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Plasma and salivary cortisol levels in transportation-stressed Aardi goats

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1 SUMMARY

The objective of this study was to assess salivary and plasma cortisol levels and their correlation in Aardi goats subjected to transportation. Twenty-seven (27) healthy male goats were used in this experiment. The goats were transported for 240 km for 3 hrs, and 480 km for 6 hours, Blood and saliva samples were collected at 0.00 h (pre-transportation); at 30, 60, 120, 240 min and 24 hrs post transportation. Both distances resulted in statistically significantly ($P < 0.0001$) increase in cortisol plasma and salivary levels after the transportation. The correlation coefficient between saliva and plasma cortisol was 0.895. The current findings indicated that transportation is a stress challenge in Aardi goat, and salivary levels of cortisol reflect its concentration in plasma samples of Aardi goat.

2 INTRODUCTION

Aardi goat is one of the indigenous Saudi goats, well-adapted to desert condition (El-Nouty *et al.*, 1990; Alamer, 2006; and they utilize water more efficiently at higher ambient temperature than Awassi sheep (Alamer, 2009, 2011). Studies on animal welfare have received little attention in Saudi Arabia as compared to western countries. These include the isolation stress affected blood profile in Najdi goats (Al-Qarawi and Ali, 2005), and elevated plasma concentration of cortisol in Najdi sheep (Al-Qarawi, 2005). Cortisol is a glucocorticoid produced by the adrenal cortex as a result of the activation of the hypothalamic-pituitary adrenal axis (HPA) during a stressful situation, and is used as an indicator of animal welfare, since its level increases during times of distress. For example, short-term transportation caused a significant increase in blood cortisol (Odore *et al.*, 2011). Cortisol concentrations increased from a Normal plasma cortisol values in goat is 18 ng/mL (Kannan *et al.*, 2000). Cortisol levels in saliva correspond to the free fraction of cortisol in plasma (Lac, 1998), and it is a better indicator of the possible effects of the corticotropic axis on the animal organism than plasma cortisol. Cortisol can be found not only in the blood serum but also in other body fluids including body excrements (Mostl and Palme, 2002). However, the focus here will be on the invasive (plasma) and the non-invasive sampling protocols. It is of no doubt that, animal welfare is of increasing importance as it is related to productivity; and transportation affects the production and reproduction of animals. For example, the stress of handling and transportation in developed countries are well investigated (Hartung, 2006). However, in Saudi Arabia, studies related to transportation are lacking. Therefore, this study was designed to assess the effects of transportation on plasma and salivary cortisol levels in Aardi goats; and their correlation coefficient.

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Photo: Male Aardi goat

3 MATERIALS AND METHODS

Twenty-seven healthy male Aardi goats were used in this experiment. They were fed on quality-dried hay, Lucerne and water *ad libitum*. Concentrate (Wheat) and mineral block were also available. Prior to the experiment, animals were kept for an adaptation period of 2 weeks. They were assigned to three groups of 9 goats each (group I, control, non-transported); group II, transported for 240 km for 3 hrs, and group III, which is transported for 480 km for 6 hours. Blood and saliva samples were collected at 0.00 h (pre-transportation); 30, 60, 120, 240 min and 24 hrs post transportation. Salivary and plasma cortisol levels were estimated by ELISA (Lewis and Elder, 1985). Data were analyzed using General Linear Models (GLM) procedure for analysis of variance (ANOVA) by the Statistical Analysis System (SAS; 1995). A completely randomized design was used in this study. Factors included were (sampling time, distance), animal, and their interactions. Statistical means were compared using least square means. Spearman Correlations between saliva and plasma cortisol were obtained.

4 RESULTS AND DISCUSSION

The present study was conducted to investigate the effects of transportation on plasma and salivary cortisol, and their correlation. Figure 1 shows the effect of transportation on the concentrations of cortisol in plasma of Aardi goats.

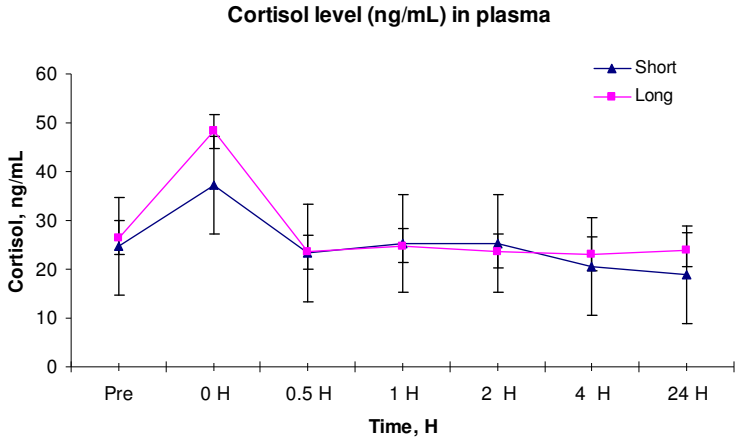

Figure 1: Plasma cortisol levels in transportation-stressed Aardi goats

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In the present study, road transportation for short (3 hrs) and long (6hrs) distance resulted in variable and statistically significantly ($P < 0.0001$) increases in cortisol concentration after the transportation. Similar results were obtained in goat (Ali *et al*., 2005; Kadim *et al*., 2010); camel (Saeb *et al*., 2010); sheep (Al-Muffarej *et al*., 2008). Figure 2 shows the effect of transportation stress on cortisol level in saliva of Aardi goat. For 240 and 480 km transportation, baseline salivary values varied between 22.00-28.3 nm/ml, respectively; with sampling time showed significant effects ($P < 0.04$). This study demonstrated the significance of salivary cortisol as a non-invasive stress measure in Aardi goat. Similar trend of increase were reported in goats (Greenwood and Shutt, 1992).

