RESEARCH ARTICLE

Effect of Roofing Materials on Hemato-Biochemical, Hormonal and Antioxidant Profile of Sheared and Non-Sheared Sheep

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Abstract

The effect of roofing material on hemato-biochemical, hormonal and antioxident parameters of sheared and non-sheared sheep was invastigated. Twenty four adult dry indigenous sheep were distributed randomly on the basis of body weight (20-35 kg) into two roof treatment groups, *i.e.,* T_1: asbestos roof and T_2: agronet roof. Each treatment comprised of six sheared and six non-sheared animals. Hemoglobin (g/dL) and PCV (%) concentrations of sheep were comparable between roof treatments and between shearing practices. Serum glucose level was significantly ($p < 0.05$) higher in sheared and non sheared sheep reared under asbestose roof (44.76 ± 0.31, 45.29 ± 0.31 mg/dl) than the agronet roof shelter (43.78 ± 0.31, 43.46 ± 0.33 mg/dl). Serum uric acid level was significantly ($p < 0.05$) decreased in sheared animals reared under agronet roofed shelter as compared to non-sheared animals reared under abstestos roofed shelter (0.41 ± 0.05 vs. 0.55 ± 0.06 mg/dL). Serum urea and creatinine levels of sheared sheep were lower than non-sheared ones under both the roofing materials with significant difference only in creatinine. The serum levels of hormone T_3 and cortisol were statistically similar between roof treatments and shearing practices, whereas serum T_4 was significantly ($p < 0.05$) higher in sheared animals (37.19 ± 3.17 ng/ml) reared under asbestos roofed shelter compared to agronet. Glutathione peroxidase activity was increased significantly ($p < 0.05$) in sheared and non-sheared animals reared under asbestos roofed shelter, whereas superoxide dismutase activity decreased significantly ($p < 0.05$) in sheared animals under agronet roof (5.73 ± 0.27 U/ml). However, lipid hydroperoxide, catalase and heat shock protein 70 activity were neither influenced significantly by roofing materials nor by shearing practices. The results indicated the role of effective roofing material of shelter and shearing plans in reducing the effect of heat stress on sheared and unsheared sheep.

Keywords: Blood biochemicals, HSP70, Roof type, Serum hormones, Shearing, Sheep.

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Introduction

Stress has cumulative detrimental effect on health and performance of the animals. The animals subjected to various kinds of stressors, *i.e.*, physical, nutritional, chemical, psychological and heat stress. Among all these, heat stress is the most concerning issue now a days. Heat stress is the perceived discomfort and physiological strain associated with an exposure to an extreme and hot environment (Gupta *et al.,* 2013; Khant *et al.,* 2021). Traditionally sheeps are reared under extensive system, whereas in organized farms they are housed in asbestos roofed sheds with open sides during monsoon and summer and covered side during winter. It has been established that the provision of shade within intensive animal production system is advantageous and reduces the animals' exposure to direct solar radiation. The system of housing as well as alteration in management practices should reduce the heat stress leading to comfort of animals. Shearing of sheep is a common management procedure and domestic sheep do not shed the wool naturally. Shearing usually results in an enhancement of energy exchange betweeen the animals and its surroundings (Aleksiev, 2008) and this may affect nutrient intake, productivity and welfare of the sheep (Khant *et al.,* 2021). Shearing is considered to be stressful to sheep, capable of causing some behavioral changes immediately after shering and results in thermal stress. Stressful condition leads to excessive production of free redicals which results in oxidative stress. Determination of catalase and glutathione reductase allows the detection

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of the degree of oxidative stress in ruminants (Hefnawy *et al*., 2018). In view of above fact, the present investigation was planned to assess the effect of different roofing material on blood biochemical, hormonal and antioxodent parameters of sheared and non-sheared sheep during hot dry season.

Materials and Methods

The study was carried out at Livestock Farm Complex, College of Veterinary Science & Animal Husbandry, Anand Agricultural University, Anand for a period of six weeks during May-June, 2019. The institute is located at 22°: 35'N and 72°: 55' E longitude at an elevation of 45 meter above the mean sea level with a semi-arid climate. Maximum temperature in hot dry season was 41.5°C, whereas minimum temperature was 25.5°C. Animal care, handling and sampling procedures were approved by the Institutional Animal Ethics Committee (IAEC) as per the guidelines recommended by the Committee for the Purpose of Control and Supervision of Experiment on Animal, India.

