

Rainbow trout (*Onchorhynchus mykiss*) corneal lesions as an indicator of water quality in TiO₂-Photoelectrocatalysis

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Since sustainability in food production has become a main concern, recirculating aquaculture systems (RAS) are now available besides the traditional rainbow trout (*O. mykiss*) farming in a continuous water flow system. RAS are land-based aquaculture facilities that minimize water consumption by reusing water after it has been biofiltered to reduce ammonia toxicity. A novel technique combining photoelectrocatalysis (PEC), UV filtration, and biofiltration has recently been developed with the aim of enhancing the quality of recirculating water. In this study we aim to assess PEC efficacy by using corneal damage as an indicator of water quality, in fact cornea is in indirect contact with water and the presence of toxic chemicals such as ammonia directly affects its homeostasis, resulting in anatomical changes.

Rainbow trout was reared in six tanks for 28 days in RAS at a density of 30 kg/m³: three tanks were equipped of PEC system while the remaining ones served as the control (CTR) group, utilizing conventional filtration. Water quality parameters (ammonia, nitrites, and nitrates) were registered twice a week. At the end of the study fish corneal integrity was assessed by i) morphological evaluation with ii) optical coherence tomography (OCT) and in iii) HE stained glass slides; ii) mucin production evaluation via AB-PAS and HID-AB staining; iii) oxidative epithelial cell damage evaluation with 8-hydroxy-2-deoxyguanosine (8-OHdG) antibody immunohistochemistry.

At the end of the study, ammonia levels were significantly higher in CTR group water. From a pathological standpoint although oxidative stress (8-OHdG positivity) affected both groups, corneal lesions such as disepithelization and fibrosis were more severe in the CTR group, proving a protective effect of PEC system. No relevant difference was noticed in mucous cell production. Corneal evaluation proved to be a useful bio-parameter in water quality assessment and shows the efficacy of PEC in enhancing water quality by preventing ocular damage.