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Associated expressions of heat shock protein (70 and 60) with physiological adaptation with in dairy goats

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Abstract

This study aimed to investigate the HSPs (60 and 70) expressions and physiological parameters of heat-stressed. This study involved 65 Saanen and 73 Alpine crossbreds reared at the Dairy Goat Research Farm of Çukurova University, Adana (Turkey). Physiological parameters (rectal temperature, respiration and pulse rate) and climatic data (air temperature, relative humidity) were recorded. In addition, blood samples were collected from jugular vein to get the plasma samples which were used to assay the concentration of HSP 60 and 70. The environmental conditions reflected through a high THI (THI= 82.6) showed that the goats were subjected to thermal stress. On the other hand, the average HSP 60 significantly lower in winter (4.4 ± 0.5 ng/ml) followed by spring (7.6 ± 0.6 ng/ml) and summer (9.05 ± 0.82 ng/ml). Whilst, the HSP 70 was 22.6 ± 0.6 , 14.4 ± 0.5 and 13.3 ± 0.4 ng/ml in summer, spring and winter respectively. We can concluded that under harsh conditions the dairy goats synthesised more heat shock protein which can be used as thermoregulatory indicator.

Keywords: Dairy goat, heat shock protein, Goats, Adaptation

1. Introduction

The adaptation mechanism of goats to the thermal stress include behavioural, physiological, biochemical, hormonal, cellular and morphological responses. The exposure of cells to thermal stimuli lead to the activation and formation of heat shock proteins (HSPs) by genes. HSPs are molecular chaperons that maintain native conformation of proteins and cell viability during stress period (Kishore *et al.*, 2016) [8]. They protect cells, tissues, and organs from stress by helping protein folding (assembly and refolding) in endoplasmic reticulum (Gade *et al.*, 2010; Jee, 2016) [6, 7]. HSPs' expression acts as a potential indicator of animal thermo-tolerance ability (Kishore *et al.*, 2016) [8]. This study was undertaken to investigate the HSPs (60 and 70) expressions and physiological parameters of heat-stressed goats.

2. Materials and Methods

This study was carried out at the Dairy Goat Research Farm of Çukurova University located in the province of Adana which is characterized by mild and wet winters and hot and dry summers. This study involved 160 goats of 18 months old: Saanen (n= 65), Alpine (n= 73) housed in semi-opened pens and fed on forage (oats and alfalfa hay), corn silage and 500g concentrate feed (18% crude protein and 2500 kcal ME/kg DM). The experiments were carried out in winter (January) and summer (July). Serum samples were obtained from 5-8 ml of blood were collected from jugular vein into heparinized vacutainers tubes. Blood samples were centrifuged for 15 minutes at 1500 rpm and 210ul of serum were taken into labelled microtubes and stored at -20°C . Serum HSP70 and HSP60 levels were assayed using ELISA test kit (Sun Red Biotechnology Co., Shanghai, China).

Physiological data including rectal temperature (RT), respiration rate (RR) and pulse rate (PR) were recorded in the morning at (07:00-08:00) and afternoon (13:00-14:00). During the trials, the daily environmental data i.e. ambient temperature and relative humidity were recorded. The temperature humidity index (THI) according to the following formula:
 $\text{THI} = \text{db} - (0.55 - 0.55 \text{ RH}) (\text{db} - 58)$; db: the dry bulb temperature (Abdel-Samee, 1996) [1].
HSPs levels and physiological data were statistically analysed following the GLM procedures in the Statistical Analysis System (SAS V. 2004). Differences were tested with Duncan's

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Multiple Range Test at a level of 5% or 1%.

3. Results and Discussion

During trials, the average THI were 55.09 and 80.81 in winter and summer respectively. The results indicated that experimental does were subjected to severe thermal stress in summer. Heat stress results into thermoregulatory misbalance which is manifested by the alterations of physiological parameters. In winter and summer, the RT in all breeds groups were significantly ($P < 0.05$) lower in morning ($35.1 \pm 0.25^\circ\text{C}$ vs. $36.2 \pm 0.13^\circ\text{C}$) when compared to the recorded value in afternoon ($37.6 \pm 0.12^\circ\text{C}$ vs. $40.7 \pm 0.3^\circ\text{C}$). In the current study, the PR ranged between 104.9 ± 2.27 and 111.9 ± 2.07 bpm, while RR varied between 67.1 ± 2.5 and 100.7 ± 3.17 breaths/minutes. Similar results were reported through literature (Darcan *et al.*, 2007; Darcan and Güney, 2008; Patbandha *et al.*, 2018; Agossou *et al.*, 2019) [5, 4, 9, 2]. The increase of ambient temperature during the day causes environmental stress and an increase of RT. In addition, the results indicated that goats had significantly ($P < 0.05$) lower RR and PR in the morning. Animal exposed to thermal stress increase their respiratory magnitude and heart rate to loss of heat by evaporation. This thermoregulatory mechanism helps to maintain homeothermy and avoid increased rectal temperature.

The serum concentration of HSP60 (11.1 ± 0.85 vs. 6.7 ± 0.62 ng/ml) and HSP70 (21.6 ± 0.76 vs. 20.9 ± 0.53) were significantly higher ($P < 0.05$) in all breed groups during summer season when compared to winter. In addition, a positive and significant correlation were observed between THI, RT, PR, RR and HSP concentration. The current findings were in accordance with previous investigations (Kishore *et al.*, 2016; Archana *et al.*, 2017) [8, 3]. High levels of HSP 60 and 70 was reported as indicator of thermo-tolerance in animals subjected to thermal stress and water deprivation.

4. Conclusion

In heat stressed dairy goats, the changes of environmental conditions associated with high ambient temperature lead to thermal stress. This negatively alters physiological state of goats causing an increase of RR, RT and PR and plasma level of HSPs. This thermoregulatory mechanism set by animal under hot environment contributes to maintain homeothermy.

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