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CHANGES IN BODY FLUID COMPARTMENTS DURING DEHYDRATION AND REHYDRATION IN INDIAN DROMEDARY (*Camelus dromedarius*)

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ABSTRACT

The changes in body fluid compartments were studied in eight female dromedary camels (*Camelus dromedarius*) during dehydration and rehydration in summer and winter seasons. The mean values of all the body fluid compartments viz. total body water (TBW), plasma volume (PV), blood volume (BV), red cell volume (RCV), extracellular fluid volume (ECF), intracellular fluid volume (ICF) and interstitial fluid (ISF)volume were non significantly ($p > 0.05$) higher during summer than winter control. The mean values of body fluid compartments in litres decreased during dehydration in winter and summer. The percent decline was higher during summer dehydration. During dehydration the percent change was from control values and during rehydration it was from dehydrated values. During winter the percent decline was maximum in ICF volume on day 6 and then on day 12 onwards it was maximum in ISF volume. Immediately after rehydration the percent recoveries were comparatively higher in PV, BV and RCV. It was minimum in ICF. During summer on days 4 and 8 of dehydration the percent declines in ICF and ISF volumes were almost equal and maximum. On day 12 the percent decline was maximum in ISF volume. Immediately after drinking water in summer the percent recoveries were found higher for PV, BV and RCV.

Key words: Body fluid compartments, dehydration, dromedary camels, rehydration, summer and winter

The total amount of water in the body remains relatively constant from day to day however, considerable variation is observed in total body water content of an animal due to different conditions particularly those related with environment and lack of water. The intake of water is intermittent and loss of water is continuous therefore the animal is always faced with the problem of slow dehydration. A wide range of adaptation to lack of water is there in domestic animals to a certain extent and camel is one of them. Generally in camels the problem of lack of water is compounded by exposure to higher temperatures although they have legendary ability to withstand heat and water lack as substantiated by the studies of earlier workers. However, severe lack of water terminates in dehydration thereby altering the fluid balance. The determination of organisation and composition of body fluid compartments is a key to unlock the complexities of altered fluid balance. In the field conditions dehydration results from inadequate fluid intake coupled with increased fluid losses. It disturbs the normal fluid balance affecting the distribution of fluid. In veterinary practice knowledge of the changes in distribution of fluid may be of great help in understanding the clinicopathological manifestations of altered fluid balance particularly in camels which are least studied in this respect. For this purpose the best experimental model is by maintaining the animals for various periods without drinking water (Ziv *et al*, 1997). In view of this the present investigation was planned to determine changes in body fluid compartments in winter and summer during dehydration and rehydration in dromedary camel (*Camelus dromedarius*).

Materials and methods

Eight apparently healthy adult female camels (*Camelus dromedarius*) ageing 6 to 10 years, belonging to National Research Centre on

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Camel, Bikaner, India were used in the present investigation. The investigation was divided into control, dehydration and rehydration phases in winter and summer seasons. The control phase in each season was comprised of 10 days. During this phase the animals were provided with 14 kg feed once in 24 hours and watered *ad libitum*. The dehydration phase was of 24 days in winter and 13 days in summer. The animals were kept under same feeding and managemental conditions but with complete water restriction. The rehydration phase in each season was comprised of 5 days. After the end of dehydration phase water was provided *ad libitum* to each animal. In all the three phases of both the seasons the different body fluid compartments were determined alongwith packed cell volume (Jain, 1986) and body weights.

1. Body fluid compartments: For determination of body fluid compartments the procedure described by Banerjee and Bhattacharjee (1963) was followed.

(i) Total body water was determined by using urea dilution technique.

(ii) Extracellular fluid was determined by using sodium thiocyanate.

(iii) T-1824 dye (Evans' blue) dilution technique was used to determine plasma volume.

Body fluid compartments were determined during control; day 6, 12, 18 and 23 of dehydration; and hour 2, 56 and 104 of rehydration in winter; and control; day 4, 8 and 12 of dehydration; and hour 2, 56 and 104 of rehydration in summer.

