Hematological and serum biochemical studies on Japanese quails (\textit{Coturnix coturnix japonica}) fed different levels of furazolidone

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**SUMMARY**

To evaluate the effects of feeding furazolidone on hematological and serum biochemical parameters of blood, an experiment was conducted using 121 female adult Japanese quails. Blood samples were collected for determining the control values before the administration of furazolidone. Furazolidone was administered as a feed additive at doses of 400, 800 and 1200 mg/kg to feed for a period of 15 days. Following the administration of furazolidone, the number of WBCs and lymphocytes significantly decreased (P < 0.05). The concentration of cholesterol, uric acid, inorganic phosphorus and the activity of aspartate aminotransferase (AST), lactate dehydrogenase (LD) and alkaline phosphatase (ALP) significantly increased (P < 0.05). In contrast, the concentration of total protein and calcium decreased significantly (P < 0.05). Dose-dependent effects were observed.


**RéSUMÉ**

Études hématologiques et études biochimiques des sérum sur des cailles japonaises (\textit{Coturnix coturnix Japonica}), nourries à différents niveaux de furazolidone. Par S. NAZIFI et K. ASASI.

Pour évaluer les effets nutritionnels de la furazolidone sur des paramètres hématologiques et biochimiques des sérums, une expérience avait été conduite, en utilisant 121 cailles femelles adultes japonaises. Des échantillons de sang ont été collectés pour déterminer les valeurs de contrôle avant d’utiliser la furazolidone. Cette dernière avait été utilisée comme complément nutritionnel de la dose 400, 800 et 1200 mg par kg, comme nourriture pendant une période de 15 jours. En continuant d’utiliser la furazolidone, le nombre de WBCs et de lymphocytes a diminué significativement (P < 0,05). Les concentrations en cholestérol, urique, phosphore inorganique et l’activité de l’aspartate aminotransférase (AST), de la lactate dehydrogénase (LD) et de l’alkaline phosphatase (ALP) ont augmenté significativement (P < 0,05). Au contraire, les concentrations en protéines totales et calcium ont diminué significativement (P < 0,05) et les effets de la dose dépendante ont été observés.

**MOTS-CLÉS**: paramètres hématologiques - sérums biochimiques - furazolidone - caille japonaise.

**Introduction**

Furazolidone is a nitrofuran derivative that have activity against protozoa and bacteria. Furazolidone is bacteriostatic and function by blocking oxidative decarboxylation of pyruvate to acetyl coenzyme A, depriving susceptible organisms of vital energy production pathways. The spectrum of activity encompasses gram positive and gram negative bacteria and some protozoa, but furazolidone is most effective against the gram negative bacteria \cite{1}. Oral absorption is enhanced when administered with feed : it is widely distributed throughout the body but in low concentrations \cite{1, 4}. DNA is the principal target of furazolidone in some cells \textit{in vivo}, causing cuts and mutations in DNA and binding to DNA, hence blocking the replication and transcription processes \cite{1, 17}. The toxicology of furazolidone has been investigated extensively in laboratory, food and companion animals. The effects of feeding furazolidone to poultry have been reported \cite{4, 9, 11, 12, 13, 16, 17, 19}. Despite of some official restrictions on the administration of furazolidone in Iran, poultry producers have much interest to use furazolidone as a feed additive in broiler chickens and quails for prevention and treatment of bacterial diseases. In chickens fed toxic dosage of furazolidone, cardiomyopathy, degeneration and necrosis of liver and kidney and atrophy of the ovaries have been reported \cite{12, 13, 16}. The toxicological effects of feeding furazolidone to Japanese quails have been investigated \cite{5, 10, 18}. To our knowledge, no published information is available regarding hematological and serum biochemical parameters of Japanese quails fed different levels of furazolidone. Therefore, the present study was undertaken to evaluate the hematological and serum biochemical parameters of Japanese quails which had been experimentally fed different levels of furazolidone.
Materials and methods

One hundred and twenty one 7 weeks old female Japanese quails, were divided into 4 experimental groups. They were in good condition and clinically normal. Each treatment group reared in 80 x 200 cm cage in similar environmental condition. Blood samples were collected for determining the control values before the administration of furazolidone (group 1). Furazolidone was administered as a feed additive at doses of 400 (group 2), 800 (group 3) and 1200 (group 4) mg/kg to feed for a period of 15 days. For the hematology analysis blood samples were collected by wing venepuncture into vacutainers containing EDTA as an anticoagulant. For the serum biochemical analysis, blood samples were collected into vacutainers and the serum was separated by centrifugation at 750 g for 15 min and was stored in deep freeze until use. Total erythrocyte counts (RBC) and total leucocyte counts (WBC) were determined using the NATT and HERRICK method [7]. Hemoglobin was measured by the cyanmethemoglobin method and PCV was determined by microhematocrit. Blood films were stained with Giemsa for differential leukocyte analysis and assessment of cellular morphology [8].

