Efficient low-temperature nutrient removal from digestate by microalgae

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Chorella sorokiniana could effectively remove total nitrogen and total phosphorus from diluted digestate under unfavorable growing conditions in novel pilot-scale cultivation system integrated into a biogas plant.

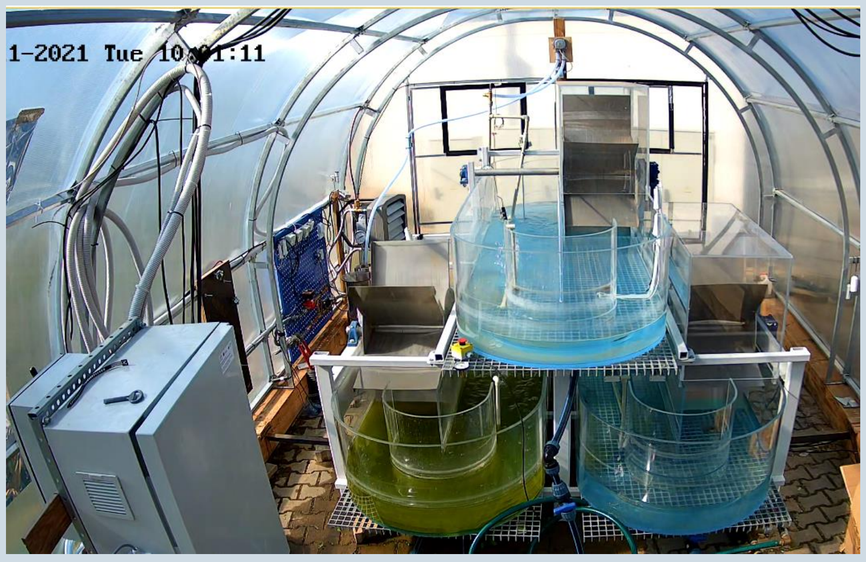

Fig. 1. Novel microalgae cultivation system integrated into a biogas plant using its waste products.

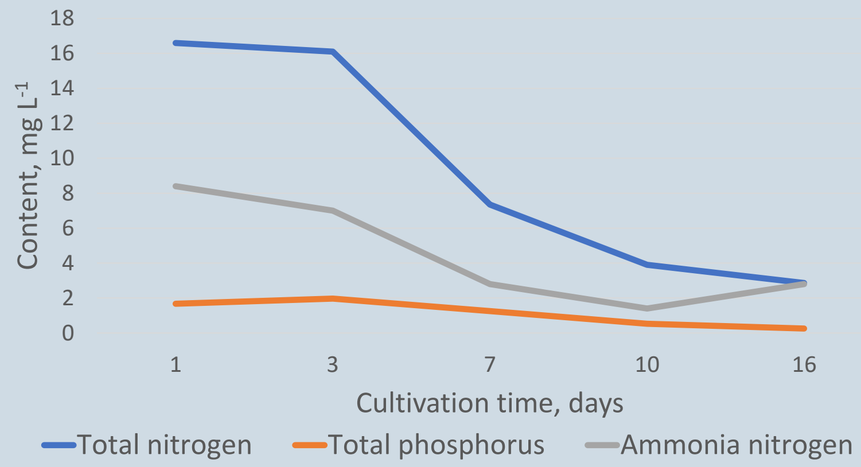

Fig. 2. Removal of total nitrogen, total phosphorus and ammonia nitrogen by *C. sorokiniana* during 16-day

Table 1. Nutrient removal from a diluted digestate during *Chlorella sorokiniana* cultivation.

Parameter	Initial level, mg L^{-1}	Removal, mg L^{-1}	Removal rate, %
Total nitrogen	16.6	13.74	**83**
Total phosphorus	1.67	1.416	**85**
Ammonia nitrogen	8.4	7	**83**
Nitrate nitrogen	<0.3	NA	NA
Chemical oxygen demand	83	-12	-14.5

Introduction

Microalgae are regarded as a promising feedstock for sustainable energy production, CO_2 sequestration and as a source of value-added compounds.

Utilizing digestate as a cost-effective nutrient source not only enhances the sustainability and economic feasibility of microalgal biofuels but also offers a method for wastewater treatment and CO_2 sequestration.

Studies on microalgae cultivation in high-latitude regions are very limited.

Results

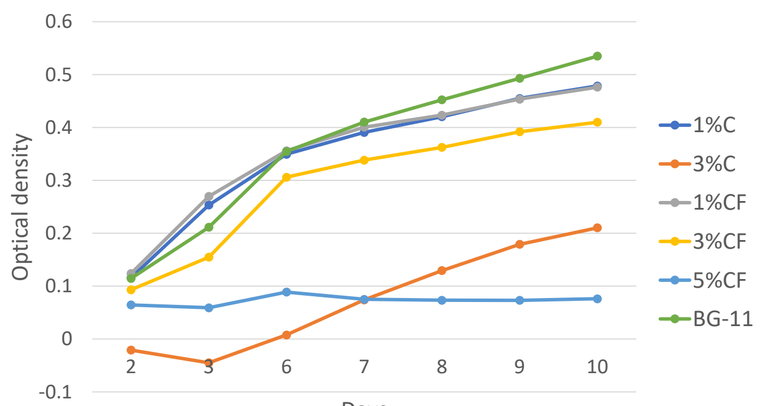

Fig. 3. Cultivation of *C. vulgaris* in 1, 3 and 5% digestate pretreated using centrifugation (C) and filtration (CF).

