THE EFFECTS OF TRANSPORTATION ON ANTIOXIDATIVE BIOMARKERS, RECTAL AND SKIN TEMPERATURES IN AARDI GOATS

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ABSTRACT

The effects of transportation on oxidative stress biomarkers, rectal (R<sub>T</sub>) and skin temperature (S<sub>T</sub>) in male Aardi goats (Capra aegagrus hircus) were investigated. Fifteen animals of 9-12 months age, and 33.6-42.9 kg body weight were used in this study. Goats were transported for 240 km for 3 hrs, and 480 km for 6 hours. Blood samples were collected at 0 (pre-transportation); and at 30, 60, 120, and 240 minutes, and 24 hrs post-transportation. Both distances resulted in a significant (P < 0.05) increase in plasma malondialdehyde (MDA) levels and significant (P < 0.05) decrease in superoxide dismutase (SOD) and total antioxidant contents (TAC) levels post-transportation. Plasma zinc and copper levels showed non-significant differences post-transportation, irrespective of the distance. Both rectal temperature (R<sub>T</sub>) and skin temperature (S<sub>T</sub>) increased after transportation, but R<sub>T</sub> was significant (P < 0.05) at 240 km, while S<sub>T</sub> was significant (P < 0.05) at 480 km. In conclusion, transportation decreased the antioxidant status in Aardi goat, and supplemental antioxidant prior transportation may negate these effects.

Key words: Aardi goat, Antioxidant, Rectal temperature, Skin, Transportation.

INTRODUCTION

Transportation is an acute stress leading to negative and economic impact on performance, production, health, welfare in livestock (Hartung, 2003). However, it is an essential component of sheep production. It results in increased body temperature (Celi et al., 2010), and rectal temperature (Adenkola et al., 2009), over-production of reactive oxygen metabolites in calve (Wernicki et al., 2006), and increased plasma lipid peroxides (Wernicki et al., 2006). Oxidative stress in farm animal resulted in an imbalance between oxidant and antioxidant (Lykkesfeldt and Svendsen, 2007; Piccione et al., 2007). The latter include SOD and catalase (CAT), as well as vitamins (C and E), and copper and zinc (Tuncer et al 2010). Recent work indicated that estimation level of antioxidant enzyme is a good and sensitive marker for oxidative stress during transportation (Piccione et al., 2013). Therefore, the objective of this study was to evaluate the effects of transportation on antioxidative biomarker in transportation-stressed Aardi male goats.

MATERIALS AND METHODS

Fifteen male Aardi goats, aged 9-12 months and weighing 33.6-42.9 kg were randomly assigned to three groups of five goats each; group I (control, not transported); group II (transported for 240 km for 3 hrs); and group III (transported for 480 km for 6 hrs). The animals were fed on commercial concentrate (Al-Wafi Peletes, Arasco, Saudi Arabia); water and mineral block ad libitum. Prior to the experiment, animals were acclimatized for three weeks with daily monitoring. Ambient temperature, relative humidity was recorded at an hourly interval using data logger. Blood samples were taken from the jugular vein of each goat at 0.00 h (pre-transportation), and immediately at 0:00, 30, 60, 120, 240 min and 24 hrs post-transportation. Samples were then stored at -80°C until analysis for plasma content of MDA, SOD and TAC using Cayman kits, USA. Plasma Cu and Zn were determined using Randox kits, UK. Before and after transportation was recorded rectal and skin temperature during pre and post transportation from the control group at 9:00, 15:00 and 9:00 from next

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day, from group II and III in at 0.00 h (pre-transportation), and immediately at 0:00, 30, 60, 120, and 240 min, and 24 hrs post-transportation. Individual rectal temperature was recorded, and the skin temperature were measured by infrared thermometer in four cleaned and shaved areas of skin in right and left shoulders, right and left hips. A General Linear Model (GLM) was used for statistical analysis of data. A completely randomized design with 2 treatments and 5 replicates was applied for analysis. Statistical means were compared using least square means.

RESULTS AND DISCUSSION
Mean of the ambient temperature (A<sub>r</sub>) ranged from 8°C to 23.24°C, and the relative humidity (RH) was 12.30 to 40.20, while, the temperature-humidity index (THI) was 9 to 20.84.

Significant effects of transportation on plasma MDA levels were observed in both distances (Fig. 1). At 0 h after transportation, maximal MDA were reached in both distances, and its measurement determines the degree of damage due to oxidative stress. The results of plasma MDA was similar with results obtained in horses (Onmaz et al., 2011); in beef cattle (Sahin et al., 2009; Chirase et al., 2004); calve (Wernicki et al., 2006), in dromedary camels (Nazifi et al., 2009).

