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Effect of parity and breed on some physico-chemical components of Sudanese camel milk

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Abstract

Milk samples from 60 she-camels (*Camelus dromedaries)* in different parity numbers (one to fifth) and in different breed (Anafi n=10, Keneana n=20, Daili n=12 and Arabi n=18) were randomly collected to investigate the effect of parity and breed on some physico-chemical components of camels milk. Milk yield, fat, solid not fat (SNF) and protein were affect by parity number ($P<0.05$). Significant differences ($P<0.05$) of breed types were recorded in freezing point, conductivity, milk yield, fat, lactose, ash, SNF and protein. The results showed strong positive correlation ($P<0.01$) in density, freezing point, fat, SNF, lactose, ash and protein. But between fat and lactose, fat and ash were positively correlated ($P<0.05$). The correlation of each parameter with the added water and conductivity was negatively highly significant ($P<0.01$). The study concludes that parity and breed had significant effect on some physico-chemical components of camel milk.

Keywords: Camel, SNF, Fat, milk analysis, lactation

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Introduction

Camels live in vast pastoral areas in Africa and Asia and are divided into two different species belonging to the genus Camelus. Dromedary camels (*Camelus dromedarius*, one humped) are mainly found in the desert areas (arid), and Bactrian camel (*Camelus bactrianus*, two-humped) are the inhabitant of cold areas (Farah, 1996; Yagil, 1982). The total camel population in the world is estimated to be about 26 million (FAO, 2011). Ministry of Animal Resources, Fisheries and Ranges (MARFR, 2011) estimated the total camel population as 4.6 millions in Sudan. Camels are considered to be a good source of milk and meat, and are used for other purposes such as transportation and sport racing. Camel milk has an important role in human nutrition in the hot regions and arid countries it contains all the essential nutrients found in bovine milk (El-Agamy et al., 1998). The general composition of camel milk varies in various parts of the world with a range of 3.5 to 4.5% protein, 3.4 to 5.6% lactose, 3.07 to 5.50% fat, 0.7 to 0.95% ash and 12.1 to 15% total solids (Gnan and Sheriha, 1986). These wide variations in the components of milk were attributed to some factors such as age, number of calving, management and stage of lactation (Abu-Lehia, 1987; Alshaikh and Salah, 1994) and feed quality (Parraguez et al., 2003). Compared to cow milk, camel milk contains more proteins and whey (Farah, 1993 and Walstra et al., 1999). In addition, it contains vitamin A, E, D, B and vitamin C source of camel milk has been reported to be three to five times higher than that in bovine milk (Stahl et al., 2006).

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Konuspayeva et al. (2009) mentioned that fat content of camel milk is between 1.2 and 6.4 %. Yagil and Etzion (1980) reported that fat content of camel milk tends to decrease from 4.3 to 1.1 percent in milk produced by thirsty camels. Compared with bovine milk, camel milk fat contains smaller amounts of short chain fatty acids (Abu-Lehia, 1989) and a lower content of carotene (Stahl et al., 2006). This lower carotene content could explain the whiter colour of camel milk fat (Abu-Lehia, 1989). Higher contents of long chain fatty acids were also reported for camel milk fat compared with bovine milk fat (Konuspayeva et al., 2008). Similarly, the unsaturated fatty acid is higher in camel milk, especially the essential fatty acids (Abu-Lehia, 1989; Haddadin et al., 2008). Gast et al. (1969) claimed that the value of camel milk is to be found in the highest concentrations of volatile acids especially, linoleic acid and the polyunsaturated acids, which are essential for human nutrition. A strong positive correlation between fat and protein contents was found by Haddadin et al. (2008). Total protein content of camel milk ranges from 2.15 to 4.90% (Konuspayeva et al., 2009). Camel breeds and seasonal conditions were found, in particular, to play a role in camel milk protein content. The main components of protein are casein and whey proteins was found to be similar for camel milk of the same breed (Sawaya et al., 1984; Elamin and Wilcox, 1992), but varied for other breed milk was reported to have difference in protein content when compared with other camel breeds (Mehaia et al., 1995). Protein content was also reported to vary according to season for the same breed and was found to be lowest (2.48%) in summer and highest (2.9%) in winter (Haddadin et al., 2008). The lactose content of camel milk varies from 2.40 to 5.80% (Konuspayeva et al., 2009). The wide variation of lactose content could be due to the type of plants eaten in the deserts (Khaskheli et al., 2005). Camels usually prefer halophilic plants such as Atriplex, Salosa and Acacia to meet their physiological requirements of salts (Yagil, 1982). Therefore, camel milk is sometimes described as sweet, salty and at other times as bitter. It has been reported that the lactose content is the only component that almost remains unchanged over seasons (Haddadin et al., 2008) under hydrated or dehydrated conditions (Yagil and Etzion, 1980). The total content of minerals (ash) varies from 0.6 to 0.9% in camel milk (Konuspayeva et al., 2009). These variations were attributed to breed differences, feeding (Mehaia et al., 1995) and water intake (Haddadin et al., 2008). Khaskheli et al. (2005) mentioned that pH values of fresh camel milk ranged between 6.57 and 6.97. Many evidences in ruminants has demonstrated that milk composition is strongly influenced by feeding conditions (Sampelayo et al., 1998) and it is suggested that when animals are breeding in environments quite different from that considered natural for them, a difference in milk composition may be found. Moreover, Bekele et al. (2002) concluded that if camel had been kept under better management conditions milk production would be better.

