



UNIVERSITI PUTRA MALAYSIA

**THE EFFECT OF FEEDING SOY WASTE ON GROWTH PERFORMANCE
AND CRUDE PROTEIN COMPOSITION IN RED HYBRID TILAPIA**

MUHAMMAD HAZIQ BIN MOHD JOHA

**Ip
FPV 2016 97**

**THE EFFECT OF FEEDING SOY WASTE ON GROWTH
PERFORMANCE AND CRUDE PROTEIN COMPOSITION IN RED
HYBRID TILAPIA**

MUHAMMAD HAZIQ BIN MOHD JOHA

**A project paper submitted to the
Faculty of Veterinary Medicine, Universiti Putra Malaysia
In partial fulfilment of the requirement for the
DEGREE OF DOCTOR OF VETERINARY MEDICINE
Universiti Putra Malaysia
Serdang, Selangor Darul Ehsan**

MARCH 2016

CERTIFICATION

It is hereby certified that I have read this project paper entitled “The Effect Of Feeding Soy Waste On Growth Performance And Crude Protein Composition In Red Hybrid Tilapia”, by Muhammad Haziq bin Mohd Joha and in my opinion it is satisfactory in term of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999- Final Year Project.

DR. HASLIZA BT ABU HASSIM

DVM, MSc. (UPM), PhD (Ghent, Belgium)

Senior Lecturer,

Department of Veterinary Preclinical Sciences,

Faculty of Veterinary Medicine

Universiti Putra Malaysia

(Supervisor)

ASSOC. PROF. DR. MD SABRI MOHD YUSOFF

DVM, MVSc., PhD (UPM)

Senior Lecturer,

Department of Veterinary Pathology and Microbiology,

Faculty of Veterinary Medicine

Universiti Putra Malaysia

(Co-Supervisor)

DR. MURNI MARLINA ABDUL KARIM

BSc, Msc (UPM), PhD (URI, USA)

Senior Lecturer,

Department of Aquaculture,

Faculty of Agriculture

Universiti Putra Malaysia

(Co-Supervisor)

DEDICATIONS

This project paper is dedicated to Allah S.W.T., who had created me and made all things possible throughout this project,

To my family,

My father, Mohd Joha bin Che Lop

My mother, Juriyah binti Ismail

My siblings; Nur Sakinah, Muhammad Hazwan, Muhammad Afiq,
Muhammad Akmal, Nur Athirah, Izzul Muqri

My friends

And to all my teachers who have committed themselves towards the noble cause of education. Thank you for your continuous support and care.

May this will be your inspiration and motivation for your future endeavours

ACKNOWLEDGEMENTS

First and foremost, I would like to thank Allah S.W.T for giving me chance to breath and strength physically and mentally throughout my life and to be aware of the desire for knowledge as well as to improve myself and to contribute this knowledge with objective as a purpose to contribute the country in economic and intellectual field to become more successful in the future.

I would like to express my biggest gratitude to by beloved supervisor Dr. Hasliza Abu Hassim and co-supervisors Assoc. Prof. Dr Md Sabri Mohd Yusoff and Dr. Murni Marlina Abdul Karim for their invaluable knowledge sharing, time, support and guidance throughout this research. Their motivation and knowledge had contributed to the completion of this research project.

I also would like to thank En. Hafiz, laboratory assistant of Nutrition Unit in Faculty of Veterinary Medicine, UPM and also Master students; Dr.Afifi, Dr.Syafiq, Dr. Ajadi, Dr Abdul Salam, Dr Tanko, Azri and Didi for their guidance, suggestion and support.

Last but not least, my most heartfelt gratitude to my family; my parents and siblings and friends for their love and support throughout my studies. Not to forget my supporting hands, Ainul Riza, Hafizatul Aiezzah, Saiful Azri, Aqmalhakim, Afina, and 'Aisyah.

CONTENTS

	Page No.
TITLE	i
CERTIFICATION	ii
DEDICATIONS	v
ACKNOWLEDGEMENTS	vi
CONTENTS	vii
LIST OF TABLES	x
LIST OF CHARTS	xi
LIST OF ABBREVIATIONS	xi
ABSTRAK	xii
ABSTRACT	xiv
1.0 INTRODUCTION	
1.1 Study background	1
1.2 Objective	1
1.3 Justification	2
1.4 Hypothesis	2

