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Short Communication

Role of Amla (*Emblica officinalis*) supplementation as an antioxidant in mitigation of heat stress in Buffaloes

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Heat stress occurs in an animal if there is an imbalance between heat production within the body and its dissipation. Stress is the state manifested by a specific syndrome, which consists of all the non-specifically induced changes within a biological system. Both external and internal stressors cause pronounced behavioral, physiological and hematological alterations in tropical livestock. Heat stress is one of the wide varieties of factors, which cause oxidative stress in the animal. Oxidative stress can be regarded as an imbalance between free radical production and antioxidant defense in the body. There is growing evidence that oxidative stress significantly impairs growth, production and reproductive performance. Use of antioxidant supplementation enhances the endogenous antioxidant capacity of animal.

KEY WORDS: Heat stress, antioxidant,

INTRODUCTION

Heat stress can have adverse effect on various aspect of metabolism and reproductive performance of domestic animals. These adverse effects of heat stress are the results of either the disturbance in the hyperthermic status of the animal associated with heat stress or the physiological/biochemical adjustments made by the animal to cope with the rise in temperature. Stress causes pronounced behavioral, physiological and hematological alterations in tropical livestock. The water buffalo has only $1/10^{th}$ the number of sweat glands per unit area of skin compared to zebu cattle and must rely on wallowing or wetting of the skin during heat conditions to reduce heat load. Thus, placing buffaloes at disadvantage under solar radiation as to enhanced re-absorption of solar radiation interferes with heat loss resulting in higher heat storage. So, buffaloes have poor capacity to withstand high temperature thus requiring greater attention to protection against adverse climatic conditions. As indicated by the physiological responses of these animals, environmental stress has a profound effect on some biochemical and hematological parameters (Marai et al; 1995). Sweating, high respiration rate, vasodilation with increased blood flow to skin surface, high rectal temperature, reduced metabolic rate, decreased DM intake, and efficiency of feed utilization and altered water metabolism are the physiological responses that are associated with negative impacts of heat stress on production and reproduction in dairy animals (West *et al.,*1999).

The major strategies for lowering the heat stress of the animal during summer is to increase evaporating cooling by providing shade, use of sprinklers, fans, etc (Bucklin *et al.,* 1991). These are not only capital intensive but also do not prove effective under semi-intensive system (Shivakumar *et al.,* 2010). Thus, there is a need for additional/alternative approach to ameliorate the oxidative/thermal stress experienced by the animals during summer.

Heat stress is one of the wide varieties of factors which cause oxidative stress in the animal. Oxidative stress can be regarded as an imbalance between free radical production and antioxidant defense in the body. There is growing evidence that oxidative stress significantly impairs growth, production and reproductive performance

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of the animal and a tight relationship between oxidative stress and impaired fertility has been reported in buffalo-cows (Ahmed *et al.,* 1995).

Reactive oxygen species (ROS), the major culprit for causing oxidative stress, are constantly generated *in vivo* as an integral part of metabolism. ROS may cause oxidative stress when their level exceeds the threshold value. They trigger progressive destruction of polyunsaturated fatty acids (PUFA), ultimately leading to membrane destruction. Body employs antioxidants to quench these free radicals.

Amla as an Antioxidant

Vitamin C is a classic example of antioxidants and its supplementation has been found to ameliorate the heat stress in goats (Kumar, 2009), cows (Ul-Haq *et al.,* 2013) and buffaloes (Sunilkumar *et al.,* 2010; Lakhani *et al*., 2016). The powerful antioxidant properties of amla were first discovered in 1936 (Damodaran and Nair 1936). Its strong antioxidant properties are due to its small molecular weight tannoid complexes. Apart from being one of the most potent sources of vitamin C, amla is rich in amino acids tannins and flavinoids that are known to protect the body against free radicals. Therefore, use of amla powder as an antioxidant can be of practical importance to ameliorate the adverse effect of heat stress in buffaloes. Usefulness of amla powder as an antioxidant has been found to reduce the adverse effects of summer stress in cattle (Ul-Haq *et al*., 2013) and buffaloes (Lakhani *et al*., 2016).

Effect of Amla on Immunity

Vitamin C is the major antioxidant that plays a role in keeping the structural integrity of immune cell and plays an important role in various functions of body like hydroxylation reaction when animals are subjected to stress. *E. officinalis* is reported to possess free radical scavenging, antioxidant, anti-inflammatory, antimutagenic and immune modulatory activities (Bhandari and Kamdod, 2012). Immunoglobulins in serum and extra vascular spaces considered to be capable of carrying out all of the functions of immunity, an increase in immunoglobulins level on amla powder supplementation in buffaloes was observed (Lakhani *et al*., 2016).

