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The Effect of Water Deprivation on Blood Constituents of the Dromedary Camel (*Camelus dromedarius*)

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Abstract

The study aimed to elucidate the status of blood constituents and the physiological body reactions in term of core temperature, pulse rate and respiration rate in five male dromedary camels aged three to four years and weighed 350 to 420kg, housed in open yards in the experimental farm of Sudan University for Science and Technology and deprived of water for 48 hours. The results revealed significant increase ($P< 0.05$) in temperature, insignificant change in respiratory rate and a significant decrease in the pulse rate. With the exception to WBCs and level of glucose, the remaining blood constituents showed significant difference ($P< 0.05$) when compared with the control group. Of these, significant increase was found for RBCs, Urea, total protein and creatinine whereas significant decrease for the mean values of PCV and haemoglobin concentration. Based on the results achieved and the discussion undertaken in relation to data of relevant studies conducted elsewhere, the present study would conclude that the changes revealed were indicative to the adaptive ability of the animal to tolerate water deprivation for 48h.

Keywords: Water deprivation; Heat- stressed camel; Water-deprived camel; Camel water budget; Camel water economy; One- humped camel; Camel blood constituents.

1. Introduction

The camel is one of the most animals that are considered to live successfully in arid environments. It was reported that it had an ability to withstand severe dehydration and lack of water for several days [1, 2, 3, 4]. However, implications of dehydration were previously studied on water balance [5], urea excretion [6], temperature regulation [7], metabolism [8], water turnover [9, 10] and renal function of the dromedary camel [11].

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Under such condition of water deprivation, the camel was reported to tolerate water losses of up to 30% [5, 8, 9]. In addition to those parameters, seasonal variations of blood constituents were investigated in a large sample of one-humped camel during dry and wet season [12]. These constituents had been also investigated but in small number of water-deprived female camels [13] as well as in male ones [14]. Together with these aspects, thermo-physiological characteristics and haematological parameters were studied under hot conditions in water–deprived camels [15].

So far few studies were undertaken to elucidate the effect of water deprivation on the blood constituents of the camel and some of those conducted previously used a sample size of not more than three animals. However, this brings about the need for further studies with adequate sample size, of at least five animals, so as to enable acquisition of realistic and meaningful data about these constituents. Therefore, the present study is aimed to achieve this goal using adequate sample of one-humped dromedary camel (*Camelus dromedaries*) deprived of water for 48h during summer season.

2. Materials and methods

Five male dromedary camels of Bishari type, aged between three to four years and weighed 350 to 420 kg were obtained from The Experimental Farm of Sudan University of Science and Technology at Khartoum. The animals were housed in the open yards of this farm. The animals were measured while not being deprived of water (NDW), deprived of water for 48h (DW) and four hours after being provided with water (PW). The non-deprived animals were fed on fresh feed ad libitum while deprived ones on dry hay.

For blood constituents of camels, 10 ml of blood sample were collected from the jugular vein of each one of those non-deprived, deprived and 4h after being re-hydrated. Each sample was placed in a clean dry EDTA tube. The anti-coagulated blood was used for determination of red blood cells (RBCs), white blood cells (WBCs), packed cell volume (PCV), and hemoglobin (Hb), while the serum obtained from the remaining blood sample was used to determine biochemical constituents including glucose level, urea, Albumin, total protein and creatinine concentration using spectrophotometer and relevant kits.

Paralleled with these, the animal respiration rate was achieved by counting the rhythmical movement of abdomen per minute, its pulse rate by the number of waves per minute being detected by pressing gently a ball of one finger on the coccygeal artery and its core temperature by inserting thermometer in its rectum.

Mean values of blood parameters as well as of biochemical constituents of the group deprived of water and those of the group provided with water after deprivation were compared using student T-test, and means of each of them were compared with those of the group not deprived of water.

3. Results

The results of mean values of respiration rate, pulse rate and rectal temperature are shown in Table1. The results showed that the mean values of respiration rates did not vary significantly ($P > 0.05$) in water deprived camel when compared with either non-deprived camel (NDW) or those provided with water (PW).

