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RESEARCH ARTICLE

IMPACT OF WATER RESTRICTION AND REHYDRATION ON BIOCHEMICAL PROFILES OF SHEEP AND GOATS UNDER MIDDLE GUJARAT AGROCLIMATIC CONDITION

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ABSTRACT

The blood glucose level (mg/dl) declined significantly ($P < 0.05$) to the tune of 7.32% in hot humid season as compared to hot dry season. The blood glucose level (mg/dl) did not change in hot dry season due to rehydration. The blood glucose level (mg/dl) recovered at much faster rate in Goats after 2nd (7.31%) and 4th (11.26%) day of rehydration as compared to Sheep (3.25 and 11.09%). The significant ($P < 0.05$) increase in serum urea (mg/dl) concentration in the experimental animals under 50% water restriction group dropped down significantly ($P < 0.05$) due to rehydration to the tune of 30.00 and 34.58% after 2nd and 4th day of rehydration, respectively in hot dry season. The corresponding values for hot humid season were 26.75 and 32.08%, respectively. The uric acid concentration (mg/dl) significantly ($P < 0.05$) increased by 8.88% when experimental animals were subjected to 50% water restriction which dropped down significantly ($P < 0.05$) by 14 and 27.40% after 2nd and 4th day of rehydration, respectively. Whereas, in same experimental animals during hot humid season uric acid concentration (mg/dl) dropped down non significantly ($P < 0.05$) after rehydration by 8.77%, but, after 4th day of rehydration uric acid concentration (mg/dl) dropped down significantly ($P < 0.05$) by 34.25%. The creatinine (mg %) level raised significantly ($P < 0.05$) by 6.89% when experimental animals exposed to 50% water restriction. The creatinine (mg %) level dropped down significantly ($P < 0.05$) after 4th day of rehydration by 20.57% in hot dry season and 7.50% in hot humid season. In both the species of experiment this creatinine (mg %) level again dropped down significantly ($P < 0.05$) after 4th day of rehydration by 13.12% (Sheep) and 15.42% (Goats).

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INTRODUCTION

Urea (mg/dl) is mainly synthesized in the liver using $NH4^+$ the end product of protein catabolism, and is released to the blood. Urea is excreted by the kidneys to rid the body of the excess N^+ intake that was not used for maintenance or production, or it is recycled through saliva or by reabsorption into the rumen to be utilized by rumen microflora (Moorby *et al*., 2002), Creatinine is produced in the muscles and excreted by the kidneys in proportion to the muscle mass and the rate of proteolysis. The transfer function of the kidney is altered under water stress with slower glomerular filtration and higher urea re-absorption (Kataria and Kataria, 2007).

MATERIALS AND METHODS

Twenty four sheep and Goats were randomly divided in to two water restriction treatment groups on the basis of body weight (25-30 kg) after accessing individual water requirement during adaptation period viz. T_1 (0% WR), T_2 (50% WR) during two different seasons viz hot dry (S_1) and hot humid (S_2). The water restriction phase was of 28 days which divided in to four periods (P_1, P_2, P_3 and P_4) followed by 4 days of rehydration. The experimental animals were fed on pelleted concentrate mixture (Amul Dan) and chaffed dry wheat straw as per ICAR (1998) feeding standard. The water ingestion of all experimental animals was assessed by offering *ad lib* water after measuring in measuring cylinder during period of 15 days adaptation to decide the quantum of water required by the animals. The animals of control group were offered the water in three instalments i.e. 9.00 am, 2.00 and 4.00 pm. after measuring every time while in water restriction groups, the whole day water requirement was measured once in morning and kept in respective labelled bucket. During rehydration phase all experimental animals offered *ad lib* measured water in three installments i.e. 9.00 am, 2.00 and 4.00 pm. Blood collection was done weekly and their after for two times for rehydration effect by vacutainer tubes and analysed by 320 automatic blood chemistry analyser.

