ORIGINAL RESEARCH PAPER
Volume - 11 | Issue - 10 | October - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFECT OF THERMAL STRESS ON THERMOREGULATORY AND ALLOMETRIC MEASUREMENTS OF ROHILKHANDI BUCKS (CAPRA HIRCUS)

Veterinary Science

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ABSTRACT

The present study was designed to determine the effect of heat stress on thermoregulatory and allometric parameters of native goats so as to add knowledge about how and upto what extent thermal stress affects the male goat reproduction and other physiological parameters, regarding changing environment, conducted in the Psychometric chamber. In Control group (n=8): bucks were kept at comfortable temperature (20-28oC) in animal shed confinement and in Treatment group (n=8): 6 hours heat stress per day (10.00hrs to 16.00 hrs) provided with exposure to 42oC temperature in Pshycrometric chamber. Allometric measurements were recorded at fortnightly interval. Body weight and Body Condition Scoring of the animals were recorded. Physiological observations were recorded from all experimental groups twice a day (9:00AM and 2:00PM) at seven days interval up to 70 days, The results indicated that the after exposure RT in treated group (42oC), was found significantly higher (P<0.05) than RT of the control group. The PR increased much at 42oC. The BW at 42oC thermal exposure was significantly (p<0.05) lower than of the control group. The Heart girth of 42oC exposed group was significantly (p<0.05) less than the control group. The BCS of 42oC exposed group was significantly (p<0.05) lower than the control group. It was concluded that high thermal load significantly affect the thermoregulatory physiological parameters and the body measurement.

KEYWORDS

Goats, Heat Stress, Psychometric Chamber, Allometric and Thermoregulatory Parameters.

INTRODUCTION

Heat is a major constraint on animal productivity in the tropical belt and arid areas (Silanikove, 1992). Among different domesticated species, sheep and goats are considered less sensitive to heat stress than cattle (Silanikove, 2000 and Khalifa et al., 2005). The observed global warming during the past 50 years also alarmed for the time to come AS global mean surface temperatures is expected to increase by 1.1–6.4 °C in next century (IPCC, 2007). Among the physical environmental stressors, ambient temperature is ecologically the most important. Heat stress is the most detrimental to commercial livestock and results in the hindrance of feed consumption, decreased milk production and reproductive performance (Farooq et al., 2010). Heat stress has been generally associated with detrimental effects on physiological equilibriums of goats and their various systems (nervous, endocrine and immune) have been implicated with specific responses and reciprocal regulatory influences (Castanheira et al., 2010). Two reasons for the goat's ability to survive in some of the most inhospitable regions of the world are their exceptional tolerance to heat stress (Norman, 1991) and ability to grow on poor quality feed. Therefore goat production is equally suited to marginal farming areas, small farms or large scale production. Goats are considered highly suitable to be raised in hot and arid regions of world where they were first domesticated (Alamer et al., 2006). They are exposed to wide range of stresses under field existence mainly thermal, nutritional and walking, management, disease, predation etc. These lead to decreased growth, reproduction, production and health. It becomes even more important when seen in context of climate change and crunch in feed resource. The immediate responses to heat load are increased respiration rates, decreased feed intake and increased water intake (Bernabucci et al., 2010). These initial responses are considered homeostatic mechanisms and include increased water intake, sweating and respiration rates, reduced heart rate and feed intake. Apart from allometric measurements, haematological parameters are also altered. Proper management of an animal's exposure to thermal stress will maximize animal well-being and can have beneficial effects on animal performance. The present study was designed to determine the effect of heat stress on thermoregulatory and allometric parameters of native goats so as to add knowledge about how and upto what extent thermal stress affects the male goat reproduction and other physiological parameters, regarding changing environment.

