J. Agric. Sci. Mansoura Univ., 28(5): 3361 - 3373, 2003

ADAPTIVE PHYSIOLOGICAL RESPONSES OF BALADI AND GABALI GOAT BUCKS TO NATURAL SHELTERING IN SUMMER UNDER SEMI-ARID CONDITIONS

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ABSRACT

Ten adult Baladi bucks (2.5–3.5 years old and average live body weight of 36.5±0.87 kg) in addition to 10 Syrian Gabali bucks (2.5–3.5 years old and average live body weight of 40.5±0.57 kg) were used to compare their thermo-respiratory and cardiac responses to tree sheltering during summer season. Each breed group was divided into two sub-groups (5 each). The first sub-group of each Baladi and Gabali bucks was kept under tree natural sheltering (*Casurina equistifolia)* while the second sub-group was left unsheltered in wire-fenced pens along day and night during the experimental period from July to September, 2000. Thermo-respiratory parameters (rectal temperature (RT), respiration rate (RR), skin temperature (ST), coat temperature (CT) and different temperature gradients (RT-ST, ST-CT, RT-CT and RT-AT) were recorded once weekly twice a day at 08.00 hr and 14.00 hr. In addition, plasma and blood volumes, plasma proteins, potassium, sodium and aldosterone hormone were also determined.

Results revealed that the tree sheltering tempered the thermal conditions of the microclimate particularly radiant ambient temperature. Sheltered groups had more limited diurnal increases of RT (0.45 vs. 1.10 °C), RR (9.6 vs. 41.0 breaths/min), ST (0.7 vs. 2.6 °C), CT (0.5 vs. 2.7 °C) and heart beat (8.4 vs. 29.5 beats/min) as compared with unsheltered ones. Consequently, both Baladi and Gabali bucks would be more heat tolerant by tree sheltering during the hot period of the day. Body-environment temperature gradients (RT-ST, ST-CT and RT-CT) were also discussed.

Summer heat stress did not affect significantly hematocrit value, hemoglobin concentration, plasma protein levels and albumin/globulin ratio for either Baladi or Gabali goat bucks. Plasma and blood volumes and their percentages from body weight tended to increase insignificantly in heat stressed groups. Without sheltering, plasma concentrations of aldosterone hormone, sodium and potassium decreased by 29, 8.8 and 15.8% for Baladi bucks and 35, 10.3 and 13.5 % for Gabali bucks, respectively.

The present results indicated that sheltering might act as temperature regulator for the microclimate and in turn for body temperature of sheltered animals. Also, under heat stress conditions Gabali bucks were more able to sustain their thermal balance with less physiological efforts, so they seemed to be more adapted rather than Baladi bucks under semi-arid conditions.

Keywords: Baladi and Gabali bucks, natural sheltering, thermal and hematological responses

INTRODUCTION

Goats are considered one of the farm animals although they are widely accepted as a desert mammal. In Egypt, goats are raised mainly in desert areas such as the North Western Coastal Zone and the Sinai Peninsula. In such areas, they are considered as the cow of the nomad. Their survivability and tolerance to adverse environmental conditions are evidence to their rapid propagation and persistency in equatorial arid zones. Johnson (1965) when classifying the farm animals into different categories of adaptability compiled both tolerance to heat and level of production. Accordingly, heat tolerant-low productive group refers to the native breeds of sub-tropics whereas heat intolerant-high productive group usually are temperate zone breeds. Increasing goat production could be achieved through introducing exotic breeds and development of new breeds being well adapted to the harsh conditions (heat stress, shortage of food and water, salinity and diseases) in order to achieve maximum productivity allowed by their genetic potentialities. To Egypt, a flock of Syrian Gabaly goats was imported for the first time in February 1997. Therefore, the present work was carried out to test the effect of tree sheltering on alleviating the heat stress for Baladi and Gabali goats in terms of thermo-respiratory and cardiac responses alongside plasma and blood volumes and their relation to plasma proteins, potassium, sodium and aldosterone hormone.

MATERIALS AND METHODS

Shelterbelt:

Trees (*Casurina equisetifolia*) shelterbelt of the station farm were of more than 25 years old, 15-20 meter height and 10 meter branching width. Shadow beneath such trees has been noticed to cover a vast area of the ground along the whole day. Therefore, the idea was to exploit such naturally sheltered area in protecting bucks from the high-energy radiation common during summer season.

Animals:

Ten adult Baladi bucks (2.5–3.5 years old and average live body weight of 36.5±0.87 kg) in addition to ten Gabali (Syrian) bucks (2.5–3.5 years old and average live body weight of 40.5±0.57 kg) were used in this study. These bucks were a part of the flock of Maryout Research Station (35 km southwest of Alexandria) that belongs to Desert Research Center.

On July 1st, 2000, Baladi and Gabali bucks were randomly divided into two equal groups (5 each); and assigned to 4 open pens (5×5 meters, just fenced by wire net). Two pens were erected under shelterbelt (sheltered groups) while the others were left unsheltered. All animal groups were allowed to drink fresh water twice a day. Treatment extended up to the September 20th (end of summer season). Bucks were kept in their pens along day and night during the experimental period.