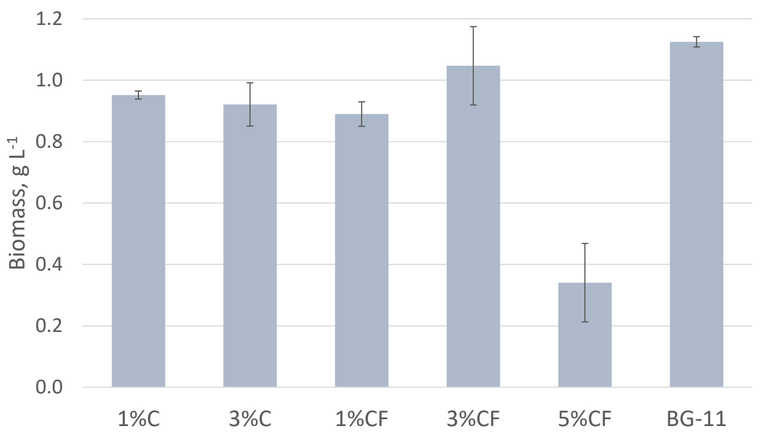

Fig. 4. Biomass yield of *C. vulgaris* cultivated in 1%, 3% and 5% pretreated digestate. C- centrifugation, CF - filtration. Error bars represent Standard deviation (n=3).

Fig. 5. Microalgae cultivation in various dilutions of pretreated digestate as a growth medium.

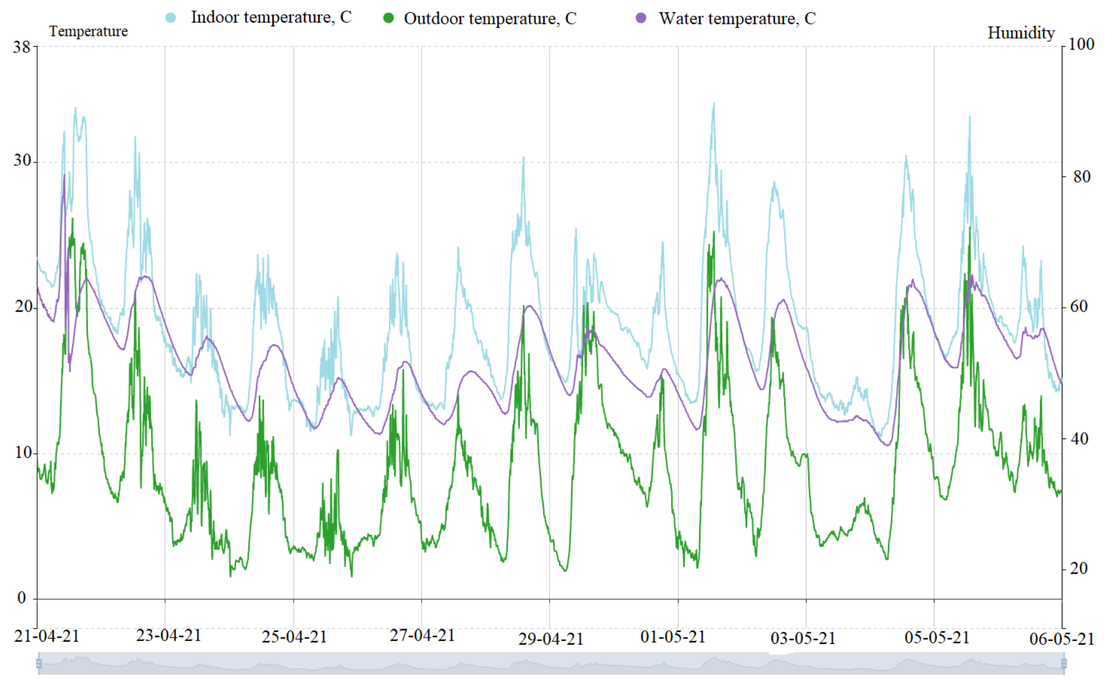

Fig..6. Outdoor temperature, indoor temperature at the greenhouse and pond water temperature during the biomass cultivation test.

Conclusions

A high dilution rate is required for digestate application as a nutrient source for microalgae cultivation.

Centrifugation and filtration significantly decreased the amount of solids but were not efficient in lowering the optical density.

C. sorokiniana could remove 83% of total nitrogen and 85% of total phosphorus during the cultivation in a pilot-scale cultivation system under low-temperature conditions.