Effect of water restriction on milk yield and milk composition in camels (*Camelus dromedarius*)

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Abstract

This experiment was conducted to study the effect of water deprivation on daily milk yield and milk composition in she camels **(***Camelus dromedarius***).** Six lactating she camels of approximately equal daily milk yield were selected and divided randomly into three experimental groups of two each. The average daily water requirement and the average daily milk yield of the she camels were determined. During the experiment, each group received a different watering regime. Group 1 (G1) was allowed free access to water, group 2 (G2) was offered half the average daily water requirement (18 litters/head/day) while Group 3 (G3) was allowed to get the actual average daily camel's water requirement (36 litters/head/day) as a control group. The results elucidated that, the daily milk yield and composition were significantly ($p<0.05$) affected by the amount of water offered to the camels. Camels offered half the average daily water requirement (G2) produced higher ($p<0.05$) amount of milk (5.39 kg) than both G1 (4.98 kg) and G3 (5.27 kg). As for milk composition, the fat content of the milk produced by camels of G2 was found to be lower ($p<0.05$) (3%) than that of the milk produced by the other two groups. No significant differences were observed among the three groups regarding protein, lactose, solid not fat content and pH. These results proved the capability of camels to tolerate the dehydration conditions and produce sufficient amount of milk.

KEY WORDS: ***camel, water consumption, milk yield, milk composition.***

الملخص:

أجريت هذة التجربة لدراسة أثر نقص معدل ماء الشرب على الإنتاج اليومى للبن الإبل والتركيب الكيميائى لمكوناته. تم إختيار ست من النوق الحلوب متساوية تقريباً فى الإنتاج اليومى للبن وقسمت عشوائياً إلى ثلاث مجموعات الأولى سقيت سقاية حرة والثانية أعطيت نصف الإحتياج اليومي للإبل من الماء (١٨ لتر/الرأس/اليوم) بينما أعطيت المجموعة الثالثة هى المجموعة الضابطة الإحتياج الفعلى للإبل من الماء (٣٦ لتر/الرأس/اليوم). أظهرت النتائج فروقاً معنوية فى الإنتاج اليومى للبن حيث تفوقت المجموعة الثانية (التي أعطيت نصف الإحتياج اليومي من الماء) في كمية الحليب المنتج (٥.٣٩ كجم) على المجموعتين الأخريين (٥.٢٧ كجم و٤.٩٨كجم) على التوالى ، مع إنخفاض فى نسبة دهن اللبن للمجموعة الأولى (٣%) مقارنة بمجموعة الماء المتاح (٤.٣٤%).

هذه النتيجة أظهرت قدرة الإبل على مقاومة العطش والإستمرار فى إنتاج اللبن ذي الدهن والبروتين القليلين. كما لم تلاحظ أي فروق معنوية فى نسبة سكر اللاكتوز،الجوامد الغير دهنية ودرجة الحموضة والقلوية للبن المنتج.

Introduction

The one-humped camel (*Camelus dromedarius*) is an important domesticated animal for food production in the dry arid zones (Yagil, 1982). In Sudan camels are found mainly in the Eastern and Western regions of the country, where the average rainfall is less than 350 mm per year (El-Amin, 1979). The total camel population of Sudan is estimated at 3 million heads (M. A. R., 1999) out of the 20 millions dromedary camels living in the world (FAO, 1999). Camel is the only animal that can exist for weeks during the hot weather conditions without drinking water and still provide its offspring with milk. The camel's ability to utilize the scanty, poor and fibrous fodder resources of the arid zones for body maintenance, growth and production makes this animal a potentially important source of food (Farid *et al*., 1979). Milk is the main food obtained from camel herds (Dahl and Hjort, 1979). The composition of camel milk has been studied by many researchers (Ohri and Joshi, 1961; Kheraskov, 1961; Khalid and Appanna, 1964; Mohamed,

1985 and Bochmann and Schulthess, 1987). The availability of drinking water was shown to have a direct effect on milk fat content, with limited drinking water causing a decrease in milk fat and protein content (Yagil and Etzion, 1980a). The present study was conducted to investigate the effect of water restriction on camel milk yield and milk composition.