Statistical evaluation

The data of body weight during dehydration phase was analysed by four factorial completely randomized design while

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the data of rehydration phase was analysed by one way Anova by standard methods.

RESULTS

The blood glucose (mg/dl) level was significantly ($P < 0.05$) affected by season and periods of experiment but, treatment and species effect was at par. The blood glucose level declined significantly ($P < 0.05$) to the tune of 7.32% in hot humid season as compared to hot dry season. The blood glucose level was significantly ($P < 0.05$) lower in hot humid season than winter season was reported by Pandey *et al*. (2012) and Neelam (2013). The blood glucose level started declining from P_1onwards up to end of experiment and declined significantly ($P < 0.05$) to the tune of 11.92%. The blood glucose level declined to the tune of 5.59 and 2.51% in Sheep and Goats, respectively, when subjected to water restriction. Neelam (2013) reported higher values of glucose level in hot humid season (39.65 ± 0.87) and winter (43.12 ± 0.65) than present findings. The blood glucose level due to rehydration did not change in hot dry season which was well supported by Neelam (2013) and Abdelatif *et al*. (2010) who reported that water deprivation and rehydration had no significant effect on plasma glucose level. However, blood glucose level significantly ($P < 0.05$) increased by rehydration to the tune of 10.80 and 19.93% after 2nd and 4th day of rehydration, respectively in hot humid season. The blood glucose level recovered much faster rate in Goats after 2nd (7.31%) day of rehydration as compared to Sheep (3.25%).The blood glucose level significantly ($P < 0.05$) influenced by TxSP, SPxP, SExP, SExSxP, TxSExP and TxSPxSExP interaction effects.

arginine vasopressin which released from hypothalamus in response to dehydration and it increases permeability of collecting duct of kidneys and there by promote urea reabsorption in the kidneys and reduced the loss of urea concentration (Meintjes and Engelbrecht, 1999). The urea retention was significantly ($P < 0.05$) higher (19.78%) in Goats as compared to Sheep. The urea concentration maintained at higher level in Goats throughout experiment as compared to Sheep. Similarly, urea concentration was observed to be higher (16.99%) in hot dry than hot humid season. The water deprivation was associated with significant ($P < 0.05$) increase in serum urea concentration as reported by Alamer (2006), Hamadeh *et al*. (2006), Kataria and Kataria (2006) Kheir and Ahmed (2008) and Abdelatif *et al*. (2010) which supports the present findings. The 24 hrs of water deprivation in non pregnant and non lactating Nubian Goat by Basheir *et al*. (2009) reported no effect on serum urea concentration. The serum urea increased significantly ($P < 0.05$) in Sheep due to 50% water restriction by (15.12%) and in Goats (4.72%).Whereas, urea retention dropped down significantly ($P < 0.05$) in hot humid season by 9.76% in Sheep and 18.40% in Goats. This may be due to change in climate. The urea retention of experimental animals consistently and significantly ($P < 0.05$) increased in experimental animals of T_2 group indicated adaptation of experimental animals to water restriction. The serum urea concentration significantly ($P < 0.05$) influenced by TxSP, TxSE, TxP, SPxSE, SPxP, SExP, SPxSExP, and TxSExP interaction effects. The serum urea concentration of experimental animals dropped down significantly ($P < 0.05$) due to rehydration to the tune of 30.00 and 34.58% after 2nd and 4th day of rehydration, respectively in

