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Research Article

EFFECTS OF SOME MANAGEMENT FACTORS (HOUSING CONDITION AND WATERING REGIMEN) ON PHYSIOLOGICAL RESPONSES OF DESERT GOATS

[1]Salah Abdulabar Salah Bukhari, [2]Initsar Elnour Ibrahim, [1]Musa Ahmed Musa Tibin, [3]Adris Adam Idris Abdalla, [2]El Shafei Intisar Musa, [4]Saliha Hammad Kafey Teya, [5,] *Jumaa Barram Jadalla

[1]Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Alsallam Elfula, Sudan.
[2]Department of school Farming, Faculty of Education, University of Kordofan, Sudan.
[3]Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan, Sudan.
[4]Department of Food Science and Technology, Faculty of Natural Resources and Environmental Studies, University of Kordofan, Sudan.
[5]Department of Animal Production, Faculty of Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan.

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ABSTRACT

This work was carried out in Sheikan locality, North Kordofan State, Sudan. The objective was to study the effects of some management factors on physiological responses of Desert goats and the experimental period lasted for 10 months. The results showed that lowest average goat Respiration Rate was at 12:00 pm while the highest Respiration Rate was at 18:00 pm (P<0.001). Rectal temperature, on the other hand, was highest (P<0.001) at the evenings (18:00 pm) and lowest (P<0.001) at the morning (8:00 pm). Respiration rates and rectal temperatures were comparatively higher under direct sunlight conditions in comparison with those for goats under shade , Goats with access to drinking water everyday had slightly lower (P<0.05) Respiration Rate and Rectal temperature compared with goats watered every other day. Respiration Rate stated low during May and rose in July August through December and then started to decline in January and February whereas Rectal temperature was almost constant with very slight fluctuations throughout the ten months of the experimental period. Goats had the lowest Respiration Rate during the summer season and the highest Respiration Rate during the rainy season (P<0.001), with winter season, but unlike Respiration Rate, Rectal temperature was lowest during the winter season. . Dry goats had comparatively higher RR and RT compared with pregnant ones..

Keywords: Desert goat, seasons, Physiological responses, rectal temperature, respiration rate.

INTRODUCTION

Goats are very important animals because of their favorable characteristics and capacity to adjust to harsh environmental (arid, semi-arid, tropical, sub tropical, etc.) conditions throughout the world. In tropical and sub-tropical regions high ambient temperature is the major constraint on animal production (Marai *et al.*, 2007). This effect is aggravated when heat stress is accompanied by high ambient humidity. Excessive heat stress may cause hyperthermia and have several physiological side effects and economic impacts on animal productivity (Al-Tamimi, 2007). Most of goats in Sudan are of the Desert type. Sudanese desert goats are mainly found in Western region of the Sudan which including Darfur and Kordofan states. Desert goats are mainly raised for meat production especially in rural area and they also provide milk for family needs (Itidal,1989). Greater Kordofan total goats population is estimated at 7.9 million with North Kordofan holding about 4.0 million heads (MARF. 2010).The majority of studies conducted on goats are on productive and reproductive performance. However, in comparison with other livestock, there is paucity of information regarding seasonality in physiological responses of goats to environmental stresses. This work was undertaken with an ultimate objective of studying the effects of some management factors on physiological responses of Desert goats

MATERIALS AND METHODS

Study Area

Corresponding Author: Jumaa Barram Jadalla,
5Department of Animal Production, Faculty of Department of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan.
jumaaaringola2000@gmail.com

This study was conducted at El-Obeid, Sheikan Province, North Kordofan State (latitudes11°:15'-16°:30'N; longitudes 27-32°E; altitudes 560 meter above sea level. Average temperature varies between 30-35°C during most of the year with peaks of above 40°C during April, May and June. The rainy season extends from July to October with maximum rainfall in August. Long-term average annual rainfall is about 280 mm (Technoseve, 1987; El-Tahir *et al.*, 1999).

Experimental Animals

Twenty eight (28) Sudan Desert goats (3-4 months old, average body weight 11.8±1.35 kg) were used in those trials. Goats were ear-tagged, vaccinated with Ivomec (Ivomectin^{R}), at 0. 5 cc/goat/body weight administered twice at an interval of three weeks, and with oxy-tetracycline as an anti-coccidian treatment applied at 0.5 cc/goat/ body weight. All goats were allowed a one week as an adaptation period.

Trials Layout

The goats were randomly divided into two equal groups based on their initial body weight and age. One group was randomly allocated to a shaded condition in pens of 9x4 m^2 while the other group was left on the open with no shade. All goats were tethered and were provided with individual feeding and watering troughs. Each group was again randomly subdivided into two similar groups based on initial body weight and age. One received water every day whereas the other one was watered every other day.

