ABAH BIOFLUX
Animal Biology & Animal Husbandry
International Journal of the Bioflux Society

Electrolyte and antioxidant profiling of dromedary camel (*Camelus dromedarius*) with mandible fracture

[1]Nalini Kataria, [1]Ruchi Maan, [1]Ashish Joshi, [2]Seema Mathur, [3]Anil K. Kataria

[1] Department of Veterinary Physiology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India; [2] Department of Animal Husbandry, Ajmer, Government of Rajasthan, India; [3] Apex Centre for Animal Disease Investigation, Monitoring and Surveillance, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India. Corresponding author: N. Kataria, nalinikataria@rediffmail.com

Abstract. In the present investigation healthy and adult male dromedary camel (*Camelus dromedarius*) with mandible fracture were investigated. All animals belonged to farmers' stock from arid tract of Rajasthan, India. The blood samples were analyzed to determine serum electrolytes *viz*. calcium, phosphorus and magnesium and serum antioxidants *viz.* superoxide dismutase (SOD), glutathione reductase (GR), catalase (CAT), vitamin A, vitamin E, vitamin C and glutathione. Among the electrolytes, the mean values of serum calcium, phosphorus and magnesium showed significant decrease ($p \leq 0.05$) in the cases with mandible fracture in comparison to healthy dromedaries. The mean values of calcium, phosphorus and magnesium were 1.59, 1.74 and 1.52 fold lower, respectively in affected cases. Among the antioxidants, the mean values of serum enzymes *viz*. SOD, GR and CAT showed significant increase ($p \leq 0.05$) in the cases with mandible fracture. The mean values were 1.41, 3.29 and 1.45 fold higher, respectively in affected cases. Among the antioxidants, the mean values of vitamin A, E and C and glutathione showed significant decrease ($p \leq 0.05$) in the cases with mandible fracture. The mean values were 1.77, 1.61, 1.34 and 1.61 fold lower, respectively in affected cases. It was observed that an association existed between ailment and pattern of variation of the parameters studied. Electrolyte variation showed the physiological adjustments to facilitate more minerals for healing and as a result blood levels decreased. Changes in antioxidants clearly reflected the presence of oxidative stress in the affected dromedaries. Present study provided data which can be used as reference values to assess the extent of oxidative stress in the cases like surgical affections. This would be helpful in recommending the supplementation of the minerals and immune nutrients to the affected animals.
Key Words: Antioxidants, dromedary, electrolytes, mandible fracture, oxidative stress.

Introduction. Diseases affecting bone and mineral metabolism encompass a wide range of skeletal and soft tissue disorders. Major research efforts are being made worldwide to improve the currently available treatment options of fractures and to develop new strategies for the surgical treatment and simultaneous health management. Mandible fractures are common among camels and commonly occur during the breeding season (Al-Mujalli 2012). Mandibular fracture is most commonly caused by bites and can be repaired by interdental wiring or a U-bar technique (Ahmed 2011). There is a need to understand the role of electrolytes in the healing process of the bones so that proper mineral supplementation can be carried out during the healing period and afterwards.

Endogenous antioxidants are very useful in combating excessive reactive oxygen species (ROS) produced during various processes. Certain enzymes *viz.* superoxide dismutase, glutathione reductase and catalase and vitamins like A, E and C function as antioxidants (Kataria et al 2010a). Faster rate of formation of ROS may exhaust the endogenous sources of antioxidants leading to a phenomenon named as oxidative stress (Kataria et al 2010b). Detection of oxidative stress is the need of health management to

timely treat the animals. Many a times it has been observed that an ailment requires specific line of treatment like fractures or surgical affections but due to other associates reactions, animal simultaneously suffers from oxidative stress which may hinder in the recovery process of main ailment. In such situations it becomes mandatory to provide supportive treatment to combat oxidative stress. Eloquence in understanding of the mechanism behind the development of oxidative stress in animals may help in developing categorical therapies including supplementation of antioxidants. This can provide features to understand the connection of oxidative stress with various kinds of stressors (Kataria et al 2010c).