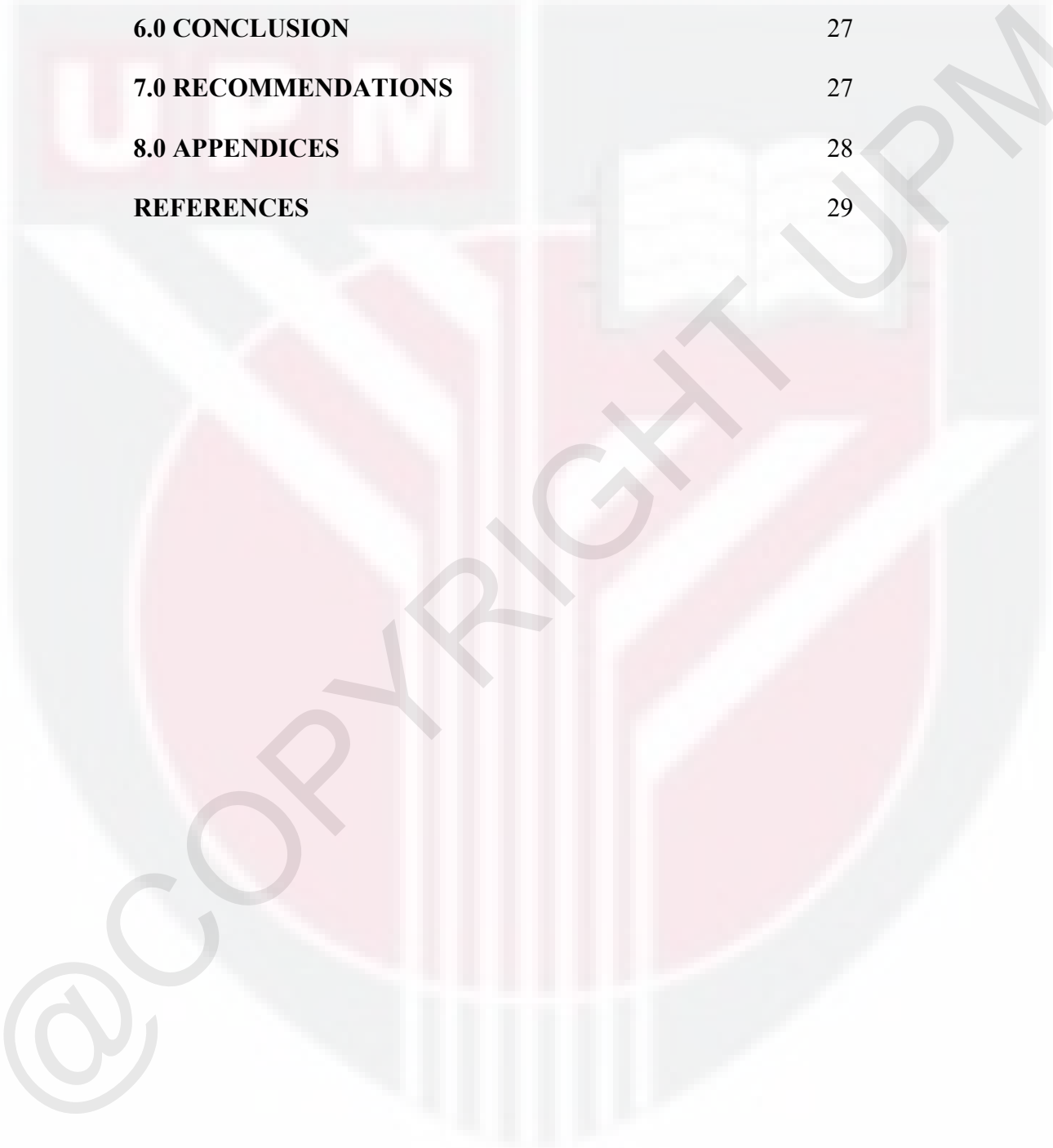
2.0 LITERATURE REVIEW

2.1 Aquaculture Industry In Malaysia	2
2.2 Tilapia	3
2.3 Red Hybrid Tilapia	4
2.4 Soy Waste	8

3.0 MATERIALS AND METHODS

3.1 Experimental Design	9
3.2 Experimental Diets	10
3.3 Feed Analysis	10
3.3.1 Sample Collection	10
3.3.2 Sample Preparation	11
3.3.3 Proximate Analysis	11
3.3.3.1 Dry matter and moisture content	12
3.3.3.2 Ash content	13
3.3.3.3 Crude protein	13
3.3.3.4 Crude fiber	16
3.3.3.5 Ether extract	17
3.4 Growth Measurement	18
3.5 Experimental Red Hybrid Tilapia Crude Protein Composition	18
3.6 Statistical Analysis	19

4.0 RESULTS	20
5.0 DISCUSSION	26
6.0 CONCLUSION	27
7.0 RECOMMENDATIONS	27
8.0 APPENDICES	28
REFERENCES	29



LIST OF TABLES

	Page no.
Table 1 : Tilapia Classification	28
Table 2 : Red Hybrid Tilapia Classification	4
Table 3 : Elements composition in Red Hybrid Tilapia meat according to different type of feed.	7
Table 4 : Composition of feed formulation .	10
Table 5 : Proximate Analysis results of all feed formulation.	20

LIST OF FIGURES

Figure 1 : Body weight	21
Figure 2 : Body length	22
Figure 3 : Body girth	24
Figure 4 : Crude protein composition of fish.	25

LIST OF ABBREVIATIONS

% : Percent

O.Mossambicus : *Oreochromis mossambicus*

O.Nilotocus : *Oreochromis niloticus*

°C : Degree Celcius

DM : Dry matter

g : Gram

cm : Centimeter

ANOVA : Analysis of Variance

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999- Projek Ilmiah Tahun Akhir

KESAN SISA SOYA PADA KADAR PERTUMBUHAN DAN KOMPOSISI PROTIN MENTAH DALAM IKAN TILAPIA MERAH

Oleh

Muhammad Haziq Bin Mohd Joha

2016

Penyelia: Dr. Hasliza Bt Abu Hassim

Penyelia Bersama:

Prof. Madya Dr. Mohd Sabri Bin Mohd Yusoff

Dr. Murni Marlina Bt Abdul Karim

Salah satu kepentingan utama dalam penternakan ikan tilapia di dunia adalah untuk mengurangkan kos pengeluaran terutamanya pada kos makanan dan meningkatkan kadar pengeluaran dalam masa yang singkat. Hampas soya adalah salah satu bahan buangan sedia ada yang mempunyai kandungan

protin yang tinggi dan berpotensi untuk dijadikan sebagai salah satu bahan dalam makanan haiwan. Oleh itu, kajian ini bertujuan untuk mengenalpasti kesan hampas soya sebagai makanan pada prestasi pertumbuhan dan kandungan protin mentah dalam ikan Tilapia Merah Hibrid. Empat puluh lima ikan Tilapia Merah Hibrid telah dibahagikan kepada tiga kumpulan (Kumpulan 1: 40% hampas soya + 60% diet komersial; Kumpulan 2: 20% hampas soya + 80% diet komersial dan Kumpulan 3: kawalan, tiada kandungan hampas soya, 100% diet komersial). Analisis proksima terhadap diet formulasi telah dilakukan dan ia menunjukkan bahawa kandungan protin adalah tinggi dengan campuran hampas soya ke dalam diet. Keputusan menunjukkan bahawa dengan campuran hampas soya ke dalam diet komersial adalah signifikan dalam kumpulan yang mempunyai peratusan kandungan hampas soya paling tinggi berbanding kumpulan kawalan dari segi berat badan, panjang badan, ukur lilit badan dan komposisi protin. Sememangnya, kumpulan 1 yang mempunyai 40% komposisi hampas soya mengandungi kandungan protin dan lemak yang tinggi berbanding kumpulan yang lain. Hasil dari kajian ini, ikan dari kumpulan 1 adalah lebih cenderung untuk mempunyai prestasi pertumbuhan dan komposisi protein yang lebih baik.

Kata kunci: Tilapia Merah Hibrid, hampas soya, kadar pertumbuhan, komposisi protin

ABSTRACT

Abstract of the project paper presented to the Faculty of Veterinary
Medicine in partial requirement for the course VPD 4999 – Project.

