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Microalgae cultivation in continuous reactor using mixotrophic anaerobic effluent: effect of dilution rate on biomass productivity and tertiary treatment

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Microalgae are continuously attracting main attention from biomass researchers, especially due to their capacity of fast growth, CO_2 abatement and land-free cultivation as compared with conventional crops. Additionally, municipal wastewater has been long recognized as a suitable media for the cultivation of microalgae biomass. Culturing microalgae with wastewater effluents also promotes a process of tertiary treatment, characterized by removal of main nutrients (N, P) from wastewater and simultaneously achieving high biomass productivities. However, few studies report data concerning biomass productivity in continuous mode using unsterilized mixotrophic wastewater effluent and we found no reports of E. coli population decay rates in these continuous reactors. This study focuses on the selection of native microalgae strains that are applicable for biomass production and tertiary wastewater treatment in continuous mode. Five strains were isolated and cultivated in unsterilized anaerobic effluent in batch growth mode, to identify the efficient microalgae isolates for biomass conversion. The isolate L06 (Chlorella sp.) was selected and evaluated based on five dilution rates from 0.1 to 0.5 1/day on continuous growth reactor, resulting in five steady state conditions. Maximal volumetric biomass productivity of 294 mg/L day was obtained at 0.3 1/day without CO_2 addition or air bubbling. Carbohydrates were the major fraction of the dried biomass, followed by proteins and then lipids. The highest removal rates of total nitrogen and phosphorus from the liquid phase were 13.0 and 1.4 mg/L day, respectively, and were achieved at 0.4 1/day. The maximal decay rate for E. coli (3.7 1/day) was also achieved at this dilution rate, representing approximately a 99.9% population reduction of this bioindicator over a period of 2.5 days. Therefore, L06 – Chlorella sp. continuous cultivation using secondary-treated wastewater can be adjusted depending on its objective: for biomass production, a dilution rate of approximately 0.3 1/day is recommended; and for tertiary treatment a rate of 0.4 l/day is suggested.

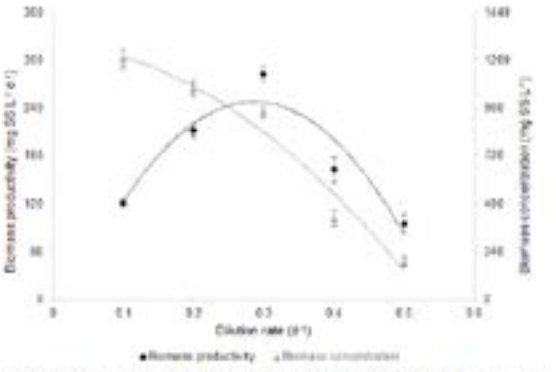

Fig 1. Variation in biomass productivity and concentration of L06 – *Chlorella* sp. cultures at steady-state as a function of the dilution rate applied to the system (n=6 and ±SD).

Recent Publications

1. Caporgno et al. (2015) Microalgae cultivation in urban wastewater: Nutrient removal and biomass production for biodiesel and methane. Algal Research 10:232-239
2. Gonçalves A L, Pires J C M and Simões M (2016) Biotechnological potential of Synechocystis salina co-cultures with selected microalgae and cyanobacteria: Nutrients removal, biomass and lipid production. Bioresource Technology 200:279-286.

3. Menna F Z, Arbib Z and Perales J A (2015) Urban wastewater treatment by seven species of microalgae and an algal bloom: biomass production, N and P removal kinetics and harvestability. Water Research 83:42-51.
4. Room R, Babor T and Rehm J (2005) Alcohol and public health. Lancet 365: 519-530.
5. Thiansathit et al. (2015) The kinetics of Scenedesmus obliquus microalgae growth utilizing carbon dioxide gas from biogas. Biomass and Bioenergy 76:79-8.

Biography

Servio Tulio Cassini has completed his B S degree in Biological Science from UFMG, Brazil in 1975, MS in Agricultural Microbiology from USP, Brazil in 1980, PhD in Environmental Microbiology from North Carolina State University NCSU-USA in 1988. During 1976-1999, he was a Full Professor in Universidade Federal Vicosa, Full Professor in Environmental Microbiology at Universidade Federal do Espirito Santo UFES-Brazil 1999- till now. During 1996-1997, he was a Visiting Professor in University of Tennessee at Knoxville UTK-USA. He was an Environmental Engineering Graduate Program Coordinator during 2000-2006, UFES Brazil and Brazilian Sanitation Research Program PROSAB-FINEP sludge network coordinator during 2002-2004. His main projects on wastewater and bioenergy and microbiology applied to sanitation engineering.

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