Management:

Group feeding was followed offering *ad libitum* berseem (*Trifolium alexandrinum*) hay along with a commercial concentrate mixture (11% yellow corn, 7% rice bran, 42% wheat bran, 9% linseed meal, 12% corticated cotton seed cake, 8% rice milling, 7% molasses, 3% ground limestone and 1% common salts) at the rate of 500 g/head/day according to NRC (1975) during the treatment period.

Measurements:

Rectal, skin and coat temperatures (°C), respiration rate (breaths/min) and heart beats (beats/min) were recorded once weekly at 08.00 and 14.00 hr. Rectal temperature was measured by a clinical thermometer, while skin and coat temperatures by digital telethermometer. Respiration rate was measured by counting the flank movement for 1 min, and heart beats by stethoscope. Body-environment temperature gradients in terms of inner gradient (RT-ST), middle gradient (ST-CT), outer gradient (RT-CT) and total gradient (RT-AT) were also calculated. The diurnal changes in such parameters were taken as indices for tolerance to heat load during summer. Meteorological data in terms of ambient temperature (°C), relative humidity (%), radiant ambient temperature (°C) and soil temperature were recorded once weekly at 08.00 and 14.00 hr under both sheltered and unsheltered conditions using centigrade thermometer, hair hygrometer, the black copper ball and telethermometer with soil probe, respectively.

Blood biochemical analyses

Blood samples from all bucks were collected biweekly via jugular vein in heparinized tubes, in the morning before water and food offered, then animals injected by Evan's blue dye (T 1824) for the determination of PV. Clear plasma obtained by centrifugation (at 3000 r.p.m. for 15 minute) and stored at -20 °C till the further assay was performed. Hematocrit value and hemoglobin concentration (g/dl) were measured in the fresh blood samples using Wintrob tubes and available kits supplied by bioMe'traux-France Company, respectively. Plasma total proteins (g/dl) and albumin (g/dl) levels were determined using the kits supplied by bioMe'traux-France Company according to Doumas *et al.*, (1971) from which globulin level (g/dl) and albumin/ globulin ratio were calculated. Flame Emisson Spectro-Photometer was used to determine sodium and potassium concentrations in plasma according to Oser (1965) and A. O. A. C. (1980). Radioimmunoassay technique was used for determining the level of the aldosterone hormone using the kits produced by Diagnostic Products Corporation (DPC, Los Angles, USA). Intra and inter assay precessions ranged from 2.7 to 8.3 and 3.9 to 10.4 5, respectively. Specificity and lower limit for sensitivity were 100% and 12 pg/ml, respectively. Plasma volume (PV) was determined as described by Hodgetts (1959) and then blood volume was calculated.

Statistical analysis

Data collected periodically from the same animals were analyzed as split-plot repeated measurements according to SAS (1988) utilizing general linear model. Duncan's Multiple Range Test (DMRT) was done to detect significance of differences between means.

RESULTS AND DISCUSSION

Shelterbelt and alteration of microclimatic conditions

Meteorological data prevailed during the experimental period under both tree-sheltered and unsheltered sites were illustrated in Table (1). Diurnal rhythms in ambient temperature (AT), radiant ambient temperature (RAT) and soil temperature (SOT) were observed, to be the highest values in the afternoon (14.00 hr) and the lowest in the morning (08.00 hr). The diurnal differences in AT, RAT and SOT were of low magnitude under shelterbelt as compared to those under direct solar radiation (Table1). Diurnal changes in AT and RAT were reported by Gawish *et al.* (1999), Badawy *et al.* (1999) and

Khalifa *et al.* (2000) to affect various physiological parameters of the animals in spite of their thermostability. However, these diurnal rhythms might also reflect the changes in animal behavior in terms of activity, rest, feeding and fasting.

Table 1: Meteorological data recorded at 08.00 and 14.00 hr. under direct solar radiation and shelterbelt during treatment period.

Variable	Tree-Sheltering	Unsheltering	Change[1]
Ambient temperature (AT, °C)			
08.00 hr.	25.0	24.5	+ 0.5 (2.0%)
14.00 hr.	27.5	32.9	- 5.4 (16.4%)
Change[2]	+2.5	+8.4	- 5.9 (70 %)
Radiant ambient temperature (RAT, °C)			
08.00 hr.	25.5	26.5	-1.0 (3.8 %)
14.00 hr.	28.4	43.5	-15.1 (34.7%)
Change[2]	+ 2.9	+17.0	- 14.1(83.0%)
Soil temperature (SOT, °C)			
08.00 hr.	23.3	23.0	+ 0.3 (1.3 %)
14.00 hr.	25.1	28.9	- 3.8 (13.1%)
Change[2]	+ 1.8	+ 5.9	- 4.1 (69.5 %)
Relative humidity (RH, %)			
08.00 hr.	95.5	88.5	+ 7.0 (7.9 %)
14.00 hr.	77.9	66.4	+ 11.5 (17.3)
Change[2]	- 17.6	- 22.1	-4.5 (20 %)

1; Change in microclimate due to tree-sheltering. 2; Changes due to 14.00 hr.

