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Short Communication

The Effect of Selenium and Vitamin E on Growth and Energy Linked Biochemical Profile of Damani Goat under Heat Stress

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ABSTRACT

Nurturing goat is a traditional profession of marginal farmers and landless workers in different regions of under-developed countries. The present study was conducted to determine the effect of vitamin E and selenium (Se) on physiological and hormonal status of Damani goat in Dera Ismail Khan, under high ambient temperature. Forty Damani healthy, non-pregnant goats having similar initial body weight were selected. The diets of goats in the treated groups were supplemented with Se (0.3 mg/Kg) and vitamin E (50 mg/Kg) for 4 weeks. Twenty non-Damani local goats were as control and were not supplemented with Se and vitamin E in diet. It was observed that the mean values of TSH, T3 and T4 were significantly higher in control than experimental Damani breed. Similarly, the mean values of cortisol were comparatively higher in control breed than Damani experimental group, showing that Damani breed was more prone to heat stress conditions than control group and that oxidative stress, induced by heat stress, may have a negative effect on the availability of Se, which accordingly resulted in reduced synthesis of thyroid hormones. Beside that the concentrations of total protein, cholesterol, albumin and glucose were found significantly higher in Damani breed than control group, indicating that Damani breed had comparatively better adaptive capabilities in preparing the internal physiology and metabolic processes in response to heat-stress environmental conditions. Hence, vitamin E, in combination with Se improved the physiological and biochemical profile of blood in Damani goat.

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Key words
Damani goat, Vitamin E, Selenium, Heat stress, Livestock

Goat has a significant role all over the world in increasing the economy of thousands of poor people, who earn their money by nurturing them in different environmental conditions (Larson and Bradley, 2014). In Pakistan, livestock sector has a unique position in relation to the socio-economic growth and has a significant role in the rural economy. It is estimated that about 30-35 million rural population is engaged in livestock raising (Larson and Bradley, 2014). Many people living in urban and rural areas keep goats and sheep to get milk and yogurt for domestic use in Pakistani community (Sarwar *et al*., 2013; Ali and Khan, 2013). Goats have the ability to survive in stressful foraging conditions that distinguish them from other livestock species (Chung *et al*., 2007; Srikandakumar *et al*., 2003; Bagha *et al*., 2009). In tropical, subtropical and dry areas, high temperature is considered as a high-risk factor in animal production. Hot environmental conditions challenge the animal's capability to maintain its energy, mineral water and hormonal balance (Bernabucci *et al*., 2010). These stressful environments have been reported to decrease the testosterone level and sperm production, abolish motility of sperm, decrease fertility rate, impair follicular and oocyte growth and decrease steroid production (Saini *et al*., 2007; Majid *et al*., 2015; Yue *et al*., 2010; Rasooli *et al*., 2004). Here, we report the mitigating role of vitamin E, in combination with selenium (Se), on the hormonal and biochemical components of blood serum of Damani goat under severe heat stress conditions of D.I. Khan.

Materials and methods

A total of 20 healthy adult goats (10, each of Damani and non-Damani, as experimental and control groups

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respectively) were randomly selected from livestock department of D.I. Khan where they were properly managed and vaccinated. Experimental group was provided with 50mg vitamin E and 0.3mg Se/kg diet during the hot months of May, June and July.

A blood sample of 5 ml from jugular vein in 15 falcon tube was collected in duplicate from each goat on the 14th and 28th day of each month after administration of combination of vitamin E and Se. Serum was separated by centrifugation at 3000rpm for 10-15 min and used for estimation of total protein, glucose, albumin, T3, T4, TSH and cortisol with the help of commercially available kits (BioCheck, USA).

Mean± S.D. and Euclidean distance statistical tool was used for comparing the difference/distance between experimental and control group for different parameters.

Results and discussion

Table I shows the effect of vitamin E and Se on various energy related (total protein, glucose, cholesterol and albumin) and growth related parameters (T3, T4, TSH, cortisol) in the blood sera of Damani goats during the heat season of May, June and July in D.I. Khan division.

