ANNEX 7
Results of Assay and Tests in Evaluation of the Endocrine Disrupting Activities in Fish (Medaka)

4-tert-octylphenol

1. Vitellogenin Assay

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mortality (%)</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>male</td>
<td>female</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>1.9 ± 1.0</td>
<td>4.8 ± 1.0</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0</td>
<td>1.8 ± 0.9</td>
<td>4.0 ± 1.1</td>
</tr>
<tr>
<td>12.7 (µg/L)</td>
<td>0</td>
<td>2.0 ± 0.6</td>
<td>4.4 ± 0.8</td>
</tr>
<tr>
<td>27.8 (µg/L)</td>
<td>0</td>
<td>1.8 ± 0.3</td>
<td>4.0 ± 0.6</td>
</tr>
<tr>
<td>64.1 (µg/L)</td>
<td>0</td>
<td>2.2 ± 0.8</td>
<td>4.3 ± 1.1</td>
</tr>
<tr>
<td>129 (µg/L)</td>
<td>6.3</td>
<td>2.6 ± 0.3</td>
<td>3.8 ± 0.9</td>
</tr>
<tr>
<td>296 (µg/L)</td>
<td>0</td>
<td>2.8 ± 0.6</td>
<td>4.2 ± 0.9</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (** indicates \( p < 0.01 \), * indicates \( p < 0.05 \))

2. Partial Life Cycle Test

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>98 ± 3.3</td>
<td>9.1 ± 0.3</td>
<td>5.0 ± 3.3</td>
<td>26.2 ± 2.1</td>
<td>188 ± 35</td>
</tr>
<tr>
<td>Solvent control</td>
<td>98 ± 3.3</td>
<td>9.0 ± 0.1</td>
<td>5.0 ± 6.4</td>
<td>26.2 ± 2.0</td>
<td>157 ± 35</td>
</tr>
<tr>
<td>6.94 (µg/L)</td>
<td>95 ± 6.4</td>
<td>8.9 ± 0.1</td>
<td>3.6 ± 4.2</td>
<td>26.6 ± 1.8</td>
<td>163 ± 37</td>
</tr>
<tr>
<td>11.4 (µg/L)</td>
<td>98 ± 3.3</td>
<td>9.0 ± 0</td>
<td>5.1 ± 6.4</td>
<td>26.6 ± 1.5</td>
<td>169 ± 34</td>
</tr>
<tr>
<td>23.7 (µg/L)</td>
<td>100 ± 0</td>
<td>8.9 ± 0.1</td>
<td>20 ± 12*</td>
<td>27.3 ± 1.6**</td>
<td>187 ± 39**</td>
</tr>
<tr>
<td>48.1 (µg/L)</td>
<td>95 ± 6.4</td>
<td>9.0 ± 0</td>
<td>1.9 ± 3.9</td>
<td>26.1 ± 1.7</td>
<td>167 ± 34</td>
</tr>
<tr>
<td>94.0 (µg/L)</td>
<td>97 ± 6.7</td>
<td>9.0 ± 0</td>
<td>5.5 ± 7.3</td>
<td>25.5 ± 2.1</td>
<td>159 ± 39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of Testis-ova/No. of males</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
<td>No. of fishes</td>
<td>male</td>
</tr>
<tr>
<td>Control</td>
<td>0.47 ± 0.2</td>
<td>1.8 ± 1.8</td>
<td>20</td>
<td>2.2 ± 0.6</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0.85 ± 0.9</td>
<td>2.9 ± 2.9</td>
<td>20</td>
<td>2.1 ± 0.7</td>
</tr>
<tr>
<td>6.94 (µg/L)</td>
<td>0.78 ± 0.3</td>
<td>4.5 ± 2.9</td>
<td>20</td>
<td>2.8 ± 0.6*</td>
</tr>
<tr>
<td>11.4 (µg/L)</td>
<td>0.88 ± 0.4</td>
<td>4.4 ± 3.0</td>
<td>20</td>
<td>2.7 ± 0.5</td>
</tr>
<tr>
<td>23.7 (µg/L)</td>
<td>0.71 ± 0.3</td>
<td>3.2 ± 3.3</td>
<td>20</td>
<td>2.8 ± 0.8*</td>
</tr>
<tr>
<td>48.1 (µg/L)</td>
<td>0.64 ± 0.2</td>
<td>2.8 ± 2.4</td>
<td>20</td>
<td>2.4 ± 0.7</td>
</tr>
<tr>
<td>94.0 (µg/L)</td>
<td>0.39 ± 0.4</td>
<td>0.60 ± 0.5**</td>
<td>5/10 **</td>
<td>3.3 ± 0.6**</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (** indicates \( p < 0.01 \), * indicates \( p < 0.05 \))
Statistically significant differences from solvent control group (*** indicates \( p < 0.01 \), **** indicates \( p < 0.05 \))
### Table 3-A generation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>100</td>
<td>8.5 ± 0.3</td>
<td>1.7</td>
<td>30.5 ± 1.3</td>
<td>269 ± 32</td>
<td>20</td>
<td>0/8</td>
</tr>
<tr>
<td>Solvent control</td>
<td>97 ± 3.9</td>
<td>8.4 ± 0.2</td>
<td>6.7</td>
<td>31.6 ± 1.4</td>
<td>307 ± 43</td>
<td>20</td>
<td>0/9</td>
</tr>
<tr>
<td>1.68 (µg/L)</td>
<td>88 ± 11</td>
<td>8.1 ± 0.2</td>
<td>8.4</td>
<td>31.7 ± 1.8</td>
<td>310 ± 62</td>
<td>20</td>
<td>0/10</td>
</tr>
<tr>
<td>4.27 (µg/L)</td>
<td>92 ± 8.4</td>
<td>8.2 ± 0.4</td>
<td>5.8</td>
<td>31.5 ± 1.2</td>
<td>298 ± 35</td>
<td>20</td>
<td>0/10</td>
</tr>
<tr>
<td>9.92 (µg/L)</td>
<td>97 ± 6.7</td>
<td>8.4 ± 0.1</td>
<td>12</td>
<td>32.0 ± 1.2</td>
<td>301 ± 42</td>
<td>20</td>
<td>1/10</td>
</tr>
<tr>
<td>30.4 (µg/L)</td>
<td>88 ± 6.4</td>
<td>8.3 ± 0.4</td>
<td>11</td>
<td>32.1 ± 1.5</td>
<td>322 ± 50</td>
<td>20</td>
<td>5/7</td>
</tr>
<tr>
<td>82.3 (µg/L)</td>
<td>92 ± 8.4</td>
<td>8.2 ± 0.1</td>
<td>5.8</td>
<td>31.7 ± 1.5</td>
<td>310 ± 44</td>
<td>20</td>
<td>7/8</td>
</tr>
</tbody>
</table>

*Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

### Table 3-B generation (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of eggs</th>
<th>Fertility (%)</th>
<th>Gonadosomatic Index (%)</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>653 ± 89</td>
<td>97 ± 3.3</td>
<td>0.81 ± 0.1</td>
<td>7.5 ± 1.5</td>
<td>1.7 ± 0.6</td>
</tr>
<tr>
<td>Solvent control</td>
<td>500 ± 170</td>
<td>90 ± 15</td>
<td>0.65 ± 0.2</td>
<td>7.7 ± 1.7</td>
<td>1.6 ± 0.4</td>
</tr>
<tr>
<td>1.68 (µg/L)</td>
<td>659 ± 130</td>
<td>97 ± 1.2</td>
<td>0.86 ± 0.2</td>
<td>7.6 ± 1.5</td>
<td>1.4 ± 0.5</td>
</tr>
<tr>
<td>4.27 (µg/L)</td>
<td>667 ± 60</td>
<td>98 ± 2.1</td>
<td>0.98 ± 0.2</td>
<td>8.0 ± 0.7</td>
<td>1.4 ± 0.2</td>
</tr>
<tr>
<td>9.92 (µg/L)</td>
<td>631 ± 80</td>
<td>93 ± 7.4</td>
<td>0.93 ± 0.2</td>
<td>8.3 ± 1.2</td>
<td>1.8 ± 0.8</td>
</tr>
<tr>
<td>30.4 (µg/L)</td>
<td>520 ± 150</td>
<td>92 ± 8.0</td>
<td>0.92 ± 0.3</td>
<td>7.8 ± 1.9</td>
<td>1.9 ± 0.1</td>
</tr>
<tr>
<td>82.3 (µg/L)</td>
<td>45 ± 87**</td>
<td>35 ± 36*</td>
<td>1.0 ± 0.3</td>
<td>8.2 ± 3.8</td>
<td>2.6 ± 0.7</td>
</tr>
</tbody>
</table>

### Table 3-C generation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>94 ± 7.6</td>
<td>9.7 ± 0.4</td>
<td>1.7</td>
<td>28.7 ± 1.6</td>
<td>252 ± 45</td>
<td>20</td>
<td>0/11</td>
</tr>
<tr>
<td>Solvent control</td>
<td>80 ± 29</td>
<td>9.4 ± 0.6</td>
<td>6.7</td>
<td>28.9 ± 1.7</td>
<td>253 ± 41</td>
<td>20</td>
<td>0/12</td>
</tr>
<tr>
<td>1.68 (µg/L)</td>
<td>90 ± 14</td>
<td>9.2 ± 0.4</td>
<td>6.7</td>
<td>28.2 ± 1.7</td>
<td>242 ± 39</td>
<td>20</td>
<td>0/14</td>
</tr>
<tr>
<td>4.27 (µg/L)</td>
<td>92 ± 7.8</td>
<td>9.4 ± 0.5</td>
<td>8.3</td>
<td>28.7 ± 1.7</td>
<td>243 ± 37</td>
<td>20</td>
<td>0/11</td>
</tr>
<tr>
<td>9.92 (µg/L)</td>
<td>96 ± 6.8</td>
<td>9.5 ± 0.6</td>
<td>0</td>
<td>28.3 ± 2.1</td>
<td>243 ± 27</td>
<td>20</td>
<td>0/8</td>
</tr>
<tr>
<td>30.4 (µg/L)</td>
<td>97 ± 7.4</td>
<td>9.5 ± 0.5</td>
<td>0</td>
<td>28.7 ± 1.1</td>
<td>243 ± 30</td>
<td>20</td>
<td>4/8</td>
</tr>
<tr>
<td>82.3 (µg/L)</td>
<td>51 ± 49</td>
<td>9.6 ± 0.3</td>
<td>6.1</td>
<td>28.8 ± 1.0</td>
<td>252 ± 28</td>
<td>20</td>
<td>10/15</td>
</tr>
</tbody>
</table>

### Table 3-D generation (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
</tr>
<tr>
<td>Control</td>
<td>3.1 ± 2.6</td>
</tr>
<tr>
<td>Solvent control</td>
<td>4.3 ± 5.0</td>
</tr>
<tr>
<td>1.68 (µg/L)</td>
<td>3.1 ± 4.4</td>
</tr>
<tr>
<td>4.27 (µg/L)</td>
<td>6.5 ± 19</td>
</tr>
<tr>
<td>9.92 (µg/L)</td>
<td>24 ± 22**</td>
</tr>
<tr>
<td>30.4 (µg/L)</td>
<td>42 ± 29**</td>
</tr>
<tr>
<td>82.3 (µg/L)</td>
<td>22 ± 22*</td>
</tr>
</tbody>
</table>

*Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))
## 1. Vitellogenin Assay

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mortality (%)</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>male</td>
<td>female</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>1.9 ± 0.4</td>
<td>4.6 ± 0.9</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0</td>
<td>1.8 ± 0.6</td>
<td>4.1 ± 1.2</td>
</tr>
<tr>
<td>24.4 (µg/L)</td>
<td>0</td>
<td>2.0 ± 0.6</td>
<td>4.1 ± 1.2</td>
</tr>
<tr>
<td>55.3 (µg/L)</td>
<td>0</td>
<td>2.1 ± 1.0</td>
<td>4.4 ± 0.8</td>
</tr>
<tr>
<td>133 (µg/L)</td>
<td>0</td>
<td>2.3 ± 0.7</td>
<td>4.5 ± 1.1</td>
</tr>
<tr>
<td>328 (µg/L)</td>
<td>5</td>
<td>2.5 ± 0.6*</td>
<td>5.6 ± 1.8</td>
</tr>
<tr>
<td>822 (µg/L)</td>
<td>0</td>
<td>2.8 ± 0.6**</td>
<td>4.3 ± 0.9</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

## 2. Partial Life Cycle Test

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>97 ± 3.9</td>
<td>10 ± 0.1</td>
<td>8.6 ± 6.6</td>
<td>29.5 ± 1.4</td>
<td>256 ± 42</td>
</tr>
<tr>
<td>Solvent control</td>
<td>97 ± 3.9</td>
<td>10 ± 0.2</td>
<td>11 ± 4.4</td>
<td>29.6 ± 1.3</td>
<td>256 ± 41</td>
</tr>
<tr>
<td>7.09 (µg/L)</td>
<td>95 ± 6.4</td>
<td>9.8 ± 0.1</td>
<td>12 ± 8.6</td>
<td>29.8 ± 1.5</td>
<td>266 ± 50</td>
</tr>
<tr>
<td>21.9 (µg/L)</td>
<td>87 ± 14</td>
<td>9.8 ± 0.2</td>
<td>8.9 ± 10</td>
<td>29.5 ± 1.4</td>
<td>259 ± 46</td>
</tr>
<tr>
<td>72.8 (µg/L)</td>
<td>97 ± 3.9</td>
<td>9.9 ± 0.1</td>
<td>21 ± 5.1*</td>
<td>30.1 ± 1.5</td>
<td>269 ± 38</td>
</tr>
<tr>
<td>235 (µg/L)</td>
<td>100</td>
<td>10 ± 0.3</td>
<td>48 ± 18*</td>
<td>29.6 ± 1.7</td>
<td>269 ± 48</td>
</tr>
<tr>
<td>850 (µg/L)</td>
<td>8.3 ± 10*</td>
<td>16 ± 0.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- indicates 100% mortality

### Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>0.64 ± 0.2</td>
<td>3.9 ± 2.5</td>
<td>20</td>
<td>3.4 ± 0.9</td>
<td>4.1 ± 0.6</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0.68 ± 0.2</td>
<td>2.5 ± 2.7</td>
<td>20</td>
<td>3.2 ± 1.0</td>
<td>5.0 ± 1.4</td>
</tr>
<tr>
<td>7.09 (µg/L)</td>
<td>0.61 ± 0.2</td>
<td>3.9 ± 3.4</td>
<td>20</td>
<td>3.6 ± 0.9</td>
<td>5.6 ± 0.6*</td>
</tr>
<tr>
<td>21.9 (µg/L)</td>
<td>0.63 ± 0.3</td>
<td>4.5 ± 4.0</td>
<td>20</td>
<td>3.5 ± 1.2</td>
<td>4.4 ± 1.0</td>
</tr>
<tr>
<td>72.8 (µg/L)</td>
<td>0.73 ± 0.3</td>
<td>4.6 ± 3.8</td>
<td>20</td>
<td>3.2 ± 1.1</td>
<td>4.3 ± 0.8</td>
</tr>
<tr>
<td>235 (µg/L)</td>
<td>0.63 ± 0.3</td>
<td>2.6 ± 3.6</td>
<td>20</td>
<td>3.4 ± 0.8</td>
<td>4.2 ± 1.0</td>
</tr>
<tr>
<td>850 (µg/L)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- indicates 100% mortality

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))
### Table 3-A F0 generation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>92 ± 8.4</td>
<td>9.9 ± 0.3</td>
<td>13</td>
<td>29.1 ± 1.4</td>
<td>236 ± 44</td>
<td>20</td>
<td>0/8</td>
</tr>
<tr>
<td>Solvent control</td>
<td>95 ± 6.4</td>
<td>10 ± 0.4</td>
<td>18</td>
<td>29.6 ± 1.2</td>
<td>245 ± 35</td>
<td>20</td>
<td>0/9</td>
</tr>
<tr>
<td>2.61 (µg/L)</td>
<td>98 ± 3.3</td>
<td>9.8 ± 0.2</td>
<td>12</td>
<td>28.6 ± 1.5</td>
<td>218 ± 39</td>
<td>20</td>
<td>1/8</td>
</tr>
<tr>
<td>7.52 (µg/L)</td>
<td>97 ± 3.8</td>
<td>9.8 ± 0.2</td>
<td>16</td>
<td>29.3 ± 1.3</td>
<td>239 ± 34</td>
<td>20</td>
<td>0/11</td>
</tr>
<tr>
<td>23.9 (µg/L)</td>
<td>95 ± 6.4</td>
<td>10 ± 0.3</td>
<td>5.6</td>
<td>29.1 ± 1.4</td>
<td>233 ± 38</td>
<td>20</td>
<td>0/6</td>
</tr>
<tr>
<td>74.5 (µg/L)</td>
<td>95 ± 6.4</td>
<td>10 ± 0.1</td>
<td>24</td>
<td>30.1 ± 1.7</td>
<td>259 ± 49</td>
<td>20</td>
<td>1/9</td>
</tr>
<tr>
<td>233 (µg/L)</td>
<td>98 ± 3.3</td>
<td>10 ± 0.2</td>
<td>15</td>
<td>28.6 ± 1.8</td>
<td>226 ± 50</td>
<td>20</td>
<td>2/8 *</td>
</tr>
</tbody>
</table>

### Table 3-B generation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of eggs</th>
<th>Fertility (%)</th>
<th>Gonadosomatic Index (%)</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>560 ± 210</td>
<td>94 ± 6.5</td>
<td>0.78 ± 0.2</td>
<td>9.3 ± 1.6</td>
<td>1.3 ± 0.4</td>
</tr>
<tr>
<td>Solvent control</td>
<td>625 ± 130</td>
<td>87 ± 26</td>
<td>0.89 ± 0.2</td>
<td>8.1 ± 0.9</td>
<td>1.5 ± 0.3</td>
</tr>
<tr>
<td>2.61 (µg/L)</td>
<td>602 ± 110</td>
<td>96 ± 5.6</td>
<td>0.86 ± 0.2</td>
<td>7.5 ± 0.7</td>
<td>1.4 ± 0.3</td>
</tr>
<tr>
<td>7.52 (µg/L)</td>
<td>668 ± 100</td>
<td>94 ± 8.9</td>
<td>0.92 ± 0.2</td>
<td>8.0 ± 0.9</td>
<td>1.4 ± 0.2</td>
</tr>
<tr>
<td>23.9 (µg/L)</td>
<td>543 ± 110</td>
<td>94 ± 3.1</td>
<td>1.1 ± 0.1</td>
<td>9.0 ± 0.5</td>
<td>1.3 ± 0.4</td>
</tr>
<tr>
<td>74.5 (µg/L)</td>
<td>554 ± 180</td>
<td>97 ± 1.6</td>
<td>0.92 ± 0.2</td>
<td>7.8 ± 1.1</td>
<td>1.6 ± 0.4</td>
</tr>
<tr>
<td>233 (µg/L)</td>
<td>539 ± 240</td>
<td>91 ± 11</td>
<td>0.97 ± 0.3</td>
<td>9.4 ± 2.6</td>
<td>1.8 ± 0.2</td>
</tr>
</tbody>
</table>

