Faculty of Resource Science and Technology

GROWTH AND SURVIVAL OF TILAPIA FRY (*Oreochromis* sp.) IN DIFFERENT SALINITY CONCENTRATION IN EXPERIMENT TANK

Nurul Nassita Binti Lias

Bachelor of Science with Honours
(Aquatic Science and Resource Management)
2015

GROWTH AND SURVIVAL OF TILAPIA FRY (*Oreochromis* sp.) IN DIFFERENT SALINITY CONCENTRATION IN EXPERIMENT TANK

NURUL NASSITA BINTI LIAS

(39938)

This project report is submitted in partial fulfilment of the requirements for the Degree of Bachelor of Science with Honours
(Aquatic Science and Resource Management)

Supervisor: Dr. Khairul Adha A. Rahim

Aquatic Resource Science and Management
Department of Aquatic
Faculty Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2015

Acknowledgement

First and foremost, I would like to express my gratitude and thanks to **Allah s.w.t** for the best gifts of health in term of physical, mental and emotional throughout this study. Besides, I would like to thank and proud of **myself** who can successfully face and go through all the obstacles, hurdles, and difficulties during this study then become a stronger person and ready to face a real challenging life ahead.

The infinite gratitude goes to my supervisor, **Dr. Khairul Adha A. Rahim** for his guidance, support, advice, and effort in order to correct and improve all my mistakes during this study. His knowledge and experience was tremendously important to assist me running this study smoothly. Special thank also goes to other lecturer in Aquatic Department of FSTS, Unimas, which always have their time to share and help me in many ways.

Love and encouragement from my family, especially my parents, **Lias Bin Bol** and **Kalpana Bt Kamal,** and my grandmother **Kayah Bt Mantali**, were become the major contributors in finishing my study successfully. A bunch of thanks goes to **my friends and love ones**, who always be with me in ups and downs and gave me additional supports instead of giving some good, relevant, and ideas.

Finally, I would like to express my sincere gratitude to undergraduate students, **Faznur Fateh Bt Firdaus@Nicholas** and **Sharir Suhaili** for their helps and advices in this study. A special appreciation to **Mr, Zaidi Ibrahim, Mr Zulkifli Ahmad, Mr Nazri Latip, and Mr. Azlan** for their physical contributions and also to **Department of Marine Fisheries Sarawak at Santubong** which providing a good services during the visiting.

Faculty of Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2015

DECLARATION

I hereby declare that no portion of this dissertation has been submitted in support of an application for another degree of qualification of this or any other university or institution of higher learning.

____

NURUL NASSITA BINTI LIAS

Aquatic Science and Resource Management

Department of Aquatic Science

Faculty of Resource Science and Technology

Universiti Malaysia Sarawak

The project entitled “Growth and Survival of Tilapia Fry (*Oreochromis* sp.) in Different Salinity Concentration in Experiment Tank” was prepared by Nurul Nassita Binti Lias and submitted to the Faculty of Resource Science and Technology in partial fulfilment of the requirements for the Degree of Bachelor of Science (Honours) in Aquatic Science and Resource Management.

Received for examination by:

____

(Dr Khairul Adha A. Rahim)

Date: ______________________

Table of Contents

Contents **Page**

List of Abbreviations

PPT	Part Per Thousand ($^{o}/_{oo}$)
FCR	Feed Conversion Ratio
DO	Dissolve Oxygen
SGR	Specific Growth Rate
ANOVA	Analysis of Variance
LWR	Length-Weight Relationship

List of Tables

Tables **Page**

List of Figures

List of Equations

Growth and survival of Tilapia fry (*Oreochromis* sp.) in different salinity concentration in experiment tank

Nurul Nassita Binti Lias
(39938)

Aquatic Resource Science and Management
Faculty of Resource Science and Technology
Universiti Malaysia Sarawak

