Hemato Biochemical Changes in Fenvalerate Toxicity and Amelioration with Vitamin E in Broiler Chicks

R. Ramana Murthy, K. Sujatha*, Ch. Srilatha, D. Sreenivasulu

Department of Veterinary Pathology, College of Veterinary Science, Sri Venkateswara Veterinary University Tirupati – 517502, Andhra Pradesh, India


Article history:
Received: 19 May, 2014
Accepted: 22 May, 2014
Available online: 31 July, 2014

Keywords:
Hematology, Biochemical alterations, Fenvalerate toxicity, Vitamin E, chicks

Corresponding Author:
Sujatha K.*
Associate Professor
Email: karamalasujatha@gmail.com

Murthy R.R.
Associate Professor

Srilatha Ch.
Professor & University Head

Sreenivasulu D.
Associate Dean

Abstract
Poultry is highly vulnerable to pesticide toxicity because grain crops, store houses, poultry houses and when birds are dusted with pesticides. So its exposure causes health hazards, economic losses and potential threat to public health due to its residues in poultry meat and organs. Hence present research carry out with objective of study the hematobiochemical alterations and ameliorating effect of vitamin E in experimentally induced fenvalerate toxicity in broiler chicks. For this study one hundred fifty apparently healthy unsexed broiler chicks(White Leghorn) were randomly divided into five groups (Control, Group I, Group II, Group III, Group IV) consisting of 30 chicks in each group. The control chicks fed with normal feed without fenvalerate. Group I and II fed with 20 ppm/kg feed and 40 ppm/kg feed Fenvalerate respectively. Whereas Group III and IV chicks were feed with 20 ppm/kg feed and 40 ppm /kg feed Fenvalerate respectively along with Vitamin E @ 2.5 ml each (62.5 mgs) in water. Hematologically, significant decrease in TLC and ALC was noticed among treated groups when compared to control as dose dependent manner. Whereas no significant change was noticed in TEC, Hb, PCV, AHC, AEC, AMC and ABC among treated and control chicks. Biochemically increased serum glucose, serum creatinine and decreased total serum protein, serum AChE were noticed in all fenvalerate treated birds when compared to control. Protective action of vitamin E at this dose level (@ 2.5 ml each to group III and IV throughout the experiment daily in water) was negligible. For future research the Vitamin E dose may be enhanced to see the ameliorative effect against fenvalerate toxicity.

Citation:

All Rights Reserved with Photon.
Photon Ignitor: ISJN17846372D706631072014

1. Introduction

Pesticides are commonly used to control pests and vectors in various agricultural and animal husbandry practices of public health concern. Chicken is highly vulnerable to pesticide toxicity because grain crops, store houses, poultry houses and when birds are dusted with pesticides. So its exposure causes health hazards, economic losses and potential threat to public health due to its residues in poultry meat and organs. Chronic and sub acute pesticide toxicities are one of the reasons for decreased body weight, immunosuppression leading to poor response to antibiotics, vaccination failures, increased susceptibility to infections and mortality in broilers (Selveraj et al., 2001; Garg et al., 2004).
Fenvalerate, a synthetic pyrethroid and a potent insecticide has been in use since 1980 in India. It is mostly employed in agriculture but also for insect control in homes and gardens and on livestock, alone or in combination with other insecticides. It is being commonly used now a days after withdrawal of DDT and BHC for pest control of maize, rice, cotton and oil seeds etc. which are incorporated in the poultry ration. Agrochemical usage practices are currently shifting, with a general movement away from organophosphates (OPs) towards pyrethroid pesticides. Considering the paucity of literature on fenvalerate toxicity in broiler chicken (Majunder 1994 and 1997).

1.1 Objective of research
- To study the haematological changes and biochemical changes associated with Fenvalerate toxicity in broiler chicks.
- To study the amelioration effect of Vitamin E against Fenvalerate toxicity in broiler chicks.

1.2 Justification of research
Recent years’ indiscriminate usage of pesticides to control pests throughout the world, so it causes adverse effect on health, production, immune status of animals and poultry. Now days after withdrawal of DDT and BHC for pest control of maize, rice, cotton and oil seeds etc. Fenvalerate, a synthetic pyrethroid and a potent insecticide being used in India since 1980. It is mostly employed in agriculture but also for insect control in homes and gardens and on livestock, alone or in combination with other insecticides. Hence the present study was undertaken to know the fenvalerate toxicity on hematopoietic system and biochemical constituents in broiler chicks along with amelioration effect of Vitamin E.