### Table 3-C F1 generation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>87 ± 8.9</td>
<td>9.4 ± 0.6</td>
<td>0</td>
<td>30.7 ± 1.2</td>
<td>276 ± 39</td>
<td>20</td>
<td>0/9</td>
</tr>
<tr>
<td>Solvent control</td>
<td>85 ± 11</td>
<td>9.4 ± 0.5</td>
<td>0</td>
<td>30.5 ± 1.4</td>
<td>281 ± 39</td>
<td>20</td>
<td>0/7</td>
</tr>
<tr>
<td>2.61 (µg/L)</td>
<td>89 ± 8.8</td>
<td>9.1 ± 0.6</td>
<td>0</td>
<td>30.8 ± 1.2</td>
<td>274 ± 34</td>
<td>20</td>
<td>2/10</td>
</tr>
<tr>
<td>7.52 (µg/L)</td>
<td>94 ± 6.4**</td>
<td>9.4 ± 0.5</td>
<td>1.7</td>
<td>31.7 ± 1.1**</td>
<td>297 ± 41*</td>
<td>20</td>
<td>2/13 *</td>
</tr>
<tr>
<td>23.9 (µg/L)</td>
<td>72 ± 21</td>
<td>8.6 ± 1.1</td>
<td>1.7</td>
<td>30.8 ± 1.3</td>
<td>283 ± 33</td>
<td>20</td>
<td>1/11</td>
</tr>
<tr>
<td>74.5 (µg/L)</td>
<td>90 ± 12</td>
<td>9.8 ± 0.4*</td>
<td>0</td>
<td>30.8 ± 1.3</td>
<td>290 ± 31</td>
<td>20</td>
<td>1/14</td>
</tr>
<tr>
<td>233 (µg/L)</td>
<td>94 ± 6.6*</td>
<td>11 ± 1.2**</td>
<td>3.3</td>
<td>30.2 ± 1.2</td>
<td>292 ± 39</td>
<td>20</td>
<td>0/9</td>
</tr>
</tbody>
</table>

### Table 3-D F1 generation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.8 ± 1.1</td>
</tr>
<tr>
<td>Solvent control</td>
<td>ND</td>
</tr>
<tr>
<td>2.61 (µg/L)</td>
<td>3.8 ± 5.0*</td>
</tr>
<tr>
<td>7.52 (µg/L)</td>
<td>9.1 ± 8.5**</td>
</tr>
<tr>
<td>23.9 (µg/L)</td>
<td>14 ± 29</td>
</tr>
<tr>
<td>74.5 (µg/L)</td>
<td>3.3 ± 2.7**</td>
</tr>
<tr>
<td>233 (µg/L)</td>
<td>2.5 ± 3.0</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group(**indicates \( p < 0.01, \ *indicates \( p < 0.05)\)
## 1. Vitellogenin Assay

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitellogenin (ng/mg liver)</th>
<th>Hepatosomatic Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14 days</td>
<td>21 days</td>
</tr>
<tr>
<td>Control</td>
<td>ND</td>
<td>0.53±0.13</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0.55±0.21</td>
<td>ND</td>
</tr>
<tr>
<td>19 (µg/L)</td>
<td>0.62±0.46</td>
<td>ND</td>
</tr>
<tr>
<td>43 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>96 (µg/L)</td>
<td>0.58±0.31</td>
<td>ND</td>
</tr>
<tr>
<td>210 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>410 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

## 2. Partial Life Cycle Test

### Table 2-A Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>93±7.7</td>
<td>8.8±0.5</td>
<td>0.0±0.0</td>
<td>30.3±1.5</td>
<td>271±43</td>
</tr>
<tr>
<td>Solvent control</td>
<td>98±3.3</td>
<td>9.2±0.2</td>
<td>1.9±3.9</td>
<td>30.4±1.6</td>
<td>275±52</td>
</tr>
<tr>
<td>11.0 (µg/L)</td>
<td>93±0</td>
<td>9.0±0.3</td>
<td>1.8±3.6</td>
<td>30.7±1.5</td>
<td>290±45</td>
</tr>
<tr>
<td>28.4 (µg/L)</td>
<td>100±0</td>
<td>9.1±0.1</td>
<td>0.0±0.0</td>
<td>30.1±2.0</td>
<td>270±58</td>
</tr>
<tr>
<td>73.4 (µg/L)</td>
<td>95±10</td>
<td>9.1±0.1</td>
<td>0.0±0.0</td>
<td>30.5±1.6</td>
<td>263±49</td>
</tr>
<tr>
<td>186 (µg/L)</td>
<td>95±6.4</td>
<td>9.0±0.1</td>
<td>1.8±3.6</td>
<td>30.2±2.0</td>
<td>261±51</td>
</tr>
<tr>
<td>446 (µg/L)</td>
<td>95±6.8</td>
<td>9.0±0.2</td>
<td>2.1±4.2</td>
<td>30.3±2.0</td>
<td>264±48</td>
</tr>
</tbody>
</table>

### Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
<td></td>
<td></td>
<td>male</td>
</tr>
<tr>
<td>Control</td>
<td>0.78±0.21</td>
<td>5.0±2.7</td>
<td>20</td>
<td>0/13</td>
<td>2.2±0.7</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0.71±0.23</td>
<td>6.2±3.6</td>
<td>20</td>
<td>0/10</td>
<td>2.0±0.2</td>
</tr>
<tr>
<td>11.0 (µg/L)</td>
<td>0.82±0.27</td>
<td>3.8±2.6</td>
<td>20</td>
<td>0/12</td>
<td>1.8±0.6</td>
</tr>
<tr>
<td>28.4 (µg/L)</td>
<td>0.97±0.40</td>
<td>4.3±2.9</td>
<td>20</td>
<td>0/10</td>
<td>1.6±0.7</td>
</tr>
<tr>
<td>73.4 (µg/L)</td>
<td>0.83±0.26</td>
<td>5.2±3.4</td>
<td>20</td>
<td>1/11</td>
<td>2.6±0.9</td>
</tr>
<tr>
<td>186 (µg/L)</td>
<td>0.76±0.26</td>
<td>6.4±3.9</td>
<td>20</td>
<td>0/10</td>
<td>2.3±0.6</td>
</tr>
<tr>
<td>446 (µg/L)</td>
<td>0.86±0.37</td>
<td>6.0±3.3</td>
<td>20</td>
<td>0/12</td>
<td>2.3±0.7</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))
Di-cyclohexyl phthalate

1. Vitellogenin Assay

Table 1 Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitellogenin (ng/mg liver)</th>
<th>Hepatosomatic Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14 days</td>
<td>21 days</td>
</tr>
<tr>
<td>Control</td>
<td>0.55±0.21</td>
<td>ND</td>
</tr>
<tr>
<td>Solvent control</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>18 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>38 (µg/L)</td>
<td>0.53±0.13</td>
<td>ND</td>
</tr>
<tr>
<td>87 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>190 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>390 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group(**indicates \(p<0.01\), *indicates \(p<0.05\))

