

The effect of water deprivation on milk production of camels (*Camelus dromedarius*)*

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ABSTRACT

The effect of sixteen days of dehydration on milk production was investigated using seven lactating camels. The mean milk yield was 2.17 ± 0.20 kg and decreased to 1.24 ± 0.34 kg ($P < 0.05$). The milk water content was $87 \pm 0.7\%$ and did not show significant changes. The plasma and milk osmolality increased ($P < 0.001$) from 318 ± 2 to 345 ± 2 and from 319 ± 4 to 348 ± 4 , respectively. The total fat, protein, and lactose yields dropped proportional to milk volume. The effect of dehydration on milk production should be considered in watering strategies of lactating camels.

KEY WORDS: camel, water deprivation, milk yield, milk composition, osmolality

INTRODUCTION

In arid areas camels are good sources of milk, meat and draught power to pastoralists and agro-pastoralists. In Ethiopia camel husbandry practice is targeted mainly for milk production. The habitat of camels is characterized by shortage of water and high temperature. It has been reported that camels can maintain milk production and dilute their milk during water deprivation (Yagil and Etzion 1980a,b). However, Dahlborn et al. (1997), could not verify this. Therefore, this study was undertaken to examine the effect of dehydration on the milk quantity and quality.

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MATERIAL AND METHODS

This experiment was undertaken in August 2003, at the Alemaya University ca mel research site in Errer valley, Eastern Ethiopia. Seven camels were used for this study with a lactation stage of 15 days to eight months and parity one to four. The milk production of the camels varied between 1.5 and 4 kg/day. The initial body weights of the camels were 426 ± 33 kg. The animals were given ten days of adaptation before water was withheld for sixteen days. The camels were offered hay *ad libitum* and supplemented with 3 kg of concentrate, with a dry matter content of 91 and 92%, respectively. The concentrate consisted of, %: wheat bran 50, wheat short 25, groundnut 21, bone meal 3.5 and salt 0.5. The experiment was undertaken in a paddock (24×30 m). During the nights the camels were kept in a smaller pen (6×6 m) inside the paddock. At 7 h camels were tied up and fed hay and concentrate and hand milked. The camels were released at 9 h to walk freely in the paddock until 12 h. The camels were weighed and tied to feed concentrate and hay at 12.15 until 13 h. Then released to walk until 17 h when they were tied up and offered hay and concentrate and hand milked. On day 16 the camels were offered water at 13 h for 15 min. During morning and evening milking, the volume was measured in a graduated cylinder; samples were collected in pre-chilled tubes containing 10 µl of 0.02% 2-bromo-2-nitro-1,3-propanediol (Merck no. 814603) for gross milk composition analysis and osmolality measurements. Every 4th day blood samples were collected in pre-chilled 5 ml Li-heparin venoject tubes for measuring osmolality, then centrifuged at 3000 rpm at 4°C for 10 min and stored at -20°C until analysis. The osmolality of both milk and blood were measured using the Osmometer (Fiske 2400 Multi-Sample Osmometer, USA), and the gross milk composition using the milk analyser (FARM milk analyser 2001, Sweden). The data are presented as mean \pm standard error of mean and the difference along the dehydration days were analysed by SAS (1996).

RESULTS

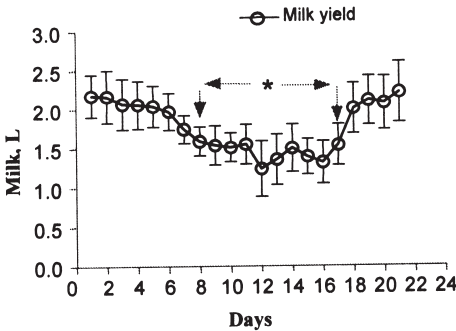
The mean milk yield was 2.17 ± 0.2 kg on day one and steadily dropped to 1.24 ± 0.34 kg ($P < 0.05$) at day twelve (Figure 1a). The water percent in the milk was 87 ± 0.7 and 88 ± 0.7 in the first and last day, respectively. The total fat, protein and lactose yields declined (Table 1). The osmolality of the milk and plasma steadily increased ($P < 0.001$) during water deprivation (Figure 1b). The camels had lost 22.7% (96.6 kg) of the initial body weight at day 16 and drunk 90 ± 9 L of water corresponding to 21% of their original body weight. Camels started to recover from dehydration immediately after rehydration and had fully recovered at day 21 (Figure 1a).