Both transportation distances decreased plasma SOD levels (p < 0.02). However, distance has a non significant effect on SOD (Fig. 2). This is due to the increase consumption of SOD to overcome the effects of transportation. A significant reduction in the plasma SOD activity compared to baseline values was reported in horses transported for 12 hrs (Omnaz et al., 2011), beef cattle (Celi et al., 2010), in goat (Kannan et al., 2007).

During pre and post transportation intervals, baseline TAC values varied at 0 h after transportation compared with transportation; the period and have significant (p < 0.05) effects (Fig. 3). The reduction in TAC may be due to transportation stress due to the consumption of antioxidants during stress. Similar results on TAS were reported in beef cattle (Chirase et al., 2004, Pregel et al., 2005).

The road transportation resulted in a statistically significant (P < 0.05) increases in RT and ST immediately after the transportation, indicating sampling time has significant (p < 0.05) effects on RT, while sampling time and distance x time, had no significant effect. The overall mean and maximum RT values obtained in experimental and control goat before the transportation fell within normal range of 38.5°C to 38.8°C in the early morning, and 39.2°C to 39.5°C in the late afternoon (Alamer, 2006). RT showed diurnal fluctuations in goats (Minka et al., 2009, and in birds (Minka and Ayo, 2007).

Skin temperature recorded a significant decrease at 06:00 during the last 8-10 days of the

![FIG. 1: Plasma concentration of MDA (µM) in transported-Aardi goat.](image-url)
Rectal temperature increased over time ($P<0.001$) but was not affected by temperament ($P=0.57$). (Fig. 4).

Change in rectal temperature may be partially attributable not only to the stress of transportation only, but also to the change in ambient temperature as the two were highly correlated ($r = 0.73$ and 0.72 for calm and temperamental bulls, respectively) (Burdick et al., 2011). In a similar study in goats, rectal temperature increased above normal
reference values post-transporation (Minka and Ayogu, 2011). The current study clearly indicated that transportation time plays a crucial role in RT values of transported Aardi goats; with trip should not be more than 6 hrs.

Table 1 shows the effect of transportation on plasma Zn and Cu concentrations of Aardi goats. Road transportation, irrespective of distance covered resulted in changes Zn concentration after the transportation. Sampling time and distance have a highly significant (P < 0.0001, 0.0005) effects on Zn concentration (Table 1). The decrease in copper status may be related to the increase in utilization of SOD; an antioxidant dependent on copper. As for copper, statistically, sampling time and distance x time showed significant (P < 0.05), with no effects due to distance. Similar trend of reduction of copper and zinc was reported in transported beef (Sahin et al., 2009; Ward and Spears, 1999). The changes manifested in the physiological variables could be due to direct effect of ambient temperature, and not only by the transportation.

Cortisol is one of the main biomarkers of stress including transportation; though not indicated in this work, and its increase has been associated with decrease in total antioxidant levels and low TAC as obtained in the current experiment.

In conclusion, the transportation of Aardi goats in open vehicles may compound the stress of transportation; therefore it could be difficult to isolate the effects of transportation stress from that of climatic changes.

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![Fig. 4: Rectal and skin temperature (°C) during short 240 Km (a) and long distance (b) in male Aardi goat.](image)

### Table 1: Mean and Standard Error of Plasma concentration of Zn and Cu in transportation-Aardi goat.

<table>
<thead>
<tr>
<th>Sampling of time</th>
<th>Zn (µmol/l)</th>
<th>Cu (µmol/l)</th>
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<tbody>
<tr>
<td></td>
<td>ST</td>
<td>LT</td>
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<tr>
<td>Pre-transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29.658 ± 1.442&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>26.993 ± 3.175&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>After-transportation</td>
<td>34.571 ± 2.041&lt;sup&gt;b&lt;/sup&gt;</td>
<td>29.351 ± 0.209&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>0 H</td>
<td>40.486 ± 6.932&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.205 ± 0.625&lt;sup&gt;abc&lt;/sup&gt;</td>
</tr>
<tr>
<td>1 H</td>
<td>26.269 ± 2.461&lt;sup&gt;abcd&lt;/sup&gt;</td>
<td>25.552 ± 2.975&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 H</td>
<td>25.469 ± 1.383&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>20.178 ± 1.993&lt;sup&gt;bc&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 H</td>
<td>23.821 ± 1.383&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>19.216 ± 2.112&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>24 H</td>
<td>19.537 ± 0.939&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.238 ± 0.638&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Means with the same latter are not significantly different at P< 0.05; ST = short; LT= Long transportation.
REFERENCES


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