Veterinary Research 6 (3): 54-57, 2013
ISSN: 1993-5412

Oxidative Stress Vis a Vis Gatsrointestinal Parasitism and Pneumonia in Marwari Goat

[1]P.K. Pilania, [2]S. Solanki, [3]N. Mohammed, [2]S. Asopa, [3]R. Maan, [3]A. Joshi,
[3]L.N. Sankhala, [2]M. Mathur, [3]M.K. Thori, [3]J.S. Gaur, [3]A. Meena and [3]N. Kataria
[1]Department of Animal Husbandry, Haryana, India
[2]Department of Animal Husbandry, Rajasthan, India
[3]College of Veterinary and Animal Science,
Rajasthan University of Veterinary and Animal Sciences,
Bikaner-334 001, Rajasthan, India

Abstract: An investigation was carried out to assess oxidative stress in goats of Marwari breed affected from gastrointestinal parasitism and pneumonia belonging to farmers' stock of arid tract of Rajasthan State, India. The animals were grouped into healthy and affected. All the blood samples were collected in sterile tubes with anticoagulants for erythrocyte separation and determination of erythrocytic Catalase (CAT) and Superoxide Dismutase (SOD) as biomarkers of oxidative stress. Activities of both the enzymes were significantly ($p \leq 0.05$) higher in affected animals in comparison to healthy lot. Erythrocytic catalase activity was 2.37 times higher in goats having gastrointestinal parasitism and 3.06 times higher in goats affected with pneumonia. Erythrocytic superoxide dismutase activity was 4.77 times higher in goats having gastrointestinal parasitism and 6.40 times higher in goats affected with pneumonia. It was observed that goats affected with pneumonia showed higher magnitude of enzyme activities in comparison to those having gastrointestinal parasites. Magnitude of change was greater in SOD activities than CAT activities. It can be concluded that gastrointestinal parasites and pneumonia served to produce oxidative stress in the goat. Catalase and superoxide dismutase are considered as potent biomarkers of oxidative stress. They are also named as antioxidant enzymes. Increased activities of both these enzymes signified the presence of oxidative stress in order to combat excessive production of free radicals. Antioxidant supplementation is recommended in cases affected with conditions like parasites and pneumonia to protect the animals from oxidative stress and ensuing damage to cellular machinery.

Key words: Goat, gastrointestinal parasitism, erythrocytes, CAT, SOD, pneumonia

INTRODUCTION

Research in the area of oxidative stress requires tremendous scientific attention particularly in veterinary field. Oxidative stress is considered as end point of various stress reactions. Oxidative stress can be the chief reason of any disease or can be an outcome of the disease process. Scope of oxidative stress needs establishment of suitable biomarkers along with generation of their reference values for a particular breed and species. Scientists are of the opinion that a major challenge in veterinary oxidative stress research is the development of a set of blood biomarkers that can reliably and reasonably reflect the oxidative profile of the affected cases. Many causes for the development of oxidative stress has been identified by the scientific community (Kataria and Kataria, 2012a, b; Kataria *et al*., 2012a, b). Parasitism is known to exacerbate oxidative stress in animals. Presence of parasites can produce oxidative insult to host cells. Oxidative stress contributes to parasite persistence in host tissues and damage caused by it contributes to development of pathological condition.

Many factors help in alleviation of oxidative stress. Certain endogenous enzymes also serve this vital function namely superoxide dismutase and catalase (Kataria *et al*., 2010a). An imbalance between the production of reactive oxygen and a biological systems' ability to readily detoxify the reactive intermediates or easily repair the resulting damage can cause oxidative stress. Oxidative stress can influence the metabolism of cells in vital organs of the body (Kataria *et al*., 2010b). The erythrocyte is the preferable target of oxidative modification in the blood and is prone to degradation leading to anaemia. Oxidative stress can disturb biochemical and physiological functions of red blood cells

Corresponding Author: Nalini Kataria, Department of Veterinary Physiology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner-334 001, Rajasthan, India

thereby affecting membrane integrity. Since, oxidized erythrocyte components are antigenic in regards to the formation of auto antibodies, a long-term exposure to severe oxidative stress consequently causes an autoimmune response to oxidized erythrocytes that can be regarded as an acquired antigen by oxidative modification (Iuchi *et al*., 2007).

