Factors affecting the success of algae cultivation in recycled medium
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Abstract

Water used for microalgae cultivation must be reused to maximize cost-efficiency and environmental benefits of large-scale algae production. Recycled growth medium may accumulate various compounds, particles, and microorganisms that can affect algae growth. Through a meta-analysis of prior studies and new experiments, our objective is to determine how factors such as algae strains, microbial interactions, and harvesting methods affect algae growth in recycled medium. A cross-study comparison reveals that successful growth in recycled medium may be situation-specific, though green algae strains harvested by flocculation seems most promising for reusing harvest water. New data from pilot crop rotation experiments show that while some strains are unaffected by recycled medium, the filtrate of certain strains can universally decrease growth rates and total lipid concentrations of other strains. More studies on microbial interactions and algal exudates in recycled medium can provide recommendations for improving biomass productivity and quality of algae growing in this water.

Literature Meta-Analysis

Methods

Categorized the effect of recycled medium on algae growth rate (or biomass productivity or final biomass) for each experimental treatment. Classified effect as stimulatory if growth was significantly greater (or at least 10% greater) than in the control; as inhibitory if growth was significantly less (or at least 10% less) than in the control; or otherwise neutral.

Results

Fig. 1 A) Effect of marine versus freshwater algae on algal growth response in recycled medium. B) Effect of 1 round of crop rotation on algal growth response in recycled medium. More studies testing marine algae strains and the potential of crop rotation are warranted.

Fig. 2 The percent of stimulatory, neutral, and inhibitory growth responses of algae in recycled medium based on: A) harvesting method, B) genus of the growing algae strain, and C) genus of the algae strain from which spent medium was collected. N indicates the number of experimental treatments represented, with a requirement of at least n = 3. Factors such as harvesting method and algae strain have mixed effects on algae growth in recycled medium, indicating that successful growth may be situation-specific. Although some companies successfully reuse harvest water with proprietary methods, data from published studies provides insight into what conditions may allow reuse of harvest water with less costly treatments.

Summary

• Past studies suggest that successful algae growth in recycled medium may be situation-specific, although green algae strains and harvesting by flocculation seem most promising for reusing harvest water.

• Some algae strains can achieve the same growth in recycled medium as in fresh medium, while other strains may produce a recycled medium that is universally inhibiting.

• More experimental work on microbial interactions and algae crop rotation in recycled medium is recommended, because rotating crops may optimize nutrient utilization and prevent the build-up of strain-specific inhibitory products.

Literature Cited