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RESPONSE OF CAMELS, SHEEP AND GOATS TO SALINE WATER. 2. WATER AND MINERAL METABOLISM

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SUMMARY

Three salinity levels of drinking water of 256 (tap water), 9472 (low salinity) and 16896 (high salinity) ppm total soluble salts (TSS) were used to study the effect of salt stress on water, sodium, potassium and chlorine metabolism and kidney function of three sheep, three goats and two female camels in an incomplete Latin square design. Sheep and goats were free choice offered drinking water with the three salinity levels but camels were exposed only to tap and high salinity level. All-berseem hay ration was offered ad. libitum to the three animal species.

Water intake and urinary water excretion as well as insensible water loss significantly increased as the salinity level of drinking water increased. However, fecal water loss showed no significant changes. These changes were drastic by sheep and goats than camels.

Increasing water salinity increased the intakes and urinary losses of sodium, potassium and chlorine by the three species while the relatively lower water consumption by camels reduced the electrolytes input in comparison with sheep and goats.

Blood plasma concentrations of sodium, potassium and chlorine increased by drinking high saline water (TSS 16896 ppm). Camels offered either tap or high saline water showed higher plasma sodium and chlorine than sheep and goats. Plasma total protein, albumin, globulin, urea and creatinine showed no significant

changes due to the increase in salinity level of drinking water.

Kidney function determined as urea and creatinine clearance rates increased as the salinity of drinking water increased but with lower rate by camels than sheep and goats.

Keywords: Camel, sheep, goat, water salinity, water and mineral metabolism, kidney function

INTRODUCTION

The salinity of underground water which is commonly used as drinking water for animals in arid desert sometimes exceed total soluble salts (TSS) of 13,000 ppm (Abou El-Nasr et al., 1988). Maximum salinity levels have been recommended for farm animals as 3500 ppm TSS (Addison, 1968 and Anon, 1980). However, Kandil et al., (1985) Abou El-Nasr et al. (1988), Khamis et al. (1989) in Egypt found that sheep may tolerate salinity up to 13,000 ppm TSS and camels tolerate more than 15,000 ppm TSS. Moreover, Australian studies suggested similar or somewhat higher salinity tolerance by sheep (Peirce 1960, 1966; Potter 1961, 1968 and Tomas et al. (1973). There is no available information about salinity tolerance of goats.

Although the predominant salt is sodium chloride, there are other electrolytes in underground water. Therefore, Rashidi crude salt which is the solid residues produced from the sun evaporation of sea water was used in the present study and salinity was expressed as ppm total soluble salt. The study aimed to evaluate water, sodium, potassium and chlorine metabolism by camels, sheep and goats offered saline drinking water.

MATERIALS AND METHODS

Three mature Rahmany rams of 55.3 Kg body weight and three Zaraibi bucks of 38.2 Kg body weight were arranged in three 3x3 Latin squares. Three levels of drinking water salinity were tested with sheep and goats, tap water of 256 ppm total soluble salts (TSS), low salinity of 9472 ppm TSS and high salinity of 16896 ppm TSS. However, two levels of drinking water salinity (tap water and high salinity) were tested with two mature female camels of 450 Kg body weight in 2x2 Latin squares.

Saline water was freshly prepared every two days by dissolving 0.75 % or 1.5 % crude salt (Rashidi salt) in tap water. Physical and chemical properties of drinking water was presented in Table 1. Animals were watered one hour post feeding twice a day and free choice water consumption was daily recorded.

Table 1. Analysis of drinking water

Item	Tap	Low	High
EC, mOsm/ml	0.40	14.80	26.40
TSS,ppm	256	9472	16896
Na, ppm	160	2479	5599
K, ppm	37	115	125
Cl, ppm	49	5680	9372

EC electric conductivity; TSS total soluble salts

Camels, sheep and goats were fed ad. libitum berseem hay composed of 90.61 % Dry matter, 87.31% Organic matter, 14.62% crude protein, 38.46 crude fiber and 32.23% nitrogen free extract.

