Influence of Probiotics and Spirulina on Growth Performance and the Expression of *gh*, *igf-1*, and *igf-2* Genes in Nile Tilapia (*Oreochromis niloticus*) Under Sumithion Induced Toxicity

Shaharier Ahmed

Roll No.: 0124/07

Registration No.: 1486

Session: 2023−2024

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

Chattogram-4225, Bangladesh

June 2025

Authorization

I affirm that this thesis is wholly my own original creation. I permit Chattogram Veterinary and Animal Sciences University (CVASU) to distribute this thesis to individuals or entities for the purpose of academic research. Moreover, I allow CVASU to duplicate this thesis, either in its entirety or in sections, via photocopying or other methods, as requested by any individual or organization for academic purposes. Additionally, I confirm that the digital copy of this thesis submitted to the CVASU Library is an authentic and precise representation of the printed version, to the extent permitted by existing technology.

The author

June 2025

Influence of Probiotics and Spirulina on Growth Performance and the Expression of *gh, igf-1,* and *igf-2* Genes in Nile Tilapia (*Oreochromis niloticus*) Under Sumithion Induced Toxicity

Shaharier Ahmed

Roll No.: 0124/07

Registration No.: 1486

Session: 2023−2024

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

…….	..…….
Dr. Ishrat Zahan Anka	**Dr. Md. Mahiuddin Zahangir**
Supervisor	**Co-supervisor**

……..

Dr. Md. Mahiuddin Zahangir

Chairman of the Examination Committee

Department of Fish Biology and Biotechnology

Faculty of Fisheries

Chattogram Veterinary and Animal Sciences University

Khulshi, Chattogram-4225, Bangladesh

June 2025

Acknowledgment

All praises and thanks are due to Allah, the Most Merciful and Compassionate, for granting me the strength, patience, and perseverance to successfully complete my MS thesis under the Department of Fish Biology and Biotechnology. The boundless blessings have been a continuous source of guidance and inspiration throughout this academic journey.

I am profoundly grateful to **Professor Dr. Mohammad Lutfur Rahman**, Honorable Vice Chancellor of Chattogram Veterinary and Animal Sciences University (CVASU), for his visionary leadership and continued support, which have fostered a stimulating academic atmosphere essential for research excellence.

I would like to express my heartfelt appreciation to **Professor Dr. Mohammed Nurul Absar Khan**, Head, Department of Fishing and Post-Harvest Technology, Faculty of Fisheries, CVASU, for his thoughtful mentorship, invaluable encouragement, and insightful guidance throughout my academic journey. His influence has played a vital role in shaping my research perspective.

My sincere thanks go to **Professor Dr. Md. Shahjahan**, Department of Fisheries Management, Faculty of Fisheries, Bangladesh Agricultural University (BAU), for his kind cooperation and support, which significantly enriched the direction and implementation of my research work.

I am deeply indebted to my MS Supervisor, **Dr. Ishrat Zahan Anka**, Associate Professor and Head, Department of Aquaculture, Faculty of Fisheries, CVASU, for her unwavering guidance, meticulous supervision, and constructive feedback throughout the entire research process. Her support has been instrumental in the successful completion of this thesis.

It is a great privilege to acknowledge my Co-supervisor, **Dr. Md. Mahiuddin Zahangir**, Associate Professor and Head, Department of Fish Biology and Biotechnology, Faculty of Fisheries, CVASU, for his scholarly guidance, critical insights, and continuous encouragement. His support has significantly contributed to both the quality of my research and my academic growth.

I am truly appreciative of **Professor Dr. Mohammed Yousuf Elahi Chowdhury**, Coordinator of Advanced Studies and Research (CASR), and Professor in the Department of Medicine and Surgery, Faculty of Veterinary Medicine, CVASU, for his unwavering commitment to enhancing student development through opportunities for international exposure and applied learning. His efforts have greatly broadened my academic outlook and strengthened my research capacity, contributing immensely to my overall educational journey.

I also extend my sincere thanks to **Mrs. Shifat Ara Noor** and **Mrs. Azmaien Naziat**, Lecturers, Department of Fish Biology and Biotechnology, CVASU, for their kind support, encouragement, and assistance throughout this research period.

I am grateful to my fellow researchers **Haphsa Khanom, Md. Jobran Mia, Md. Shamim Rahman, Atika Anjum, Esrat Zahan Etti**, and junior colleagues **Md. Rakib Hasan Bhuiyan, Purnima Rani Debi**, and **Mahzabin Mariya**, for their camaraderie, cooperation, and moral support, which have created a collaborative and inspiring research environment.

With deepest respect and heartfelt gratitude, I acknowledge the unconditional love, patience, and sacrifices of my beloved parents, **Md. Shah Alam** and **Most. Sawkat Ara Begum**, and my sister, **Dr. Shahrima Afroj** along with my entire family. Their unwavering support has been the cornerstone of my academic accomplishments.

Lastly, I wish to thank my dear batchmates for their friendship, shared experiences, and mutual support throughout this academic journey. Their presence has made this experience more memorable and meaningful.

This research endeavor would not have been possible without the collective contributions, encouragement, and assistance of all the aforementioned individuals. I remain truly grateful for the opportunity to learn, grow, and contribute through the pursuit of this MS thesis.

The Author
June 2025

Table of Contents

List of Plates

List of Figures

List of Tables

Abstract

Sumithion, a commonly used pesticide in aquaculture, poses potential toxicity risks to fish. This study aimed to evaluate the protective effects of probiotics and *Spirulina* against sumithion toxicity on growth performance including weight gain (WG), specific growth rate (SGR), and feed conversion ratio (FCR), along with the mRNA levels of growth hormone (*gh*) genes in the pituitary and insulin-like growth factors (*igf-1 and igf-2*) genes in the liver were assessed in Nile tilapia (*Oreochromis niloticus*). Fish were assigned to four treatment groups: Control (no sumithion, probiotics, or spirulina), Sumithion-exposed (0.3 mg/L), Sumithion + Probiotics (1.0 ml/L in water), and Sumithion + Spirulina (50 g/kg feed), with three replicates per group over a 42-day trial. Fish in the sumithion + probiotics group exhibited the highest WG (40.86 ± 7.38 g) and SGR (1.30 ± 0.22 %/day) while achieving the lowest FCR (0.94 ± 0.24). The intestine-somatic index (ISI) was highest in the sumithion + probiotics group (2.58 ± 0.49), whereas the hepatosomatic index (HSI) was significantly increased in the sumithion + spirulina group (2.32 ± 0.28). Relative expression of *gh* mRNA in the pituitary was significantly upregulated in fish treated with sumithion + probiotics compared to the other groups. Similarly, a 3-fold and 1.92-fold expression of *igf-1* and *igf-2* respectively were found markedly higher in the sumithion + probiotics group compared to the control in the liver. These findings indicate that probiotics and spirulina can mitigate sumithion-induced toxicity, enhance growth performance, and activate the GH/IGF axis highlighting the potential dietary supplements for improving fish health in aquaculture.

Keywords: Sumithion, Probiotics, *Spirulina*, Growth, Insulin-like growth factor, Nile tilapia