THE EFFECT OF SOY WASTE ON GROWTH PERFORMANCE AND CRUDE PROTEIN COMPOSITION IN RED TILAPIA

By

Muhammad Haziq bin Mohd Joha

2016

Supervisor: Dr Hasliza bt Abu Hassim

Co-Supervisors:

Prof. Dr. Mohd Sabri bin Mohd Yusoff

Dr. Murni Marlina bt Abdul Karim

One of the commonest interests in tilapia farming worldwide is to diminish production cost particularly on the feeding cost and extends outputs in the shortest time. Soy waste is one of the locally available waste products which have high protein content and has potential to be used as one of the feedstuffs in animal feed. Hence, this study was aimed to determine the effect of feeding soy waste on growth performance and crude protein composition in Red

Hybrid Tilapia. Forty-five juvenile Red Hybrid Tilapia was divided into 3 groups (Group 1: 40% soy waste + 60% commercial diets; Group 2: 20% soy waste + 80% commercial diets; and Group 3: control, no inclusion of soy waste). Proximate analysis on formulated diet was done and it shows that protein content higher as the inclusion of soy waste increasing in the diet. Result shows that the inclusion of soy waste into commercial diet is significant in group with highest soy waste percentage as compared to control group in relation to its body weight, length, girth and the fish protein composition. Indeed, Group 1, which has 40% inclusion of soy waste contain high protein and fat as compared to other groups. Thus, the fish from group 1 is more likely to have better growth performance and protein composition.

Keywords: *Red Hybrid Tilapia, soy waste, growth performance, protein composition.*

1.0 INTRODUCTION

1.1 Study background

The demand for the cheap and affordable animal protein has been rising day by day due to consistent growth of human population. Aquaculture which is a major food industry with more than 45.5 million tons/year of fish production globally, is bracing itself up to face the challenges on this front (FAO, 2006). Aquaculture products are also cost effective, affordable and a good protein source. With an average annual growth rate of 8.9% over the past few decades that has been surpassing both terrestrial livestock meat production and capture fisheries. This indeed has become the fastest-growing industry in the food sector (Dey *et al.*, 2006). The aquaculture practices have also been significantly contributing substantially for the local food security and livelihood to fishermen and rural community (Faizah Shaharom *et al.*, 2011).

1.2 Justification

1. Lack of studies of the effect of using soy waste on growth performance and crude protein composition in Red Hybrid Tilapia.
2. To access the potential of soy waste to be included in total mixed ration of Red Hybrid Tilapia.

1.3 Objectives

1. To determine the nutrient content of soybean waste and commercial feed of Red Hybrid Tilapia.
2. To access the effects of feeding soy waste on growth performance and crude protein composition in Red Hybrid Tilapia.

1.4 Hypothesis

Ho: The intervention of soy waste into total mixed ration will not affect the growth performance and crude protein composition in Red Hybrid Tilapia.

Ha: The intervention of soy waste into total mixed ration will affect the growth performance and crude protein composition in Red Hybrid Tilapia.

2.0 LITERATURE REVIEW

2.1 Aquaculture industry in Malaysia

Initially in the early centuries, the fish farming techniques were limited to freshwater fishes but by the 20th century, new techniques were developed to breed saltwater species. The new successful methods for the aquaculture industry had really started blooming towards the end of 20th century and early 21st century (Dey *et al.*, 2006). Fish farmer then slowly started adopting improved techniques to gain more control over the fish health and culture as the scientists learned more about the life cycles of harvestable

fish and different factor that encourage development of the fish. Further interventions by the scientists and farmers in fish breeding lead to adoption of the factors that were ideal for commercial farms. The most important factors were stimuli that encouraged growth, sexual maturation, reproduction, disease control and immunology. The main focus was given to the expensive species of fishes, such as salmons and shrimps, even during that period. However this trend had changed in the modern era as new technologies have allowed cultivation of the non-luxury (affordable) food fishes in an efficient and cost-effective way (Faizah Shaharom *et al.*, 2011).

In Malaysia, there are several common aquaculture farming practice includes Tilapias farming, Catfish group farming and carps farming. Freshwater cultures involving these groups and other species is carried out in freshwater ponds, cages, cement tanks and ex-mining pools. Brakish water culture of various fish species is also practiced.

2.2 Tilapia

Tilapia is actually a generic term used to represent a group of commercially-important food fish belonging to the family Cichlidae (Chapman, 2000; Sofy *et al.*, 2008). The Cichlidae family consist of almost 1524 species of fishes (Eli, 2005; Altun *et al.*, 2006). The word “tilapia” is derived from the African’s native Bechuana word “thiape” meaning fish (Chapman, 2000).

Taxonomic classification of tilapia has always been debatable and confusing (El-Sayed, 2006). The classification of the Tilapiines to differentiate between species at the generic or subgeneric level has basically depended on their differences in breeding and brooding behaviour (Sofy *et al.*, 2008). The scientific names of tilapia have been revised several times in the last 30 years (Popma and Masser, 1999; Nandlal and Pickering, 2004). Taxonomic classification of tilapia is shown in Table 1.

2.3 Red Hybrid Tilapia



Table 2: Red Hybrid Tilapia Classification

Phylum	Chordata (Notochord group of animals)
Subphylum	Vertebrate (Animals with a backbone)
Class	Osteichthyes (Bony fishes)
Order	Perciformes (Perch-like fishes)
Family	Cichlidae (Cichlid fishes)
Genus	<i>Oreochromis</i>
Species	Red Hybrid (<i>O.Niloticus</i> x <i>O.Mossambicus</i>)

The growing popularity of red hybrid tilapia among consumers and the ever increasing need to improve food production, impose the need to seek production alternatives to culture red hybrid tilapia, such the use of saline

environments and even marine waters, the popularity is due to its market acceptability and for relatively tolerance to a wide range of water temperature, dissolved oxygen, salinity, pH, light intensity and photoperiods. However, the determination of stocking density for cultured tilapia is essential for the maximization of its production, profitability and sustainability (José L. Balcázar *et al.*, 2000).