Sheep and goats were individually housed in metabolic cages for 30 days for each metabolism trial, 21-day preliminary and 7 day collection periods. However, camels were housed in individual pens. Feces and urine were collected by the ordinary methods from sheep and goats while feces was collected through a long harness fitted to the back and urine of camels were collected through plastic tube surgically inserted into the vulva lips of she camels. The detailed procedure was illustrated by El-Banna (1993).

Blood samples were withdrawn from the left jugular vein into heparinized tube and spent at 3,000 rpm for 10 minutes. Urine and plasma potassium, chlorine, proteins, urea and creatinine were determined according to the methods described by Varley (1969). Plasma total protein and albumin was also determined (Varley, 1969).

Sodium, potassium and chlorine in feed, drinking water and feces were determined according to the A.O.A.C. (1984) methods.

Data collected were statistically analyzed using the

General Linear Model (GLM) procedure of SAS (1990). Duncan's multiple range test was used to separate means at alpha = 0.05.

RESULTS AND DISCUSSION

Increasing water salinity to 9472 or 16,896 ppm significantly increased total water intake, urinary water loss but had no significant effect on fecal water loss. Wilson (1966) reported that water intake increased in relation to the amount of sodium chloride ingested irrespective of diet or means of ingestion (food or water). Moreover, Wilson and Dudzinski (1973) suggested that the volume of urine excreted was related to the amount of sodium and potassium to be excreted, while the amount of water lost in feces was related to the quantity of fecal dry matter excreted and the type of diet. Insensible water loss also increased but not significantly. No significant differences in water intake and losses were found between the low and high level of salinity. Increasing water salinity altered the distribution of water output, since fecal and insensible water losses as percentages of water intake insignificantly decreased but urinary water loss as a percentage of water intake significantly increased without significant difference between high and low salinity levels (Table 2). These results were in agreement with the findings of Peirce (1966) on sheep, Kandil (1985) on camels, Saul and Flinn (1985) on weaner heifers and Khamis et al. (1989) on sheep and camels.

Data in Table 2 also showed that camels showed extremely lower water intake and losses as well in comparison with sheep and goats. No significant differences between sheep and goats were found in water metabolism. This result indicated that camels were more economic in their usage of drinking water (Gihad et al., 1994, Farid et al., 1979 and 1985). The low water intake and fecal loss by camels might be due to their low feed intake (Gihad et al., 1994). However, the low water loss by camels than sheep and goats might be related to the capacity of kidney to reduce urine output by the high ability of filtration by the reabsorption of water (Maloiy et al., 1972).

Table 2. Mean effects of water salinity and animal species on water metabolism (ml/Kg $W^{0.82}$)

Item	Water salinity			SE	Animal species			SE
	Tap	Low	High		Camels	Sheep	Goats	
Intake	180.1b	311.6a	314.8a	43.0	107.5b	343.3a	318.6a	29.9
Loss:								
Fecal	36.8	41.0	38.6	5.4	25.6b	53.7a	34.6a	3.2
Urinary	80.5b	181.2a	209.3a	30.5	48.4b	200.8a	198.9a	26.2
Total	117.3b	222.2a	247.9a	33.3	74.0b	254.5b	233.5a	26.4
Ins.	62.8	89.4	66.9	14.9	33.6b	88.9a	85.0a	12.1
Percentage of total water intake:								
Fecal	22.3	13.7	15.2	3.0	24.7a	17.7ab	11.3b	2.6
Urinary	44.4b	58.1a	62.4a	4.0	45.3b	55.5ab	61.5a	4.3
Ins.	33.3	28.2	22.5	3.6	29.9	27.0	27.2	3.9

Insensible water loss (Ins.) = Intake - (fecal loss + urinary loss) .
a,b Means in the same row within each trait bearing different superscripts differ (P<0.05).

The response of the three species to the high saline drinking water were different in water metabolism (Table 3). Camels were less affected by increasing water salinity followed by goats then sheep showing low water intake and urinary water loss. Sheep, goats and camels showed comparable response to drinking water salinity in fecal and insensible water losses. The effect of increasing water salinity was more drastic to alter the distribution of water output in sheep and goats than camels since the decrease in fecal and insensible water losses and the increase in urinary water loss as percentages of water intake were more obvious by sheep and goats than camels. Sooud et al. (1993) found that drinking saline water increased the proportion of water lost in urine than that lost in feces of camels. In this connection, Khamis et al. (1989) found almost similar trend in comparative study between sheep and camels offered saline drinking water. The minor changes in water intake and losses by camels might explain their higher tolerance of drinking saline water than sheep or goats.

