Residual Effect of Fenvalerate Toxicity in Broiler Chicks and Amelioration with Vitamin E

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Abstract
To study the residual effect of fenvalerate in broiler chicks 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 fed 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. Residue levels in liver were estimated by Gas chromatograph and were 0.0081 ppm, 0.0540 ppm, 0.0060 ppm, 0.0506 ppm for group I, II, III and IV respectively. Positive results for fenvalerate residues in liver indicated the residual effect of fenvalerate in liver. 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.

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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. India is using approximately 85,000 tonnes of pesticides per annum. Currently 400 members of three groups of pesticides i.e. Chlorinated hydrocarbons (CHC), Organophosphates (OP) and Synthetic pyrethroids (SP) are being used in India and the use of CHC, OP and SP was 40%, 30% and 30% respectively (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 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. Analytical methods were
introduced for the determination of residues of ectoparasiticides containing pyrethroid and organophosphate active ingredients in food. Milk and edible tissues of cows were tested for three experimental ectoparasiticides. Synthetic pyrethroid residues were not detected in any of the samples processed (Szerletics Turi et. al., 2000). The present study was undertaken to know the residual effect of fenvalerate in broiler chicks and ameliorating effect of vitamin E in experimentally induced fenvalerate toxicity in broiler chicks.

1.1 Objective of Research
To study the residual effect of fenvalerate in broiler chicks
To study the ameliorating effect of vitamin E against Fenvalerate induced residues 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. Nowadays 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. So residues of pesticides will increasing day by day in all vegetables, fruits and all kinds of meat and affect the either human and animal systems especially it effects immune system, haemopoitic system, hepatic system and nervous system etc. Hence the present study was undertaken to know the residual effect of fenvalerate in broiler chicks and ameliorating effect of vitamin E.

2. Materials and Methods

2.1 Experimental Design
Day old commercial broiler (White Leghorn) chicks were procured from a local hatchery. All the chicks were vaccinated against Mareks disease prior to the delivery. 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 fed 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 Fenvalate 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 Study of fenvalerate residual levels in liver
Liver samples (each sample 5grams) were collected from all experimental groups including control at every fortnight interval to till the end of experiment (i.e. 3rd fortnight). All the samples were processed for residual estimation by Gas chromatography.

2.2.1 Principle
Fat and residues are removed from animal tissue by dissolving them in petroleum ether. Anhydrous sodium sulphate removes water from the tissue and helps to disintegrate the sample. The extract is cleaned up on florisol column.

2.2.2 Procedure:
Approximately 20 g of liver tissue was taken and thoroughly mixed and ground by homogenizer.

- 40 g Sodium sulphate was moistened with petroleum ether and added to the sample.
- By using stirring rod, the sample was mixed and let it stood for 20 min, and mixed again.
- 100 ml petroleum ether was added to the sample and mixed again with stirring rod and extracted as before.
- Extraction was repeated with 70 ml petroleum ether, combining all three extractions in the same flask.
- The extract was concentrated to a suitable volume for florisol clean up.

2.2.3 Florisol column clean up
Activated florisol 4 g was placed in 10 mm id glass column, about 20 g sodium sulphate was added. About 25 ml petroleum ether was added to florisol column. As solvent level reached just above the sodium sulphate, 3 ml concentrated sample extract was transferred to glass column. Column was eluated with 35 ml each of

1. 6% ethyl ether / petroleum ether
2. 15% ethyl ether / petroleum ether.
Each eluate was concentrated to suitable definite volume in vacuum rotary evaporator for Gas Liquid Chromatograph (GLC) analysis.

<table>
<thead>
<tr>
<th>Name of the Gas Chromatograph</th>
<th>VARIAN CP 3800 Instrument – I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the Column</td>
<td>VARIAN Factor four for Capillary Column</td>
</tr>
<tr>
<td></td>
<td>VF-1 MS, 15 mts, 0.25 mm ID, 0.25 μm film.</td>
</tr>
<tr>
<td>Carrier Gas used</td>
<td>Nitrogen, IOLAR - I</td>
</tr>
<tr>
<td>Carrier Gas Flow</td>
<td>1.0 ml/min</td>
</tr>
<tr>
<td>Column Temperature/ Oven Temperature</td>
<td>200 °C - 5 min - 5 °C - 240 °C - 35 min</td>
</tr>
<tr>
<td>Injector Temperature (°C)</td>
<td>260 °C</td>
</tr>
<tr>
<td>Injector Split Ratio</td>
<td>Off</td>
</tr>
<tr>
<td>Detector</td>
<td>ECD</td>
</tr>
<tr>
<td>Detector Temperature (°C)</td>
<td>280 °C</td>
</tr>
<tr>
<td>Detector Range</td>
<td>1</td>
</tr>
<tr>
<td>Make – up gas flow (ml/min)</td>
<td>25</td>
</tr>
</tbody>
</table>

**Parameters of the Gas Chromatograph used**

<table>
<thead>
<tr>
<th>Residue in ppm</th>
<th>Area of sample</th>
<th>ng. of standard injected</th>
<th>final volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>---------------</td>
<td>--------------------------</td>
<td>--------------</td>
</tr>
</tbody>
</table>

