The Development of the C2F Seawater to Freshwater Converting Bioplant

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Recent changes in climate, increased energy production, overpopulation, and inadequate water use and infrastructure led to freshwater shortage globally. There is an urgent need to develop new technology to produce freshwater due to the inadequacy of currently used methods. Biomimicry is a method which can use ideas found in nature to create long-term, eco-friendly, and sustainable solutions to human challenges. Key ideas from salt transporting organs such as the kidney and the fish gill may be used to remove salt from a solution thus converting seawater into freshwater. In this study we addressed the hypothesis that fish gill cells grown in a filter scaffold system can be used to develop a seawater-to-freshwater (C2F) converting bioplant prototype. We aimed to demonstrate proof of principle that the C2F bioplant can reduce NaCl concentration ([NaCl]) of seawater test solution (3.6% [NaCl]). RTgill-W1 fish gill cells grown on permeable support in a transwell culturing system were used to form a confluent cell monolayer. Fluorescence microscopy with a green sodium sensitive fluorescent dye CoroNA was used to measure changes in [NaCl] of the luminal fluid compartment. Our C2F prototype significantly reduced [NaCl] in the luminal compartment from 3.6% to 0.3% in 45 minutes ($n=4$, $p<0.0001$). The integrity of the cell monolayer was preserved throughout the experiment confirmed by confocal fluorescence microscopy. In conclusion, our study provided proof of concept that cell-based strategies can be used to efficiently convert seawater to freshwater. Our C2F prototype may be further developed to build eco-friendly and sustainable solutions to our global fresh water problem.

Awards Won:
Third Award of $1,000