Method of Infusion

Preparation of Solution for Infusion

Sterile solutions of 12.5 g sodium thiocyanate and 330 mg of T-1824 in 250 ml distilled water and 150 g urea in 500 ml distilled water were prepared and mixed. A 200 ml sterile normal saline solution (NSS) was also taken in a flask.

Technique

Before each infusion blood sample was collected in EDTA which served as control. Then the solution was injected rapidly into the jugular vein by using multiple syringes (already loaded 50 ml in each). The NSS was used to rinse the traces of dye from the syringes and flask and injected immediately. The whole process of infusion was completed within 10 minutes and the completion time was noted accurately. Four samples of blood were collected at half - hourly interval i.e., 30, 60, 90 and 120 minutes after the infusion, from the jugular vein of opposite side. Haematocrit was determined from every sample and plasma was separated out. All estimations were performed in duplicate.

1. Total Body Water (TBW) : The blood urea was determined in the plasma samples by diacetyl monoxime method (Varley, 1988).

Calculation

A graph was plotted with concentrations of urea at different time intervals and was extrapolated back at 0 to determine the concentration at 0 time from the graph.

$$\text{TBW (ml)} = \frac{\text{Total amount of urea injected, mg}}{\text{Concentration of urea at zero time, mg/ml}}$$

2. Extracellular Fluid Volume (ECF) : ECF volume was estimated by the method of Wrenn *et al* (1962).

Calculation

The concentration of sodium thiocyanate was estimated in the four plasma samples collected at 30 minutes interval and graph was drawn between time and concentration of thiocyanate and extrapolated to zero time which gave the concentration at 0 time.

$$\text{ECF Volume, ml} = \frac{\text{Total amount of thiocyanate injected, mg}}{\text{Concentration of thiocyanate at zero time, mg/ml}}$$

3. Plasma Volume (PV) : The optical densities of the plasma samples collected at 30 minute interval were recorded by a spectrophotometer at 620 mμ against the control plasma (Plasma before infusion) as a blank. The concentrations of Evans' blue dye in plasma samples were measured from a standard graph.

Calculation

The concentrations of Evans' blue in plasma samples were plotted against time and graph was extrapolated to determine concentration of dye at zero time.

$$PV, ml = \frac{\text{Amount of dye injected, mg}}{\text{Concentration of dye in plasma at zero time}}$$

The other volumes were calculated from the formulae as given below:

4. Blood Volume (BV)

$$BV = PV \times \frac{100}{100 - (\text{Venous PCV}) (\text{Correction factor for true PCV and body PCV})}$$

5. Red Cell Volume (RCV)

$$RCV = PV \times \frac{(\text{Venous PCV}) (\text{Correction factor for true PCV and body PCV})}{100 - (\text{Venous PCV}) (\text{Correction factor for true PCV and body PCV})}$$

Correction factor = 0.864

6. Intracellular Fluid Volume (ICF)

ICF = TBW - ECF

7. Interstitial Fluid Volume (ISF)

ISF = ECF - BV

8. Body weight

It was recorded daily in the morning before feeding throughout the course of experiment in both seasons by using a weigh bridge (AVERY, India). During rehydration phase, apart from normal morning schedule, it was also measured after water intake.

9. Statistical analysis

The experiment in each season was divided into three phases and their subsets viz. days (dehydration phase) and hours (rehydration phase). For each subset, data were expressed as mean ± SEM. The changes in means were measured as the difference between the control mean and the value at a particular subset, whether each mean change was significantly different from control was assessed by paired 't' test (Snedecor and Cochran, 1967). Mixed model least square and maximum likelihood computer programme PC - I (Copyright 1987 Walter R. Harvey) were used to determine analysis of variance, to test the significance of the effects of dehydration and rehydration.