Data Recording

Respiration rate (RR) and rectal temperature (RT):

Respiration rate and rectal temperature were measured on monthly-basis and were done in each month. At that day respiration rates and rectal temperatures were measured at the morning (at 08:00 am) and then every two hour until evening at (06:00 pm). Respiration rate was done through counting the flank movement for one minute while RT was determined by using clinical thermometer inserted in the rectum for one minute with an accuracy of ±0.1°C.

Statistical Analyses

The experimental data was analyzed as a completely randomized block design. Analysis of variance test (ANOVA) of two- way interactions was done according to Snedecor and Cochran, (1980). Time of the day was included as a factor with season, shade condition and watering regime to test their effects on respiration rate and rectal temperature statistically analyzed as two-way interactions using the general linear model (GLM) procedure of SPSS software version 16, 1999).

RESULTS

Climatic Conditions

The ambient temperature and relative humidity prevailing during the experimental period (May 2010- February 2011), covering different times of the day are shown in Table (1). The highest values of ambient temperature and relative humidity were recorded at 18:00 pm and at 08: 00 am, respectively, while the respective lowest ambient temperature and highest relative humidity were at 08:00 am and 18:00 pm. Ambient temperature and relative humidity followed an opposite trend while one was increasing the other was decreasing (Figure 4-1). The average monthly ambient temperature and relative humidity for the three seasons of the experimental period (May 2010-February 2011), are shown in Table (2). The highest values of ambient temperature were recorded during May 2010, in summer while the minimum values were recorded during January 2010 in winter. The relative humidity was at minimum during winter and the highest values were recorded in the rainy season.

Respiration rate (RR) and Rectal temperature (RT)

The effects of time of the day, housing condition and water regime on respiration rate (RR) and rectal temperature (RT) are presented in Table (4-4). Time of the day (T) had significant main effects on both RR and RT. The lowest average goat RR was at 12:00 am while the highest RR was at 18:00 pm (P<0.001). Differences in RR at 14:00 pm up to the evening (18:00 pm) were not significant (P>0.05). RT showed a rise from the morning (8:00 am) up to 10:00 am then slowed down up to noon time (12:00 pm) and rose again up to the evening (Figure 4-2). On the other hand Rectal temperature, was highest (P<0.001) at the evenings (18:00 pm) and lowest (P<0.001) at the morning (8:00 am). However, diurnal variations in goat RT were within a very narrow range of 38.8-39.5°C. Housing condition and watering regime had no main effect (P>0.05) on Respiration rate and Rectal temperature. Nonetheless, Respiration rate and rectal temperature were comparatively higher under direct sunlight conditions in comparison with those for goats under shade (Table 4-4). Goats with access to drinking water everyday had slightly lower (P>0.05) RR and RT compared with goats watered every other day (Table 4-4). Diurnal fluctuations in RT maintained the same picture under both daily watering and every other day watering regimen with goats on the latter regimen recording comparatively higher RR throughout the different times of daily measurements (Figure 4-3) and throughout monthly fluctuations of the experimental period (Figure 4-3).No significant (P>0.05) interaction effects were found among the three factors of (time of the day, housing condition and watering regimen). Average diurnal rectal temperature for goats under shade and those under direct sunlight fluctuated within a very narrow range with RT for goats under direct sunlight slightly higher (Figure 4-4) compared with those under shade. Furthermore, monthly average RT was comparatively higher for goats under direct sunlight than that for goats under shade (Figure 4-5).The effects of season, housing condition and water regime on respiration rate (RR) and rectal temperature (RT) are displayed in Table (4-4). Seasonal main effects on goat RR and RT were highly significant (P<0.001). Goats had the lowest RR during the summer season and the highest RR during the rainy season (P<0.001), with winter season resulting in an intermediate RR. Similarly, goat RT was highest during the rainy season, but unlike RR, RT was lowest during the winter season, with no differences in goat RT between summer and rainy seasons (Table 4-4). It is worth noting here that RR stated low during May and rose in July August through December and then started to decline in January February whereas RT was almost constant with very slight fluctuations throughout the ten months of the experimental period (Table 4-5) (Figure4- 6). Nonetheless, goats under direct sunlight had relatively higher RT and RR throughout the experimental period compared with those under shade (Figure 4-7). Interaction effects among the different factors (Table 4-4) were not significant (P>0.05).
The main effects of physiological state and interaction effects of physiological state with season, housing condition and watering regimen on respiration rate (RR) and rectal temperature (RT) of goats are shown in Table (4-6). Physiological state seemed to exert no main effect (P>0.05) on goat RR and RT. However, dry goats had comparatively higher RR and RT compared with pregnant ones. Respective RR for dry and pregnant goats were 32.9 and 32.2 breathes/minute while respective RT for the two physiological states were 39.2 and 39.1°C. Interaction effects between physiological state, season, housing condition and watering regimen and their combinations were not significant (P>0.00).