Nutrition is the most important aspect to be considered in feeding practices of culture species including red hybrid tilapia. Protein is the major nutritional needs of the fish which is required at varying levels from fingerling stage to adults. Feed for fingerlings has been recommended to contain 35-45% protein, whereas for juveniles, it is between 30-40% (Siddiqui *et al.*, 1988; El-Sayed and Teshima, 1992). However, adult tilapia requires 20-30% protein for optimum biological performances. On the other hand, tilapia brood stock requires 35-45% dietary protein for optimum reproduction, spawning efficiency, larval growth and survival (Gunasekera *et al.*, 1996 a, b; Siddiqui *et al.*, 1998; El-Sayed *et al.*, 2003). For lipid, tilapias are known to utilise dietary lipids very efficiently. Generally tilapia require about 10-15% dietary lipids for maximum growth performance. Carbohydrates, the cheapest source of dietary energy, are known to be utilised more efficiently by tilapias and form 35-40% of the diet (El-Sayed *et al.*, 2003). For tilapia's artificial feed, the major dietary carbohydrate source comes from wheat bran, maize and rice bran.

Red Hybrid tilapia feed mainly on phytoplankton, periphyton and detritus. Red hybrid tilapia can efficiently ingest the food by active filter feeding (Harbott, 1982). For intensive tilapia farming, commercialized pelleted feed is given as artificial feed that have been formulated according to its nutrient requirement.

Feeding rates are directly affected by the temperature of water. Fishes of all age group eat less or stop taking feed as the temperature of water increases or decreases beyond the optimal range which lies between 25-30° Celsius. A feeding frequency requirement of 5-8 times per day, 2-4 times per day, 2-4 times per day and 2-4 times per day is required for fry, fingerling, juvenile and adult respectively.

Floating type of feed is preferred tilapia as it allows observing feeding response of the fish. Moreover, the soluble nutrients in the feed once it is put into the water, start leeching out from the feed which can also affect the water quality. Hence, it is important to optimise the quantity of feed as well as feeding frequency to promote efficient and rapid consumption of the feed by the fish.

The estimated time to raise tilapia from egg to marketable size is highly variable but usually ranges between 6 to 12 months. The time required for better growth is primarily dependent on several factors like water temperature (25-30°C), supplemental feeding of high protein level and stocking density (140-248 fish per cubic meter) (Chapman, 2006).

In 2009, (A. Che Rohani *et al.*) Red tilapia proximate analysis of the fish fillet has been done to the fish that fed with commercial feed, feed formulated by Department of Fisheries, feed formulated by Department of Fisheries with added vitamin E, and traditional feed by farmers consisting of chicken processing waste and commercial feed. The results are shown as in the table 3 below:

Table 3: Elements composition in Red Hybrid Tilapia meat according to different type of feed.

Type of feed	Elements	Composition
Commercial feed	Protein	15.8 - 17.2%
	Fat	1.8 - 4.4%
	Moisture	77.7 - 80.5%
Type of feed	Elements	Composition
Feed formulated by Department of Fisheries	Protein	15.7 - 18.1%
	Fat	0.7 - 1.1%
	Moisture	79.3 - 81.7%
Type of feed	Elements	Composition
	Protein	15.7 - 17.1%
	Fat	0.4 - 1.2%

Feed formulated by Department of Fisheries with added vitamin E	Moisture	80.4 - 82.2%
Type of feed	Elements	Composition
Traditional feed by farmers consisting of chicken processing waste and commercial feed	Protein	15.1 - 17.3%
	Fat	2.9 - 5.7%
	Moisture	75.7 - 79.9%

2.4 Soy waste



Soy waste, which is famously called 'okara' or soybean residue is the residue obtained from ground soybean after removing the water extractable fraction used to produce tofu or soymilk.

Soy waste is one of the locally available feed ingredients waste products which have high protein content. Soy waste is mostly dump and burn in normal practice due to lack of proper usage. It is also used as feed for ruminants due to its high in nutritional value and excellent functional

properties (Rahman et al.,2014). It is well documented that soy waste contains 27% protein with a superior protein efficiency ratio which shows a potential source of low cost protein for animal consumption. Indeed, high protein diet may give high protein deposition in fish meat. However there are limited data on soy waste utilization in aquaculture and its feeding impact on fish species (e.g: Red Hybrid Tilapia) particularly on growth performance and crude protein composition.

3.0 MATERIALS AND METHOD

3.1 Experimental Design

Several transportation plastic bags containing juvenile Red Hybrid Tilapia were took from Jabatan Perikanan Bukit Tinggi and brought back to Faculty of Veterinary Medicine, UPM. After that, forty five juvenile Red Hybrid Tilapia were selected and divided into three different groups (n=15) according to their different experimental formulation of feeds. The groups then were labelled as Feed 1, Feed 2, and Feed 3 (control group). The feed ingredients and composition of the experimental diets was illustrated in Table 4. The feeding trial lasted for 21 days where initial growth measurement was taken at the beginning of the study and ongoing growth is measured at 7th, 14th, and 21st day of study. Each group is given same size of aquarium and same source and volume of water. The water was changed once daily and the

aquarium was cleaned once weekly. At the end of 21st day, all the fish were sacrificed for determining its crude protein composition.

3.2 Experimental Diets

Table 4 shows different composition of feed formulation in the experimental diets and all diets were analysed for its nutrient composition. Group 1 was fed with Feed 1 consisting 40% soy waste and 60% commercial diets; Group 2 was fed with Feed 2 consisting 20% soy waste and 80% commercial diets; and Group 3 was a control group which were given 100% commercial tilapia feed and no inclusion of soy waste.

Table 4: Composition of feed formulation.

	Soy waste	Commercial Diet
Group 1	40%	60%
Group 2	20%	80%
Group 3	0%	100%

3.3 Feed Analysis

3.3.1 Sample Collection

Commercial pellet were bought from nearby fish feed store and soy waste were collected from Tok Seri Buak Agro Farm, Negeri Sembilan.

3.3.2 Sample Preparation

Both soy waste and commercial pellet samples were dried in the oven at 65°C for two days. After that, samples were grinded and kept in labelled air-tight plastic containers before being used for total mix ration diet. These steps were applied to both soy waste and commercial pellet. Fifty gram sample was prepared for each experimental diet according to the composition needed. Each ingredient was weighed using analytical balance and reading was recorded. The experimental diet was then kept in labelled air-tight plastic container before proceeding for proximate analysis.

