Effect of organic zinc supplementation on growth, metabolic profile and antioxidant status of Ganjam sheep


Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar-751 003, India

Received: 30-08-2016 Accepted: 12-04-2017 DOI:10.18805/ijar.B-3297

ABSTRACT

Fifteen Ganjam sheep (3-4 months of age) were stratified into three equal groups and fed a basal diet consisting of concentrate mixture and paddy straw. T1 served as control (without any supplementation), T2 and T3 were supplemented with 20 and 40 mg zinc/kg DM as zinc methionine respectively. Experimental feeding continued for a period of 90 days. Blood samples were collected on 90 days of the experimental feeding. Results revealed non significant (P>0.05) increase in body weight gain in zinc supplemented groups. Hemoglobin content, packed cell volume, glucose, total protein, albumin, globulin and urea concentration were similar (P>0.05) among the three groups. The antioxidant enzymes concentration were significantly (P<0.05) higher in zinc supplemented group than control. It may be concluded that supplementation of organic zinc prevents stress without affecting growth and blood chemistry of sheep.

Key words: Antioxidants, Blood, Growth, Sheep, Zinc methionine.

INTRODUCTION

Zinc (Zn) is an essential trace element required for carbohydrate, energy, protein and nucleic acid metabolism (Droke and Spears, 1993). Zn is known to affect growth, production and reproduction of the animals by influencing enzyme activity and gene expression of proteins (MacDonald, 2000). Generally, Zn is supplemented in the diet of animals as inorganic salts, which are not sufficiently absorbed and retained in the body, whereas organic source has higher retention and bioavailability in animals (Cao et al., 2000). Zn supplementation enhanced utilization of amino acids for protein synthesis (Spears, 1989). It has also been observed that the performance of calves (Mandal et al., 2007) and lambs (Garg et al., 2008) given organic Zn was better than calves given inorganic sources of Zn. Zn is required for the synthesis of anti oxidative enzymes like superoxide dismutase (SOD) which protects the cell from reactive oxygen species (Gaafar et al., 2010). Keeping this in view, a study was proposed on Ganjam sheep to assess the effect of Zn - methionine on growth, blood chemistry and anti-oxidant enzyme status in sheep.

MATERIALS AND METHODS

An experiment was conducted on 15 Ganjam sheep (3-4 months of age with mean body weight of 8.25 ± 0.21 kg) at Instructional Livestock Farm, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha. The sheep were divided into three groups of five each on the basis of their body weights following randomized block design. They were kept in a well ventilated shed with individual feeding and watering arrangements. Sheep in all the groups were fed on concentrate mixture and paddy straw to meet their nutrient requirements (NRC, 2007). The concentrate mixture consisted of crushed maize grain 30%, soybean meal 35%, wheat bran 32%, mineral mixture 2% and common salt 1%. Treatments were T1 (control: without any supplementation), T2 (supplemented with 20 ppm Zn as Zn Methionine) and T3 (supplemented with 40 ppm Zn as Zn Methionine) through the concentrate mixture. Paddy straw was provided ad libitum. All the lambs were offered 100 g of maize (Zea mays) fodder once a week to meet their vitamin A requirements. Clean and fresh drinking water was provided twice a day to all the lambs. This feeding practice continued for 90 days. Feed samples were analyzed for proximate principles (AOAC, 2000). All the lambs were weighed at fortnightly intervals in the morning before offering them any feed or water.

About 10 ml blood was collected from each lamb through jugular venipuncture in the morning (before watering and feeding) at 90days of the experimental feeding. Out of 10 ml, 08 ml blood was collected into clean and dry test tube and kept in slanting position for 45 min for the separation of serum for blood chemistry and thyroid hormones. Remaining 2 ml was taken in another clean and dry ependroph tube (2 ml) containing anticoagulant (heparin) for the haematological studies. The blood samples were centrifuged at 3000 rpm for 10 min and serum was separated. The serum was collected in plastic vials and kept at -40°C until further analysis. Haemoglobin (Hb) content and packed
Table 1: Chemical composition (% DM basis) of concentrate mixture and paddy straw fed to sheep

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Concentrate mixture</th>
<th>Paddy straw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic matter</td>
<td>90.70</td>
<td>87.30</td>
</tr>
<tr>
<td>Crude protein</td>
<td>17.50</td>
<td>2.90</td>
</tr>
<tr>
<td>Ether extract</td>
<td>2.30</td>
<td>1.10</td>
</tr>
<tr>
<td>Neutral detergent fibre</td>
<td>35.20</td>
<td>75.00</td>
</tr>
<tr>
<td>Acid detergent fibre</td>
<td>11.50</td>
<td>57.10</td>
</tr>
<tr>
<td>Hemicelluloses</td>
<td>23.70</td>
<td>18.90</td>
</tr>
<tr>
<td>Cellulose</td>
<td>10.60</td>
<td>42.50</td>
</tr>
<tr>
<td>Total ash</td>
<td>9.30</td>
<td>12.70</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.40</td>
<td>0.72</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.69</td>
<td>0.22</td>
</tr>
<tr>
<td>Zinc (ppm)</td>
<td>22.00</td>
<td>9.30</td>
</tr>
</tbody>
</table>

Table 2: Growth performance and feed conversion efficiency of Ganjam sheep

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Dietary group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
</tr>
<tr>
<td>Initial BW (kg)</td>
<td>8.35±0.85</td>
<td>8.30±0.71</td>
</tr>
<tr>
<td>Final BW (kg)</td>
<td>12.20±1.67</td>
<td>12.32±1.53</td>
</tr>
<tr>
<td>Total weight gain (kg)</td>
<td>3.85±0.90</td>
<td>4.02±0.58</td>
</tr>
<tr>
<td>ADG (g)</td>
<td>42.77±8.74</td>
<td>44.66±8.32</td>
</tr>
<tr>
<td>Total DMI (g)</td>
<td>315.21±18.53</td>
<td>319.31±11.07</td>
</tr>
<tr>
<td>Feed: Gain</td>
<td>7.37±0.56</td>
<td>7.15±0.42</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

