Sunlight Inactivation of Bacteria in Open-Water Unit Process Treatment Wetlands: Modeling Inactivation Rates

Research Group:

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Research Questions:

1. Can we develop predictive photoaction spectrum models for endogenous inactivation of *E. faecalis* and *E. coli*?
2. How does the selected growth media affect the apparent inactivation rate of *E. coli*?

Background:

- Constructed wetlands can be used as a natural, low cost and low energy technology for wastewater treatment.
- Constructed wetlands have the ability to remove pathogens from wastewater effluent through sunlight inactivation.
- Previous studies used Idexx media for collecting wetland bacteria monitoring data, instead of mTEC agar.
- Photoaction spectra are functions that consist of wavelength-specific sensitivity coefficients that describe the biological response of an organism to radiation.

Study site: Discovery Bay, CA

Figure credit: Jasper et al. 2013. *Env. Eng. Science*. 30: 421-436
Results:

**Average Inactivation Rates**

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>LB + Kanamycin</th>
<th>mTEC</th>
<th>Idexx</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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**Observed Inactivation Rate**

<table>
<thead>
<tr>
<th>Growth Media</th>
<th>k observed</th>
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</thead>
<tbody>
<tr>
<td>LB + kanamycin</td>
<td>3.8</td>
</tr>
<tr>
<td>mTEC</td>
<td>5.3</td>
</tr>
<tr>
<td>Idexx</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Conclusions:

- Non-selective media (LB + kanamycin) is less damaging to bacterial growth, resulting in a lower observed inactivation rate.
- Due to the similarity in observed inactivation rates between mTEC agar and Idexx media it is possible to use monitoring data found in previous studies to validate our photoaction spectrum model.

Future Research:

- Validate our photoaction spectrum model using Idexx monitoring data
- Create photoaction spectrum for environmental *E. coli* and *E. faecalis*