ABSTRACT

Effect of different salinity concentration of growth and survival of Tilapia fry (*Oreochromis* sp.) was evaluated for a period 6 weeks in experiment tanks. Twenty (20) individual of fry were stocked in each aquarium with a mean length and weight 0.86 ± 0.08 gm and 37.42 ± 1.12 mm respectively. Fish fry were feed with commercial pellet twice a day (0800 am: 1600 pm) based on 10% of total biomass in each treatment. The basic physic-chemical water quality parameters were maintained and monitored continuously. The fish growth and survival were monitored once in fortnight. The result shows the highest weight gain was shown in T1. The highest total length gain was shown in T5. T1 shows the highest survival rate among the treatment and the highest specific growth rate (SGR) was shown in T5. The best FCR was observed in T2. However, the optimum salinity for growth and survival of fish fry is 10 ppt where the survival rate and growth rate was higher and simultaneously.

Keyword: Salinity, Tilapia fry (*Oreochromis* sp.), growth and survival, FCR, SGR

ABSTRAK

Kesan kepekatan kemasinan yang berbeza pada pertumbuhan dan kemandirian anak ikan Tilapia (Oreochromis sp.) telah dinilai untuk tempoh 6 minggu di dalam akuarium. Setiap akuarium diletakkan sebanyak 20 ekor anak ikan dengan purata panjang dan berat masing-masing 0.86 ± 0.08 gm dan 37.42 ± 1.12 mm. Anak ikan telah diberi makan dengan pelet komersial dua kali sehari (0800 pagi: 1600 petang) berdasarkan 10% daripada jumlah biomass bagi setiap akuarium. Parameter asas fiziko-kimia kualiti air dikekalkan dan dipantau secara serentak. Pertumbuhan ikan dan kemandirian dipantau sekali dalam dua minggu. Hasil kajian menunjukkan pertambahan berat badan tertinggi diperhatikan dalam T1 dan jumlah panjang total yang paling tinggi ditunjukkan dalam T5. T1 menunjukkan kadar kemandirian yang tertinggi dan SGR yang tertinggi telah ditunjukkan dalam T5. FCR terbaik diperhatikan dalam T2. Walau bagaimanapun, kemasinan yang optimum untuk pertumbuhan dan kemandirian anak ikan adalah 10 ppt di mana kadar hidup dan kadar pertumbuhan adalah tinggi dan sekata.

Kata kunci: Kemasinan, anak ikan Tilapia (Oreochromis sp.), Tumbesaran dan kemandirian, FCR

1.0 Introduction

Tilapias are one of the popular culture species and it will continue to be particularly for the lesser-developed countries in tropics (FAO, 2001; El-Zaeem *et al.,* 2010). While the overall proportion of aquaculture production taking place in brackish has diminish over the past decades (El-Zaeem *et al.,* 2010). Karim and Mair (2005) stated that there is significant arising in the production of tilapia in brackish water reflecting a paucity of finfish species well suited to this condition of environment (El-Zaeem *et al.*, 2010).

El-Sayed (2006a) stated that the shortage in freshwater in many countries, the competition and urban activities has increases the pressure to develop aquaculture in brackish water and seawater. Thus, due to the ability to wide range of water salinity, tilapia has become an excellent candidate for aquaculture in brackish and seawater.

The cichlids of the genera *Tilapia* and *Oreochromis* are known to have evolved from the marine environment, are euryhaline, as they have the genes for salinity tolerance and can adapt, grow, and even breed in seawater (Likongwe, 2002). The salinity tolerant is different depends on tilapia species and strains. For example, Balarian and Haller (1982) reported that, *O. aureus* can grow well at salinity 36 to 44 ppt, while the reproduction occurs at 19 ppt. It also can tolerate the salinity up to 54 ppt with the gradual acclimation. In addition, the metabolic rates of tilapia are increase with increasing water salinity (El-Sayed, 2006a).

