

## OP28-5 | Enhancing aquaculture sustainability: Application of photo-electrocatalysis in recirculating aquaculture systems

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In recent years, aquaculture has experienced rapid growth, raising concerns about environmental pollution and depletion of natural resources. To address these challenges, farms need cutting-edge technologies to minimise water pollution and preserve biodiversity and human health.

To mitigate pollution, advanced techniques such as photocatalysis (PC) and photo-electrocatalysis (PEC) have emerged as promising low-cost and effective methods. Particularly, PEC can boost ammonia oxidation, avoiding its accumulation in water, by converting it into harmless molecular nitrogen.

The Fish-PhotoCAT project (founded by PRIMA) focuses on evaluating the efficiency of PEC on recirculating aquaculture systems (RAS), introducing a simple improvement to the usual technology used in RAS, i.e. biofiltration and UV-sterilization technology.

This study reports the first trial of the project, in which three 500 L tanks, equipped with the standard water filtration system (mechanical and biofiltration + UV-lamp), were compared to three tanks equipped with the same setup in terms of mechanical-biofiltration, with a photo-electrocatalytic reactor instead of the classic UV-lamp. The two systems were tested in a RAS lodging adult rainbow trout (90 g) reared for one month at a density of 15 kg/m<sup>3</sup>.

To achieve our purpose, water quality parameters were monitored, including nitrogen compounds (NH<sub>3</sub>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>), biological oxygen demand (BOD), chemical oxygen demand (COD), and physical parameters, i.e. temperature, pH, dissolved oxygen and water saturation. To ensure animals' welfare also stress gene expressions and health performance have been analysed (still under evaluation).

No significant difference was found in NH<sub>3</sub> mean concentrations between the control and treatment tanks (0.15 mg/L vs. 0.16 mg/L); the mean concentration of nitrites was higher in the control tanks than in the PEC tanks (1.210 mg/L vs. 0.740 mg/L; with a significance tendency  $p < 0.08$ ), an encouraging result considering its higher toxicity for fish. Finally, the mean concentration of nitrates demonstrated a statistically significant difference between the control and treatment tanks (122.211 mg/L vs. 108.510 mg/L;  $p < 0.001$ ), likely due to the parallel ammonia oxidation to molecular nitrogen. To enhance system efficiency, NaCl will be added in the next trials since chlorine radicals can undergo several reactions in the aqueous phase, that can further react with ammonia.

In conclusion, the research findings could allow the development of eco-friendly aquaculture systems that can reduce negative impacts on water quality and promote the well-being of aquatic organisms, contributing to the sustainable advancement of aquaculture practices.

**Keywords:** Sustainable aquaculture, Photo-electrocatalysis, Water quality, Nitrogen compounds