The decrease in Na, K and Cl intakes from diet due to drinking saline water was related to its adverse effect on feed intake. However, drinking saline water significantly increased the consumption of Na, K and Cl as well as the total intakes of these electrolytes. The fecal output of Na, K and Cl was not affected by increasing salinity of drinking water indicating that urine was the main output pathway of these electrolytes. This is clear from the barrel increase in urinary Na, K and Cl with the increases in the intakes. The changes in the input and output resulted in a significant higher retention of sodium and chlorine but a decrease in potassium retention (Table 4).

Table 3. Response of camels, sheep and goats to drinking water salinity in water metabolism (ml/Kg $W^{0.82}$)

Item	Camels		Sheep			Goats			
	Tap	High	Tap	Low	High	Tap	low	High	SE
Intake	85.1e	130.0e	250.5d	280.0cd	499.5a	236.3d	343.1bc	376.4b	23.0
Loss:									
Fecal	l21.9d	29.2cd	61.8a	44.3bc	55.1ab	31.5cd	37.7cd	34.6cd	14.4
Urinary	33.0f	63.9f	100.2e	160.8d	341.2a	124.1e	201.5c	271.2b	11.7
Tota	l54.9f	93.1e	162.0d	205.1c	396.3a	155.6d	239.2c	305.8b	12.3
Ins.	30.2b	36.9ab	88.5ab	74.9ab	103.2a	80.7ab	103.9a	70.6ab	4.2
Percentage of total water intake:									
Fecal	27.0a	22.4abc	24.9ab	16.2abc	11.4c	13.5bc	11.2c	9.2c	4.1
Urinary	40.9d	49.8cd	40.2d	57.3abcd	69.0ab	53.2bcd	58.9abc	72.4a	5.3
Ins.	32.1	27.8	34.9	26.5	19.6	33.3	29.9	18.4	6.3

a,b,c,d Means in the same row bearing different superscripts differ ($P<0.05$)

Potter (1968) reported that the excretion of sodium and chloride tended to be greater in sheep maintained on saline water. Moreover, Tomas et al. (1973) found a decrease in potassium balance of sheep offered saline water containing 1.3% sodium chloride and they concluded that saline water ingestion caused alteration in the pathways of excretion of minerals and mineral balances but the changes would appear to be of insufficient consequence to have detrimental effects.

The lower Na, K and Cl intakes from diet and drinking water by camels than goats and sheep might be due to the low DM intake and water consumption by camels. Little differences in fecal output among the three species were found. The species difference in urinary excretion of Na, K and Cl were significant since goats and sheep excreted more Na, K and Cl in urine than camels. These differences in intake and excretion of these electrolytes resulted in less retention by camels than sheep and goats (Table 4).

Table 4. Mean effects of water salinity and animal species on sodium, potassium and chloride metabolism (ml/Kg $W^{0.82}$)