FAO (1993) reported that tilapia species are being cultured more frequently in coastal ponds with brackish and marine water, occasionally in polyculture with shrimp (Larunbe-Moran *et al.,* 2010). However, not all tilapia species can tolerate to wide range of salinity. The increasing market demand for tilapia and the availability of vast brackish and sea water resources have led the introduction of this species at large scales (Iqbal *et al.*,2012). Therefore, the objectives of this research are;

(a) to identify the growth and survival rate of tilapia fry culture in different salinity concentration of water,

(b) to determine the correlation between weight (gm) and length (mm) of fish based on the growth rate,

(c) to identify the best Food Conversion Ratio (FCR) for all Tilapia fry (*Oreochromis* sp.) in all growing conditions.

2.0 Literature Review

2.1 Tilapia (*Oreochromis* sp.)

2.1.1 History and biology

According to Trewavas (1982), the name 'tilapia' was derived from African Bushman word meaning 'fish' in the family Cichlidae. Tilapias was represented a large number of freshwater fish species. In addition, family Cichlidae is one of the four families which are Cichlidae, Embiotocidae, Pomacentridae, and Labridae, was included in the suborder Labroidei (El-Sayed, 2006a; Kaufman and Liem, 1982). The taxonomic summary of Tilapia is shown in Table 1.

Table 1: Taxonomic summary of Tilapia (*Oreochromis* sp.)

Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterigii
Order:	Perciformes
Family:	Cichlidae
Genus:	*Oreochromis*
Species:	***Oreochromis niloticus***
	Oreochromis aureus
	Oreochromis mossambicus

(Retrieved from: http://animaldiversity.ummz.umich.edu, on 2nd October 2014)

El-Sayed (2006a) stated that the genus Tilapia was first described by Smith in year 1840 then it was later split, based on breeding behaviour and feeding habits, into two subgenera; *Tilapia* (substrate spawners) and *Sarotherodon* ('brush-toothed') or (motherbrooders). However, all these revisions and changes in taxonomic classification of tilapia did not eliminate or resolve the current confusion (El-Sayed, 2006a). Thus, the old genus Tilapia for all tilapia species was still preferable by many taxonomists and researcher.