The magnitude changes in AT were found to be 2.5 and 8.4 °C under sheltered and unsheltered sites, respectively, resulted in a reduction of 70% of ambient temperature beneath tree-shelterbelt. Likewise, in afternoon, trees reduced RAT by 83.0% (2.9 vs. 17.0 °C) as the dark material occupying the intermediate space impends the transfer of radiant heat (Esmay, 1978). However, value of AT in the morning were much similar in both sheltered (25.0 °C) and unsheltered (24.5 °C) locations. Worthwhile, the peak of RAT recorded beneath shelterbelt (28.4 °C) was closer to goats comfort zone than that recorded under direct solar radiation (43.5 °C), according to El-Sherbiny *et al.*(1983) who reported that the thermoneutral zone of the desert and non-desert Egyptian goats ranged between 20 -30°C. This might reflect the extent of heat load falling upon sun exposed animals compared to tree-sheltered ones. Likewise, soil temperature was found to follow the same trend reported for AT and RAT. The magnitudes of change in SOT were 1.8 and 5.9 °C under tree-sheltered and sun-exposed sites, respectively.

Fortunately, diurnal changes in RH% were inversely correlated with those of AT and RAT. Lowest RH % values were recorded in afternoon for both tree-sheltered (77.9%) and sun-exposed (66.4 %) sites. At the two occasions of the day, trees elevated the RH by 11% (95.5 vs. 88.5%) in the morning and 11.5% (77.9 vs. 66.4%) in the afternoon due to the continuous evaporation from their leaves. This may impose the beneficial cooling to air.

Although the shelterbelt reduced the air movement along the day, its velocity recorded at mid-day was still adequate to permit an efficient convective and evaporative cooling for animals in confinement (more than 2 meters / second) according to Hahn (1982). Therefore, it appeared that tree sheltering had tempered the microclimate conditions and provided a partial protection against the stressful solar radiation especially in the afternoon.

The present findings support those of Hahn (1982) and Azamel *et al.*, (1994). They reported that the natural shade is a cost-effective means for modifying environmental conditions of the tropics and sub-tropics.

Thermal responses in relation to tree sheltering

Mean values of the physiological parameters (RT, RR, ST and CT) of both Baladi and Gabali bucks under shelterbelt and direct sun exposure during the experimental period were presented in Table (2). Diurnally rhythms in all physiological parameters studied were found to follow the previous trends reported for AT and RAT where the lowest values were recorded in the morning (08.00 hr) and the highest values the afternoon (14.00 hr).

Overall, mean values of RT during the experimental period were found to be 39.0 and 39.1 °C for both Baladi and Gabali bucks, respectively. These estimates lies within the normal range reported for goats being 37.5 to 39.7 °C (Ghosh. et al, 1993). This result indicated that Baladi and Gabali goat bucks were able to sustain homeothermy and keeping their body temperature within a narrow range regardless of considerable changes in AT. Diurnal changes in RT were found to follow the diurnal changes in both AT and RAT. Singh *et al*, (1982) found that the average RT values tended to increase insignificantly with the increase in AT. In response to the high AT in afternoon, Baladi and Gabali goats showed maximum mean values of RT either under shelterbelt (39.3 and 39.3 °C) or direct sun (39.5 and 39.6 °C) which means that the Gabali bucks as much as Baladi ones were able to control their body temperature under such conditions. These results consisted with those of Shalaby and Johnson (1993), who recorded a significant increase in RT of goats from 37.0 to 39.3°C when AT increased from 25 to 35 °C. The magnitude of diurnal variations in RT of Baladi and Gabali bucks were nearly similar and low under shelterbelt (0.4 and 0.5 °C) as compared to their counterparts (1.1 and 0.9 °C) under direct sun in both Baladi and Gabali bucks, respectively. These estimates of diurnal variations in RT were nearly similar to those reported on sheep (1.0 °C) by Gawish, *et al.* (1999) and on Baladi goats (0.8 °C) by Badawy *et al.*(1999).

Collectively, the magnitude of diurnal changes in RT was reported to be affected by season (Das. *et al.*, 1991), breed (El-Nouty *et al.*, 1990), sex (Kasa. *et al.*, 1995) and solar radiation (Shalaby *et al.*, 1989).Significant ($P<0.05$) diurnal rhythm in ST was also found (Table 2). Diurnal changes in ST beneath tree-sheltering was found to be of lower magnitude (0.8 and 0.6 °C) as compared to unsheltering ones (2.3 and 2.9 °C) for both Baladi and Gabali bucks, respectively. The present results supported well those of Azamel *et al.* (1994) on natural shading of Barki and Barki x Merino ewes.

Table 2: Thermo–respiratory parameters of Baladi and Gabali bucks under tree-shelterbelt and direct solar radiation.

