

Pathogen Capture Using Floating Films

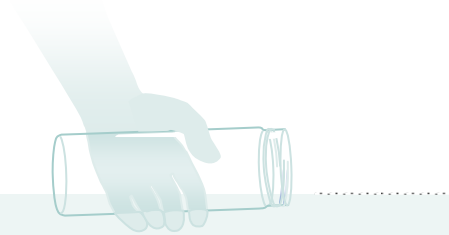
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MITRE Sponsored Research

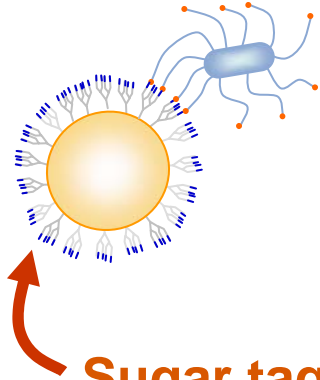


Problem



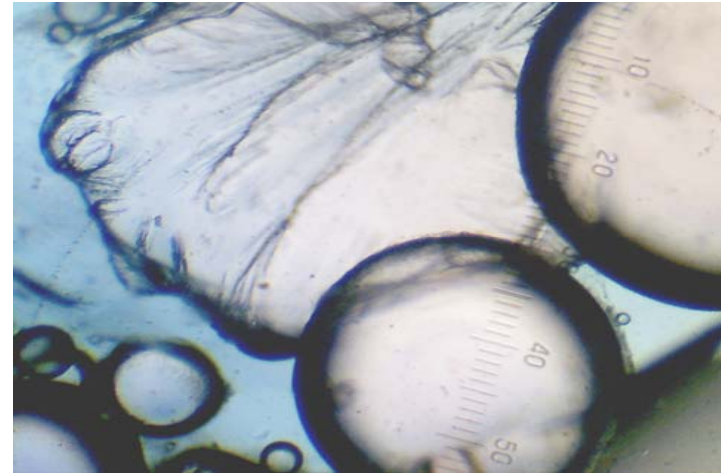
- **Low concentrations of harmful microbes are difficult to detect in large bodies of water.**
- **We will design and test a novel method of capturing and concentrating pathogens at the water surface.**

Background



A pathogen must stick to a tissue surface in order to cause an infection.

Sugar tags on animal cell surfaces are often targets of viral and bacterial pathogens.



Bubbles of lipo-glycoprotein film

- Sugar targets can be used to **trap** pathogens.
- Plant and animal tissue fluids contain glycoproteins that can be induced to produce floating biocapture films laced with host-specific sugar targets.


Objective

- **Design and test a prototype film to collect and concentrate specific pathogens**
- **Provide a low-cost method of rapidly surveying surface waters**
 - **to facilitate the collection of water samples for analysis**
 - **to provide early warning of harmful biological contamination**

Activities

- **Optimize and quantify the film's stability and efficiency under different conditions**
 - Vary micelle size and composition, pathogen concentration, and exposure time
 - Experimentally measure sensitivity and selectivity of capture surface
- **Plan and implement field tests**

Highlight


SugarBindDB
Pathogen Sugar-Binding Database

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Search Results

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Pathogen or Toxin	Carbohydrate or Ligand	Pub Year		Citation
Rotavirus	NeuGc(a2-3)Gal(b1-4)Glc(b1-1)	2003	<input type="checkbox"/>	Biochemical Pharmacology, 2003 Mar 1; vol. 65, no. 5: 699-707. Review
Salmonella	Man			
Sendai virus	NeuAc			
Sendai virus	NeuAc(a2-3)[NeuAc(a2-3)Gal(b1-3)GalNAc(b1-4)] Gal(b1-4)Glc(b1-1)			
Serratia marcescens	Man			
Shiga toxin	Gal(a1-4)Gal(b1-1)			
Shigella dysenteriae	Gal(a1-4)Gal(b1-4)Glc(b1-1)Cer			
Staphylococcus saprophyticus	Gal(b1-4)GalNAc			
Streptococcus aureus	GalNAc(b1-4)Gal	1988	<input type="checkbox"/>	Proceedings of the National Academy of Sciences of the United States of America, 1983 Aug; vol. 85, no. 16: 6157-6161.

