Effect of *Butea monosperma* feeding in ameliorating the toxicity of imidacloprid in liver in Japanese quails

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ABSTRACT

The effects of feeding imidacloprid were assessed in the liver of Japanese quails and studied the effect of feed mix of *Butea monosperma* on ameliorating effect against the imidacloprid toxicity. The serum biochemical assay revealed significant increase in AST, ALT and GGT in imidacloprid treated birds. Histologically, the liver showed sinusoidal dilatation, bile duct hyperplasia and periportal necrosis. Ultra thin sections of liver revealed numerous fat globules, condensed hepatocytes and mitochondria with granular cytoplasm. It was observed that co-treatment with *Butea monosperma* moderately restored the imidacloprid induced changes.

Key words: *Butea monosperma*, Imidacloprid, Japanese quails, Liver, Toxicity.

Abbreviations: AST= Aspartate transaminase; ALT= Alanine transaminase; GGT= Gamma glutamyl transferase, *B. monosperma*= *Butea Monosperma*

INTRODUCTION

Neonicotinoids, were the most widely used insecticides, because they showed reduced toxicity compared to previously used organophosphate and carbamate insecticides according to their selective toxicity. Imidacloprid [1 (6 – chloro – 3 - pyridymethyl) – N – nitroimidazolidin - 2-ylideneamine] was the first representative of neonicotinoid insecticides to be registered for use and is presently the most important commercial product because of its high efficacy against insects at very low application rate with low soil persistence. Due to its toxic effect, the World Health Organization (WHO) has classified imidacloprid as a moderately hazardous Class II pesticide (WHO, 2004). Imidacloprid is a potent neuro, hepato and renal toxic agent in chicken (Kammon et al., 2010). *Butea monosperma* was claimed to possess hepatoprotective property (Chavan et al., 2010) because of their polyphenolic constituents like flavonoids. They are potent antioxidants and have free radical scavenging abilities (Raj Narayana et al., 2001). The aim of the present study was to evaluate the pathological effects of subacute imidacloprid toxicity and ameliorating effect of *Butea monosperma* in Japanese quail.

MATERIALS AND METHODS

Two-weeks-old unsexed 75 Japanese quails procured from Venkteshwara Hatcheries, Pune were acclimatized for one week and divided into five groups comprising 15 birds in each group kept on *ad libitum* supply of feed and water. The experimental trial was approved by the Institutional Animal Ethics Committee (312/CPCSEA).

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RESULTS AND DISCUSSION
Effect on serum biochemical markers: Serum analysis revealed a non-significant difference in mean values of total protein, albumin, globulin and A/G ratio on 28th day of experiment (Table 1). A significant (P<0.05) increase in ALT, AST and GGT activity was seen at the end of 28 day of experiment following imidacloprid administration in group II. Co-administration of B. monosperma significantly (P<0.05) reversed the above values with more pronounced effect at 4 g/kg in feed (Table 2).

A significant increase in serum AST, ALT and GGT levels in group II birds were observed when compared with control group. These results are consistent with the earlier reports of Balani et al., (2011) in White leghorn cockerels. Imidacloprid is rapidly absorbed via the gastrointestinal tract (Meister, 1994) and the liver is the main organ to metabolize this compound. Generally, increased enzyme concentrations are a measure of recent organ damage rather than decreased organ function. The increase of plasma AST and ALT activity is the most specific indicators of muscle and liver cell damage (Lumaij, 1997). The increases of plasma AST activity and bile acid concentration were the most specific indicators of liver disease in the racing pigeons intoxicated by ethylene glycol (Lumeij, 1997). In our study plasma AST and ALT activities were significantly increased in imidacloprid intoxicated birds. These results suggest that administration of this insecticide causes necrotic changes in the liver thus causing leakage of the enzymes into the blood. These findings were correlated with the histopathological and ultrastructural changes observed in the liver of group II birds.

Non-significant differences were observed in levels of total protein, albumin, globulin and A:G ratio in the present experiment. These findings are in accordance with the findings of Kammon et al., (2010). The results of the present study

**Table 1:** Serobiochemical profiles (Mean± S.E.) in birds of different groups (n=6).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Total protein (gm/dL)</th>
<th>Albumin (gm/dL)</th>
<th>Globulin* (gm/dL)</th>
<th>A:G Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.23 ± 0.214</td>
<td>1.41 ± 0.060</td>
<td>2.81 ± 0.163</td>
<td>0.50 ± 0.016</td>
</tr>
<tr>
<td>2</td>
<td>3.41 ± 0.186</td>
<td>1.28 ± 0.079</td>
<td>2.12 ± 0.145</td>
<td>0.62 ± 0.056</td>
</tr>
<tr>
<td>3</td>
<td>4.25 ± 0.399</td>
<td>1.48 ± 0.212</td>
<td>2.77 ± 0.250</td>
<td>0.54 ± 0.063</td>
</tr>
<tr>
<td>4</td>
<td>3.85 ± 0.358</td>
<td>1.37 ± 0.056</td>
<td>2.48 ± 0.372</td>
<td>0.65 ± 0.142</td>
</tr>
<tr>
<td>5</td>
<td>3.95 ± 0.321</td>
<td>1.43 ± 0.109</td>
<td>2.52 ± 0.246</td>
<td>0.59 ± 0.053</td>
</tr>
</tbody>
</table>

