A Study of the Effect of Vitamin C and Ocimum Sanctum Supplementation on Antioxidant Enzyme Levels in Broilers Under Heat-Stress

L.S.S.Varaprasad Reddy1*, V.Leela2, B.Sudhakara Reddy3, P.Ananda Reddy4

1Assistant Professor, Dept. of Veterinary Physiology, Sri Venkateswara Veterinary University, Y.S.R.District, Andhra Pradesh, India.
2Professor, Dept. of Veterinary Physiology, Madras Veterinary College, Chennai, Tamil Nadu, India
3Assistant Professor (Veterinary Medicine), Teaching Veterinary Clinical Complex, Sri Venkateswara Veterinary University, Y.S.R.District, Andhra Pradesh, India.
4Associate Professor & Head, Dept. of Poultry Science, Sri Venkateswara Veterinary University, Y.S.R.District, Andhra Pradesh, India.

Abstract

This experiment was conducted in heat-stressed broiler chicken to evaluate the effect of dietary supplementation of Vitamin C and Ocimum sanctum on antioxidative enzyme levels. A total of forty broiler chickens of day old age were divided into 4 groups of 10 each, were used for this study. Vitamin C (300 mg/kg), Ocimum sanctum leaf powder (0.5%) and their combination were added to the basal diet. Superoxide dismutase (SOD), glutathione peroxidase (GSH-px), catalase, reduced glutathione (GSH) and lipid peroxidation levels in plasma were measured at the end of 6 weeks of age. Dietary supplementation of Vitamin C itself increased SOD, GSH-px, catalase enzyme levels significantly (p<0.05). However, supplementation of both Vitamin C and Ocimum sanctum effectively enhanced the levels of SOD, GSH-px, catalase, and GSH with concomitant decrease in lipid peroxidation levels in plasma. It is concluded that dietary supplementation of Vitamin C and its combination with Ocimum sanctum at 0.5% level can combat oxidative stress caused by high environmental temperature in broilers, by enhancing antioxidative enzyme levels.

Key Words: Antioxidants; Vitamin C; Ocimum sanctum; SOD; GSH-Px; Catalase; GSH; Lipid Peroxidation; Broiler Chickens.

Introduction

Poultry production suffers significant losses because of heat stress. Heat stress adversely affects broiler performance and livability. Body temperature and metabolism rate of birds are relatively high compared to mammals, which make birds vulnerable to oxidative stress under high environmental temperature, which is the major cause of sudden death syndrome [1]. Heat stress not only adversely affects production performance but also increases the incidence of infectious and metabolic diseases in poultry. This can be minimized by the use of anti-stress compounds. Antioxidants are substances, present biologically lower concentrations and significantly delay or prevent oxidation of substances like protein, lipids, DNA and carbohydrates [2]. External sources of antioxidant are essential for the control of oxidation process, which include vitamin C & E, carotenoids, phytoflavanoids etc.

Vitamin C also commonly known as ascorbic acid is an important antioxidant. Although birds synthesize vitamin C in their body, however, its supplementation in the poultry diet has been recommended during stressful conditions [3]. Several herbal plants are found to possess anti oxidant properties and the ubiquitous herb, Ocimum sanctum which belongs to Lamiaceae family is a fairly economic therapeutic agent for several pathological conditions as well as anti-stress [4] and antioxidant agent [5].

The present study was conducted to evaluate the effect of Vitamin C and Ocimum sanctum on antioxidative enzyme levels in broiler chicken under heat stress.

Materials and Methods

A forty broiler chicks of day old age were randomly divided into 4 groups comprising of 10 birds in each group with following dietary regimes.

- Group I: Standard diet (Control)
- Group II: Standard diet + Vitamin C (300mg/kg)
- Group III: Standard diet + Ocimum sanctum (0.5%) 
- Group IV: Standard diet + Vitamin C (300mg/kg) + Ocimum sanctum (0.5%)

The birds were reared from day old to 6th week of age in cages under standard managemental practices during months of April & May. The temperature inside the house is ranged from 35 – 38°C. Freshly collected O. sanctum leaves were shade dried and powdered. Vitamin C and Ocimum sanctum leaf powder were sup-
Blood samples were collected at the end of 6th week from the wing vein using heparinised vacutainer for separating plasma by standard procedures of centrifugation. The levels of superoxide dismutase (SOD) activity in plasma was measured by the method of [7], glutathione peroxidase (GSH-Px) activity as per the method described by [8] and catalase activity as per the method of [9]. Reduced glutathione levels in plasma were estimated by the method of [10]. Lipid peroxidation assay was carried out according to [11]. Statistical analysis of the data was analyzed by randomized block design as per [12].