2. Materials and Methods
2.1 Experimental design
The present study was carried out by procuring one hundred fifty apparently healthy unsexed broiler chicks (White Leghorn) were procured from a local hatchery. All the chicks were vaccinated against Mareks disease prior to the delivery and maintained in deep litter system throughout the experimental period for 8 weeks by taking necessary precautions. The chicks were randomly divided into five groups (Control, Group I, Group II, Group III, Group IV) consisting of 30 chicks in each group. The control chicks fed with normal feed without fenvalerate. Group I and II fed with 20 ppm/kg feed and 40 ppm/kg feed Fenvalerate respectively. Whereas Group III and IV chicks were feed with 20 ppm/kg feed and 40 ppm/kg feed Fenvalerate respectively along with Vitamin E @ 2.5 ml each (62.5 mgs) in water to study the ameliorating effect of Vitamin E against Fenvalerate toxicity. (Vitamin E provided by Neospark Company). Five birds from each group were randomly picked up and sacrificed at every fortnight interval after starting the experiment i.e., 2nd, 4th and 6th week.

2.2 Collection of sample
Blood was collected in 10% EDTA solution from all groups in each sacrifice. Packed cell volume (PCV) was estimated by micro haematocrit method (Jain, 1993). Haemoglobin (Hb) by Sahli’s method (Coles, 1986). Total leukocyte count (TLC) (Nambiar, 1961) was also counted. DLC was made by following battlement method (Jain, 1986).

At each sacrifice serum was collected and the Total Protein (Span Diagnostics Ltd.), Glucose (Ozone Biochemical’s Ltd.), Creatinine (Span Diagnostics Ltd.) and Acetyl cholinesterase (Sigma Chemicals Ltd.) were estimated by using diagnostic kits.

2.3 Statistical analysis
The results were analyzed statistically (Snedecor and Cochran, 1994) for performing analysis of variance.

2.4 Review of literature
2.4.1 Haematology
Singh et al. (2001) recorded decrease in the values of total erythrocyte count, Hb and PCV in cockerels fed on higher concentration of fenvalerate (@4000 ppm) for 20 weeks.

Singh et al. (2001) observed significant reduction in total leukocyte and lymphocyte count in birds fed with fenvalerate @ 20 ppm for 6 months.

Satish-Mundas et al. (2001) noticed formation of microthrombi in the vessels and intravascular clumping of RBCs in birds fed with fenvalerate @100ppm for 8 weeks.

Garg et al. (2004a) did not observe any changes in total erythrocyte count, packed cell volume, hemoglobin, eosinophil and monocyte counts. But total leukocyte and lymphocyte counts were lower (p<0.01), in all treated birds with 20 ppm fenvalerate for 8 weeks.
2.4.2 Biochemical changes
Permethrin, a synthetic pyrethroid insecticide (40% cis; 60% trans) has been found to be an effective inhibitor of rat brain acetyl cholinesterase both under in vitro and in vivo conditions (Rajyasree Bandopadhyay 1982). Mohamed and Adam (1990) noticed reduction in the concentrations of total protein and calcium due to fenvalerate toxicity in goats.

Serum creatinine levels were increased and calcium levels were decreased in 21-day-old fayoumi chicks administered with fenvalerate @ 40 ppm orally for 135 days (Sobbhy et al., 1994). Inhibition of cholinesterase activity of the erythrocytes, liver and brain of rats was observed by Kagan et al. (1996).

Majumder et al. (1997) stated that fenvalerate has the capacity of inhibiting both pseudo and true cholinesterase enzyme.

Garg et al. (2004a) recorded decrease in blood glucose, serum globulin and acetyl cholinesterase (AChE) activity levels (P<0.01) in broiler chicken fed with fenvalerate @ 20 ppm for 8 weeks.

3. Results

The Mean and S.E values of Hematological parameters and Biochemical parameters of Control, fenvalerate treated and fenvalerate treated along with Vitamin E are shown in Table I and II respectively.