3.3.3 Proximate Analysis

Proximate analysis is the most common analysis performed on feed samples where it consists of a series of analyses to estimate the nutrient compositions of feeds which includes the following: dry matter, crude protein, ether extract, crude fiber and ash. All analyses were carried out according to certification procedures outlined by the Manual of Laboratory Techniques, Universiti Putra Malaysia. Each experimental diet was analyzed for 3 replicates making up to a total of 6.

3.3.3.1 Dry matter (DM) and moisture content

Labelled porcelain crucibles were dried in an oven for 30 minutes at 105°C. Then, the crucibles were cooled in dessicator for 20 minutes and the empty labelled crucibles were weighed. 3g of each experimental diets were weighed and placed inside respective crucible according to their label. The sample were dried in the oven at 105°C for 24 hours for drying process. After drying, the crucibles containing the samples were cooled down in dessicator for 20 minutes and weighed. The dry matter and moisture content were calculated by using formula below:

$$\text{Moisture (\%)} = \frac{\text{Sample weight before drying} - \text{Sample weight after drying}}{\text{Sample weight before drying}}$$

$$\text{DM (\%)} = 100 - \text{Moisture content (\%)}$$

3.3.3.2 Ash

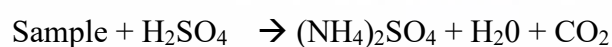
Samples from DM (%) were placed inside a muffle furnace at 550°C for 4 hours. After 4 hours, the crucibles containing ash were cooled down in desiccator for 30 minutes and later were weighed for ash determination by using formula below:

$$\text{Ash (\%)} = \frac{\text{Weight of crucible after ashing} - \text{Weight of empty crucibles}}{\text{Weight of sample}}$$

3.3.3.3 Crude Protein

Crude protein of feed samples was determined by using Kjeldahl Method which comprises of three steps; digestion, distillation and titration. In digestion step, 1g of sample was weighed and placed into Kjeldahl flask together with Kjeldahl catalyzer tablet (3.5g K₂SO₄ + 0.4g CuSO₄ x 5H₂O). 20ml of sulphuric acid (98%) was poured into 250 ml Kjeldahl flask and shake gently. Kjeldahl flask containing sample were then fix into Kjeldahl digestion set (Gerhardt Malaysia). The temperature of the heating block was gradually increased to maximum and the digestion was continued until the solution become clear (bluish/greenish) in color.

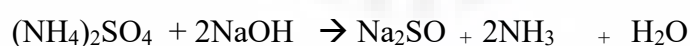
The chemical reaction occurring during digestion process can be summarized as follow:



Whilst the samples are being digested, acid standardization was done to determine the acid normality of a previously prepared 0.1M hydrochloric acid (HCl).

After digestion process completed, the flasks were allowed to cooled down before proceed to distillation process by using Kjeldahl distillation set (Vapodest 20[®], Gerhardt Malaysia). A solution made of 75ml of 2% Boric acid and 8 drops indicator (Methyl red & Bromohexdiol green) was earlier prepared in labelled Erlenmeyer flask was placed at the distillation platform. 15ml of distilled water was poured slowly into digester and then transferred into distillation tube. Another 15ml of distilled water used to rinse the Kjeldahl flask to clear any remaining of digester. The distillation then fixed to the distillation tube. During this process, 50ml of distilled water and 32% of NaOH were added as it was set up by the distillation set.

This process took about 3 minutes where the entrapped sulphate salt of ammonium were released thus producing ammonia, which is collected by the Boric acid (2%) at the distillation set via following reaction:





The mixture in the Erlenmeyer flask was then titrated with 0.1M hydrochloric acid to determine the nitrogen content by using formula below:

$$\text{Nitrogen (\%)} = \frac{(\text{Vol. of titrant} - \text{Blank Value}) \times \text{Acid Normality} \times 14.0067 \times 100}{\text{Weight of sample}}$$

$$\text{Crude Protein (\%)} = \% \text{ Nitrogen} \times \text{Protein factor}$$

$$\text{Where; Blank Value} = 0.2 \text{ ml}$$

$$\text{Acid Normality} = 0.0955$$

$$\text{Protein Factor} = 6.25$$

3.3.3.4 Crude Fiber

The crude fiber content of samples were determined by using Gerhardt Fiberbag System. The fiberbags were labelled and dried in the oven at 105°C for 1 hour to remove moisture and further allowed to cool down in the dessicator for 20 minutes. Each fiberbags were weighed and inserted with a

fiber glass before 3g of sample was added into each labelled fiberbags. A beaker containing 360mL of 0.13mol/L sulphuric acid that was earlier prepared then heated on the heating plate. The fiberbags were then loaded on the carousel and inserted into the beaker for 30 minutes for boiling process. After that, the fiberbags were rinsed with boiling distilled water while another beaker containing 360mL of 0.32mol/L NaOH and placed on the heating plate. The rinsed fiberbags were inserted into the boiling NaOH for 30 minutes before being rinsed with running water to settle down samples to the bottom of the fiberbags. Then, the fiberbags were dried by using paper towel and left overnight in oven at 105°C. After drying process, the dried labelled fiberbags were cooled down in dessicator for about 30 minutes before being put inside a previously weighed porcelain crucible and kept in muffle furnace at 600°C for 4 hours to produce ash. After 4 hours, the crucibles left to cool down inside a dessicator before being weighed.

The amount of crude fiber was calculated via the following formula:

$$\text{Crude fiber (\%)} = \frac{\text{Wa (g)} - \text{Wb (g)} \times 100}{\text{Sample of weight (g)}}$$

Where ; Wa = Weight of crucible and sample after drying

Wb = Weight of empty crucible and sample after ashing

3.3.3.5 Ether extract

Empty labelled round bottom flask were dried in the oven at 105°C for 1 hour. After that, the empty round bottom flask were weigh before being poured with 250mL of petroleum benzene. 3g of sample was weighed and recorded before being transferred into extraction thimble and covered with cotton wool. The thimble and flask containing petroleum benzene were then fixed into Soxhlet apparatus. Water flow was allowed so that condensation process would be occur. The temperature of heating plate was increased gradually and boiling was allowed for 4 hours. After boiling completed, the flask was detached and dried in the oven at 80°C overnight.