Superoxide dismutases, glutathione reductase and catalase are well known antioxidant enzymes which help to alleviate the menace of free radicals before they produce harmful effects. Dromedary camels contribute immensely in short distance transport in western states of India. It becomes essential to monitor general health condition during such problems to protect the animals from peril of stress. Oxidative stress is extremely dangerous (Kataria et al 2010a) and can be a prelude to many disease conditions. For stress free management of the animals, assessment of oxidative stress is mandatory (Kataria et al 2010d). Paucity of research work relating surgical affections with oxidative stress in dromedary camel led the foundation of this investigation.

Material and Method. In the present investigation 44 adult male dromedary camels (*Camelus dromedarius*) were used, out of which twenty two animals were healthy and rest dromedaries were having mandible fracture. All animals belonged to farmers' stock from arid tract of Rajasthan, India. The samples were analyzed to determine serum antioxidants *viz.* superoxide dismutase (SOD), glutathione reductase (GR), catalase (CAT), vitamin A, vitamin E, vitamin C and glutathione and serum electrolytes *viz*. calcium, phosphorus and magnesium. Antioxidants were determined following the methods as described by Kataria et al (2010d) and electrolytes as per the standard techniques (Oser 1976). The mean value of each parameter of the animals with mandible fracture was compared to the corresponding mean value of the healthy animals to test (students' 't' test) the significance (Kaps & Lamberson 2004).

Results and Discussion

Mean ± SEM values of serum antioxidants and electrolytes are presented in table 1.

Table 1

Mean ± SEM values of serum antioxidants and electrolytes in the healthy and with mandible fracture dromedaries (*Camelus dromedarius*)

Serum parameters	*Healthy (n=22)*	*With mandible fracture (n=22)*	*Magnitude of variation value (fold)*
Calcium, $mmolL^{-1}$	2.75 ± 0.05	1.72 * ± 0.04	- 1.59
Phosphorus, $mmolL^{-1}$	2.25 ± 0.04	1.29 * ± 0.03	- 1.74
Magnesium, $mmolL^{-1}$	0.78 ± 0.006	0.51 * ± 0.003	- 1.52
Superoxide dismutase, k U L^{-1}	133.40 ± 4.11	188.32 * ± 3.31	+1.41
Glutathione reductase, k U L^{-1}	3.10 ± 0.003	10.21 * ± 0.004	+3.29
Catalase, k U L^{-1}	75.93 ± 3.22	110.10 * ± 3.12	+1.45
Vitamin A, µmol L^{-1}	1.99 ± 0.09	1.12 * ± 0.05	- 1.77
Vitamin E, µmol L^{-1}	6.63 ± 0.10	4.11 * ± 0.08	- 1.61
Vitamin C, µmol L^{-1}	25.87 ± 1.00	19.21 * ± 1.00	- 1.34
Glutathione, µmol L^{-1}	5.00 ± 0.09	3.10 * ± 0.04	- 1.61

* significant ($p \leq 0.05$) difference from healthy mean value, + increase from healthy mean value, - decrease from healthy mean value.

Electrolytes. Among the electrolytes, the mean values of serum calcium, phosphorus and magnesium showed significant decrease ($p \leq 0.05$) in the cases with mandible fracture in comparison to healthy dromedaries. The mean values calcium, phosphorus and magnesium were 1.59, 1.74 and 1.52 fold lower, respectively in affected cases. The mean values of healthy dromedaries corroborated the earlier findings (Kataria et al 2002). Electrolyte concentration particularly of magnesium reflects changes due to oxidative stress (Kataria et al 2012a). Earlier researchers have also reported lower levels of calcium, phosphorus and magnesium in the dromedaries with fractured jaw and attributed them as one of the contributing factors in the occurrence of fracture (Al-Mujalli 2012).

