ACUTE AND CHRONIC TOXICITY OF AMMONIA ON PSEUDODIAPTOMUS FORBESI

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Abstract
This study was conducted to determine the acute and chronic effects of ammonia, and the interaction of pH and ammonia to the copepod, Pseudodiaptomus forbesi. Ammonia concentrations were analyzed with an ion selective electrode (ISE) and meter. The ISE meter was calibrated using the EPA method 350.3 with stock solutions prepared and certified by Fisher Scientific.

Materials and Methods
Objective
To determine unionized ammonia and ionized ammonia concentrations and pH levels that cause acute and chronic toxicity in Pseudodiaptomus forbesi.

Temperature (ºC) ±1
20-30
Salinity (ppt) ±1
3.0-6.0
pH 7.4-7.8
Acceptability of control survival >80%
Size of test beaker (ml) 600 ml
Volume of test solution (ml) 500 ml
Life stage of copepods Juvenile
# of replicates per concentration 4
Nominal Concentrations (mg/L) 0.5-0.8

Acute Toxicity Experiment

Mortality vs. Time at pH 7.4

Table 1. Measured Ammonia Concentrations

<table>
<thead>
<tr>
<th>Concentration (mg/L)</th>
<th>Measured Concentration (mg/L)</th>
<th>0.00</th>
<th>1.00</th>
<th>2.00</th>
<th>4.00</th>
<th>6.00</th>
<th>8.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>at pH 7.4</td>
<td>5 ppm</td>
<td>0.00±0.00</td>
<td>0.00±0.00</td>
<td>1.54±0.02</td>
<td>2.75±0.02</td>
<td>3.98±0.02</td>
<td>4.71±0.01</td>
</tr>
<tr>
<td>at pH 7.8</td>
<td>8 ppm</td>
<td>0.00±0.00</td>
<td>0.00±0.00</td>
<td>1.08±0.00</td>
<td>2.10±0.01</td>
<td>4.71±0.01</td>
<td>6.23±0.03</td>
</tr>
</tbody>
</table>

Mortality vs. Total Ammonia Concentration

Table 2. LC50 data of Acute Toxicity Experiments (USEPA Probil Analysis Program Version 1.5)

<table>
<thead>
<tr>
<th>pH</th>
<th>LC50 (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.4 (96 hrs)</td>
<td>2.960</td>
</tr>
<tr>
<td>7.8 (144 hrs)</td>
<td>6.014</td>
</tr>
</tbody>
</table>

Discussion
Ammonia toxicity is dependent on pH levels. P. forbesi is more sensitive to pH 7.4 compared to pH 7.8 indicating sensitivity to increasing IA concentrations. At constant TAN, P. forbesi is more sensitive at high pH due to increasing UA concentrations. Ongoing experiment will determine the chronic levels of UA and IA and their overall effects on copepod growth and reproduction.

Acknowledgements
Funding support for this study was provided by the State Water Board Agreement No. 86-447-300 Subtask# 14 to Swee Teh. We greatly appreciate SWRCB program managers: Chris Foe and Mark Gowdy for their patience and understanding.

References
Foe, C.A. “Preliminary Ammonia Results from an Ongoing Monitoring Program”, presented at the 19-20 August 2009 Ammonia Summit at The Central Valley Regional Water Quality Control Board.

Summary of Results
- Time to 50% lethality was shorter at pH 7.4 compared to pH 7.8.
- At pH 7.4, 4-d LC50: UA=0.033 mg/L, IA=2.927 mg/L.
- At pH 7.8, 6-d LC50:UA=0.150 mg/L, IA=5.864 mg/L; no LC50 was observed at 4-d exposure.
- In the pH experiment, a positive dose response was observed for % mortality with increasing UA at 4-d LC10=0.038 mg/L, 4-d LC50=0.303 mg/L.

Discussion
Ammonia toxicity is dependent on pH levels. P. forbesi is more sensitive to pH 7.4 compared to pH 7.8 indicating sensitivity to increasing IA concentrations. At constant TAN, P. forbesi is more sensitive at high pH due to increasing UA concentrations. Ongoing experiment will determine the chronic levels of UA and IA and their overall effects on copepod growth and reproduction.

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