Effect of Citrinin and Aflatoxin on Serum Lipid Profile of Broiler Chicken*

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Abstract

The present study was undertaken to find out the individual and combined effects of citrinin (CTN) (5 ppm) and aflatoxin (AF) (0.5 ppm) on serum lipid profile in broiler chicken, by feeding the toxins from 0 to 6 weeks of age. Significant (P<0.05) increase in the serum triglycerides, very low density lipoproteins and total cholesterol/ high density lipoprotein ratio and significant (P<0.05) decrease in the total cholesterol, high density lipoproteins and low density lipoproteins were observed in the mycotoxin fed birds. The CTN+AF combined toxicity had more effect. However, AF seemed to play a major role and the combined effect due to CTN was less than additive.

Key words: aflatoxin, citrinin, broiler chicken, lipid profile.

Inadequate storage of agricultural products in high humidity and conducive temperature facilitates the development of fungi which results in spoilage of the products, poor quality and the development of mycotoxins. Citrinin (CTN) and aflatoxin (AF) are two hepatonephrotoxic mycotoxins that affect the growth and productivity of broiler chicken. At present, CTN is seen together with AF more frequently in the feed samples. Ahamed and Vairamuthu (2000) reported that the co-contamination of AF and CTN in feed was 9.3 per cent. Considering the paucity of literature on the effect of CTN and AF in affecting the serum lipid profile of broiler chicken at minimum dose level, the individual and combined effects of CTN at 5 ppm and AF at 0.5 ppm level, were studied.

Materials and Methods

Citrinin was produced on maize and rice and the AF was produced on rice as reported earlier (Theophilus Anand Kumar and Balachandran, 2014). Two experimental trials were conducted using 96 broiler chicks. In each trial, a total of 48 newly hatched broiler chicks were randomly allotted to 4 groups of 12 birds each and fed with control, CTN (5 ppm), AF (0.5 ppm) and CTN (5 ppm) + AF (0.5 ppm) diets from 0 to 6 weeks of age. Blood samples of six birds from each group were collected at the end of 3rd and 6th week of age from both the trials. The blood samples were allowed to clot and centrifuged at 1500 rpm for 20 min to separate the sera.

Total cholesterol was estimated by cholesterol dehydrogenase/peroxidase method, triglycerides by colorimetric enzymatic method, HDL by precipitation method, VLDL using the formula TG/5, LDL using the formula (TC-HDL-VLDL) and TC/HDL ratio, by using semi-auto analyser (Prime, Biosed). The data generated were subjected to two way analysis of variance using SPSS version 9.0 software for windows.

Results and Discussion

No mortality was observed in the control and mycotoxin fed groups. The mean ± SE serum triglycerides, total cholesterol, HDL, LDL and VLDL and TC/HDL values of broiler chicks fed with control, CTN, AF and CTN+AF diets are shown in Tables 1 and 2. Significant (P<0.05) differences were observed between the control and mycotoxin treated groups for triglycerides, total cholesterol, HDL, LDL, VLDL and TC/HDL values. Serum triglycerides and VLDL levels differed significantly (P<0.05) in the AF and CTN-AF groups compared to control and CTN groups. The AF and CTN+AF groups

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showed significant (P<0.05) increase in the overall mean values of triglyceride and VLDL levels when compared to the control and CTN groups. Hypertriglyceridaemia and increased VLDL found in the AF group concurred with the findings of Gounalan (2005) who reported a significant increase in triglyceride and VLDL levels in layer chicks fed with 0.5 ppm AF for 12 weeks.

Total cholesterol, HDL and LDL levels in the AF and CTN-AF groups were significantly (P<0.05) decreased from that of control and CTN groups. No significant difference in the total cholesterol, HDL and LDL levels was observed between the AF and CTN+AF groups as well as between the control and CTN groups. CTN differed significantly (P<0.05) from that of AF and CTN+AF groups for HDL. There was a significant (P<0.05) decrease in the total cholesterol, LDL and HDL levels in the mycotoxin treated groups when compared to the control. This concurred with the findings of Ahamad (1999) in birds fed with 150 ppm CTN from 3 to 30 days of age. However, Swaminathan (2002) observed a significant increase in the value of cholesterol when CTN was fed at 150 ppm to broiler chicks for 28 days. Hypcholesterolaemia and decreased HDL and LDL levels in the AF and CTN+AF groups agreed with the findings of Gounalan (loc.cit.). Similar reduction in serum cholesterol level was also recorded in broiler chicks fed at and above 0.1 ppm AF (Ahamad loc.cit.; Kumar and Balachandran, 2005)

TC/HDL ratio revealed significantly (P<0.05) increased values in all mycotoxin fed groups when compared to the control. No significant difference was observed between the CTN and AF fed groups. Significant increase was observed in the CTN+AF when compared to the individual toxin fed groups. Gounalan (loc.cit.) also observed a significant increase in the TC/HDL ratio in layer chicken fed with 0.5 ppm AF for 12 weeks.