Item	Water salinity				Animal species			
	Tap	Low	High	SE	Camels	Sheep	Goats	SE
Sodium								
Dietary	0.817ab	0.871a	0.699b	0.050	0.618c	0.790b	0.926a	0.037
Water	0.049c	0.993b	2.259a	0.269	0.483b	1.512a	1.285ab	0.409
T.intake	0.866c	1.864b	2.958a	0.288	1.101b	2.302a	2.211ab	0.389
Fecal	0.193	0.188	0.207	0.077	0.146b	0.254a	0.185b	0.017
Urinary	0.677c	1.492b	2.426a	0.221	0.921b	1.817a	1.807a	0.318
T. loss	0.870c	1.680b	2.633a	0.234	1.067b	2.071a	1.992ab	0.322
Ret.	-0.004b	0.184	0.325	0.068	0.034b	0.230a	0.219a	0.078
Potassium								
Dietary	1.109	1.167	0.941	0.077	0.819b	1.088a	1.239a	0.537
Water	0.009b	0.045a	0.051a	0.006	0.014b	0.044a	0.040a	0.008
T.intake	1.118	1.212	0.992	0.080	0.833b	1.132a	1.279a	0.051
Fecal	0.072	0.069	0.066	0.002	0.065	0.077	0.065	0.007
Urinary	0.785	0.859	0.770	0.057	0.663b	0.798a	0.912a	0.044
T. loss	0.857	0.928	0.835	0.056	0.728b	0.875a	0.977a	0.043
Ret.	0.261a	0.284a	0.157b	0.003	0.105b	0.257a	0.302a	0.070
Chlorine								
Dietary	0.698	0.730	0.593	0.047	0.519c	0.680b	0.779a	0.032
Water	0.012c	2.274b	3.815a	0.418	0.898b	2.642a	2.328a	0.678
T.intake	0.710c	3.004b	4.408a	0.432	1.417b	3.322a	3.107a	0.659
Fecal	0.036b	0.050ab	0.053a	0.005	0.031b	0.050a	0.055a	0.005
Urinary	0.586c	2.641b	3.784a	0.372	1.236b	2.888a	2.629a	0.572
T. loss	0.622c	2.691b	3.837a	0.375	1.267b	2.938a	2.684a	0.575
Ret.	0.087c	0.313b	0.571a	0.064	0.149b	0.384ab	0.423b	0.089

a,b,c Means in the same row within each trait bearing different superscripts differ (P<0.05).

Increasing drinking water salinity increased Na, K and Cl intake from drinking water but had no significant effect on dietary Na, K and Cl intakes. The less saline water intake by camels reduced the electrolytes input in comparison with sheep and goats. Increasing drinking water salinity increased the excretion of Na, K and Cl. It had marginal effect on fecal output and increased the retention but with higher rate by sheep and goats than that by camels due to the lower intake of these electrolytes by camels (Table 5). This result might indicate that the three species regulate the access of electrolytes intake by different ways, i.e. sheep and goats tended to increase the urinary loss but camels decreased their intake of these electrolytes. In this connection Potter (1961) suggested that sheep could tolerate relatively high salt water by virtue of a renal adjustment which favors increased filtration and so the elimination of the ingested salt.

Table 5. Response of camels, sheep and goats to drinking water salinity in sodium, potassium and chloride metabolism (ml/KgW$^{0.82}$)

Item	Camels		Sheep			Goats			SE
	Tap	High	Tap	Low	High	Tap	low	High	
Sodium									
Dietary	0.61d	0.62d	0.90ab	0.76c	0.71cd	1.00a	0.98a	0.79bc	0.04
Water	0.02d	0.95c	0.06d	0.91c	3.57a	0.08d	1.08c	2.70b	0.13
T. intake	0.63e	1.57d	0.96e	1.67cd	4.28a	1.08e	2.06c	3.49b	0.15
Fecal	0.13d	0.16cd	0.25ab	0.22bc	0.30a	0.22bc	0.16cd	0.18cd	0.02
Urinary	0.50f	1.34d	0.78ef	1.29d	3.38a	0.81e	1.70c	2.91b	0.09
T. loss	0.63f	1.50d	1.03e	1.51d	3.68a	1.03e	1.86c	3.09b	0.32
Retention	0.00cd	0.07cd	-0.07d	0.16bc	0.60a	0.05cd	0.20bc	0.40ab	0.07
Potassium									
Dietary	0.80d	0.84cd	1.28a	1.02bc	0.96bcd	1.34a	1.32a	1.06b	0.06
Water	0.01e	0.02d	0.01e	0.04c	0.08a	0.01e	0.05c	0.06b	0.01
T. intake	0.81e	0.86de	1.29ab	1.06cd	1.04cd	1.35a	1.37a	1.12bc	0.07
Fecal	0.08	0.06	0.07	0.07	0.09	0.07	0.07	0.06	0.01
Urinary	0.60c	0.73abc	0.91ab	0.76ab	0.72bc	0.90ab	0.96a	0.88ab	0.07
T. loss	0.68c	0.79bc	0.98ab	0.83ab	0.81ab	0.97ab	1.03a	0.94ab	0.07
Retention	0.13cd	0.07d	0.31a	0.23b	0.23b	0.38a	0.34a	0.18bc	0.02
Chloride									
Dietary	0.51d	0.53d	0.80a	0.64b	0.60b	0.84a	0.83a	0.67b	0.04
Water	0.01d	1.79c	0.02d	2.08c	5.83a	0.02d	2.46c	4.51b	0.65
T. intake	0.52e	2.32d	0.82d	2.72c	6.43a	0.86d	3.29c	5.18b	0.23
Fecal	0.03	0.04	0.04	0.04	0.07	0.04	0.06	0.06	0.06
Urinary	0.46e	2.02d	0.68e	2.41cd	5.57a	0.67e	2.87c	4.36b	0.21
T. loss	0.49e	2.06d	0.72e	2.45cd	5.64 a	0.71e	2.93c	4.42b	0.21
Ret.	0.03d	0.26bc	0.1d	0.27bc	0.79a	0.15cd	0.36b	0.76a	0.04