The objective of this study was to determine the effects of parity and breed on some physico-chemical components of Sudanese camel milk.

Materials and Methods

Study area

Butana plain is a semiarid clay region covers most of the present Kassala and Gedaref States in Eastern Sudan. It lies between Latitude 13º 40' and 17 50' North and Longitude 32º 40' and 36 00' East and bound by the Main River Nile on its northwestern border, the Blue Nile on its southwestern edge, the Atbara River in the northeast and by the railway connecting Kassala and Sennar on the south. The area is composed of mountainous ranges intersecting the plain to the western and southern borders. It is crossed by many seasonal rivers namely, Atbara, Seitite, Ba-Salam, Gash and Rahad Rivers. Small temporary seasonal valleys do run through these plains during the rainy season. Camel grazes in Butana on different types of browsed plants include trees (*Sunut, Samar, Kitir, Sayyal, Salam, Lao'at and Sidir*), legumes (*Tabar, Hantout, Diraisa, Shara and Siha*), grasses (*Dobalab, Tumam and Ghabash*), bushes and shrubs (*Tondub and Kormut*) as reported by Darosa and Agab (2008).

Milk sampling and collection

A total of sixty camel milk samples (*Camelus dromedaries)* in different parity numbers (one to fifth) and in different breeds (Anafi n=10, Keneana n=20, Daili n=12 and Arabi n=18) were randomly collected (40 ml) in clean plastic containers. Samples were kept in ice thermo flask until analysis. Milk yield data was taken from the records of herders.

Milk analysis

The determination of density, conductivity, freezing point, pH, fat, solids non fat, lactose, protein and ash, were done using automatic milk analyzer (Lactoscan^{TM}, LA, Bulgaria).

Statistical analysis

The obtained data on the effect of parity and breed on milk yield and components was analyzed with ANOVA test followed by multiple comparisons using Fisher test (LSD). The correlation between different components of camel milk was calculated using Pearson's correlation.

Results and Discussion

The mean values of camel milk yield and component affected by parity number showed significant differences

