Emir. J. Food Agric. 2014. 26 (4): 349-353
doi: 10.9755/ejfa.v26i4.17276
http://www.ejfa.info/

REGULAR ARTICLE

Some lipid components of the camel milk and blood in intensive farm in Saudi Arabia

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Abstract

Eight lactating camels in intensive dairy farm were sampled for the determination of some lipid components of milk and serum. The gross composition of camel milk samples was close that was shown in literature. The main milk fatty acids (FA) were represented by long chain FA. The proportion of polyunsaturated FA was 3.4%, of monounsaturated 30.3% and of saturated was 66.4% with a ratio saturated/unsaturated FA of 1.97:1. The total cholesterol was on average 118.5 ± 13.0 mg/L, while vitamin A was 419.9 ± 80.9 IU/L, vitamin E 20.2 ± 1.05 µg/100mL and vitamin C, 26.1 ± 3.5 mg/L. Vitamin D3 was below the detection limit. In serum, four FA were mostly present: C16:0, C18:0, C18:1 n-9 and C18:2 n-6 representing 89.1% of the whole FA. Total cholesterol was on average 130.0 ± 18.7 mg/L. According to global FA status, saturated FAs were 59.1%, monounsaturated 16.2% and polyunsaturated 24.1% with a ratio saturated/unsaturated of 1.5 only. There was no significant correlation between cholesterol content in milk and in blood samples, also between the main FA in milk and blood. Under in-door system, the camel receiving intensive diet did not change significantly the main composition of its milk and serum except low level in vitamins.

Key words: Camel, Lipid, Milk, Serum, Intensive System

Introduction

The composition of the camel milk is widely described in the literature, especially regarding its gross composition for long time, the first publication on the camel milk composition dating from 1905 (see the meta-analysis of Konuspayeva et al., 2009). Recent advances in fine milk composition are also available, notably regarding the protein (Al-Haj and Al-Kanhal, 2010) or lipid composition (Konuspayeva et al., 2008). However, the observed variability is high and linked to the nutritional and physiological status of the animals.

It is known that main components of milk are coming from serum. But few data are available in the literature, especially on camel regarding parallel study on fatty acid and cholesterol content in milk and serum blood as well as regarding the level of the vitamin content.

Moreover, the current intensification of the farming system in camel growing countries like Saudi Arabia could also have an effect on the milk composition, notably because the intensive in-door feeding (alfalfa hay with barley or wheat bran or other concentrates) leads to a monotonous diet far away from the variability of the desert plants.

In the present study, only female camels at similar lactation stage and receiving the same diet in an intensive dairy farm were taking in account in order to analyzed the variability of some gross (fat, protein, lactose and ash) and fine components (fatty acids, vitamins, cholesterol) of the camel milk, as well as in blood with the aim to compare the results to those of camel reared in other contexts.

Received 22 May 2013; Revised 18 June 2013; Accepted 19 June 2013; Published Online 11 October 2013

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Material and Methods

Location and animals

This study was carried out in the camel farm of Al -Jouf "Camel & Range Research Center" located in north-west Saudi Arabia, 950 km from Riyadh. Average annual temperature was 20°C, ranging from 12°C to 27°C, and average annual rainfall was 55 mm. The 8 sampled camels 5 to 11 years old belonged to four ecotype breeds: Malhah, Waddah,

Hamrah and Safrah. The range of their live weights was 552 to 831 kg. Camels were kept in-door throughout the year and housed in pens. Their normal diet was composed of alfalfa (*ad-libitum*), barley (3 kg/day/animal), salt, wheat bran (1 kg/day/animal). As the calving season occurred between December and February, the milk sampling was achieved at different time for each animal according to their lactation stage in order to get milk samples at the same stage, i.e. at the third month of lactation.

Sampling

The individual milk production not including part drunken by camel calves was recorded routinely. The milk sampling was achieved at the morning milking time (6:00) in clean plastic bottles (40 mL) in each camel included in the monitoring. Approximately 20 mL of blood was collected at the mammary vein in vacutainer dry tube, then centrifuged (15 min, 8000 rpm) for getting serum.

