Microalgae-bacterial granular sludge systems - On the road for more sustainable processes in the aquaculture sector

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With population growth and stagnation of capture fisheries, the aquaculture sector has been challenged to achieve remarkable production targets to meet the ever-increasing fish demand. However, land-based aquaculture industries need to capture high water volumes from nearby water bodies to ensure an adequate production and, consequently, high wastewater volumes, containing organic carbon, nutrients, and often contaminants of emerging concern, are produced. If not properly handled, aquaculture effluents pose a threat to receiving aquatic ecosystems. The rapid expansion of these industries, facing the increased demand for food worldwide, is only possible if more sustainable practices are adopted. To face the current water shortages and protect water resources, the development of environmentally friendly treatment systems that allow water recirculation is of utmost importance.

This work aimed to develop a microalgae-bacteria granular sludge system able to efficiently treat marine aquaculture effluents so they can meet the requirements for recirculation. A photo-sequencing batch reactor was inoculated with a phototrophic microbial consortium obtained from water streams in a marine aquaculture facility and was fed with wastewater mimicking marine aquaculture streams. The aggregation of the microbial biomass occurred rapidly and, on day-21, ca. 49% of the total reactor biomass was in the form of granules. The system exhibited high and stable organic carbon removal (>80%), even when florfenicol, an antibiotic widely used in aquaculture, was present in the wastewater. Concerning the nitrogen content, a high-chemical quality effluent was obtained, complying with ammonium, nitrite, and nitrate concentrations for water recirculation within a marine aquaculture farm, even in periods where florfenicol was present in the wastewater. In addition, the dissolved oxygen levels in the treated effluents where within the ideal range for fish growth thus reducing the need for oxygenation and, consequently, the farms operational costs. Additionally, the coexistence of microalgae and bacteria within the granules allowed to treat wastewater at low air flow rates potentially reducing the energy needed for system's aeration.

Microalgae-bacterial granular sludge systems can contribute for the aquaculture sector sustainability as they enable to reduce energy and water usage whilst ensuring environmental protection.

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