Twenty four adult dry indigenous sheep (20-35 kg body weight) were randomly alloted into two different shelter system, *i.e.,* asbestos roof (T_1) and agro-net (T_2) roof with soil floor. Each treatment comprised of six sheared and six non-sheared animals. Experimental animals were maintained on total mixed ration (TMR). Blood samples were collected at the end of experiment. The whole blood was used to estimate hemoglobin (g/dl) and PCV (%) by using automated blood cell counter (Mindray – BC -2800 VET). Serum glucose (GOD/POD method), urea (GLDH kinetic method), uric acid (uricase) and creatinine (modified Jaffe's kinetic method) concentration were estimated using kit provided by Coral Clinical Systems, India. Serum hormone triiodothyronine (T_3), thyroxine (T_4) and cortisol concentrations were estimated by standard Radio-Immuno-Assay (RIA) technique. RIA kits were procured from Immunotech - SAS © 2016, Beckman Coulter, Inc. Marseille, France. Oxidative stress biomarks, *viz.* catalase (CAT), glutathione peroxidase (GPx), superoxide dismutase (SOD), lipid hydroperoxide (MDA) and heat shock protein (HSP70) activity were determined using commercially available kits supplied by Cayman, USA. The results of the experiment were expressed as means ± SEs and were analyzed by factorial CRD. Differences were declared significant when $p < 0.05$ (Snedecor and Cochran, 1994).

Results and Discussion

The results on the effect of roofing materials on different hemato-biochemcial parameters of sheared and non-sheared sheep have been presented in Table 1. Hemoglobin (g/dL) and PCV (%) concentrations of experimental animals were comparable between roofing treatments and between shearing practices. Serum glucose level was significantly higher in sheared and non sheared sheep reared under asbestos roofed shelter as compared to sheep reared under agronet roofed shelter. Serum uric acid level was significantly ($p < 0.05$) higher in non-sheared animals (0.55 ± 0.06) reared under asbestos roofed shelters. Serum urea and creatinine

Table 1: Mean (± SE) hemato-biochemical variables of sheared and non-sheared sheep under different roof type

	Asbestos (T_1)		*Agro-net (T_2)*	
Variables	*Sheared*	*Non-Sheared*	*Sheared*	*Non-Sheared*
Haemoglobin (g/dL)	9.55 ± 0.59	9.43 ± 0.60	9.72 ± 0.44	10.21 ± 0.53
PCV (%)	34.9 ± 2.16	34.2 ± 2.15	34.91 ± 1.72	36.67 ± 1.59
Glucose	44.76 ± 0.31^{a}	45.29 ± 0.31^{a}	43.78 ± 0.31^{b}	43.46 ± 0.33^{b}
Urea (mg/dL)	37.17 ± 2.50	40.75 ± 3.35	36.45 ± 2.47	38.97 ± 2.77
Uric acid (mg/dL)	0.48 ± 0.03^{ab}	0.55 ± 0.06^{a}	0.41 ± 0.05^{b}	0.46 ± 0.04^{ab}
Creatinine (mg/dL)	1.18 ± 0.13^{b}	1.39 ± 0.14^{a}	1.22 ± 0.12^{b}	1.50 ± 0.12^{a}

Means with different superscripts with in a row differ significantly ($p < 0.05$).

Table 2: Mean (± SE) hormonal and antioxidant variables of sheared and non-sheared sheep under different roofing materials

	Asbestos (T_1)		*Agro-net (T_2)*	
Variables	*Sheared*	*Non-Sheared*	*Sheared*	*Non-Sheared*
Triiodothyronine (ng/ml)	3.16 ± 0.75	2.02 ± 0.40	2.46 ± 0.36	2.04 ± 0.29
Thyroxine (ng/ml)	37.19 ± 3.17^{a}	29.18 ± 3.16^{ab}	26.49 ± 3.24^{b}	21.96 ± 2.84^{b}
Cortisol (ng/ml)	40.35 ± 6.49	42.01 ± 4.26	47.64 ± 6.68	32.92 ± 3.87
Superoxide dismutase (U/ml)	8.47 ± 0.61^{a}	8.02 ± 0.52^{a}	5.73 ± 0.27^{b}	8.92 ± 0.47^{a}
Glutathione peroxidase (U/ml)	95.70 ± 3.38^{a}	97.01 ± 3.75^{a}	84.98 ± 3.63^{b}	91.32 ± 3.77^{ab}
Lipid hydroperoxide (nmol of MDA/ml of packed cells)	3.52 ± 0.29	4.02 ± 0.22	3.27 ± 0.28	3.72 ± 0.37
Catalase (nmol/min/ml)	6.77 ± 0.88	6.95 ± 0.68	5.58 ± 0.59	5.76 ± 0.70
Heat shock protein 70 (ng/mL)	51.94 ± 1.87	56.59 ± 3.61	56.74 ± 3.66	47.59 ± 1.96

Means with different superscripts within a row differ significantly ($p < 0.05$).

were higher in non-sheared than sheared animals under both the roof types with significant difference only in serum creatinine concentrations (Table 1). Hematological and biochemical parameters recorded in the study were within the normal range and in accordance with Singh (2007).

