EFFECT OF HEAT STRESS ON SERUM ELECTROLYTES LEVEL OF SIROHI GOAT[#]

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ABSTRACT

The present investigation was designed to evaluate the effect of heat stress on serum electrolytes concentration *viz*. calcium, phosphorus, magnesium, sodium, potassium and chloride. During hot ambience serum sodium and chloride levels were increased significantly ($p<0.05$) than moderate ambience while serum calcium, phosphorus, magnesium and potassium levels were decreased significantly ($p<0.05$) than moderate ambience. Thus it could be considered that during heat stress condition goat health status can be improved through electrolytes supplementation.

Key words: Heat stress, goat, electrolytes

Introduction

Heat, cold, dehydration, crowding, regrouping, noise, confinement, trauma, transportation, infections etc. are the common agents of stress experienced by the goats. Recent researches indicate that during extreme high environmental temperature, internal homeostasis is changed causing change in working efficiency of organs and body systems, which can be represented in terms of reduced metabolism and growth. The variations in physiological parameters are indicative of stress during heat which directly or indirectly affects the performance. Due to heat stress, metabolism of individual may change to accommodate the body according to the environmental changes. The determination of values of electrolytes reflects the physiological status of affected animals, which is helpful in direct intervention.

Materials and Methods

To investigate the effect of heat stress the whole experiment was divided into two periods of extreme hot and moderate environmental temperature periods (ETPs). The months of May and June were considered as extreme hot (average environmental temperature 26-44^{o}C) and of October and November (Average environmental temperature 19-30^{o}C) were considered as moderate environmental temperature periods. In each ETP, samplings were done according to male and female sex groups, in first group blood samples were collected from 1 year to 4 years age group male and non pregnant female animals. To assess the effect of extreme environmental temperature, the results of various physiological parameters analyzed were compared with those analyzed during moderate serving as control periods. All efforts were made to analyze serum samples immediately, however, if needed, collected serum samples were stored in a deep freeze at -20^{0}C till analysis.

During experiment the serum level of calcium, phosphorus, magnesium and chloride were determined by standard manual methods, while the serum sodium and potassium levels were estimated by colorimeter method of end point assay (SP twin electrolytes test kit).

The statistical method of t-test was used for data analysis with Microsoft excel software and SPSS software.

Results and Discussion

The mean values of serum calcium, phosphorus, magnesium, sodium, potassium and chloride during moderate and hot ambience in male and female Sirohi goats are presented in Table 1 and 2, respectively.

Effect of hot ambience on serum calcium, phosphorus and magnesium

In the present investigation the mean values of serum calcium, phosphorus and magnesium obtained during moderate ambience in Sirohi goats are approximately similar to numerical values as determined by Yatoo *et al.* (2013). The reported mean values of serum calcium and phosphorus obtained during moderate ambience are approximately similar as determined by Ishag *et al*. (2014) and mean values of serum phosphorus and magnesium were similar as determined by Hafid *et al.* (2013). The mean value of serum calcium was approximately similar to numerical value as determined by Okoruwa (2014) in goat. The mean value of serum magnesium value isapproximately similar to numerical value as determined by Olafadehan (2011).

In the present investigation the mean values of serum calcium, phosphorus and magnesium obtained during moderate ambience was lower than as determined by Kalio *et al.* (2013). The mean value of serum magnesium was lower than as determined by Waziri *et al.* (2010).

During hot ambience serum calcium, phosphorus and magnesium levels were significantly ($P<0.05$) decreased in male as well as in female goats. The serum phosphorus and magnesium concentrations are similar as reported by Ishag *et al.* (2014). The mean value of serum calcium was approximately similar as determined by Okoruwa (2014).

Oxidative stress and heat stress are combine cause for the movement of calcium from the extracellular environment in to the cytoplasm and then into mitochondria and disrupting normal metabolism even leading to cell death (Ermak and Davies, 2002). Sandabe and Chaudhary (2000) reported that serum phosphorus level was higher during summer and the

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cause was feeding of cereal grains in the form of concentrate. The low serum calcium and phosphorus levels were probably consequence of feeding regimen of the animals (Daramola *et al.,* 2005). During hot ambience decreased concentration of serum magnesium indicated towards its active role in oxidative stress reaction of the body. Changes in serum magnesium concentration directly influence the cellular redox state and its deficiency is associated with induction of immune reaction (Schiffrin and Touyz, 2005). Formation of free radicals alter oxidative metabolism which causes disruption of ionic environment of cell resulting in low serum phosphorus level (Walwadkar *et al.,* 2006). The lower phosphorus concentration could be attributed to the reduce capacity of gastrointestinal tract to absorb phosphorus from diet (Blood and Radostits, 1989). The decreased concentration of serum magnesium during humid hot season could be due to consumption of green grass (Odette, 2005). The slight decrease in serum magnesium level might be due to decreased intestinal absorption or decreased bone stores (Marx, 2002). Extreme ambience associated with decrease in serum calcium indicates towards oxidative stress according to Ermak and Davies (2002). During stress serum calcium is influenced due to disrupt of physiological pathways. This intracellular excess of calcium is the main cause of developing oxidative stress (Brookes *et al.,* 2000).

