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Use of microalgae grown on fish tank residual nutrients as feed for copepods to enable circular bio-economy in aquaculture

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Abstract: This study focuses on the development of a new value chain in aquaculture, whereby nutrients from fish tank effluents are first encapsulated in algal biomass. Algal biomass will be fed to copepods, which are a good feed for fish larvae. The study offers a cost-effective algal biomass utilization compared to traditional approaches which require resource intensive processes for harvesting.

Keywords: Green micro-algae; nutrient recovery; aquaculture

Aquaculture involves farming freshwater and saltwater fish populations under controlled conditions, mainly for producing food. While some aquaculture practices may have ecological benefits (e.g., cultivation of shellfish may act as filter improving water quality), tank effluents often have high nutrient and organic carbon content which need to be treated either before recirculation to the tanks or discharge to the environment (Bregnballe, 2015). So far, the use of biofilters for nitrification-denitrification is the most widely applied practice for water remediation. Treatment of these effluents with green microalgae enables nutrient capture and valorisation as an alternative protein source and is less resource intensive than conventional treatments (Rasouli et al., 2018). Furthermore, algae are rich in pigments that are valuable antioxidants, like carotenoids. Algae can be harvested and added as ingredient for different feeds for animals. Yet, the cost of harvesting and downstream processing is rather high and usually makes the overall process unfeasible. Thus, alternative harvesting methods are needed to ensure feasible nutrient recovery via green microalgae cultivation.

This study will focus on the development and optimization of algal cultivation, which aims to balance protein, lipid and pigment production to maximize the overall nutritional value of microalgae. The algae will be cultivated in the effluent from a 1500 ton/year production of yellowtail amberjack (*Seriola lalandi*), previously treated with a biofilter, drum filters and UV light. The sampling protocol consisted in 24 h pool samples, with a sampling frequency of an hour. Three different solid retention

times will be applied and nutrient removal and macromolecular algal biomass composition (including protein, carbohydrate, lipid and pigment content and quality) will be characterized. Two different algal species will be compared, namely *Tetraselmis sp.* and *Rhodomonas salina*.

Algal biomass can be employed as part of the feed formula for fish and crustaceans. However, harvesting cost (e.g., flocculation, drying, etc.) are usually the bottleneck for full scale commercialization. Hence, this study explores the use of algae cultured in residual nutrients as feed for the copepod *Acartia tonsa*. Contrary to algae, copepods are easier to harvest due to its larger size. Furthermore, copepods can be used as feed for fish larvae, without the need of further processing, offering a cost-efficient alternative to normal microalgal biomass utilization. Copepod macromolecular composition will be monitored as well, and benchmarked against existing literature.

This study will serve as proof of concept for a new value chain in aquaculture, which follows the model of circular bio-economy.

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