Oxidative stress profile during postpartum period in Surti goats

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Received: 19-01-2016 Accepted: 16-04-2016

ABSTRACT

Present study was conducted to investigate postpartum oxidative stress in 20 Surti goats. Blood samples were collected on 0, 7th, 14th, 21st, 30th and 45th days postpartum and analysed for Superoxide Dismutase (SOD), Glutathione Peroxidase (GPx), lipid peroxidation (LPO), reduced Glutathione (GSH) and uric acid. SOD differed significantly between 0, 14th and 21st day postpartum. GPx was significantly low on 14th day and then increased significantly (P<0.01) up to 45th day. Significant (P<0.01) difference was observed between days except 0 and 21st. LPO increased significantly (P<0.01) from 0 to 14th day and then decreased non-significantly up to 45th day. Reduced glutathione was significantly (P<0.05) higher on 0 day. Uric acid was lowest on 0 day and highest on 45th day however they were non-significantly different on 7th, 14th, 30th and 45th day. It can be summarized that on 14th day post kidding, the values of SOD, GPx and GSH were lowest while LPO was highest. Uric acid was significantly (P<0.01) low on the day of kidding. Thus it may be concluded that in Surti goats the period from 0 day to 14th day postpartum is most stressful and critical care should be taken during this period. GPx, SOD along with LPO and GSH can be used as marker of stress during postpartum period.

Key words: Antioxidant, Oxidative stress, Postpartum, Surti Goat.

INTRODUCTION

Goats being termed as ‘poor man’s cow’ also have distinct economic, managerial, social, and biological advantages over other livestock species. As per 19th Livestock Census, 3.67% of 135.17 million goats of India belong to Gujarat. One of the popular breeds of this state is Surti. This medium sized dual purpose breed is mostly stall fed, non-nomadic and found in suburban areas of middle and southern Gujarat as well as also in some neighbouring areas of Maharashtra. Apart from being known for their prolificacy, fertility, quality of milk and meat they are also known for their good adaptability to the hot and humid conditions. In spite of its good production potential, this precious goat breed of South Gujarat has been declared as endangered since 1980’s. Very little efforts have been made in the past towards its conservation as gazed by very few studies done on it and thus there are all possibilities of this breed going extinct.

Physiological stages like pregnancy followed by lactation can be considered to be metabolically stressful. Postpartum period, a part of the transition period, 45 days after parturition is the most stressful period because of the depressed feed intake, endocrine and metabolic changes at parturition and lactation. During the transition from pregnancy to lactation, adjustments in metabolism appear to be important in establishing metabolic priority for lactation.

Oxidative stress plays a role in multiple physiological processes from oocytes maturation to fertilization, embryo development during pregnancy, in normal parturition and in initiation of preterm labor (Agarwal et al., 2005). In normal pregnancy, the plasma free radical trapping and antioxidant potential are able to counteract oxidative stress through enzymatic induction and activity of superoxide dismutase (SOD), glutathione peroxidase (GPx), Glutathione (GSH) as well as through non enzymatic free radical protectors and scavengers (Wang et al., 1991).

The present study was therefore done with the aim to study oxidative stress parameters through frequent sampling during the postparturient period in Surti goats.

MATERIALS AND METHODS

The study was conducted following approved guidelines of the Institutional Animal Ethics Committee in the Department of Veterinary Physiology and Biochemistry. Twenty apparently healthy Surti goats (aged 36 to 51 month) were selected for the study. Parity of all the goats ranged from first to sixth. The experimental animals were maintained at Livestock Research Station, Navsari Agricultural University, Navsari (altitude -11.89 meter above mean sea level, latitude of 20°-57′0″ north and longitude of 72°-54′0″ east). All the goats were housed in pucca shed with concrete floor and feeding was done as per the ICAR feeding standards, 1998. In this region, winter is cool and dry while summer and monsoon remain hot and humid. Variation in
The duration of study was 45 days postpartum wherein blood was collected on day of kidding (0 day), 7th, 14th, 21st, 30th and 45th days postpartum. Approximately 5 ml of whole blood from each animal was collected from jugular vein in heparinized vacutainers for Superoxide Dismutase (SOD), Glutathione Peroxidase (GPx), lipid peroxidation in terms of MDA (Malondialdehyde) production, reduced Glutathione (GSH) and in vacutainers containing K3 EDTA for uric acid. SOD, GPx concentration, LPO (lipid peroxidation in terms of MDA production) and reduced glutathione were measured by method of Madesh and Balasubramanian (1998), UV method of Pagalia and Valentine (1967), Rehman (1984) and Moron et al., (1979) respectively. Uric acid was analyzed by the use of Randox kits (enzymatic colorimetric method). The collected data for all the parameters were analysed using randomized block design as cited by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The levels of different oxidative stress parameters during postpartum period on 0, 7th, 14th, 21st, 30th and 45th days postpartum are given in Table-1. The ANOVA (Analysis of variance) for different oxidative stress parameters is presented in Table 2.