Item	Tree-sheltering		Unsheltering		S.E[1]
	Baladi	Gabali	Baladi	Gabali	
Rectal Temperature ©					
08.00 hr.	38.9	38.8	38.4	38.7	0.06 **
14.00 hr.	39.3	39.3	39.5	39.6	0.10 **
Change (°C)	+ 0.4	+ 0.5	+1.1	+ 0.9	
Change (%)	1.03	1.29	2.86	2.33	
Skin Temperature (°C)					
08.00 hr.	35.1	35.4	34.9	35.3	0.04
14.00 hr.	35.9	36.0	37.2	38.2	0.12**
Change (°C)	0.8	0.6	2.3	2.9	
Change (%)	2.3	1.7	6.6	8.2	
Coat Temperature (°C)					
08.00 hr.	34.2	34.6	34.3	34.1	0.08
14.00 hr.	34.7	35.1	36.5	37.0	0.12*
Change (°C)	0.5	0.5	2.2	2.9	
Change (%)	1.5	1.4	6.4	8.5	
Respiration rate (breaths / min.)					
08.00 hr.	29.8	28.5	23.9	24.3	2.5 **
14.00 hr.	39.9	37.6	67.7	62.5	3.62 **
Change (°C)	+10.1	+ 9.1	+ 43.8	+ 38.2	
Change (%)	33.9	31.9	183.3	157.23	
Heart beats (beats /min)					
08.00 hr.	85.5	88.0	82.4	86.5	2.5
14.00 hr.	90.3	100.0	106.5	121.4	3.3*
Change (°C)	4.8	12.0	24.1	34.9	
Change (%)	5.6	13.6	29.2	40.3	

F-Test

Main effects		RT	ST	CT	RR	HB
Breed.	Baladi	39.1 a	35.8 a	35.0 a	33.4 a	91.2 a
	Gabali	39.2 a	36.3 b	35.3 a	38.3 b	98.0 b
Treatment.	Sheltered	39.1 a	35.7 a	34.7 a	34.0 a	86.0 a
	Unsheltered	39.1 a	36.4 b	35.5 b	44.6 b	99.0 b

S.E[1]; Standard error of breed = that of treatment. *, $P<0.05$. **; $P<0.01$. Means with the same letters in the same column for each parameter did not differ significantly.

Moreover, the present results indicated that, during mid-day, animals attained higher ST to reduce the temperature gradient between body surface and the environment, which might be a mean to conserve water instead of expenditure in evaporative cooling. These results agreed with those of Yousef (1985), Badawy *et al.* (1999) and Khalifa *et al.* (2000). Skin temperature is regulated by blood flow to the skin and evaporation, conduction and radiation from the skin. At low peripheral blood flow (vasoconstriction), ST is low and heat loss to environment is reduced. At high peripheral blood flow (vasodialation), ST approaches the core temperature and heat loss to the environment is increased (Yousef, 1985).

Likewise, tree sheltering was found to affect significantly (P<0.01) coat temperature (Table 2). During the hot period of the day, CT values were lower under tree sheltering in both Baladi (34.7 vs. 36.5 °C) and Gabali bucks (35.1 vs. 37.0 °C) as compared to their unsheltered mates, respectively. The magnitude changes in CT were 0.5 vs. 2.2 °C for Baladi bucks and 0.5 vs. 2.9 °C for Gabali bucks under sheltered and unsheltered sites, respectively reflecting the significant role of their coat in maintaining body temperature through increase heat loss from the coat to the surrounded environment.

As mentioned previously, breed type and time of day had affected significantly (P<0.01) RR as well as other physiological parameters as shown in Table (2). Minimum values of RR for Baladi and Gabali bucks, were recorded at 08.00 hr either beneath shelterbelt (29.8 and 28.5 breaths/min) or under direct sun (23.9 and 24.3 breaths/min), respectively while the corresponding maximum values were recorded at 14.00 hr being 39.9 and 37.6 breaths/min beneath shelterbelt and 67.7 and 62.5 breaths/min. under direct sun. The magnitudes of diurnal increases in RR from 08.00 to 14.00 hr for Baladi and Gabali bucks were lowered under shelterbelt (33.9 and 31.9%) as compared to that under direct sun (183.3 and 158.3%), respectively. These results, however, were in accordance with those of El-Sherbiny *et al* (1983); Dahlanuddin and Thewaites (1993), Badawy *et al.* (1999) and Khalifa, *et al.* (2000). Also, Shalaby and Johnson (1993) found that RR of Anglo-Nubian goats increased by about 150% as AT increased from 25°C (in early morning) to 35°C (at noon). Evaporative water loss through respiratory tract is the main avenue for heat dissipation in heat-stressed goats and sheep (Robertshow, 1982; Azamel *et al.*, 1996; Khalifa *et al.*, 2000).

This response involves the peripheral receptors and the heat center of the hypothalamus to stimulate the respiratory musculature for increasing respiratory activity. However, the previous results indicated the higher ability of Gabali bucks to control body temperature and this ability was achieved by less respiratory evaporation efforts. Sheltering improved heat tolerance of bucks as indicated by the significantly lower values of RT and RR at 14.00 hr. Shelterbelt, therefore, may act as temperature regulator for the microclimate and in turn for body temperature of sheltered animals.