Table 1: Effect of parity on milk yield and component of Sudanese Camel

Parity	Milk yield (kg)	Fat (%)	SNF (%)	Density (kg/m^3)	Lactose (%)	Ash (%)	Protein (%)	Temp. (˚C)	Freezing point (˚C)	Conductivity (mS/cm)	pH
1st	4.05±	4.06±	7.86±	27.5±	4.32±	0.58±	2.87±	14.16±	0.51±	7.78±	6.66±
(N=16)	1.26^{b}	2.75^{a}	0.36^{ab}	1.21	0.27	0.08	0.13^{a}	4.09	0.02	1.25	0.15
2nd	4.48±	3.61±	8.1±	28.6±	4.61±	0.6±	2.96±	14.22±	0.51±	6.74±	6.65±
(N=8)	1.25^{ab}	0.44^{ab}	0.39^{a}	1.44	0.24	0.1	0.14^{a}	3.29	0.03	0.93	0.05
3rd	5.16±	3.37±	7.62±	27.13±	4.34±	0.58±	2.78±	12.67±	0.47±	8.23±	6.62±
(N=16)	1.41^{a}	0.92^{b}	0.61a^{bc}	1.99	0.5	0.06	0.22^{ab}	4.84	0.05	1.75	0.13
4th	5.68±	3.25±	7.54±	26.92±	4.45±	0.6±	2.75±	13.26±	0.48±	7.8±	6.59±
(N=15)	1.95^{a}	0.98^{b}	0.68^{b}	2.29	0.54	0.05	0.25^{b}	5.3	0.04	1.39	0.08
5th	4.81±	2.67±	7.18±	25.94±	4.4±	0.56±	2.62±	12.34±	0.47±	8.41±	6.66±
(N=5)	0.88^{ab}	0.86^{b}	0.97^{bc}	3.38	1.09	0.06	0.35^{b}	6.48	0.07	2.59	0.13
Over all	4.88±	3.49±	6.69±	27.26±	4.4±	0.59±	2.81±	13.39±	0.49±	7.82±	6.63±
	1.56	0.91	0.62	2.02	0.5	0.07	0.22	4.64	0.04	1.56	0.12
Significant	*	*	*	NS	NS	NS	*	NS	NS	NS	NS

Different superscript letters in the same column means significant at P<0.05: *significant at P<0.05, NS: no significant

Table 2: Effect of breed on milk yield and components of Sudanese camel

Type	Milk yield (kg)	Fat (%)	SNF (%)	Density (kg/m^3)	Lactose (%)	Ash (%)	Protein (%)	Temperature (˚C)	Freezing point (˚C)	Conductivity (mS/cm)	pH
Anafi	5.22±	2.53±	7±	25.38±	3.91±	0.57±	2.57±	10.24±	0.43±	9.25±	6.62±
(N=10)	1.14^{ab}	0.76^{b}	0.59^{b}	1.84	0.43^{b}	0.08^{b}	0.21^{b}	2.27	0.04^{b}	1.3^{a}	0.1
Kenana	5.92±	4.04±	8.1±	28.44±	4.45±	0.66±	2.96±	13.60±	0.50±	7.98±	6.62±
(N=21)	1.55^{a}	0.64^{a}	1.31^{a}	4.88	0.72^{a}	0.11^{a}	0.48^{a}	4.93	0.04^{a}	1.36^{b}	0.12
Daili	4.34±	3.49±	7.97±	28.21±	4.57±	0.56±	2.91±	12.58±	0.50±	6.95±	6.63±
(N=12)	1.35^{c}	0.69^{a}	0.55^{a}	1.69	0.39^{a}	0.05^{b}	0.2^{a}	3.53	0.03^{a}	1.2^{c}	0.1
Arabi	3.93±	3.53±	7.73±	27.45±	4.69±	0.55±	2.83±	15.14±	0.50±	7.45±	6.65±
(N=18)	1.19^{c}	1.05^{a}	0.49^{a}	1.5	0.54^{a}	0.06^{b}	0.18^{a}	5.23	0.03^{a}	1.6^{bc}	0.13
Overall	4.91±	3.53±	7.79±	27.6±	4.46±	0.59±	2.85±	13.3±	0.49±	7.83±	6.63±
	1.56	0.94	0.94	3.28	0.62	0.09	0.34	4.65	0.04	1.55	0.12
Significant	**	**	*	NS	**	**	*	NS	**	**	NS

Different superscript letters in the same column means significant at P<0.05; **significant at P<0.01; *significant at P<0.05; NS: no significant

Table 3: Milk components correlation matrix of some Sudanese camel breed types (n=60)

