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REGULAR ARTICLE

Effects of oestrus on milk yield and composition in Tunisian Maghrebi camels (*Camelus dromedarius*)

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Abstract

In order to investigate the effects of oestrus on milk yield and composition in camel (Camelus dromedarius) reared in oasis intensive system in southern Tunisia, 8 healthy females Maghrebi camels (age: 10.6 ± 2.9 years, body weight: 505 ± 39 kg and day in milk: 275 ± 18 days) were equitably divided in two groups. Each female in group 1 received 5 ml of Receptal® (20 µg Buserelin; GnRH analogue) to induce oestrus while dams in group 2 were not injected and served as control. Females were monitored during morning milking for the following 15 days, to record oestrus behaviour, œstradiol-17β levels, milk yield, estimated daily milk, lag-time, time of milking, titrable acidity and density of raw and 24 h conserved milk, somatic cell count (SCC) and milk's major components (dry matter, fat, protein and ashes). Our results suggest that oestrus did not affect (P>0.05) production and physicochemical parameters in milk and did not alter milk conserved in 4°C during 24 h. These data indicate that changes in physiological status of dairy camels during the breeding season do not require alternative measures to guarantee milk quality.

Key words: Dromedary camel, Milk yield and composition, Oestrus, SCC

Introduction

In the last few years, Tunisian farmers became more interested in dairy camels breeding due to the increasing consumption of camel's milk in the market. Therefore a number of dairy camels' intensive farms rose in the oasis of southern Tunisia. The integrity and persistence of these farms rely on succeeding both reproduction and milking management of the she-camel.

Among these milking units, it has been recorded a change of milk physical characteristics and its aptitude to conservation that coincide with the onset of the seasonal mating period and associate with some changes in social and sexual behaviours of the she-camel. These signs suppose that the reproductive status, especially oestrus, during the breeding season influence the milk characteristics. The influence of the oestrus on milk characteristics has been reported in many dairy species. In dairy goat, McDougall and Voermans (2002) reported a decrease in milk yield associate to the induction of oestrus. Increases in SCC have been reported to coincide with the onset of the seasonal mating period (Calderini et al., 1994; Moroni et al., 2007) and associated with induction of oestrus in dairy goats (McDougall and Voermans, 2002; Christodoulopoulos et al., 2008). Likewise, increases in protein content have been recorded during oestrus (Moroni et al., 2007) and associate to synchronization treatments; though, fat and lactose were not affected by oestrus (Christodoulopoulos et al., 2008).

In dairy cattle, several studies reported a decrease in milk yield and an increase in SCC and fat content during oestrus (King, 1977; Horrell et al., 1986; Lopez et al., 2005). Whereas, other studies state that oestrus have no effect neither on SCC (Anderson et al., 1983) nor milk yield and composition (Cowan and Larson, 1979). Therefore, data from cattle are equivocal about the effect of oestrus on milk yield and composition.

The aim of this study was to investigate the effects of oestrus in dairy camels on milk yield, milk composition and SCC.

Materials and Methods

Animals' management

The study was conducted on eight multiparous Maghrebi dairy camel (age: 10.6±2.9 years, body weight: 505±39 kg and day in milk (DIM): 275±18 days) from the experimental farm of the Arid

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Regions Institute (IRA, Medenine, Tunisia). Camels were housed in loose stalls and exercise area was 25 m^2/ camel. Each animal was identified by an ear tag. Daily ration per animal was 10 kg of oat hay (DM, 86.9%; CP, 4.1%; NDF, 66.1%; on DM basis), supplemented with 2 kg of a commercial concentrate (DM, 87.9%; CP, 15.2%; NDF, 22.6%; on DM basis). Animals had a*d-libitum* access to clean water.

Experimental design

The experiment was carried out at the onset of the breeding season (mid-September till mid-December). The she-camels were daily monitored to investigate oestrus behaviour in absence and in presence of sire. At the end of November, females were equitably divided in two groups; each female in group 1 (#240, #229, #237, #250) received intravenous (i.v.) injection of 5 ml of Receptal® (20 µg of Buserelin; GnRH analogue) to induce oestrus (Skidmore, 2004), while dams in group 2 (#228, #232, #238, #243) were not injected and served as control. Females were monitored for signs of oestrus during 15 days following injection. Oestrus was considered when these signs had occurred: the female is repeatedly chasing and biting other females, restlessness, swelling of the vulva, vaginal mucus discharge, straddling the hind legs, raising the tail and urinating frequently, and most important seeking the male.

