Effect of difference salinity on growth quality, survivality and flesh diameter of Red Tilapia (*Oreochromis sp*)

By

Muhammad Irfan bin Jalalludin

F16A0111

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DECLARATION

I hereby declare that the work embodied in here is the result of my own research except for the excerpt as cited in the references.

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Signature

Student's Name : MUHAMMAD IRFAN BIN JALALLUDIN

Matric No : F16A0111

Date : 5/12/2019

Verified by :

_____

Supervisor Signature

Supervisor's Name : DR. HASNITA BINTI CHE HARUN

Stamp :

Date : 5/12/2019

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ABSTRACT

Oreochromus .sp or also known as Red Tilapia is freshwater fish that always been cultured in world. A one month's research was conducted in glass tanks with Ninety fish of tilapia (*Oreochromus .sp*) same size were selected for analysis of the effect of difference salinity on growth quality, survivality and flesh quality in Red Tilapia. Each fish was measured growth quality, survivality and flesh quality in Red Tilapia (*Oreochromis sp*) in different salinity which is 0 ppt, 15 ppt and 32 ppt. The fish were put directly into the three different salinity of water. Each fish was weight for every week to observe the weight increase, the number of mortality and diameter of flesh also recorded. Result for survivality shows that most high survivality rate is fish in tank 15 ppt with survival rate is 75% and the lowest is at 32 ppt with 0% survival rate. This result was same with the growth rate and diameter of flesh. The relative growth rate was $323.53\%/30days$ for 0 ppt and in 15 ppt shows the highest with $376.47\%/30days$. Both treatments show the almost same flesh diameter but treatment with 15 ppt shows the highest diameter 1.8 cm compared to 0 ppt is 1.7 cm. This shows that 15 ppt is best growth factor in this experiment. The experiment were conducted with the same dissolved oxygen, pH of the water, volume and also the temperature because any difference of this will cause the mortality and also the growth rate of the fish been effected. Obstacles or obstacles during or during the study can also be minimized by using the right steps.

Keywords: *Oreochromus .sp,* Salinity, survivality, flesh diameter

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ABSTRAK

Oreochromus .sp atau juga tahu sebagai Tilapia Merah adalah ikan air tawar yang sentiasa diternak di dunia. Penyelidikan satu bulan dijalankan di dalam tangki kaca dengan sembilan puluh ikan tilapia (*Oreochromus .sp*) saiz yang sama dipilih untuk menganalisis kesan kemasinan perbezaan pada kualiti pertumbuhan, jumlah yang hidup dan kualiti daging di Tilapia merah. Setiap ikan diukur dengan kualiti pertumbuhan, hidup dan kualiti daging di Tilapia merah (*Oreochromis sp*) dalam kemasinan yang berbeza adalah 0 ppt, 15 ppt dan 32 ppt. Ikan itu dimasukkan ke dalam tiga air dengan kemasinan yang berbeza. Setiap berat ikan di ukur untuk setiap minggu untuk melihat peningkatan berat badan, jumlah kematian dan diameter daging ikan juga direkodkan. Hasil jumlah yang hidup menunjukkan bahawa kadar jumlah yang hidup yang paling tinggi adalah ikan dalam tangki 15 ppt dengan kadar hidup 75% dan terendah adalah pada 32 ppt dengan kadar hidup 0%. Keputusan ini sama dengan kadar pertumbuhan dan diameter dagingikan. Kadar pertumbuhan relatif 323.53% / 30 hari untuk 0 ppt dan 15 ppt menunjukkan tertinggi dengan 376.47 % / 30 hari. Kedua-dua rawatan menunjukkan diameter daging hampir sama tetapi rawatan dengan 15 ppt menunjukkan diameter tertinggi 1.8 cm berbanding dengan 0 ppt adalah 1.7 cm. Ini menunjukkan bahawa 15 ppt adalah faktor pertumbuhan terbaik dalam eksperimen ini. Eksperimen ini dijalankan dengan oksigen terlarut yang sama, pH air, jumlah dan juga suhu kerana sebarang perbezaan ini akan menyebabkan kematian dan juga kadar pertumbuhan ikan telah dilaksanakan. Halangan atau rintangan ketika atau semasa melakukan kajian juga dapat dikurangkan jika menggunakan langkah-langkah yang betul.

Kata kunci: *Oreochromus .sp*, kemasinan, kemandiran, lebar daging ikan

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LIST OF ABBREVIATIONS

PPT	Part per Thousand
FCR	Feed Conversion Ratio
DO	Dissolve Oxygen
SGR	Specific Growth Rate
ANOVA	Analysis of Variance
MT	methyltestostwerone
SR	Survival Rate
RGR	Relative Growth Rate

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LIST OF SYMBOLS

˚c	Degree Celsius
%	Percentage
cm	Centimetre
mm	millimetre

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Recent studies have showed a potential culture of aquatic species beyond the range of its natural environment. These studies reported an increment in the growth and survivality as well as meat quality of the species. Thus, this study was designed to investigate different salinities in culturing Red Tilapia.

Tilapia is mainly a freshwater fish and the red tilapia (*Oreochromis sp*) is natural to Central and North Africa including the Middle East (Boyd, 2004). The way of life of Nile tilapia can be followed to old Egyptian occasions as delineated on bas-help from an Egyptian tomb going back more than 4000 years, which demonstrated the fish held in elaborate lakes. Nile tilapia from Japan was acquainted with Thailand in 1965, and from Thailand they were sent to the Philippines (Fisheries & Aquaculture National Aquaculture Sector Overview, 2008). In Kenya, it was introduced to control mosquitoes which were causing malaria, consequently reducing the numbers of mosquitoes because the tilapia consumes mosquito larvae (Louca, Lucas, Green, Majambere, & Lindsay, 2010).

Red tilapia is the subsequent significant fish created after catfish in Malaysia. In any case, the generation of tilapia has been beginning to diminish every year, from

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51, 554 matric tones in 2012 to 35,996 matric tones in 2016(Norziah, Kee, & Norita, 2014). The decrease in tilapia generation has reviewed activities to expand fish the board systems and tilapia culture rehearses. Subsequently they discover qualities that help the stimulating of development which will lessen the way of life period in this manner would raise the gainfulness to the ranchers (Norita, 2018).

Sexual development is come to at three to a half year relying upon temperature. Multiplication happens when temperatures are over 20°C. Tilapia can produce at regular intervals in a single year. Females' tilapia broods eggs inside their mouths for about seven days where hatchlings incubate and it stay until the vitellus is reabsorbed. Larval length at bring forth 4 millimetre, egg size 1.5 millimetre. brings forth in stable sand in water from 0.6 to 2 meter deep of lakes and inshore waters (Ph, Ricardo, & Rudolf, 1930).

The Nile tilapia can just endure bitter water with saltiness up to 25 sections part Per thousand (ppt) while the Mozambique tilapia can endure saltiness up to 40 ppt while Red Tilapia can get by in unadulterated seawater up to 32 ppt (Jaspe and Caipang, 2011). On account of that tilapia can be species that are best choice since they are omnivorous and can be just adjusted on make due at low oxygen, endure a wide scope of saltiness, levels non-characteristic encourage and can be refined on low limit with high densities (Iqbal, Qureshi, Ashraf, Sciences, and Khan, 2012). For economical aquaculture, accessibility of good quality fish seed in mass amounts is the essential prerequisite (Iqbal, Qureshi, Ashraf, Sciences, & Khan, 2012).