a,b,c,d Means in the same row bearing different superscripts differ ($P<0.05$).

Increasing drinking water salinity from 256 (tap water) to 16,896 ppm significantly increased plasma sodium concentration. However, no significant difference in plasma sodium concentration between the tap and low salinity water was found. Plasma chloride concentrations of animals offered low or high salinity did not significantly differ than those offered tap water. Peirce (1960) found that saline drinking water containing 1.3% sodium chloride had no effect on concentrations of sodium potassium and chlorine in blood plasma of sheep. Increasing drinking water salinity had no significant effect on plasma proteins, urea and creatinine (Table 6). However, Weeth and Haverland (1961) found a negative correlation ($r=-.68$) between water consumption and blood urea of heifers offered drinking water containing 1.2, 1.5 and 1.75 % NaCl.

Camels showed higher plasma sodium and chloride but comparable potassium concentrations in comparison with sheep and goats. Goats showed higher plasma total protein and globulin but camels showed higher albumin concentrations and sheep showed intermediate values. Plasma urea and creatinine in blood plasma of camels were ($P<0.05$) higher than those of sheep and goats (Table 6).

Table 6. Mean effects of water salinity and animal species on plasma sodium, potassium and chloride (mg,%), proteins, urea and creatinine percentages

Item	Water salinity				Animal species			
	Tap	Low	High	SE	Camels	Sheep	Goats	SE
Sodium	377b	372b	388a	3	388a	376b	377b	3
Potassium	16.1b	19.3a	20.4a	0.6	17.8	19.9	17.8	0.9
Chlorine	114ab	111b	122a	4	127a	112b	110b	3.0
T. protein	6.43	6.79	6.72	1.99	6.14b	6.52b	7.16a	0.13
Albumin	3.58	3.40	3.40	0.10	3.68a	3.37b	3.37b	0.25
Globulin	2.85	3.39	3.32	0.22	2.46c	3.15b	3.79a	0.13
A/G ratio	1.36	1.01	1.06	0.11	1.54a	1.09b	0.90b	0.08
Urea	36.5	34.9	34.9	2.1	39.0a	30.8b	37.0a	1.7
Creatinine	2.60	2.36	2.35	0.12	2.60a	2.45ab	2.31b	0.12

a,b Means in the same row within each trait bearing different superscripts differ ($P<0.05$).

The increase in plasma concentrations of sodium and chlorine was greater in camels than sheep and goats drinking high saline water. However the response of the three species to increase plasma concentrations of potassium by drinking high saline water was almost comparable. This could refer to that camels offered high saline drinking water might tolerate higher plasma sodium and chlorine than sheep and goats. Increasing drinking water salinity had no effect on plasma proteins, urea and creatinine of the three species except the decrease in plasma albumin by camels offered high saline water (Table 7). This might indicate that the three species had almost comparable response in plasma proteins, urea and creatinine to the increase in drinking water salinity.

