Lecture 23: Water Microbiology

NOTICE

Non-potable water
Not for drinking or cooking use

I. Introduction
A. Water microbiology is the _________________________________. This is done to determine what organisms are present, and if they are helpful or harmful.
B. The safety of water for drink and contact is the main reason for _________________________________. We must know if the water will cause harm to us or the environment. Some microorganisms can actually reduce the amount of environmental damage. We treat drinking water to make it potable.

II. Harmful organisms (Bacteria, Parasites and Viruses)
A. __________________________________________________________ may affect as few as 1 or 2 people, or they may affect enough people to reach epidemic proportions. Luckily, the Safe Water Drinking Act and the ______________________________ help keep us safe. Water Treatment is not without flaws, so it is still a _______________ that drinking water is safe, especially with the increased number of HIV/AIDS patients.
B. Water contamination from __________________________________________________________ introduces into the water:
   1. Pathogenic Bacteria (Mostly enteric or GI Tract)
      a. Vibrio cholerae which causes Cholera
      b. ________________ including Salmonella typhi
      c. Cyanobacteria which may be a risk factor in cancer
      d. Mycobacterium
   2. _______________ including the “Super Bugs” Cryptosporidium and Giardia
   3. Viruses including Hepatitis viruses.

III. Screening for pathogens
A. It is ________________________________ to screen for enteric pathogens (e.g. Shigella and _______________) for several reasons:
   1. These pathogens enter the water supply ________________________________ because not everyone is infected and shedding them continuously.
2. Most enteric pathogens are not stable in the environment, therefore they
__________________________________________________________.

3. These pathogens are generally ____________________________ so they may ____________________________.

4. __________________________________________ are required to culture enteric pathogens.

B. Due to these problems associated with finding pathogens in large volumes of
water, we will instead look for __________________________________________ whose presence indicates fecal contamination. The most common group of these
indicator organisms are called ____________________________.

C. Coliforms are ____________________________ that are present in the
___________________________ of every warm blooded animal. They are defined as
aerobic or facultative anaerobic Gram-negative rods that do not form spores, but
do _____________________________________________.

The ____________________________ than enteric pathogens for several reasons:

1. Animals and humans ____________________________ in their GI tract.

2. They are ____________________________ in feces.

3. Their presence in water will indicate fecal contamination which suggests
the possibility of pathogen contamination.

4. Coliforms ____________________________ in water and are much
___________________________ in the lab.

D. The detection of coliforms is complicated by the fact that ____________________________
________________________________________. In fact, some are commonly
found in the environment. Because of this, we commonly distinguish coliforms
biochemically, to determine ____________________________ using the
__________________________________________.

<table>
<thead>
<tr>
<th>IMViC</th>
<th>(__________ )</th>
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<tbody>
<tr>
<td>Organism</td>
<td>Indole</td>
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<tr>
<td>fecal coliforms <em>(Escherichia coli)</em></td>
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<tr>
<td>non-fecal coliforms <em>(Enterobacter aerogenes)</em></td>
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IV. We will screen waste water treatment plant (WWTP) influent and effluent, Laramie River water, water treatment plant (WTP) influent and effluent and drinking water for the presence of coliforms.

*_________________ are one main reason for __________________________ of water.
V. Tests for Coliforms

A. The ________________________________

1. The PA is used to quickly examine for the presence of coliforms. This test is able to detect ________________________________.

2. The PA broth contains ___________ and a pH indicator which will change from a purple color to a ________________________________ from the fermentation of lactose.

B. The ________________________________ is a test that may be used to assay a ________________________________ and allow us to ________________________________ the number of coliforms in that sample.

1. The water is passed through a 0.45 micron ________________.

2. The filter is then placed on a selective and differential medium, usually EMB or Endo agar, which allows for identification of coliforms.
Endo media contains sodium sulfite and basic fuchsin to inhibit the growth of _______________ organisms. Coliforms that ferment lactose form red or pink colonies that may be _______________.

**Profile:** _______________

How many coliforms/100 mL are present in this sample?
2. ______________________________ is performed by inoculating MacConkey agar that contains MUG (4-Methylumbelliferyl-β-D-glucuronide). Selected Gram-negative colonies that ferment lactose turn bright pink; if the enzyme ______________________ is present, it will hydrolyze MUG to form a compound that _______________ under long wavelength UV. Because 96-97% of E. coli strains produce β-glucuronidase, this test is said to verify E. coli colonies.¹

3. ______________________________ is done by selecting a lac+, fluorescent colony from the MacConkey/MUG plate and _______________ to verify lactose fermentation. Also, the same colony should be stained to verify the Gram-negative, _____________________ character.

E. These tests are done on numerous bodies and sources of water _________________.

VI. Other microbiology applications in water treatment

A. Biosensing is one of the new breakthroughs in microbiology. Korean scientists are using ___________________ containing the lux operon to indicate if there has been a failure in waste water treatment.

B. Britain has the Microtox System which uses *Photobacterium* directly to detect pollutants. They can’t __________________________.

C. *Pseudomonas* expressing ______________ and other genes encoding toluene or benzene recognition will fluoresce in presence of these pollutants.

¹ American Society for Microbiology, Microbe Library (2009).