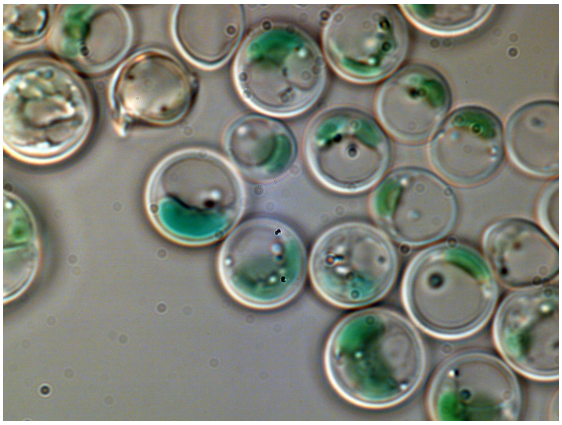
Using Algae to Clean Urban Wastewater

NSF Highlights – Track 1 Research

Title

Evaluation of *Galdieria sulphuraria* for nutrient removal from urban wastewaters



Microscopic image of *Galdieria sulphuraria*.

Outcome

The team involved in this study concluded that *Galdieria sulphuraria* can be cultivated in primary effluent to achieve high nutrient removal efficiencies and at removal rates comparable to other strains. *G. sulphuraria* is especially useful because it can thrive in extreme conditions, including an acidic environment with temperatures up to 56°C, conditions that many competitors, predators, viruses, and pathogens will not tolerate.

Impact / Benefits

The high biomass yield recorded under laboratory conditions as well as the high areal productivity achieved under outdoor conditions in the closed photobiorector (PBR) configuration that minimizes evaporative losses and contamination, hold promise for *Galdieria sulphuraria* as a preferred strain for energy-efficient nutrient removal from urban wastewaters. The extremes of temperature and pH that allow G. *sulphuraria* to thrive are expected to drastically reduce the number of microorganisms present, which bodes well for further optimization of overall system design to leverage biological and chemical engineering approaches to reduce the required footprint of an algae-based wastewater treatment systems and minimize it's hydraulic residence time.

Explanation

Urban wastewaters are laden with high levels of organic carbon and different forms of nitrogen (N) and phosphorous (P) that must be removed prior to discharge into receiving waters. Although traditional wastewater treatment plants (WWTPs) equipped with secondary treatment meet the discharge standards for organic carbon (BOD), they fall short of meeting the discharge standards for nutrients. There is growing interest in developing energy-efficient and sustainable technologies that minimize or eliminate the energetic cost of managing urban wastewaters. Recognizing that algal-based wastewater treatment systems use photosynthetic energy to drive nutrient removal, recent studies have sought to build on the early efforts to develop improved algal systems for urban wastewater treatment.

The premise of this approach is that, mixed algal/bacterial systems can simultaneously reduce BOD, N, and P in urban wastewaters. The energy-rich biomass produced would then serve as feedstock for producing gaseous or liquid biofuels. This approach incorporates much of the internal energy of the wastewater into the biomass as well as solar energy captured via photosynthesis. This study proposes a potentially energy-positive WWTP process specifically intended for warm-to-hot, arid regions where water is precious, such as New Mexico. This study presents nutrient removal ability of an algal

extremophile, *Galdieria sulphuraria*, with a broad genetic capacity for organic carbon utilization. Both laboratory assessment of nutrient removal capability and outdoor cultivation results are presented in the research.

Source: Dr. Peter Lammers, NMSU; Dr. Wayne VanVoories, NMSU; edited by Natalie Willoughby, NM EPSCoR
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