Results and Discussion

The mean ± SEM values of body fluid changes during different phases viz. control, dehydration and rehydration are presented in table 1 for winter and table 2 for summer.

The mean values of all the body fluid compartments viz. total body water (TBW), plasma volume (PV), blood volume (BV), red cell volume (RCV), extracellular fluid volume (ECF), intracellular fluid volume (ICF) and interstitial fluid (ISF) volume were non significantly ($p > 0.05$) higher during summer than winter control. The low TBW in winter was probably due to low requirement of water in comparison to summer. The higher TBW during summer in camels helped them to store the heat in the body water. The increased tolerance of the camel to the deprivation of water in hot summer months (Schidt-Nielsen *et al*, 1956) might be due to its power to hold more water in its body specially in plasma. Increased BV and PV during summer in camels suggested increased blood flow due to peripheral vasodilatation which increased the blood volume. It may also be due to the ability of camels to retain more water in blood and plasma which offered better tolerance to water deprivation in camels without causing circulatory collapse, though TBW loss was there. Razdan *et al* (1966) determined higher blood and plasma volume in winter than in summer in cattle.

The mean values of TBW, PV and BV obtained in the present study were in accordance, of ICF were higher and of ISF were lower than those reported by Banerjee and Bhattacharjee (1963) and Ghosal (1971). The range of ECF volumes obtained was slightly lower than those reported by Banerjee and Bhattacharjee (1963) and higher than those reported by Ghosal (1971) in camels. The high volume of ICF is significant for the camel as it could be mobilised to ECF with electrolytes to maintain the water balance when water is not available.

The mean values of body fluid compartments in litres decreased during dehydration phase in winter and summer. During dehydration the percent change was from control values and during rehydration it was from dehydrated values. The rate of percent decline was higher during summer dehydration. During winter, on day 6 of dehydration the maximum

Table 1. Body water changes in camels during different phases of dehydration and rehydration in winter (mean ± SEM, N=8).

