



EFFECT OF DIFFERENT MICROALGAE ON GROWTH,
SURVIVAL, WATER QUALITY AND NUTRITIONAL
COMPOSITION ON JUVENILE TILAPIA (*Oreochromis
niloticus*)

Jinat Afruj

Roll No.: 0119/05

Registration No.: 695

Session: 2019-2020

**A thesis submitted in the partial fulfillment of the requirements for the degree of
Master of Science in Aquaculture**

Department of Aquaculture

Faculty of Fisheries

Chattogram Veterinary and Animal Sciences University

Chattogram-4225, Bangladesh

JUNE 2020

Authorization

I hereby declare that I am the sole author of the thesis. I also authorize the Chattogram Veterinary and Animal Sciences University (CVASU) to lend this thesis to other institutions or individuals for the purpose of scholarly research. I further authorize the CVASU to reproduce the thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

I, the undersigned, and author of this work, declare that the **electronic copy** of this thesis provided to the CVASU Library, is an accurate copy of the print thesis submitted, within the limits of the technology available.

Jinat Afruj

June, 2020

**EFFECT OF DIFFERENT MICROALGAE ON GROWTH,
SURVIVAL, WATER QUALITY AND NUTRITIONAL
COMPOSITION ON JUVENILE TILAPIA (*Oreochromis
niloticus*)**

Jinat Afruj

Roll No: 0119/05

Registration No: 695

Session: 2019-2020

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

(Joyshri Sarker)

Supervisor

Mohammad Redwanur Rahman

Co-supervisor

(Joyshri Sarker)

Chairman of the Examination Committee

Department of Aquaculture

Faculty of Fisheries

Chattogram Veterinary and Animal Sciences University

Khulshi, Chattogram-4225, Bangladesh

JUNE, 2020

ACKNOWLEDGEMENT

All praises to the Almighty Allah for blessing me with the strength, aptitude, patience and enabling me to pursue higher education and to complete the thesis for the degree of Masters of Science (MS) in Aquaculture.

I would like to convey my heartfelt love, and earnest gratitude to my parents who brought me in the light of earth and nursed me with all the facility needed to be succeeded in life.

First of all, I want to pay heartily gratitude to **Professor Dr. Goutam Buddha Das**, Vice-Chancellor, Chattogram Veterinary and Animal Sciences University (CVASU) for giving special opportunity and providing such research facilities.

I would like to pay my sincere regards and thanks to **Prof. Dr. M. Nurul Absar Khan**, Dean, Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University, who introduced Master's program in the Faculty of Fisheries and provided updated instrument and laboratory for conducting any kind of research.

I would like to express my deepest sense of gratitude, sincere appreciation, deep respect and profound indebtedness to my honorable instructor and research supervisor **Joyshri Sarker**, Assistant Professor & Head, Department of Aquaculture, Chattogram Veterinary and Animal Sciences University, for giving the opportunity to do research and providing invaluable guidance and continuous support. I was profoundly motivated by her dynamism, vision, honesty and inspiration. Under her guidance, it was a great pleasure and honor to work and learn.

I feel proud in expressing my regard and immense gratitude to my co-supervisor **Mohammad Redwanur Rahman**, Assistant Professor, Department of Aquaculture, Chattogram Veterinary and Animal Sciences University, for his kind co-operation, valuable suggestions and constructive criticism in improving the quality of the research work.

I am greatly indebted to **Dr. Helena Khatoon**, Assistant Professor, Dept. of Aquaculture, CVASU for her valuable advice, scholastic guidance, suggestions and inspiration throughout the research.

I express my deepest sense of gratitude, indebtedness, sincere appreciation to my honorable teacher, **Ishrat Jahan Anka**, Assistant Professor, Department of Aquaculture, CVASU for her scholastic guidance, cordial support, constant encouragement and valuable suggestions throughout this research work and during the write up of the thesis.

I acknowledge the consistent academic support, co-operation and guidance of all the teachers of Faculty of Fisheries during my one and half year's study period at Chattogram Veterinary and Animal Sciences University, Chattogram.

Finally, I would like to express my cordial thanks to Tashrif Mahmud Minhaz, Mohammad Jabelul Islam, Md Shahadat Hossain, Turfatul Jannat, staffs of different labs and all other persons who directly and indirectly supported me during field and lab work of my research.