Field of oxidative stress is of great concern to scientific community because of its negative impact on health and production of the animals. Perception of the mechanisms and reactions associated with oxidative stress can be of immense help in designing specific antioxidant therapies. With the fact that efforts to detect oxidative stress in small ruminant science are still in the infancy, an endeavor was taken to assess oxidative stress in Marwari goats affected with gastrointestinal parasitism and pneumonia.

MATERIALS AND METHODS

Animals: Oxidative stress was assessed in adult male and female goat of Marwari breed belonging to farmers' stock of arid tract of Rajasthan State, India. The animals were grouped into healthy (25) and affected (50). In healthy animals the blood samples were collected as a part of routine health checkup. The affected group comprised of goats having gastrointestinal parasites (25) and goats affected with pneumonia (25). All the samples were collected in sterile tubes with anticoagulants for erythrocyte separation and determination of erythrocytic catalase and superoxide dismutase.

Analysis: Blood samples were collected in di potassium EDTA and erythrocytes and plasma were separated by centrifugation. Aliquots of erythrocytes were washed twice with isotonic saline solution. Erythrocytes were haemolysed with four volumes of ice cold distilled water (Russell *et al*., 1985). For the determination of enzyme activities the haemolysates were treated with equal volumes of ethanol/chloroform (3:5 v/v) mixture. Then, centrifuged for 20 min at 2700 rpm. This precipitated the haemoglobin and stroma free haemolysate was obtained which was used to determine Catalase (CAT) and Superoxide Dismutase (SOD). On the basis of quantity of haemoglobin present in haemolysate, calculations for various parameters were made. Quantity of haemoglobin present in haemolysate was calculated on per litre instead of per 100 mL to ease out the conversion. In the case of samples showing optical densities beyond the standard range, dilutions were made and then necessary corrections were made while doing the calculation.

Catalase: It was determined by basic Colorimetric Method as described by Goldblith and Proctor (1950) with little modifications (Kataria *et al*., 2010b). For erythrocytic catalase, 1 mL of stroma free haemolysate was used. The activity was converted into U/gHb.

Superoxide dismutase: It was determined by colorimetric method of Winterbourn *et al.* (2002) with little modifications (Kataria *et al*., 2010b). For erythrocytic SOD, the same method was used. Serum quantities were replaced by stroma free haemolysate and the values were converted to kU/gHb.

Haemoglobin: It was determined by using standard technique (Oser, 1976) and used for calculation of enzyme activity. Mean values of affected animals were compared with the respective healthy mean values (Kaps and Lamberson, 2004).

RESULTS AND DISCUSSION

Mean±SEM values of erythrocytic catalase and superoxide dismutase in healthy and goats affected with gastrointestinal parasitism and pneumonia are presented in Table 1. Activities of both the enzymes were significantly ($p \leq 0.05$) higher in affected animals in comparison to healthy lot. Erythrocytic catalase activity was 2.37 times higher in goats having gastrointestinal parasitism and 3.06 times higher in goats affected with pneumonia. Erythrocytic superoxide dismutase activity was 4.77 times higher in goats having gastrointestinal parasitism and 6.40 times higher in goats affected with pneumonia. It was observed that goats affected with pneumonia showed higher magnitude of enzyme activities in comparison to those having gastrointestinal parasites. Magnitude of change was greater in SOD activities than CAT activities.

