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Influence of seasonal variation on fractional excretion of electrolytes in *Sirohi* goat from Southern Rajasthan

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Abstract

The present investigation was planned to appraise the Influence of seasonal variation on fractional excretion of electrolytes in *Sirohi* Goat from Southern Rajasthan. Kidney plays an important role in water retention. Kidney functions exhibit adaptational changes in handling water and electrolytes. Maintenance of healthy fluid status is the combined effect of circulatory system, kidneys and hormonal factors. The extremes of environmental conditions resulted in significant changes of kidney functions in goat in terms of significant variation in fractional excretion of electrolytes. In present investigation it was observed that the overall mean values of fractional excretion of sodium (FE_{Na}), potassium (FE_K), chloride (FE_{Cl}), calcium (FE_{Ca}), phosphate (FE_{PO_4}) and magnesium (FE_{Mg}) were significantly ($p \leq 0.05$) higher during dry-hot, humid-hot and cold EPs as compared to intervening mean overall value. During humid hot, the per cent variation in the value of (FE_{Na}), (FE_K), (FE_{Cl}), (FE_{Ca}), (FE_{PO_4}) and (FE_{Mg}) were found maximum (+92.96), (+62.58), (+74.17), (+91.60), (+72.77) and (+46.21), respectively. These results showed that important ions of the body like sodium, potassium and chloride divulged lesser modulations comparatively exhibiting the power of the physiological reactions to help the body to sustain in adverse climatic conditions.

Keywords: goat, EP, FE_{Na} , FE_K , FE_{Cl} , FE_{Ca} , FE_{PO_4} and FE_{Mg}

Introduction

Physiological-ecology is the study of the short and long-term physiological and behavioural variations in animals making animal organizations to keep alive and reproduce profitably in their always-varying environments. Endeavours concerning native breeds of animals can ease in realizing the explicit physical situation of the animals. To understand the concern of animals to their physical ambience is the main point of explorations in the arena of physiological-ecology. Maintenance of constant extraellular environment is an important function of kidney. Fluid and electrolyte equilibrium is significant for homeostasis, however, it has been observed that renal handling of electrolytes show environmental effects ^[1]. Research carried out in various animals native to semi-arid and arid tract has demonstrated that water deficit can occur due to extreme ambiances ^[7]. Therefore, assessment of fluid and electrolyte balance in animals is essential to evaluate water deficit. The assessment of fractional excretion of electrolytes in *Sirohi* goat from southern Rajasthan is the effort made to analyse the influence of environmental variation on working efficiency of kidney and body fluid status as well as to establish the reference values of native goat in the southern Rajasthan.

Materials and Methods

For the assessment of effect of extreme environment on fluctuations in metabolic retorts in *Sirohi* goat from semi-arid expanses of Rajasthan, 1280 apparently healthy male and female *Sirohi* goat of different age groups were explored. Animals belonged to unorganized sector in and around Udaipur district, Rajasthan. Blood sample collection was carried out during the course of slaughtering from the *Sirohi* goat with the permission of Institutional Animal Ethics Committee (IAEC), Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan. Blood was collected to harvest serum during various environmental periods (EPs) of the year incorporating intervening EP (October-November); dry-hot EP (April, May and June); humid-hot EP (July, August and September) and cold EP (December and January). In each environmental period (EP), *Sirohi* goat were grouped as male (160) and female (160). Fractional excretion of sodium (FE_{Na}) was determined by method as per ^[5], potassium (FE_K) and phosphate (FE_{PO_4}) were determined by method as per described by ^[2], calcium (FE_{Ca}) as given by ^[10] and magnesium (FE_{Mg}) as given by ^[11].

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The changes in the means were evaluated by Duncan's new multiple range test [4].

Results and Discussion

Portrayal of changes in values of (FENa), (FEK), (FECl) during varying EPs

The overall mean values of FENa were significantly (p<0.05) higher during dry-hot, humid-hot and cold as compared to

intervening EP mean overall value. A highly significant (p<0.01) effect of extreme EPs i.e. dry-hot, humid-hot and cold was observed by analysis of variance. Maximum level of FENa was noted during humid-hot EP Table 01. During humid-hot, the per cent variation in the value of FENa was found to be maximum (+92.96). The results corroborated the earlier studies [3] in goat and [8] in sheep.