Table 1: Enzymatic and Non-enzymatic markers of oxidative stress (Mean ± SE) in Surti goats postpartum

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Day of Kidding</th>
<th>Days of Postpartum</th>
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<tbody>
<tr>
<td></td>
<td>0 day</td>
<td>7th day</td>
</tr>
<tr>
<td>SOD(U)</td>
<td>1.83±0.13&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.47±0.20&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>GPx(U/L)</td>
<td>218.35±9.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>197.37±12.41&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>LPO(nM of MDA/ml of packed cells)</td>
<td>5.27±0.79&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.05±0.40&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Reduced GSH(mg/dl)</td>
<td>8.92±0.15&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.76±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Uric acid(mg/dl)</td>
<td>0.83±0.03&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.29±0.03&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean bearing different superscript differ significantly at P<0.01 for SOD, LPO and Uric Acid and P<0.05 for GSH
hemoglobin oxidation (Markiewicz et al., 2005). Three weeks after kidding low levels of SOD have been reported (Skotnicka et al., 2010) as compared to 2nd week after kidding. Non-significant changes in SOD during postpartum period have been reported by Celi et al., (2008). Present findings also shows that superoxide dismutase values between 0 day, 7th, 30th and 45th day of postpartum were non-significant similar to that observed by Celi et al., (2008).

The values of Glutathione Peroxidase (GPx(U/L)) on 0, 7th, 14th, 21st, 30th and 45th day post kidding were 218.35±9.92, 197.37±12.41, 168.62±13.06, 234.67±14.30, 299.17±17.82 and 386.20±16.85 respectively (Table-1). The Glutathione Peroxidase concentration was also found to be significantly low on 14th day postpartum and then after significant (P<0.01) increase for GPx was observed. A significant (P<0.01) difference was observed between different days except 0 and 21st day postpartum. In the present study the value of GPx just like SOD was also found low on the 14th day postpartum. GPx is also one of the enzyme indicative of stress. GPx enzyme catalyze conversion of reduced form of glutathione to its oxidize form and removal of \( \text{H}_2\text{O}_2 \). Since GPx is directly targeted at removing \( \text{H}_2\text{O}_2 \) generated during the dismutation of free radicals (Droge, 2002), a parallel decrease in reactive oxygen metabolite (ROM) levels is also expected. Other antioxidant molecules such as catalase (antioxidant enzyme that can catalobize \( \text{H}_2\text{O}_2 \)) (Droge, 2002) may have played a role in keeping constant levels of ROMs. The lipid peroxidation (nM of MDA/ml of packed cells) on 0, 7th, 14th, 21st, 30th and 45thday post kidding were 5.27±0.79, 7.05±0.40, 10.88±0.22, 3.93±0.68, 3.47±0.50 and 3.22±0.30 respectively (Table-1). Lipid peroxidation was found to be higher on 14th day postpartum. Lipid peroxidation increased significantly (P<0.01) from 0 to 14th day and then decreased non-significantly up to 45th day postpartum, however, LPO levels on 21st, 30th and 45th day postpartum were almost comparable. Lipid peroxidation occurs when lipids interact with free oxygen radicals. Lipid peroxidation is non-enzymatic chain reaction that leads to creation of lipid peroxide. Lipid peroxidation is assessed in terms of malondialdehyde (MDA) production. The LPO increased on 14th day postpartum which was simultaneous to decrease in SOD and GPxs. This indicates that animals were in maximum stress on 14th day post kidding. High values of malondialdehyde on the day of kidding have been reported by Rejitha and Karthiayini (2013). However on the supplementation of ascorbic acid during the periparturient period significant decrease in MDA on 0 day and 7th day post kidding was also observed by them. Malondialdehyde concentration in serum was also reduced by supplementation of vitamin A in ewe during lactation period (Wang et al., 2008). This decreased level was attributed to reduction in free radicals because of vitamin A acting as powerful scavengers of free radicals.