Parameters	Control Phase	Dehydration Phase				Rehydration Phase		
		6 days	12 days	18 days	23 days	2 Hrs	56 Hrs	104 Hrs
B.Wt, kg	490.25 ±19.51	428.50 ±15.00	392.37 ±11.64	364.875 ±11.411	341.5 ±10.727	410.25 ±9.97	434.62 ±13.05	445.125 ±15.40
% Change in B.Wt	-	-12.595	-19.96	-25.573	-30.341	±22.28	±26.48	±29.53
TBW, I	293.62 ±14.23	243.62 ±11.71	214.12 ±8.80	196.62 ±8.58	183.37 ±8.04	251.62 ±7.35	259.62 ±8.24	265.25 ±10.10
TBW, ml/kg B.Wt	597.45 ±6.87	564.23 ±9.41	544.51 ±7.91	534.53 ±9.31	532.38 ±10.32	612.95 ±6.30	597.34 ±7.40	595.02 ±6.06
TBW % B.Wt	59.75 ±0.68	56.42^{b} ±0.94	54.45^{b} ±0.791	53.45^{b} ±0.931	53.23^{b} ±1.032	61.29^{a} ±0.630	059.73^{a} ±0.74	59.50^{a} ±0.606
% Change in TBW	-	-17.02	-27.07	-33.03	-37.54	±37.21	±41.58	±44.65
PV, I	25.00 ±0.981	21.37 ±0.62	18.75 ±0.365	17.62 ±0.419	15.75 ±0.59	23.12 ±0.61	22.56 ±0.863	22.75 ±0.995
PV ml/kg B.Wt	50.99 ±0.327	51.14 ±1.66	48.01 ±1.032	48.23 ±1.59	45.92 ±1.50	56.39 ±1.03	51.84 ±0.779	51.01 ±0.813
PV% B.Wt.	5.09 ±0.032	5.10^{a} ±0.166	4.79^{b} ±0.132	4.82^{b} ±0.160	4.59^{b} ±0.151	5.63^{b} ±0.104	5.18^{a} ±0.077	5.09^{a} ±0.082
% Change in PV	-	-14.52	-25	29.52	-37	±46.79	±43.23	±44.44
BV, I	35.46 ±1.32	23.68 ±1.08	31.37 ±0.656	27.03 ±0.867	22.00 ±0.762	32.70 ±0.876	34.13 ±1.44	31.16 ±2.13
BV, ml/kg B.Wt	72.36 ±0.804	75.98 ±1.19	80.25 ±2.199	74.037 ±2.87	64.11 ±1.837	79.75 ±1.341	78.36 ±1.25	72.72 ±1.12
BV% B.Wt	7.23 ±0.080	7.59^{b} ±0.119	8.02^{b} ±0.219	7.40^{a} ±0.287	6.53^{b} ±0.246	7.97^{b} ±0.134	7.83^{b} ±0.125	7.27^{a} ±0.112
% Change in BV	-	-7.83	-11.53	-23.77	-37.95	±48.63	±55.13	±41.63
RCV, I	10.46 ±0.481	11.31 ±0.539	12.622 ±0.398	9.41 ±0.522	6.25 ±0.306	9.59 ±0.431	11.57 ±0.624	9.667 ±0.37
RCV, ml/log B.Wt	21.36 ±0.757	26.27 ±0.952	32.23 ±1.11	25.75 ±1.53	18.18 ±0.831	23.32 ±0.89	26.50 ±0.724	21.68 ±0.531
RCV % B.Wt.	2.13 ±0.075	2.62^{b} ±0.095	3.22^{b} ±0.111	2.57^{b} ±0.153	1.81^{b} ±0.083	2.33^{a} ±0.089	2.65^{b} ±0.072	2.168^{a} ±0.053
% Change in RCV	-	±8.126	±20.66	-10.03	-40.24	±53.44	±85.12	±54.67
ECF, I	95.25 ±5.28	81.75 ±3.99	69.37 ±3.28	63.5 ±3.84	56.25 ±3.25	80.50 ±3.95	86.00 ±4.57	88.25 ±5.18
ECF, ml/Kg B.Wt	193.97 ±7.08	189.70 ±6.231	176.53 ±5.74	172.40 ±6.64	163.24 ±7.20	195.86 ±7.53	197.60 ±8.17	198.02 ±9.28
ECF % B.Wt	19.39 ±0.708	18.96^{a} ±0.622	17.65^{a} ±0.774	17.23^{b} ±0.664	16.32^{b} ±0.720	19.58^{a} ±0.753	19.75^{a} ±0.815	19.79^{a} ±0.928
% Change in ECF	-	-14.17	-27.17	-33.33	-40.94	±43.11	±52.88	±56.88
ICF, I	198.37 ±10.29	161.87 ±9.00	144.75 ±6.67	133.12 ±5.85	127.12 ±6.45	171.12 ±5.30	173.62 ±6.19	177.00 ±7.91
ICF, ml/kg B.Wt	403.51 ±7.48	374.5 ±10.59	367.96 ±9.12	362.23 ±9.42	369.17 ±12.14	417.04 ±8.24	399.78 ±10.17	397.45 ±10.48
ICF, % B.Wt	40.35 ±0.748	37.45^{b} ±1.059	36.79^{b} ±0.912	36.22^{b} ±0.942	36.91^{b} ±1.21	41.70^{a} ±0.824	39.97^{a} ±1.017	39.74^{a} ±1.04
% Change in ICF	-	-18.39	-27.03	-32.89	-35.91	±34.61	±36.57	±39.23
ISF, I	59.78 ±4.38	49.06 ±3.31	38.002 ±3.15	36.46 ±3.88	34.24 ±2.99	46.54 ±3.63	51.86 ±3.58	55.83 ±4.45
ISF, ml/kg B.Wt	121.49 ±7.26	113.65 ±6.36	96.21 ±6.57	98.16 ±8.30	99.06 ±7.44	113.55 ±9.33	119.13 ±7.57	125.22 ±9.23
ISF % B.Wt	12.14 ±0.726	11.36^{a} ±0.636	9.62^{b} ±0.657	9.81^{b} ±0.83	9.90^{b}± 0.744	11.60^{a} ±0.825	11.91^{a} ±0.757	12.52^{a} ±0.923
% Change in ISF	-	-17.93	-36.43	-39.00	-42.72	±35.92	±51.46	±63.05