The Author

June, 2020

Table of contents

Contents	Page No.
Title Page	I
Authorization	II
Signature Page	III
Acknowledgement	IV – V
List of Abbreviations	X
List of Figures	XI-XII
List of Tables	XIII
Abstract	XIV
Chapter-1: Introduction	1 – 3
1.1 Objectives of the Study	3
Chapter-2: Review of Literature	4 – 10
2.1 General Attributes of Microalgae	4
2.2 Impotence of Microalgae as Fish Feed	4-5
2.3 Characterization of the Microalgae Species	5
2.3.1 <i>Tetraselmis chuii</i>	5-6
2.3.2 <i>Nannochloropsis sp</i>	6
2.4 Biology and Ecology of <i>Oreochromis niloticus</i>	7
2.4.1 Biological Features	7
2.4.2 Habitat and Distribution	7-8
2.4.3 Reproductive Biology	8
2.4.4 Feeding Habit	8-9
2.4.5 Nutritional Profile	9
2.4.6 Culture Conditions	8-9
2.4.7 Global Production and significance of Nile Tilapia	9-10
Chapter-3: Materials and Methods	11 – 18
3.1 Study area and Collection of Microalgae Species	11
3.2 Seawater collection	11
3.3 Media Preparation	11-12
3.4 Culture of Microalgae	13

3.5	Mass Culture of Microalgae	13
3.6	Feed Formulation for <i>Oreochromis niloticus</i> larvae	13-14
3.7	Proximate Analysis of the Formulated Feed	14
	3.7.1. Protein Analysis	14-15
	3.7.2. Lipid Analysis	15
	3.7.3 Carbohydrate Analysis	15
3.8	Feeding Experiment	15-16
3.9	Physicochemical Analysis	16
	3.9.1 Total ammonium nitrogen (TAN)	16
	3.9.2 Nitrite (NO ₂ -N)	17
	3.9.3 Soluble Reactive Phosphorus (PO ₄ -P)	17
3.10	Survival and Growth Analysis of Tilapia Fry	17
3.11	Statistical analysis	17-18
	Chapter-4: Results	19-23
4.1	Specific Growth Rate and Survival Rate of Juvenile Tilapia	19-20
4.2	Proximate Composition of Microalgae and Juvenile Tilapia	21-23
4.3	Water Quality of the Culture Tanks	24-26
	Chapter-5: Discussion	27-30
5.1	Specific Growth Rate and Survival Rate of Juvenile Tilapia	27-28
5.2	Proximate Composition of Microalgae and Juvenile Tilapia	28-29
5.3	Water Quality of the Culture Tanks	29-31
	Chapter-6: Conclusions	32
	Chapter-7: Recommendations and Future Prospects	33
	References	34-42
	Appendices	43-52
	Appendix A : Mass Culture of Selected Microalgae and Biomass Production	43
	Appendix B: Feed Preparation for <i>Oreochromis niloticus</i>	44
	Appendix C: Experimental set up	44
	Appendix D: Determination of Survival rate of Fish	45

Appendix E: Determination of Water Quality Parameter	46
Appendix F: Determination of Protein Content	46
Appendix G: Determination of Carbohydrate Content	47
Appendix H: Determination of Lipid Content	
Appendix I: One-way Analysis of Variance examining the growth of <i>Oreochromis niloticus</i> after the microalgae used as fish diet	48
Appendix J: One-way Analysis of Variance examining the survival rate of <i>Oreochromis niloticus</i> after the microalgae used as fish diet	49
Appendix K: One-way Analysis of Variance examining the water quality of treatment tanks of <i>Oreochromis niloticus</i> after the microalgae used as fish diet	49
Appendix L: One-way Analysis of Variance examining the protein content of <i>Oreochromis niloticus</i> after the microalgae used as fish diet	50
Appendix M: One-way Analysis of Variance examining the lipid content of <i>Oreochromis niloticus</i> after the microalgae used as fish diet	51
Appendix N: One-way Analysis of Variance examining the carbohydrate content of <i>Oreochromis niloticus</i> after the microalgae used as fish diet	51-52
Brief Biography of the Author	53

List of Abbreviation

Acronym	Definition
ANOVA	Analysis of Variance
CF	Control Feed
cm	Centimeter
DHA	Docosahexaenoic Acid
et al.	Associates
EPA	Eicosapentanoic Acid
g	Gram
h	Hour
L	Liter
Mg	Milligram
MT	Metric ton
MUFA	Mono Unsaturated Fatty Acids
mg/L	Milligram/Liter
SE	Standard Error
SGR	Specific Growth Rate

