ABSTRACT

The aquatic-plant-based wastewater treatment has received a growing attention due to simultaneous biomass production and nutrient removal. These aquatic plants also help to reduce the eutrophication otherwise caused by release of excessive nitrogen and phosphorous into water bodies, by utilizing these nutrients for their growth. The aquatic macrophyte *Salvinia cucullata* based oxidation pond was used in this study to remove organic matter, nutrient and heavy metals from domestic wastewater. The maximum chemical oxygen demand removal in *S. cucullata* based oxidation pond was found to be 14.37 $g.m^{-2}.d^{-1}$, when the combination of influent nitrogen was 40 $mg.L^{-1}$, influent phosphorous was 15 $mg.L^{-1}$ and hydraulic retention time of 3 days was maintained. Numerical optimization technique has been used for simultaneous optimization of N removal efficiency and P removal efficiency. The maximum nitrogen removal of 1.538 ±0.06 $g.m^{-2}.d^{-1}$ and P removal of 0.316 ±0.02 $g.m^{-2}.d^{-1}$ was served, when influent N of 40 $mg.L^{-1}$, influent P of 7.15 $mg.L^{-1}$ and HRT of 3 days were used. The maximum biomass growth was found to be 0.26 $kg.m^{-2}.d^{-1}$, when the influent N was 40 $mg.L^{-1}$, influent P was 15 $mg.L^{-1}$ and HRT of 3 days and in the combination of influent N was 40 $mg.L^{-1}$, influent P was 5 $mg.L^{-1}$ & HRT of 3 days. Different pretreatment processes were evaluated for delignification of harvested biomass of *S. cucullata* to facilitate bioethanol production. Effective delignification was observed when the harvested *Salvinia cucullata* biomass was treated with alkaline and oxidative pretreatment method. This pretreated biomass was subsequently hrodolysed by crude Cellulase enzyme produced from *Tricoderma resii* Rut C30. Pretreated *S. cucullata* were simultaneously sachharified and fermented for bioethanol production and maximum ethanol production of 1.87 ±0.15% (%, v/v) was found. Economic analysis was done for typical aquatic pond required for 1 MLD sewage treatment considering total area of 0.75 ha consists of two oxidation ponds in series by using *S. cucullata* for domestic wastewater treatment, and the treated water was used for fish production. It was found that total capital cost can be recovered through aquaculture and bioethanol production within 9 years of operation and 10^{th} year onwards, profit can be earned in an estimated service life period of 30 years of operation of the oxidation pond.

Keywords: Bioethanol; Heavy metal; Phytoremediation; *S. cucullata;* Wastewater treatment