Subclass means within a given parameter superscribed by letter 'a' do not differ significantly ($p > 0.05$) and by letter 'b' differ significantly ($p \leq 0.05$) from control means. N = number of camels; RCV = Red Cell Volume; B.Wt. = Body Weight; TBW = Total Body Water; ECF = Extra Cellular Fluid Volume; BV = Blood Volume; PV = Plasma Volume; ICF = Intra Cellular Fluid Volume; ISF = Interstitial Fluid Volume.

Table 2. Body water changes in camels during different phases of dehydration and rehydration in summer (mean±SEM, N=8).

Parameters	Control Phase	Dehydration Phase			Rehydration Phase		
		4 days	8 days	12 days	2 Hrs	56 Hrs	104 Hrs
B.Wt, kg	512.162 ±14.464	428.87 ±13.81	379.00 ±12.71	341.62 ±10.56	408.00 ±11.44	467.25 ±13.92	471.12 ±14.69
% Change in B.Wt	-	-16.25	-25.99	-33.29	±19.50	±36.77	±37.90
TBW, I	313.50 ±12.354	229.75 ±14.13	191.87 ±11.87	166.37 ±9.48	242.62 ±9.41	280.25 ±11.08	284.00 ±11.32
TBW, ml/kg B.Wt	610.592 ±7.417	532.13 ±17.17	503.20 ±16.23	484.366 ±13.89	593.32 ±8.06	598.68 ±7.60	601.84 ±7.90
TBW % B.Wt.	61.061 ±0.742	53.21[b] ±1.716	50.32[b] ±1.622	48.43[b] ±1.389	59.32[a] ±0.80	59.86[a] ±0.76	60.18[a] ±0.79
% Change in TBW	-	-26.71	-38.79	-46.93	±45.83	±68.44	±70.70
PV, I	26.812 ±0.925	22.25 ±0.94	18.00 ±0.327	15.625 ±0.625	24.12 ±0.95	24.737 ±1.198	24.62 ±1.13
PV ml/kg B.Wt	52.306 ±0.847	51.84 ±1.31	47.84 ±1.741	45.758 ±1.373	58.98 ±1.006	52.806 ±1.47	52.15 ±1.28
PV% B.Wt.	5.228 ±0.084	5.17[a] ±0.136	4.78[b] ±0.174	4.575[b] ±0.137	5.89[b] ±0.099	5.277[a] ±0.147	5.21[a] ±0.128
% Change in PV	-	-17.014	-32.86	-41.72	±54.36	±58.31	±57.56
BV, I	38.36 ±1.224	35.021 ±1.375	27.27 ±0.489	21.702 ±0.844	33.42 ±1.39	37.43 ±1.70	34.98 ±1.50
BV, ml/kg B.Wt	74.862 ±1.238	81.72 ±2.37	72.59 ±3.326	63.53 ±1.891	81.67 ±1.78	79.912 ±2.04	74.05 ±1.45
BV % B.Wt.	7.486 ±0.123	8.17[b] ±0.237	7.26[a] ±0.332	6.353[b] ±0.189	8.167[b] ±0.178	7.99[a] ±0.20	7.4[a] ±0.145
% Change in BV	-	-8.70	-28.91	-43.43	±54.00	±72.48	±61.19
RCV, I	11.551 ±0.486	12.77 ±0.610	9.27 ±0.396	5.843 ±0.306	9.296 ±0.652	12.69 ±0.58	10.35 ±0.51
RCV, ml/log B.Wt	22.55 ±0.827	29.86 ±1.48	24.77 ±1.80	17.117 ±0.866	22.697 ±1.343	27.09 ±0.837	21.91 ±0.67
RCV, % B.Wt	2.255 ±0.082	2.98[b] ±0.15	2.477[a] ±0.180	1.711[b] ±0.086	2.268[a] ±0.134	2.709[b] ±0.083	2.19[a] ±0.067
% Change in RCV	-	±10.56	-19.74	-49.41	±59.09	±117.18	±77.13
ECF, I	100.275 ±4.581	78.75 ±4.26	64.25 ±3.47	52.125 ±3.367	77.625 ±3.411	86.25 ±4.06	92.50 ±4.95
ECF, ml/ Kg B.Wt	195.501 ±6.785	182.87 ±5.84	168.87 ±5.15	152.199 ±7.441	190.006 ±6.317	184.24 ±5.82	195.88 ±7.71
ECF % B.Wt	19.54 ±0.678	18.28[a] ±0.584	16.885[b] ±0.515	15.21[b] ±0.783	18.997[a] ±0.631	18.416[a] ±0.579	19.58[a] ±0.771
% Change in ECF	-	-21.46	-35.92	-48.01	±48.92	±65.46	±77.45
ICF, I	213.22 ±9.341	151.00 ±10.58	127.62 ±9.34	114.25 ±8.184	165.00 ±7.035	194.00 ±8.514	191.50 ±8.96
ICF, ml/Kg B.Wt	415.148 ±7.631	349.21 ±15.14	334.31 ±16.08	332.082 ±16.884	403.21 ±7.44	414.46 ±9.313	405.94 ±11.84
ICF, % B.Wt	41.513 ±0.762	34.92[b] ±1.51	33.43[b] ±1.60	33.207[b] ±1.688	40.32[a] ±0.745	41.44[a] ±0.931	40.59[a] ±1.18
% Change in ICF	-	-29.18	-40.14	-46.41	-44.42	±69.80	±67.61
ISF, I	61.912 ±4.135	43.72 ±3.58	36.97 ±3.56	30.422 ±2.785	44.20 ±2.80	48.814 ±2.839	57.52 ±3.89
ISF, ml/Kg B.Wt	120.65 ±7.343	101.09 ±6.87	96.20 ±7.30	88.589 ±6.948	108.24 ±6.64	104.273 ±5.199	121.75 ±7.26
ISF % B.Wt	12.06 ±0.734	10.11[a] ±0.687	9.62[b] ±0.730	8.858[b] ±0.694	10.82[a] ±0.664	10.42[a] ±0.519	12.17[a] ±0.726
% Change in ISF	-	-29.38	-40.28	-50.862	±45.28	±60.45	±89.07