MATERIALS AND METHODS

The study was conducted for a period of ten weeks using the Psychometric chamber. Eight (08) healthy male goats of uniform age and weight were selected. The bucks were maintained under stall fed condition and were divided into two groups viz; Control group (n=8): where bucks were kept at comfortable temperature (20-28°C) in animal shed confinement. Treatment group (n=8): 6 hours heat stress per day (10.00hrs to 16.00 hrs) by providing exposure to 42 °C temperature in Pshycrometric chamber. Severity of heat stress was calculated weekly in terms of THI, by formula of Marai et.al. (2001). Mean shed temperature of 24 hours duration, was taken as dry bulb temperature for that week. For treatment exposure temperature taken as dry bulb temperature for calculating THI.

THI = db oC – {(0.31 – 0.31 RH)(db oC – 14.4)}

where db °C is the dry bulb temperature (°C) and RH is the relative humidity (RH%)/100.

Physiological observations were recorded from all experimental groups twice a day (9:00AM and 2:00PM) at seven days interval up to 70 days. The rectal temperature (RT) was recorded by a clinical thermometer. The respiration rate (RR) was recorded by observing the flank movement. The Pulse rate of animal was recorded by palpating the pulsation of femoral artery. The Allometric measurements were recorded at fortnightly interval. Weighing was done in empty stomach during the early morning hours. Heart girth was measured directly behind the front leg as vertically as possible with a tailors tape rule in centimeters. Body Condition Scoring was done as per method of Maurya et.al. (2007)

RESULTS AND DISCUSSION

The physiological responses (RT, PR, RR) of control and treated groups have been presented in table 3.1, indicated that the after exposure RT in treated group was observed significantly higher (P<0.05) than evening RT of the control group. Banerjee and Ashutosh (2011) also reported an increased RT in thermal stressed group of animals. The increase in RT after exposure at 42°C indicated that the animals were not able to maintain their RT at 42°C which showed that the normal physiological methods of thermal regulation failed to maintain RT at thermal exposure of 42°C. Our findings were in agreement of Maurya et al. (2007) , Krode and Ahmed (2004) on sheep and Temizel et al. (2009) on heat stressed goats. Coelho et al. (2006) noticed non significant increase in RT, due the fact that exposure temperature was only 34°C.

Respiration rate (RR) has been used to evaluate the comfort level of heat-stressed animal (Gaughan et al., 2000). In present study, RR was

 PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

found higher before thermal stress at 42°C because the mean ambient temperature was higher during this phase of experiment than the control group. Therefore, as acclimatization mechanism, bucks increased their RR in order to loss their excess body heat. In our study, after thermal exposure, RR increased at 42°C as compared to RR of control group, and similar trend was observed when comparisons was made between RR before and after thermal exposure, in treated group. Thermal exposure led to activation of evaporative heat loss mechanisms involving an increase in respiratory rate (Brown-Brandl et al., 2005) which was very much proportional to intensity of thermal exposure.

Change in PR has been used to assess stress in animal (Brown-Brandl et al., 2005). The after exposure PR in treated group (42 °C), was significantly higher ($p<0.05$) than PR of the control group. There was no overall significant difference between before exposure RR of control and PR of treated group. The PR before exposure was non-significantly ($P<0.05$) different between control and treated group. One reaction of animals to stress is an increased secretion of adrenalin and noradrenalin from the adrenal gland, resulting in an accelerated heart rate (Janzekovic et al., 2006).

In our study, after thermal exposure, the PR increased much at 42 °C which may be attributed to increased catecholamine secretions but, not in the same ratio as RR was increased. It may be to reduce metabolic rate so that less heat can be generated. The before exposure PR was more than control due to existing thermal load in treated group. Also the PR after exposure in treated group was almost consistent during full course of thermal treatment. Jawahar (2008) on buffalo, Maurya et al. (2007) and Ahmed (2004) on sheep and Temizel et al. (2009) on heat stressed goats, found similar observations.

