Protective Role of Probiotics and *Spirulina* in Modulating Immune and Antioxidant Genes Expression Against Sumithion Toxicity in Nile Tilapia (*Oreochromis niloticus*)

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A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Science in Fish Biology and Biotechnology

Department of Fish Biology and Biotechnology

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JUNE 2025

Authorization

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This is to certify that we have examined the above Master's thesis and have found that is complete and satisfactory in all respects, and that all revisions required by the thesis examination committee have been made

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ABSTRACT

Pesticide pollution in aquatic ecosystems is intensifying, and organophosphate like sumithion causes major threats to non-target species such as Nile tilapia (*Oreochromis niloticus*). This study systematically evaluates the efficiency of dietary supplementation with probiotics and *Spirulina platensis* to ameliorate sumithion-induced oxidative stress, immunosuppression, and hematological impairments in Nile tilapia (*Oreochromis niloticus*). A total of 320 *O. niloticus* fingerlings (12.8 ± 0.09 g) were randomly selected for four groups: control, sumithion (0.50 mg/L), sumithion supplemented with probiotics (0.50 mg/L and 1 mL/L) and sumithion supplemented with *Spirulina* (0.50 mg/L and 50 g/kg), each with three replicates for 6 weeks were investigated. During the experiment, blood samples were tested for hemoglobin (Hb) and glucose (Glu) concentration and at the same time liver tissues were collected for qRT-PCR analysis to evaluate the expression of anti-oxidant (superoxide dismutase, *SOD* and catalase, *CAT*) and immune (tumor necrosis factor alpha, *TNF-α*, interleukin beta, *IL-1β* and interferon gamma, *IFN-γ*) genes. It was reported that exposure to sumithion caused significant ($p < 0.05$) physiological stress, evident in elevated oxidative (*SOD* and *CAT*) and metabolic markers, decreased hemoglobin and hyperglycemia, and downregulation of immune-related gene expression (*TNF-α*, *IL-1β*, and *IFN-γ*). Supplementation with probiotics and *Spirulina* to these stressed fish improved such alterations with recovered antioxidant and immune gene expression toward homeostatic levels. Probiotics proved to exert much stronger effects on immune recovery and glucose (Glu) amelioration, while *Spirulina* had an imperative impact on antioxidant stabilization and hematological parameters (Hb). This research findings emphasizes to highlight therapeutic potential of functional feed additives as eco-friendly strategies to counteract pesticide-induced toxicity and demonstrate their applicability in sustainable aquaculture production systems.

***Keywords*:** Sumithion, *Spirulina platensis*, Probiotics, Anti-oxidant genes, Immunity, Hematology, Nile Tilapia