The values of reduced Glutathione (GSH (mg/dl)) on 0, 7th, 14th, 21st, 30th and 45th day post kidding were 8.92±0.15, 7.76±0.13, 7.39±0.13, 7.35±0.09, 7.11±0.17 and 7.08±0.19 respectively (Table-1). The levels of glutathione were found to be significantly (P<0.05) higher on 0 day of kidding. The present findings are in agreement with values of Rejitha and Karthiayini (2013). The GSH values in mg/100ml of erythrocytes in Sannen and Turkish goats have been reported 40.5±0.1 and 24.4±2.2 respectively (Aydin et al., 2008). As compared to this, values in our findings are lower which could be due to the type of sample used i.e. blood plasma. Reduced Glutathione functions by protecting the protein-SH groups of enzymes, haemoglobin or the membrane from oxidation (Agar et al., 1983). Reduced Glutathione has important role in the potassium transport system in the red cells of sheep, but this role in goats is poorly understood. Dick et al., (1969) suggested that sodium-potassium activated ATPase activity is inhibited by oxidized glutathione. Tucker and Kilgour (1972) reported that sheep with genetically determined deficiency of reduced GSH in their red cells had lower than normal red cell potassium, and probably also lower red cell sodium concentrations.

The values of uric acid (mg/dl) on 0, 7th, 14th, 21st, 30th and 45th day post kidding were 0.83±0.03, 1.29±0.03, 1.42±0.07, 1.81±0.09, 2.39±0.20 and 2.58±0.25 respectively (Table-1). Uric acid concentration was lowest on the 0 day and highest on 45th day postpartum. There was non-significant difference for 7th, 14th, 30th and 45th day postpartum. High uric acid concentration during periparturient period (especially 4 weeks to +2 weeks kidding) has been reported by Skotnicka et al., (2010). In the conditions of cell energy crisis the increase of uric acid concentration and increase of free oxygen radicals can be observed. Uric acid which is also considered a cell energy state indicator. The uric acid inhibits the xanthine dehydrogenase activity which results in an increase of

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>DF</th>
<th>SOD(U)</th>
<th>GPx(U/L)</th>
<th>LPO(nM of MDA/ml of packed cells)</th>
<th>GSH (mg/dl)</th>
<th>Uric acid (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>6</td>
<td>5.22**</td>
<td>115100.91**</td>
<td>180.72**</td>
<td>8.03*</td>
<td>11.12**</td>
</tr>
<tr>
<td>Error</td>
<td>133</td>
<td>0.80</td>
<td>4121.64</td>
<td>4.74</td>
<td>3.79</td>
<td>0.33</td>
</tr>
</tbody>
</table>

* P<0.05, ** P<0.01
hypoxanthine concentration – lowered cell ATP concentration marker.

Briefly it can be summarized that on 14th day post kidding, the values of SOD, GPx and GSH were lowest while LPO was highest. Superoxide dismutase is responsible for removal of superoxide anion radical and results into formation of $H_2O_2$ while GPx utilizes $H_2O_2$ and converts to $H_2O$. The concentration of uric acid was significantly ($P<0.01$) low on 0 day as compared to 7th and 14th day postpartum.

Thus based on oxidative stress parameters evaluated in the present study it can be concluded that the period from 0 day to 14th day postpartum in Surti goats is most stressful and critical care should be taken during this period. Antioxidant enzymes viz. GPx and SOD along with LPO and GSH can be used as marker of stress during postpartum period.

**ACKNOWLEDGMENT**

The authors are highly thankful to the Dean, Vanbandhu College of Veterinary Science and A.H. for financial assistance and research facilities to conduct this experiment. The authors also thank Research Scientist, Livestock Research Station, NAU and Project Incharge of AICRP on goat improvement Surti field unit at LRS, NAU Navsari for experimental animals.

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