Elucidating Terrestrial Optical Refrigeration Through Transpiration in Rhizophora mangle and Chlorophyll A Fluorescence in Low-Polarity Mediums

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It is predicted that fresh water scarcity will affect over half of the global population as a consequence of continued population growth, increasing industry, and global warming. Research has yet to develop a sustainable and accessible method of fresh water acquisition or explore optical refrigeration as a novel cooling technique for the collection of transpired water. This study investigated prospects of transpiration and biodesalination using red mangroves (Rhizophora mangle) grown in tank conditions as well as optical refrigeration in chlorophyll a (ChlA) and sodium copper chlorophyllin (SCC). Temperature, light cycles, and pH levels remained constant. R. mangle plants passively desalinated 16% of the salinity in the brackish water despite an increased concentration from evaporation, and transpired 5% more water than the control tank. Both transpiration and desalination were effective in the experimental tank, providing water with a decreased salt content. Light absorption measurements were conducted using a Newport Oriel spectral photometer with a lock-in amplifier for all absorption and scattering measurements. Approximately 16% efficiency and scattering/reflection experiments were carried out with the photodetector. The concentration-dependent absorption was examined at a number of solvent polarities with SCC. Both ChlA and SCC dispersed in diethyl displayed the desired optical properties under illumination at various wavelengths including high reflectivity and low absorption rates to perform optical refrigeration successfully. The examination of Mangrove plant transpiration, chlorophyll/sodium copper chlorophyllin photoabsorption, and wavelength scattering illustrates a viable method for nature to be used for terrestrial optical refrigeration.

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