Vol 18 No 2, p 209-212

ASSESSMENT OF NUTRITIONAL STATUS IN FEED DEPRIVED ONE-HUMPED CAMELS

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ABSTRACT

Camels are known to survive and reproduce in arid and semiarid areas despite the scarcity of feed and water. It was the intention of this study to assess energy and nitrogen balances of feed deprived dromedary camels using specific blood metabolites concentrations as biological markers. In this study 5 camels of different age and sex were totally deprived of feed for 7 days. Feed deprivation caused no change in plasma glucose, and serum triglycerides and β-hydroxybutyrate concentrations, indicating that energy deficit did not occur. The serum albumin concentration remained stable during feed deprivation, while urea concentration increased. This clearly indicates the ability of camels to use efficient recycling of urea to maintain their nitrogen balance. Our results also show that dromedary camels maintained their serum osmolality during feed deprivation. However, packed cell volume (PCV), haemoglobin concentration (Hb), forestomach liquor Na^+ and K^+ concentrations and osmolality were slightly reduced.

Key words: Dromedary camel, energy balance, feed deprivation, nitrogen balance

Camels suffer the least during successive years of drought which occur from time to time in the dry belts of the tropics and cause ecological catastrophes for livestock and human population that depend on them. Further, camels are known to travel long distances (5-7 days) with little or no food and water. We hypothesised that dromedary camel might tolerate moderate fasting without serious alteration in its nutritional status.

The capability of dromedary camels to tolerate lack of food is related to unique adaptive mechanisms including the mobilisation of lipids during malnutrition and the storage of fat during favourable periods (Tarik *et al,* 1994; Diallo, 2000; Dereje and Udén, 2005). In dehydrated dromedaries, liver lipids were reported to decrease from 13 to 2.5%, however, concentrations of triglycerides and fatty acids remain unchanged (Mahmud *et al,* 1984). Moreover, it has been reported that ketogenesis is weak in the dromedary and that plasma concentrations of β-hydroxybutyrate and acetoacetate were 33 and 4 fold lower compared to sheep (Chilliard *et al,* 2000). Compared to ruminants, the dromedary is characterised by a norm higher plasma glucose concentration of about 5 mmol/L, a value similar to that of monogastric species (Cebra *et al,* 2001). This is due to the fact that dromedary has a high gluconeogenesis and a very low insulin (Souilem *et al,* 1999).

Camelids can recycle up to 90% of blood urea nitrogen, in contrast to 10-30% reported in ruminants (Von Engelhardt *et al,* 1978). The nitrogen recycling in camelids has been reported to increase in the case of lower protein diet and/or dehydration (Gihad *et al,* 1989; Souilem and Djegham, 1994; Gallacher and Hill, 2006). The concentration of blood metabolites are sensitive to changes in nutrient supply, and could be used as indicators of nutritional status (Pambu-Gollah *et al,* 2000). Therefore, it was the intention of this study to use these indices as biomarkers for assessing the nutritional status, namely, energy, protein and minerals status of dromedary camels fasted for one week.

Materials and Methods

Animals and samples collection

This study was carried out on five one-humped camels of different age and sex. Camels were subjected to experimental feed deprivation for one week with free access to water. Blood and forestomach liqour samples were collected prior to feed deprivation (day zero) and after one week of feed deprivation (fasting). Blood samples were collected using jugular vein puncture, while the forestomach

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liquor samples were collected using stomach tube connected to special pump (Abdoun *et al,* 2010).

Laboratory analysis

The blood samples with or without anticoagulant (Sodium fluoride) were centrifuged at 3000 rpm for 10 minutes and the supernatant fluid (serum/plasma) was pipette into clean vials. All samples were stored at -18°C for subsequent analysis. The samples of the forestomach liquor were sieved and after that a 10 ml samples was centrifuged at 6000 rpm for 10 minutes.

Packed cell volume (PCV) was determined using capillary tube and haematocrit centrifuge, while blood haemoglobin concentration was determined calorimetrically by cyanomethaemoglobin method as described by Van Kampen and Zijlster (1961). Plasma glucose level, and serum total protein, albumin, urea and triglycerides levels were determined by enzymatic calorimetric method using commercial kits (Spinreact, S. and Bio System, S.A., Spain). Serum β-hydroxybutyrate concentration was determined by enzymatic calorimetric method using commercial kit (Biopharm AG; Darmstadt, Germany). Na^+ and K^+ concentrations in serum and forestomach liquor were determined using flame photometer (Jenway, England). The osmolality of serum and forestomach liquor samples were measured using Osmometer (Osmomat® 30; Gonotec, Germany).

Statistical analysis

The data obtained from the analysis of serum and forestomach liquor collected from the camels have been subjected to standard statistical analysis. Statistical evaluations were carried out by means of SPSS program version 10.0 for Windows (SPSS, 1999). Results are given as mean values with their standard errors. Student's t-test was used to evaluate the effects of feed deprivation on the measured parameters. Significant effects were reported at $P<0.05$.

