Some Biochemical Alterations in Liver and Kidney of *Clarias batrachus* in Response to Arsenic Administration

(Received September 15, 1987, Revised received November 17, 1987)

S.D. Sharma & Maya
Department of Zoology, D.A.V. (P.G.) College, Muzaffarnagar, India

A sublethal dose of disodium orthoarsenate (0.5%) was administered on the alternate days till the model fish *Clarias batrachus* received 15000 μg toxin (Single dose 1000 μg). After processing the tissues liver and kidney, a significant depletion in liver glycogen was observed. Phosphatases (AcPase and AlPase), transaminases (GOT & GPT) ribonuclease and lactic dehydrogenase depicted lowered activities. Cholesterol, however, was recorded elevated.

Arsenic from industries and as residue from arsinate/arsenic pesticides is cumulatively added in inland waters and renders tremendous metallic load on inhabiting flora and fauna including fish. Toxicity of metals to aquatic life has been reviewed by different authors and our laboratory also\(^4\)–\(^5\). Recently we have published haematological characteristics of *Clarias batrachus* under the stress of arsenic\(^4\). Carcinogenicity and liver cirrhosis in response to arsenic administration have also been worked out\(^6\)–\(^8\). Kyle and Pease\(^7\) reported the haematological alterations alongwith skin changes during chronic arsenic poisoning. The present communication deals with some biochemical and enzymological changes in the liver and kidney of *Clarias batrachus* in response to arsenic administration.

MATERIALS AND METHODS

Live specimens of *C. batrachus* were procured from the local river (Kalinadi) and acclimatized to the laboratory conditions for seven days (Temp. 22±3°C, pH 6.5 mg/l, hardness 8.6 mg/l and total solids 22.3 mg/l). Fifty, apparently healthy, fishes weighing 60-70 gm. each, were selected irrespective of their sex and divided into two groups. To
the animals of 1st group, 1000 µg di-sodium orthoarsenate (DSOA) in distilled water was administered by subcutaneous injections at the base of caudal peduncle, on alternate days. Till 15 doses were completed i.e. 15000 µg DSOA was administered to each animal. The fish of 2nd group were injected with equal volumes of distilled water on the respective day and treated as control.

Fish of both the groups were sacrificed at the end of the experiment. Tissues, liver and kidney were separated out carefully and processed for biochemical analysis. Glycogen and ribonuclease were assayed by the methods of Stetten et. al. and MacDonald, respectively, while phosphatases (AcPase & AlPase), transaminases (GOT & GPT), cholesterol and lactic dehydrogenase (LDH) were assayed following the methods of Usher. All the data were statistically analysed at 1% and 5% levels of significance.

RESULTS

The data of experimental and control animals are presented in Table 1. Administration of 15 doses of DSOA induced several significant changes in biochemistry of fish. The recorded values reveal marked decrease in liver glycogen, in kidney, however, it elevated non-significant. A significant decline in acid phosphatase (AcPase), alkaline phosphatase (AlPase), ribonuclease (RNase), glutamic oxalacetic transaminase (GOT), glutamic pyruvic transaminase (GPT) and lactic dehydrogenase (LDH) in both tissues revealed severe stressful conditions of fish. Marked elevation in cholesterol further confirmed metabolic alterations in intoxicated fish.

DISCUSSION

Alpase mediates membrane transport in the cell as well as the transphosphorylation. The significant fall in its activity in liver and kidney of the test fish exposed to DSOA may therefore, indicative of decreased rate of transphosphorylation reaction. AcPase enzyme helps in the autolysis of cells after their death. Suppression of tissue enzymes during arsenic toxicity may be due to its direct reaction with the sulfhydryl groups of the enzymes11. However, decreased levels of enzymes are attributed to their leakage from the tissue to blood stream due to toxic effects12.

Elevated serum RNase level in fish associated with decreased enzyme activity in tissues has been elicited under the pesticidal stress13. Our earlier findings have revealed increased
Table 1. Biochemical changes in *Clarias batrachus* during metallic stress of arsenic. All values are mean ± Standard Error for 6 observations each. Significant levels—a: P < 0.01; b: P < 0.05.

<table>
<thead>
<tr>
<th>Enzyme biochemical</th>
<th>Control</th>
<th>Experimental</th>
<th>Control</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALPase (mg IP/g tissue)</td>
<td>0.820±0.03</td>
<td>0.747±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.270±0.00</td>
<td>3.295±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>AcPase (mg IP/g)</td>
<td>0.550±0.03</td>
<td>0.390±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.790±0.02</td>
<td>0.502±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>RNase (mg IP/g)</td>
<td>0.945±0.02</td>
<td>0.800±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.790±0.00</td>
<td>1.200±0.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>GOT (unit/g)</td>
<td>24.307±0.60</td>
<td>18.840±0.48&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.850±0.63</td>
<td>10.020±0.37&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>GPT (unit/g)</td>
<td>20.800±1.48</td>
<td>14.950±0.48&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.650±0.34</td>
<td>8.200±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>LDH (unit/g)</td>
<td>132.040±0.76</td>
<td>102.090±1.39&lt;sup&gt;a&lt;/sup&gt;</td>
<td>71.040±0.66</td>
<td>53.500±0.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Glycogen (mg/g)</td>
<td>67.500±1.80</td>
<td>28.010±0.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.120±1.80</td>
<td>12.690±0.41</td>
</tr>
<tr>
<td>Cholesterol (mg/g)</td>
<td>15.090±0.09</td>
<td>44.110±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.030±0.19</td>
<td>18.62±0.37&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Tissue RNase activity following lithium intoxication in *Clarias batrachus*. RNase being a lysosomal enzyme might undergo leakage from damaged cells thereby decreasing the concentration in tissues. GOT and GPT also depicted decreased transamination reaction in both tissues. Similar diminution of transaminases following phenylene brown exposure has been reported in fish.<sup>16</sup>

Depleted glycogen content is most sensitive sign of hepatic lesion which is partly due to the disturbed metabolism and energy imbalance of liver cells and partly due to the toxic influence of arsenic on the kidney. Present observations are in accordance to our earlier observations<sup>3</sup>, while depletion in glycogen was possibly due to more glycogenolysis to meet the extra energy demands in stressful conditions<sup>15</sup>. Hepatorenal hypercholesterolemia in response to arsenic administration is possibly due to impaired liver functions<sup>18</sup>. Irregularity in TCA cycle was also evident due to the significant decrease in LDH activity.<sup>3</sup>

ACKNOWLEDGEMENT

The authors owe their thanks to Dr. K.A. Gool and Dr. V.P. Agrawal for suggestions and guidance.
REFERENCES