Table 1. Changes in fat, protein and lactose, %, and milk yield in camels

Day	Fat		Protein		Lactose	
	%	g/day	%	g/day	%	g/day
1	4.26 ± 0.37	96.5 ± 9.8	2.79 ± 0.38	61.5 ± 6.6	4.52 ± 0.29	96.0 ± 13
2	4.12 ± 0.35	86.6 ± 9.8	3.07 ± 0.35	61.2 ± 6.6	4.46 ± 0.27	96.7 ± 13
3	3.98 ± 0.35	88.3 ± 9.8	3.07 ± 0.35	61.7 ± 6.6	4.45 ± 0.27	92.9 ± 13
4	4.12 ± 0.35	88.8 ± 9.8	3.24 ± 0.35	62.4 ± 6.6	4.27 ± 0.27	91.7 ± 13
5	3.99 ± 0.35	85.4 ± 11.5	2.96 ± 0.35	63.4 ± 7.8	4.27 ± 0.27	92.6 ± 16
6	3.79 ± 0.35*	79.8 ± 10.5	2.97 ± 0.35	56.2 ± 7.1	4.00 ± 0.27	83.1 ± 14
7	4.27 ± 0.35	76.4 ± 9.8	3.15 ± 0.35	51.7 ± 6.6	3.96 ± 0.27	70.2 ± 13
8	4.35 ± 0.35	63.0 ± 9.8*	3.37 ± 0.35	45.2 ± 6.6	3.74 ± 0.27	58.0 ± 13
9	4.41 ± 0.35	68.6 ± 9.8*	3.17 ± 0.35	45.2 ± 6.6	4.11 ± 0.27	67.2 ± 13
10	4.56 ± 0.35	69.1 ± 9.8	3.20 ± 0.35	43.0 ± 6.6	3.98 ± 0.27	60.4 ± 13
11	4.68 ± 0.35	68.4 ± 9.8	3.24 ± 0.35	44.4 ± 6.6	3.83 ± 0.27	63.1 ± 13
12	4.21 ± 0.35	52.3 ± 10.5**	3.13 ± 0.38	35.6 ± 6.6**	3.65 ± 0.28*	50.3 ± 14*
13	4.91 ± 0.38*	57.9 ± 10.5*	3.27 ± 0.38	36.8 ± 7.2**	3.79 ± 0.28	54.0 ± 14*
14	4.55 ± 0.38	64.1 ± 10.5*	2.96 ± 0.38	40.2 ± 7.2**	3.85 ± 0.28	59.9 ± 14
15	4.54 ± 0.38	63.5 ± 10.5*	2.89 ± 0.38	38.3 ± 7.2**	4.15 ± 0.28	58.8 ± 14
16	4.79 ± 0.38*	64.6 ± 10.5*	3.07 ± 0.38	38.1 ± 7.2**	4.06 ± 0.28	55.0 ± 14*

values within column among factors differ at * (P<0.05), ** (P<0.01)

1a



1b

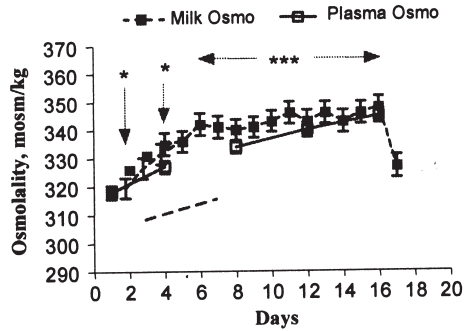


Figure 1. Changes in milk yield (1a) and plasma and milk osmolality (1b) during water deprivation. *P<0.05, ***P<0.001

DISCUSSION

In the present study a decrease in milk yield was observed during water deprivation, which is in agreement with earlier finding by Dahlborn et al. (1997), but different to the report of Yagil and Etzion (1980b). The milk water content did not change inconsistent with the report of Yagil and Etzion (1980a) that stated that the dehydrated camels produce milk having elevated water content. It must be noted that during their study, the actual milk yield was not measured. Instead they

estimated the milk yield based on the dilution of injected tritium labelled water by the milk drunk by the calf. The unchanged dry matter content and the increased milk osmolality show that no dilution of the milk occurred during water restriction. Hossaini-Hilali et al. (1994) and Dahlborn et al. (1997) reported similar findings in goats and camels, respectively. Therefore, the report of Yagil and Etzion (1980a), that is dilution of milk during water deprivation as an adaptive mechanism for the desert animal, was not supported by the out come of this study. Complementary to that of Dahlborn et al. (1997), the milk and the plasma osmolality increased simultaneously as the days of dehydration continued. An increase in the plasma osmolality is an indication of a drop in the total body water content and plasma volume (Dahlborn et al., 1997). In the Error valley watering of camels differ with season (Bekele et al., 2002). During the wet season the camels depend mainly on the water contained in browsing plants whereas in the dry season the camels were watered from well water once a week with maintained milk production. However, in both, this study and earlier studies (Yagil and Etzion, 1980a,b; Dahlborn et al., 1997) the camels were fed dry roughage and concentrate, during these circumstances drinking water is necessary to maintain milk production. In this study, throughout the water deprivation period there was no change in the provided feed quality and quantity but camels feed intake declined and on day 16 markedly depressed. This might contribute to the decline in milk production in conjugation with water deprivation and a decrease in plasma volume.

CONCLUSIONS

Camels cannot directly regulate the water content in milk and milk production will decrease at times of dehydration.

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