Biological effects of synthetic estrogens in wastewater treatment effluent

Emily Notch, Greg Mayer

Xenoestrogens

Ethinyylestradiol

- Major synthetic component of oral contraceptives
- Enters aquatic environment via wastewater treatment plants

Maine POTW Facility Secondary Treatment Type

- Site A - Activated Sludge
- Site B - Rotating Biological Contactors with aeration
- Site C - Trickling Filter & Activated Sludge

MVLN cell line

5'-AGGTCANTGACCT-3' → Xenopus vitellogenin promoter

Luciferase

In vitro Biological Activity

Zebrafish exposures

- 7 day
- Static water renewal daily
- Male and females separately
vtg1 transcript in females

**Fold change in transcript**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VTG 100</td>
<td>VTG 1000</td>
<td>VTG 10000</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

male vtg1 transcript

**Fold change in transcript**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VTG 100</td>
<td>VTG 1000</td>
<td>VTG 10000</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

cyp1a1

**Fold change in transcript**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VTG 100</td>
<td>VTG 1000</td>
<td>VTG 10000</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Ethinylestradiol – known, non-mutagenic carcinogen:

What affect does ethinylestradiol have on DNA repair?

HR23B

**Fold change in transcript**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VTG 100</td>
<td>VTG 1000</td>
<td>VTG 10000</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
What about exposures to mixtures like WWTP effluent?
Conclusions

- Estrogenic compounds are present in WWTP effluent in sufficient concentrations to elicit biological effects
- Estrogens have deleterious effects on aquatic organisms beyond altered reproduction
Future work

• Downstream sampling

• Effluent effect "repair capacity"

• Mechanisms causing decreased NER transcript

• Increased risk of mutations or tumors

Acknowledgements

Mayer Laboratory
• Danielle Miniutti
• Cassandra Patenaude
• Cassie Wicks
• Ashley Duncan
• Dr. Greg Mayer

• Mark Nilan – UMaine Zebrafish facility