Effect of hot ambience on serum sodium, potassium and chloride

In the present investigation the mean values of serum sodium and potassium obtained during moderate ambience are more or less similar to numerical values as determined by Daramola *et al*. (2005), the mean values of serum sodium and chloride are approximately similar as determined by Kalio *et al*. (2013). The mean value of serum sodium is similar to as reported by Sanadabe and Chaudhary (2000) and Waziri *et al*. (2010). The mean value of serum potassium was similar to as reported by Aiello (2000) and Okoruwa and Ikhimioya (2014) and serum chloride level was similar to numerical value as determined by Pandey *et al*. (2006). The mean value of serum sodium obtained during moderate ambience is lower than as determined by Pandey *et al*. (2006) and Olafadehan (2011) and serum potassium value was lower than as determined by Opera *et al*. (2010).

During hot ambience the serum sodium and chloride levels were significantly (P<0.05) increased, while the serum potassium level was significantly (P<0.05) decreased in Sirohi goats. The serum sodium and potassium levels are almost similar to as reported by Abdel-Fattah (2014) and Hooda and Upadhyay (2014).

Increased concentration of sodium during hot ambience could be due to oxidative stress and changes in mechanism of body (Kataria *et al.,* 2002). An increased plasma sodium concentration during heat exposure stimulates vasopressin secretion and thirst which leads to enlarged plasma volume (Olsson, 2005). El-Nouty *et al.* (1980) reported that decreased concentration of potassium in cow blood serum during prolonged heat stress was due to loss of potassium ion in sweat. It is suggested that during heat stress potassium excretion is increased due to increased aldosterone in dairy cattle. The increased potassium ion concentration was correlated with stress induced activation of cortisol secretion which also caused stimulation of gluconeogensis (Marai *et al.,* 2007). The low serum sodium during hot season could be due to physiological adaptation while reduced serum potassium concentration during hot ambience is due to dehydration (Azabe and AbedlMaksoud, 1999). Chloride is one of the important biochemical parameter used to detect homeostatic mechanism. In the body chloride follows sodium ions in maintenance of acid base balance during hot ambience Renin-Angiotensin-Aldosterone-System mechanism affects chloride absorption along with sodium ions (Halevy *et al.,* 1986). The decrease in serum electrolyte concentration during hot ambience may be due to expanded blood volume where water is transported in the circulatory system for evaporative cooling as suggested by Al-Haidary (2004). The increase in serum chloride level may be the result of water loss from plasma. Kataria *et al. (*2002) reported that during dehydration condition, aldosterone is mainly responsible to retain water, sodium and chloride ion and to secrete potassium ion in kidney.

Table 1: The comparison of serum calcium, phosphorus and magnesium (Mean±SEM) in male and female Sirohi goats during moderate and hot ambience

Effect	Calcium (mg %)		Phosphorus (mg %)		Magnesium (mg/dl)	
	Male	Female	Male	Female	Male	Female
Moderate	11.442 ±0.40	10.125 ±0.36	6.075 ±0.20	5.396 ±0.17	2.787 ±0.12	2.282 ±0.09
Hot	10.325^{d} ±0.34	9.00^{d} ±0.38	5.029^{d} ±0.21	4.338^{d} ±0.21	2.225^{d} ±0.14	1.731^{d} ±0.15

i. Figures in parentheses indicate number of male and female goats.
ii. The mean value of parameters in extreme hot ambience has been compared with the respective mean value in moderate ambience.
iii. Significant (P<0.05**)** variations have been shown by using superscript'd'.

Table 2: The comparison of serum sodium, potassium and chloride (Mean±SEM) in male and female Sirohi goats during moderate and hot ambience

Effect	Sodium (meq/l)		Potassium (meq/l)		Chloride (meq/l)	
	Male	Female	Male	Female	Male	Female
Moderate	143.275 ±3.21	135.020 ±2.41	5.097 ±0.24	4.426 ±0.18	111.347 ±2.19	101.977 ±2.89
Hot	151.793^{d} ±2.61	143.345^{d} ±2.64	4.235^{d} ±0.14	3.760^{d} ±0.16	119.843^{d} ±2.44	110.703^{d} ±3.03

i. Figures in parentheses indicate number of male and female goats.
ii. The mean value of parameters in extreme hot ambience has been compared with the respective mean value in moderate ambience.
iii. Significant (P<0.05**)** variations have been shown by using superscript'd'.

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