



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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TABLE OF CONTENTS

CHAPTER	TITLE	PAGE NO.
	AUTHORIZATION	II
	SIGNATURE PAGE	III
	ACKNOWLEDGEMENT	IV–V
	TABLE OF CONTENTS	VI–VIII
	LIST OF PLATES	IX
	LIST OF FIGURES	X
	LIST OF TABLES	XI
	ABSTRACT	XII
01.	INTRODUCTION	01–07
	1.1. Background	02–07
	1.2 Objectives of the study	07
02.	REVIEW OF LITERATURE	08–20
	2.1 Sumithion	09–10
	2.2 Probiotics	10–11
	2.2.1 Probiotics in Nile tilapia	10–11
	2.3 Growth hormone	11–13
	2.3.1 History of growth hormone	11
	2.3.2 Growth hormone structures	11–12
	2.3.3 Effects of sumithion on growth hormone	12–13
	2.4 Cytokines	13–14
	2.4.1 Effects of sumithion on cytokines	13
	2.4.2 Effects of probiotics on cytokines	13–14
	2.5 Antioxidant	14–15
	2.5.1 Effects of probiotics on antioxidant and stress-related genes	14–15
	2.6 Effects of sumithion and probiotics on blood parameters and the gastrointestinal tract	15
	2.6.1 Effects of sumithion on blood parameters and the gastrointestinal tract	15

	2.6.2 Effects of probiotics on blood parameters and gastrointestinal tract	15
	2.7 Goblet cell	16
	2.8 Impact of sumithion on intestinal morphology	16
	2.9 Impact of sumithion on immunity	16–17
	2.10 Investigations on mitigating pesticide toxicity	17–18
	2.11 Nile tilapia	18–19
	2.12 Research gap	19–20
03.	MATERIALS AND METHODS	21–30
	3.1 Experimental fish	22
	3.2 Experimental design	22–23
	3.3 Sampling and data collection	23
	3.4 Growth performance of Nile tilapia	23–24
	3.5 Hematobiochemical parameters analysis	24
	3.6 Blood abnormalities analysis	25
	3.7 Histopathological observation of the intestine	25–26
	3.8 Extraction and quantification of RNA	26–27
	3.9 Preparation for cDNA	28
	3.10 Real-time PCR assays	28–30
	3.11 Statistical analysis	30
04.	RESULTS	31–41
	4.1 Growth performance of <i>Oreochromis niloticus</i>	32
	4.2 Changes in hemato-biochemical parameters	32–33
	4.3 Erythrocytic nuclear and cellular abnormalities	34–35
	4.4 Changes in intestinal morphology	35–37
	4.5 Expression of growth-related genes (<i>gh</i> , <i>igf-1</i> , <i>igf-2</i>) in the pituitary and liver of <i>O. niloticus</i>	38–39
	4.6 Expression of antioxidant-related genes (<i>SOD</i> and <i>CAT</i>) in the liver of <i>O. niloticus</i>	40

4.7	Expression of immune response-related genes (<i>TNF-α</i> , <i>IL-1β</i> , <i>IFN-γ</i>) in the liver of <i>O. niloticus</i>	41–43
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05.	DISCUSSION	42–48
06.	CONCLUSIONS	49–50
07.	RECOMMENDATIONS AND FUTURE PROSPECTS	51–52
	REFEREENCES	53–75
	BRIEF BIOGRAPHY OF THE AUTHOR	76

LIST OF PLATES

PLATE NO.	TITLE	PAGE NO.
01.	Experimental fish	22
02.	Experimental setup	23
03.	Sampling of Nile tilapia	23
04.	Measuring blood parameters	24
05.	Blood smearing for identification of cellular and nuclear abnormalities	25
06.	Histology of the intestine of Nile tilapia (<i>O. niloticus</i>) reared with different treatments for 42 days	26
07.	Extraction and quantification of RNA	27
08.	Preparation of cDNA	28
09.	Procedure for real-time PCR assay	30

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
01.	Alteration in (A) Hemoglobin (Hb) and (B) Glucose (Glu) levels of Nile tilapia (<i>O. niloticus</i>) reared with sumithion, probiotics, and sumithion + probiotics for 42 days.	33
02.	(A) Cellular abnormalities (a-d) of erythrocytes of Nile tilapia (<i>O. niloticus</i>) reared for 42 days at different treatments.	34
	(B) Alteration in frequencies of erythrocytic cellular abnormalities, (a) Tear drop; (b) Twin; (c) Spindle; (d) Fusion, of Nile tilapia (<i>O. niloticus</i>) reared with sumithion, probiotics, and sumithion + probiotics for 42 days.	34
03.	(A) Nuclear abnormalities (a-d) of erythrocytes of Nile tilapia (<i>O. niloticus</i>) reared for 42 days at different treatments	35
	(B) Alteration in frequencies of erythrocytic nuclear abnormalities, (a) Nuclear buds; (b) Notched nuclei; (c) Nuclear bridge; (d) Karyopkinesis, of Nile tilapia (<i>O. niloticus</i>) reared with sumithion, probiotics, and sumithion+probiotics for 42 days.	35
04.	Immune response indicators in gut histology of Nile tilapia (<i>O. niloticus</i>) reared with various treatments for 42 days.	37
05.	Relative expression of (A) <i>gh</i> in the pituitary, (B) <i>igf-1</i> and (C) <i>igf-2</i> in the liver of Nile tilapia (<i>O. niloticus</i>) (n=6) exposed to different treatments (control, T1; sumithion, T2; probiotics, T3; sumithion + probiotics, T4) for 42 days.	39
06.	Relative expression of (A) <i>SOD</i> and (B) <i>CAT</i> in the liver of Nile tilapia (<i>O. niloticus</i>) (n=6) exposed to different treatments (control, T1; sumithion, T2; probiotics, T3; sumithion + probiotics, T4) for 42 days.	40
07.	Relative expression of (A) <i>TNF-α</i> and (B) <i>IL-1β</i> in the liver of Nile tilapia (<i>O. niloticus</i>) (n=6) exposed to different treatments (control, T1; sumithion, T2; probiotics, T3; sumithion + probiotics, T4) for 42 days.	41
08.	Relative expression of <i>IFN-γ</i> in the liver of Nile tilapia (<i>O. niloticus</i>) (n=6) exposed to different treatments (control, T1; sumithion, T2; probiotics, T3; sumithion + probiotics, T4) for 42 days.	42

LIST OF TABLES

TABLE NO	TITLE	PAGE NO.
01.	Temperature cycle for cDNA preparation	28
02.	List of primers used in the real-time PCR	29
03.	Growth response of Nile tilapia (<i>O. niloticus</i>) reared with sumithion, probiotics, and sumithion + probiotics for 42 days (n=12)	32
04.	Histological changes in the gut of Nile tilapia (<i>O. niloticus</i>) reared with various treatments for 42 days	36

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