Table 1: Mean ± SEM values of fractional excretion of sodium (FENa, %) in the *Sirohi* goat during varying environmental periods (EPs)

S. No.	Effects	Mean ± SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	1.322 ^b ±0.003	2.322 ^b ±0.003	2.551 ^b ±0.008	1.747 ^b ±0.006
I.	Male (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of males (160)	1.336 ^{ba} ±0.0033	2.298 ^{bc} ±0.0042	2.398 ^{bc} ±0.0123	1.626 ^{bc} ±0.0063
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females (160)	1.307 ^{ba} ±0.0030	2.347 ^{bc} ±0.0026	2.705 ^{bc} ±0.0040	1.589 ^{bc} ±0.0063

The overall mean values of FEK were significantly (p<0.05) higher during dry-hot, humid-hot and cold as compared to intervening EP mean overall value. A highly significant (p<0.01) effect of extreme EPs i.e. dry-hot, humid-hot and cold was observed by analysis of variance. Maximum level of FEK was noted during dry-hot EP Table 02. During dry-hot, the per cent variation in the value of FEK was found to be

maximum (+62.58). Remarkable lowering during hot ambience was observed. In a study, [12] screened renal functions in diarrhoeic calves and it was observed that prior the therapy, lowering of fractional excretion of potassium (15.07±8.56%) was there. It was inferred that the FE of Na and K play a chief role in evaluating renal function in diarrhoeic calves.

Table 2: Mean ± SEM values of fractional excretion of potassium (FEK, %) in the *Sirohi* goat during varying environmental periods (EPs)

S. No.	Effects	Mean ± SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	0.850 ^b ±0.40	1.382 ^b ±0.43	1.356 ^b ±0.45	1.141 ^b ±0.41
2.	Categorization as male and female (I & II categories)				
I.	Male (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of males (160)	0.838 ^{bc} ±0.10	1.338 ^{bd} ±0.11	1.325 ^d ±0.12	1.109 ^{bd} ±0.10
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females (160)	0.862 ^{bc} ±0.10	1.401 ^{bc} ±0.10	1.387 ^{bc} ±0.12	1.173 ^{bc} ±0.10

The overall mean values of FECl were significantly (p<0.05) higher during dry-hot, humid-hot and cold as compared to intervening EP mean overall value Table 03. A highly significant (p<0.01) effect of extreme EPs i.e. dry-hot, humid-

hot and cold was observed by analysis of variance. Maximum level of FECl was noted during humid-hot EP. During humid-hot, the per cent variation in the value of FECl was found to be maximum (+74.17).

Table 3: Mean ± SEM values of in the fractional excretion (FECl, %) of chloride *Sirohi* goat during varying environmental periods (EPs)

S. No.	Effects	Mean ± SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	5.329 ^b ±0.007	9.304 ^b ±0.013	10.025 ^b ±0.165	7.050 ^b ±0.135
2.	Categorization as male and female (I & II categories)				
I.	Male (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of males (160)	5.357 ^{ba} ±0.0036	9.184 ^{bc} ±0.0160	9.803 ^{bc} ±0.324	6.943 ^{bc} ±0.0153
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females (160)	5.302 ^{ba} ±0.0120	9.424 ^{bc} ±0.0112	10.255 ^{bc} ±0.0065	7.16 ^{bc} ±0.256

Portrayal of changes in values of (FECa), (FEP04), (FEMg) during varying EPs

The overall mean values of FECa were significantly (p<0.05) higher during dry-hot, humid-hot and cold as compared to intervening EP mean overall value. A highly significant (p<0.01) effect of extreme EPs i.e. dry-hot, humid-hot and cold was observed by analysis of variance. Maximum level of FECa was noted during humid-hot EP Table 04. During

humid-hot, the per cent variation in the value of FECa was found to be maximum (+91.60). Calcium metabolism reveals alterations due to extreme ambient conditions. Earlier researchers have divulged changes in calcium levels in ruminants owing to extreme hot and extreme cold environmental periods [7] in camel. The results of present study during varying EPs attempted to corroborate the observations recorded by [6] in cattle.

