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ORIGINAL ARTICLE

Effect of extreme hot condition on serum biochemical constituents in Marwari Goats

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Abstract

Three hundred Marwari goats of both sexes 0-3 years of age were used to study the changes in serum Total Proteins, Albumin, Globulin, Albumin/Globulin (A/G) ratio, Urea, Creatinine and Total Bilirubin during extreme hot and moderate climatic conditions. Overall mean values of Total Proteins (g/dl), Albumin (g/dl), Globulin(g/dl), A/G ratio and Urea (mg/dl), Creatinine (mg/dl) and Bilirubin (mg/dl) were 4.41±0.04, 2.62±0.04, 1.75±0.02, 1.65±0.05, 26.29 ± 0.53, 0.73 ± 0,02 and 0.10 ± 0.003, respectively. Climatic conditions had significant ($p \leq 0.05$) effect on serum creatinine and bilirubin. Significant ($p \leq 0.05$) effect was observed in serum globulin, creatinine and bilirubin in moderate and total protein in extreme climatic conditions in sex groups, however, globulin and A/G ratio was significantly ($p \leq 0.05$) affected in extreme hot conditions. Significant ($p \leq 0.05$) effect was observed on age in extreme hot conditions in total bilirubin. Males showed higher values of serum biochemical parameters in comparison to females in both climatic conditions except urea in extreme hot conditions. Animals of 0-1 year age group showed higher values in albumin, globulin, urea and creatinine in moderate while A/G ratio in extreme hot conditions than above1year age groups, while animals above 1 year showed higher values for total bilirubin.

Key words: Marwari goat, climate, total protein, creatinine, total bilirubin, urea

Introduction

Climatic regulation in goat production has a wide economical significance disturbing reproductive and productive efficiency including quality of product produced such as meat, milk and hair. Heat and humidity place a direct stress on these animals particularly at the time of grazing in the pastures or in the field conditions. Climate controls forage production and quality, which have influence on the growth of animals. Some data are available on the physiological and biochemical characteristics of goats under normal environmental conditions particularly thermal stress (Appleman, 1958). Marwari is one of the native breed of goats in the region of Marwar of Rajasthan state. The concentration of blood constituents varies with age, sex and some environmental factors. In view of the scanty information available on serum constituents *viz.* serum total protein, albumin, globulin, A/G ratio, urea, creatinine and total bilirubin at different age groups and sex of Marwari goats under extreme hot conditions the present study was undertaken.

Materials and Methods

Three hundred numbers of goats of both the sexes ageing 0-3 years were used in the present investigation. The scheme of experiment is shown with table 1. The feeding management was of range type where animals used to consume *Ziziphus numularia* leaves *and* looping of *Prosopis cineraria* trees. Blood was collected from jugular vein in vacutte and processed on same day. Standard methods were used to determine serum constitutes *viz*. total proteins and albumin by Biuret and BCG dye binding method of kit (Glaxo), Globulin by subtracting albumin concentration from total protein concentration, A/G ratio by dividing albumin concentration to globulin concentration, urea by Berthold method of kit (Wipro), serum creatinine by Jafferate method of kit (Wipro) and total bilirubin by Jendrassik-Grof method of kit (Wipro). Mixed model least square and maximum likelihood computer programmes PC-1 (Copyright, 1987, Walter R. Harvey) were used to determined analyses of variance to test the significance of the effect of climatic conditions, sex and age groups by applying `t´ test.

Results and Discussion

Mean ± SEM values of serum parameters *viz.* total protein, albumin, globulin, A/G ratio, urea, creatinine and total bilirubin during moderate and extreme climatic conditions, age groups and sex in Marwari goats are presented in table 2. Overall mean values of total proteins (g/dl), albumin (g/dl), globulin (g/dl), A/G ratio, urea (mg/dl), creatinine (mg/dl) and total bilirubin (mg/dl) were 4.41±0.04, 2.62±0.04, 1.75±0.02, 1.65±0.05, 26.29 ± 0.53, 0.73 ± 0,02 and 0.10 ± 0.003, respectively. Overall mean value of total serum protein in the present investigation was lower than the standard value for goat (5.95 to 7.43 g %) given by earlier workers (Verma, 1967; Castro *et al.*, 1977). This was probably due to valuable nutritional and managemental practices. Overall mean value of serum urea in the present investigation was lower than the normal standard range from 35.73 to 57.43 mg% given by earlier workers (Verma, 1967; Behra *et al*., 1993). The overall mean values of serum creatinine in the present investigation were within the normal standard range for creatinine (0.6 to 2.0 mg %) as given by Chiofalo *et al*. (1984) and Peake and Whiting (2006).