Milk and blood sampling

Dams were machine milked once a day (8:00 h) in restraining stall and using a portable milking machine. The milking machine was set on 48 kPa, 60 pulses/min, and 60:40 pulsation ratio. Milk ejection was enhanced by tactile stimulation of udders. Lag-time from start of teat stimulation until onset of milk ejection and milking time from attachment of milking unit until milk flow ceased, were recorded. A commercially available iodine disinfectant was applied by dipping each teat after milking.

Milk yield was measured and a milk sample (~ 250 ml) was collected from each camel. The samples were processed immediately after milking and 24h later for physical parameters (titrable acidity and density). Two other samples for chemical analysis (~ 60 ml, -20°C) and SCC determination (+pinch of $K_2Cr_2O_7$, 4°C) were stored.

A blood sample was taken from the jugular vein of each camel after milking using a venoject tubes. Blood samples were centrifuged and sera were stored at -20°C until analysis.

Analyses

Milk density was assessed using a thermolactodensimeter (Funke-Gerber, Berlin, Germany). The titrable acidity (°D) was obtained by titrating 10 ml of milk with N/9 NaOH, using phenolphtalein as an indicator. Total milk solids and ashes were analyzed by gravimetry. Milk protein content was determined by spectrophotometer using Bradford method (Bradford, 1976) and fat was determined by butyrometer using the Neusal method (Wangoh and Farah, 2004). SCC was determined using a Fossomatic 5000.

Oestradiol-17β was determined by direct RIA kits. Gamma counter was used for counting and the produced number was converted by the way of calibration curve for measuring the hormone in unknown samples. Sensitivity was 6 pg/ml and intra-and inter assay coefficients of variation were 12.1 and 11.2%, respectively.

Statistical analysis

Data were statically analysed by the GLM procedure of SAS (SAS version 9.0, SAS Inst. Inc., Cary, NC). The model included the general mean, the fixed effect of physiological state and the residual terms. Results are presented in least squares means ± standard error.

Results and Discussion

Confirmation of oestrus

Three out of four dams injected with Buserelin did exhibit oestrus signs that lasted 4 to 5 days. Two camels of the untreated group have shown spontaneous oestrus signs. These signs lasted 2 to 4 days. The occurrence of oestrus was confirmed by the oestradiol-17β profiles (Figures 1 and 2). These profiles show that maximum levels did not exceed 20 pg/ml for camels which did not exhibit signs of heat, while, for camels in heat, these levels reach 52 pg/ml. The peak of oestradiol-17β lasted 2 to 4 days and the average level was mainly 32.8 ± 13.9 pg/mL.