The background of study of Effect of difference salinity on growth quality, survivality and flesh quality in Red Tilapia (*Oreochromis sp*) especially in Malaysia will be covered including the activity in different salinity of water will affect the growth quality, survivality and flesh quality to improve production of Red Tilapia in Malaysia.

This chapter will also covered the research questions, research objectives, problems statements, scope of study and significant of study.

In areas where freshwater is unusual, fish culture in saline water or seawater can make available a basis of additional profits (Dimaggio, Ohs, & Petty, 2009). Tilapia will be raised in this kind of atmosphere if steady adjustment ways are implemented (Dimaggio et al., 2009). The Nile tilapia (*Oreochromis niloticus*) is usually cultured in lake water. Nevertheless, it stands some stages of saltiness that being measured or calls it as *euryhaline*. In spite of its good adaptation size to salinity, so it is a smaller amount accepting than other types of tilapia such as *Oreochromis aureus* and *Oreochromis mossambicus* (Hena, Kamal, & Mair, 2005).

The technique that every species of tilapia answers to various saltiness stages lets estimation of the best spot for it's to culture. Accordingly, a few readings have assessed the impact of this parameter on the everyday practice of euryhaline fish (Tsuzuki, Sugai, Cesar, Francisco, & Cerqueira, 2007). Moreover the performance it is essential to estimate the end product of the salinity on fish healthiness and body part (Árnason, Magnadóttir, & Björnsson, 2013). The gills and the digestive tube that continue in straight interaction with liquid and under chemical and physical atmosphere alterations can hurt morphologic changes (Reis, Mello, Sant, & Fernandes, 2009).

The imperative structures are gills for the fish condition, being associated with the methodology of osmoregulation with nitrogen composites discharge, by method for well similar to the key site for vaporous associations. Certain useful modifications, for example, the Na+-K+-ATPase and gill epithelium chloride cells movement were experiential during the adjustment of tilapia to salt water (Güner, Özden, Irgan, Altunok, & Kizak, 2005). Therefore, some injury to the branchial lamellae and filaments that can affect with their purpose, will cause the survival of these fish (Reis et

al., 2009). The lessons histopathological has be present established to assess the things of pollutants taking place fish health in the atmosphere and to assistance start a causal relationship among exposure to toxic materials and various biological responses (Schwaiger, Adam, Pawert, Honnen, & Triebskorn, 1997) . Here is an ascent event of neurotic and ailments situations in fish, just as an assortment of aetiologies. This ascent is a pointer of ecological weight and gives a complete organic end purpose of the past of introduction to a contamination (Schwaiger et al., 1997).

1.2 Problem Statement

Cost of production is increase in line with time to grow the livestock due to the increase of feed. Beside, unsatisfied quality of meat in red tilapia has become a problem that limits the production of aquaculture in tilapia.

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1.3 Objectives

To study the growth, survivality and flesh diameter of Red Tilapia (*Oreochromis .sp*) culture in difference salinities.

1.4 Scope of Study

The scopes of this study are focusing on the difference salinity on growth quality, survivality and flesh quality in Red Tilapia. To identify the different 3 aquariums or tank will be set up. Each of aquariums will put seawater, tap water as

control and river. The main focuses of this study are to observe the survivality and flesh quality of different salinity of water.

1.5 Significances of Study

This study shows the ability of growth and survival of juvenile stages with different salinity from 0 ppt to 32 ppt. In this study also exposed the juvenile of *Oreochromis sp* to higher salinities of freshwater. Besides, the study may know the suitable salinity tolerance juvenile in freshwater and will not extreme effect when in brackish water with the quality of flesh.

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CHAPTER 2

LITERATURE REVIEW

2.1 General about *Oreochromis sp*

The aquaculture of Nile tilapia first found in ancient Egyptian from 4000 ages before, which showed the fish from ornamental pond (FAO Fisheries and Aquaculture *Oreochromis sp,* 2019). Nile tilapias from Japan were come together to Thailand in 1965, and then it spread to Philippines. The tilapia species on Cote d'Ivoire was bringing in Brazil country in year 1971, and then it was delivering to the United State at year 1974.

In year 1978, Nile tilapia fish was come to China which indications the world in tilapia manufacture and regularly produced extra than half of the global production in every single year since 1992 until 2003. The breeding of wild tilapia in ponds, which led to extreme recruitment, stunting and a low ratio of marketable-sized fish, reduced the initial interest for tilapia as a diet fish. The growth of hormonal sex-reversal methods in the 1970's represented a main advance that permitted male mono-sex populations to be raised to uniform, marketable sizes.

Also, investigate on nourishment and culture frameworks, alongside advertise advancement and handling enhancements, made a beeline for fast extension of the business from when the mid-1980s. A few sorts of tilapia are refined financially, yet Nile tilapia types are the major refined sort general. Despite the fact that Tilapia angles

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being freshwater angles, are expected to have been advanced from oceanic predecessors (Company & Kirk, 1968). It can raise and breed normally in saline water.

It is no surprise, so that most of these fishes are capable to stand a high range of water salinity. Certain this species can even grow and reproduce at very high water salinity. Some of countries lack of freshwater, besides the competition for it with other metropolitan activities and agriculture has raised the burden to improve aquaculture in saline water. Thus, the first applicant that one may consider for aquaculture in saline water is tilapia. The momentum examination tosses a few lights on tilapia culture in seawater/saline water, with accentuation on their ecological prerequisites, financial potential and supplement necessities. Still restricted information are possible on tilapia culture in seawater and salty water, contrasted with the voluminous data accessible on their societies in freshwater conditions. Figure 2.1 shown the fish anatomy by (Weatherley and Gill, 2014).

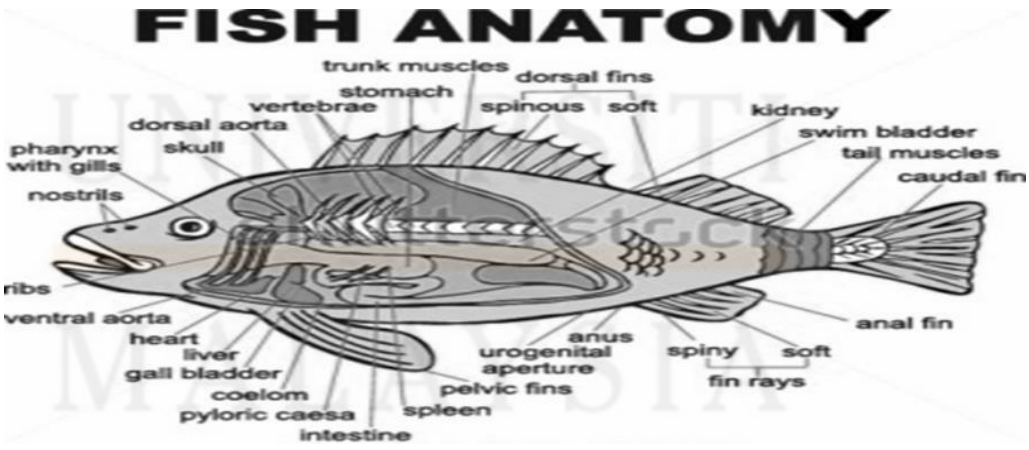

Figure 2.2: Fish anatomy (Weatherley and Gill, 2014)

2.1.1 Salinity of *Oreochromis .sp*

Saltiness is one of noteworthy condition factors upsetting endurance, development and dissemination of a few sea-going animals (Kumlu and Jones, 1995, Kumlu et al, 1999 and Kumlu et al., 2000). Saltiness is well-characterized as the aggregate of entirely particles in water which incorporates principally of chloride, sodium, bicarbonate, potassium, magnesium, calcium, and sulfate particles. Saltiness is a crucial water quality parameter for the fish development (Mapenzi and Mmochi, J Aquac Res Development, 2016).