Heart beat under direct sun relative to that under shelterbelt increased (P<0.01) by 17.9% (106.5 vs. 90.3 beats/min) and 21.4% (121.4 vs. 100 beats/min) for both Baladi and Gabali bucks, respectively. This increase in pulse rate might enhance the heat loss mechanism through the increase in internal conduction where more heat could be transferred from core to skin surface. Kumar and Singh (1994) and Khalifa, *et al.* (2000), found similar results. They stated that exposure to solar radiation increased heart rate of native goats by 32.5% (from 83 to 123 beat /min). Tree-sheltering on the other hand, alleviated the heat impact on animals during the heat period of the day judging by the least percentage increases in heart beat for either Balady bucks (5.6 vs. 29.2 %) or Gabali bucks (13.6 vs. 40.3%) as compared to unshaded ones.

Body-environment temperature gradients:

The gradient between body and air temperatures (Table 3) decreased in the two breeds in accordance with the increase in air temperature denoting a proportional increase in body temperature for each unit increase in air temperature. During the hot period of the day, the inner gradient decreased under unsheltered site either for Baladi (2.9 vs. 3.7 °C) or Gabali bucks (2.4 vs. 3.4 °C) as compared to tree-sheltered mates. This might be due to increase in ST partly due to superficial vasodilatation of skin as suggested by El-Ganaieny *et al.* (2001). On the other hand, the differences between RT and ST indicated that goats always maintained lower ST than RT during the morning and afternoon, which might demonstrate the role played by the coat in thermoregulation. Skin and coat temperatures were more influenced by the change in AT than did RT and this may due to the direct exposure of coat surface to the changes in the climatic temperature.

Table 3: Body-environment temperature gradients of Baladi and Gabali bucks under Shelterbelt and direct sun exposure during the experimental period.

Temperature gradients	Tree-Sheltered		Unsheltered		± SE
	08.00 h.	14.00 hr	08.00 hr	14.00 hr	
Inner gradient (RT-ST)					
Baladi	3.8	3.4	3.5	2.3	0.61
Gabali	3.4	3.3	3.4	1.4	0.72
Middle gradient (ST-CT)					
Baladi	0.9	1.2	0.6	0.7	0.05
Gabali	0.8	0.9	1.2	1.2	0.14
Outer gradient (RT-CT)					
Baladi	4.7	4.6	4.1	3.0	0.33
Gabali	4.2	4.2	4.6	2.6	0.22
Total gradient (RT-AT)					
Baladi	13.9	11.8	13.9	6.6	0.24
Gabali	13.8	11.8	14.2	6.7	0.15

F- Test

Item	RT- ST	ST-CT	RT-CT	RT-AT
Baladi	3.3 a	0.9 a	4.1 a	14.0 a
Gabali	2.9 b	1.1 a	3.9 a	9.3 b
Sheltered	3.5 a	1.0 a	4.5 a	12.9 a
Unsheltered	2.4 b	1.0 a	3.6 b	10.4 b

Column with different letters for each parameter differed significantly.

Meanwhile, ST was affected largely by CT particularly in the presence or absence of different coat types. This might reflect the insulating efficiency of hair coat as an external barrier that might help animals to maintain constant body temperature. Skin-coat temperature gradient was of low magnitude (Table 3) and this might reduce the insulation capacity of the coat, thus permitting more heat flow and faster heat dissipation from the body.

These results confirmed with those reported by Aboul-Ezz (2000) and El-Ganainey, *et al.* (2001). It is clear that the inner and outer gradient temperatures of the unsheltered animals decreased either in the morning or in the afternoon (Table 3) indicating low heat flow from body to the surrounding environment. On the other hand, sheltering was found to be of a great significance in alleviation of radiant heat impacts on animals allowing physical rather physiological means in maintaining RT nearly constant. However, Gabali bucks under direct solar radiation were relatively heat stressed allowing relatively physiological mechanism to sustain their normal body temperature nearly constant under such conditions.

Blood biochemical analyses

Results (Table 4) reveal that heat stress slightly increased Ht value from 25 to 28% for Baladi bucks and from 26.5 to 30.0% for Gabaly bucks as well as Hb concentration. Plasma volume also increased slightly which indicates an increase in blood cell count and/or volume with differences being not significant. However, More *et al.* (1978) and Gawish *et al.* (1999) reported conflicting results. This confliction could explained by the fact that Ht % depends on the changes in both PV and corpuscular volume. Thus, the increase in Ht % value after heat exposure might be due to a reduction in PV and/or an increase in corpuscular volume as reported by Khalifa *et al.* (2000).

Table 4: Hematological parameters of Baladi and Gabali bucks under shelterbelt and direct sun exposure during the experimental period.