Changes in the inorganic metabolism of the minerals may determine the deposition of bone salts and the process must take place at the site of fracture. Parathyroid hormone secretion is normally increased in response to even slight decreases in blood calcium concentration. However, hypomagnaesemia can blunt this response (Rude et al 1978). Changes in the levels of calcium regulating hormones are important for fracture repair. Fracture repair is generally coupled with increased levels of parathyroid hormone, calcitonin and vitamin D. This showed that all the aspects of calcium metabolism should be covered at the time of healing process. Probably this could be the reason of variation in electrolyte levels in the present study. Scientists have observed that levels of minerals return to normal during callus formation (Meller et al 1984). Lower levels of electrolytes in the present investigation also explained the mobilization of minerals in the bone.

Antioxidants. Among the antioxidants, the mean values of serum enzymes *viz*. SOD, GR and CAT showed significant increase ($p \leq 0.05$) in the cases with mandible fracture. The mean values were 1.41, 3.29 and 1.45 fold higher, respectively in affected cases.

Probably fracture in the dromedaries produced immense stress. Relationship of stress associated increased activities of the antioxidant enzymes have been reported by the earlier studies due to biotic and abiotic stressors (Kataria et al 2010b; Kataria et al 2010c; Kataria et al 2010d; Maan & Kataria 2012; Kataria & Kataria 2012a; Kataria & Kataria 2012b; Kataria & Kataria 2012c; Kataria et al 2012a; Maan et al 2013). Increased activities were probably to neutralize the free radicals produced.

Superoxide dismutase is responsible for the quenching of superoxide radicals which are released during the chemical reactions and serum increased activity can be used as biomarker of oxidative stress. This principle antioxidant enzyme is involved in reversion of myofibroblasts to fibroblasts (Kataria et al 2010d). Scientists have attributes protection of cells from oxidative stress as a primary role of SOD. Catalase functions to catalyze the decomposition of hydrogen peroxide to water and oxygen (Chelikani et al 2004). Oxidative stress results in higher CAT activity making the latter a potent biomarker of oxidative stress (Maan & Kataria 2012). Glutathione reductase is an enzyme that reduces glutathione disulfide to the sulfhydryl form GSH, which is an important cellular antioxidant. The activity of glutathione reductase is used as an indicator for oxidative stress. Researchers have recommended the use of catalase in the situations where free radicals are formed (Seekamp et al 1988).

Among the antioxidants, the mean values of vitamin A, E and C and glutathione showed significant decrease ($p \leq 0.05$) in the cases with mandible fracture. The mean values were 1.77, 1.61, 1.34 and 1.61 fold lower, respectively in affected cases.

Relationship of stress associated decreased levels of the antioxidants have been reported by the earlier workers due to biotic and abiotic stressors (Chaturvedi & Kataria 2012; Kataria et al 2012b; Pandey et al 2012; Joshi et al 2013). Low levels of antioxidants result in development of oxidative stress which may damage or kill cells along with alteration in the immune status of animals by increasing susceptibility to various infections. A decrease in antioxidant defense leads to oxidative damage of biomolecules (Beckman & Ames 1998).

Vitamin A is considered as a powerful antioxidant along with other vitamins like C and E with its role in health maintenance (Schünemann et al 2001; Dimri et al 2012). Vitamin A has an effect on lipid peroxidation whereas Vitamin C protects the body against

oxidative stress (Padayatty et al 2003). Stress can use up large quantities of vitamin C (Kataria et al 2010b). Vitamin E stops the production of ROS during oxidation of fat. It protects cell membranes from oxidation by reacting with lipid radicals produced in the lipid peroxidation chain reaction. Vitamin E is important in cell homeostasis. Glutathione is the major endogenous antioxidant produced by the cells, participating directly in the neutralization of free radicals and reactive oxygen compounds, as well as maintaining other antioxidants such as vitamins C and E in their reduced or active forms (Kataria et al 2010c).