Subclass means within a given parameter superscribed by letter 'a' do not differ significantly ($p > 0.05$) and by letter 'b' differ significantly ($p \leq 0.05$) from control means. N = Number of Camels; RCV = Red Cell Volume; B.Wt. = Body Weight; TBW = Total Body Water; ECF = Extra Cellular Fluid Volume; BV = Blood Volume; PV = Plasma Volume.

percent decline was observed in ICF. On day 12 of dehydration the percent decline was found highest in ISF volume and then onwards it was maintained. Immediately upon rehydration the percent recoveries were comparatively higher in PV, BV and RCV, highest being in RCV. It was minimum in ICF. During summer on days 4 and 8 of dehydration the percent declines in ICF and ISF volumes were almost equal and found to be maximum in comparison with other compartments. On day 12, the per cent decline was maximum in ISF volume. Immediately after drinking water in summer the percent recoveries were found higher for PV, BV and RCV, highest being in RCV.

The data regarding losses in body fluid compartments presented by Macfarlane *et al* (1962) in camels after dehydration were lower than observed in present study. The reason for the discrepancy was possibly the greater length of dehydration period in the present study which caused a higher stress to the animals. Bengoumi *et al* (1993) observed a decrease of 42.3% in PV in female camels following 14 days of water deprivation.