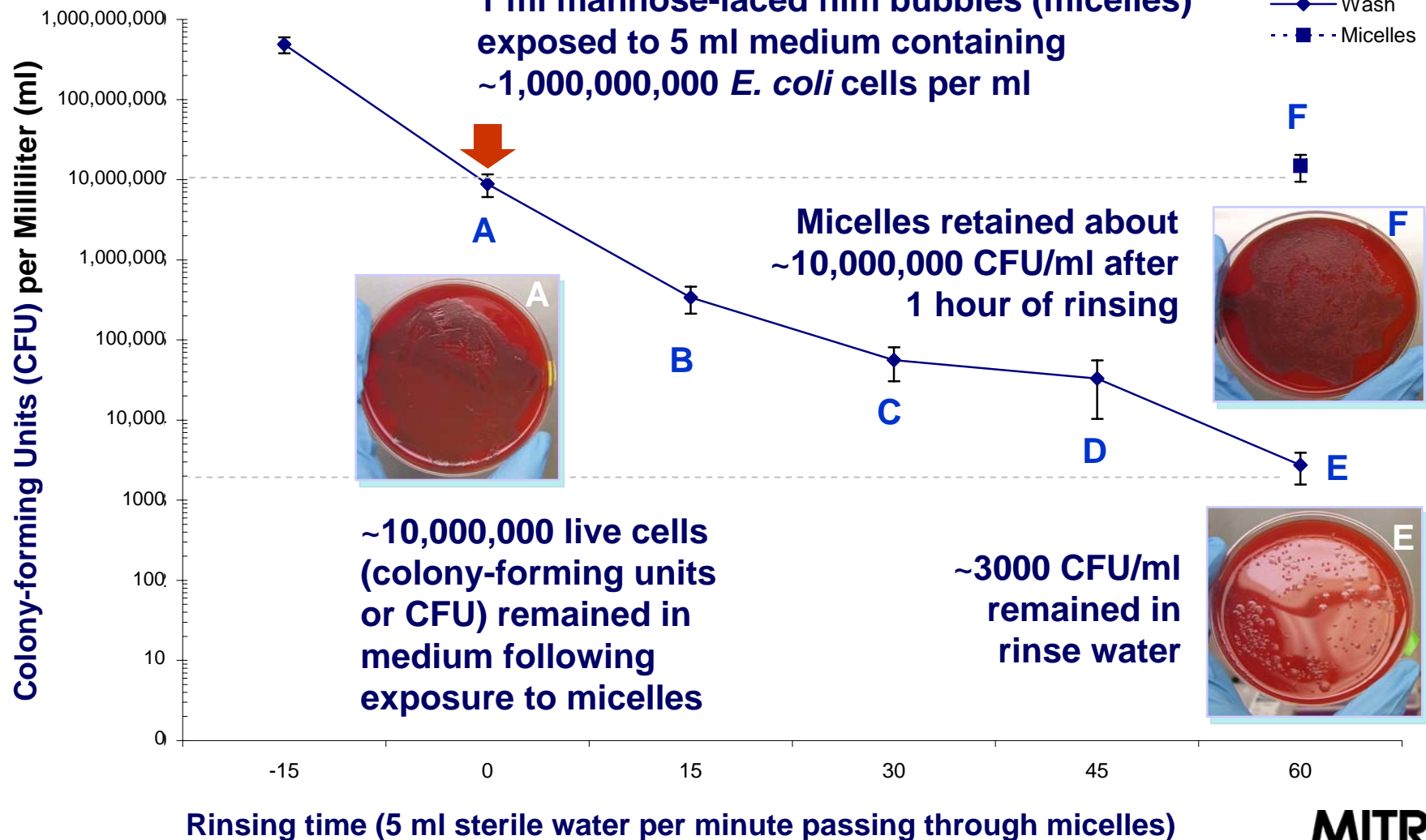
Proteins on the surfaces of bacterial cells, toxins and viruses bind to carbohydrate sequences listed in SugarBindDB, a new, free database available on the Internet at

<http://sugarbinddb.mitre.org/>

Highlight:

Biocapture Experiment

1 ml mannose-laced film bubbles (micelles) exposed to 5 ml medium containing ~1,000,000,000 *E. coli* cells per ml



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Impacts

- **“Designer films” offer an inexpensive means of concentrating pathogens and toxins at the water surface.**
- **The technology will facilitate the collection of water samples for analysis.**
- **MITRE is building a patent portfolio in this area.**

Future Plans

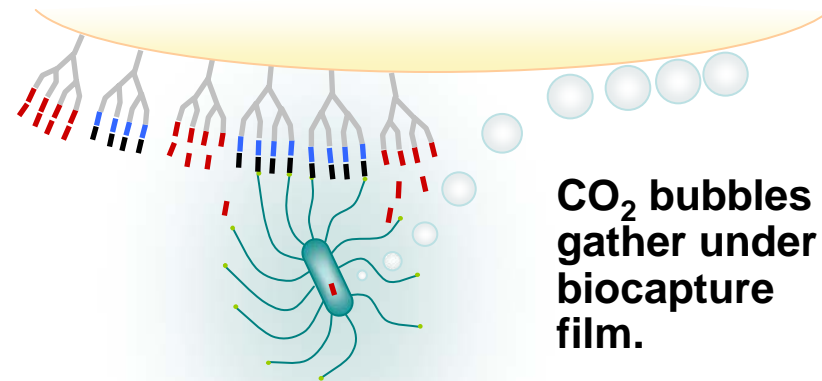
■ Produce a designer film bearing two different sugar strings:

- One to capture
- One to report the production of a species-specific enzyme

■ Detect release of carbon dioxide



Bubbles of CO₂ gas are visible on film surfaces.



Bacteria produce enzymes to break specific carbohydrate linkages, releasing simple sugars that can enter the cell.

When sugars are metabolized, CO₂ gas is released.

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