Trauma of fracture may bring about burst of free radicals contributing in the development of oxidative stress. This can devastate the endogenous antioxidants. It was observed that an association existed between ailment and pattern of variation of the parameters studied. Electrolyte variation showed the physiological adjustments to facilitate more minerals for healing and as a result blood levels decreased. Dietary deficiency of minerals was not present as all the animals were well fed. Changes in antioxidants clearly reflected the presence of oxidative stress in the affected dromedaries.

Conclusions. Results clearly indicated the presence of oxidative stress in dromedaries having mandible fracture. The changes in electrolytes reflected their mobilization to bones for healing. In a part low levels could also be due to oxidative stress. Present study provided data which can be used as reference values to assess the extent of oxidative stress in the cases like surgical affections. This would be helpful in recommending the supplementation of the minerals and immune nutrients to the affected animals.

References

Ahmed A. F., 2011 Mandibular fracture in single-humped camels. Vet Surg 40:903-907.

Al-Mujalli A. M., 2012 Relationship between mineral status and jaw fractures in dromedary camels *Camelus dromedarius*. Bulgarian J Vet Med 15:110-114.

Beckman K. B., Ames B. N., 1998 The free radical theory of ageing matures. Physiol Rev 78:547-581.

Chaturvedi M., Kataria N., 2012 Assessment of role of antioxidants in erythrocytes of Marwari goat from arid tracts in India to evaluate oxidative stress. ELBA Bioflux 51:1-8.

Chelikani P., Fita I., Loewen P. C., 2004 Diversity of structures and properties among catalase. Cell Mol Life Sci 612:192-208.

Dimri U., Sharma M. C., Singh S. K., Kumar P., Jhambh R., Singh B., Bandhyopadhyay S., Verma M. R., 2012 Amelioration of altered oxidant/antioxidant balance of Indian water buffaloes with subclinical mastitis by vitamins A, D(3), E, and H supplementation. Trop Anim Health Prod PMID: 23239221.

Joshi A., Kataria N., Kataria A. K., Pandey N., Asopa S., Sankhala L. N., Pachaury R., Khan S., 2013 Stress related variations in serum vitamin E and C levels of *Murrah* buffaloes. J Stress Physiol Biochem 9(1):28-34.

Kaps M., Lamberson W. R., 2004 Biostatistics for animal science. CABI Publishing Oxfordshire.

Kataria A. K., Kataria N., 2012a Assessment of oxidative stress in goats affected with *Peste des petits ruminants.* Media Peternakan 3:170-174.

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

Kataria A. K., Kataria N., 2012c Evaluation of oxidative stress in sheep affected with peste des petits ruminants. J Stress Physiol Biochem 84:*72-77.*

Kataria N., Kataria A. K., Agarwal V. K., Garg S. L., Sahani M. S., 2002 Effect of long term dehydration on serum constituents in extreme climatic conditions in camel *Camelus dromedarius*. Indian J Physiol Pharmacol 46(2):218-222.

Kataria N., Kataria A. K., Pandey N., Maan R., Joshi A., Sankhala L. N., Chaturvedi M., Pachaury R., Pilania P. K., 2012a Use of serum magnesium as a biomarker of oxidative stress in Marwari goat from arid tracts in India. Vet Res 5(4):91-96.