In the present experimental study, there was no significant difference was observed in fenvalerate treated groups in total erythrocyte count (TEC), PCV values, hemoglobin, absolute heterophil count (AHC), absolute

<table>
<thead>
<tr>
<th>Experimental groups</th>
<th>TLC (Thousands/cu.mm)</th>
<th>ALC (Thousands/cu.mm)</th>
<th>TEC (millions/cu.mm)</th>
<th>Hb (g%)</th>
<th>PCV (%)</th>
<th>AHC (Thousands/cu.mm)</th>
<th>AEC (Thousands/cu.mm)</th>
<th>AMC (Thousands/cu.mm)</th>
<th>ABC (Thousands/cu.mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>28.30 ± 0.23</td>
<td>15.62 ± 0.16</td>
<td>2.96 ± 0.13</td>
<td>10.62 ± 0.16</td>
<td>29.40 ± 0.50</td>
<td>9.08 ± 0.30</td>
<td>0.55 ± 0.01</td>
<td>1.85 ± 0.07</td>
<td>0.32 ± 0.02</td>
</tr>
<tr>
<td>G1</td>
<td>20.35 ± 0.16</td>
<td>11.07 ± 0.07</td>
<td>2.80 ± 0.32</td>
<td>10.60 ± 0.14</td>
<td>29.06 ± 0.52</td>
<td>9.08 ± 0.30</td>
<td>0.75 ± 0.04</td>
<td>1.40 ± 0.09</td>
<td>0.46 ± 0.11</td>
</tr>
<tr>
<td>G2</td>
<td>19.34 ± 0.13</td>
<td>10.43 ± 0.15</td>
<td>2.94 ± 0.29</td>
<td>10.25 ± 0.17</td>
<td>29.00 ± 0.60</td>
<td>9.48 ± 0.37</td>
<td>0.75 ± 0.04</td>
<td>1.36 ± 0.04</td>
<td>0.32 ± 0.01</td>
</tr>
<tr>
<td>G3</td>
<td>21.10 ± 0.20</td>
<td>11.76 ± 0.14</td>
<td>2.87 ± 0.51</td>
<td>10.32 ± 0.21</td>
<td>28.40 ± 0.46</td>
<td>8.46 ± 0.69</td>
<td>0.90 ± 0.01</td>
<td>1.27 ± 0.02</td>
<td>0.30 ± 0.01</td>
</tr>
<tr>
<td>G4</td>
<td>19.50 ± 0.13</td>
<td>11.16 ± 0.13</td>
<td>2.85 ± 0.32</td>
<td>10.64 ± 0.14</td>
<td>28.53 ± 0.49</td>
<td>8.88 ± 0.44</td>
<td>0.89 ± 0.01</td>
<td>1.48 ± 0.08</td>
<td>0.38 ± 0.06</td>
</tr>
</tbody>
</table>
eosinophil count (AEC), absolute monocyte count (AMC) and absolute basophil count (ABC) when compared to the control group. Similarly There was no ameliorating effect was noticed between fenvalerate treated groups and fenvalerate with vitamin E treated groups.

Table 2: Mean and SE values of different biochemical alterations of different experimental groups

<table>
<thead>
<tr>
<th>Experimental groups</th>
<th>Serum Glucose (mg%)</th>
<th>Serum Creatinine (mg/100ml)</th>
<th>Serum Protein (g%)</th>
<th>Serum AchE(nmol Ach/mg protein/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>182.75±2.93</td>
<td>0.61±0.01</td>
<td>3.68±0.09</td>
<td>18.43±0.10</td>
</tr>
<tr>
<td>Group-I</td>
<td>214.03±1.13</td>
<td>1.23±0.07</td>
<td>2.48±0.01</td>
<td>15.21±0.08</td>
</tr>
<tr>
<td>Group-II</td>
<td>219.09±1.09</td>
<td>1.62±0.03</td>
<td>2.38±0.02</td>
<td>14.62±0.14</td>
</tr>
<tr>
<td>Group-III</td>
<td>213.18±1.56</td>
<td>1.23±0.04</td>
<td>2.43±0.21</td>
<td>15.03±0.08</td>
</tr>
<tr>
<td>Group-IV</td>
<td>220.91±2.02</td>
<td>1.43±0.03</td>
<td>2.53±0.02</td>
<td>14.34±0.07</td>
</tr>
</tbody>
</table>

Biochemically increased serum glucose, serum creatinine and decreased total serum protein, serum AchE were noticed in all fenvalerate treated birds when compared to control.