Catalase: Catalase activities of erythrocytes are considered important to assess oxidative stress (Kataria *et al*., 2010a). Variation in the values of catalase in different species could be related to free radical formation and decomposition of hydrogen peroxide (Kataria *et al*., 2010b, c). Scientists are of the opinion that

Table 1: Mean±SEM values of erythrocytic catalase and superoxide dismutase in healthy and in goats affected with gastrointestinal parasitism and pneumonia

Parameters	Healthy (n = 25)	Gastrointestinal parasitism (n = 25)	Pneumonia (n = 25)
Catalase (CAT, kU gHb^{-1})	1.83±0.009	4.34±0.007*	5.61±0.008*
Superoxide Dismutase (SOD, kU gHb^{-1})	1.89±0.009	9.02±0.012*	12.11±0.010*

*Significant ($p \leq 0.05$) difference from respective healthy mean value

antioxidant therapy results in low activity of enzyme catalase (Carpenter *et al*., 2001) showing its significance in the situation of free radical generation. Earlier researchers have also recommended the use of catalase in the situations where free radicals are formed (Seekamp *et al*., 1988). In a study, the activity of erythrocyte catalase was significantly higher in the theileriosis affected cattle showing oxidative stress (Rezaei and Dalir-Naghadeh, 2006). The increased activity of erythrocytic catalase in affected cases suggested the ability of the animals to provide defense against free radicals. Probably it was the body's response to combat the oxidative stress (Kataria *et al*., 2010d) as it is an enzyme of antioxidant defense system that eliminates and controls the toxic oxygen species.

Increased catalase activities showed activation of defense system and hence can be used effectively as marker of oxidative stress in cases affected with some pathological condition. From the results, it can be hypothesised that presence of parasites in goat and pneumonia resulted in excessive production of free radicals producing oxidative stress and an imbalance between oxidant and antioxidant system (Maan and Kataria, 2012). Stress due to any reason may provoke oxidative stress (Kataria *et al*., 2010b).

Superoxide dismutase: Earlier researchers showed increased activities of SOD in various animals due to heat stress (Kataria *et al*., 2010b) in goats and (Kataria *et al*., 2010d) in dromedary camel. In present study, the higher values of erythrocytic SOD in affected cases were probably to scavenge the free radicals produced. The increased activities of erythrocytic SOD could be attributed to physiological upregulation of this enzyme in an attempt to mitigate superoxide radical challenge (Kahlon and Singh, 2003). Maral *et al*. (1977) indicated a primary role for this enzyme in protection of the cells against uncontrolled oxidative processes. It can be reiterated that parasitism and presence of pneumonia exerted stress to the animals leading to generation of free radicals to produce oxidative stress. In toxicity related stress also scientists (Rana *et al*., 2013) have used erythrocytic SOD as one of the biomarkers. Higher erythrocytic activity of SOD probably suggested a stress response of affected animals in an attempt to combat the stress.

CONCLUSION

It can be concluded that gastrointestinal parasites and pneumonia served to produce oxidative stress in the goat. Catalase and superoxide dismutase are considered as potent biomarkers of oxidative stress. They are also named as antioxidant enzymes. Increased activities of both these enzymes signified the presence of oxidative stress in order to combat excessive production of free radicals. Antioxidant supplementation is recommended in cases affected with conditions like parasites and pneumonia to protect the animals from oxidative stress and ensuing damage to cellular machinery.

REFERENCES

Carpenter, D., H. Larkin, A. Chang, E. Morris, J. O'Neill and J. Curtis, 2001. Superoxide dismutase and catalase do not affect the pulmonary hypertensive response to group B streptococcus in the lamb. Pediatr. Res., 49: 181-188.

Goldblith, S.A. and B.E. Proctor, 1950. Photometric determination of catalase activity. J. Biol. Chem., 87: 705-709.

Iuchi, Y., F. Okada, K. Onuma, T. Onuda, H. Asao, M. Kobayashi and J. Fujii, 2007. Elevated oxidative stress in erythrocytes due to an SOD 1 deficiency causes anaemia and triggers auto antibody production. Biochem. J., 402: 219-227.