Laboratory analysis

In milk, the gross composition was determined (fat, total protein, lactose and ash) by automatic milk analyzer (lactoscan MCC) calibrated for camel milk. Density and conductivity were also reported. The fatty acid (FA) composition was determined at the UMR IATE-lipotechnie (CIRAD, France) by using the method already described by Konuspayeva et al. (2008). In addition to that, cholesterol and fat soluble vitamins (A,D and E) and vitamin C were analyzed at the IDAC laboratory (Al-Kharj, KSA).

In serum, cholesterol, triglycerides were determined by Kenza-Max biochemistry analyzer (Biolabo, France). The fatty acid composition of the serum was determined by using capillary gas-liquid chromatography at IDAC laboratory (Al-Kharj, KSA).

Statistical analysis

The different parameters were described by their mean ± standard-deviation and the correlations by using Pearson coefficient. The test of Mann-Whitney was used to compare the distribution of fatty acids between milk and serum samples. The software XLSTAT (Addinsoft©) was used for the data analysis.

Results

Milk components

The gross composition of camel milk samples was in g/L 29.4 ± 0.99 fat matter, 28.7 ± 2.0 proteins, 40.9 ± 2.8 lactose, 0.72 ± 0.05% ash, 1027 ± 1 kg/m^3 density, and 76.8 ± 5.4 g/L solid non fat. The main milk fatty acids were myristic acid (C14:0), palmitic acid (C16:0), palmitoleic acid (C16:1 n-7), stearic acid (c18:0) and oleic acid (C18:1 n-9) representing as the whole 86.7 % of the milk fatty acids (Table 1). The proportion of polyunsaturated fatty acids (PUFA) was 3.4%, of monounsaturated (MUFA) 30.3% and of saturated (SAT) was 66.4% with a ratio SAT/unsaturated fatty acid of 1.97. The total cholesterol in our camel milk samples was on average 118.5 ± 13.0 mg/L (table 1) while vitamin A was 419.9 ± 80.9 IU/L, vitamin E 20.2 ± 1.05 µg/100mL and vitamin C, 26.1 ± 3.5 mg/L. Vitamin D3 was below the detection limit.

Table 1. Composition on some lipid components and vitamins of the camel milk and blood in intensive farming system in Saudi Arabia.

Components	Milk	Serum
Total fat (%)	2.94 ± 0.99	nd
Cholesterol (mg/L)	118.5 ± 13.0	13.0 ± 1.8
Triglycerides (g/L)	nd	0.5 ± 0.2
C4:0	0.11 ± 0.08	-
C6:0	0. 9 ± 0.06	-
C8:0	0.22 ± 0.05	-
C10:0	0.23 ± 0.08	-
C12:0	1.54 ± 0.72	0.32 ± 0.04
C14:0	15.89 ± 2.66	2.29 ± 0.25
C15:0 ante iso	0.56 ± 0.08	-
C15:0	1.39 ± 0.16	0.76 ± 0.14
C16:0 iso	0.50 ± 0.09	-
C16:0	34.65 ± 3.91	30.09 ± 3.48
C16:0 isom	0.73 ± 0.34	-
C16:1 (n-7)	11.87 ± 1.54	-
C17:0 iso	0.89 ± 0.17	-
C17:0	0.58 ± 0.09	-
C17:1	0.64 ± 0.14	-
C18:0	8.88 ± 1.49	0.52 ± 0.09
C18:1 iso	0.82 ± 0.94	-
C18:1 (n-9)	15.44 ± 2.64	23.38 ± 1.85
C18:1 (n-7)	1.24 ± 0.37	-
C18:2iso	0.23± 0.06	
C18:2(n-6)	2.14 ± 0.17	16.13± 1.55
C18:3 (n-6)	0.28 ± 0.12	19.51 ± 1.63
C18:3 (n-3)	0.51 ± 0.06	-
C20:1 (n-9)	0.23 ± 0.04	1.05 ± 0.34
C20:4	-	3.45 ± 0.68
C20:5 (n-3)	0.05 ± 0.02	-
C22:0	-	0.53 ± 0.15
C22:6 (n-3)	0.19 ± 0.06	-
C23:0	-	0.65 ± 0.2
C24:0	-	0.51 ± 0.13
Vitamin A (µg/100mL)	12.6 ± 2,4	nd
Vitamin E (µg/100mL)	20.2 ± 1.05	nd
Vitamin C (mg/L)	26.1 ± 3.5	nd
Vitamin D3 (IU/L)	BLD	BLD