After drying, the flask were allowed to be cooled inside dessicator before weigh. Crude fat determination was carried as follow:

Crude Fat (%) =

$$\frac{\text{Dried flask after evaporation weight} - \text{Empty flask weight}}{\text{Weight of sample}} \times 100$$

3.4 Growth Measurement

Fish growth can be measured by determining its body weight, total length and girth (Florida Fish and Wildlife Conservation Commission, 2015). In this study, body weight was measured by weighing the fish on the electronic balance. Total length was measured by determining the fish length from tip of the mouth until the end of the tail by using ruler. Lastly the fish body girth was measured by determining the fish body diameter by using course thread and the thread that measuring the fish body diameter is marked and measure the thread using ruler.

3.5 Experimental Red Hybrid Tilapia Crude Protein Composition.

At the end of the 21st day, all fish from different groups were sacrificed and the flesh was harvested for determination of crude protein composition. All fish flesh were collected and separated according to their groups. After that the flesh sample was dried in oven in 60°C for 2 days. Later, the sample was grinded and duplicate test was done to all three groups for determination of crude protein composition.

3.6 Statistical analysis

The statistical analysis were performed using SPSS version 20. For normally distributed data, one-way analysis of variance (ANOVA) was done

and for not normally distributed data, Kruskal-Wallis ANOVA test and Mann-Whitney test was done.

4.0 RESULTS

4.1 Proximate Analysis

Table 5: Proximate Analysis results of all feed formulation

Mean of percentage (%)	*Feed 1	**Feed 2	***Feed 3
Dry Matter	94.3	93.4	92.49
Ash	7.05	9.26	10.09

Crude Fiber	8.64	6.34	3.68
Crude Fat	6.11	5.05	3.99
Crude Protein	18.17	17.82	17.46

*Feed 1: 40% Soy waste + 60% Commercial diets

**Feed 2: 20% Soy waste + 80% Commercial diets

***Feed 3: 100% Commercial diets

The results for proximate analysis were tabulated in Table 5. Result obtained revealed that Dry Matter for Feed 1 was the highest followed by Feed 2 and Feed 3. For the ash, Feed 3 showed the highest percentage and followed by Feed 2 and Feed 1. Crude fiber, Crude Fat, and Crude Protein for Feed 1 showed the highest value and followed by Feed 2 and Feed 3.

4.2 Body Weight Result

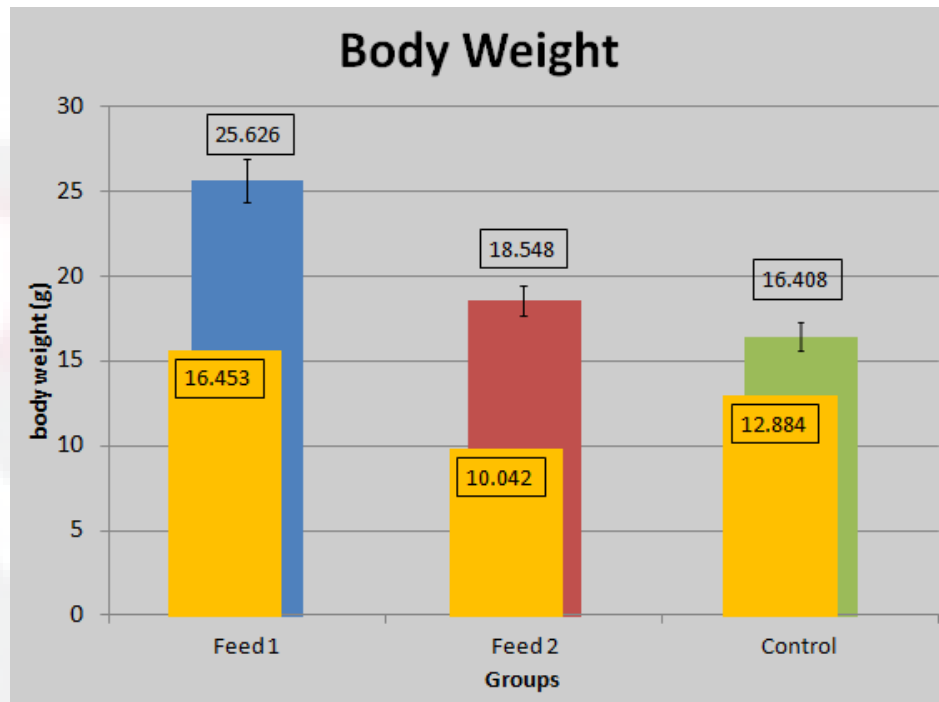


Figure 1: Body weight.

In the duration of three weeks, the body weight was measured and the means of the data was used to determine the body weight gain. For Group 1 which acquired Feed 1, the mean of final body weight was 25.62g as compared to the initial body weight which was 16.45g record the difference of 9.17g. For Group 2 which acquired Feed 2, the mean of final body weight was 18.54g as compared to the initial body weight which was 10.04g record the difference of 8.51g. For Group 3 which acquired Feed 3, the mean of final body weight was 16.41g as compared to the initial body weight which was 12.88g record the difference of 3.52g. Based on the results, it shows that Group 1 have the highest mean on body weight gain in three weeks time of

study followed by Group 2 and Group 3. In addition, both experimental group 1 and 2 shows significant value as compared to control group.