(Köksal, Özkul, and Çag, 2008) on demonstrate slow fish growth at changed saline environments that related to our researched. Their research fish in river or sea atmospheres use energy to grip ions off or in their bodies separately from osmoregulation. Their researches indicate faster fish growth in brackish water compared to fresh water and Full Strength Sea Water (FSSW). Then, the saltiness acclimation procedure forces the fish to experience endocronological with biochemical changes and morphological.

The changes disturb both oxygen and energy consumption in fish. Some research were conducted on condition factor and weight- length relationship for *O. urolepis* plus *Tilapia zilli* at fresh water and FSSW, result of altered salinities on survival and growth of *Oreochromis Aureus* and *Oreochromis sp* (Küçük, 2013). Here is a common result of the hybrids resulting from saltiness tolerating guardians are saltiness tolerant. Additionally, *Oreochomis niloticus* was affirmed high development and bigger size at adulthood between tilapia species while *Oreochromis urolepis* has extraordinary saltiness resilience however low development rates at development. Along these lines, cross breeds were unsurprising to have saltiness resilience and extraordinary improvement rates than their folks.The environmental influences

influencing tilapia in the nature or under aquaculture situations contain temperature, saltiness, alkali and nitrites, broke up oxygen, pH, and water turbidity, photoperiod. However, this assessment will concentrate on saltiness and survivality as the two most huge issues. Wide exertion has been given on the flexibility and acknowledgment of tilapia to water saltiness and the appropriateness for tilapia for life in salt water culture (Table 2.1). A large portion of this work showed that salt resistance hold tight for the most part on tilapia size, strains and species, technique and adjustment time and ecological aspects (Suresh & Lm, 1992).

Table 2.1: Salinity tolerance (%) of tilapia (Source from El-Sayed, 2006)

Species	Upper limit		Optimum limit	Remarks	Reference
	Direct transfer	Gradual transfer			
O. niloticus	18[1]	36[1]	5-10[2], 15[3]	Reproduce at 13.5-29‰[4]	[1]Al-Amoudi (1987a), [2]Payne and Collinson (1983), [3]Alfredo and Hector (2002), [4]Balarin and Haller (1982)
O. mossambicus	27[5]	120[6]	17.5[7]	Spawn at up to 49‰[8]	[5]Al-Amoudi (1987b), [6]Whitefield and Blaber (1979), [7]Canagaratnam (1966), [8]Popper and Lichatowich (1975)
O. aureus	27[5]	54[4]	10-15[9]	Reproduce at 5-20‰, low growth and high mortality at 36‰[10]	[4]Balarin and Haller (1982), [9]Perry and Avault (1972), [10]McGeachin, Wicklund, Olla and Winton (1987)
O. spilurus	33[4]	40[11]	3-8[11]	Good growth and survival in seawater, but low fecundity[11]	[11]Al-Ahmed (2001)
S. galilaeus		29[4]	19[4]	Reproduce in the wild at 29‰[4]	
T. rendalli		13-19[4]	0[12]		[12]Likongwe (2002)
T. zillii		45[13]		Grow and reproduce naturally at 10->30‰[14]	[13]Chervinski (1982), [14]El-Sayed (pers. communication)
O. niloticus x *O. mossambicus*		35[15]	15[15]	At 35‰, the fish failed to adapt	[15]Alfredo and Hector (2002)
Florida red tilapia			17.8[16]	Grow normally up to 36.2‰	[16]El-Ebiary *et al.* (1997)

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2.1.2 Early development of Oreochromis mossambicus

The buds of a caudal fin rays just begun to form and notochord bent gradually upward. At three days of stage, the notochord length about 5.7 millimetres, nostrils just made while the physique wall continuous to descend and blood circulation was detected where veins had looked at the an anterior ration of yolk sac. Next to days four of stage, the standard length was 5.8 millimetres, and the caudal fin support was nearly complete. At five days of stage, the standard length was 6.0 millimetres, the quantity of melanophores had a little increased plus the pectoral fin rays had made.

Next, by days six of phase, standard length about 6.6 millimetres, the embryo free first swimming then the buds of dorsal plus anal fin rays had appeared. On seven days of phase, standard length was 6.7 millimetres, guanine was existent. Newly hatch embryo with 4.0 millimetres the notochord length. One day old, about 4.5 millimetres notochord length and the first segmentation the soft rays of the dorsal fin had been occurred. The four days old with 5.8 mm in standard length. At day five the standard length is 6.0. By eight days, standard length become 7.1 millimetres long, and melanophores by the on the side of the body that enlarged density equalled to the earlier stage.

By 10 days of phase, standard length was increase to 7.6 millimetres, and a pelvic fin bud was existed. By 2 week of stage, the visceral cavity was enclosed, standard length become 9.4 millimetres and creation of all the fins was done develop, including the fin rays. The bottom juvenile which was together in natural waters was 8.1 millimetre standard length. On days 16 of phase, standard length increase to 9.7 mm, while yolk had totally remained immersed, and dotted ocella look to be appeared on the dorsal fin. Standard length about 11.4 millimetres with the Figure structure was

morphologically alike to an adult by the age of 20 days. Figure 2.2 and 2.3 has shown the development of tilapia (Köksal, 2008).

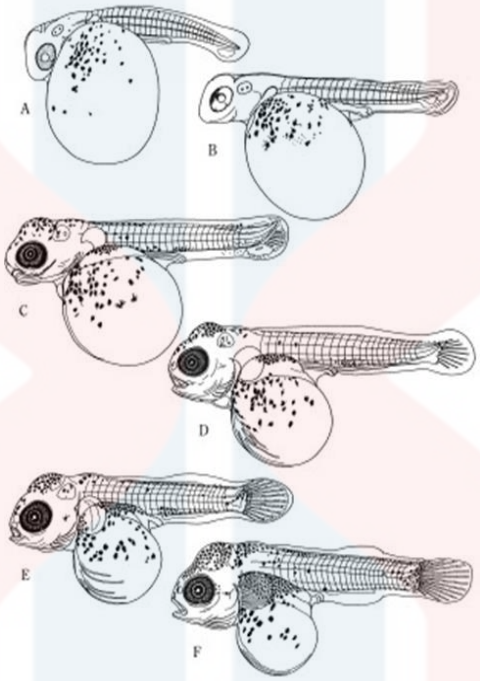

Figure 3.2: Development of tilapia(Köksal, 2008)

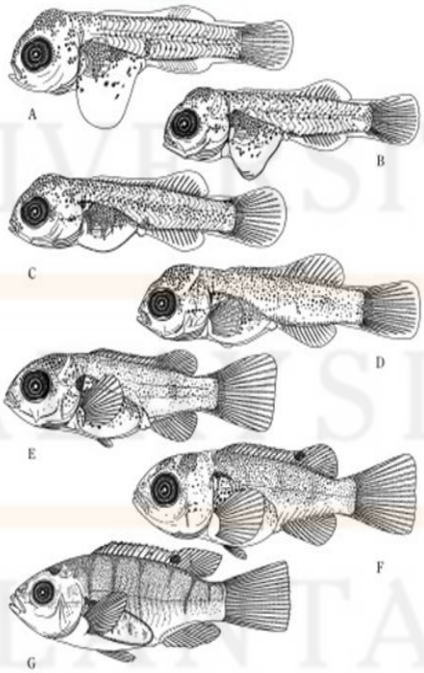

Figure 2.3: Development of tilapia(Köksal, 2008)

2.1.3 Salinity on survival and growth

Depends on the species, the tilapias proves that the capability to alive in salt water that is salinity tolerance, the technique of allocation, the feeding methods for pre-acclimation, the mean individual heaviness, extra generally the consequence of environmental factors and the bodily status of the fish (Chervinski,1982). *O.niloticus* is well-thought-out to be an animal varieties which grows for the most part well yet has little resistance to saltiness this demonstrates the resilience to salt water is frequently contrarily related with the development limit.

