The Efficacy of LifeStraw® Water Filters In Filtering *Enterococci* From Various Water Samples

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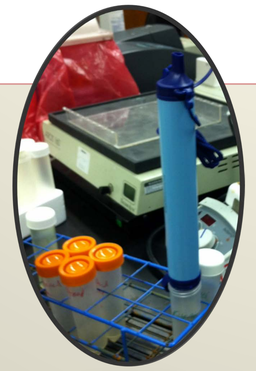
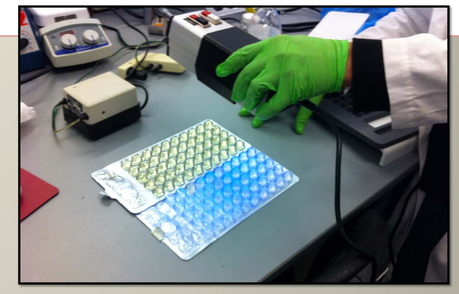
Null hypothesis: There is no difference between LifeStraw® post-filtered water quality and pre-filtered water in counts of *Enterococci.*

Abstract

Enterococci, contained in normal human fecal flora, can be dangerous to humans if ingested in large quantities. LifeStraw® water filters (by Vestergaard) have been shown to filter water that might be contaminated with Enterococc*i* and other bacteria. In this study, samples of undiluted marine and fresh water were filtered using a LifeStraw® water filter in an attempt to test the efficacy of these filters.. Tap water was used as a negative control. Test samples included brackish water from the Brooklyn Bridge Park (East River) and a fresh water sample from the Spuyten Duyvil Pond in the Bronx. Unfiltered samples tested positive with an Enterolert® detection kit. Samples filtered through the LifeStraw® water filter yielded the same results as the negative control, as did water from an aquarium containing zebrafish. Therefore, we have shown that LifeStraw® water filters are an efficacious way to filter water contaminated with *Enterococci*. Next steps include testing additional water samples from various locations with the LifeStraw®.





UV light depicts negative on top and positive on bottom with marine water sample.

Materials and Methods

Sterile 10 ml pipettes
Safety Pipette Filler Bulb
1 liter beaker
LifeStraw® filter
Distilled water
marine water and fresh water samples
IDEXX Quanti-tray Most Probable Number (MPN)
1 Iron to seal Quanti-tray
IDEXX Enterolert reagents
41 ± 0.5°C incubator
Long-wave UV Lamp (365-366 nm).
Sterile transparent non-fluorescent 100 ml vessels
50 ml sterile tubes

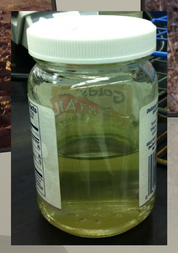
1) We added the unfiltered water samples and tap water to the 100 ml sterile vessel (one sample at a time, not all on the same day).
2) Then we added Enterolert reagent and shook the bottle for 60 seconds until the reagent had been dissolved in the water.
3) Then we poured the solution into the Quanti-Tray (the best way to open the tray is by pushing the top of the Quanti-Tray while squishing your hand into a complete circle then relax your hands and pull the top part away from the plastic site and avoid touching the inside of the tray). Then iron the tray in a slow and steady motion as this will seal the tray (make sure that the Iron is hot otherwise it will not work).
4) We place the tray in the 41ºC incubator for 24 hours and the result were read within 24 to 28 Hours (if not then the result are not accurate).
5) After the incubation we placed the tray under the UV lamp and looked for a light blue color which meant that the solution was positive for enterococcus bacteria.
6) We next filtered the water samples (one at a time, not all on the same day) by pouring 50 ml at a time into the top of the Lifestraw and letting it drip through gravity into a second 50 ml tube (2 tubes were collected in all for each sample.)
7) Steps 1-5 were repeated. (replace the word "unfiltered" with "filtered").

Results

The tap water negative control did not show any growth, and the Brooklyn Bridge Park marine water sample turned blue, indicative of *Enterococca*l growth, so we felt confidant enough to proceed and test the LifeStraw®. The LifeStraw® was able to successfully filter both the marine and fresh water samples (Brooklyn Bridge Park and Spuyten Duyvil Pond). The aquarium water with the zebrafish did not depict *Enterococcal* growth, probably because of the tank filter. We did not dilute the marine water (future experiment) and, since the tray turned completely blue, the *Enterococci* were too numerous to count. The undiluted pond water, however, supported less *Enterococci,* which we were thus able to count.

Brooklyn Bridge Park

Spuyten Duyvil Pond



Location and date	Unfiltered water	Filtered water with LifeStraw®
Marine water Brooklyn Bridge Park 4/9/15	Tray turned completely blue (*Enterococci* too numerous to count)	Clear; no *Enterococci*
Fresh water Spuyten Duyvil Pond(Bronx)4/15/15	MPN = 28.8 Confidence limits: 19-43.9	Clear; no *Enterococci*
Fresh water Aquarium with zebrafish 4/16/15	Clear; no *Enterococci*	NA

Pond water filtered through LifeStraw® on left and unfiltered on right.

Introduction

Enterococcus is a genus of lactic acid bacteria of the Phylum Firmicutes. *Enterococci* are gram-positive cocci that often occurs in pairs (diplococci) or short chains. They are used as indicators of the presence of fecal material in drinking and recreational waters, which could indicate the possible presence of disease-causing bacteria, viruses, and protozoans. Such pathogens may pose health risks to people fishing and swimming in a water body. Sources of bacteria include improperly functioning wastewater treatment plants, leaking septic systems, storm water runoff, animal carcasses, and runoff from animal manure and manure storage areas.

Enterococci are facultative anaerobic organisms that are capable of cellular respiration in both oxygen-rich and oxygen-poor environments. Ingestion of *Enterococci* could lead to varies health condition such as urinary tract infection, bacteremia, bacteria endocarditis, diverticulitis, and meningitis. Sensitive strains of these bacteria can be treated with ampicillin, penicillin and vancomycin.

The purpose of this experiment is to test whether or not the LifeStraw® is safe to use and if it could protect the LifeStraw® user from *Enterococcal* bacteria.

Conclusions and Future Research Needs

In water, *Enterococci* are used as indicators of environmental contamination, because they are found in high concentrations in feces, and exposure to *Enterococci* is linked to adverse health effects in swimmers.. LifeStraws® safely filter waters that have been contaminated with *Enterococci*. A method to detect sources of *Enterococci* found in surface waters would be beneficial . This could be in the form of a molecular microbial source tracking tool, analogous to the tools used to track sources of *Bacteroidales.* Researchers have just recently started to use *Enterococci* on hands as indicators of hand hygiene. Additional studies that link *Enterococci* density on skin to hand hygiene practices (like hand washing) and health outcomes such as respiratory disease and gastrointestinal illness will further lend credence to their use as hygiene indicators.