SYNERGISM OF VITAMIN E AND SELENIUM ON OXIDATIVE STRESS DURING TRANSITION PERIOD IN KANKREJ CATTLE

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ABSTRACT

It has been observed that during the transition period cows experience oxidative stress which may contribute to periparturient disorders and may be associated with metabolic diseases. Vitamin E and selenium (Se) play vital role in reduction of oxidative stress and maintain the health of living animals. The concentration of MDA was significantly (P<0.05) lower in Vit.E + Se supplemented group as compared to control group in stage-I, II and III (late pregnancy, recent parturition and early postpartum) during transition period in Kankrej cattle. However, in the treatment group the SOD level was significantly (P<0.05) reduced as compared to control group at stage of recent parturition.

KEY WORDS: Oxidative stress, Transition period, Kankrej Cows, Vitamin-E, Selenium.

INTRODUCTION

During the transition or periparturient period (4 weeks before and after parturition, dairy cows experience drastic physiological changes critical for their health and subsequent performance. This period involves physiological stresses associated with rapid differentiation of secretory parenchyma, intense mammary gland growth, and the onset of copious milk synthesis and secretion which are accompanied by a high energy demand and an increased oxygen requirement (Gitto *et al*., 2002). This increased oxygen demand augments the production of oxygen-derived reactants, collectively termed as reactive oxygen species (ROS). Excessive production of free radicals and ROS, and/ or a decrease in body antioxidant defence, lead to damage of biological macromolecules and disruption of normal metabolism and physiology (Trevisan *et al.*, 2001). Supplementation of vitamin-E and selenium during this period is associated with their enhanced health. The action of vitamin E and selenium appears to be synergistic (Papas *et al*., 1990). Acting in conjunction with selenium, vitamin E prevents oxidative damage to sensitive membrane lipids by suppressing hydro peroxide formation (Putman and Comben, 1987) and protects cellular membranes and lipid containing organelles from peroxidative damage by inhibition and destruction of endogenous peroxides, thus maintaining membrane integrity and reducing oxidative stress (Hogan *et al,* 1993). The determination of products of peroxidative damage to macromolecules and antioxidant substances like glutathione and enzymes (e.g. Superoxide dismutase-SOD, Reduced glutathione-GSHPx and Catalase) are useful markers for the oxidative stress and antioxidant status, respectively. Hence, the present study was conducted to determine the effect of vitamin-E and selenium supplements to decrease oxidative stress in Kankrej cows during transition period.

MATERIALS AND METHODS

The present study was carried out in 20 transitional Kankrej cows maintained at Livestock Research Station, SDAU, Sardarkrushinagar, Gujarat. All the cows included in the study were of 3rd to 5th lactation aged 5 to 8 years and had completed 8 month of gestation period when selected. These cows were maintained on uniform feeding and management practices followed on the farm. The animals were randomly divided into two equal groups (Group-I: Control group and Group-II: Vit-

E + Se supplemented group). Transition period was divided into three stages Stage I: Stage of late pregnancy (28 days before expected date of parturition), Stage II: Stage of recent parturition (Day of parturition to 2nd day postpartum), Stage III: Stage of early postpartum (7th to 28th days postpartum).

Group I animals served as control and did not receive any treatment, while Group II cows were treated with vitamin-E (500 mg) and selenium (15 mg, Inj. E-CARE Se^{Ò}, @ 10 ml i/m, Vetcare, India*; Each ml of Inj. E-CARE SeÒ contains 50 mg DL-a-tocopheryl acetate and 1.5 mg sodium selenite) twice at 28th & 14th day before expected date of parturition. In both groups the blood samples were collected on day -28, -21, -14, -7, 0 (day of parturition), 1, 2, 7, 14, 21 & 28 of postpartum. The blood biochemical markers of oxidative stress, *viz.,* lipid peroxidation (in terms of malondialdehyde - MDA) & superoxide dismutase (SOD) were studied. Membrane peroxidative damage in erythrocytes was determined in terms of malondialdehyde production by the method of Shafiq-U-Rehman (1984). Superoxide dismutase was estimated as per the method described by Madhesh and Balasubramanian (1998). The findings between stages (average of each stage) were compared by using Duncan's multiple range test (Snedecor and Cochran, 1994).