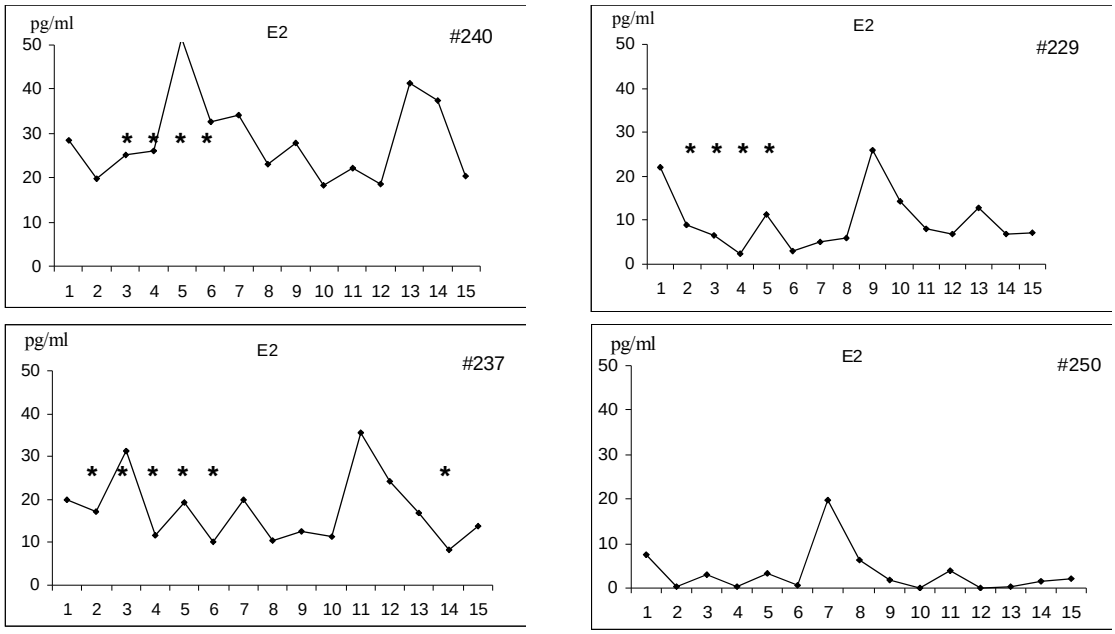

Figure 1. Oestradiol-17β concentration and oestrus days (*) in females treated by Buserelin.

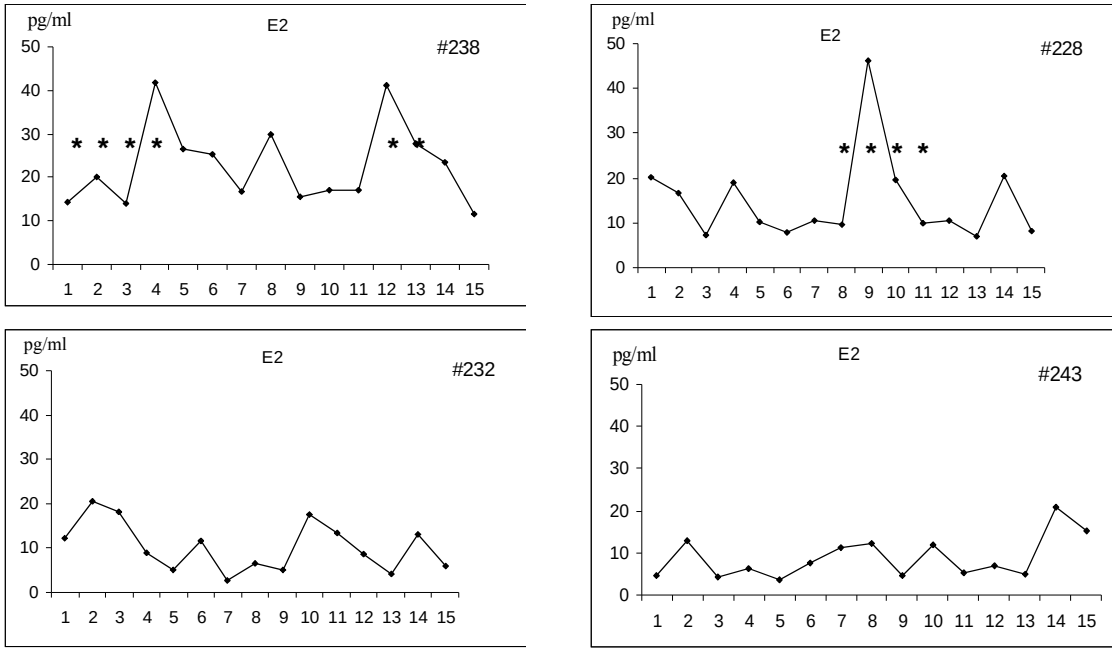

Figure 2. Oestradiol-17β concentration and oestrus days (*) in untreated females.

Milking parameters

Regarding milk yield, lag-time and milking time during oestrus (Table 1), our data suggested that oestrus had no effect neither on lag-time nor on milking time ($P>0.05$). This indicates that oestrus does not alter the milk ejection reflex of the she-camel. In fact, during milking, dams entered the milking parlour in the usual order and they had shown only minor signs of stress. These findings support an earlier study in dairy cattle, Horrell et al. (1984) stated that readiness to enter the parlour, restlessness and elimination in the parlour were not found to be significantly affected by oestrus.