4.3 Body Length Result

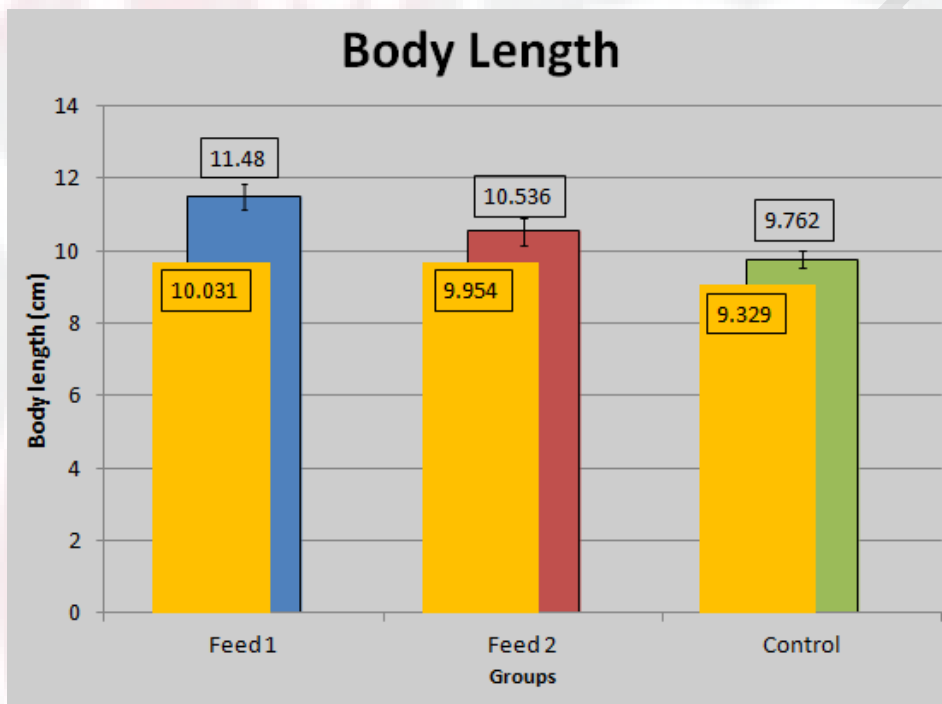


Figure 2: Body length

In the duration of three weeks, the body length was measured and the means of the data was used to determine the body length gain. For Group 1 which acquired Feed 1, the mean of final body length was 11.48cm as compared to the initial body length which was 10.03cm record the difference of 1.45cm. For Group 2 which acquired Feed 2, the mean of final body length was 10.54cm as compared to the initial body length which was 9.95cm record

the difference of 0.58cm. For Group 3 which acquired Feed 3, the mean of final body length was 9.76cm as compared to the initial body length which was 9.33cm record the difference of 0.43cm. Based on the results, it shows that Group 1 have the highest mean on body length gain in three weeks time of study followed by Group 2 and Group 3. In addition, both experimental group 1 and 2 shows significant value as compared to control group.

4.4 Body Girth Result

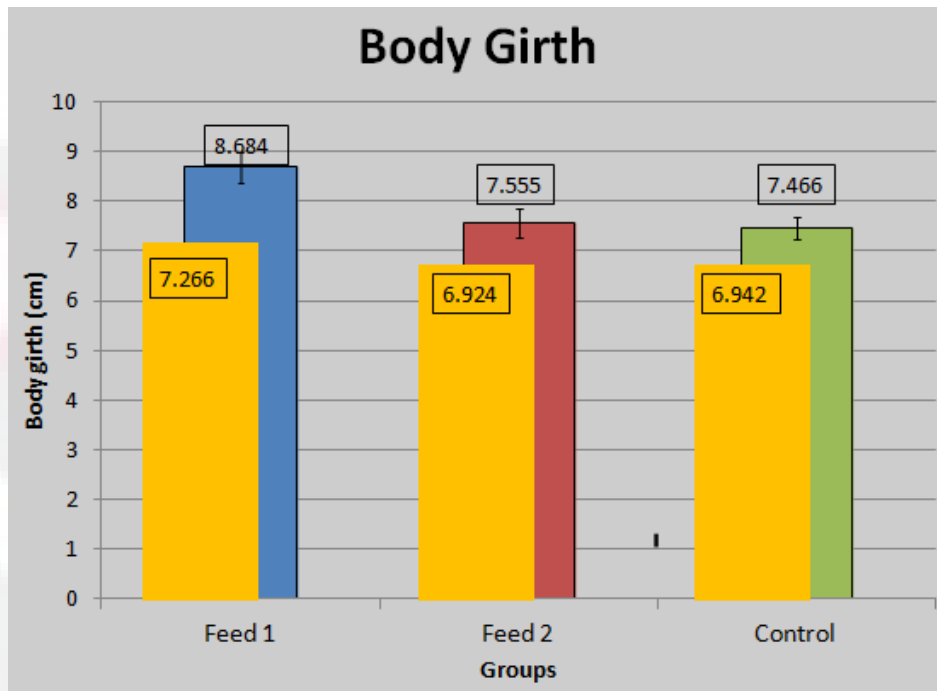


Figure 3: Body girth

In the duration of three weeks, the body girth was measured and the means of the data was used to determine the body girth gain. For Group 1 which acquired Feed 1, the mean of final body girth was 8.65cm as compared to the initial body girth which was 7.27cm record the difference of 1.42cm. For Group 2 which acquired Feed 2, the mean of final body girth was 7.56cm as compared to the initial body girth which was 6.92cm record the difference of 0.63cm. For Group 3 which acquired Feed 3, the mean of final body girth was 7.47cm as compared to the initial body girth which was 6.94cm record the difference of 0.52cm. Based on the results, it shows that Group 1 have the highest mean on body girth gain in three weeks time of study followed by

Group 2 and Group 3. In addition, both experimental group 1 and 2 shows significant value as compared to control group.

4.5 Experimental Red Hybrid Tilapia Crude Protein Composition Result

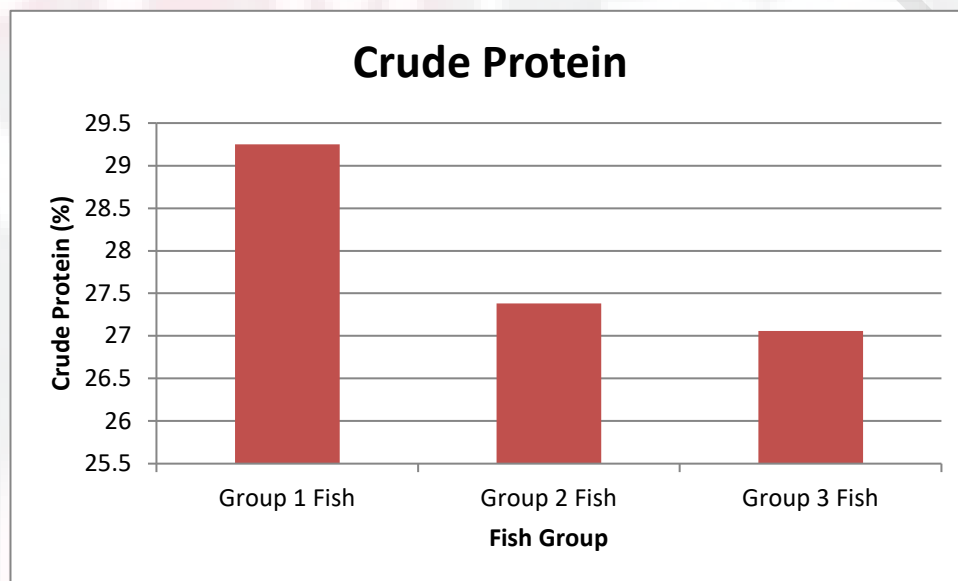


Figure 4: Crude protein composition of fish

Crude protein composition of fish in each group is demonstrated in Graph 4. From the graph, Group 1 that acquire Feed 1 shows highest crude protein composition which is 29.25%. Followed by group 2 fish that acquire Feed 2 record the second highest crude protein composition which is 27.38%. Lastly, control group; group 3 fish recorded least value of crude protein composition among all group tested which is 27.06%.