The mean values of total protein, albumin, globulin and urea were found to be higher non-significantly (P>0.05), while serum creatinine and total bilirubin were significantly (P≤0.05) higher during extreme climatic condition than the moderate one. Serum A/G ratio was found lower non-significantly (P>0.05) in extreme climatic condition than respective mean during moderate. The percent increment for total protein, albumin, globulin, urea, creatinine and total bilirubin were 2.76, 2.32, 5.26, 12.55, 23.07 and 22.22, respectively, while percent decrement in A/G ratio was 4.71. Brody (1949) and Blincoe and Brody (1951) also observed non significant (P>0.05) effect of high temperature on plasma protein levels in cattle. The plasma protein concentration is also related with head stress and help in maintaining the water metabolism (Kataria *et al*., 1993). However, Appleman and Delouche (1958) found an increased plasma protein concentration with rising temperature in goats.

Table 1: Experimental Population

Age Group	Extreme Hot		Moderate	
	Min. Temp. (^oC)	**Max. Temp. (^oC)**	Min. Temp. (^oC)	Max. Temp. (^oC)
	27.54 ± 1.01	42.25 ± 1.22	22.18± 0.58	34.42 ± 0.22
	Male	Females	Male	Females
(0-1 Year)	70	30	70	30
(> 1 Year)	30	20	30	20

Khanna (1993) reported higher total serum protein values in summer and Al-Qarani (1999) reported high blood protein during summer in camels. Changes in total serum protein concentration due to climatic conditions were non-significant (P>0.05) in present investigation. These were in lines with the reporting of Kataria *et al*. (1993) in goats. This indicated better adaptability of goats to desert environment particularly in summer season. No significant (P≤0.05) rise in protein during hot conditions indicated that animals maintained their circulatory volume (Kataria, 2000). No significant (P≤0.05) effect of climatic condition was observed on serum urea values in present investigation which corroborated the findings of Kataria *et al*. (1993) in goats. Akthar *et al*. (1977) and Charan (2002) also reported higher serum creatinine value in goats during summer as observed in present investigation. Creatinine concentration in present study was higher during extreme hot which indicated increased muscle metabolism during hot condition (Kataria, 2000).

Table 2: Mean± SEM values of serum Total Protein, Albumin, Globulin, A/G ratio, Urea, creatinine and total bilirubin during moderate and extreme climatic conditions, age groups and sex in Marwari goats.

Sl.No	Main effects	Total proteins (g /dl)	Albumin (g/dl)	Globulin (g/dl)	A/G ratio	Urea (mg/dl)	Creatinine (mg/dl)	Bilirubin (mg/dl)
1	Overall (300)	4.41±0.04	2.62±0.04	1.75±0.02	1.65±0.05	26.29±0.53	0.73±0.02	0.10±0.003
2.	Climatic condition							
(i)	Moderate (150)	4.35±0.06^{a}	2.59±0.06^{a}	1.71±0.04^{a}	1.68±0.07^{a}	24.74±0.82^{a}	0.65±0.02^{a}	0.09±0.01^{a}
(ii)	Extreme (150)	4.47±0.05^{a}	2.65±0.04^{a}	1.80±0.03^{a}	1.61±0.06^{a}	27.84±0.65^{a}	0.80±0.03^{b}	0.11±0.01^{b}
3(a)	Moderate (Sex)							
(i).	Male (100)	4.53±0.14^{c}	2.69±0.11^{c}	1.86±0.09^{c}	1.92±0.15^{c}	24.63±1.45^{c}	0.71±0.05^{c}	0.11±0.01^{c}
(ii).	Female (50)	4.30±0.11^{c}	2.65±0.11^{c}	1.58±0.07^{d}	1.52±0.14^{c}	23.96±2.15^{c}	0.53±0.06^{d}	0.09±0.01^{d}
3(b).	Extreme							
(i).	Male (100)	4.75±0.10^{c}	2.64±0.09^{c}	1.90±0.07^{c}	1.56±0.11^{c}	27.55±1.09^{c}	0.85±0.06^{c}	0.10±0.01^{c}
(ii).	Female (50)	4.45±0.10^{d}	2.60±0.09^{c}	1.84±0.06^{c}	1.46±0.10^{c}	28.15±1.60^{c}	0.69±0.07^{c}	0.01±0.01^{c}
4(a).	Moderate (Age group)							
(i).	0-1 year (100)	4.37±0.09^{e}	2.53±0.12^{e}	1.79±0.07^{e}	1.55±0.12^{e}	25.42±1.59^{e}	0.63±0.05^{e}	0.09±0.01^{e}
(ii).	Above 1 year (50)	4.45±0.15^{e}	2.18±0.16^{e}	1.65±0.08^{e}	1.88±0.17^{e}	24.14±2.01^{e}	0.61±0.07^{e}	0.11±0.01^{e}
4(b).	Extreme							
(i).	0-1 year (100)	4.48±0.11^{e}	2.50±0.09^{e}	1.76±0.05^{e}	1.68±0.01^{e}	27.10±1.17^{e}	0.76±0.05^{e}	0.11±0.01^{e}
(ii).	Above 1 year (50)	4.53±0.09^{e}	2.73±0.08^{e}	1.98±0.08^{f}	1.33±0.11^{f}	28.60±1.51^{e}	0.77±0.07^{e}	0.07±0.01^{f}