4. Discussion

Significant (p<0.05) decrease in total leukocyte count and absolute lymphocyte count was observed in Fenvalerate treated groups when compared to control group. There was non significant improvement was noticed in ALC values in Vitamin E treated groups (III & IV) as dose dependent manner. which was gained support from Garg et al. (2004a) who observed no change in TEC, PCV, Hb, AEC, AMC and significant (p<0.01) decrease in TLC and ALC in birds treated with 20 ppm fenvalerate for 8 weeks. But Singh et al., (2001) recorded decrease in values of TEC, Hb and PCV in cockerels fed on higher concentration of fenvalerate (@ 4000 ppm) for 20 weeks. It indicated that fenvalerate feeding at low dose levels (20 ppm, 40 ppm) caused no significant change in some hematological parameters like TEC, Hb, PCV, AEC, AMC and ABC. Reduction in absolute lymphocytes might be due to depletion of lymphoid tissue in the thymus and bursa. This decrease in absolute lymphocyte count might be reflected by decrease in total leukocyte count.

Significant (p<0.01) increase in serum glucose values were noticed in group I, II, III and IV when compared to control. There was no significant difference was noticed among fenvalerate treated and fenvalerate and Vitamin E treated groups. The similar observation was made by Garg et al., (2004) who recorded hyperglycemia (p<0.01) in broiler chicken fed with fenvalerate @ 20 ppm for 8 weeks. Hyperglycemia might be due to depletion of islets of langerhans in pancreas, which was observed microscopically in the present experiment. It might be also due to hyperexitability and enhanced glycogenolysis via stimulation of adenyl cyclase system (Singhal and Kacew., 1976) or due to release of corticosteroids by the stimulation of the adrenal glands.

Total serum protein (TSP) values were decreased significantly (p<0.01) in group I, II, III and IV when compared to control. There was no significant difference was noticed among fenvalerate treated and fenvalerate and Vitamin E treated groups. Garg et al. (2004) observed decrease in serum globulin in broiler chicken fed with fenvalerate @ 20 ppm for 8 weeks. Similar reduction in total serum protein was noticed by Mohamed and Adam., (1990) in Nubian goats fed with single dose of fenvalerate @ 1350 ppm. Decrease in total serum protein might be due to decrease in serum globulin. The rough endoplasmic reticulum, which was primary organelle for globulin synthesis and hepatorenal insufficiency, might be affected due to fenvalerate toxicity.

Significant (p<0.05) decrease in serum AchE was noticed in group I, II, III and IV when compared to control. There was no significant difference was noticed among fenvalerate treated and fenvalerate and Vitamin E treated groups. Garg et al. (2004) observed significant decrease in serum AchE followed by oral administration of fenvalerate @ 20 ppm daily for 8 weeks to broiler chicks. Decrease in serum AchE might be due to fenvalerate effect on nicotinic AchE receptors.

Significant (p<0.05) increase in serum creatinine was noticed in all experimental groups when compared to control. There was no significant improvement was noticed in among fenvalerate treated (40 ppm) and fenvalerate and Vitamin E treated group (40 ppm + 2.5 ml of Vit.E). Sobbhy et al. (1994) observed increased serum creatinine levels after administration of fenvalerate @ 40 ppm daily for 135 days to 21 day old fayoumi chicks. Demerdash et al., (2004) recorded a significant (p<0.05) increase in plasma
creatinine values following oral administration of fenvalerate @ 20 ppm for 30 days in rats. The increase in serum creatinine might be due to hepato-renal insufficiency caused by fenvalerate.

Conclusions

In the present study, hematologically leucopenia with lymphocytopenia was recorded. Biochemically increased serum glucose, serum creatinine and decreased total serum protein, serum AChE were noticed in all fenvalerate treated birds when compared to control. These results indicates that immunosupression, nephrotoxic and hepatotoxic effect of fenvalerate in chicks. It was concluded that fenvalerate at 20 ppm , 40 ppm in feed for 6 weeks was mildly to moderately toxic. Protective action of vitamin E at this dose level (@ 2.5 ml each to group III and IV throughout the experiment daily in water) was negligible. Keeping in view, further studies may be advocated by using higher doses of vitamin E for ameliorative effect.

Research Highlights

- Fenvalerate toxicity causes Leucocytopenia and lymphopenia, so it indicates immunosuppressive effect.
- Decreased serum protein concentration indicates hepatotoxic effect of fenvalerate.
- Increased serum Creatinine levels indicate nephrotoxic effect of fenvalerate.

Acknowledgements

The authors are thankful to Sri Venkateswara Veterinary University, Tirupati for providing facilities to carry out post graduate research work at Department of Pathology, College of Veterinary Science, Tirupati.

References


