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Developing a Desalination System Using Edible Vegetables

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Summary

Global demand for freshwater has been increasing owing to population growth, increased economic activity, and changing dietary habits (e.g., more animal-based diets), resulting in a shortage of freshwater in many regions. Although water covers 70.8% of Earth's surface, it is difficult to use it because of its salinity. Seawater and glaciers account for 97% and 2% of the water on Earth, respectively, leaving only approximately 1% of Earth's freshwater available for human use. If freshwater can be obtained from seawater, problems related to the lack of freshwater availability can be mitigated. Hence, various technologies have been developed to desalinate seawater and make more freshwater available for human use. In this study, freshwater was generated from seawater using a desalination system in which vegetables were grown. Lettuce (*Lactuca sativa* L.) was used as a model vegetable herein. The desalination system consisted of a lettuce plant community composed of six plants, seawater, and containers, a white LED light source, thermally insulated box (0.85 m (W)×0.42 m (L)×0.42 m (H), the number of air exchange: 7.1 h^{-1}), a cooling system using Peltier devices, and a CO_2 gas cylinder. When artificial seawater with less than 20% of the specified concentration was used, freshwater with a low electric conductivity was recovered through the lettuce plant community in the desalination system. The amount of freshwater harvested was significantly higher using this desalination system than using the conventional method. By decreasing the CO_2 concentration in the desalination system due to photosynthesis by the lettuce plants, the amount of freshwater harvested increased, suggesting that lowering the CO_2 concentration can improve harvesting efficiency when harvesting freshwater is the main objective of the desalination system. However, if both freshwater and plants are to be produced in the desalination system, the CO_2 concentration should be maintained at approximately the atmospheric standard (ca. 500 μmol mol^{-1}) to maintain photosynthesis in the lettuce plant community. In the future, we would like to work on energy reduction in desalination systems and to explore suitable vegetables for desalination.