Table 4: Mean \pm SEM values of fractional excretion of calcium (FE_{Ca}, %) in the *Sirohi* goat during varying environmental periods (EPs)

S. No.	Effects	Mean \pm SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	7.217 ^b \pm 0.0127	12.599 ^b \pm 0.233	13.828 ^b \pm 0.116	9.774 ^b \pm 0.0292
2.	Categorization as male and female (I & II categories)				
I.	Male (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of males (160)	7.232 ^{ba} \pm 0.0130	12.782 ^{bc} \pm 0.0071	13.480 ^{bc} \pm 0.0901	9.663 ^{bc} \pm 0.0372
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females (160)	7.202 ^{ba} \pm 0.0130	12.416 ^{bc} \pm 0.0071	14.176 ^{bc} \pm 0.0264	9.885 ^{bc} \pm 0.0220

The overall mean values of FE_{PO₄}% were significantly ($p \leq 0.05$) higher during dry-hot, humid-hot and cold as compared to intervening EP mean overall value. A highly significant ($p \leq 0.01$) effect of extreme EPs i.e. dry-hot, humid-hot and cold was observed by analysis of variance. Maximum level of FE_{PO₄}% was noted during humid-hot EP 05. During

humid-hot, the per cent variation in the value of FE_{PO₄}% was found to be maximum (+72.77). [3] explored the goat and fractional excretion of phosphorus (phosphate) in % was 33.04 \pm 2.02 and the value then was observed to become low during extreme cold and high during extreme hot as compared to moderate.

Table 5: Mean \pm SEM values of fractional excretion of phosphate (FE_{PO₄}, %) in the *Sirohi* goat during varying environmental periods (EPs)

S. No.	Effects	Mean \pm SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	5.825 ^b \pm 0.015	9.306 ^b \pm 0.008	10.064 ^b \pm 0.024	8.050 ^b \pm 0.018
2.	Categorization as male and female (I & II categories)				
I.	Male (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of males (160)	5.454 ^{ba} \pm 0.016	9.204 ^{bc} \pm 0.007	9.640 ^{bc} \pm 0.037	7.822 ^{bc} \pm 0.027
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females (160)	6.197 ^{ba} \pm 0.014	9.409 ^{bc} \pm 0.010	10.489 ^{bc} \pm 0.011	8.278 ^{bc} \pm 0.010

The overall mean values of FE_{Mg} were significantly ($p \leq 0.05$) higher during dry-hot, humid-hot and cold as compared to intervening EP mean overall value. A highly significant ($p \leq 0.01$) effect of extreme EPs i.e. dry-hot, humid-hot and cold was observed by analysis of variance. maximum level of FE_{Mg} was noted during humid-hot EP 06. During humid-hot, the per cent variation in the value of FE_{Mg} was found to be

maximum (+46.21). In an investigation by [9], sheep were explored to measure renal handling of magnesium. Extreme hot and cold ambiances caused alterations in magnesium renal clearance. The values showed a decline during extreme hot and increase during cold ambience as compared to moderate in sheep.

Table 6: Mean \pm SEM values of fractional excretion of magnesium (FE_{Mg}, %) in the *Sirohi* goat during varying environmental periods (EPs)

S. No.	Effects	Mean \pm SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	11.10 ^b \pm 0.154	14.81 ^b \pm 0.285	16.23 ^b \pm 0.153	12.48 ^b \pm 1.356
2.	Categorization as male and female (I & II categories)				
I.	Male (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of males (160)	11.02 ^{ba} \pm 0.200	14.70 ^{bc} \pm 0.250	16.01 ^{bc} \pm 0.285	12.52 ^{bc} \pm 0.1893
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females (160)	11.19 ^{ba} \pm 0.1088	14.93 ^{bc} \pm 0.320	16.45 ^{bc} \pm 0.0221	12.44 ^{bc} \pm 0.0820

Figures in the parenthesis = Number of *Sirohi* goat

EP = Environmental period

^b = Significant ($p \leq 0.05$) differences among mean values for a row.

^c = Significant ($p \leq 0.05$) differences between overall mean values of males and females for an EP

^d = Significant ($p \leq 0.05$) differences among mean values of different gender specific age groups for an EP

^e = Significant ($p \leq 0.05$) differences among mean values of different age groups for an EP irrespective of gender

Renal functions in animals can be assessed on the basis of certain urine analytes. Urine analytes can be important indicators of health status in animals.

Conclusion

Quintessence can be drawn from the outcome of the present study that extreme environmental periods, especially humid-hot and dry-hot generated stress and oxidative stress in the *Sirohi* goat with alterations in the kidney functions to an extent which can cause anguish to the goat resulting into health problems. Protracted harrowing of the condition may endanger immune system of the animals and can affect growth, production and reproduction effectively.

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