Table 1. Lag time, milking time and milk yield in camels during and out of oestrus.

	oestrus	Out of oestrus	*P*-value
Lag-time (s)	68 ± 4	74 ± 5	0.619
Milking time (s)	210 ± 6	211 ± 6	0.925
Milk yield (ml)	3698 ± 155	3714 ± 84	0.935
EDMP* (ml)	5547 ± 233	5571 ± 126	0.935

*Estimated daily milk production

Milk yield and estimated daily milk production of the she-camel seem to be irrelevant of oestrus. There were no reports on the effect of oestrus on the she-camel milk that we know about till the day of the study. However, several previous studies in dairy cattle and dairy goat provided evidence of a decline in milk volume associated with oestrous (King, 1977; Cowan et Larson, 1979; Mc Dougall et Voermans, 2002; Lopez et al., 2005). Erb et al. (1952) reported that this decline was more apparent as stage of lactation increased. Although camels were in late lactation (275 DIM), the effect of oestrus was not obvious.

Milk conservation ability

As camel milk is usually consumed raw or conserved at 4°C for few days, we aimed to study the potential effect of oestrus on conservation ability of camel milk. Therefore, we estimated the following parameters:

*d (density) = (Milk density 24h later) – (raw milk density)

*d (acidity) = (Milk acidity 24h later) – (raw milk acidity)

Our results regarding the variations in physical parameters of raw and milk conserved at 4°C for 24h associated with oestrus are presented in table 2.

Our results indicated that oestrus had no significant (P>0.05) effect on raw milk physical parameters and it didn't cause a change after 24 h at 4°C (table 2). Hammadi et al. (2007) had studied the effect of breeding system on camel's milk conservation ability. They reported that milk acidity did not change after 24 h of conservation at 4°C.

Milk composition and SCC

Regarding the effect of oestrus on chemical composition and SCC (table 3), our findings suggested that oestrus had no significant (P>0.05) effect on gross components of camel's milk, except for ash that seemed to decrease (P<0.05) during oestrus.

These results were in accordance with those reported by Cowen and Larson (1979) in dairy cattle at early lactation. Nevertheless, for cows at late lactation, oestrus caused an increase of fat content. As for the other major content, Erb et al. (1952) found that they are perturbed during oestrus. In dairy goat, some studies reported an increase of protein content and a decrease of fat content associated with oestrus (Christodoulopoulos et al., 2008; Moroni et al., 2007).

The present study indicates that oestrus is not linked to SCC of camel's milk. These results agreed with those in dairy cattle (Cowan and Larson, 1979, Anderson et al., 1983), yet, disagreed with those found in dairy goat and dairy ewe in which oestrus appeared to provoke a significant increase in SCC (Aleandri et al., 1994; Mc dougall et Voermans, 2002; Christodoulopoulos et al., 2008; Talafha et al., 2009).

Table 2. Effect of oestrus on physical parameters of raw milk and milk conserved for 24h.

		Oestrus	Out of oestrus	*P*-value
Density (g/l)	Raw milk	1.0311 ± 0.0003	1.0303 ± 0.0002	0.163
	Milk 24 h later	1.0325 ± 0.0003	1.0314 ± 0.0003	0.059
	d (density)	0.0015 ± 0.00017	0.0011 ± 0.00009	
Acidity (°D)	Raw milk	17.6 ± 0.3	17.6 ± 0.1	0.869
	Milk 24 h later	17.8 ± 0.3	17.9 ± 0.1	0.774
	d (acidity)	0.2 ± 0.2	0.4 ± 0.1	

Table 3. Effect of oestrus on gross components and SCC of milk.

	Oestrus	Out of oestrus	*P*-value
Total solid (g/l)	121 ± 2.6	118.2 ± 1.35	0.384
Fat (g/l)	44.2 ± 2.2	41.7 ± 0.95	0.281
Protein (g/l)	28.1 ± 0.9	27.5 ± 0.46	0.607
Ash (g/l)	8.6 ± 0.06	8.9 ± 0.04	0.013
SCC (cell/ml)	299750 ± 58744	312362 ± 27516	0.922

Conclusion

Oestrus had no significant effect on physical and chemical camel's milk parameters and it did not alter milk conserved 24h at 4°C. This suggests that no major procedure is needed to ensure milk quality during the breeding season of the she camel. Other studies are required to investigate hygienic practices during milking and milk storage to reveal the reasons of changing milk physical characteristics and its aptitude to conservation in private farms.

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