* Values calculated by subtracting albumin from total protein

**Table 2:** Serobiochemical profiles and liver weights (Mean ± S.E.) in birds of different groups (n=6).

<table>
<thead>
<tr>
<th>Groups</th>
<th>AST (IU/L)</th>
<th>ALT (IU/L)</th>
<th>GGT (IU/L)</th>
<th>Liver weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>221.55±11.626</td>
<td>24.22±1.922</td>
<td>9.01±0.228</td>
<td>4.48±0.410</td>
</tr>
<tr>
<td>2</td>
<td>286.20±24.591</td>
<td>35.50±2.571</td>
<td>12.53±0.866</td>
<td>4.87±0.428</td>
</tr>
<tr>
<td>3</td>
<td>203.83±2.528</td>
<td>22.19±1.507</td>
<td>8.01±0.174</td>
<td>4.39±0.260</td>
</tr>
<tr>
<td>4</td>
<td>228.35±8.099</td>
<td>29.02±1.170</td>
<td>10.95±1.566</td>
<td>4.60±0.178</td>
</tr>
<tr>
<td>5</td>
<td>217.36±5.303</td>
<td>25.67±1.044</td>
<td>9.68±0.115</td>
<td>4.55±0.153</td>
</tr>
</tbody>
</table>

Means bearing common superscripts did not differ significantly (P<0.05).
were in agreement with previous studies, where supplementation of *Butea monosperma* restored AST, ALT and GGT levels to normal in Japanese quails given imidacloprid (Sathish *et al.*, 2011).

**Effect on organ weight, gross pathology and histopathology of liver:** Liver showed non-significant difference in weight as compared to their weights in control group. Preeti *et al.*, (2014) also found non-significant difference in the liver weight when imidacloprid was given to Swiss albino mice. Gross abnormalities observed in liver were pale discoloration with haemorrhages and increased fragility in group II. Histopathologically in group II, liver showed cellular swelling, dilatation of sinusoidal space in hepatic parenchyma, fatty degenerative changes with infiltration of round cells (Fig. 1). Remarkable changes noticed include, disruption of normal structural organization of hepatic lobule and cord like arrangement of hepatocytes. Hepatic congestion, bile duct hyperplasia and periportal necrosis (Fig. 2) were also observed in liver of group II. Few sections of liver showed dilatation of central vein. Pyknotic nuclei and irregularly arranged hepatic cords were also observed. In group III, no lesions of pathological significance were observed and liver sections of group IV and group V revealed mild sinusoidal dilatation, lesser degree of focal haemorrhages and almost intact lobular structure as compared to that of group II birds.

The results of gross abnormalities of pale discoloration with haemorrhages and increased fragility in group II in the present study and histological changes were in accordance with histopathological lesions observed in livers Japanese quail (Eissa, 2004), layer chickens (Kammon *et al.*, 2010) and rats (Lohiya *et al.*, 2017). These changes might be due to accumulation of imidacloprid metabolites in liver as it is the principle target organ for any detoxification mechanism. The vacuolation of hepatocytes could be due to the retention of fluid inside the cell resulting in cellular swelling probably due to reduction of energy supply necessary for regulation of ion concentration of the cells. Liver of groups IV and V showing mild sinusoidal dilatation, lesser degree of focal haemorrhage and almost intact lobular structure could be attributed to hepatoprotective activity of *B. monosperma* that might have resulted in mild regeneration and repair of damaged hepatocytes. The results of the present study were in agreement with previous studies, where supplementation of *Butea monosperma* brought improvement in histoarchitecture of liver (Sharma and Shukla, 2011).

**Effect on ultra structural pathology of liver:** Ultrastucturally in group II, liver revealed numerous fat globules variable in shape and size, vesicular structures in the vicinity of fat globules and periphery of fat globules showed electron dense granular material. Liver also revealed condensed hepatocytes, granular cytoplasm and condensed hazy mitochondria appeared to be electron dense. In group IV and V, liver revealed vesicular cytoplasm with small sized globules, congestion of sinusoidal area and condensed hepatocytes. Ultra structural changes noticed in liver of group II birds could not be compared as no previous study in birds could be traced in the literature; however the results correlated with the findings of a study on imidacliplrid induced toxicity in male Albino rats (Soujanya *et al.*, 2013).

*Butea monosperma* has antistress, antioxidant, anti-inflammatory and hepato-protective activity. In the present study supplementation of *Butea monosperma* brought moderate protection in all the above parameters. Relatively milder pathological changes observed in group IV and V with more pronounced effect at 4 g/kg of feed suggesting hepatoprotective property of *Butea monosperma* by enhancing the regenerative ability of liver which may be attributed to the antioxidant potential and the phytochemical constituents of the plant. This might be due to the presence of butrin and isobutrin in *B. monosperma* that possess antihepatotoxic properties which have been confirmed by the studies of Sharma and Shukla (2011).

**CONCLUSION**

Imidacloprid exposure leads to marked alterations in serobiochemical parameters, histopathology and ultra structure of liver. Imidacloprid was found to be a potent hepatotoxic agent and co-treatment with *Butea monosperma* moderately restored the imidacloprid induced hepatic changes.
REFERENCES