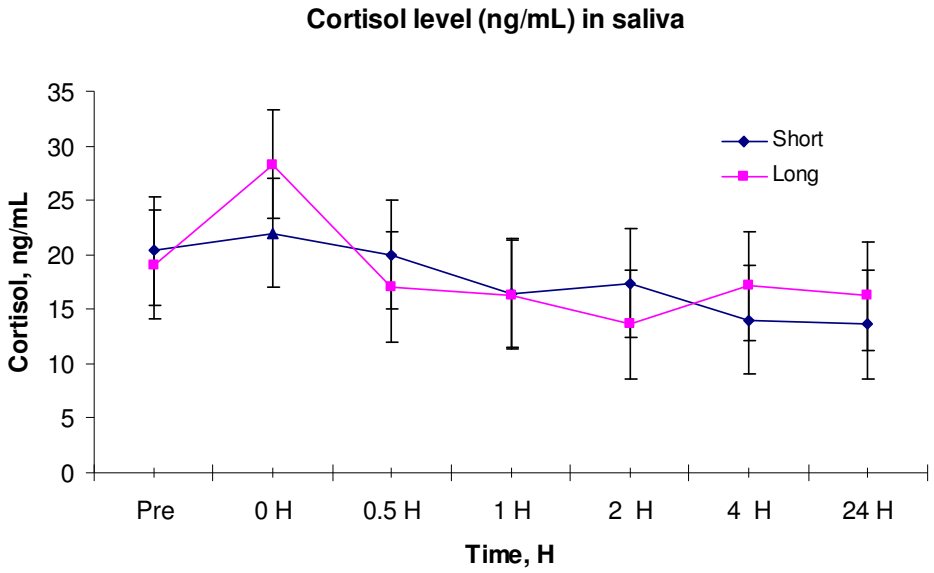

Figure 2: Cortisol salivary levels in transported-stressed Aardi goats

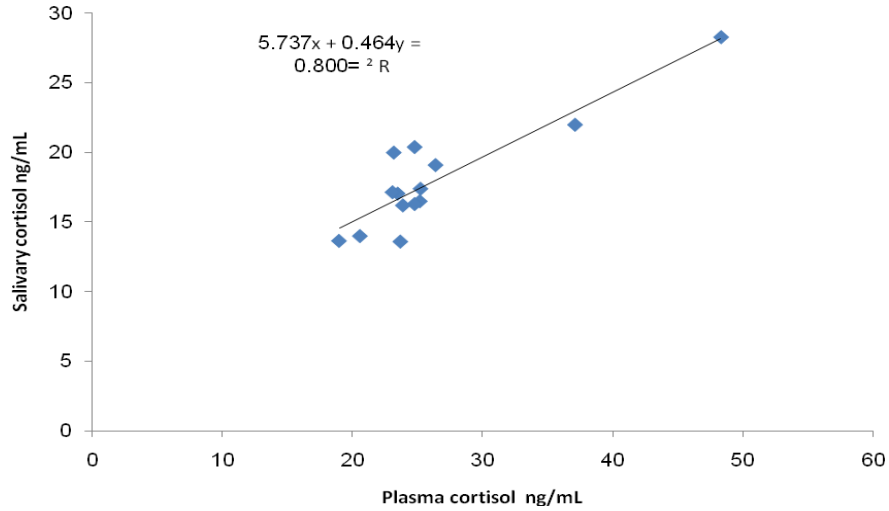

Figure 3: Correlation between Salivary and plasma cortisol levels

Figure 3 shows the correlation between salivary and plasma cortisol and the current study showed a highly significant correlation of 0.895. Similar results were obtained in goats (0.97) (Greenwood and Shutt, 1992); in ewes (0.88), (Yates *et al*, 2010); and in horses 0.80 (Peeters *et al*., 2011). The present work confirmed that transportation, irrespective of distance significantly caused stress to Aardi goat. It should be mentioned that, measuring a corticosteroid hormone in saliva or plasma, their daily rhythms should be taken into account.

Loading and unloading are usually the most stressful parts of animals transport (Nwe *et al*., 1996). In the current study, the methods of loading and unloading might be one of the reasons of high cortisol levels determined in the current study. Therefore, the presence of well-designed loading and unloading of goats are pre-requisite for minimizing the stress and improving animal welfare. In addition, during blood collection, Aardi goats were subjected to additional stress from both restraint and sampling. This stress occurred even during saliva sample collection, though it is a non-invasive protocol. Another factor affecting cortisol status is the sampling time and is attributed to the presence of a circadian rhythm in farm animals (Nwe *et al*., 1996). The first period of transportation is the most critical one, and thus controlling the reaction of Aardi goats at the start of transportation may reduce their response to the acute stress of transportation. In conclusion, transportation of Aardi goat is a stress challenge, and the present data on Aardi goats may contribute to an improvement in the productivity of this valuable animal to the kingdom. A further study using a larger sample is recommended.

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