Mic-RAS: Novel Intensive Recirculating Aquaculture System Integrating a Photo-Membrane-Bioreactor

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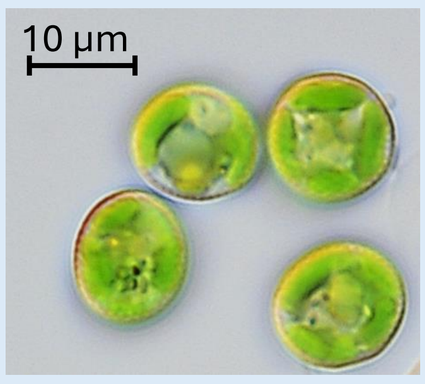
Background and Aim

Traditional Recirculating Aquaculture Systems (RAS) rely on nitrification of toxic ammonia. Solids and accumulated nitrate are removed through water exchange. Their discharge results in waste of valuable nutrients and environmental pollution. The microalga BZ (temporary name) of the Eustigmatophytes is a novel freshwater species, accumulating the high-value EPA (omega-3 fatty-acid).

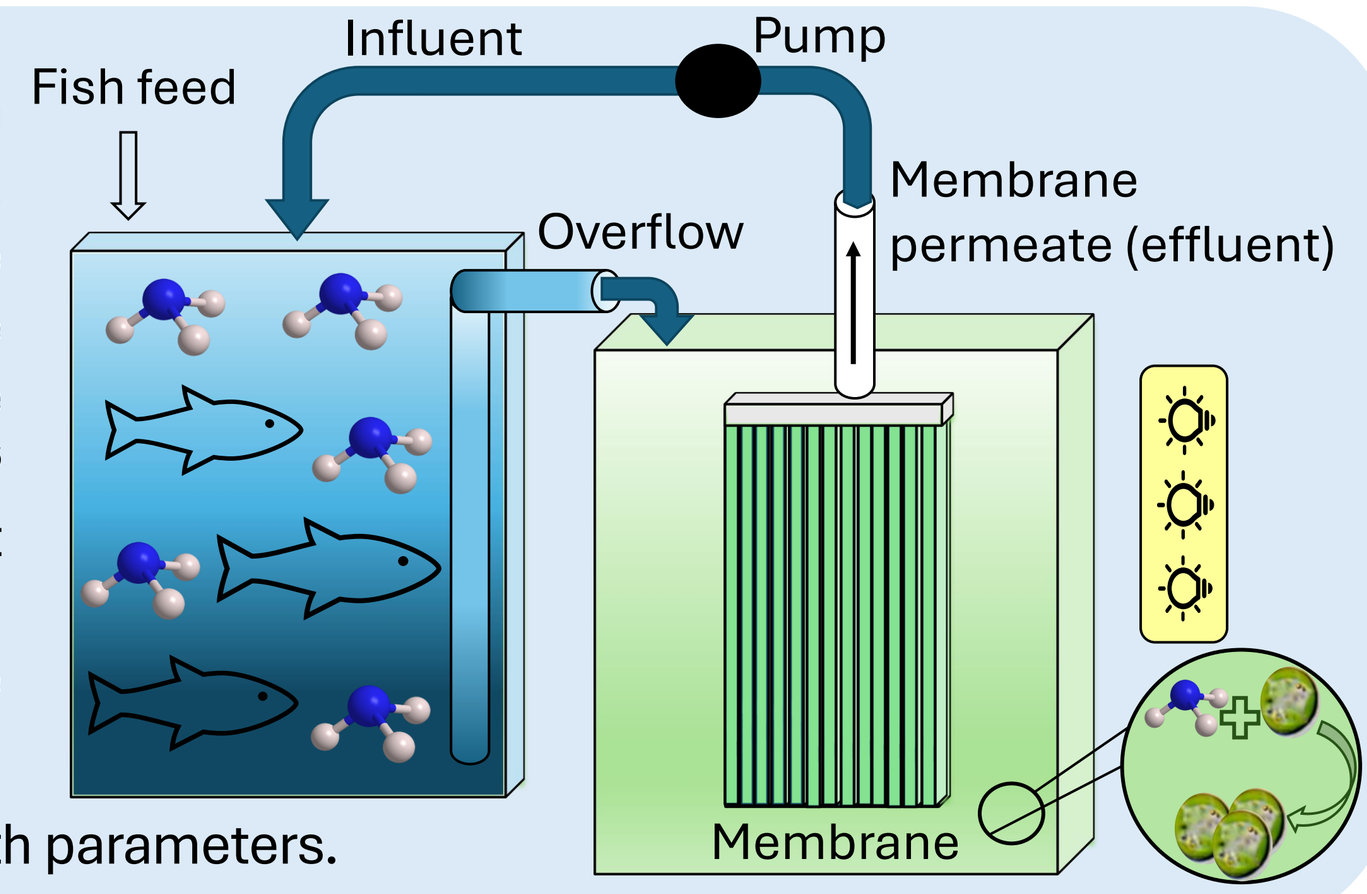
Microalgae require a steady supply of nutrients for biomass production, primarily carbon, nitrogen and phosphorus, all of which are found in fish excretions. **Our aim** was to develop **a microalgae-integrated RAS (mic-RAS)** where microalgae are used to remove fish excretions (soluble and solids), circulating back clean water to the fish tank, while producing valuable biomass.