List of Figures

Sl No.	Description	Page No.
1	<i>Tetraselmis chuii</i>	6
2	<i>Nannochloropsis sp.</i>	6
3	<i>Oreochromis niloticus</i>	7
4	SGR (% day ⁻¹) of juvenile Tilapia (<i>Oreochromis niloticus</i>) in different treatments. T25, T50, and T75 are the replacement of fishmeal with <i>Tetraselmis sp.</i> at 25%, 50%, and 75%, respectively; N25, N50, and N75 are the replacement of fishmeal with <i>Nannochloropsis sp.</i> at 25%, 50%, and 75%, respectively. Values with different letters are significantly different ($p < 0.05$).	19
5	Survival (%) of juvenile Tilapia (<i>Oreochromis niloticus</i>) in different treatments. T25, T50, and T75 are the replacement of fishmeal with <i>Tetraselmis sp.</i> at 25%, 50%, and 75%, respectively; N25, N50, and N75 are the replacement of fishmeal with <i>Nannochloropsis sp.</i> at 25%, 50%, and 75%, respectively. Values with different letters are significantly different ($p < 0.05$).	20
6	Proximate composition (dry weight basis) of juvenile Tilapia (<i>Oreochromis niloticus</i>) in different treatments. T25, T50, and T75 are the replacement of fishmeal with <i>Tetraselmis sp.</i> at 25%, 50%, and 75%, respectively; N25, N50, and N75 are the replacement of fishmeal with <i>Nannochloropsis sp.</i> at 25%, 50%, and 75%, respectively. Values with different letters within each series are significantly different ($p < 0.05$).	22
7	Total ammonia nitrogen (mg/L) of juvenile Tilapia culture tanks during the feeding experiment. T25, T50, and T75 are the replacement of fishmeal with <i>Tetraselmis sp.</i> at 25%, 50%, and 75%, respectively; N25, N50, and N75 are the replacement of fishmeal with <i>Nannochloropsis sp.</i> at 25%, 50%, and 75%, respectively. Values with different letters within each series are significantly different ($p < 0.05$).	24
8	Nitrite -nitrogen (mg/L) of juvenile Tilapia culture tanks during the feeding experiment. T25, T50, and T75 are the replacement of fishmeal with <i>Tetraselmis sp.</i> at 25%, 50%, and 75%, respectively; N25, N50, and N75 are the replacement of fishmeal with <i>Nannochloropsis sp.</i> at 25%, 50%, and 75%, respectively. Values with different letters within each series are significantly different ($p < 0.05$).	25

9	Soluble reactive phosphate (mg/L) of juvenile <i>Tilapia</i> culture tanks during the feeding experiment. T25, T50, and T75 are the replacement of fishmeal with <i>Tetraselmis</i> sp. at 25%, 50%, and 75%, respectively; N25, N50, and N75 are the replacement of fishmeal with <i>Nannochloropsis</i> sp. at 25%, 50%, and 75%, respectively. Values with different letters within each series are significantly different ($p < 0.05$).	26
---	--	----

List of Table

Sl No.	Description	Page No.
1	Chemical composition of Conway medium (Tompkins et al., 1995)	25-26
2	Feed formulation for the experimental diets	27
3	Proximate composition of experimental diets	28
4	Proximate composition of dried biomass of <i>Nannochloropsis</i> sp. and <i>Tetraselmis chuii</i> used to replace fish meal in diets for Tilapia (<i>Oreochromis niloticus</i>) fry.	29
5	Dissolve oxygen, water temperature, and pH recorded in different juvenile Tilapia culture tanks under different treatments.	30

Abstract

In the present study, two selected marine microalgae were combined to produce a high-performing feed for Nile tilapia (*Oreochromis niloticus*)—the world's second largest group of cultivated fish. In this study, a feeding trial was conducted with fry of Nile Tilapia *Oreochromis niloticus* in which two types of microalgae such as *Tetraselmis chuii* and *Nannochloropsis* sp. were used for replacement of fish meal protein. Seven experimental diet containing two microalgae were formulated to replace 0%, 25%, 50% and 75% of fish meal where each assigned to three replicate tanks, and each tank was stocked with 30 fry of Nile Tilapia from their first feeding for 22 days indoor feeding trial. The results of this study showed that two experimental diet T50% and N75% were performed significantly ($P < 0.05$) to obtain high weight gain / better growth than the formulated feed with 100% fish meal. Survival rate was found significantly ($P < 0.05$) higher in all treatments than control. SGR and water quality were also significantly ($P < 0.05$) higher than the formulated diets. In addition, the protein, lipid and carbohydrate content in Nile Tilapia fry reared in tanks with T50% and N75% were higher than for fry grown in control tanks. Therefore, this study suggests that Nile Tilapia fry reared in tanks can gain nutrition from the selected microalgae. Moreover, the presence of microalgae in the tanks has also been shown to maintain low level of TAN and nitrite in the culture system. Thus, microalgae used as feed supplement practice in hatcheries can be considered as a viable technology. Hence, selected marine microalgae could be used as feed supplement in enhancing the growth and survival of Nile Tilapia fry.

Keywords: Nile Tilapia, microalgae, survival rate, growth, nutritional composition