On the other hand, species such *as 0.mossambicus* viewed as between the most extreme levels known in tilapia species which have normally low development sizes endure a saltiness of 80 to 117g 1 to 1 in the wild (Stickney, 1986). Tilapia angles, regardless of being crisp water, are accepted to have developed from marine predecessors (Kirk, 1972) hence with a wide scope of water saltiness, a portion of these fishes can endure. Specific species can even deliver and imitate at most elevated saltiness and in bitter water. The expanded the worry to create aquaculture in bitter water and seawater because of the worldwide freshwater competing and shortage necessities.

Some research has verity about tilapia culture in seawater and brackish water related to the voluminous information accessible on their way of life in crisp water conditions. Because of water impediment, tilapia make is just done in minor scale along these lines the re-flowing framework is prescribed to effectively use water in Kuwait. In the mean time it was arranged that tilapia would be refined uniquely in seawater, the Kuwait most plentiful asset, just in seawater the greatest trainings done on develop out generation were done (Cruz and Ridha, 2006) and in brackish water only breeding activities were conducted in 2 until 4 ppt. saltiness, temperature, disintegrated oxygen,

Ammonia and nitrites, pH, photoperiod and water turbidity are the natural calculates that influencing tilapia the wild or under aquaculture environment.

The previous researches showed that salt resistance hold tight basically on tilapia species, adjustment time, strains and size and strategy and natural variables (Chervinski, 2017). The versatility and resistance of tilapia to water saltiness and the rightness of salt water for tilapia culture broad work has been distributed. It has been expressed that 0 mossambicus, 0 aureus and T zilli it was the greatest saltiness tolerant tilapia species. 0 mossambicus can endure up to 120% water saltiness (Whitefied & Blaber, 2011).

In addition they can breed and rise regularly at water saltiness of 49 percent and at 69 percent their fry develop and live sanely well (Whitefied & Blaber, 1979). Other tilapia is typically can stand water salinities extending from around 20 to 35 percent and not as much of *euryhaline* including *0.niloticus*. At 0 to 29 percent, most of this tilapia last, raise and breed dependent on the acclimation period and species. Sex and size also affected by fish because saltiness resistance of tilapia. Fry and adolescents were less salt tolerant than grown-up fish. The creators related these ontogenetic changes in saltiness resilience to body size than to sequential age. The tilapia females will in general be less salt tolerant than male (Köksal et al., 2008). In the interim it the entirety number of bring forth of Nile tilapia females was more noteworthy in bitter water 5 to 15 percent than in either new water or full quality saltwater (Kuo, 2019).

2.1.4 Acclimation

Pre-acclimation to salt water and normal exchange to high satiness have a significant effect on tilapia development and endurance, as has been affirmed by (V, 1987). The essayist found that *O. spilurus*, *O. aureus* and *O. mossambicus* need

smaller acclimation time around 4 days for a designation to full-quality saltwater than *O. aureus* x *O. niloticus* crossovers and *O. niloticus* around 8 days. The outcomes showed that the previous tilapia groups are more adjust than the subsequent gathering. Al- Amoudi, El-Sayed, & El-Ghobashy in year 1996 that found also that *O. mossambicus* are extra impervious to thermohaline stuns than *O. niloticus* x *O. aureus* hybrids. Equally, the respiratory responses and physiological of *O. mossambicus* to saltiness acclimation have be there assessed by Morgan, Sakamoto, Grau and Iwama in year 1997.

Fish brought up in freshwater were moved to freshwater, isotonic saltiness (Iso) about 12‰ and 75% saltwater about 25 ppt and an amount of physiological parameters was observed. The researchers observe that plasma Cl- and Na+ was raised one day when transfer to saltwater, but returned to freshwater levels on day four. Glucose levels and plasma cortisol were higher while development hormone, Na+, K+ ATPase exercises and prolactins were lower in freshwater and isotonic saltiness than in saltwater. These outcomes proposed that the physiological changes related with saltwater acclimation in tilapia are present moment, vitality requesting and may represent as much as 20 % of all out body digestion following four days in saltwater. The ascent in the metabolic vitality redirected into osmoregulation, with ascent of water saltiness has likewise been accounted for in *O. spilurus* and *O. mossambicus* (Payne, Ridgway & Hamer, 1988), common carp and *O. aureus x O. niloticus* (Payne, 1983).

Feed tilapia brood stock by nourishments that containing more prominent salt levels may make seeds with better versatility to seawater. This supposition by sustaining Taiwanese red tilapia (*O. mossambicus x O. niloticus*) brood stock nourishments containing 0.8, 3, 6, 9 or 12% salt for 2 months before producing

examined by Turingan and Kubaryk (1992). The specialist likewise found that egg hatchability was more noteworthy in saltwater looked at in new water. The hatchability and larval advancement were top in fish encouraged 12% salt in saltwater and least in crisp water.

In extra update, that the endurance of fry made from prepared eggs of Nile tilapia produced in freshwater and developed at raised up salinities of 0, 5, 10, 15, 20, 25 and 32‰ was 85.5, 84.4, 82.5, 56.3, 37.9, 20.0 and 0%, independently appear by Watanabe et al. (1985). Fry saltiness resistance expanded likewise with rise the saltiness of bring forth, acclimatization or producing. In including, the proportionate saltiness, early presentation of tilapia brood stock to high saltiness made posterity with high saltiness acknowledgment contrast with those brought forth in crisp water and rose at high saltiness.

The decreased routine digestion of euryhaline tilapia raised at high saltiness reason for the steroid hormones and, thusly, improves fish development. The development of *O. mossambicus* continually treated with 17α-methyltestostwerone (MT) was faster than ahead of schedule or late methyltestostwerone treated fish in crisp water and saltwater. The development of always treated fish was 5 to 7 periods more prominent in saltwater than in freshwater (Kuwaye, Okimoto, Shimoda, Howerton, Lin, Pang and Grau, 1993). Same results were accounted for by Ron, Shimoda, Iwama and Gordon Grau (1995) that looks into the impacts of methyltestostwerone treatment and encouraging rate on the advancement of *O. mossambicus* raised in crisp water and salt water.

The best improvement was exploratory in methyltestostwerone treated fish nourished twofold proportion in salt water. Oxygen utilization the normal digestion was

additionally a lot lesser in saltwater than in crisp water. The essayists suggested that the decline in routine digestion in fish raised in saltwater may have represented the ascent in development rates, connected to angle raised in freshwater.