nd : non determined, BLD: below limit of detection

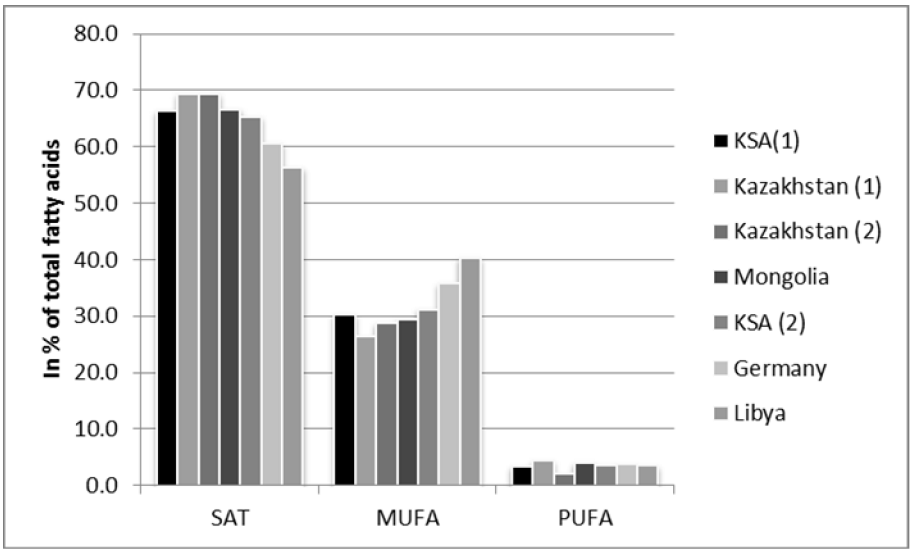

Figure 1. Comparison between fatty acid composition of camel milk according to Narmuratova et al, 2006 (Kazakhstan 1), Konuspayeva et al., 2008 (Kazakhstan 2), Jirimutu et al., 2010 (Mongolia), Dreiucker and Vetter, 2011 (Germany), Shibani et al., 2011 (Libya), Faye et al., 2013 (KSA1) and our results (KSA2).

Serum components

In serum, four acids only were widely present. Palmitic acid (C16:0), stearic acid (C18:0), oleic acid (C18:1 n-9) and linoleic acid (C18:2 n-6) representing 89.1 of the whole fatty acids (Table 1). Total cholesterol was on average 130.0 ± 18.7 mg/L (Table 1). According to saturated status of FA, SAT was 59.1%, MUFA 16.2% and PUFA 24.1% with a ratio saturated/unsaturated of 1.5 only.

There was no significant correlation between cholesterol content in milk and in blood samples. There was no correlation also between the main fatty acids in milk and blood (palmitic, stearic, oleic and linoleic acids). However, the distribution of FA groups (SAT, MUFA and PUFA) were comparable in milk and blood (test of Mann-Whitney not significant).

Discussion

On average, the fatty acid composition of dromedary milk in our study was in the range of the values reported in the recent references in very various conditions (FigURE 1): Samples mixing Bactrian and dromedary camels (Konuspayeva et al., 2008; Narmuratova et al., 2005), Maghrebi camel from Saudi Arabia (Shibani et al., 2011) or dromedaries reared in Germany (Dreiucker and Vetter, 2011).