Methods

A fish and microalgal bioreactor of 7.5 L each was equipped with a microfiltration membrane, filtering at 0.1 µm to retain algal biomass while water flows to the fish tank. Guppy fish were stocked at an initial mass of 4g. BZ microalgae tank was stocked at an initial density of $3*10^6$ cells/mL and illuminated with 4000K LED light at 100 µE $m^{-2}s^{-1}$.

Nitrification filter and no-filter systems were used for comparison.



Analyses: Water quality and microalgal growth parameters.

Results

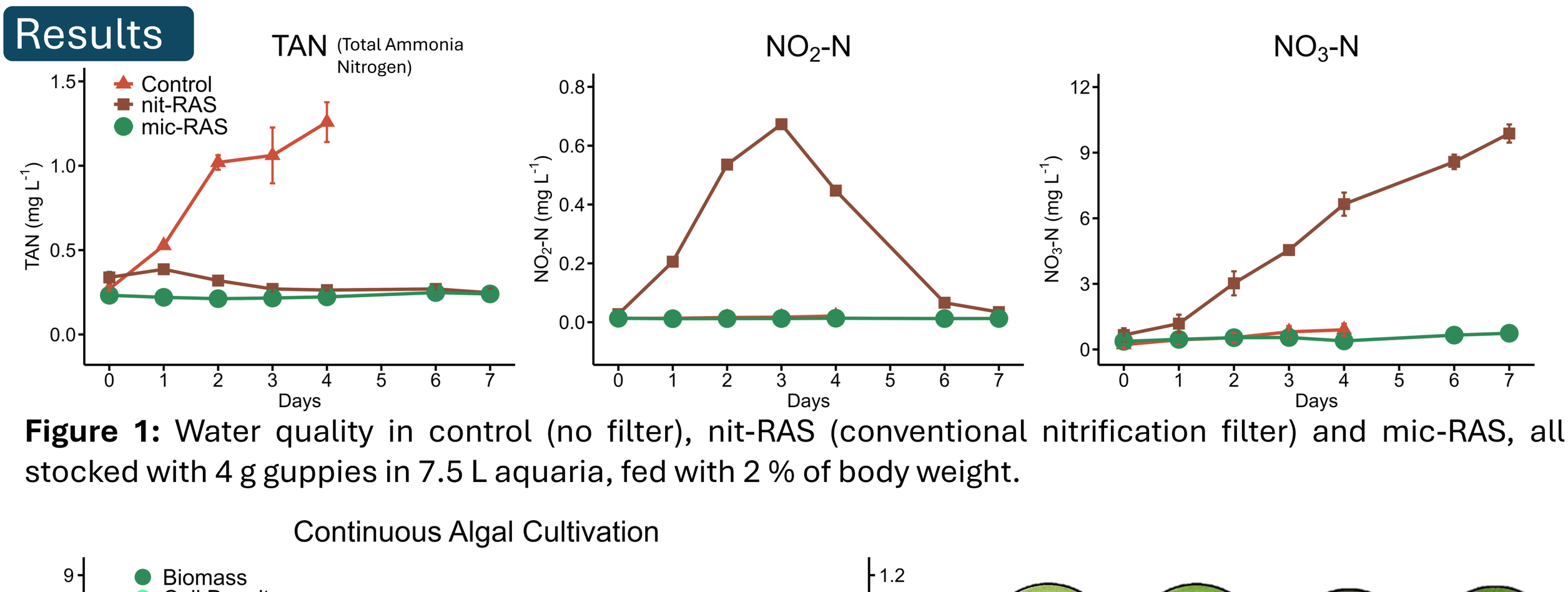
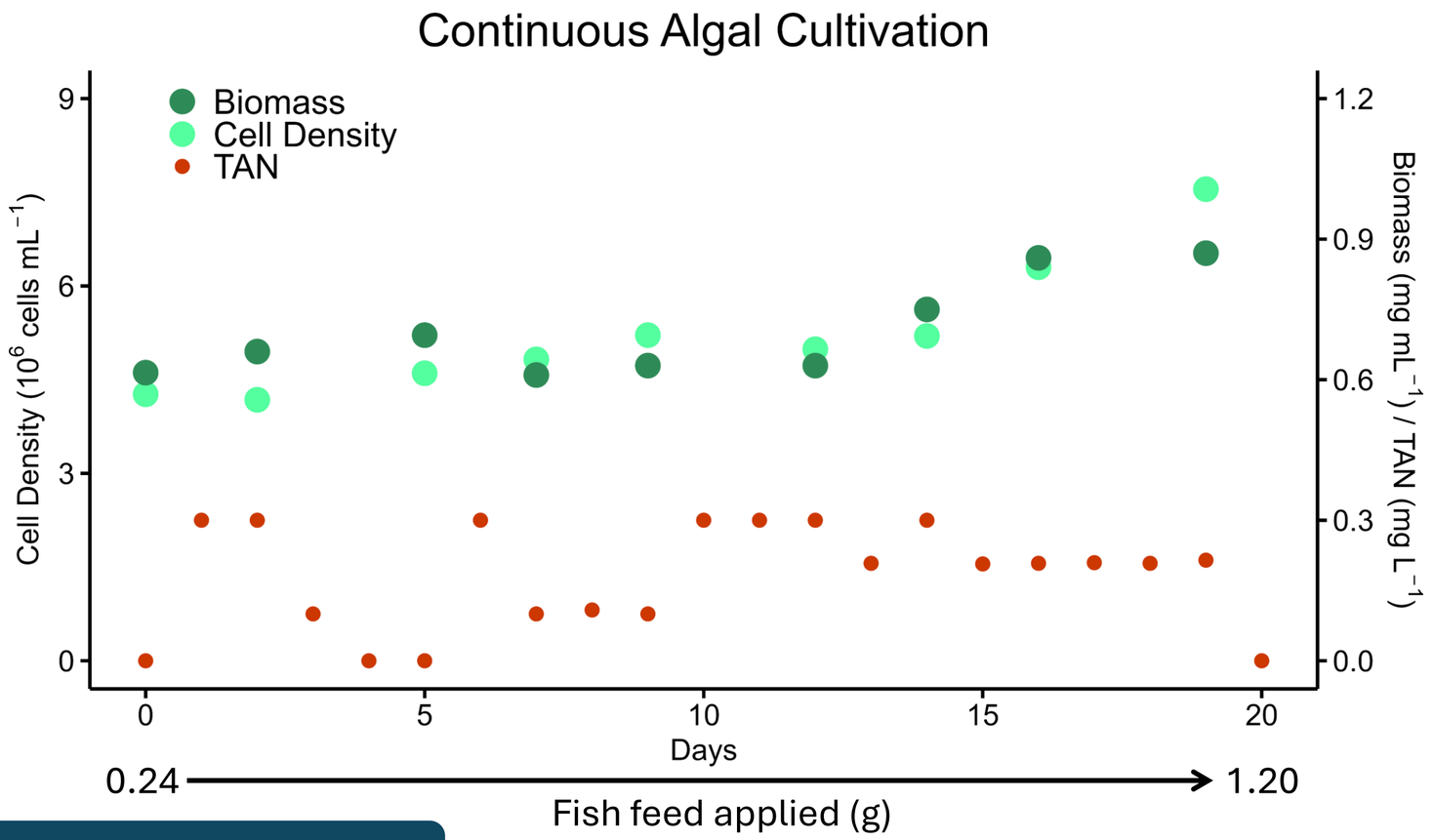