Also, the results showed deprived camel to exhibit significantly reduced pulse rate when compared with non-deprived camels ($P < 0.01$). Moreover, deprived camel revealed to have significant increase in rectal temperature (RT) when compared with non-deprived camel ($P < 0.01$) as well as with those provided with water.

Table 1: Mean values (± SD) of respiratory rate (RR), pulse rate (PR) and rectal temperature (RT) of camel; non-deprived of water (NDW), deprived of water (DW) and 4h after being provided with water (PW).

Parameters	NDW	DW	PW
RR, min	5.6 ± o.5	8.2 ± 2.6	6 ± 1.2
PR/min	37.2 ± 2.5	29.8 ± 0.4**	37.4 ± 1.8 ##
RT(C°)	36 ± 0.04	37.5 ± 0.04**	35.2 ± 0.5* ##

Values are means ± SD, n= 5, * = $P \leq 0.05$, ** = $P \leq 0.01$.* = DW and PW versus NDW

= $P \leq 0.05$, ## = $P \leq 0.01$. # = PW versus DW

Blood parameter namely PCV, Hb, RBCs and WBCs are shown in Table 2. The results revealed that PCV was highly reduced ($P<0.01$) in deprived camels and in those examined after 4 hours of being provided with water when compared with non-deprived camel. While, Hb reduced in deprived group ($P < 0.05$) and highly reduced in camels after 4 hours of being provided with water ($P < 0.01$). Regarding, RBCs, it was highly reduced in the group measured after 4 hours of being provided with water ($P < 0.01$), but increased significantly in water – deprived group ($P < 0.05$).

Table 2: Mean values (± SD) of blood parameters of camel, non-deprived of water (NDW), deprived of water for 48h (DW) and 4h after being provided with water (PW).

Parameters	NDW	DW	PW
PCV (%)	28.7 ± 1.5	26.2 ± 1.1**	23.4 ± 0.5** ##
Hb g/100 ml	12.8 ± 0.6	11.7 ± 0.5*	10.1 ± 0.4** ##
RBCs ($X10^6$)	8.6 ± 0.5	11.6 ± 1.5*	7.9. ± 0.6** ##
WBCs ($x10^3$)	10.8 ± 2.4	12.7 ± 1.9	10.2 ± 2.0 ##

Values are means ± SD, n= 5, * = $P \leq 0.05$, ** = $P \leq 0.01$.* = DW and PW versus NDW

= $P \leq 0.05$, ## = $P \leq 0.01$. # = PW versus DW

For the biochemical constituents: glucose level, urea, total protein, albumin and creatinine the results are shown in Table 3.

They showed urea, albumin and creatinine in deprived group were significantly different ($P<0.05$), of which total protein level was highly significantly different when compared with the non-deprived group ($P<0.01$). The glucose level, however, did not show any significant difference ($P> 0.05$) among the three categories.

Table 3: Mean values (± SD) of biochemical constituents of blood in camel non-deprived of water (NDN), deprived of water for 48h (DW) and provided with water after 4h (PW).

Parameters	NDW	DW	PW
Glucose mg/dl	82.3 ± 14.1	106.7 ± 26.6	79.7 ± 8.2
Urea (mg/dl)	27.4 ± 4.1	36.4 ± 0.9*	28.1 ± 5.1$^{\#}$
Total protein (g/dl)	5.1 ± 0.3	6.8 ± 0.8**	5.3 ± 0.2 $^{\#}$
Albumin (g/dl)	2.6 ± 0.4	3.7 ± 0.3*	3.2 ± 0.2 $^{\#}$
Creatinine (mg/dl)	1.5 ± 0.3	2 ± 0.3*	1.5 ± 0.3

Values are means ± SD, n= 5, * = $P \leq 0.05$, ** = $P \leq 0.01$.* = DW and PW versus NDW

$^{\#}$ = $P \leq 0.05$, $^{\#\#}$ = $P \leq 0.01$. $^{\#}$ = PW versus DW

4. Discussion

The camel is one of the most well adapted animals to live in arid environments. It has an extraordinary capacity to withstand water deprivation for several days [3, 15]. This tolerance to water lack is attributed to its ability to produce concentrated urine, to entertain less cooling evaporative water loss and pass feces with minimal water loss [16, 17, 18].