2.1.5 Temperature

Earlier readings showed that rates of development the red tilapia in Florida cultivated on dissimilar salinities risen with rise of temperature in the range is about 22° C to 32° C (Sallam, Fayed, El-absawy, Aly, & El-greisy, 2017). At 18ºC and 36 ppt, the top development and feed consumption were obtained at 32ºC therefore at salinity 0 ppt, fish presentation was limited at 27° C. In any change of temperatures, fish performance was better at 18 ppt compared at 0ºC and 35 ppt, was indicating a benefit of tilapia pet in brackish water related to fresh water and saltwater in some subtropical areas.

Though, it would remain said that cold acceptance of tilapia raised under diverse salinities was type of specific. For species *O. spilurus* raised in saltwater and can lived and rose healthy in falling temperature, although *O. aureus* presented lesser survival and development. Likewise, Allanson, Bok & VanWyk in their research in year 1971 had found that *O. mossambicus* accepted 5‰ at11° C, whereas fish that rose in freshwater see to not live at that temperature. Those writers recommended that the skill of *O. mossambicus* to stand low water temperature is related with the maintenance of high chloride concentration and plasma sodium. In contrast, Jennings in experiment on year 1991 stated that cold acceptance of *Sarotherodon melanotheron* did not change with water salinity ranging from 35 to 5‰. On the opposing, in Malta plus Kuwait was in the decline in water temperature through season times because it has remained specified that the main problem of culture in cage of this type of fish in saltwater.

CHAPTER 3

MATERIALS AND METHODS

3.1 Materials

Materials that has been used in this experiment are red tilapia, anti-chlorine, tap water, fish feed, magnesium carbonate, brackish water, saltwater. The apparatus and equipment that will be used is 9 units of tank or aquarium with the size 12cmx18cmx12cm, 3 aerators, 3 extensions wire and Multiparameter HANNA.

3.2 Methods

3.2.1 Preparation of aquarium or tanks

The aquariums have been washed and cleaned properly aquarium or tank prior for the experiment to prevent the water supply effect the result. The tank or aquarium will be first wash properly, rinse and filled with tap water and let for one night. Next, that the tank or aquarium has been washed with Clorox to kill bacterial and left for another one night. On day 3, the tank or aquariums will be rinse and it was prepared to fill with salt water and tap water. 2/3 of the tank or aquarium has been filled with tap water and saltwater then additional of anti-chlorine is put in it is functions to neutralize chlorine in the tap water. Aeration will be supplied to each aquarium or tank. Lastly, observed the salinity of both water supplies.

3.2.2 Experimental design

Samplings of tilapias were collected from Ayer Lanas, Jeli which is around 270 with weight around 4 gram. The transportation that has been used to transport the fish by car and the distance was about 8 to 7 km. After collect, tilapias were transferred and let in freshwater for 3 day to avoid the tilapia stress in aquarium or tank that prepared at Aqua laboratory University Malaysia Kelantan, Jeli Campus. The saltwater will take from Fisheries Research Institute (FRI) Besut Terengganu using water several water container. Feed will be given two times per day. Feed will be given followed by feed conversion ratio; F.C.R. = Feed given / Animal weight gain. Tank fibre will be used as a main place to prepare 3 different rate salinities of water which is less than 0 ppt, 15 ppt and 35 ppt. A total of 270 of tilapias were introduce to each tank or and the salinity, pH, temperature, volume of the water, and Dissolve Oxygen (D.O) has been observed and were maintained to optimum level. Every tank or aquarium will place 30 tilapias fish. The water will change for every 7 days or the pH or others fixed variable changed. Every tank or aquarium will be tag as A, B and C. the water cultured water is different with another A 0% salinities, B with 50% salinities and C with 100% of salinities and if any change of the salinity the seawater were added or remove to maintained the salinities level. The excess feed was siphon out using small tube to make the water is cleaned and avoid the ammonia level to increase. All the data were observed and recorded using the proper material and apparatus. The apparatus has been test for the zero error and been repaired.

3.2.3 Growth rates

Growth performance of the tilapia fish will be recorded and observed 5 times a week for duration of 40 days. The weight of tilapias was been weight using the digital

weight. Average that been taken for get the mean of the weight was about 3 fishes. The growth rate of tilapia has been calculated followed by (Osofero, 2007) and the given formula which the Wi was the Initial average of the weight at the starting of the experiments and Wf was the final average of the weight at the finish of the experiments

$$\mathrm{RGR}(\%) = (\mathrm{Wf} - \mathrm{Wi})\ \mathrm{x}\ 100 \div \mathrm{Wi}$$

3.2.4 Survivality

The survival was observed at the end of experiment and the mortality also been recordedto observed the survivality of the fish. The ways to define the survival rate (SR) of several treatments by the formula (Ogunji, Toor, Schulz, & Kloas, 2008)

$$\%SR = \text{(Initial number of fish stocked} - \text{mortality)/(Initial number of fish stocked)} \times 100$$

3.2.5 Flesh diameter

After complete the experiment, tilapias were observed the size of flesh and the diameter of flesh, to observe the thickness of the flesh using the ruler to compare the mean diameter flesh of fish.

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CHAPTER 4

RESULTS AND DISCUSSION

4.1.1 The Maintenance of Culture Water

In the result saltwater and fresh water the parameters of quality of water, pH, dissolved oxygen and temperature did not change. Therefore, it will not disturb the result. The pH values were maintain for 6-8 pH and had been checked every week, if there change of pH is too large of the water, the water was changed. Temperature were change due to condition of weather and time but the change is no high and to low but it was not exceed the range 28-32℃ (Likongwe, 2010). Revealed that growth rate in juvenile Nile tilapia, *Oreochromis niloticus* was greatly influenced by fluctuations in temperature and salinity. Therefore change will affect the growth and survival of the tilapia fish so the temperature was always monitor in all tank.

Dissolve oxygen was maintain with the presence of air ration. Lei (2002) stated that oxygen intake in *Oreochromis niloticus* and *O. mossambicus* varied significantly with differently levels of salinity. Low dissolved oxygen (DO) concentration in the water is known as a main reason of pressure, slow development, lowly appetite, death, and disease susceptibility in fisheries animals. It was commonly accepted that the smallest everyday dissolved oxygen concentration in pond water culture systems is one of greatest fear in the aquaculture animals. The dissolved oxygen stages will be high through greatest of a 24 hour of time, however during the night the response of culture types of fish seems to be affected mainly by the lowest dissolved oxygen concentration.

Though, criteria for warm water aquaculture species have not been created the accepted of minimum dissolved oxygen. When temperature exceeds 27°C the growth and survival in fish are not affected at different salinity levels but salinity has pronounced effect if the temperatures below 25°C in any salinity (Said & Division, 2019).

Table 4.1: Parameter of the culture water in the experimental aquarium tanks with the different treatment.