Figure 1: Water quality in control (no filter), nit-RAS (conventional nitrification filter) and mic-RAS, all stocked with 4 g guppies in 7.5 L aquaria, fed with 2 % of body weight.



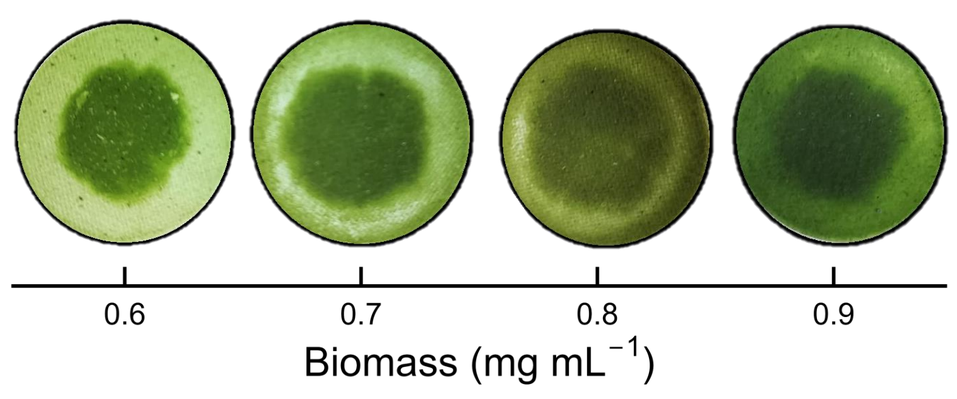


Figure 2: Cell density, dry biomass and TAN concentrations in the continuous system. BZ dry biomass filters photographs.

Conclusions

BZ microalgae in the mic-RAS photo-membrane-bioreactor can remove solid and soluble fish waste including toxic ammonia, recirculating clean water to the fish while utilising nutrients for algal growth. Calibration, optimisation and pilot system development are underway.

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References: Provisional Patent Application in United States of America "System and method for cultivation of aquatic animals"