Results and Discussion

Plasma glucose and serum triglycerides and β-hydroxybutyrate concentrations were used as biomarkers to assess the energy balance (Pambu-Gollah *et al,* 2000) of camels fasted for one week. One week fasting did not significantly alter the concentrations of these markers (Table 1). However, slightly decreasing and slightly increasing trends were observed for plasma glucose and serum triglycerides concentrations, respectively. In llamas it has been observed that diminished feed intake decreased maintenance energy requirements (Schneider *et al,* 1974). Triglycerides are known to provide the metabolic fuel for most tissues when the animal has energy deficit (Beitz, 1993). In addition, feed deprivation was reported to decrease plasma glucose levels in monogasrtric mammals and ruminants (Evans, 1971 and Rule *et al,* 1985) and to result in a significant ketogenesis with blood accumulation of β-hydroxybutyrate in ruminants (Chillard *et al,* 1995). Therefore, the observed results clearly indicate the ability of dromedary camel to withstand fasting for one week without serious effects on its energy balance.

Table 1. Energy status in feed deprived camels (N = 5).

Parameters	Prefasting	7 days fasting	P value
Serum glucose (mg/dL)	77.00 ± 8.19	69.60 ± 4.00	0.39
Serum triglycerides (mg/dL)	37.10 ± 3.6	41.80 ± 2.20	0.25
Serum β-hydroxybutyrate (g/L)	3.30 ± 1.25	3.38 ± 0.93	0.69

Serum albumin and urea concentrations were used as biomarkers (Lynch and Jackson, 1983) to evaluate the nitrogen balance of camels fasted for one week. Feed deprivation for 7 days didn't significantly alter serum albumin concentration, however, serum urea concentration was significantly ($p<0.05$) elevated (Table 2). On the other hand, serum total protein concentration was increased as a result of an increase in serum globulin concentration ($p<0.1$). The elevated serum urea concentration might cause efficient nitrogen recycling to support microbial protein synthesis in the forestomach under fasting condition. Nitrogen losses have been reported to decrease in response to a decline in nitrogen intake due to sparing renal activities that are accompanied by increased urea recycling to the gut in desert herbivores, particularly desert goats and camels (Mousa *et al,* 1983; Silanikove *et al,* 1980). The observed increase in serum globulin and total protein concentrations could be attributed to the stresses to which camels were subjected under fasting condition. Since serum albumin concentration didn't change, this indicates the ability of dromedary camel to maintain its nitrogen balance during 7 days fasting.

The effects of 7 days fasting on camel's PCV, Hb concentration, serum osmolality, serum Na^+ and K^+ concentrations were also tested (Table 3). Fasting resulted in a significant ($p<0.1$) reduction of PCV, Hb and serum K^+ concentrations. However, serum osmolality and Na^+ concentration didnot change significantly. Fasting seems to reduce blood

haematological parameters (PCV, Hb) probably due to the reducing effect of energy deprivation on plasma iron and serum transfer levels (Jan, 2009). The observed maintenance of serum Na^+ concentration and serum osmolality during fasting could be attributed to the unchanged activation of the renin-angiotensin-aldosterone system (RAAS) in feed deprived camels (Dahlborn *et al,* 1992).

The changes in camel's forestomach liquor osmolality, Na^+ and K^+ concentrations due to fasting are presented in table 4. Seven days fasting resulted in a significant ($p<0.1$) reduction of K^+ and Na^+ concentrations in the forestomach liquor which was reflected on the observed decreasing trend of liquor osmolality. Saliva flow has been reported to increase during feeding and rumination (Carr, 1984). Therefore, the observed results could be attributed to the lack of feed sources of these minerals and the reduction of saliva flow during fasting.

Conclusion

Dromedary camels show the capability of tolerating 7 days fasting, by maintaining their energy and nitrogen balance in addition to the blood osmolality. Some haematological parameters (PCV, Hb) and the forestomach liquor osmolality were slightly affected during the fasting period. These physiological particularities enable the dromedary camels to live under desert conditions and to survive in the incredibly hard environment of the Sahara.

Table 2. Protein status in feed deprived camels (N = 5).

Parameters	Prefasting	7 days fasting	P value
Serum total protein (mg/dL)	6.24 ± 0.13	6.72 ± 0.05	0.06
Serum albumin (mg/dL)	3.60 ± 0.08	3.74 ± 0.07	0.24
Serum globulin (mg/dL)	2.64 ± 0.11	2.98 ± 0.10	0.07
Serum urea (mg/dL)	44.00 ± 1.22	58.20 ± 1.88	0.00004

Table 3. Minerals status and haematology in feed deprived camels (N = 5).

Parameters	Prefasting	7 days fasting	P value
Serum Na (mEq)	137.50 ± 2.10	141.00 ± 0.71	0.23
Serum K (mEq)	5.25 ± 0.14	4.70 ± 0.20	0.04
Serum osmolality (mosmol)	336.00 ± 7.11	332.20 ± 3.40	0.70
Packed cell volume (%)	31.00 ± 4.51	22.60 ± 1.29	0.06
Hb (g/dL)	13.03 ± 1.25	10.32 ± 0.20	0.03

Table 4. Osmolality, Na+ and K+ concentrations of forestomach liquor in feed deprived camels (N = 5).

Parameters	Prefasting	7 days fasting	P value
Na (mEq)	110.67 ± 4.37	102.00 ± 0.41	0.07
K (mEq)	23.40 ± 0.83	19.20 ± 0.74	0.01
osmolality (mosmol)	270.00 ± 15.72	242.75 ± 3.40	0.11

Acknowledgements

This study was sponsored by a return fellowship from Alexander von Hombolt Foundation, Germany.

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