Biochemical analysis including serum total protein was done by the Biuret method, glucose by the O- Toluidine method, cholesterol by a modified Abell-Kendall/Levey-Brodie (A- K) method, uric acid by the phosphotungstic acid (PTA) method, inorganic phosphorus by the ammonium molybdate method, AST by the colorimetric method of Reitman and Frankel, LD by the Sigma colorimetric (Cabaud- Wroblewski) method and ALP by modified method of Bowers and McComb. All the enzyme activities were measured at 37°C and the results have been presented in U/L [6]. The samples were analysed for calcium by the atomic absorption spectrophotometer (Shimadzo, AA- 670, Kyoto, Japan).

The data were expressed in SI unit and analysed statistically by analysis of variance (ANOVA). The differences between the means were statistically estimated by the Duncans test. All values were expressed in mean (standard error (SE)) using a significant level of P < 0.05 [14].

Results

Different levels of furazolidone had profound effects on hematological and serum biochemical parameters of Japanese quails. High levels of furazolidone (800 and 1200 mg/kg) significantly altered growth, decreased feed consumption and appetite caused pronounced atrophy of the ovaries and oviducts leading to cessation of egg laying and emaciation followed by nervous disturbances. Autopsy findings leading to death included cardiomyopathy, degenerative changes and congestion in liver and kidney and atrophy of the ovaries.

The mean ± standard error of hematological and serum biochemical parameters in Japanese quails fed different levels of furazolidone are presented in tables I and II, respectively.

Following the administration of furazolidone, the number of WBCs and lymphocytes significantly decreased (P < 0.05). Moreover, the results showed that the concentration of total protein, cholesterol, uric acid, calcium, inorganic phosphorus and the activity of AST, LDH and ALP in different groups were significantly different (P < 0.05). The concentration of cholesterol, uric acid, inorganic phosphorus and the activity of AST, LDH, and ALP significantly increased (P < 0.05). In contrast, the concentration of total protein and calcium decreased significantly (P < 0.05). Dose-dependent effects were observed, so that in the severely intoxicated quails, WBCs, lymphocytes and the concentration of total protein and calcium decreased and the concentration of cholesterol, uric acid, inorganic phosphorus and the activity of AST, LDH and ALP increased as compared with the lower intoxicated quails.

Discussion

The clinical signs of furazolidone toxicosis in this study were in agreement with the observations of ARBID et al [5] and DIXON et al [15] in Japanese quails and ALI et al [3], MUSTAFA et al [13], ORR et al [15], ZAMAN et al [19] and ULLAH et al [18] in chickens. In contrast to our results, ARBID et al [5] reported that in Japanese quails fed graded levels of furazolidone cardiomyopathy were not occurred. In our study, hypertrophy of the adrenal gland was not observed. But, ALI [2] reported that in chickens fed furazolidone (0.04 % in the feed for 10 days) hypertrophy of the cortex of adrenal gland was occurred. In our study, the decrease in body weight was related to reduced feed intake. In chickens fed furazolidone in toxic doses, ascites was observed [15, 19]. In our study, ascites was not associated with other clinical signs of furazolidone toxicosis.

Following the administration of furazolidone, the number of WBCs and lymphocytes significantly decreased (P < 0.05). These changes in hematological parameters are probably due to immuno-suppressive effects of furazolidone and drug toxemia [8]. To our knowledge, no information about the hematological parameters in furazolidone toxicosis of chickens and quails is available in literature. ZAMAN et al [19] reported that in furazolidone toxicosis in broiler chicks anemia was occurred. But, in our study, anemia was not observed. In furazolidone- treated quails, the increase in serum AST, LD and ALP activities and decrease in serum total protein are probably due to degenerative changes of the hepatocytes. Our results were similar to findings of ARBID et al [5] in Japanese quails. ARBID et al [5] reported that in Japanese quails fed 600 and 800 mg/kg of furazolidone, an increase in serum AST, ALT and ALP was related to hepato-cellular degeneration and necrosis. OYEJIDE et al [16] reported that in chickens fed furazolidone, at the two treatment levels (5 g/L for 2 weeks and 0.5 g/L for 4 weeks), furazolidone did not cause appreciable histopathological changes in the liver.

The concentration of serum cholesterol, uric acid and inorganic phosphorus increased. In contrast, the concentration of calcium significantly decreased (P < 0.05). These changes in
**HEMATOLOGICAL AND SERUM BIOCHEMICAL STUDIES ON JAPANESE QUAILS (COTURNIX COTURNIX JAPONICA)**

**TABLE I.** — The mean ± standard error of hematological parameters in Japanese quails fed different levels of furazolidone (FZ).