Parameter	Sheltered		Unsheltered		± SE[1]
	Baladi	Gabali	Baladi	Gabali	
Ht %	25.0	26.5	28.0	30.0	2.30
Hb (g/dl)	10.5	11.8	12.2	13.8	0.35
PV (Litre)	1.60	2.0	2.10	2.50	0.20
PV %	4.4	4.9	5.7	6.2	
BV (Litre)	2.6	3.0	2.7	3.4	0.30
BV %	7.0	7.5	7.5	8.4	
TP (g/dl)	7.1	7.2	7.3	7.5	0.42
AL (g/dl)	2.5	2.7	2.6	2.6	0.12
GL (g/dl)	4.60	4.50	4.70	4.90	0.16
A/G ratio	0.54	0.53	0.55	0.53	0.22
Na^+ (mmol/l)	163.4	120.9	149.1	108.5	14.80
K^+ (m mol/l)	5.7	5.2	4.8	4.5	0.09
Aldo (Pg/l)	42.6	40.5	30.2	26.2	10.90

SE[1]; Standared error of sheltering= standared error of breed. Ht; Hematocrit. Hb; Hemoglobin TP; Total protein. AL; Albumin. GL; Globulin. A/G; Albumin/globulin ratio. PV; Plasma volume. BV; Blood volume. Na^+; Sodium. K^+; Potassium. Aldo; Aldosterone hormone.

Exposure to solar radiation had no significant effect on plasma and blood volumes or their percentages from body weight (Table 4). However, they tended to increase slightly under sun exposure. These results were in accordance with those of Silanokove (1987) and Khalifa *et al.* (2000). Silanokove (1987) added that both PV and extracellular fluid volume were significantly higher in unsheltered than sheltered sheep. The increase in PV after exposure to solar radiation might be due to the positive water balance as suggested by Kamal *et al.* (1987) or to an increase in cortisol level (Parrott *et al.*, 1987) or to a shift of fluids from extracellular space or digestive tract (EL-Sherif and El-Hassanin, 1996). On the other hand, exposure to heat stress did not affect significantly plasma proteins or A/G ratio (Table 4). This result consisted with those of Khalifa *et al.* (2000).

The present results revealed that heat stress had no significant effect on plasma concentrations of aldosterone, Na^+ and K^+. In addition, there was a tendency of reduction in plasma concentrations of aldosterone hormone, sodium and potassium by 29, 8.8 and 15.8% for Baladi bucks and 35, 10.3 and 13.5 %. for Gabali bucks, respectively.

El-Nouty (1996) found a similar trend for aldosterone, since its level decreased under heat exposure. Macferline *et al.* (1966) reported also, a reduction in plasma Na^+ and K^+ by about 4.5 % after exposure to sunshine on shorn sheep. The present results were in harmony with those of Khalifa *et al.* (2000) in Baladi goats. They reported 43.6, 13.0 and 36.0% reduction in Aldosterone, Na^+ and K^+ concentrations during exposure to 4 hours of solar radiation, respectively. They attributed the reduction to the increase in PV, which coincided with a reduction in aldosterone, Na and K concentrations as in case in the present study. However, Shebaita *et al.*, (1991) found that plasma Na^+ and K^+ increased during heat stress that might be due to a reduction in PV contrary to a slight increase in PV in the present study. It well be known that if PV decreased, aldosterone concentration would be increased to increase Na retention. The above mentioned reduction after exposure can be explained by the fact that ruminants lose K^+ during sweating which decrease K^+ concentrations, consequently any increase in aldosterone will increase the loss of K^+ in urine, so the reduction in aldosterone will minimized the reduction in K^+ during exposure.

Conclusion

From the previous results, it can be noticed that Gabali goats are heat tolerant animals. Exposure of goats to solar radiation caused a significant rise in their RT accompanied by a significant increase in RR, thus increased vaporization. Also, it increased heat loss by vasodialation in skin (as indicated by ST) and internal conduction (HB). However, this increase in evaporative cooling did not cause a reduction in PV that increased slightly. No noticeable changes in AL or A/G ratio were observed, while plasma aldosterone, Na^+ and K^+ concentrations decreased. Therefore, the increase in PV after exposure of goats to solar radiation might be due to the increase in cortisol level or to positive water balance by increased water intake. The insignificant reduction in aldosterone during heat stress although there was a reduction in Na^+ concentration may be an attempt to reduce the loss in K^+ which already decreased due to the increase in sweating rate. On the other hand, tree sheltering had tempered the thermal conditions of the local climate particularly radiant ambient temperature. Consequently, shelterbelt enabled animals to be more tolerant during the hot period of the day. Further experiments are still required to study the reproductive and productive performance of goats under prevailing harsh conditions using tree-shelterbelt.

REFERENCES

A. O. A. C. (1980). Association of Official Agriculture Chemists. Official methods of analysis, 13th ed., Washington. D. C., U. S. A.

Aboul-Ezz S. S. (2000). Comparative study on thermo-respiratory responses between Syrian Gabali and Balady goats under semi arid conditions of the Egyptian north western coast. Minufiya J. Agric. Res. Vol. 25 No. 1:125-134.

Azamel, A. A.; N. A. El-Sayed and M. A.. El-Sherif. (1996). Seasonal rhythms of cutaneous and respiratory water losses as mechanisms for thermoregulation by desert sheep and goats. Vet. Med. J., Vol. 44 (2): 425-433.