Table 4-2. The ambient temperature (Ta) and relative humidity (RH) during time of the day (average values of total period)

Time of the day	Air Temperature (ºC)	Relative Humidity (RH %)
08: 00	21.3	43.7
10: 00	23.5	31.4
12:00	30.0	27.1
14:00	31.9	23.7
16:00	33.0	27.6
18:00	33.7	33.6

Source: El-Obeid Agriculture Research Station (2012)

Figure 4-1. Average diurnal ambient temperature and relative humidity at different times of the day.

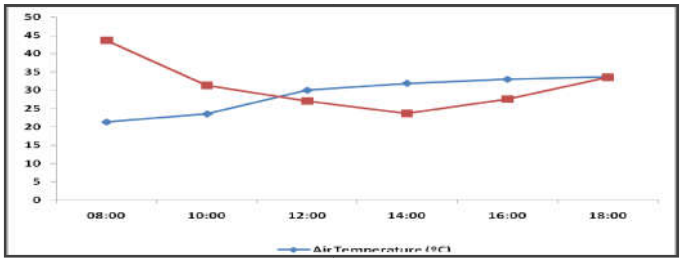

Table 4-3. The ambient temperature (Ta) and relative humidity (RH) at El-Obeid during the experimental period

Season	Month	AT (°C) Min	AT (°C) Max	RH (%)
Summer	May	20.8	38.9	39.1
	June	19.1	35.3	68.2
	July	19.4	34.5	71.3

Rainy	August	19.3	36.3	26.7
	September	20.6	38.3	36.4
	October	13.6	38.2	24.7
Winter	December	09.6	34.7	26.4
	January	09.2	33.4	21.3
	February	12.3	40.4	12.5

Source: El-Obeid Agriculture Research Station (2012) July is a summer month.

Table 4-4. Main effects of time of the day (T), Housing Condition (HC) and watering regime (WR) on respiration rate (RR) and rectal temperature (RT) of Desert goat

Factor	Respiration Rate (R R) (Breaths/Minute)	Rectal Temperature(RT) (°C)
Time of the Day (T):		
08: 00	32.5[a]	38.8[a]
10: 00	30.8[ab]	39.5[b]
12: 00	28.8[b]	39.0[c]
14: 00	35.8[c]	39.3[d]
16: 00	35.4[c]	39.4[b]
18: 00	37.8[c]	39.5[b]
SE±	1.39***	.051***
Season (S):		
Summer	27.0[a]	39.1[a]
Rainy	36.3[b]	39.4[b]
Winter	34.5[c]	39.0[a]
SE±	0.575***	0 .045***
Housing Condition (HC)		
Shade	32.8	39.2
Sunlight	34.1	39.3
SE±	0. 57 NS	0.31 NS
Watering Regime (WR):		
Daily	32.7	39.2
Every other day	34.3	39.3
SE±	0 .574 NS	0.32NS
Interaction effects of T, HC and WR: HC×WR		
	33.5	39.2
SE±	0.81*	0.045NS
HC × T	35.8	39.4
SE±	1.30 NS	0.073 NS
T × WR	30.7	39.4
SE±	1.31 NS	0.69NS
HC × WR × T	29.8	39.0
SE±	1.86 NS	0.087 NS

Table 4-5.Main effects of Housing Condition (HC), watering regime (WR) and Months (M) on respiration rate (RR) and rectal temperature (RT) of Desert goat

Factor	Respiration Rate Breath/minute	Rectal Température °C
Month		
May	25.321	39.461
June	30.214	39.561
Jul	25.536	39.521
Aug	35.821	39.586
Sep	35.429	38.511
Oct	37.786	39.477
Dec	39.643	38.507
Jan	31.335	
Feb	32.429	38.512
SE±	0.893***	0.239***
Housing Conditions:		
Shade	31.943	39.076
Sunlight	33.282	39.234
SE±	0.417*	0.053**
Watering Regime:		
Daily	32.080	39.024
After day	33.146	39.290
SE±	0.417*	0.053***
Interaction: SE±		
HC × WR	0.890*	0.077 NS
HC × M	1.249 NS	0.237 NS
WR × M	1.269 NS	0.239 NS
HC × WR × M	33.714 NS	0.307 NS

(NS, Not Significant P>0.05, * Significant P<0.05, *** Highly Significant P<0.01)

Table 4-6. Main effects of physiological state (PS) and interaction effects with season (S), housing condition (HC) and watering regime (WR) on Desert goats respiration rate (RR) and rectal temperature (RT)