2. Partial Life Cycle Test

Table 2-A Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>98±3.3</td>
<td>9.7±0.2</td>
<td>0±0</td>
<td>28.0±1.4</td>
<td>220±36</td>
</tr>
<tr>
<td>Solvent control</td>
<td>92±13</td>
<td>9.2±0.3</td>
<td>3.3±6.7</td>
<td>27.3±2.8</td>
<td>250±50</td>
</tr>
<tr>
<td>0.429 (µg/L)</td>
<td>100±0</td>
<td>9.1±0.1</td>
<td>1.8±3.6</td>
<td>28.8±1.5**</td>
<td>225±41*</td>
</tr>
<tr>
<td>1.41 (µg/L)</td>
<td>93±9.4</td>
<td>9.1±0.1</td>
<td>7.6±11</td>
<td>28.4±2.3</td>
<td>241±44</td>
</tr>
<tr>
<td>4.39 (µg/L)</td>
<td>92±8.4</td>
<td>9.1±0.1</td>
<td>5.6±7.3</td>
<td>30.0±1.6**</td>
<td>250±47</td>
</tr>
<tr>
<td>13.3 (µg/L)</td>
<td>100±0</td>
<td>9.3±0.4</td>
<td>0±0</td>
<td>29.0±1.7**</td>
<td>237±45</td>
</tr>
<tr>
<td>35.8 (µg/L)</td>
<td>90±8.6</td>
<td>9.1±0.1</td>
<td>13±10</td>
<td>29.8±1.8**</td>
<td>265±48</td>
</tr>
</tbody>
</table>

Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
<th>Hepatosomatic Index (%)</th>
<th>No. of males</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
<td>male</td>
<td>female</td>
<td>male</td>
<td>female</td>
</tr>
<tr>
<td>Control</td>
<td>0.75±0.2</td>
<td>4.3±3.3</td>
<td>20</td>
<td>0/13</td>
<td>2.7±0.7</td>
<td>3.6±1.0</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0.74±0.2</td>
<td>5.2±3.3</td>
<td>20</td>
<td>0/12</td>
<td>2.5±0.4</td>
<td>4.0±0.7</td>
</tr>
<tr>
<td>0.429 (µg/L)</td>
<td>0.83±0.2</td>
<td>5.5±3.1</td>
<td>20</td>
<td>0/13</td>
<td>2.4±0.4</td>
<td>3.6±0.9</td>
</tr>
<tr>
<td>1.41 (µg/L)</td>
<td>0.69±0.2</td>
<td>2.9±2.6</td>
<td>20</td>
<td>0/13</td>
<td>2.4±0.6</td>
<td>3.0±0.5</td>
</tr>
<tr>
<td>4.39 (µg/L)</td>
<td>0.85±0.3</td>
<td>5.8±3.7</td>
<td>20</td>
<td>0/14</td>
<td>2.2±0.6</td>
<td>3.6±0.5</td>
</tr>
<tr>
<td>13.3 (µg/L)</td>
<td>0.76±0.2</td>
<td>3.9±2.8</td>
<td>20</td>
<td>0/11</td>
<td>2.1±0.5</td>
<td>3.2±0.7</td>
</tr>
<tr>
<td>35.8 (µg/L)</td>
<td>1.1±0.3**</td>
<td>5.9±3.1</td>
<td>20</td>
<td>1/10</td>
<td>2.2±0.9</td>
<td>3.7±1.0</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group(**indicates \(p<0.01\), *indicates \(p<0.05\))
Statistically significant differences from solvent control group(***indicates \(p<0.01\), ****indicates \(p<0.05\))
# Di-ethyl phthalate

## 1. Vitellogenin Assay

### Table 1 Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitellogenin (ng/mg liver)</th>
<th>Hepatosomatic Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14 days</td>
<td>21 days</td>
</tr>
<tr>
<td>Control</td>
<td>4.4±1.1</td>
<td>1.3±0.1</td>
</tr>
<tr>
<td>8.1 (µg/L)</td>
<td>2.1±0.2</td>
<td>2.3±0.6</td>
</tr>
<tr>
<td>26.8 (µg/L)</td>
<td>4.8±1.5</td>
<td>1.8±0.5</td>
</tr>
<tr>
<td>119.8 (µg/L)</td>
<td>2.7±0.8</td>
<td>2.2±0.8</td>
</tr>
<tr>
<td>355.8 (µg/L)</td>
<td>2.4±0.4</td>
<td>1.0±0.1</td>
</tr>
<tr>
<td>1,053.3 (µg/L)</td>
<td>2.5±0.7*</td>
<td>1.2±0.2</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

## 2. Partial Life Cycle Test

### Table 2-A Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>81</td>
<td>11.2±0.3</td>
<td>8.6</td>
<td>20.8±0.3</td>
<td>164.5±6.6</td>
</tr>
<tr>
<td>0.6 (µg/L)</td>
<td>80</td>
<td>12.3±0.4</td>
<td>3.8</td>
<td>20.6±0.2</td>
<td>158.1±5.4</td>
</tr>
<tr>
<td>2.5 (µg/L)</td>
<td>83</td>
<td>12.4±0.4*</td>
<td>13.3</td>
<td>21.1±0.2</td>
<td>167.7±4.5</td>
</tr>
<tr>
<td>8.4 (µg/L)</td>
<td>91</td>
<td>12.3±0.5*</td>
<td>17.6</td>
<td>21.5±0.2</td>
<td>167.8±4.1</td>
</tr>
<tr>
<td>36.0 (µg/L)</td>
<td>92</td>
<td>11.8±0.3*</td>
<td>5.4</td>
<td>20.1±0.2*</td>
<td>142.0±3.8*</td>
</tr>
<tr>
<td>121.6 (µg/L)</td>
<td>88</td>
<td>11.3±0.3</td>
<td>2.3</td>
<td>20.3±0.2</td>
<td>140.5±3.9*</td>
</tr>
</tbody>
</table>

### Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of fishes</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
<td>No. of males with testis-ova/No. of males</td>
<td>male</td>
</tr>
<tr>
<td>Control</td>
<td>109±0.07</td>
<td>7.5±0.19</td>
<td>20/0</td>
<td>4.49±0.60</td>
</tr>
<tr>
<td>0.6 (µg/L)</td>
<td>0.87±0.10</td>
<td>7.4±0.21</td>
<td>20/0</td>
<td>4.19±0.36</td>
</tr>
<tr>
<td>2.5 (µg/L)</td>
<td>1.02±0.06</td>
<td>7.3±0.19</td>
<td>20/0</td>
<td>3.89±0.42</td>
</tr>
<tr>
<td>8.4 (µg/L)</td>
<td>0.84±0.08</td>
<td>7.4±0.15</td>
<td>20/0</td>
<td>3.99±0.44</td>
</tr>
<tr>
<td>36.0 (µg/L)</td>
<td>0.92±0.11</td>
<td>7.09±0.21</td>
<td>20/0</td>
<td>4.46±0.45</td>
</tr>
<tr>
<td>121.6 (µg/L)</td>
<td>0.90±0.11</td>
<td>6.91±0.21</td>
<td>20/0</td>
<td>4.96±0.29</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))
Butylbenzyl phthalate