2.1.2 Ecomorphology of Tilapia

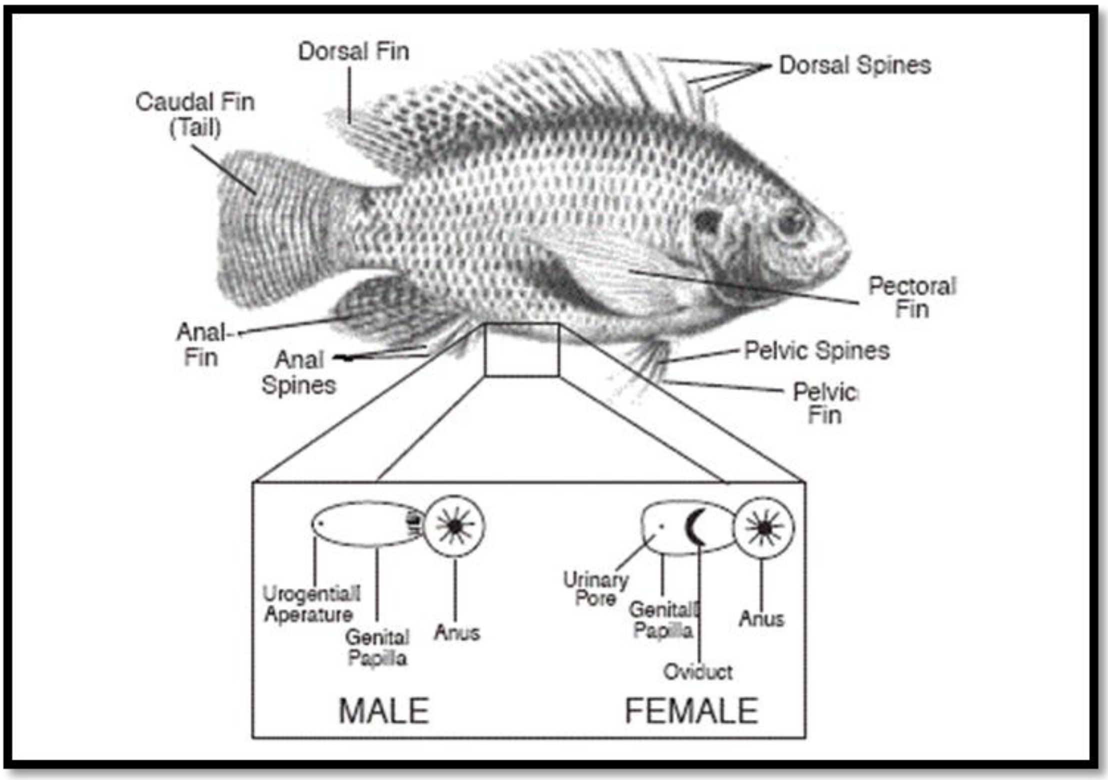

Figure 1: The morphological structure of Tilapia (*Oreochromis* sp.) (FAO, 2014)

Popma and Masser (1999) stated that tilapia are easily identified by an interrupted lateral line characteristic of the Cichlid family of fishes. Tilapias have fairly conventional, laterally compressed, deep body shape (El-Sayed, 2006a). Ross (2000) stated that the body of tilapia is covered with relatively large, cycloid scales, which are not easily dislodged (El-Sayed, 2006a). Tilapia have a large pectoral and pelvic fins and more anterior in an advance configuration in order to provides the great control over swimming and manoeuvring. In addition, the fins are also used for locomotion and this is as a reason for the cichlids fishes to have red muscles that designed for relatively low speed but continuous movement (Ross, 2000). Species distinction and identification of tilapia also use widely the number of scales, vertebrate, gill rackers, fin rays and spine. Moreover, the number of fin spines and/or rays of the same species may vary from one strain to another and from one aquatic environment to another (El-Sayed, 2006a). Siddique *et al* (2007) described the number of dorsal fin spines ranging from 16 to 17, dorsal fin soft rays from 11 to 15, pectoral fin soft rays 15, pelvic fin spines 1, pelvic fin soft rays 5, anal fin spines 3 and anal fin soft rays from 8-11 were present *Oreochromis niloticus* (Shahriar Nazrul *et al.*, 2011).

Tilapias bodies are generally characterized by vertical bars, with relatively subdued colours and with little contrast with the body colours (El-Sayed, 2006a). Changing their colours, in response to stress, by controlling skin chromatophores was provided by this colouration. Popma and Masser (1999) reported that the main cultured species of tilapia usually can be distinguished by different banding patterns on the caudal fin. For example, Nile tilapia have strong vertical bands (Popma and Masser, 1999). In addition, the colour patterns on the body and fins also may distinguish species such as maturemale Nile tilapia have gray or pink pigmentation in the throat region,while Mozambique tilapia have amore yellow coloration (Popma and Masser, 1999). A clearly visible lateral line and prominent nares was represented for providing well-developed sense organ for tilapias and also the large eyes were providing the fish with an excellent visual capability (El-Sayed, 2006a).

2.1.3 Tilapia in Aquaculture

Aquaculture is a method where the fish is raising in the ponds, tanks, cages, raceways, and net-enclosure; either for commercial purpose or individual consumption. According to Fitzsimmon (2000), culture methods have become more intensive in recent years, with improved feeds, development of cage and raceway culture, genetic manipulations and more skilled producers and there are many species are now raised domestically and there is a well developed aquaculture infrastructure. As well as the interest in commercial production of tilapia was initially dampened by a small harvest size resulting from excessive reproduction and stunting (Popma and Lovshin, 1995). Furthermore, within the past thirty years, commercially viable techniques have been developed to control over crowding in ponds, thereby permitting growth to more marketable sizes (Popma and Lovshin, 1995). Fitzsimmons and Naim (2010) reported that in 2009 more than 3 million metric tons of tilapia were raised and throughout the year until now, tilapia is a commonly raised fish in the world, second only to Carp (Murnyak, 2010). In addition, Murnyak (2010) stated that there are over 100 different species of tilapia, each with unique characteristics, behavior, and suitability to fish farming or aquaculture. Fitzsimmon *et al.* (2010) reported that global production of all species of tilapia has increased from 1.5 million tonnes in 2003 to 3.2 million tonnes in 2010, with a sales value of more than $5 billion, and throughout the world, Asia is the biggest producer, followed by Africa, and South America (SEAFISH, 2011; GLOBEFISH, 2010). A part from that, reported that the US is the single largest export market for tilapia, however, the European market is still relatively small (SEAFISH, 2011; GLOBEFISH, 2010).