The observations on allometric parameters have been presented in table 3.2. The BW at 42°C thermal exposure was significantly ($p<0.05$) reduced than of the control group. The HG of 42°C exposed group was significantly ($p<0.05$) less than the control group. The BCS of 42°C exposed group was significantly ($p<0.05$) lower than the control group. Heat treatment significantly reduced all growth parameters, body weight and BCS (Pragna, et al., 2018). Allometric measurements of the animals decreased in heat stressed group which might be attributed to decrease in feed matter intake. However, the decrease in these allometric measurements might be also due to use of muscle protein as source of energy to regulate excessive heat load.

CONCLUSION

High thermal load significantly affect the thermoregulatory physiological parameters and the body measurement. The most heat tolerant species struggles with heat stress could survive yet the productivity is reduced. Despite the great adaptability, the heat tolerability of goat somewhat compromised at 42°C so, Goat production under such condition would require environmental and/or nutritional modification to alleviate the impact of heat stress on goats.

Table 3.1 : Mean±SE Physiological Responses in control and after exposure Heat stress groups of bucks

weeks	Rectal Temperature (°C)		Respiratory Rate (per min.)		Pulse Rate (per min.)	
	Control	Treated	Control	Treated	Control	Treated
1	38.93±0.08 b	39.98±0.17 a	24.75±0.65 b	106.50±10.45 a	86.00±1.13 b	121.12±3.34 a
2	38.93±0.08 b	39.68±0.18 a	24.50±0.82 b	104.50±5.15 a	88.50±3.98 b	119.50±3.80 a
3	38.93±0.08 b	39.61±0.15 a	22.50±0.73 b	101.75±7.56 a	94.00±6.30 b	118.25±7.38 a
4	38.11±0.68 b	39.80±0.16 a	23.75±0.70 b	95.25±11.04 a	87.50±0.98 b	116.50±4.35 a
5	38.69±1.30 b	39.94±0.15 a	24.00±0.38 b	107.50±7.18 a	86.50±1.35 b	117.50±4.08 a
6	38.65±1.30 b	39.84±0.11 a	24.50±0.63 b	97.50±11.68 a	86.25±1.16 b	119.63±5.35 a
7	36.84±0.98 b	39.93±0.11 a	24.00±0.85 b	108.75±7.95 a	91.00±3.12 b	120.38±5.51 a
8	38.89±0.10 b	39.73±0.10 a	24.75±0.53 b	95.25±8.91a	93.42±2.39 b	119.75±4.67 a
9	36.98±1.32	39.48±0.22	24.75±0.65 b	98.75±8.39 a	96.25±4.74 b	116.13±5.04 a
10	38.21±1.10	39.49±0.21	24.25±0.45 b	97.75±15.60 a	93.00±3.78 b	118.00±2.42 a
Overall Mean	38.32±0.25 b	39.75±0.06 a	24.18±0.22 b	101.35±1.63 a	90.24±1.19 b	118.68±0.53 a

Means bearing different superscripts in a row differs significantly

Tale 3.2.: Mean±SE allometric parameters in control and heat stressed groups of bucks

Fortnights	Body Weight (kg)		Heart Girth (cm)		BCS (1-5)	
	Control	Treated	Control	Treated	Control	Treated
1	22.73+0.41	23.72+0.55	65.84+1.36	65.50+1.51	3.28+0.07	3.21+0.05
2	23.20+0.43	22.56+0.49	66.39+1.44	64.48+1.28	3.35+0.07 a	3.16+0.05 b
3	23.49+0.47 a	21.86+0.41 b	66.69+1.39	63.65+1.26	3.36+0.05 a	3.10+0.05 b
4	23.93+0.57 a	20.96+0.22 b	67.10+1.36 a	62.99+1.18 b	3.39+0.04 a	3.03+0.05 b
5	23.81+0.58 a	20.84+0.18 b	66.78+1.42 a	62.75+1.14 b	3.41+0.03 a	2.96+0.06 b
Overall Mean	23.43+0.22 a	21.99+0.24 b	66.56+0.60 a	63.87+0.57 b	3.36+0.02 a	3.09+0.03 b

Means bearing different superscripts in a row differs significantly

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