Materials and methods

Animal management: This experiment was conducted at the College of Veterinary Medicine and Animal Production, Sudan University of Science and Technology, Kuku. It was a part of a joined research project that aim to study several production parameters of camels under Sudan conditions. Six lactating she camels at the same stage of lactation with average daily milk yield of 5.17 kg and nearly same daily water requirement (36 litres) were selected. All camels were de-wormed and treated against both internal and external parasites. The camels were then ear-tagged and divided randomly into three groups of two camels each. Each group was provided with different watering regime. Group 1 (G1) was allowed to have free access to water, while Group 2 (G2) was offered half the average daily water requirement (18 liters/head/day). Group 3 (G3) (the control group) was allowed to have the actual average daily camel water requirement (36 liters/head/day) throughout the experimentation period which lasted for six weeks. The camels were housed individually in separate open pens and were offered a maintenance diet of roughages and concentrate ration.

Data collection: The lactating she camels were milked twice a day (morning and evening milkings). Prior to milking, suckling calves were allowed to suckle for a few seconds to stimulate milk letdown. Immediately thereafter, milking men standing on opposite side of the lactating camel started hand milking into a steel

container. The total amount of milk collected from each dam in the two milkings (morning and evening) was considered as the daily milk production of that dam.

Samples of milk from the six dams were analyzed at the Milk Technology Laboratory, Animal Production Research Center, Kuku, to determine the protein, fat, total solids and ash contents by using Milko Tester Machine.

2.3 Statistical analysis:

The data of milk yield and milk composition were subjected to analysis of variance using the SPSS software programme.

Results and Discussion

The means and standard deviation of daily milk yield and milk composition of the experimental camels were presented in Table 1 and Figure 1. The results showed that the daily milk yield and milk composition were significantly ($p<0.05$) affected by amount of water offered. Camels offered less water (G2) produced a higher ($p<0.05$) average daily milk (5.39 kg) than those offered their actual daily requirement (G3), and also higher than camels in G1 which produced an average of 4.34 kg of milk per day. One of the most remarkable documented features of dehydrated camels is their ability to continue lactation and to secret more diluted milk than when offered sufficient water amounts (Yagil and Etzion, 1980b). A similar trend was observed in dromedary camels deprived of water for 16 days **(**Bekele1 and Dahlborn, 2004) and was also observed with the advancement of dehydration (Yagil and Etzion, 1980b). The plasma and milk osmolality increased ($P<0.001$) from 318±2 osmole/litre to 345±2 osmole/litre and from 319±4 osmole/litre to 348±4 osmole/litre, respectively. Therefore, the above report which claimed that the camel cannot directly regulate the water content in its milk and

that the milk production will decrease at times of dehydration was not supported by the findings of this study.

In this study, the milk fat content was found to increase with limited water supply. A similar trend was observed in dromedary camels exposed to partial dehydration although significant differences could not be detected. Camels in G2 had a lower milk fat content (3%) followed by the control group (G3) while G1 recorded a higher milk fat content (4.34%) (Fig. 2). The results obtained for the fat percentage in this study were in line with the findings of Yagil and Etzion (1980a) who reported that the availability of drinking water was shown to have a direct effect on milk fat content. These authors found that the milk fat and protein contents were 4.3% and 4.6% with plentiful-drinking of water but decreased to 1.1% and 2.5%, respectively, with limited-drinking water. Kheraskov (1961) examined four breeds of camels and found the value for total protein to vary from 3.5% to 3.8% and the casein varied from 2.7% to 2.9%. In the present study, no significant difference for protein content was observed, but G2 showed lower protein content than the other groups which agreed with the results obtained by Yagil and Etzion (1980a) and Aman *et al*. (2006). Water consumption rate didn't affect ($P>0.05$) the lactose and total solid contents. Kheraskov (1961) reported 4.9% and 9.59%, respectively, for the lactose and total solids content in dromedary milk, while Ohri and Joshi (1961) reported 4.47% and 9.15% for the same parameters in Indian camels. Milk lactose content obtained in this study was in the range recorded by the above authors. Sestuzheva (1958) and Zeleke (2007), however, found that the lactose content of camel milk remained unchanged from the first months up to the end of lactation. The lactose concentrations in camel milk was found to vary from 2.8% (Grigoryants, 1954) to 5.8% (Yasin and Wahid, 1957). These were approximately the same ranges found in the hydrated and