Parameter	Control	Treatment 1	Treatment 2	Optimum
Salinity (ppt)	0	15	32	0.2
Temperature (ºC)	28.19 ± 1.25	28.19 ± 1.25	28.19 ± 1.25	27.19 ± 1.25
pH	7.06 ± 0.73	7.16 ± 0.15	7.14 ± 0.13	7.154.75±0.53
Dissolved oxygen (mg L-1)	4.75 ± 0.73	4.75 ± 0.63	4.75 ± 0.53	4.75 ± 0.53

4.1.2 Growth rates of the tilapia

In controlling growth in tilapia that shows better performance in saline water the situation was believed that salinity is a key factor of it (Bœuf & Payan, 2001). In order to observe the growth rate of tilapia the increase of average weight of tilapia fish is recorded every week. In current learning, growth rate in terms of average weight gain (g) is recorded in every week. For control the salinity is 0.5 to 0 ppt and the initial weight of tilapia is about 5.2g while the treatment 1 is 15 ppt and treatment 3 is 35 ppt and both weights of fish were about 5.1g. After a week the weight of fish in control were increased to 8.4 g which is higher than treatment 1 that only recorded increase to 7.4 g. In treatment 3 was no record because all of the tilapia fishes die due to high salinity. In week 3 the result show that treatment 1 is highly increase of weight compare to the control. Figure1 shows that the highest increase of weight on both treatments

were on week 4 and the lowest growth on the week 2 and 3. The growth of hybrids between of the *O. mossambicus* and *O. niloticus* has very possible to combine with the saltwater tolerance of the latter therefore the greater growth potential of the former and thus does seem to represent in saline water in aquaculture a potential commercial application for hybridisation (Hena et al., 2005).

Its confirm that higher salinities are quite favourable for the growth of this species(Iqbal et al., 2012). Figure1 also shows that the highest increase in average weight gain in every week is treatment 1. McElwee et al. (2002) had stated quicker growth of tilapia in 10% salinity water declaring it a probable candidate for saline water aquaculture. Relative growth rate (RGR) of control is $323.53\%/30days$ and the RGR for treatment 1 is $376.47\%/30days$ and its show that treatment 1 has high GRG than control. Sparks in year 2003 stated that saltwater rearing of tilapia improved it growing. The weight of tilapia showed that significantly different between 0 ppt and 15 ppt p-value was 0.000374 and indicates it was significant as p-value low than 0.0500. According to Mena in research 2002 even though no significant dissimilarities were observed in freshwater versus 15% salinity, the growth rates among 35% and 25% freshwater versus salinities were pointedly dissimilar. Collinson and Payne in year 1983 also stated that the salinity range for well growth 5 to 10 ppt for species *O. niloticus* whereas performed best of at intermediate salinities that is 15 ppt and high salinities 32 ppt for species *O. mossambicus*.

Tilapia development are affected by space, feed, temperature, season, water salinity, and activity of physical (Louca, 2010). Meanwhile fish are living lastingly deep in water, they are cause by alterations in their environment factor (Weatherley & Gill, 2014) the alteration magnitude in term growth has been showed. The flexible undergoing change could be the measurement or other bodily dimensions, as well as,

weight, mass or volume either of an organism's whole-body or its several tissues or it may relate to other chemical constituent, protein content, or lipids of the physique. Growth can effected by the alteration in in feed on the amount of fish in population (Weatherley & Gill, 2014).

Amount of composition of the tilapia was good time consuming to measure but will be present a good indicator of the physiological condition of a fish. Some studies shows that immediate body arrangement is the analysis of water, fat, protein and ash contents of fish with Non-protein and carbohydrates compounds are surviving in slight amount and are usually discounted for routine analysis of the fish (Andrefouët, Newman, Hicks, & Beymer-farris, 2016). The ratio of water is good indicator of its relative contents of proteins, lipids and energy. The lesser the percentage of water, the larger the fats and protein substances and greater the energy of the density of the fish (Dempson, et al., 2004). In addition, those ideals differ significantly within and among sexual condition, type of fish, size, physical activity and feed season. Protein content, was significant component, be disposed to vary little in well fish (Hasan et al., 2017). At hand are riches of writings available on physique structure of several fish type (Id et al., 2019). Though, tiny was acknowledged round the development of fish originate in saline marine in Pakistan.

In southern Punjab, a place that lack of fresh water resource, so they culture in the saltwater (Davidson, 2000). Otcome from this study reported that this species grow healthier at brackish. A group of researcher from Pakistan was carried out a study about the effect of saline water with the physique of the fish and it show that the fish in saline water have more good physique compared to freshwater (Ali, Iqbal, Salam, Iram, & Athar, 2005).

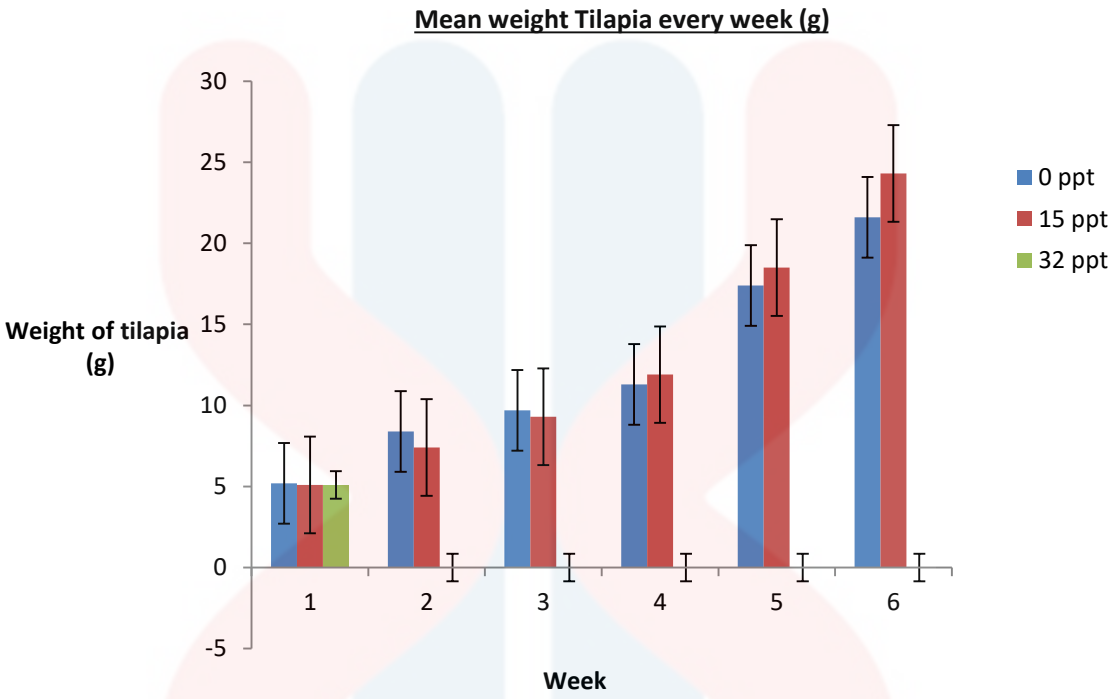

Figure 4.1: Mean weight Tilapia every week (g)

4.1.3 Survivality of the fish

Tilapia fishes survive and development will be cause by the water parameters (Article et al., 2019). In treatment 32 ppt shows that all the tilapia fish was dead because been introduced to high salinity of water by surprise. Pompa et al., (1999) stated that the Nile tilapia grows fine up to 15ppt salinity. Villegas (1990) found juvenile Nile tilapia could survive fine with the survivality is 87% at 15ppt and direct allocations of Nile tilapia to more than 15ppt resulted in 50% death at 20ppt and complete death at 32ppt. this were slightly same in the result of the study but the different is the species of fish, phase of fish and result in 15 ppt also show positive towards the survivality. The

fingerling tilapia is used in this experiment because in (Andrefouët et al., 2016) studies had reported that salinity tolerance limits of this species are very much related to its developmental phases and smaller fish is extra tolerant than larger one but this phenomenon was not experimental in progress studies though there was important and positive connection between salinity levels and growth of fish tested. In Figure2 shows that tilapia in treatment 0 ppt is high number of fish survive in week 1 compared to the control 5 ppt and 32 ppt. Therefore in week 5 shows that the numbers of fish survive in 15 ppt is more than 0 ppt. survival rate 0 ppt is 70% and the highest survival rate was 15 ppt about 75% while the lowest survival rate is 32 ppt is 0%. This shows that result in 15 ppt has higher survival rate compared to others.