**1. Vitellogenin Assay**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitellogenin (ng/mg liver)</th>
<th>Hepatopsmatic Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14 days</td>
<td>21 days</td>
</tr>
<tr>
<td>Control</td>
<td>0.6±0.1</td>
<td>1.5±0.2</td>
</tr>
<tr>
<td>14.0 (µg/L)</td>
<td>0.6±0.1</td>
<td>1.2±0.2</td>
</tr>
<tr>
<td>26.7 (µg/L)</td>
<td>0.7±0.1</td>
<td>1.3±0.1</td>
</tr>
<tr>
<td>69.7 (µg/L)</td>
<td>1.1±0.2</td>
<td>1.5±0.1</td>
</tr>
<tr>
<td>337.1 (µg/L)</td>
<td>0.8±0.2</td>
<td>1.3±0.1</td>
</tr>
<tr>
<td>1,045.4 (µg/L)</td>
<td>2.6±0.5**</td>
<td>1.5±0.1</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

**2. Partial Life Cycle Test**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>98</td>
<td>12.7±1.0</td>
</tr>
<tr>
<td>0.7 (µg/L)</td>
<td>94</td>
<td>11.1±0.7</td>
</tr>
<tr>
<td>2.7 (µg/L)</td>
<td>89</td>
<td>14.9±1.1**</td>
</tr>
<tr>
<td>11.5 (µg/L)</td>
<td>99</td>
<td>15.4±1.1**</td>
</tr>
<tr>
<td>28.6 (µg/L)</td>
<td>96</td>
<td>12.1±0.7**</td>
</tr>
<tr>
<td>99.5 (µg/L)</td>
<td>86</td>
<td>14.2±1.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
</tr>
<tr>
<td>Control</td>
<td>0.83±0.07</td>
<td>7.40±0.26</td>
</tr>
<tr>
<td>0.7 (µg/L)</td>
<td>0.96±0.11</td>
<td>7.60±0.21</td>
</tr>
<tr>
<td>2.7 (µg/L)</td>
<td>1.09±0.08</td>
<td>7.63±0.19</td>
</tr>
<tr>
<td>11.5 (µg/L)</td>
<td>1.12±0.08</td>
<td>7.43±0.28</td>
</tr>
<tr>
<td>28.6 (µg/L)</td>
<td>1.16±0.09</td>
<td>7.52±0.23</td>
</tr>
<tr>
<td>99.5 (µg/L)</td>
<td>1.17±0.07</td>
<td>7.55±0.31</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))
**Vitellogenin Assay**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>14 days</th>
<th>21 days</th>
<th>14 days</th>
<th>21 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.20±0.02</td>
<td>0.36±0.02</td>
<td>2.31±0.16</td>
<td>2.60±0.10</td>
</tr>
<tr>
<td>2.4 (µg/L)</td>
<td>0.18±0.01</td>
<td>0.42±0.04</td>
<td>2.49±0.17</td>
<td>2.21±0.14*</td>
</tr>
<tr>
<td>7.9 (µg/L)</td>
<td>0.16±0.05</td>
<td>0.38±0.03</td>
<td>2.77±0.21</td>
<td>2.30±0.12</td>
</tr>
<tr>
<td>21.5 (µg/L)</td>
<td>0.18±0.01</td>
<td>0.37±0.02</td>
<td>2.61±0.16</td>
<td>2.47±0.14</td>
</tr>
<tr>
<td>181.7 (µg/L)</td>
<td>0.15±0.01</td>
<td>0.33±0.02</td>
<td>2.53±0.12</td>
<td>2.64±0.10</td>
</tr>
<tr>
<td>453.6 (µg/L)</td>
<td>0.21±0.04</td>
<td>0.46±0.05</td>
<td>2.21±0.15</td>
<td>2.42±0.20</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

2. Partial Life Cycle Test

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>97 ± 3.9</td>
<td>8.3 ± 0.1</td>
<td>3.5 ± 4.0</td>
<td>30.1 ± 2.1</td>
<td>260 ± 56</td>
</tr>
<tr>
<td>Solvent control</td>
<td>92 ± 8.4</td>
<td>8.4 ± 0.2</td>
<td>7.5 ± 8.8</td>
<td>31.0 ± 1.5</td>
<td>277 ± 51</td>
</tr>
<tr>
<td>0.711 (µg/L)</td>
<td>98 ± 3.3</td>
<td>8.1 ± 0.2</td>
<td>1.8 ± 3.6</td>
<td>30.0 ± 2.4</td>
<td>261 ± 64</td>
</tr>
<tr>
<td>2.33 (µg/L)</td>
<td>95 ± 3.3</td>
<td>8.2 ± 0.2</td>
<td>6.8 ± 9.4</td>
<td>31.0 ± 1.7</td>
<td>286 ± 55</td>
</tr>
<tr>
<td>7.88 (µg/L)</td>
<td>92 ± 3.3</td>
<td>8.1 ± 0.3</td>
<td>13 ± 13</td>
<td>31.2 ± 1.9</td>
<td>301 ± 71**</td>
</tr>
<tr>
<td>263 (µg/L)</td>
<td>95 ± 6.4</td>
<td>8.2 ± 0.1</td>
<td>5.1 ± 6.4</td>
<td>31.1 ± 1.3</td>
<td>280 ± 44</td>
</tr>
<tr>
<td>87.1 (µg/L)</td>
<td>95 ± 6.4</td>
<td>8.3 ± 0.2</td>
<td>4.0 ± 4.6</td>
<td>31.1 ± 1.6</td>
<td>280 ± 54</td>
</tr>
</tbody>
</table>

Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
<td></td>
<td>male</td>
<td>female</td>
</tr>
<tr>
<td>Control</td>
<td>1.1 ± 0.2</td>
<td>6.9 ± 2.9</td>
<td>20</td>
<td>0/8</td>
<td>1.8 ± 0.5</td>
</tr>
<tr>
<td>Solvent control</td>
<td>1.2 ± 0.4</td>
<td>9.1 ± 1.9</td>
<td>20</td>
<td>1/14</td>
<td>1.9 ± 0.5</td>
</tr>
<tr>
<td>0.711 (µg/L)</td>
<td>1.1 ± 0.4</td>
<td>6.7 ± 2.7</td>
<td>20</td>
<td>0/10</td>
<td>1.9 ± 0.4</td>
</tr>
<tr>
<td>2.33 (µg/L)</td>
<td>1.3 ± 0.4</td>
<td>8.6 ± 2.7</td>
<td>20</td>
<td>0/6</td>
<td>1.8 ± 0.2</td>
</tr>
<tr>
<td>7.88 (µg/L)</td>
<td>1.2 ± 0.2</td>
<td>7.5 ± 2.7</td>
<td>20</td>
<td>1/9</td>
<td>1.8 ± 0.3</td>
</tr>
<tr>
<td>26.3 (µg/L)</td>
<td>1.0 ± 0.3</td>
<td>6.7 ± 3.0</td>
<td>20</td>
<td>0/13</td>
<td>1.8 ± 0.5</td>
</tr>
<tr>
<td>87.1 (µg/L)</td>
<td>1.0 ± 0.2</td>
<td>5.7 ± 3.6</td>
<td>20</td>
<td>0/12</td>
<td>1.8 ± 0.3</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))
Triphenyl tin chloride