Mean of moderate and extreme condition for each parameters have been compared with the same conditions. Superscript on the mean of extreme condition indicates that mean change is significant (P≤ 0.05) or non-significant (P>0.05) differences. Figures in the parentheses are number of animals

Simultaneously, higher creatinine concentration in serum in present study could be the indicative of low GFR as indicated earlier by Charan, 2002. Coles (1986) and Lamb *et al.* (2005) have also described decreases in GFR will due to an increase in the concentration of serum creatinine. In present investigation also the bilirubin values were higher during summer as compared to winter. In present investigation also the bilirubin value was higher in extreme hot conditions. Higher bilirubin concentration in serum during hot condition was also suggestive of slight haemoconcentration (Pareek, 2001) as reflected by slightly higher PCV in present study during extreme hot condition. Mean values of serum total protein, globulin urea and creatinine were found to be higher whereas albumin A/G ratio and total bilirubin found to be lower in both sexes in extreme climatic condition than moderate condition. Mean values of serum total protein, albumin, globulin, A/G ratio and creatinine were found to be higher while serum urea and total bilirubin to be lower in both age groups in extreme climatic condition than in moderate climatic condition.

In the present study it was observed that mean serum globulin, creatinine and total bilirubin values were significantly (P<0.05) lower while total protein, albumin, A/G ratio and urea were non significantly (P>0.05) lower in female animals than male in moderate climatic condition. Mean values of serum total proteins, albumin, globulin and A/G ratio were found to be lower non significantly (P>0.05) while serum urea to be higher non significantly (P>0.05) in female animals than male in extreme climatic conditions. Several workers (Lewis, 1976; Ghosh *et al.,* 1981; Bogin *et al.*, 1981; Chiofalo *et al.,* 1984, Djuricic *et al.*, 2010 etc) have reported the effect of sex and age on the serum protein values in goats. However, in present study the significant (P<0.05) effect of sex was observed in extreme condition only. The effect of age was non significant (P>0.05). Behra *et al.* (1993) reported a significant (P<0.05) decrease in globulin concentration from 3 months in all the goats. However, in present investigation a significant (P<0.05) increase was observed in serum globulin with the advancement of age during extreme conditions. In present investigation no effect of sex was observed on urea values in both the conditions. Behra *et al.* (1993) also reported non significant (P>0.05) effect of sex on urea values. No significant (P<0.05) effect of age was observed in present investigation on the mean urea values in both the conditions. Mean values of serum total protein A/G ratio and bilirubin were higher non-significantly (P>0.05), while serum albumin, globulin urea and creatinine were lower non-significantly (P>0.05) in above 1 year age group animals than 0-1 age groups in moderate climatic conditions. Mean values of serum globulin were observed to be significantly (P<0.05) higher while total protein, albumin urea and creatinine higher non significantly (P>0.05) and serum A/G ratio and bilirubin significantly (P<0.05) lower in above one year's age group animals than 0-1 year age group in extreme climatic condition. Physiological protein concentrations are rarely influenced by age in the adult animals; in the neonate these are strictly dependent on days of life as affirmed by Piccione *et al.* (2011). Various researchers (Sharma, 1990; Behra, 1993; Kumar, 1997; Junge *et al.*, 2004; Sema *et al.,* 2009) reported higher values of creatinine in male goats. Age effect was non significant (P>0.05) on the mean creatinine values in both the conditions in present study. Behra *et al.* (1993) and Myers *et al.* (2006) also reported non-significant (P>0.05) age effect. Castro *et al.* (1977) observed that the concentration decreased with increase in age from 1 year to 4-6 years.

Conclusion

Serum creatinine and bilirubin values significantly increased in extreme climatic condition than to moderate one. Significant decrement observed in serum globulin, creatinine and bilirubin in moderate and total protein in extreme climatic conditions in females. Males showed higher values of serum biochemical parameters in comparison to females in both climatic conditions except urea

in extreme hot conditions. Animals of 0-1 year age group showed higher values in albumin, globulin, urea and creatinine in moderate while A/G ratio in extreme hot conditions than above1year age groups, while animals above 1 year showed higher values for total bilirubin.

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