Here

\[ \text{ng of standard injected} = 1 \text{ng.} \]
\[ \text{μl of sample injected} = 1 \text{ μl} \]
\[ \text{Final Volume} = 10 \text{ ml} \]
3. Results

3.1 Fenvalerate residue in liver

Fenvalerate residue was found in livers of group I, II, III and IV. No residue was found in control livers. Fenvalerate peaks were shown in fig. 1, 2, 3 and 4 for group I, II, III and IV accordingly. Standard fenvalerate peak and data for 1 ppm fenvalerate was presented in fig 5. Fenvalerate residues (ppm) in liver of different experimental groups was shown in Table 1.

\[
\text{Residue (in mg kg}^{-1}\text{ i.e. ppm)} = \frac{\text{Area of sample}}{\text{Area of the standard}} \times \frac{\text{ng of standard injected}}{\mu l \text{ of sample injected}} \times \frac{\text{final volume}}{\text{Weight of sample}}
\]

For all experimental group (group I, II, III and IV)

\[
\text{Area of the standard} = 497216
\]

\[
\text{ng. of standard injected} = 1 \text{ng}
\]

\[
\mu l \text{ of sample injected} = 1 \mu l
\]

\[
\text{Final volume} = 10 \text{ ml}
\]

**Group I**

Area of the sample as shown in the data is 6784 (fig.1). Weight of the liver sample was 16.72 g. By substituting the values in the above formula, fenvalerate residue was 0.00816 ppm in the liver.

**Group II**

In the data, area of the sample was 49484 (fig.2) and weight of the liver sample was 18.4 g. By substituting the values in the formula, fenvalerate residue in the liver was 0.0540 ppm.

**Group III**

Area of the sample as shown in the data was 5288 (fig.3). Weight of the liver sample was 10 g. Fenvalerate residue obtained was 0.0060 ppm.

**Group IV**

In the data, area of the sample was 25196 (fig.4) and weight of the liver sample was 10 g. By substituting the values in the formula, fenvalerate residue in the liver was 0.0506 ppm.

4. Discussion

Livers were tested for pesticidal residues by using Gas chromatography and livers from all fenvalerate treated groups (group I, II, III and IV) were given positive results with fenvalerate residues of 0.0081 ppm, 0.0540 ppm, 0.0060 ppm and 0.0506 ppm in group I, II, III and IV respectively.

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Weight of liver (Grams)</th>
<th>Data obtained in Gas chromatography</th>
<th>Fenvalerate residue in liver After calculation (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>16.72</td>
<td>6784</td>
<td>0.00816</td>
</tr>
<tr>
<td>Group II</td>
<td>18.4</td>
<td>49484</td>
<td>0.0540</td>
</tr>
<tr>
<td>Group III</td>
<td>10</td>
<td>5288</td>
<td>0.0060</td>
</tr>
<tr>
<td>Group IV</td>
<td>10</td>
<td>25196</td>
<td>0.0506</td>
</tr>
</tbody>
</table>
Figure 1: Showing Group – I liver Fenvalerate peak

Figure 2: Showing Group – II liver Fenvalerate peak
Figure 3: Showing Group – III liver Fenvalerate peak

Figure 4: Showing Group – IV liver Fenvalerate peak
Majumder et al., (1994) recorded residues in intestine followed by fat, brain, liver after oral administration of fenvalerate @ 525.6 mg once daily for 28 days in broiler chicks. Majumder et al., (1997) observed maximum amount of residues in kidneys followed by heart, body fat, liver and brain following dermal application of fenvalerate at 0.1% in chicken. It was reported that because of low application rates and rapid degradation in the environment, residues of synthetic pyrethroid in food are generally low. Whereas Mandal et al., (1992) noticed maximum residues of fenvalerate in the adrenal gland followed by the liver, kidney and intestine in goats fed with fenvalerate @ 5mg/kg. Residues in tissues peaked 4 days post treatment and then fell.

There was no appreciable decrease in severity of lesions and residual levels in group III and IV was noticed. It indicated that ameliorative effect of vitamin E @ 2.5 ml (62.5 mg vitamin E) was negligible. Observations about the ameliorative effect of vitamin E in fenvalerate toxicity in case of poultry were not available in literature to compare. But Demerdash et. al., (2004) reported that vitamin E @ 100mg/kg body weight for 30 days on every other day treated mice showed improved semen quality and minimized toxic effects of fenvalerate (@ 20 mg fenvalerate/kg for 30 days on every other day).

Conclusions

In the present study, positive results for fenvalerate residues in liver indicated the residual effect of fenvalerate in liver. 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.

Acknowledgements

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Research Highlights

Fenvalerate toxicity induces residues in livers of all experimental groups except control group.

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.

Further studies may be advocated by using higher doses of vitamin E for ameliorative effect against fenvalerate toxicity.
Recent year’s 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. So residues of pesticides will increasing day by day in all vegetables, fruits and all kinds of meat and affect the either human and animal systems especially its effects immune system, haemopoitic system, hepatic system and nervous system etc.fenvalerate in broiler chicks and ameliorating effect of vitamin E.

References