Perusal of Table 2 indicated that serum triiodothyronine and cortisol values, though apparently higher in sheared sheep, did not differ significantly between roof treatments and shearing practices groups. However, concentration of thyroxine was significantly ($p < 0.05$) higher in sheared sheep reared under asbestos roofed shelter than agronet shelter, although it did not vary significantly by shearing practices under any of the roof types.

Thyroid hormones can be considered as indicators of the metabolic and nutritional status of small ruminants and are known to play an important role in the animal's adaptation to environment changes (Todini *et al*., 2007). The experimental sheep reared under agronet roofed shelter had consumed significantly ($p < 0.05$) more dry matter and nutrients as compared to animals reared under asbestos roofed shelter, and also by sheared than non-sheared sheep under agronet and asbestos roofed shelter (Khant *et al.,* 2021) which may be because of increased confort and metabolic hormone status. The concentrations of T_3 observed during the present study were within the reference range and in accordance with Singh (2007). Besides, significant increase in T_4 concentration in sheep under asbestos roofed house may be due to poor wind velocity and ventilation during night time (Hassanin *et al*., 1996). Cortisol levels are indicators of short-term stress. In our study, the normal range of cortisol concentration with shade indicated an alleviation of heat stress (Liu *et al*., 2012). Therefore, the plasma cortisol level of sheared and non-sheared sheep was comparable under different roofing material in summer season.

Heat stress has been associated with oxidative stress. Variation in the reserves of body antioxidants as well as markers of oxidative damage could be used to assess and quantify the impact of heat stress on livestock. The glutathione peroxidase and superoxide dismutase activities were increased significantly ($p < 0.05$) in the sheep reared under asbestos roofed shelter than agronet, particularly in sheared group. Lipid hydroperoxide (MDA) and catalase activity were statistically comparable between roof treatments and shearing practices.

These observations were similar to those of Ghosh *et al.* (2013), Maan *et al.* (2013), Chaudhary *et al.* (2015) and Rathwa *et al.* (2017) in small ruminants. High environmental temperature is known to stimulate excessive production of free radicals especially superoxide anions and hydrogen peroxide (Maan *et al.,* 2013). High ambient temperature increases oxidative stress by increasing lipid peroxidation and decreasing antioxidant defence (Ghosh *et al.,* 2013). In present study, the higher level of glutathione peroxidase observed in sheep reared under asbestos roofed shelter may be due to poor wind velocity and ventilation. The provision of asbestos roof shelter may reduce air temperature under the shade during the day time, but was harmful during hot summer nights (Hassanin *et al*., 1996) which leads to increased production of free radicals. Wool is an important factor affecting heat distribution in the body. Wool inhibits evaporation of water from the body reducing heat loss through sweating. For this reason, the removal of fleece facilitates the adaptation of the ewes to high temperatures (Pehlivan *et al*., 2020) and results in reduced GPx and SOD activity in sheared group of animals reared under agronet roof shelter.

Heat shock protein 70 (HSP 70) plays a vital role by bestowing cryoprotection against diverse kinds of stress (Gade *et al.,* 2010) and ubiquitous HSP-70 is the most abundant and temperature sensitive among all HSP. It has been reported that HSP-70 is strictly stress-inducible and can only be detected following a significant stress upon the cell and organisms. HSP-70 concentrations generally followed a flat trend and significantly ($p < 0.01$) increased in periods of heat stress in sheared and non-sheared Akkaraman sheep (Pehlivan *et al*., 2020). In present study, HSP 70 concentrations did not differ significantly among roof treatments and shearing practices. However, like serum cortisol, serum HSP 70 concentration was also non-significantly much higher in sheared sheep under agronet roofed shelter (Table 2). It revealed that provision of roof improves comfort and decreases the stress of sheared and non-sheraed sheep during summer season. During the summer when sunlight comes at a right angle, shearing can be considered as a necessary management practice and the effect of heat stress can be reduced in sheep that are housed in shaded shelters (Pehlivan *et al*., 2020).

Conclusion

The results of the present study indicate that blood biochemical and hormonal parameters of sheared and non-sheard sheep are normal and within the range. The determination of oxidative stress parameters could be a new approach for evaluating stress in sheep. The provision of shelter during hot summer conditions are of extreme practical importance for animal protection against direct and indirect solar radiation in sub-tropical regions. For minimizing the effects of heat stress, shearing would be better welfare with giving an opportunity to cool them when the ambient temperature is high. The result of the current study would be helpful for sustainable sheep production in arid land which varies widely, *i.e.,* residential vs. pastoral, the combined effect of shelter and shearing strategies can be recommended depending on the farming system.

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