It was found that after 14 days treatment, all the biochemical parameters remained unaffected except for cholesterol which showed 160% increase in experimental group compared to control group, and for T3 and T4 which showed 100% and 41.68% increase in control group compared to experimental group. When this treatment was extended to 28 days, all the biochemical parameters linked with energy increased compared to their respective control; protein, glucose, cholesterol and albumin increased 230.67%, 133.72%, 160%, 320% after Se and vitamin E treatment. The growth related parameters showed significant decrease after treatment for 28 days. T3 decreased 100%, T4 decreased 41.68%, TSH decreased 89.90% and cortisol showed 180% decrease.

Cortisol is the general stress hormone and plays a critical role in many physiological, especially thermal regulation, energy productions, lactogenesis and regulation of milk production (Sejian *et al*., 2012; Ihsanullah *et al*., 2017; Maraii *et al*., 2000). The difference in mean values of cortisol in experimental and control breeds were not significant, and this was in contrary with what has previously been reported (Shakirullah *et al*., 2017). Generally, the release of cortisol is the major indication of the activation of hypothalamic– pituitary–adrenal axis during stressful condition (Rasooli *et al*., 2004; Kachuee *et al*., 2013). During heat stress, the level of production of free radicals is higher and beyond the body scope to neutralize them leading to oxidative damage (El-Shahat *et al*., 2011).

The mean values of metabolic hormones T3, T4 and TSH were significantly higher in control group compared to Damani experimental group. These findings are in disagreement with what was reported earlier (Shakirullah *et al*., 2017) on the same Damani breed, possibly because of difference in the timings of experiment, the age difference of experimental group, or the metabolic hormones had compensating effect in producing other necessary substances against severe heat stress conditions of the months of May to July. This also showed that the oxidative stress, induced by heat stress may have a negative effect on the availability of Se and thus resulted in reduced production of thyroid hormones.

Significant decrease in total protein concentration in goats has been reported during heat stress (Dangi *et al*., 2012). Depending upon heat-induced stress conditions,

Table I. Effect of selenium and vitamin E on total protein, glucose, cholesterol, serum albumin, T3, T4, TSH and cortisol in blood seum of both Damani experimental and non-Damani control group on day 14 and day 28 post supplementation. The diet of only experimental group was supplemented.

Parameter	Control group (n=10)		Experimental group (n=10)	
	Day 14	Day 28	Day 14	Day 28
Total protein	7.70±0.35	6.72±0.55	7.78±0.55	8.53±0.29*
Glucose	24.52±1.41	23.65±0.52	24.57±1.81	27.15±1.21*
Cholesterol	57.16±3.10	55.75±1.33	58.55±0.92*	60.90±0.34*
Albumin	3.21±0.38	2.88±0.13	3.95±0.39	4.10±0.40*
T3	2.19±0.35	2.19 ±0.36	2.04±0.34	1.67±0.13*
T4	75.22±5.69	70.66±3.49	71.58±6.55	63.76±1.09*
TSH	4.01±0.13	3.90±0.65	3.99±0.04*	2.90±0.19*
Cortisol	1.60±0.10	1.84±0.04	1.58±0.08	1.28±0.13*

total plasma protein, albumin and globulin levels have been found to decrease in certain goat varieties (Helal *et al*., 2010). This low level can be due to augmented plasma volume, mainly because of heat stress. In contrast, heat stress led to production of high amounts of total protein and albumin in goats (Okoruwa, 2014) which might most probably be due to dehydration that takes place as a result of increased respiration rate. During this study, interestingly, in contrast to hormonal profile, the mean concentrations of albumin, glucose, total protein content and cholesterol were found significantly higher on both 14th and 28th day post administration of Se and vitamin E in Damani breed than control breed, showing that Damani breed had comparatively better adaptive capabilities in preparing the internal physiology and metabolic processes in response to heat induced stress conditions.

Conclusion

The present findings showed that combination of Se and vitamin E significantly improved the biochemical processes in Damani goat, making the breed more tolerant to heat stress than non-Damani goat.

Statement of conflict of interest

The authors have declared no conflict of interest.

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