Results & Discussion

Superoxide dismutase is considered as critical antioxidative enzyme that acts as a scavenger of oxygen anion to form hydrogen peroxide and hence diminishes the toxic effects due to the free radical. This primary defense widely distributed in oxygen metabolizing cells to protect acerbic cells from deleterious actions of free radicals [13]. The mean plasma SOD values of broilers at 6 weeks of age as influenced by dietary supplementation of Vitamin C and Ocimum sanctum, is presented in Table 1. In the present study, dietary supplementation of Vitamin C (300mg/kg), O. sanctum at 0.5% level and their combination significantly (p<0.05) enhanced plasma SOD activity when compared control group. The results of our study are in accordance with the earlier reports of [6], along with Vitamin C (300mg/kg).

The findings of increased plasma catalase levels in the present study were in agreement with the reports of [6], they observed increases in plasma catalese enzyme levels by supplementation of O. sanctum in broilers. Similarly, [14] reported that catalase activity significantly (P<0.05) increased with dietary supplementation of Vitamin C in summer stressed broilers.

GSH (reduced glutathione) offers protection against oxygen derived free radicals and cellular lethality following exposure to oxidative stress. Its high electron donating capacity combined with higher intracellular concentrations generate great reducing power which neutralizes oxygen free radicals. This primary defense is widely distributed in oxygen metabolizing cells to protect acerbic cells from deleterious actions of free radicals [14]. Glutathione peroxidase (GSH-Px) activity increased significantly with dietary supplementation of Vitamin C and O. sanctum. This may be due to conversion of lipid peroxides to alcohol derivatives rather than MDA in the presence of higher GSH levels with Vitamin C and Ocimum sanctum.

The findings of decreased plasma malondialdehyde (MDA) levels in the present study were in agreement with the reports of [16], they observed decreases in plasma GSH enzyme levels by supplementation of O. sanctum in broilers.

Table 1. Effect of dietary supplementation of Vitamin C, Ocimum sanctum and their combinations on SOD, GSH-Px and Catalase enzyme levels in broilers.

<table>
<thead>
<tr>
<th>Groups</th>
<th>SOD (50% pyrogallol auto-oxidation/ min/mg)</th>
<th>GSH-Px (µM of GSH utilized/min/mg)</th>
<th>Catalase (µM of H2O2 decomposed/ min/mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2.23 ± 0.03</td>
<td>2.46 ± 0.01</td>
<td>41.79 ± 0.11</td>
</tr>
<tr>
<td>II</td>
<td>2.85 ± 0.02</td>
<td>2.88 ± 0.02</td>
<td>44.54 ± 0.18</td>
</tr>
<tr>
<td>III</td>
<td>2.64 ± 0.03</td>
<td>2.85 ± 0.02</td>
<td>43.87 ± 0.07</td>
</tr>
<tr>
<td>IV</td>
<td>3.15 ± 0.02</td>
<td>3.28 ± 0.01</td>
<td>45.15 ± 0.09</td>
</tr>
</tbody>
</table>

Means bearing common superscripts in column do not differ significantly (p<0.05)
Hence it is concluded that the combination of both Vitamin C and O. sanctum can combat oxidative stress caused by rapid growth rate in heat stressed broilers there by effectively enhancing the SOD, GSH-Px, catalase activities and GSH levels with concomitant decrease in lipid peroxidation levels in plasma of heat stressed broilers.

References


Table 2. Effect of dietary supplementation of Vitamin C, Ocimum sanctum and their combinations on Reduced glutathione and Lipid peroxidation levels in broilers.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Reduced glutathione (mg GSH / ml)</th>
<th>Lipid peroxidation (nM of MDA / ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1.05 ± 0.03</td>
<td>6.20 ± 0.03</td>
</tr>
<tr>
<td>II</td>
<td>1.15 ± 0.02</td>
<td>5.23 ± 0.03</td>
</tr>
<tr>
<td>III</td>
<td>1.13 ± 0.03</td>
<td>5.39 ± 0.03</td>
</tr>
<tr>
<td>IV</td>
<td>1.23 ± 0.02</td>
<td>5.08 ± 0.04</td>
</tr>
</tbody>
</table>

Means bearing common superscripts in column do not differ significantly (p<0.05)