<table>
<thead>
<tr>
<th>Groups</th>
<th>No. of quails</th>
<th>RBC $\times 10^{12}/l$</th>
<th>Hb g/l</th>
<th>HCT 1/l</th>
<th>WBC $\times 10^{9}/l$</th>
<th>Heterophil %</th>
<th>Lymphocyte $\times 10^{9}/l$</th>
<th>Eosinophil %</th>
<th>Basophil %</th>
<th>Monocyte %</th>
<th>Band heterophil %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>3.059 ± 0.085</td>
<td>119.9</td>
<td>0.42</td>
<td>2.64a</td>
<td>53.03</td>
<td>44.64a</td>
<td>1.17</td>
<td>0.08</td>
<td>0.00</td>
<td>2.23 ± 0.06</td>
</tr>
<tr>
<td>After feeding</td>
<td>28</td>
<td>2.833 ± 0.084</td>
<td>119.4</td>
<td>0.43</td>
<td>1.50b</td>
<td>58.12</td>
<td>35.54 ± 0.09</td>
<td>0.57</td>
<td>0.14</td>
<td>0.00</td>
<td>3.13 ± 0.04</td>
</tr>
<tr>
<td>of 400 ppm FZ</td>
<td>36</td>
<td>2.963 ± 0.102</td>
<td>119.1</td>
<td>0.43</td>
<td>0.98c</td>
<td>61.48</td>
<td>33.78b</td>
<td>0.33</td>
<td>0.00</td>
<td>0.00</td>
<td>3.11 ± 0.03</td>
</tr>
<tr>
<td>After feeding</td>
<td>32</td>
<td>2.954 ± 0.053</td>
<td>117.6</td>
<td>0.42</td>
<td>0.63d</td>
<td>65.19</td>
<td>31.09b</td>
<td>0.19</td>
<td>0.31</td>
<td>0.00</td>
<td>1.96 ± 0.01</td>
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<tr>
<td>of 800 ppm FZ</td>
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<td>After feeding</td>
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<td>of 1200 ppm FZ</td>
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</tbody>
</table>

$a$: values with different letters in a column differ significantly

**TABLE II.** — The mean ± standard error of serum biochemical parameters in Japanese quails fed different levels of furazolidone (FZ).

<table>
<thead>
<tr>
<th>Groups</th>
<th>No. of quails</th>
<th>Total protein g/l</th>
<th>Glucose mmol/l</th>
<th>Cholesterol mmol/l</th>
<th>uric acid mmol/l</th>
<th>Calcium mmol/l</th>
<th>Inorganic phosphorus mmol/l</th>
<th>AST IU/l</th>
<th>LDH IU/l</th>
<th>ALP IU/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25</td>
<td>26.70a</td>
<td>15.99</td>
<td>5.03a</td>
<td>0.35b</td>
<td>2.84a</td>
<td>1.29a</td>
<td>122.14a</td>
<td>247.32a</td>
<td>52.72a</td>
</tr>
<tr>
<td>After feeding</td>
<td>28</td>
<td>23.90b</td>
<td>15.69</td>
<td>5.96b</td>
<td>0.37b</td>
<td>2.65a</td>
<td>1.68b</td>
<td>137.37a</td>
<td>324.93a</td>
<td>69.34b</td>
</tr>
<tr>
<td>of 400 ppm FZ</td>
<td>36</td>
<td>23.10c</td>
<td>16.11</td>
<td>6.38c</td>
<td>0.39c</td>
<td>2.39c</td>
<td>1.79b</td>
<td>157.49b</td>
<td>479.45b</td>
<td>86.49c</td>
</tr>
<tr>
<td>After feeding</td>
<td>32</td>
<td>22.30d</td>
<td>16.07</td>
<td>6.96d</td>
<td>0.52d</td>
<td>1.54d</td>
<td>2.36d</td>
<td>174.43d</td>
<td>567.63b</td>
<td>97.24c</td>
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<tr>
<td>of 800 ppm FZ</td>
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<td>After feeding</td>
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<td>of 1200 ppm FZ</td>
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</table>

$a$: values with different letters in a column differ significantly (P < 0.05)
above mentioned biochemical parameters are probably due to renal injuries [8]. To our knowledge, there was no published informations about the renal injuries in furazolidone toxicosis of chickens and quails. Dose- dependent effects were observed, so that in the severely intoxicated quails, hematological and serum biochemical parameters was most affected. The findings of this study indicate that furazolidone toxicosis can have profound effects on hematological and serum biochemical parameters of Japanese quails. It was concluded that furazolidone as a feed additive at doses of 400, 800 and 1200 mg/kg to feed may not be appropriate for breeding Japanese quail.

References