RESUTS AND DISCUSSION

Oxidative damage is caused by free radicals which are formed during cellular metabolism and they cause damage to cell membrane, enzymes and cell nuclear materials. So, they must be converted into less reactive substances if the animal is to survive and perform well. This protection is particularly important in preventing oxidation of polyunsaturated fatty acids, which are primarily constituents of subcellular membrane and precursor of prostaglandins.

Vitamin E and selenium (Se) play vital role in prevention of such oxidation and maintain the health of living animals. Vitamin E is an antioxidant vitamin and it scavenges such free radicals thus it prevents the lipid peroxidation, whereas selenium is an important constituent of glutathione peroxidase enzyme. This glutathione peroxidase enzyme destroys any peroxidase formed during such oxidation. Thus, vitamin-E and selenium cause recovery from oxidative stress and maintain health of animals (Chakrabarti, 2006).

Malondiadehyde is a biomarker of lipid peroxidation and its level increases during oxidative stress due to various stressors. In present study, MDA concentration in control group was significantly higher than treatment group at all stages may due to pregnancy related oxidative stress of release of adrenaline, noradrenaline, glucocorticoids and eicocorticoides. Synthesis of glucocorticoids, eicocorticoides and epinephrine induces pathway for generating reactive oxygen metabolites like MDA (Patel, 2009). The concentration of MDA was significantly ($P<0.05$) lower in Vit-E + Se supplemented group as compared to control group at stage-I, II and III (late pregnancy, recent parturition and early postpartum) during transition period in Kankrej cows (Table 1). The decreased lipid peroxidation in Vit-E + Se supplemented group as compared to control group indicated beneficial effect of vitamin-E and selenium supplements against oxidative stress in Kankrej cows during transition period. These findings were in accordance with Bouwstra *et al.* (2008) and Dimri *et al.* (2010) who reported that supplementation of vitamin-E and selenium play important role in recovery of animals from parturition related oxidative stress.

The role of intracellular SOD is to scavenge the superoxide that is produced by number of reaction mechanisms, including several enzyme systems, as a part of normal cellular function. Superoxide dismutase (an enzyme containing Cu and Zn) converts superoxide to hydrogen peroxide (H_2O_2). This H_2O_2 is converted to water by glutathione peroxidase. By this mechanism these two enzymes effectively control free radicals within the Cytosol.

In present study non-significantly higher level of SOD activity in control group was noted as compared to treatment group at all stages of transition period. This may be due to more production of superoxides as a result of stress induced by pregnancy and parturition, which are converted

Table 1: Blood biochemical markers (Mean ± SE) of oxidative stress in control and Vit-E + Se supplemented group of Kankrej cows during transition period

Parameters	Stages	Untreated control group	Vit-E + Se supplemented group
Malondiadehyde - MDA (mmol/ml)	Stage I: Late pregnancy	9.13 ± 0.12^{a}	7.79 ± 0.26^{b}
	Stage II: Recent parturition	10.02 ± 0.18^{a}	8.16 ± 0.54^{b}
	Stage III: Early postpartum	7.56 ± 0.23^{a}	6.22 ± 0.32^{b}
Superoxide dismutase – SOD (U)	Stage I: Late pregnancy	2.33 ± 0.17	2.08 ± 0.09
	Stage II: Recent parturition	3.35 ± 0.14^{a}	2.92 ± 0.14^{b}
	Stage III: Early postpartum	2.75 ± 0.13	2.58 ± 0.12

by SOD into H_2O_2 (Patel, 2009). However in the treatment group the SOD level was significantly ($P<0.05$) suppressed as compared to control group at the stage of recent parturition.

CONCLUSION

The significantly lowered levels of MDA and SOD in treated group are indicative of good efficacy of vitamin E and selenium supplementation in recovery of pregnancy related oxidative stress during transition period in Kankrej cows.

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