Azamel, A. A.; N. A. El-Sayed. and M. A. El-Sherif (1994). Heat tolerance and fertility of crossbred ewes as affected by natural sheltering and thirst under semi-arid conditions. Egyptian J . Anim. Prod., Vol. 31 (supplement issue) : 347-360.

Badawy, M. T; A. A. Azamel.; M. H. Khalil. and H. T.Abdel-Bary (1999). Physiological responses and reproduction of Baladi goats suffering heat stress and dehydration under semi-arid conditions. Proceedings of workshop on livestock and drought; policies for coping with changes. Cairo, May 24-27: 31-39.

Dahlanuddin and C. J. Thewaites (1993). Feed-water intake relations in goats at high ambient temperatures. J. Anim. Physio. And Anim. Nutr., 69:169-174.

Das, S. K; Ray S. K. and B. Bhattacharya. (1991). Physiological responses of black Bengal goat under deep litter management. Indian Vet. Medical J., 15: 314-315.

Doumas, B. T.; W. A. Watson and H. Biggs. (1971). Albumin standard and measurement of serum albumin with bromocresol green. Clin. Chem. Acta., 31: 87-92.

El-Ganainey M.M.; F. I . Khatab.; A. S. Abdou. and S. A. Hekal . (2001). Hair coat characteristics of Baladi goats in relation with thermoregulation during the yearly seasons. Egyp. J. Anim. Prod., 38 (2): 111-127.

El-Nouty, F. D; A. A. Al-Haidary and S. M. Basmeel. (1990). Physiological responses,feed intake, urine volume and serum osmolarity of Arabi Goats deprived of water during spring and summer. AJAS, 3: 331-336.

El-Nouty, F. D. (1996). Heat stress and milk production: Means of Alleviation. The 9th conference of the Egyptian society of animal production. Shibin El-Kom . Menoufiya, Egypt., 11-13 November.

El-Sherbiny, A. A.; M. K. Yousef; M. H.Salem; H. H. Khalifa. H. T. Abd El Bary and M. H. Khalil. (1983). Thermoregulatory responses of a desert and non –desert goat breed. Al-Azhar Agric. Res. Bulletin, Fac. of Agric. Al-Azhar Univ, 89 : 1-10.

El-Sherif, M. A. and E. E. El-Hassanein. (1996). Influence of drinking saline water on growth and distribution of body fluids in sheep, Alex. J. Agric. Res, 41: 1-9.

Esmay, M. L. (1978). Principles of Animal Environment. Text book Edition, The AVI Publishing Company, INC Westport Connecticut.

Gawish, H. A.; A. A . Azamel.; H. T. Abdel-Bary. and A. A. El-Sherbiny . (1999). Physiological responses and reproductive performance of Barki ewes under heat, water deprivation and poor feeding stresses. In Proceedings of workshop on livestock and drought; policies for coping with changes. Cairo, May, 24-27, 40-48.
Hahn, G. L. (1982). Housing for cattle, sheep and poultry in the tropics. In: Animal production in the tropics. (Ed. M. K. Yousef). Praeger Publishers, New York, P. 43.
Hodgetts, E. V. (1959). The influence of centrifugetional treatment upon hematocrit values and the trapped plasma correction factor of sheep blood. Aust. J. Exp. Biol., 37: 97-106.
Johson, H. D. (1965). The response of animals to heat. Chap. 6 of Agricultural Meteorolgy, Meteorological Monograph, Vol.6: 109. Amer. Met.Soc., Boston Massachusetts. U.S.A.
Kasa, I. W.; M. K. Hill; C. G. Thwaites and N. D. Baillie (1995). Physiological effects of exercise in male and female saanen goats at the same body weight but different feed intake. Small Rum. Res., 16: 83-86.
Khalifa, H. H , A. A . El-Sherbiny. and T. M. M. Abdel-Khalik. (2000). Effect of exposure to solar radiation on some adaptive physiological mechanisms of Egyptian goats. Proc. Conf. Anim. Prod. In The 21 st: Challenge and prospects. 18-20 April. 297-305.
Kamal, T. H.; G. A. R . Kamar.; H. A. Gabr. and K. M. El-Masry. (1984). Water balance in goats maintained under mild and hot weather. Egyptian J. Anim. Prod., 24: 237-246.
Kumar, P. and K.. Singh. (1994). Effect of shearing on thermo-adaptability in goats of arid and semi-arid zone of India. J. Anim. Sci., 64:290-294.
Macfarline, W. V.; B. Howard and R. J. H. Morris (1966). Water metabolism of Merino sheep shorn during summer. Aust. J. Agric. Res., 17: 219-225.
More, T.; A. K. Rai and Monohar singh. (1978). Note on the effect of thermal exposure on body fluid composition of different breeds and breed crosses of sheep. Indian J. Anim. Sci., 50: 207-209.
N.R.C. (1975). Nutrient requirements of sheep in: Nutrient requirement of domestic animals National Research Council, Washington, D.C. No.5.
Oser, B. L. (1965). Hawk's Physiology Chemistry, 14th ed. Tata Mc Graw Hill publishing Co. Ltd. Bombay, New Delhi, India.
Parrott, R. F.; S. N. Thornton; M. L.. Forslink. and C.E. Delaney (1987). Endocrine and behavioural factors affecting water balance in sheep subjected to isolation stress. J. Endo., 112: 305-310.
Robertshow, D. (1982). Concepts in animal adaptation, thermoregulation of the goat. Proceeding of the third international conference on goat production and disease. January 10 to 15, Tucson, Arizona, U.S. A.
S. A. S, (1988). Statistical analysis system, STAT/user's guide, release 603 ed. SAS Institute, Cary NC. U. S. A.
Shalaby, T. H. and H. D. Johnson (1993). Heat loss through skin vaporization conditions. Egyptian Am. Conf. Physiol. Anim. Prod. El-Fayoum. Egypt.

