O.366. Efficient ammonium removal from marine aquaculture wastewater with microalgal-bacterial granular sludge technology

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Water recirculation in marine aquaculture is fundamental for the protection of water resources and for the sector sustainability as it enables to reduce water usage [1]. Microalgal-bacterial granular sludge (MBGS) has the potential to increase the removal efficiency of pollutants from wastewaters benefiting from the diverse metabolism allowing water recirculation. Moreover, MBGS would allow costs reduction both in biomass separation from the treated water given the rapid settling properties and in aeration due to microalgae oxygen production [2].

This study aimed to develop MBGS able to treat marine aquaculture effluents. For that, a lab-scale photo sequencing batch reactor was inoculated with activated sludge, previously adapted to salty wastewater, and a microalgae consortium enriched from water collected at a marine aquaculture. Feeding composition was established to simulate marine aquaculture streams.

The aggregation of microalgal and bacterial biomass to form granular structures occurred rapidly. Throughout the operation, dark green granules with a dense and compact structure became predominant together with an increase in chlorophyll and carotenoids content in biomass. Ammonia was absent from the reactor effluent, but the nitrite levels were often above the toxicity levels for fish. Nevertheless, the dissolved oxygen concentration in the treated water was high (> 8.63 mg/L).

The microalgal-bacterial granules proved to be efficient in producing streams with high dissolved oxygen levels, lowering the needed of water oxygenation before reuse and without ammonium ions. However, for water recirculation, improvement of the nitrite removal is needed to maintain the levels below the fish toxicity levels.

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O.400. Optimization of phosphate accumulating bacterial strains for phosphorous uptake in residual waters

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Phosphorus (P) is an essential element that is found in every living entity. Paradoxically, it is responsible for aquatic eutrophication, due to anthropogenic causes, and is also at risk of shortage in the future. The activated sludge (AS), produced, during wastewater treatment, is rich in P and European countries have been implementing legislations making nutrient recovery, i.e. P, from wastewater facilities mandatory.

Objective: This work focused on studying native strains from a wastewater treatment system able to take up P. Positive strains were checked for the presence of the *ppk1* gene. The *ppk1* from the most efficient strain was used to construct a genetically modified bacterial strain, *Escherichia coli* BL21_pET30a_*ppk1*, which was shown to be capable of efficiently remove P from water. To understand if in wastewater treatment plants, bioaugmentation with bacterial strains luxury up taking P improve the P removal process from water, the wild type *Acinetobacter johnsonii* 5bvlmeb2 and the genetically modified strain *Escherichia coli* BL21_pET30a_*ppk1*were used to bioaugment AS in BEHROTEST™ laboratory-scale wastewater treatment system.

Results: Daily P quantification of the effluent water from the 5-days bioaugmentation experiments was performed. The results showed that when bioaugmenting with *E. coli* BL21_pET30a_*ppk1,* the average residual P concentration was reduced by more than 50%, in comparison to the control. It was also shown that the polyphosphate accumulation increased substantially (3-fold) in the biomass. In the case of *A. johnsonii* 5bvlmeb2, the results from bioaugmentation obtained during the first 48 hours of the experiment showed an increase (2-fold) in polyphosphate accumulation when compared to the control.

Conclusion: These results indicate that while the *ppk1* gene is already present in AS, the bioaugmentation with *E. coli* BL21_pET30a_*ppk1* promotes an improvement in the P removal from 0.51 mg/l of P to 0.02mg/l of P after 5 days with P recycling experiment. The use of these strains is a stepping-stone in reducing the challenges associated.

Significance: New methodologies for P recovery from secondary sources are extremely relevant for the implementation of the EU's and UN's objectives.

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