The chemical composition of concentrate mixture and paddy straw is presented in Table 1. The crude protein content of the concentrate mixture and paddy straw was 17.50 and 2.90%, respectively, whereas the basal Zn concentration in concentrate mixture and paddy straw was 22.00 and 9.30 mg kg\(^{-1}\), respectively. Average daily gain (ADG) was not significantly (P>0.05) higher in Zn supplemented group as compared to control group (Table 2). Similar to our results, Kegley and Spear (1995) in lambs, Nocek et al. (2006) in dairy cattle and Mandal et al. (2007) in calves did not observe any significant effect of Zn-methionine supplementation on body weight gain.

Blood haematology: Results of haematological parameters studied in this experiment were presented in Table 3. The mean hemoglobin (Hb, g/dl) and PCV (%) values were in normal range and were found to be comparable (P>0.05) in all the three groups. Similar to our results, supplementation of 40 ppm of Zn in the form of Zn-methionine did not affect blood hemoglobin or PCV values in chicks (Sridhar et al., 2015) and goats (Perme et al., 2013). But Sobhanirad and Naserian (2012) observed higher haemoglobin (Hb) and PCV (%) values in Holstein dairy cows supplemented with 500 mg Zn/ kg DM as Zn-sulphate or Zn-methionine. This might be due to higher concentration of Zn in supplemented group than control.

Blood biochemicals: The data concerning serum glucose, total protein, albumin, globulin, A:G ratio and urea are presented in Table 3. The overall mean values of glucose, total protein, albumin, globulin, A:G ratio and urea were found to be similar (P>0.05) in the three groups and were within the normal range indicating that the supplementation of Zn-methionine had no effect on these parameters. Similarly, Mandal et al. (2007) in crossbred calves, Shinde et al. (2012) in Malpura sheep and Perme et al. (2013) in goats did not observe any significant effect of Zn–methionine supplementation on glucose, total protein, albumin, globulin. A:G ratio and urea concentration.

Antioxidative enzymes: Evaluation of oxidative stress indices revealed that Zn-methionine supplementation had significantly (P<0.05) increased CAT and SOD activities and levels of MDA, were significantly (P<0.05) decreased when compared to the control animals (Table 4). Zinc is an important anti-oxidant and its low concentrations predispose the animals to oxidative damage (Romanucci et al., 2011). Increased zinc levels can cause a decrease in reactive oxygen species (ROS) in the body, which might have been the reason for the decreased MDA levels in the supplemented animals.
Table 3: Effect of organic zinc supplementation on haemato-biochemical profiles of sheep

<table>
<thead>
<tr>
<th>Attributes</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin (g/dl)</td>
<td>10.15±0.31</td>
<td>11.08±0.35</td>
<td>10.96±0.21</td>
<td>0.231</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>26.30±2.04</td>
<td>28.10±1.31</td>
<td>27.40±1.98</td>
<td>0.186</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>48.35±1.14</td>
<td>47.15±1.98</td>
<td>49.00±2.88</td>
<td>0.167</td>
</tr>
<tr>
<td>Total Protein (g/dl)</td>
<td>6.50±0.29</td>
<td>6.83±0.22</td>
<td>6.87±0.35</td>
<td>0.265</td>
</tr>
<tr>
<td>Albumin (g/dl)</td>
<td>3.20±0.17</td>
<td>3.59±0.14</td>
<td>3.46±0.16</td>
<td>0.273</td>
</tr>
<tr>
<td>Globulin (g/dl)</td>
<td>3.30±0.22</td>
<td>3.24±0.14</td>
<td>3.42±0.18</td>
<td>0.112</td>
</tr>
<tr>
<td>A/G ratio</td>
<td>0.96±0.12</td>
<td>1.10±0.10</td>
<td>1.01±0.08</td>
<td>0.126</td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>21.45±3.30</td>
<td>20.05±3.18</td>
<td>22.20±2.25</td>
<td>0.364</td>
</tr>
</tbody>
</table>

Table 4: Effect on antioxidant enzyme of sheep in different dietary treatments of zinc methionine

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Dietary group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
</tr>
<tr>
<td>Catalase (U/mg Hb)</td>
<td>1.31±0.02a</td>
<td>2.23±0.06a</td>
</tr>
<tr>
<td>LPO (µmol MDA formed / mg Hb)</td>
<td>2.83±0.08a</td>
<td>1.80±0.06a</td>
</tr>
<tr>
<td>SOD(U/mg of Hb)</td>
<td>20.51±0.42a</td>
<td>25.74±0.36a</td>
</tr>
</tbody>
</table>

Zinc has been found to inhibit endogenous as well as exogenous lipid peroxidation in both in vivo and in vitro conditions (Chvapil et al., 1973) and thus increased SOD activity there by leading to increased catalase concentration (Clemen and Waller, 1987). Similar to our findings Aksu et al. (2011) reported that supplementation of Zn-methionine decreased lipid peroxidation in the chickens by lowering the plasma levels of MDA.

CONCLUSION The results indicated that supplementation of 20 ppm of organic zinc enhanced antioxidant enzyme status without affecting growth and blood chemistry of sheep.

ACKNOWLEDGEMENT The authors are thankful to the Vice Chancellor, OUAT, Bhubaneswar, Odisha, India, for providing the necessary facilities to carry out this work.

REFERENCES