dehydrated camels (Yagil and Etzion, 1980b). The changes in lactose concentration would account for the milk being described as sometimes sweet and other times bitter. It was not affected by the amount of drinking water (Zeleke, 2007). The pH of the milk in the present study was found to be 6.14, 5.95 and 6.19 for G1, G2 and G3, respectively. No significant difference among the groups for pH observed. Generally, the pH of camel milk is between 6.5 – 6.7 (Shalash, 1979) which is similar to the pH of sheep milk. When camel milk is left to stand, the acidity rapidly increases (Ohri and Joshi, 1961) and the lactic acid content was noticed to increase from 0.03% after standing for two hours to 0.14% after six hours. This finding contradicts with that reported by Dukwal *et al*. (2007) who stated that camel milk remains quite stable at room temperature and takes a comparatively longer time to become sour. Due to the type of fodder and the availability of drinking water, fresh camels' milk usually has a high pH. Therefore, the relatively lower value of pH obtained in this study with G2, although not statistically significant, might be attributed to the dehydration and insufficient amount of water provided to the camels in this group.

This results obtained in this study strengthened the hypothesis that camels had a greater capability of producing more amount of milk when subjected to conditions of limited water availability than when allowed to have sufficient water requirement. Generally, the changes that occur in the normal biochemical parameters of the camel during stress conditions, particularly in cases of water restriction, were considered as adaptive mechanisms against these harsh and unfavourable conditions (Ismail *et al*., 2006).

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Table 1. Effect of water restriction on milk yield and milk composition of lactating camels.

Parameters	Group 1 (Free water)	Group 2 (Half daily water requirement)	Group 3 (Control)	SE
Milk yield (Kg/day)	4.98± .88 $_{b}$	5.39± .71$_{a}$	5.27± .82 $_{b}$	0.14
Fat%	4.34± .73 $_{a}$	3.00± 1.0 $_{b}$	3.61± .71 $_{ab}$	0.38
Protein%	3.23± .01	3.01± .92	3.13± .59	0.33
Lactose%	4.57± .52	4.69± .48	4.26± 1.1	0.34
Solid not fat %	8.65± 1.2	4.96± 1.0	7.8± 1.9	0.64
pH	6.14± .21	5.95± .61	6.19± .12	0.17

ab means within the rows with different superscript was significantly different at level ($p<0.05$).

Fig. 1. Effect of water restriction on milk yield in the camels.

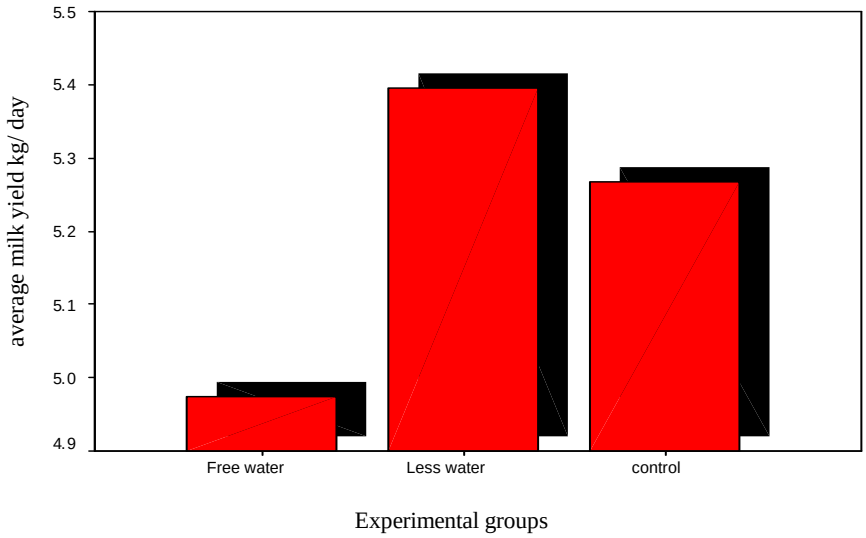

Fig. 2. Effect of water restriction on milk fat in the camel.