Table 7. Response of camels, sheep and goats to drinking water salinity in sodium, potassium and chloride (mg,%), proteins, urea and creatinine percentages

Item	Camels		Sheep			Goats			
	Tap	High	Tap	Low	High	Tap	low	High	SE
Sodium	383ab	393a	369c	357bc	385ab	377bc	369c	384ab	4
Potassium	16.3c	19.3b	16.3c	20.7ab	22.7a	15.7c	18.0bc	19.7b	0.9
Chlorine	119b	136a	115bc	110bc	112bc	106c	111bc	112bc	3
T. protein	6.1d	6.2cd	6.5bcd	6.4cd	6.7bcd	6.9abc	7.2ab	7.4a	0.2
Albumin	3.9a	3.5b	3.5b	3.3b	3.4b	3.3b	3.5b	3.3b	0.1
Globulin	2.2d	2.7cd	3.0bc	3.1bc	3.3bc	3.6ab	3.7ab	4.1a	0.6
A/G ratio	1.80	1.28	1.20	1.05	1.03	0.92	0.97	0.80	0.10
Urea	40.4	37.7	32.2	31.9	28.4	35.6	37.8	37.6	2.9
Creatinine	2.63a	2.57a	2.59a	2.27ab	2.47ab	2.55a	2.44ab	1.93b	0.19

a,b,c,d Means in the same row bearing different superscripts differ ($P<0.05$).

Drinking high saline water significantly increased chlorine but decreased potassium percentages in urine. Sodium concentration in urine increased insignificantly by drinking high saline water. Urine contents of urea and creatinine slightly decreased as the salinity of drinking water increased. Dixon and Milligan (1983) found a large increase in urinary volume but no effect of salt water ingestion on urinary urea excretion by steers. Urea and creatinine clearance rates significantly increased as salinity of drinking water increased (Table 8).

Camels excreted urine with significantly higher contents of Na, K, and Cl than sheep and goats. This might be due to the lower urine volume by camels (Table 2). Camels were reported to excrete highly concentrated urine through high water reabsorption (Schmidet- Nelson, 1964). No significant differences among the animal species was found in urine concentrations of urea and creatinine. Urea and creatinine clearance rate were lower by camels than sheep and goats. Goats showed significantly higher urea but lower creatinine clearance rates than sheep (Table 8). In this connection, Siebert and Macfarline (1971) showed that glomerular filtration rate in the camels is less than that of sheep proportionally to body weight.

Table 8. Mean effects of water salinity and animal species on urinary sodium, potassium, chloride, urea and creatinine (mg,%) and clearance rates of urea and creatinine (ml/min./ Kg $W^{0.82}$)

Item	Water salinity				Animal species			
	Tap	Low	High		Camels	Sheep	Goats	SE
Urine concentration, mg,%								
Sodium	815ab	613b	1044a	107	1259a	643b	668b	70
Potassium	983a	444b	430b	122	1061a	408b	397b	101
Chlorine	731b	976b	1589a	147	1569a	939b	927b	162
Urea	263a	256ab	253b	3	262	256	255	3
Creatinine	190a	151b	118c	8	166	140	148	12
Clearance, ml/min./Kg W0.82								
Urea	3.66b	7.30a	7.83a	1.21	1.97c	7.48b	9.22a	0.78
Creatinine	0.39b	0.83ab	1.15a	0.19	0.24c	1.89a	0.96b	0.16

a,b Means in the same row within each trait bearing different superscripts differ ($P<0.05$).

Table 9. Response of camels, sheep and goats to drinking water salinity in urinary sodium, potassium, chloride, urea and creatinine and clearance rates of urea and creatinine (ml/min./Kg $W^{0.82}$)

Item	Camels		Sheep			Goats			
	Tap	High	Tap	Low	High	Tap	low	High	SE
Urine concentration, mg,%									
Sodium	1105b	1412a	606cd	560cd	763cd	507d	663cd	834bc	98
Potassium	1354a	767b	695bc	367cde	161e	565bcd	376cde	250de	115
Chlorine	1023b	2115a	523c	1136b	1157b	413c	1114b	1252b	120
Urea	269a	255b	264a	252b	251b	253b	256b	253b	4
Creatinine	198a	133bc	191a	120cd	108d	183a	152b	109d	6
Clearance, ml/min./Kg W0.82									
Urea	1.52d	2.41d	5.38c	6.28c	10.77ab	6.04c	9.51b	12.13a	0.47
Creatinine	0.16e	0.31ef	0.55de	0.92c	2.10a	0.62d	0.96c	1.31b	0.09

a,b,c,d Means in the same row bearing different superscripts differ ($P<0.05$).