2.2 Effect of salinity on growth

Salinity as one of limiting factors in the life history of Tilapia (Lawson and Anetekhai, 2011) and a key factor in controlling growth in tilapia that shows better performance in brackish water (Iqbal *et al.*, 2012; Boeuf and Payan, 2001; Vonck et al., 1998). Tilapia are one of the best candidate for aquaculture in brackish and seawater due to their ability to tolerate in wide range of water salinity (El-Sayed, 2006b). It was supported by Iqbal *et al.* (2012) and Pullin and McConnell (1982) which reported that tilapia is one of the important fish species that has several good qualities and tolerate with wide range of salinity, can grow well in water salinities ranging from 0.1 ppt to 29 ppt, stand with temperatures between 8 to 42^{o}C, and can survive in low dissolve oxygen (DO). Since that tilapia is an euryhaline species, and different tilapia species or strains are considered to be salinity tolerant. El-Sayed (2006a) stated that the salinity tolerance of tilapia also affected by fish sex and size. In addition, adult fish were more salt-tolerant than fry and juvenile. Fry and juveniles tolerated direct transfer to 19 ppt without showing any stress and mortality. However, the mortality will 100% occurs in 27 ppt (El-Sayed, 2006a). Adult fish tolerate a direct transfer to 27 ppt and have 100% mortality at 37 ppt. According to Balarin and Haller (1982), *Oreochromis aureus* can grow well at salinity from 36 to 44 ppt, reproduction occurs at 19 ppt and with gradual acclimation, it can tolerate salinity up to 54 ppt (El-Zaeem *et al.*, 2010). Lawson and Anatekhai (2011) stated that effect of salinity on survival, growth, and reproduction was determined by Schoolfield *et al.* (2010) in *Oreochromis niloticus* from Mississippi to assist in predicting their potential spread to estuarine and coastal region. As a result, Baroiller *et al.* (2000) reported that *Oreochromis niloticus* does not tolerate salinities above 20 ppt and might not suitable for culture in full strength seawater; 37–40 ppt (Lowson and Anetekhai, 2011). However, some other tilapia species are considered ‘stenohaline’, since they tolerate only narrow range of water salinity

(El-Sayed, 2006a) such as an example of Tilapia rendalli that have maximum salinity tolerance of 18 ppt respectively (El-Sayed, 2006a; Whitefield and Blaber, 1976; Balarin and Haller, 1982; Philippart and Ruwet, 1982). The analysing data on the numeroues study of the influence of salinity on the growing capacities in larger fish, juveniles or adults by Boeuf and Payan (2001) are summarized in Table 2 below.

Table 2: The effect of salinity and growth of different species of Tilapia sp.

Species	**Tolerence (PPT)**	**Best growth (PPT)**	**References**
Oreochromis niloticus	+(0 – 16)	8	Likongwe *et al.* (1996)
Oreochromis spilurus	=(0 – 37)		Jonassen *et al.* (1997)
Oreochromis aureus	=(0 – 27)		Chervinsky and Yashouv (1971)
O. mossambicus	120	17.5	Suresh and Lin (1992)
O. *niloticus*	36	5-10	Suresh and Lin (1992)
O. aureus	40	10 – 15	Suresh and Lin (1992)
O. spilurus	35	0	Suresh and Lin (1992)
Hybrid Red Tilapia	35	30 – 35	Suresh and Lin (1991)