Shalaby, T. H.; M. B.Aboul-Ela.and A. M. Aboul-Naga. (1989). Physiological responses of Barki Desert Goats, Damascus Zaraiby and their crosses to heat stress under the semiarid conditions of the Western Desert of Egypt. Third Egyptian-British Conference on Animal, Fish and Poultry, Zagazig, Egypt.

Shebaita, M. K.; R. M. Yousri,. and A. Pfau. (1991). Body and plasma pools as indexes of heat acclimation. Int. J. Anim. Sci., 6: 43-47.

Silanokove, S. (1987). Impact of shelter in hot Mediterranean climate on feed intake, feed utilization and body fluid distribution in sheep. Appetite, 9:207-215.

Singh, M.; T. More; A. K.. Rai and S. A. Karim (1982). A note on the adaptability of native and crossbred sheep to hot summer conditions of semi- arid areas. J. Agric. Sci. Camb., 99:525.

Yousef, M. K. (1985): Measurement of heat production and heat loss. Chapter 4, Stress physiology in livestock. Vol. 1 pp. 35-45.

الاستجابات الفسيولوجية لتيوس الماعز البلدي والجبلي لتأثير التظليل الطبيعي صيفا تحت الظروف الشبه جافة

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أجريت الدراسة بمحطة بحوث مريوط التابعة لمركز بحوث الصحراء حيث استخدم ١٠ تيوس بلدي بالإضافة إلي ١٠ تيوس جبلى سوري بهدف مقارنة الاتزان الحراري لكليهما وبعض قياسات الدم ومدى تأثرنلك بالتظليل الطبيعي (أشجار الكازورينا) في فصل الصيف. قسمت كل مجموعة عشوائيا إلى مجموعتين بحيث وضعت المجموعة الأولى من كل من التيوس البلدي والجبلي فى حظائر سلك تحت ظل الشجر بينما المجموعة الأخرى تركت مكشوفة في حظائر سلك طوال فترة التجربة والتى استمرت من شهر يوليو وحتى شهر سبتمبر ٢٠٠٠ م كانت أهم النتائج كالآتي:

- أدى التظليل الطبيعي إلى تحسن معنوي في الظروف المناخية مما انعكس على الاستجابات الفسيولوجية للحيوانات حيث سجلت المجاميع المظللة أقل تغير في درجة حرارة المستقيم (٠,٤٥ مقابل ١.١°م) ، معدل التنفس (٩.٦ مقابل ٤١ تنفس/الدقيقة) ، درجة حرارة الجلد (٠.٧ مقابل ٢.٦° م) ، درجة حرارة الغطاء (٠.٥مقابل ٦و٢° م) وضربات القلب (٨.٤ مقابل ٢٩,٥ نبضة/الدقيقة) بالمقارنة بالمجاميع الغير مظللة.
- لم يؤثر التعرض للإجهاد الحراري معنويا على قيم الهيماتوكريت، الهيموجلوبين ، بروتينات انبلازما وكذلك نسبة الالبيومين/الجلوبيولين.
- أدى التعرض للإجهاد الحراري إلى انخفاض غير معنوي في تركيز هرمون الالدوستيرون بالبلازما وكذلك تركيزات الصوديوم والبوتاسيوم بمقدار ٢٩ ,٨.٨ ١٥,٨ ,% في التيوس البلدي في حين كان معدل الانخفاض فى التيوس الجبلي ٣٥، ١٠,٣، ١٣,٥ %على التوالي.
- أظهرت النتائج أن ظل الأشجار يعمل كعامل ملطف لظروف الطقس ويؤدى إلى حماية الحيوانات من حرارة الإشعاع الشمسى ومن ثم الحفاظ على درجة حرارة الجسم ثابتة في مدى ضيق وكذلك القدرة على التخلص من الحرارة الزائدة من خلال الوسائل الطبيعية لتبقى في المدى الحراري المحايد.

-أوضحت الدراسة أيضا قدرة التيوس الجبلي على التأقلم للظروف المناخية السائدة بالمنطقة من خلال استخدام بعض الميكانيزم الفسيولوجية للحفاظ على حجم بلازما الدم وكذلك نسبة الالبيومين: الجلوبيولين مما يعكس قدرة هذه السلالة على التأقلم للظروف البيئية السائدة بالمنطقة.