



Probiotics Counteract Growth Impairment, Intestinal Deformities, Cellular and Nuclear Abnormalities, and Fluctuation of Immune-Related Genes Expression in Nile Tilapia (*Oreochromis niloticus*)

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Roll No: 0124/03

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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

Faculty of Fisheries

**Chattogram Veterinary and Animal Sciences University (CVASU),
Chattogram-4225, Bangladesh**

June 2025

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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

Probiotics are important microflora that help in improving gut health, enhancing immunity, and boosting overall well-being. This study evaluates the counteracts effects of multispecies probiotics (*Bacillus subtilis*, *B. thuringiensis*, *Lactobacillus plantarum*, and *L. buchneri*) to sumithion toxicity on growth performance, hematobiochemical parameters, intestinal morphology, and expression of growth, antioxidant, and immune-related genes in Nile tilapia (*Oreochromis niloticus*). Juvenile (12.84 ± 0.09 g) Nile tilapia were reared with four treatment groups: T1 (control, no sumithion or probiotic), T2 (sumithion, $0.56 \mu\text{g/L}$), T3 (probiotics, 1.0 ml/L) and T4 (sumithion, $0.3 \mu\text{g/L}$ and probiotics, 1.0 ml/L) with three replicates for each treatment for 42 days. Results showed that fish exposed to sumithion (T2) had significantly lowered ($p < 0.05$) weight gain (WG) and specific growth rate (SGR), while supplemented with probiotics (T4) improved the growth performance. Supplementation of probiotics increases and decreases the sumithion-induced hemoglobin (Hb) and glucose (Glu) levels, respectively. Higher frequency of erythrocytic cellular and nuclear abnormalities observed in sumithion-exposed fish compared to the control group, as abnormalities were reduced in fish treated with probiotics. Multi-species probiotics led to pronounced thickened intestinal mucosal folds, increased abundance of goblet cells, wider lamina propria, and higher number of enterocytes compared to the control group. However, exposure to sumithion resulted in a marked decline in these intestinal parameters, and fish subjected to both sumithion and probiotics treatment exhibited a relatively improved intestinal structure. Significantly higher and lower levels of mRNA for growth-related gene (*gh*) and insulin-like growth factor (*igf-1* and *igf-2*) genes were found in probiotics and sumithion-exposed fish, respectively. Relative mRNA level for antioxidant genes (catalase, *CAT* and superoxide dismutase, *SOD*) was significantly decreased ($p < 0.05$) in fish exposed to sumithion, while the non-significant differences was observed in probiotics (T3) and sumithion and probiotics (T4) treated fish. Conversely, the expression of immune-related genes (tumor necrosis factor alpha, *TNF- α* , interleukin beta, *IL-1 β* , and interferon gamma, *IFN- γ*), was downregulated in sumithion-treated fish, and relative mRNA levels increased following the addition of probiotics. Therefore, incorporating probiotics into the aquatic environment demonstrated beneficial effects on haemato-biochemical properties, erythrocyte structure, and immune function, ultimately enhancing growth and countering the stress induced by sumithion pesticides.

Keywords: Probiotics, Sumithion, Growth performance, Antioxidant, Immunity, Nile tilapia