The proportion of unsaturated fatty acids in camel milk (33.6%) was higher than in cow milk (24.1% on average) as well as short-chain fatty acids (Attia et al., 2000; Karray et al., 2005). The camel milk was poor in short-chain fatty acids (C4:0 = 0.11%) compared to cow milk, which contains more than 3.0% of butyric acid (Schroeder et al., 2003). This confers upon camel milk some interesting nutritional properties; in particular, if we refer to some papers classifying short-chain fatty acids as promoters of atherosclerosis. The sum of short chain fatty acids C4 to C8 was only 0.52% in our camel milk samples, and 8.99% in the milk of cows fed with a nutritionally balanced diet (Palmquist et al., 1993). The long chain fatty acids C15 to C22 were much higher (81.8%) in our samples than in cow's milk (66.1%) (Palmquist et al., 1993). Content in C18:3 were 10 times more in camel's milk (0.79) than in cow's milk (0.07).

No reference was available on fatty acid composition of camel serum. In human, similar proportions of unsaturated and saturated fatty acids in serum and milk were reported with no significant changes along the lactation (Spear et al., 1992). The same fatty acids were in higher proportion (C16:0, C18:0, C18:1 n-9, C18:2 n-6, and C20:4) both in human and camel serum.

Regarding, cholesterol, the content in our camel milk samples appeared comparable to that in cow milk, (12-17 mg/100mL) (Sieber, 2005) and lower

than in ovine milk (28.8 mg/100 mL) (Goudjil et al., 2003). However, our result was quite lower than the value reported in camel milk from Kazakhstan (37.1 ± 7.73 mg/100mL) by Konuspayeva et al. (2008). According to Gorban and Izzeldin (1999), camel milk had a higher content of total cholesterol (31.3 mg/100mL) compared to cow milk (25.6 mg/100mL). However, the higher value observed by some authors could be due to the total fat content of camel milk (for example 6.4% on average in samples from Kazakhstan) which was nearly twice that in cow milk (3.4% on average) contrary to our results where fat content in camel milk appeared rather low (2.9% only on average).

The total cholesterol in camel serum was reported to be 235 ± 20 mg/100mL in Saudi Arabia (Ali et al., 2010), 35.4 to 48.7 mg/100mL in India (Gupta et al., 2012), 40.2 ± 12.4 mg/100mL in Iran (Mohri et al., 2008). Such wide values could be due to the analytical procedures. Our results were in the mean of those reported data. Regarding triglycerides, our results (50.0 mg/100 mL) were higher than those of Gupta et al. (2012) (22.8 - 27.9 mg/100mL), but quite lower than those of Ali et al. (2010) (173 ± 13 mg/100mL).

The content in vitamin A in our milk samples appeared in low quantity compared to the reported results of Stahl et al. (2006) (20.1 ± 1.0 µg/100mL) and quite less than the retinol content in cow milk (for example 60.9 µg/100mL for Stahl et al., 2006). Vitamin E appeared also in our milk samples lower than the 32.7 ± 12.8 µg/100mL reported by the same authors. The vitamin C content was also lower in our samples than the values reported by Stahl et al. (2006) in Emirates (52.5 ± 15.8 mg/L) and overall by Konuspayeva et al. (2011) in Kazakhstan (150.4± 105 mg/L). Thus, globally, our camel milk samples appeared poor in vitamins.

Conclusion

Under in-door system, the camel receiving intensive diet did not change drastically the main composition of its milk and serum. However, due to the nature of the grass (mainly hay of alfalfa from irrigated field) and of the concentrates (cereals), the vitamins in milk appeared relatively low compared to camel grazing out-door. Further researches have to be implemented to deepen the risk of impoverishment of dietetic and nutritive value of camel milk in case of intensification of the camel production.

Acknowledgements

This study has been achieved within FAO camel project UTF/SAU/021/SAU with the support of Camel and range research Center (CRRC). The authors thank Mr. Sallal Issa Al-Mutairi, former head of the CRRC for his encouragements and support. Thanks also to FAO team leader at Riyadh, Dr. A. Oihabi and the FAO regional officer, Dr. Bengoumi who supported this project from the beginning.

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