Amla supplementation on combating oxidative stress

Lipid peroxidation is the indicator of oxidative stress in cells and tissues. High ambient temperature causes impaired antioxidant status which is characterized by elevated lipid peroxidation. Lipid peroxides derived from polyunsaturated fatty acids are unstable and are decomposed to form a series of compounds. Amla (*Emblica officinalis)* has the ability to stimulates natural antioxidant enzyme systems including catalase, superoxide dismutase and glutathione peroxide. Erythrocytic LPO level was higher ($p<0.05$) in summer stressed buffaloes and a decrease in Erythrocytic LPO level was observed on amla powder supplementation (Lakhani *et al.,* 2016). Body is protected by a wide range of antioxidant system working in concert i.e. superoxide dismutase peroxidase and catalases which removes superoxide and peroxidase before they react with metal catalysis to form more reactive species. Superoxide dismutase (SOD) is a part of RBC protective mechanism against oxidative stress. SOD catalyses the dismutation of superoxide to hydrogen peroxide (H_2O_2) and it is considered the first defence against peroxidants (Halliwell and Chirico, 1993).

Amla supplementation on Hormones

During heat stress, there is impairment of pituitary-adrenal axis leading to increase in cortisol production which is the main hormone responsible for causing stress. On vitamin C supplementation reduction in cortisol levels by vitamin C in heat stressed buffaloes were reported by Lakhani *et al.,* (2015). This reduction in cortisol levels by vitamin C is not yet fully understood but may be achieved by reducing the synthesis and/or secretion of cortisol or by breaking it down (Webel *et al*., 1998). Decreased thyroid hormone levels during heat stress are an adaptive response and also might be an attempt to reduce metabolic rate and heat production in animals (Lakhani *et al.,* 2015).Free radical H_2O_2 serves as a substrate for the thyroperoxidase enzyme which catalyzes the synthesis of thyroid hormone, namely T_3 and T_4. Production of more H_2O_2 under stress condition might have reduced the levels of thyroid hormone (Usha *et al*., 2010). Moreover, 5' monodeiodinase, an enzyme which converts T4 to T3, is affected by free radicals under heat stress and on supplementation of amla an increase in thyroid hormones was observed (Lakhani *et al.,* 2015)

Conclusion

It is concluded that amla powder supplementation can ameliorate the heat stress in Murrah buffaloes with appropriate dosage under field condition which can ensure the complete protection against heat stress in these animals.

References:

Ahmed HIA (1995). Studies on alleviation of thermal stress in imported Friesian cattle under Egyptian environmental conditions. Ph.D. Thesis, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

Bhandari PR, Kamdod MA (2012). Emblica officinalis (Amla): A review of potential therapeutic applications,

Int. J. Green Pharm., 6: 257-69.
Bucklin RA, Turner LW, Beede DK, Bray DR, Kemken RW (1991), Methods to relive heat stress for dairy cows in hot, humid climates, Appl. Eng. Agric. **7**: 241-47.
Damodaran M, Nair KM (1936). A tannin from Indian Gooseberry (Phyllanthus emblica) with a protective action on ascorbic acid, Biochem. J. 30 (6): 1014-20.
Halliwell B, Chirico S (1993). Lipid peroxidation: its mechanism, measurement and significance. American J. Clin. Nutr.. 57: 715-25.
Kumar M (2009). Reproductive performance and blood biochemical profile of summer stressed goats following antioxidant supplementation. M.V.Sc. Thesis, submitted to Guru Angad Dev Veterinary & Animal Science University, Ludhiana, India.
Lakhani P, Jindal R, Nayyar S (2015). Supplementation of Amla Powder (Emblica officinalis) ameliorates the Summer Stress in Buffaloesc. Indian J. Anim. Nutr., 32(3): 103-105.
Lakhani P, Jindal R, Nayyar S (2016). Effect of amla powder supplementation on haematological parameters, ceruloplasmin and transferrin levels in summer stressed murrah buffaloes Theriogenology Insight, 6 (2): 109-117.
Marai IFM, Habeeb AAM, Daader AH, Yousef HM (1995). Effects of Egyptian sub-tropical conditions and the heat stress alleviation techniques of water spray and diaphoretics on the growth and physiological functions of Friesian calves. J. Arid Environ., 30: 219-225.
Sunilkumar BV, Singh G, Meur SK (2010). Effects of addition of electrolyte and ascorbic acid in feed during heat stress in buffaloes, Asian Aust. J. Anim. Sci. 23 (7): 880-888.
Ul-Haq A, Konwar D, Khan A (2013). Effect of supplementation of ascorbic acid and amla powder on hematobiochemical parameters in crossbred dairy cows, Indian J. Anim. Nutr.**30** (1): 33-37
Usha R, Deshpande LJ, Joseph UN, Patwardhan M, Samuel AM (2010). Effect of Antioxidants (Vitamin C, E and Turmeric extract) on methimazole induced hypothyroidism in rats, Indian J. Exp. Biol. 40:735-738.
Webel DM, Mahan DC, Johnson RW, Baker DH (1998). Pre treatment of young pigs with vitamin E attenuates the elevation in plasma interleukin-6 and cortisol caused by a challenge dose of lipo polysaccharide, J. Nutr. 128(10):1657- 1660.
West JW (1999). Nutritional strategies for managing the heat stressed dairy cows, J. Anim. Sci., 77 (2): 21-35.