The increase in urinary sodium and chlorine and the decrease in potassium associated with drinking high saline water was more evident in case of sheep and goats than camels. Drinking saline water had no significant effect on urea concentration of urine of goats but decreased it in camels and sheep. Urinary creatinine decreased by comparable rates in the three animal species offered saline water. Increasing drinking water salinity also slightly increased the clearance rates of urea and creatinine in camels. However, sheep and goats drinking saline water showed significantly higher urea and creatinine clearance rates (Table 9). Moreover, Potter (1968) found an increase in glomerular filtration rates in sheep which were maintained on saline water containing 1.3% sodium chloride.

It could be suggested that the mechanism by which sheep and goats control the salt load by drinking saline water is different to that of camels. Sheep and goats excreted more urine and increased the filtration rate to reduce the high salt load resulted from their high consumption of saline water. However, camels consumed relatively less saline water to reduce salt stress.

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إستجابة الإبل والأغنام والماعز لماء الشرب المالح. ٢ - تمثيل الماء والعناصر المعدنية

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حضر ماء الشرب بحيث يحتوى على ثلاثة مستويات من الملوحة هى ملوحة ماء الصنبورو ملوحة متوسطة ٠,٧٥٪ ملح خام وملوحة عالية ١,٥٪ ملح خام وقدرت تركيزات ملوحة ماء الشرب كجزء فى المليون من الأملاح الذائبة الكلية فكانت منخفضة (٢٥٦ جزء فى المليون) ومتوسطه (٩٤٧٢جزء فى المليون) و عالية (١٦٨٩٦جزء فى المليون) . درس تأثير هذه المستويات من الملوحة على تمثيل الماء و الصوديوم و البوتاسيوم والكلور على وظائف الكلى فى ثلاثه كباش وثلاثه جداء وناقتين فى تصميم مربع لاتينى ناقص عرضت فيه الأغنام والماعز للمستويات الثلاث من الملوحة بينما عرضت الناقتين الى المستوى المنخفض والعالى فقط. غذيت الحيوانات على دريس البرسيم فقط للشبع مع توافر ماء الشرب كل الوقت.

أوضحت النتائج زيادة معنوية فى كمية المستهلك من ماء الشرب وأيضا كمية الخارج منه عن طريق البول، ولم يتأثر كمية الخارج من الماء عن طريق الروث معنويا. وقد كان هذا التأثير شديدا مع الأغنام والماعز عنه مع الإبل.

أدت زياده ملوحة ماء الشرب الى زيادة الداخل وأيضا الفاقد عن طريق البول من الصوديوم و البوتاسيوم والكلور مع المجترات الثلاثة ولكن بدرجة أقل نسبيا مع الإبل التى إمتازت بإنخفاض كمية ماء الشرب العالى الملوحة فأدى الى إنخفاض كمية الإلكتروليتات الداخله الى الجسم بالمقارنة مع الأغنام والماعز.

زادت تركيزات الصوديوم والكلور فى بلازما الدم كنتيجة لشرب الماء عالى الملوحة (١٦٨٩٦ جزء بالمليون). وقد أظهرت الإبل سواء شربت الماء العادى (٢٥٦ جزء بالمليون) أو الماء عالى الملوحة (١٦٨٩٦ جزء بالمليون) تركيزات عالية من الصوديوم والكلور عن الأغنام والماعز. لم تحدث تغيرات معنوية فى تركيزات البلازما من البروتين الكلى والألبيومين والجلوبيولين و اليوريا و الكرياتينين بسبب زيادة ملوحة ماء الشرب.

وقد اظهر إختبار وظائف الكلى زيادة فى معدل إزاحة اليوريا والكرياتينين بزيادة ملوحةماء الشرب فىالمجترات الثلاثة ولكن بدرجة قل نسبيا فى الإبل