1. Vitellogenin Assay

Table 1 Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitellogenin (ng/mg liver)</th>
<th>Hepatosomatic Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14 days</td>
<td>21 days</td>
</tr>
<tr>
<td>Control</td>
<td>1.6±0.3</td>
<td>1.7±0.2</td>
</tr>
<tr>
<td>0.118 (µg/L)</td>
<td>1.1±0.1</td>
<td>1.2±0.2</td>
</tr>
<tr>
<td>0.280 (µg/L)</td>
<td>1.4±0.2</td>
<td>1.4±0.1</td>
</tr>
<tr>
<td>0.928 (µg/L)</td>
<td>0.8±0.1**</td>
<td>0.9±0.1**</td>
</tr>
<tr>
<td>2.890 (µg/L)</td>
<td>0.9±0.1*</td>
<td>0.9±0.1*</td>
</tr>
<tr>
<td>8.871 (µg/L)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*indicates 100% mortality
Statistically significant differences from control group(**indicates \( p<0.01 \), *indicates \( p<0.05 \))

2. Partial Life Cycle Test

Table 2-A Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>95</td>
<td>10.4±0.2</td>
<td>9.5</td>
<td>21.4±0.2</td>
<td>170.2±3.9</td>
</tr>
<tr>
<td>27.6 (ng/L)</td>
<td>93</td>
<td>10.2±0.3</td>
<td>5.4</td>
<td>21.3±0.2</td>
<td>162.6±3.9</td>
</tr>
<tr>
<td>80.1 (ng/L)</td>
<td>87</td>
<td>120±0.4**</td>
<td>11.5</td>
<td>21.8±0.1</td>
<td>179.6±3.8</td>
</tr>
<tr>
<td>178.0 (ng/L)</td>
<td>80</td>
<td>120±0.5**</td>
<td>12.5</td>
<td>21.8±0.2</td>
<td>181.5±5.1</td>
</tr>
<tr>
<td>619.1 (ng/L)</td>
<td>83</td>
<td>167±0.9**</td>
<td>25.3</td>
<td>22.2±0.2*</td>
<td>194.8±5.9*</td>
</tr>
<tr>
<td>1,859.5 (ng/L)</td>
<td>88</td>
<td>128±0.6**</td>
<td>17.1</td>
<td>20.3±0.2*</td>
<td>153.5±4.7</td>
</tr>
</tbody>
</table>

Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%) male</th>
<th>No. of males with testis-ovas/No. of males</th>
<th>Hepatosomatic Index (%) male</th>
<th>Vitellogenin (ng/mg liver) male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.14±0.08</td>
<td>7.57±0.17</td>
<td>3.55±0.42</td>
<td>295.5±117.9</td>
</tr>
<tr>
<td>27.6 (ng/L)</td>
<td>1.12±0.11</td>
<td>7.66±0.19</td>
<td>3.96±0.30</td>
<td>251.9±102.1</td>
</tr>
<tr>
<td>80.1 (ng/L)</td>
<td>0.98±0.09</td>
<td>7.54±0.22</td>
<td>3.72±0.36</td>
<td>276.0±99.5</td>
</tr>
<tr>
<td>178.0 (ng/L)</td>
<td>1.08±0.07</td>
<td>7.53±0.22</td>
<td>3.93±0.29</td>
<td>335.0±150.7</td>
</tr>
<tr>
<td>619.1 (ng/L)</td>
<td>1.05±0.09</td>
<td>7.22±0.20</td>
<td>5.12±0.23</td>
<td>183.6±77.7</td>
</tr>
<tr>
<td>1,859.5 (ng/L)</td>
<td>1.07±0.11</td>
<td>7.29±0.18</td>
<td>4.91±0.41</td>
<td>43.2±20.9</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group(**indicates \( p<0.01 \), *indicates \( p<0.05 \))
## Benzophenone

### 1. Vitellogenin Assay

<table>
<thead>
<tr>
<th>Treatment</th>
<th>14 days Vitellogenin (ng/mg liver)</th>
<th>21 days Vitellogenin (ng/mg liver)</th>
<th>Hepatosomatic Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>ND</td>
<td>ND</td>
<td>1.63 ± 0.38</td>
</tr>
<tr>
<td>Solvent control</td>
<td>ND</td>
<td>ND</td>
<td>1.54 ± 0.30</td>
</tr>
<tr>
<td>48 (µg/L)</td>
<td>ND</td>
<td>ND</td>
<td>1.67 ± 0.38</td>
</tr>
<tr>
<td>160 (µg/L)</td>
<td>ND</td>
<td>ND</td>
<td>1.54 ± 0.30</td>
</tr>
<tr>
<td>500 (µg/L)</td>
<td>4.7 ± 5.9**</td>
<td>2.3 ± 3.0**</td>
<td>1.62 ± 0.25</td>
</tr>
<tr>
<td>1,380 (µg/L)</td>
<td>700 ± 480**</td>
<td>1,600 ± 950**</td>
<td>2.04 ± 0.43**</td>
</tr>
<tr>
<td>4,650 (µg/L)</td>
<td>4,600 ± 2,900**</td>
<td>5,400 ± 2,600**</td>
<td>2.13 ± 0.57**</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

### 2. Partial Life Cycle Test

#### Table 2-A Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>100 ± 0</td>
<td>9.4 ± 0.4</td>
<td>10 ± 3.9</td>
<td>29.5 ± 1.9</td>
<td>254 ± 49</td>
</tr>
<tr>
<td>5.06 (µg/L)</td>
<td>100 ± 0</td>
<td>9.2 ± 0.1</td>
<td>8.3 ± 6.4</td>
<td>29.5 ± 1.6</td>
<td>253 ± 45</td>
</tr>
<tr>
<td>15.1 (µg/L)</td>
<td>97 ± 3.9</td>
<td>9.3 ± 0.2</td>
<td>3.5 ± 4.0</td>
<td>29.5 ± 1.6</td>
<td>252 ± 39</td>
</tr>
<tr>
<td>47.0 (µg/L)</td>
<td>93 ± 7.7</td>
<td>9.3 ± 0.1</td>
<td>8.9 ± 7.0</td>
<td>30.0 ± 1.4</td>
<td>270 ± 40</td>
</tr>
<tr>
<td>144 (µg/L)</td>
<td>98 ± 3.3</td>
<td>9.3 ± 0.3</td>
<td>3.3 ± 3.9</td>
<td>29.6 ± 1.3</td>
<td>264 ± 33</td>
</tr>
<tr>
<td>435 (µg/L)</td>
<td>98 ± 3.3</td>
<td>9.5 ± 0.3</td>
<td>1.7 ± 3.3</td>
<td>30.1 ± 1.6</td>
<td>265 ± 42</td>
</tr>
</tbody>
</table>

#### Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of fishes</th>
<th>No. of males with testis-ova/No. of males</th>
<th>Hepatosomatic Index (%)</th>
<th>Vitellogenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.97 ± 0.3</td>
<td>20</td>
<td>0/7</td>
<td>2.3 ± 0.6</td>
<td>4.1 ± 0.9</td>
</tr>
<tr>
<td>5.06 (µg/L)</td>
<td>0.55 ± 0.2</td>
<td>20</td>
<td>1/10</td>
<td>2.3 ± 0.5</td>
<td>4.5 ± 0.7</td>
</tr>
<tr>
<td>15.1 (µg/L)</td>
<td>0.77 ± 0.2</td>
<td>20</td>
<td>0/8</td>
<td>2.6 ± 0.6</td>
<td>4.1 ± 0.7</td>
</tr>
<tr>
<td>47.0 (µg/L)</td>
<td>0.64 ± 0.4</td>
<td>20</td>
<td>2/11</td>
<td>3.0 ± 0.7*</td>
<td>3.7 ± 0.6</td>
</tr>
<tr>
<td>144 (µg/L)</td>
<td>0.58 ± 0.2*</td>
<td>20</td>
<td>0/11</td>
<td>2.2 ± 0.4</td>
<td>3.3 ± 0.9</td>
</tr>
<tr>
<td>435 (µg/L)</td>
<td>0.88 ± 0.4</td>
<td>20</td>
<td>1/11</td>
<td>2.3 ± 0.4</td>
<td>3.8 ± 0.4</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))
### 1. Vitelloigenin Assay

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Vitelloigenin (ng/mg liver)</th>
<th>Hepatosomatic Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14 days</td>
<td>21 days</td>
</tr>
<tr>
<td>Control</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Solvent control</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>0.24 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>0.49 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>1.1 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>2.8 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>6.6 (µg/L)</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))

### 2. Partial Life Cycle Test

#### Table 2-A Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hatchability (%)</th>
<th>Time to hatching (Day)</th>
<th>Mortality (%)</th>
<th>Total length (mm)</th>
<th>Body weight (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>97 ± 3.9</td>
<td>9.1 ± 0.2</td>
<td>1.8 ± 3.6</td>
<td>30.5 ± 1.8</td>
<td>267 ± 61</td>
</tr>
<tr>
<td>Solvent control</td>
<td>97 ± 3.9</td>
<td>9.2 ± 0.1</td>
<td>6.8 ± 5.5</td>
<td>30.8 ± 1.9</td>
<td>279 ± 55</td>
</tr>
<tr>
<td>0.0519 (µg/L)</td>
<td>95 ± 6.4</td>
<td>9.1 ± 0.1</td>
<td>1.8 ± 3.6</td>
<td>29.9 ± 1.7</td>
<td>280 ± 44</td>
</tr>
<tr>
<td>0.148 (µg/L)</td>
<td>98 ± 3.3</td>
<td>9.0 ± 0.1</td>
<td>7.1 ± 10</td>
<td>30.4 ± 1.6</td>
<td>274 ± 48</td>
</tr>
<tr>
<td>0.388 (µg/L)</td>
<td>95 ± 3.3</td>
<td>9.1 ± 0.2</td>
<td>0 ± 0</td>
<td>30.5 ± 2.6</td>
<td>282 ± 60</td>
</tr>
<tr>
<td>1.30 (µg/L)</td>
<td>95 ± 3.3</td>
<td>9.1 ± 0.1</td>
<td>0 ± 0</td>
<td>30.5 ± 1.8</td>
<td>269 ± 53</td>
</tr>
<tr>
<td>5.31 (µg/L)</td>
<td>98 ± 3.6</td>
<td>9.0 ± 0.0</td>
<td>12 ± 9.2</td>
<td>30.2 ± 1.4</td>
<td>259 ± 45</td>
</tr>
</tbody>
</table>

#### Table 2-B Results (Continued)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Gonadosomatic Index (%)</th>
<th>No. of males with testis-ova/No. of males</th>
<th>Hepatosomatic Index (%)</th>
<th>No. of fishes</th>
<th>Vitelloigenin (ng/mg liver)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
<td></td>
<td>male</td>
<td>female</td>
</tr>
<tr>
<td>Control</td>
<td>0.82 ± 0.3</td>
<td>4.7 ± 3.5</td>
<td>20</td>
<td>0/11</td>
<td>2.8 ± 0.3</td>
</tr>
<tr>
<td>Solvent control</td>
<td>0.78 ± 0.2</td>
<td>3.7 ± 3.8</td>
<td>20</td>
<td>0/9</td>
<td>2.8 ± 0.5</td>
</tr>
<tr>
<td>0.0519 (µg/L)</td>
<td>0.82 ± 0.3</td>
<td>3.5 ± 3.0</td>
<td>20</td>
<td>0/7</td>
<td>2.2 ± 0.8</td>
</tr>
<tr>
<td>0.148 (µg/L)</td>
<td>0.84 ± 0.6</td>
<td>4.9 ± 4.0</td>
<td>20</td>
<td>0/13</td>
<td>2.0 ± 0.8**</td>
</tr>
<tr>
<td>0.388 (µg/L)</td>
<td>0.84 ± 0.4</td>
<td>5.2 ± 4.0</td>
<td>20</td>
<td>0/12</td>
<td>2.5 ± 0.6</td>
</tr>
<tr>
<td>1.30 (µg/L)</td>
<td>0.82 ± 0.2</td>
<td>3.9 ± 3.6</td>
<td>20</td>
<td>0/9</td>
<td>2.5 ± 0.7</td>
</tr>
<tr>
<td>5.31 (µg/L)</td>
<td>0.70 ± 0.3</td>
<td>7.7 ± 3.5</td>
<td>20</td>
<td>0/13</td>
<td>2.6 ± 0.7</td>
</tr>
</tbody>
</table>

Statistically significant differences from control group (**indicates \( p < 0.01 \), *indicates \( p < 0.05 \))