Table 1. Effect of water restriction on biochemical profiles in Sheep and Goats

Particular	Blood Glucose (mg/dl)	Urea (mg/dl)	Uric Acid (mg/dl)	Creatinine (mg %)
T1	33.26 ± 0.99	16.35^{a} ± 1.35	0.90^{a} ± 0.03	1.45^{a} ± 0.07
T2	32.72 ± 0.78	17.87^{b} ± 0.98	0.98^{b} ± 0.03	1.55^{b} ± 0.04
S1	34.25^{y} ± 0.88	18.45^{y} ± 0.99	1.01^{y} ± 0.10	1.53 ± 0.08
S2	31.74^{x} ± 0.75	15.77^{x} ± 1.29	0.87^{x} ± 0.05	1.47 ± 0.01
P0	34.98^{AB} ± 1.05	14.25^{A} ±1.55	0.64^{A} ± 0.02	1.34^{A} ± 0.09
P1	33.43^{AB} ± 2.01	14.48^{A} ± 1.78	0.82^{A} ± 0.01	1.54^{BC} ± 0.06
P2	32.39^{A} ± 1.50	15.33^{B} ± 1.70	0.88^{B} ± 0.21	1.47^{B} ± 0.01
P3	33.35^{AB} ± 0.44	19.20^{C} ± 1.79	1.14^{C} ± 0.05	1.49^{BC} ± 0.02
P4	30.81^{A} ± 0.98	22.12^{D} ± 1.60	1.22^{D} ± 0.02	1.65^{D} ± 0.02

Superscripts (a and b) in column differed significantly differ ($P < 0.05$) showing treatment effect.
Superscripts (x and y) in column differed significantly ($P < 0.05$) showing season effect.
Superscripts (A,B,C and D) in column differed significantly ($P < 0.05$) showing period effect.

Table 2. Effect of water rehydration on biochemical profiles in Sheep and Goats

Particular	Season	Particular	Blood Glucose (mg/dl)	Urea (mg/dl)	Uric Acid (mg/dl)	Creatinine (mg %)
Final weight (DH)	S1	T1	31.41 ± 0.76	18.73 ± 98	1.03 ± 0.01	1.69 ± 0.05
		T2	31.26 ± 1.27	29.20^{a} ± 0.37	1.35^{a} ± 0.01	1.75^{a} ± 0.05
	S2	T1	32.33 ± 0.94	17.40 ± 0.36	1.04 ± 0.04	1.57 ± 0.03
		T2	29.25^{A} ± 0.90	18.13^{A} ± 0.30	1.14^{A} ± 0.03	1.60^{A} ± 0.02
2nd day (RH)	S1	T1	29.16 ± 0.99	19.29 ± 1.28	1.08 ± 0.01	1.48 ± 0.06
		T2	31.16 ± 0.79	20.44^{b} ± 0.63	1.16^{b} ± 0.03	1.49^{b} ± 0.06
	S2	T1	31.00 ± 1.11	17.01 ± 0.48	0.83 ± 0.03	1.47 ± 0.05
		T2	32.41^{B} ± 1.11	15.62^{B} ± 0.22	1.94^{B} ± 0.05	1.60^{B} ± 0.04
4th day (RH)	S1	T1	29.91 ± 0.52	19.12 ± 1.17	1.09 ± 0.02	1.37 ± 0.04
		T2	32.08 ± 0.76	19.10^{b} ± 0.54	0.98^{b} ± 0.01	1.39^{b} ± 0.04
	S2	T1	32.66 ± 1.03	16.70 ± 0.55	0.73 ± 0.05	1.27 ± 0.02
		T2	35.08^{B} ± 1.20	14.70^{B} ± 0.33	0.75^{B} ± 0.04	1.48^{B} ± 0.04

The Urea (mg/dl) concentration ($P < 0.05$) was observed to be 16.35 ± 1.35 and 17.87 ± 0.98 in T_1 and T_2, respectively. The significant ($P < 0.05$) increase in serum urea (mg/dl) concentration in the experimental animals under 50% water restriction is attributed to haemoconcentration and may also be related partially with the increase in secretion of the hormone

hot dry season. The corresponding values of season S_2 were 13.84 and 18.92%, respectively. The declining rate was low in hot humid season as compared to hot dry season. This may be due to rainfall occurred during experiment and serum urea concentration level dropped down slowly in hot humid season as compared to winter season as reported by Neelam (2013).

