition of camel milk

Production system (Location)	Age/year		Chemical composition of camel milk (%)				Density (gm/cm^3)
			Fats	SNF	Lactose	Protein	
Nomadic (Darfur)	First	5 - 8	4.56[a]	9.45[a]	4.99[a]	3.65[a]	1.032[a]
	Second	9 - 12	3.99[a]	9.16[a]	4.89[a]	3.56[a]	1.032[a]
	Third	> 12	4.56[a]	9.76[a]	5.20[a]	3.81[a]	1.034[a]
Statistics	SE±		0.30	0.26	0.14	0.11	1.11
	CV (%)		13.88	6.22	5.73	5.89	6.68
Semi-nomadic (Green Valley)	First	2 - 6	4.51[a]	8.76[a]	4.49[a]	3.43[a]	1.030[a]
	Second	7 - 10	4.63[a]	9.26[a]	4.92[a]	3.61[a]	1.032[a]
	Third	> 10	3.63[a]	9.63[a]	4.96[a]	3.74[a]	1.034[a]
Statistics	SE±		0.35	0.38	0.20	0.14	1.51
	CV (%)		16.25	8.27	8.35	7.88	9.39
Semi-nomadic (Wad Hamid)	First	4 - 6	5.94[a]	9.62[a]	5.09[a]	3.78[a]	1.033[a]
	Second	7 - 9	5.57[a]	9.72[a]	5.16[a]	3.81[a]	1.033[a]
	Third	> 9	6.06[a]	9.19[a]	4.86[a]	3.62[a]	1.031[a]
Statistics	SE±		0.70	0.39	0.20	0.19	1.19
	CV (%)		23.97	8.20	7.82	8.60	7.32
Intensive (El Huda)	First	5 - 9	6.87[a]	10.17[a]	5.38[a]	4.01[a]	1.034[a]
	Second	10 - 14	7.60[a]	10.00[a]	4.75[a]	3.96[a]	1.033[a]
	Third	> 14	6.35[a]	9.50[a]	5.06[a]	3.74[a]	1.032[a]
Statistics	SE±		0.69	0.41	0.38	0.17	1.40
	CV (%)		19.76	8.31	15.09	8.39	8.41

Means within columns which followed by similar letters are not significantly different at 0.05 level of probability according to DMRT.

CONCLUSION

This study concluded that the camel milk samples examined showed high variations in the chemical composition depending on the type of production systems, which are practiced in the different locations. The availability of water and differences in feed types and sources are the main contributing factors of this variation. Also, other factors including parity orders, lactation stages and age of she camels are found to influence the level of the chemical composition of milk. It is recommended that the government and related organizations to assist camel herders in finding permanent gatherings for utilization of their milk by the urban consumers as it is a wealthy product.

ACKNOWLEDGEMENT

The authors would like to acknowledge the effort done by Mr. Hafiz, I. I. Osman during the collection of the samples obtained from North Darfur State. Thanks, should also extended to Dr. Omar A. A. Sidahmed for his assistant during statistical analysis of the data. This study was partially funded by the Ministry of Higher Education and Scientific Research, Sudan.

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Cite This Article: Sarra M. B. Mohamed-Elhassan & Ibtisam E. M. El Zubeir (2024). Factors Associated with Chemical Composition of Camel Milk from Different Production Systems in Sudan. *East African Scholars J Agri Life Sci*, *7*(4), 60-69.