Kataria N., Kataria A. K., Joshi A., Pandey N., Khan S., 2012b Serum antioxidant status to assess oxidative stress in Brucella infected buffaloes. J Stress Physiol Biochem 8(2):5-9.
Kataria N., Kataria A. K., Maan R., 2010a Correlation of serum IgE with stress in Indian dromedaries affected with skin wounds. J Stress Physiol Biochem 6:17-24.
Kataria N., Kataria A. K., Maan R., 2010b Evaluation of oxidative stress due to hot environmental condition in healthy *Marwari* goats from arid tract in India. Philipp J Vet Anim Sci 362:175-184.
Kataria N., Kataria A. K., Maan R., Gahlot A. K., 2010c Evaluation of oxidative stress in brucella infected cows. J Stress Physiol Biochem 6(2):19-31.
Kataria N., Kataria A. K., Pandey N., Gupta P., 2010d Serum biomarkers of physiological defense against reactive oxygen species during environmental stress in Indian dromedaries. HVM Bioflux 2:55-60.
Maan R., Kataria N., Pilania P. K., Sharma A., Sankhala L. N., Kataria A. K., 2013 Fluctuations of serum glutathione reductase activities due to changes in ambient temperatures in *Marwari* sheep from arid tracts. ELBA Bioflux 5(1):9-13.
Maan R., Kataria N., 2012 Evaluation of oxidative stress during adverse environmental conditions in *Marwari* sheep from arid tracts in India. ABAH Bioflux 42:48-42.
Meller Y., Kestenbaum R. S., Mozes M., Mozes G., Yagil R., Shany S., 1984 Mineral and endocrine metabolism during fracture healing in dogs. Clin Orthop Relat Res 187:289-295.
Pandey N., Kataria N., Kataria A. K., Joshi A., Sankhala L. N., Asopa S., Pachaury R., 2012 Extreme ambiences *vis-à-vis* endogenous antioxidants of Marwari goat from arid tracts in India. ELBA Bioflux 4(2):29-33.
Oser B. L., 1976 Hawk's physiological chemistry. 14th ed, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
Padayatty S., Katz A., Wang Y., Eck P., Kwon O., Lee J., Chen S., Corpe C., Dutta A., Dutta S., Levine M., 2003 Vitamin C as an antioxidant, evaluation of its role in disease prevention. J Am Coll Nutr 22(1):18–35.
Rude R. K., Oldham S. B., Sharp Jr C. F., Singer F. R., 1978 Parathyroid hormone secretion in magnesium deficiency. J Clin Endocrinol Metab 47:800–806.
Seekamp A., Lalonde C., Zhu D. G., Demling R., 1988 Catalase prevents prostanoid release and lung lipid peroxidation after endotoxaemia in sheep. J Appl Physiol 65:1210-1216.
Schünemann H. J., Grant B. J., Freudenheim J. L., Muti P., Browne R. W., Drake J. A., Klocke R. A., Trevisan M., 2001 The relation of serum levels of antioxidant vitamins C and E, retinol and carotenoids with pulmonary function in the general population. Am J Respir Crit Care Med 163(5):1246-1255.

Received: 18 February 2013. Accepted: 20 March 2013. Published online: 25 March 2013.
Authors:
Nalini Kataria, Rajasthan University of Veterinary and Animal Sciences, College of Veterinary and Animal Science, Department of Veterinary Physiology, India, Rajasthan, Bikaner - 334 001, nalinikataria@rediffmail.com
Ruchi Maan, Rajasthan University of Veterinary and Animal Sciences, College of Veterinary and Animal Science, Department of Veterinary Physiology, India, Rajasthan, Bikaner – 334 001, maanruchi@rediffmail.com
Ashish Joshi, Rajasthan University of Veterinary and Animal Sciences, College of Veterinary and Animal Science, Department of Veterinary Physiology, India, Rajasthan, Bikaner – 334 001, ashishjosh8@gmail.com
Seema Mathur, Department of Animal Husbandry, Ajmer, Government of Rajasthan, India, manojenviron@hotmail.com
Anil Kumar Kataria, Rajasthan University of Veterinary and Animal Sciences, College of Veterinary and Animal Science, Apex Centre for Animal Disease Investigation, Monitoring and Surveillance, India, Rajasthan, Bikaner – 334 001, akkataria1@rediffmail.com

How to cite this article:
Kataria N., Maan R., Joshi A., Mathur S., Kataria A. K., 2013 Electrolyte and antioxidant profiling of dromedary camel (*Camelus dromedarius*) with mandible fracture. ABAH Bioflux 5(1):44-48.