The serum urea concentration dropped down by 26.75 and 32.08% after 2nd and 4th day of rehydration in sheep, respectively. The corresponding values of serum urea concentration for Goats were 20.95 and 24.82%, respectively. The uric acid (mg/dl) concentration significantly ($P < 0.05$) increased by 8.88% when experimental animals were subjected to 50% water restriction. The uric acid concentration did not influence during P_1 but afterwards increased significantly ($P < 0.05$) by 90.62% by the end of experiment. In comparison of Sheep, Goats showed significantly ($P < 0.05$) higher (21.18%) uric acid concentration. The experimental animals during hot humid season showed significantly ($P < 0.05$) declined in uric acid concentration 13.86%. The uric acid concentration increased significantly ($P < 0.05$) in Sheep (21.05%) and Goats (7.47%) in hot humid season as compared to hot dry season.

When experimental animals were rehydrated by offering *ad lib* water at the end of experiment during hot dry season, the uric acid concentration dropped down significantly ($P < 0.05$) by 14.00 and 27.40% after 2nd and 4th day of rehydration, respectively. Whereas, same experimental animals during hot humid season showed non significant dropped down values (8.77%) of uric acid concentration. But after 4th day of rehydration uric acid concentration dropped down significantly ($P < 0.05$) by 34.25%. When Sheep and Goats exposed to rehydration the uric acid concentration dropped down by 30.50% in Sheep and 31.29% in Goats significantly ($P < 0.05$). It indicates that, four days of rehydration required for normalizing the values of uric acid concentration. The uric acid concentration significantly ($P < 0.05$) affected by TxP, SPxSE, SPxP, SExP and TxSPxP interaction effects. Basheir *et al.*, (2009) reported significant ($P < 0.05$) rise in uric acid concentration due to water deprivation. However, Neelam (2013) reported no significant rise in uric acid concentration even up to 40% water restriction. The creatinine (mg %) level raised significantly ($P < 0.05$) by 6.89% when experimental animals exposed to 50% water restriction. The initial values of creatinine increased significantly ($P < 0.05$) at the end of P_1 and declined non significantly up to P_3 but, again significantly ($P < 0.05$) increased during P_4. Both the species of experiment differ significantly ($P < 0.05$) regarding creatinine level and Goats showed significantly ($P < 0.05$) higher values (4.08%) of creatinine than Sheep. However, this creatinine level declined significantly ($P < 0.05$) during hot humid season by 3.92% as compared to hot dry season. The creatinine level neither differed in Sheep nor in Goats due to water restriction. However, experimental animals of hot humid season showed significantly ($P < 0.05$) higher (10.79%) values in Sheep but, in Goats the Creatinine level increased significantly ($P < 0.05$) in Goats during hot humid season.

The creatinine level dropped down significantly ($P < 0.05$) after 4th day of rehydration in hot dry season 20.57% and in hot humid season 7.50%. In both species creatinine level again dropped down significantly ($P < 0.05$) after 4th day of rehydration by 13.12 (Sheep) and 15.42% (Goats). The creatinine level significantly ($P < 0.05$) influenced by TxP, SPxSE, SExP, TxSPxSE, and TxSExP interaction effects. According to Alamer (2006), Hamadeh *et al.* (2006), Kataria and Kataria (2006), Basheir *et al.* (2009) and Abdelatif *et al.* (2010) serum creatinine level raised significantly ($P < 0.05$) on water restriction. However, serum creatinine (mg %) level of experimental animals did not disturb due to water restriction but, significantly ($P < 0.05$) influenced by periods and seasons of the experiment Neelam (2013).

DISCUSSION

Water restriction and rehydration had no significant effect on plasma glucose level (mg/dl), however, The Urea (mg/dl), Uric acid (mg/dl), Creatinine (mg %) level, increased significantly ($P < 0.05$) when experimental animals were subjected to 50% water restriction for 28 days. This was normalized after 2nd day of rehydration. Moreover, in both the species this creatinine (mg %) level again dropped down significantly ($P < 0.05$) after 4th day of rehydration to maintain the productivity in animals.

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