The growth presentation was found lesser up to salinity 15ppt treatment from 0ppt control (Hena, Kamal, & Mair, 2005). This was deference from our result. The number of survive in different salinity is significantly different and the p-value was 1.12. In line for to the p value was greater than 0.05, thus indicates that the model was not significant due to relative noise. Due to shortage fish and budget was not tested in water having salinity greater than 32ppt so it is not clear at the moment whether this species will carry on to develop at a quicker pace in relation to added salinity levels. As the studies, (Kang & Brown, 2008) experimental that survival rate of fish significantly varied with dissimilar salinity stages. Beyond 10.5 percent of the salinity, there remained also proof of poor development with weak, and fish could barely survive more than 5 days (Garcia & Carrera-garcía, 2017). But in current experiment shows the highest survivality is in the 15 ppt treatment. Survivalities hang on on salinity as it increase by way of salinity but until 15 ppt in the studies, which was dissimilar near acclimation readings which plasma of osmotic with concentrations rise with salinities (Pavlosky, Yamaguchi, Lerner, & Andre, 2018). High survival come upon in the

research can be recognised to dissimilar masses of the fish use in dissimilar research, somewhere bigger fish might life well than tiny fish (Garcia & Carrera-garcía, 2017), besides certain fish improved their adaptation toward sodium chloride through increased ages (Aklakur, 2017).

Fish that survive in fresh water will dilute the full power sea water needs the effective useful osmoregulatory instrument. When it directly handover from another medium to a new, the mechanism for regulatory might not alter quickly to encounter the demands of the new medium. Consequently pre-acclimation and slow transfer from lesser to greater concentrations stayed thought to give enough time to inreasing the osmotic pressure carry out on fish thru the transmission to great levels of salinity. Great survival rates of the tilapia in full strength of saltwater documented in the regular acclimation research support such an alteration in osmoregulatory tools in this fish. Though it's not as much of 0. *Niloticus, 0. aureus/O. niloticus* hybrids and euryhaline need a fairly extended dated for the alterations than did to the another species. Past research on fish (Lin, Wang, Ngoh, Ji, & Orbán, 2017) shown that the lowest period needed to achieve a stability among the efflux and influx of ions and water across *osmoregulatory* organs was 40 hours after transmission. On, the tilapia *0. Spilurus, 0. mossambicus* and 0. *aureus* its stability remained achieved within 48 hours, that seems will be a sensible period to let acclimation to great salinity stages. Considering on going discoveries suggesting that tilapia presented to changing salinities during beginning times of larval improvement can be better react to consequent saltiness challenges (Moorman, Lerner, Grau, & Seale, 2015).

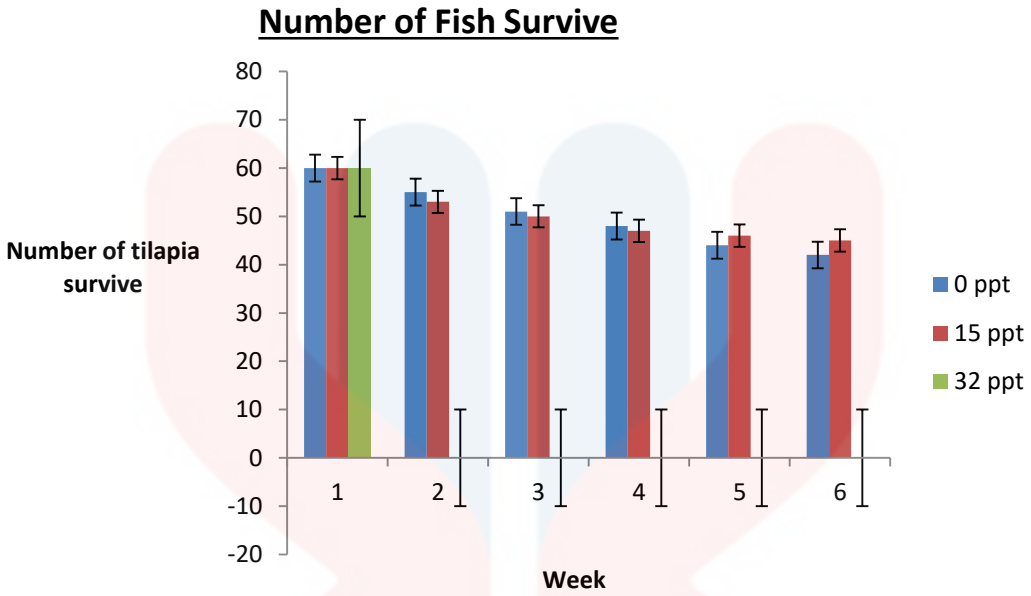

Figure 4.2: Survivality rate of tilapia in different salinities

4.1.4 Flesh Quality

Inter-specific comparisons have shown important correlations between average muscle fibre diameter and the 'firmness' of the flesh (Rodell & Hunt, 1996). In the result shows that average diameter of tilapia showed that significantly different between 0 ppt and 15 ppt and p-value was 0.00521 and indicates it was significant as p-value low than 0.0500. But the difference in the experiment shows that the size was effect in the salinity of water was not so much different. The thickness of the flesh is same and nothing different in both treatments. The flesh in 15 ppt is seems like slightly white compare to 0 ppt. Flesh size and diameter of the tilapia effected because it was cultured in the tank. The key reason aimed at this outcome is greater limitation also fewer space tilapia fish raised in net cages that can leads to fewer movement and low energy spending and effects in lipid addition (Rocha, Simões, Paiva, & Gomes, 2012). Though,

entire body content shown an alike pattern between dissimilar species as tilapia size rise (Lupatsch, Wm, & Sklan, 2001).

The pH value of the flesh fish of both treatment is neutral wish means it not so acid or alkaline. Outcome from the present study is in line with the study by (El- Sherif & El-Feky, 2019) which reported that pH 7.4 to 8 has significant effect with the development of Red tilapia (*Oreochromis sp.)* pH of culture water between 7 to 8 is optimum for tilapia culture for survival rate and best growth performance. In the bar chart in first week have shown that the initial diameter is the same. As presented in several readings, once the mass of fish rise, more fat was placed than the development of new tissues (Naeem & Salam, 2010). In week 2 shows that 0 ppt shows graph was not significant because it has higher graph compared to the 15 ppt. However, in week 3 the diameter of the tilapia in 15 ppt was increase more than 0 ppt. In week 4 both treatment in the same diameter and on the next week shows that tilapia in 15 ppt has increase the diameter more than 0 ppt. In the present study, 32 ppt treatment has no data because mortality factor. Many *euryhaline* fish grow well in seawater and all the seawater encouraged quicker growth of Tilapia fresh water (Kujawa, Lach, Pol, Ptaszkowski, & Mamcarz, 2016). Therefore this will increase the diameter size of flesh and the thickness of the flesh of fish. Feed given is similar in every tank in these studies, reported which the value of tilapia was affected by parameters such as type feed given, level of eating consumption and development (Gil, Palmer, Grau, Massutí, & Pastor, 2017).