During dehydration in present investigation the maximum loss was observed from ISF. A similar trend was also reported by Macfarlane *et al* (1962) and Schmidt and Nielsen (1964). During winter this was followed by ECF and RCV and during summer by RCV and ECF. The ICF followed by PV and BV were least affected in winter dehydration; PV and BV were least affected comparatively in summer dehydration. The percent decline in different body fluid compartments was higher during summer dehydration even though the length of period was less. This showed the effect of high temperature.

The results clearly reflected the balancing of ICF by the ECF. During winter on day 6 when the effect of dehydration was mild, the more water moved from ICF space to ECF via the ISF ultimately to regulate the rise in plasma osmolality. Then on day 12, the percent decline was greater from ISF which showed that water moved to ECF to a greater extent from the ISF space than ICF space. The ICF and ECF were in balance with each other. This stand was probably to check the greater rise in ICF osmolality. On day 18, the camels drew the water from ISF space. Although, losses did occur from the ICF space but the camels reduced the extent of losses by balancing it with ECF, as it was affected more than ICF. Dehydration of 23 days further cleared the situation. The reduction in ICF space on day 23 was slightly less than that on day 18 but the ISF and ECF compartments were affected greatly. It clearly meant that camels maintained *milieu interior* of the cells by drawing the water from ECF and ultimately from ISF. The same trend was there during summer dehydration where on day 12 the percent changes surpassed those in ICF. Nose *et al* (1988) reported that among the possible compensation was the body's ability to mobilise water from the extravascular to the intra vascular space.

After long periods of dehydration the replenishing of water losses is important. Upon rehydration in the present study the influx of water into the blood stream from the alimentary canal (Yagil, 1985) resulted in overshooting of the plasma and blood volumes which exceeded the control values on percent body weight basis. On hour 2 of rehydration in each season, the percent recovery was maximum in RCV. Probably due to water entering the cells. Camel erythrocytes are extremely resistant to hypotonicity (Yagil *et al*, 1974). Etzion *et al* (1984) confirmed the rapid uptake of water into the camel blood and suggested that after 4 hours the water apparently equilibrated throughout most of the body and erythrocytes returned to normal shape and size. In the present study, on hour 56 of rehydration in winter and summer, the percent change in RCV further increased to higher values. This showed the retention of water by the red cells even after 56 hours of rehydration. On hour 104 of rehydration in each season, the RCV returned back to control levels. The difference between percent change at hour 2 and 104 of both the seasons was higher for ISF. This indicated that this space took time in replenishing. On hour 104 of rehydration in each season the results showed that all the compartments were replenished as TBW (% body weight) reached the control levels. The mean values of all the compartments differed non-significantly from that of control in both the seasons.

The mean values of TBW on hour 104 of rehydration in winter and summer reached to

90.33 and 90.59% of respective controls. This showed that animals replenished the losses occurred during dehydration due to water. The dehydrated camels recovered their body weights considerably. On hour 104 of rehydration during winter and summer, the mean body weight values approached 90.79 and 91.98% of the respective control values. This showed that body weight loss during dehydration due to water deficit was regained and it accounted the above values. However, 9.20 and 8.01% of the body weight during winter and summer, respectively was probably due to loss of tissue substance which takes time to recover. However, Schmidt- Nielsen *et al* (1956) assumed that weight loss during dehydration was caused mostly by loss of water and not by loss of tissue substance. But in present study tissue loss did occur as the condition of camels became hide-bound in the later days of dehydration phase and their feed intake was also reduced drastically.

Conclusion

The results showed highly significant effect of dehydration and rehydration on the different measures of TBW in winter and summer. The study of body fluid compartmentalisation showed the adaptability of camels to arid regions which enabled them to withstand water scarcity particularly when it was compounded by exposure to high ambient temperature in summer.

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