ID: 715

Amelioration of Microplastics-Induced Growth Inhibition and Stress in Nile Tilapia Using Multi-Species Probiotic

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Abstract

Microplastics (MPs) are emerging pollutants in aquatic ecosystems, known for their toxic effects on various physiological processes in fish. This study aimed to evaluate the potential of multi-species probiotics in mitigating the harmful impacts of MPs on Nile tilapia (Oreochromis niloticus). Fish with an initial weight of 3.02 ± 0.27 g were exposed to four treatment groups for 42 days: (1) control (no MP or probiotics), (2) MP exposure (10 mg/L), (3) probiotics only (1 ml/L), and (4) combined MP + probiotics. The results demonstrated that MP exposure significantly reduced growth performance and survivability, lowered haemoglobin levels, and increased glucose concentration in the blood. Additionally, erythrocytic cellular and nuclear abnormalities were more prevalent in the MP-treated group. Probiotic supplementation markedly improved these conditions by enhancing growth and survival and reducing haematological and cellular damage. Goblet cell frequency, which was reduced by MP exposure, was preserved in the probiotic-treated group. The relative mRNA expression revealed that MP exposure significantly upregulated antioxidant genes (*SOD* and *CAT*) and immune-related genes (*TNF-α*, *IFN-γ*, and *IL-1β*) in the liver. However, these expression levels were downregulated when probiotics were administered alongside MPs. Overall, the findings indicate that probiotics can alleviate microplastic-induced physiological stress and immune disruption, highlighting their potential as a protective dietary supplement in aquaculture.

Keywords: Microplastics, probiotics, growth performance, oxidative stress, immune response, Nile tilapia.