Marine periphyton biofilters in mariculture effluents: Nutrient uptake and biomass development

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Abstract

Cost of effluent treatment, water quality maintenance and feeds constitute most of aquaculture's operational costs, and influence its sustainability. The present study examined the effectiveness of periphyton for biofiltration of mariculture effluents. Marine periphyton was allowed to spontaneously develop on a plastic net substrate, in experimental bioreactors that were fed with effluents from fish mariculture ponds. Biomass development and nutrient uptake were followed over four seasons. Attention was given to the orientation and area of the net substrate, season and additional operational factors. The highest specific growth rate (SGR) of 27% day^{-1} was measured during the second week of periphyton growth in the summer. Mean daily periphyton production rates in the spring and autumn were 2.4 and 1.8 g (ash- free dry weight) m^{-2} day^{-1}, respectively. The vertical orientation of the net substrate was overall advantageous over the horizontal orientation. Increasing the substrate area of vertically oriented nets in the biofilter increased the removal efficiency of total ammonia nitrogen (TAN) up to 80%, and allowed more biomass production in the biofilter. Multiple polynomial regression models suggest strong effect of biomass weight and effluent retention time on the removal efficiency of TAN and dissolved inorganic nitrogen (DIN). The removal rates of TAN and DIN in these experiments were between 0.11 – 1.2 g N m^{-2} (substrate area) day^{-1} for periphyton at the age of 7 and 42 days, respectively. Marine periphyton seems to be a simple, low cost and sustainable component, which can perform biofiltration/rehabilitation of water quality and potentially serve as feed for fish and shrimp.