	Age	Milk yield	Fat	SNF	Density	Lactose	Ash	Protein	Added water	Temp.	Freezing point	Cond.	pH
Age	1	0.358**	-0.251	0.106	0.177	0.231	0.306*	0.114	.0311*	-0.243	-0.282*	0.126	-0.234
Milk yield	-	1	-0.038	0.096	0.116	-0.127	0.386**	0.099	0.029	-0.135	-0.111	0.180	0.148
Fat	-	-	1	0.578**	0.419**	0.306*	0.317*	0.567**	-.659**	-0.180	0.455**	-0.316*	-0.004
SNF	-	-	-	1	0.980**	0.684**	0.667**	1**	-0.726**	-0.236	0.541**	-0.376**	0.067
Density	-	-	-	-	1	0.698**	0.676**	0.982**	-0.652**	-0.219	0.504**	-0.343**	0.083
Lactose	-	-	-	-	-	1	0.546**	0.684**	-0.39**	0.131	0.593**	-0.195	0.043
Ash	-	-	-	-	-	-	1	0.67**	-0.298*	0	0.219	0.099	-0.092
Protein	-	-	-	-	-	-	-	1	-0.722**	-0.237	0.537**	-0.375**	0.063
Added water	-	-	-	-	-	-	-	-	1	0.18	-0.758**	0.589**	-0.108
Temperature	-	-	-	-	-	-	-	-	-	1	0.025	0.304*	0.131
Freezing point	-	-	-	-	-	-	-	-	-	-	1	-0.479**	0.236
Conductivity	-	-	-	-	-	-	-	-	-	-	-	1	-0.152
pH	-	-	-	-	-	-	-	-	-	-	-	-	1

**correlation is significant at P<0.01; *correlation is significant at P<0.05

in milk yield, fat, SNF and protein (P<0.05) contents in different parities (Table 1). The results revealed that density, lactose, ash, sample temperature, freezing point conductivity and pH showed no significant differences (P>0.05). Fourth and third parities shows higher milk yield (5.68 and 5.16 kg respectively) while first lactation showed the lowest (4.05 kg) this in line with Al haj and Al Kanhal (2010) who stated that production of camel milk is affected by many factors such as breed, feeding and management conditions, lactation number and stage of lactation. Fat, SNF and protein contents showed gradual reduction by subsequent parity except in second lactation. Starting from the third lactation fat, SNF and protein contents gradually decreased. The milk in the first parity showed the highest fat content (4.06%) with no significant difference (from second to fifth lactation).

There was slight decrease in fat content from 3.61 to 3.49%. This finding is disagreed with the findings of Zeleke (2007) who mentioned that the effect of parity on fat content of camel milk was statistically significant. The first and second lactation showed highest SNF (7.86 and 8.1%) respectively while the other lactation showed no significant difference (P>0.05). This result is similar to those found by Riyadh et al. (2012).

Effect of breed on physico-chemical milk components is shown in Table 2. Milk yield, fat, SNF, lactose, ash, protein, freezing point, conductivity, differed significantly (P<0.05). This result agreed with those of other researchers (Alshaikh and Salah, 1994; Gaili et al., 2000; Khaskheli et al., 2005; Konuspayeva et al., 2009; Ereifej et al., 2011) who reported that camel milk component were significantly affected by breeds of lactating camels. Kenana type showed the highest milk yield (5.95 kg) compared to Arabi (3.93 kg). Fat, SNF, lactose, ash, protein and freezing point in Anafi type showed the lowest level compared to other breeds. Also the results showed that milk obtained from Anafi breed showed significantly high in conductivity while Daili was the lowest (6.95) with no significant difference (P>0.05) between Kenana and Arabi.

Most of the parameters showed positively correlation (P<0.01) with each other as shown in Table 3. This finding agreed with results of Abdelgadir et al. (2013). However, the positive correlation between fat and lactose, fat and ash did not agree with Abdelgadir et al. (2013). A negative correlation of each parameter with the added water and conductivity was found. These results were in line with those of Abdelgadir et al. (2013) who found a negative correlation in conductivity with fat, lactose, ash, protein and density.

Conclusion

Both parity and breed had significant effect on some physic-chemical components of camel milk. Highest milk production was found during 3rd and 4th parity. Moreover, Kenana breed showed high values in milk yield, fat, SNF, protein and ash.

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