Factor	respiration rate (RR)	rectal temperature (RT)
Physiological State (PS):		
Pregnant	32.238	39.060
Dry	32.896	39.168
SE±	.688 NS	.077 NS
Interactions: SE±		
PS × HC	34.328	38.827
SE±	.8100NS	.109 NS
PS x S	27.370	39.115
SE±	.9757 NS	.109NS
PS x WR	32.192	39.180
SE±	.9502 NS	.106 NS
PS x S× WR x HC	34.212	39.042
SE±	1.358NS	18.63 NS

NS Not Significant P>0.05

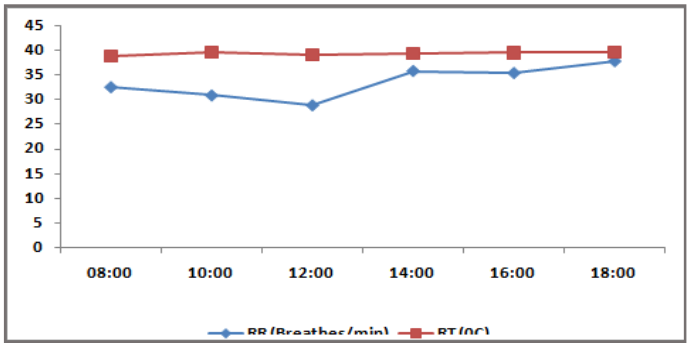

Figure 4-3. Average goat respiration rate (Breathes/minute) and rectal temperature (°C) during different times of the day.

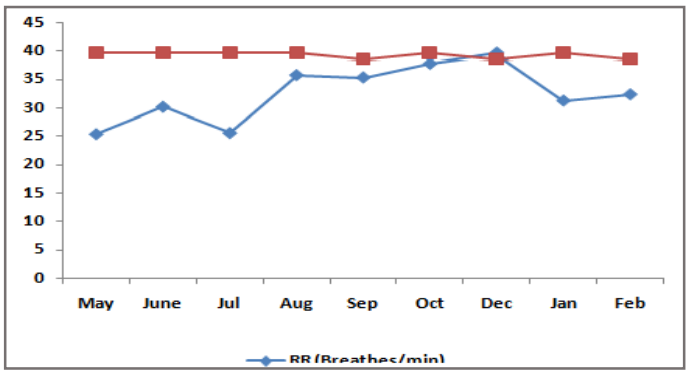

Figure 4-6. Average goat respiration rate (breathes/minute) and rectal temperature (oC) throughout the experimental period.

DISCUSSION

Time of the day had significant main effects on both RR and RT. The lowest average goat RR was at 10:00 am while the highest RR was at 18:00 pm. Differences in RR at 14:00 pm up to the evening (18:00 pm) were not significant. RR showed a rise from the morning (6:00 am) up to 10:00 am then slowed down up to noon time (12:00 pm) and rose again up to the evening. This was in line with Shalaby (1985) and Maria *et al.* (1997c and 2000), in their study on Egyptian Rahmani, Ossimi and Ossimi × Suffolk crossbred ewes, who found that respiration rate was markedly lower at 8:00 than at 12:00 and 16:00. However, these workers reported that rectal temperature was found to markedly lower levels at 8:0 than at 12:00 and 16:00, differing from the results of this study where rectal temperature was highest at the evenings (18:00 pm) and lowest at the afternoon (12:00 pm), with minimal diurnal variations (Shalaby, 1985; Yousef, 1985) that were within a very narrow range of 38.8-39.5^{o}C. Seasonal main effects on goat RR and RT were highly significant. It is worth noting here that RR stated low during May and rose in July and August through December and then started to decline in January February whereas RT was almost constant with very slight fluctuations throughout the ten months of the experimental period. These results were in agreement with Marai *et al.* (1997c), El- Darawany, (1999b) and Abdel-Hafez (2002) who observed significant variation in rectal temperature throughout the year. Nonetheless, their reported values showed markedly lower RT during winter than during summer in rams unlike goats in this study where RT was highest during winter season. Unlike RT, RR was highest during winter season and lowest during rainy season with summer recording intermediate values, which was in close accord with the findings of Fahmy (1994) and Marai *et al.* (1997c) who reported higher RR during summer in sheep. Respiration rate was not affected by housing condition or watering regime. On the contrary, Ahmed and El Kheir (2004) reported that goats restricted to 40% of their daily *ad libitum* water intake showed increased respiration rates and Aganga *et al.* (1990) found that respiration rates decreased with increased water deprivation and that RT was not affected either by housing condition or watering but time of the day had significantly ($P<0.05$) higher effect on both RR and TR Mengistu (2007) found that Ethiopian Somali goats' rectal temperature increased over the course of the day and that significant variations were observed in RR and RT when goats were watered once every fourth day. Dry goats had comparatively higher RR and RT compared with pregnant ones.

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