In the present study, the mean values of blood constituents and of those reflecting the physical physiological response of water–deprived camel such as temperature, respiration rate and pulse rate would give insight on the status of the animal under dehydration stress. However, the significant increase of core temperature in water-deprived camels from 36 C˚ to 37.5C˚ probably would indicate that the temperature did not reach the limit that would bring about the animal under heat stress. This claim might be true as elevated core temperature in these animals had not been paralleled with a significant increase in the respiration rate. However, this parameter is regarded as indicator to heat stress and probably enhancing dissipation of heat [19] and its increase in heat-stressed camel resulted in brain cooling [20]. In other studies, the increase of core temperature induced by water deprivation was thought to be due to lower water turnover of the camel that was reported to be in the range of 38 – 76 ml/kg/d compared with the sheep (62-127 ml/kg/d) and goat (76-196 ml/kg/d) [4]. Furthermore, rectal temperature was reported to increase with increase in metabolic rate and to decrease with dehydration of the animal [8].In this study, probably the increase of rectal temperature was ascribed to the smaller surface area to volume ratio that is characterizing large mammals such as camels compared to small ones such as goats [21].

On the other hand, the significant decrease in the level of PCV as well as in the concentration of Hb was more likely brought about as a result of water mobilization from the plasma as extracellular compartment to adjacent interstitial tissues of vital organs such liver, heart and the brain whose functions are of a paramount importance to survival of the animal. Differing from these changes, the significant increase in RBC count might be linked to reduction in the volume of plasma matrix due to movement of water to dehydrated tissues. However, the increased RBC also seems to be caused as a physiological response to stimulatory effect of elevated core temperature to enhance recapture more oxygen molecules for metabolism which was reported to increase with the increase of temperature [8].

However, the decreased level PCV in this study, in spite of increase number of RBC, might be referred to erythrocytes themselves as stacked thin walled structures being drained of some water content.

As anticipated, water deprivation of the camel in the present study had resulted in increased level of urea, creatinine, albumen and total protein. These results conformed with those reported elsewhere: for urea and creatinine [11, 12, 14] and for total protein [15]. However, the increase of these nitrogenous constituents is clinically considered indication to kidneys' dysfunction [22]. In this context, the recovery of almost normal levels of nitrogenous products in the camel of this study which were provided with water and measured after four hours proved the lack of this dysfunction and perhaps confirmed the claim that the elevation of these products was due to decline in the glomerular filtration rate during dehydration to conserve water content of the animal under the condition of water deprivation [11].

5. Conclusion

The study showed that the dromedary camel (*Camelus dromedaries*) could tolerate water deprivation for 48h without serious effect on blood constituents and functions of the kidneys.

6. Limitation of study

Because of being used to elucidate the effect of water deprivation for 48h, the same experimental group of camel did not allow to investigate for further extended durations as factors other than water deprivation might interfere with results.

7. Recommendations

- More extended durations of water deprivation should be investigated in separate groups of camel.
- Urine concentrations and frequency of urination should be determined.
- Images of camel erythrocytes should be visualized before and after provision of water.
- Camel body weight should be measured during water deprivation and after provision of water.

Conflict of interest

We declare that there are no conflicts of interest to disclose.

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References

[1] Maloiy, G. M. "Renal salt and water excretion in the camel Camelus dromedarius" Symposium of Zoological Society.. No 31, pp 243-259, 1972.

[2] Elkhawad, A. O. "Selective brain cooling in desert animals: the camel (Camelus dromedarius, Comparative Biochemistry and Physiology, 101A, pp 195-201, 1992.

[3] Schmidt-Neilsen, K., "Animal physiology- adaptationand environment". Cambridge University, Cambridge, Uk, 1997, pp217-293

[4] Oujad, S., and Kamel, B. "Physiological particularities of dromedary (Camelus dromedarius) and experimental implications". Scandinavian Journal of Laboratory Animals Sciences, 36, pp19-29, 2009.

