Nutrient recovery from wastewaters with microalgae

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Abstract

Microalgae have significant potential for CO_2 capture and wastewater treatment, because they can grow and fix CO_2 faster than terrestrial plants due to their simpler structure and can utilize nutrients from wastewaters for their growth. The produced microalgal biomass has various potential uses as a feedstock for biofuels, fertilizers, biochar, bioplastics, animal feed, human nutrition, cosmetics, and pharmaceuticals. However, more energy-, resource-, and cost-efficient cultivation and harvesting systems are required to enable large-scale use of microalgae for nutrient recovery and production of high-volume, low-value commodities such as energy and fuels. It is also important to select suitable microalgal species for specific wastewater and environmental conditions to enable efficient nutrient removal.

Nutrient recovery with microalgae is especially potential from for example source-separated human urine and liquid digestates from anaerobic digestion of organic wastes and wastewater sludges due to the biodegradable nature and high content of nutrients in these waste streams. Green microalga *Scenedesmus acuminatus* has been demonstrated to grow efficiently in liquid digestates originating from pulp and paper industry biosludge digestion with final biomass concentrations in 21-day batch cultivations resulting in biomass concentrations of 7.8-10.8 g L^{-1} and over 97% nutrient removal efficiency. Growth of *S. acuminatus* in source-separated human urine has been successfully demonstrated in fed-batch and continuous operation modes in a 2000 L raceway pond at temperatures ranging from 30 °C to below 5 °C and to remove up to 50% of the nitrogen and 38% of the phosphorous present in the urine.

Keywords: Microalgae; Nutrient recovery; Liquid digestate; Source-separated urine.