The entire physique structure of tilapia is affected by species, nourishment, also body size (Ebrahimi & Ouraji, 2012). Data taking place physique composition linked to tilapia dimensions can be cast-off to choose tilapia with greater protein stuffing at a particular size, for social intake (Ali et al., 2005). This outcome is in settlement with

previous study via (Ali et al., 2005) the one that revealed that growth in fat contented with rise in the size of Nile tilapia. Be that as it may, little is thought about the development of fish found in salty water in Pakistan. In southern Punjab, there is a lack of fresh water with the issue of expanding saltiness (Davidson & Davidson, 2015). Thus, the way of life of new water fish is trying in these zones. This shows fish can survive in that high salinity and improve their quality of growth.

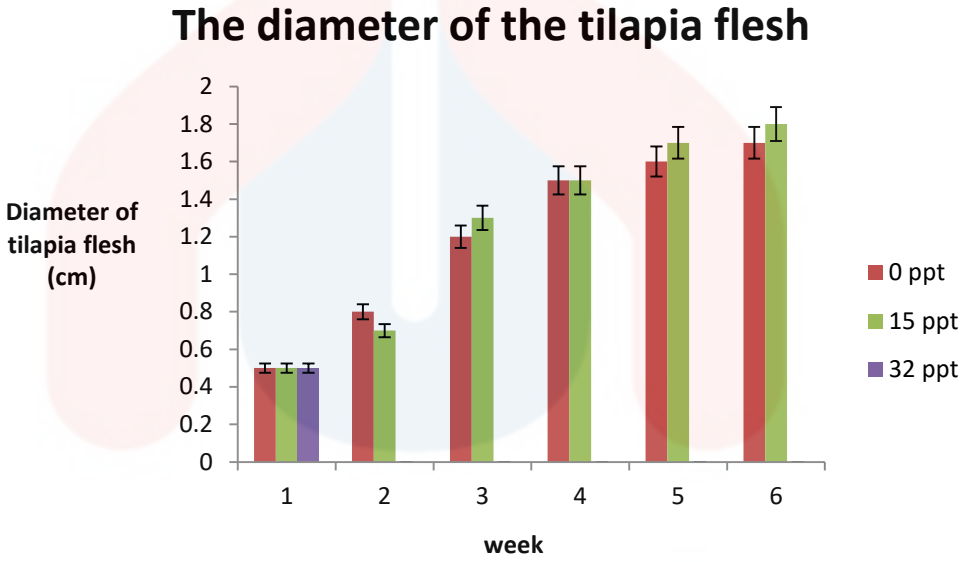

Figure 4.3: The diameter of the tilapia flesh

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

From the present study, it can be concluded that the red tilapia can survive up to 15 ppt. At this salinity, red tilapia showed fastest growth rate, higher survivality and better thickness of the meat.

5.2 Recommendation

As recommendation for improvement in future study, the duration of the study need to be increased up to 10 weeks to allow better monitoring of the growth of red tilapia and increase number of treatment using salinity at 0, 5, 10, 15, 20, 25, 32 ppt to provide more accurate result on the growth and survivality of the red tilapia. I also would like to suggestto add more analyses on the meat quality such as texture analysis.

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APPENDIX

Figure 5: Saltwater preparation

Figure 6: Tank preparation

Figure 7: Water preparation

Figure 8: Tilapia in the treatment

Figure 10: Adaptation period

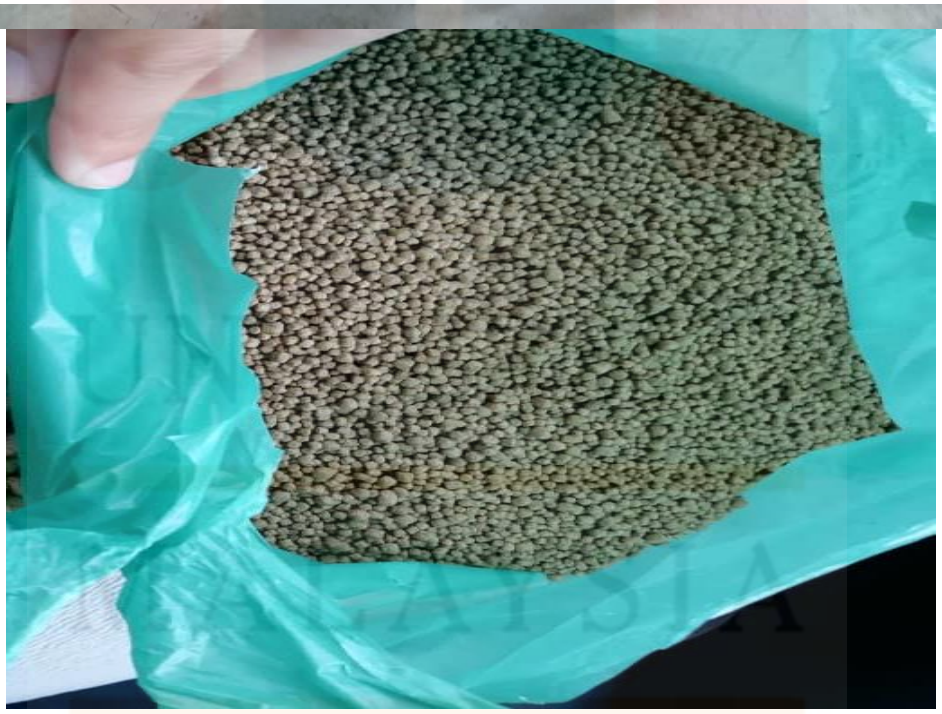

Figure 9: Feed of the Tilapia

Week/Treatment	0 ppt	15 ppt	32 ppt
0	60	60	60
1	55	53	0
2	51	50	0
3	48	47	0
4	44	46	0
5	42	45	0

Table 1: Number of tilapia survive

Week/Treatment	0 ppt	15 ppt	32 ppt
0	0	0	0
1	-5	-7	-60
2	-4	-3	0
3	-3	-3	0
4	-4	-1	0
5	-2	-1	0
Total dead	-18	-15	-60

Table 2: Number of tilapia death

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Week/Salinity	0 ppt	15 ppt	32 ppt
0	5.2	5.1	5.1
1	8.4	7.4	0
2	9.7	9.3	0
3	11.3	11.9	0
4	17.4	18.5	0
5	21.6	24.3	0

Table 3: Average total weight of tilapia

Week/Salinity	0 ppt	15 ppt	32 ppt
0	0	0	0
1	3.2	2.3	0
2	1.3	1.9	0
3	1.6	2.6	0
4	6.1	6.6	0
5	4.2	5.8	0

Table 4: Average increase weight of tilapia

week/Treatment	0 ppt	15 ppt	32 ppt
0	0.5	0.5	0.5
1	0.8	0.7	0
2	1.2	1.3	0

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3	1.5	1.5	0
4	1.6	1.7	0
5	1.7	1.8	0

Table 5: Diameter of tilapia in every week

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