[5] Schmidt-Neilsen, B., Schmidt-Neilsen, K., Houpt, T. R. and Jarnum, S. A. "Water balance of the camel". American Journal Physiology, 185, pp185-194, 1956.

[6] Schmidt-Neilsen, B., Schmidt-Neilsen, K., Houpt, T. R and Jarnum, S. A "Urea excretion in the camel", American Journal of Physiology, 188, pp 477-484, 1957a.

[7] Schmidt-Neilsen, K., Schmidt-Neilsen, B., Jarnum, S. A. and Houpt, T. R. "Body temperature of the camel and its relation to water economy" American Journal of Physiology, 188, pp 103-112, 1957b.

[8] Schmidt-Neilsen, K.,Grawford, E. C. Jr., Newsome, A. E. , Rawson, K. S. and Hammel, H. T. "Metabolic rate of camels: effect of body temperature and dehydration" American Journal of Physiology, 212pp 341-346, 1967.

[9] Macfarlane, W. V., Moris, R. J. H. and Howard, B. "Turnover and distribution of in desert camels, sheep, cattle and kangaroos", Nature, (London), 197, pp 270-271, 1963.

[10] Macfarlane, W. V. and Howard, B. "Water in the physiological ecology of ruminants. In Physiology of digestion and metabolism in the ruminant" ' Phillipson, A. T. (ed.), Newcastle upon Tyne: Oriel press, 1970, pp: 362-373,

[11] Sibert, B. D. and Macfarlane, W. V. "Water turnoverand renal function of dromedaries in the desert" Physiological Zoology, 44, pp 225-240, 1971.

[12] Amin A. S., Abdoun K. A. and Abdelatif, A. M. "Seasonal variation in blood constituents of one-humped camel (Camelus dromedarius) " Pakistani .Journal of Biological Science, 10, pp 1250-1256, 2007.

[13] Ayoub, M. A. and Saleh, A. A. "A comparative Phsiological study between camels and goats during water deprivation", Proceeding of 3rd Annual meeting for animal production under arid conditions, 1, pp 71-87, 1998.

[14] Ali, M. A., Adem, A., Chandranath, I. S., Benedict, S., Pathan, J. Y., Nagelkerke, N., Nyberg, F., Lewis, L. K., Yandle, T. G., Nicholls, G. M.,Frampton, C.M., Kazzam, E. (2012). "Responses to dehydration in the one-humped camel and effects of blocking the rennin-angiotensin system", Plus One, DOI: 10.1371/journal.pone. 0037299.

[15] Samara, E. M. Abdoun, K. A. Okab, A. B. and Al-haidary, A. A. "A comparative thermophysiological study on water deprived goats and camels".Journal of Applied Animal Research, DO 1:10.1080/09712119.2012.692326.

[16] Schmidt, K. B. "Desert animals: physiological problems of heat and water", Clarendon press, Oxford, 1964, pp. 277.

[17] Sibert, B. D. and Macfarlane, W. V. "Dehydration in desert cattle and camels" Physiological Zoology, 48, pp 36-48, 1975.

[18] Yagil, R. "The desert animal: comparative physiological adaptation" Basel, New York, Karger, 1985, pp. 163.

[19] Gaughan, J. B. Hole, S. M.; Hahn, G. L.; Mader, T. L. and Eigenberg, R. "Respiration rate- Is it a good measure of heat stress in cattle?" Asian-Australian Journal of Animal Science, 13 Supplement C, pp 329-332, 2000.

[20] Schroter, R. C.; Robershaw, D. ; Zine-Filali, R. "Brain cooling and respiratory heat exchange in camels during rest and exercise", Respiration Physiology, 78, pp 95-105, 1989.

[21] McNab, B. K. "Energetics, body size and limits to endothermy", Journal of Zoology, (London), 199, pp 1-29, 1983.

[22] Toro, G. and Aklermann, P. C. "Practical Clinical Chemistry", 1st ed., Little, Brown and Company (Inc), Boston, pp 137-164, 1975.