The increase in triglycerides, VLDL and TC/HDL levels and decrease in the serum cholesterol, HDL and LDL levels observed in this study might be due to the altered lipid metabolism following the hepatic damage. Both mycotoxins cause hepatic damage (Theophilus Anand Kumar and Balachandran, loc.cit.) and a decrease in the sterol carrier proteins resulting from decreased protein synthesis, which could affect cholesterol synthesis. Poor consumption and the gall bladder distension with interference in bile secretion and thereby leading to

### Table I. Mean (±SE) serum triglycerides, total cholesterol and HDL in broiler chicken fed with control, CTN, AF and CTN+AF diets

<table>
<thead>
<tr>
<th>Groups (n=12)</th>
<th>3rd week</th>
<th>6th week</th>
<th>Overall mean</th>
<th>3rd week</th>
<th>6th week</th>
<th>Overall mean</th>
<th>3rd week</th>
<th>6th week</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>111.57 ± 4.25</td>
<td>107.09 ± 4.88</td>
<td>109.33 ± 3.20</td>
<td>138.84 ± 6.45</td>
<td>144.30 ± 11.26</td>
<td>141.57 ± 6.37</td>
<td>43.41 ± 5.28</td>
<td>42.82 ± 6.30</td>
<td>43.11 ± 4.02</td>
</tr>
<tr>
<td>CTN (5 ppm)</td>
<td>119.30 ± 9.71</td>
<td>115.19 ± 6.96</td>
<td>117.25 ± 5.85</td>
<td>142.15 ± 9.71</td>
<td>132.30 ± 12.45</td>
<td>137.23 ± 7.79</td>
<td>35.63 ± 2.92</td>
<td>30.15 ± 2.13</td>
<td>32.88 ± 1.86</td>
</tr>
<tr>
<td>AF (0.5 ppm)</td>
<td>140.93 ± 13.29</td>
<td>139.39 ± 5.33</td>
<td>140.16 ± 7.00</td>
<td>114.69 ± 9.45</td>
<td>95.75 ± 10.21</td>
<td>105.22 ± 7.09</td>
<td>26.31 ± 2.86</td>
<td>24.69 ± 2.17</td>
<td>25.49 ± 1.77</td>
</tr>
<tr>
<td>CTN + AF</td>
<td>141.08 ± 16.46</td>
<td>144.90 ± 12.22</td>
<td>142.99 ± 10.03</td>
<td>108.01 ± 12.2</td>
<td>86.08 ± 7.53</td>
<td>97.04 ± 7.38</td>
<td>25.87 ± 2.94</td>
<td>18.09 ± 1.82</td>
<td>21.98 ± 1.87</td>
</tr>
</tbody>
</table>

Overall means with different superscripts differ significantly (P<0.05)

### Table II. Mean (±SE) serum LDL, VLDL and TC/HDL in broiler chicken fed with control, CTN, AF and CTN+AF diets

<table>
<thead>
<tr>
<th>Groups (n=12)</th>
<th>3rd week</th>
<th>6th week</th>
<th>Overall mean</th>
<th>3rd week</th>
<th>6th week</th>
<th>Overall mean</th>
<th>TC/HDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>72.51 ± 8.05</td>
<td>75.02 ± 10.02</td>
<td>73.77 ± 6.29</td>
<td>22.31 ± 0.85</td>
<td>21.42 ± 0.98</td>
<td>21.87 ± 0.64</td>
<td>3.63 ± 0.36</td>
</tr>
<tr>
<td>CTN (5 ppm)</td>
<td>81.06 ± 8.69</td>
<td>79.12 ± 12.61</td>
<td>80.09 ± 7.49</td>
<td>25.54 ± 1.77</td>
<td>23.04 ± 1.39</td>
<td>24.29 ± 1.13</td>
<td>4.23 ± 0.40</td>
</tr>
<tr>
<td>AF (0.5 ppm)</td>
<td>59.34 ± 8.86</td>
<td>43.19 ± 9.55</td>
<td>51.26 ± 6.59</td>
<td>28.18 ± 2.66</td>
<td>27.88 ± 1.07</td>
<td>28.03 ± 1.40</td>
<td>4.66 ± 0.43</td>
</tr>
<tr>
<td>CTN + AF</td>
<td>54.06 ± 12.57</td>
<td>38.01 ± 6.40</td>
<td>46.03 ± 7.10</td>
<td>28.08 ± 3.31</td>
<td>28.98 ± 2.44</td>
<td>28.53 ± 2.01</td>
<td>4.43 ± 0.52</td>
</tr>
</tbody>
</table>

Overall means with different superscripts differ significantly (P<0.05)
poor assimilation of fat could be the contributing factors. Hypocholesterolaemia observed in the CTN+AF group concurred with the findings of Ahamad (loc.cit.), who opined that this could be due to AF as there was no significant change seen in the CTN group. In the present study too, AF played a major role in causing hypocholesterolaemia in the CTN+AF group.

Summary

Feeding of citrinin (5 ppm) and aflatoxin (0.5ppm) to broiler chicken for 0-6 weeks of age significantly (P<0.05) affected the serum lipid profile levels resulting in increased serum levels of triglycerides, VLDL and TC/HDL ratio and decreased cholesterol, HDL and LDL. The CTN+AF combined toxicity had more pathological effect but it was less than additive.

References