Kahlon, R.S. and R. Singh, 2003. Status of antioxidant enzymes in normal cycling and α-tocopherol supplemented anestrus buffalo heifers (*Bubalus bubalis*). Asian-Aust. J. Anim. Sci., 16: 217-221.

Kaps, M. and W.R. Lamberson, 2004. Biostatistics for Animal Science. CABI Publishing, Oxford shire, pp: 36-270.

Kataria, A.K. and N. Kataria, 2012a. Evaluation of oxidative stress in sheep affected with peste des petits ruminants. J. Stress Physiol. Biochem., 8: 72-77.

Kataria, A.K. and N. Kataria, 2012b. Evaluation of oxidative stress in pigs affected with classical swine fever. Porcine Res., 2: 35-38.

Kataria, N., A.K. Kataria and R. Maan, 2010a. Correlation of serum IgE with stress in Indian dromedaries affected with skin wounds. J. Stress Physiol. Biochem., 6: 17-24.

Kataria, N., A.K. Kataria, R. Maan and A.K. Gahlot, 2010b. Evaluation of oxidative stress in brucella infected cows. J. Stress Physiol. Biochem., 6: 19-25.

Kataria, N., A.K. Kataria, N. Pandey and P. Gupta, 2010c. Serum biomarkers of physiological defense against reactive oxygen species during environmental stress in Indian dromedaries. HVM Bioflux., 2: 55-60.

Kataria, N., A.K. Kataria and R. Maan, 2010d. Evaluation of oxidative stress due to hot environmental condition in healthy *Marwari* goats from arid tract in India. Philipp. J. Vet. Anim. Sci., 36: 175-184.

Kataria, N., A.K. Kataria, A. Joshi, N. Pandey and S. Khan, 2012a. Serum antioxidant status to assess oxidative stress in brucella Infected buffaloes. J. Stress Physiol. Biochem., 8: 5-9.

Kataria, N., A.K. Kataria, N. Pandey, R. Maan and A. Joshi *et al*., 2012b. Use of serum magnesium as a biomarker of oxidative stress in marwari goat from arid tracts in India. Vet. Res., 5: 91-96.

Maan, R. and N. Kataria, 2012. Evaluation of oxidative stress during adverse environmental conditions in *Marwari* sheep from arid tracts in India. ABAH Bioflux, 4: 38-42.

Maral, J., K. Puget and A.M. Michelson, 1977. Comparative study of superoxide dismutase, catalase and glutathione peroxidase levels in erythrocytes of different animals. Biochem. Biophys. Res. Commun., 77: 1525-1535.

Oser, B.L., 1976. Hawk's Physiological Chemistry. 14th Edn., Tata McGraw Hill Publishing Co. Ltd., New Delhi, pp: 900-1125.

Rana, T., A.K. Bera, D. Bhattacharya, S. Das, D. Pan and S.K. Das, 2013. Characterization of arsenic induced cytotoxicity in liver with stress in erythrocytes and its reversibility with Pleurotus florida lectin. Toxicol. Ind. Health, (In Press). 10.1177/0748233712468026.

Rezaei, S.A. and B. Dalir-Naghadeh, 2006. Evaluation of antioxidant status and oxidative stress in cattle naturally infected with *Theileria annulata*. Vet. Parasitol., 142: 179-186.

Russell, L.E., R.A. Easter and P.J. Bechtel, 1985. Evaluation of the erythrocyte aspartate aminotransferase activity coefficient as an indicator of the Vitamin B-6 status of postpubertal Gilts. J. Nutr., 115: 1117-1123.

Seekamp, A., C. Lalonde, D.G. Zhu and R. Demling, 1988. Catalase prevents prostanoid release and lung lipid peroxidation after endotoxemia in sheep. J. Appl. Physiol., 65: 1210-1216.

Winterbourn, C.C., A.V. Peskin and H.N. Parsons-Mair, 2002. Thiol oxidase activity of copper, zinc superoxide dismutase. J. Biol. Chem., 277: 1906-1911.