2.3 Feeding

2.3.1 Feeding Habit

The inceasing importance of tilapia as an aquaculture candidate make it necessary to understand the food preferences and feeding regimes in their natural habitats, for preparing suitable diet for them and adaption of appropriate feeding regimes under culture conditions (El-Sayed, 2006a). Popma and Lovshin (1995) stated that tilapia are often considered filter-feeders because they can efficiently harvest planktonic organisms from the water column. Tilapia are generally herbivorous or omnivorous (El-Sayed, 2006a). In addition, Liem (1984) stated that teleost including cichlids were able to exploit more than one source. This ability to exploit different varieties of food makes *O. niloticus* to be omnivorous (Oso *et al.*,2006). Examination by Oso *at al.* (2006) on the diet of tilapia showed that there was high percentage of mud and detritus in their stomach and this is an indication that the species is a bottom grazers. Ikomi and Sikoki (2001) observed that the presence of tiny unicuspid teeth in the mouth of the fish suggests that fish species feed on plants, leaves, buds and seeds of water lilies and are thus herbivorous feeders (Oso *et al.*, 2006). According to El-Sayed (2006a), although tilapia feed at low trophic levels and feed costs are lower than carnivorous fishes, tilapia are still a source of high-quality protein suitable for human consumption, at a relatively low cost.

2.3.2 Feeding Regimes and Practices

Dupree (1984) showed that good feeding practices are as important to the aquaculturist as the availability of good feeds (Lim and Webster, 2006). Furthermore, the rate at which food is consumed and the efficiency with which it is utilized are prime factors in determining growth rate and there is a positive relation between growth and feeding frequency (Riche *et al.,* 2004). Feeding regimes are one of the most disputed areas in tilapia nutrition and some researcher suggest that daily feed will provided to the fish as a percentage of fish body weight, while other recommended *ad libitum* (or satiation) regimes for best growth and feed utilization (El-Sayed, 2006). According to Lim *et al* (2006), fish are unable to grow and reproduce efficiently and remain healthy without adequate intake of suitable quality feed. Since that tilapia have a small stomachs and are characterized by continuous feeding behaviour, El-Sayed (2006a) stated that more frequent feeding would be appropriate for them, meanwhile, feeding levels and frequency of tilapia decrease with increasing fish size. The fish require a daily ration of about 20 to 30% of their body weight during the larval stages, divided into six to eight times feedings. Compared with fish fingerlings which are require 3 to 4% of body weight, dispence three to four times daily (El-Sayed, 2006a). El-Sayed (2002) found that Nile Tilapia fry fed a larval test diets at 10 to 35% body weight per day attained their optimum performance at the 35% level, while Santiago *et al.* (1987) found that the growth of Nile tilapia fry increased with increasing feeding levels up to 65%, and no significant differences in growth rate and survival were found between the 30 to 65% feeding levels. The recommended a feeding rete of 30 to 35% body weight per day as optimal for Nile tilapia fry. Thus, it has been indicated that increasing feeding levels above fish requirements may reduce feed digestibility and utilization efficiency (El-Sayed, 2006a; Mayer-Burgdorff *et al,* 1989). Then, feeding three to four times a day resulted in a better growth and feed conversion ratio (FCR) than twice a day (El-Sayed, 2006a). The example of feeding rate and schedule is shown in Table 3.

Table 3: Feeding Rate and Schedule

Days	Types of feed	Feeding rate (gm)	Feeding frequency	Ideal weight for stocks
1 – 15	Fry mash	8% of body weight	4 times a day	6 gm at day 15
16 – 31	Fry mash	7% of body weight	4 times a day	25 gm
32 – 46	Starter	6% of body weight	4 times a day	36 gm
47 – 61	Grower	5% of body weight	3 times a day	50 gm
62 – 76	Grower	4% of body weight	3 times a day	72 gm
77 – 91	Grower	3% of body weight	3 times a day	100 gm
92 – 105	Finisher	3 – 2% of body weight	2 times a day	121 gm
106 – 120	Finisher	2% of body weight	2 times a day	150 gm

(Retrieved from: http://region2.bfar.da.gov.ph, on 2nd October 2014)