5.0 DISCUSSION

Fish growth can be measured by determining its body weight, total length and girth (Florida Fish and Wildlife Conservation Commission, 2015). Based on these 3 parameter, performance of fish that acquire Feed 1 (contain 40% soy waste) and feed 2 (contain 20% soy waste) shows a good increment of growth compared to control which were fed with commercial diet only. These may be due to high protein, fat and fiber content in Feed 1 and Feed 2 compared to group fed with commercial diet. Indeed, those components are essential in promoting growth of Red Hybrid Tilapia.

From this study, it could be suggested that soy waste is a potential waste product that can be formulated into fish feed due to its high nutritional value (especially protein). In addition, soy wastes are easily available, and cheap, and cause no harm to fish.

Tilapia that fed with only commercial diet was analyzed to have 15.8 - 17.2% crude protein (A. Che Rohani *et al.*, 2009). In this study, tilapia that fed with only commercial diet (control) was analyzed to have 27.38% crude protein. However, fish fed with Feed 1 (inclusion of 40% soy waste in the diet) have better result on its crude protein level which is 29.25%. Therefore, high protein diet will affect high protein level in fish itself.

There are several importance of protein in fish. Firstly, protein is used to repair worn or wasted tissue (tissue repair and maintenance) and to rebuild new tissue (as new protein and growth). Secondly, dietary protein may be

catabolized as a source of energy, or may serve as a substrate for the formation of tissue carbohydrates or lipids. Other than that, dietary protein is required within the animal body for the formation of hormones, enzymes and a wide variety of other biologically important substances such as antibodies and haemoglobin (FAO,2006).

6.0 CONCLUSION

From this study, it can be concluded that inclusion of soy waste up to 40% into the diet is promising and potential to improve body weight gain, length and girth as well as increasing the protein composition in Red Hybrid Tilapia.

7.0 RECOMMENDATION

Recommendation that can be suggested for future study, the feed formulation can be tested to different tilapia life stages such as fingerling and adult or/and to other fish species due to the same biological and physiological condition and function. Other than that, further meat analysis can be conducted such as texture and taste analysis. Besides, larger sample size with larger aquarium/tanks can be used to minimize statistical error.

8.0 APPENDICES

Table 1: Tilapia Classification

Phylum	Chordata (Notochord group of animals)
Subphylum	Vertebrate (Animals with a backbone)
Class	Osteichthyes (Bony fishes)
Order	Perciformes (Perch-like fishes)
Family	Cichlidae (Cichlid fishes)
Genus	<i>Oreochromis, Tilapia, Sarotherodon, Danakilia.</i>

(Faizah Shaharom *et al.*, 2011)

REFERENCE

FAO. (2006). Trends in Aquaculture Production. State of World Fisheries and Aquaculture. www.fao.org/fi/statist/FISOFT/FISHPLUS.asp.

Dey, M. M., Sheriff, N. and Bjorndal, T. (2006). Aquaculture Development In Asia: Current Status, Meriwether II, F. H., Scura, E. D. and Okamura, W. Y. 1984. Cage culture of red tilapia in prawn and shrimp ponds. *Journal of World Mariculture Society*, 15: 254-265.

Faizah Shaharom, Pradeep P. J., Anil Chatterji. (2011). *Tilapia Aquaculture Techniques and Potential: Preface*. Universiti Malaysia Terengganu. 1: xi.

Chapman, F. A. (2000). Culture of hybrid tilapia: A Reference profile. In Circular1051 of Department of Fisheries and Aquatic Sciences, Florida Cooperative Extension Service, Institute of Food and Agricultural Science, University of Florida.

Sofy, H. I., Layla, A. M. and Iman, M. K. A. (2008). Karyotypic diversity of some tilapia species. *Nature and Science*, 6(1):19-27.

Eli, A. (2005). 1524 species in family Cichlidae (Cichlids). In: R. Froese and D. Pauly (Editors). *Fishbase Worldwide Web Electronic Publication*,. www.fishbase.org.

Altun, T., Tekelioglu, N. And Danabas, D. (2006). Tilapia Culture and Its Problems in Turkey, *Journal of Fisheries and Aquatic Sciences*, 23(3-4): 473-478.

El-Sayed, A. F. M. (2006). Tilapia culture. CAB International Wallingford Oxfordshire OX10 8DE UK, 227. pp.

Siddiqui, A. Q., Howlander, M. S., and Adam, A.A. (1988). Effect on dietary protein levels on growth, diet conversion and protein utilization in fry and young Nile Tilapia, *Oreochromis niloticus*. *Aquaculture*, 70: 63,70.

El-Sayed, A. F. M., Teshima, S. (1992). Protein and Energy Requirement of Nile tilapia, *Oreochromis niloticus*, fry. *Aquaculture*, 103:55-63.

Gunasekera, R. M., Shim, K. F. And Lam, T. J. (1996 b). Influence of Protein content of broodstock diets on larval quality and performance in Nile tilapia. *Oreochromos niloticus*.(L.). *Aquaculture*, 146: 245-259.

Siddiqui, A. Q., Al Hafedh, Y.S. and Ali, S. A. (1998). Effect of dietary protein level on the reproductive performance of Nile tilapia, *Oreochromis niloticus* (L.). *Aquaculture Research*, 29: 349-358.

El-Sayed, A. F. M., Mansour, C. R. and Ezzat, A. A. (2003). Effects of dietary protein levels on spawning performance of Nile tilapia (*Oreochromis niloticus*) broodstock reared at different water salinities. *Aquaculture*, 220:619-632.

Harbott, B. J. (1982). Studies on the feeding activity of *Sarotherodon niloticus* (L.) in Lake Turkana. In: A report on the findings of the Lake Turkana Project, 1972-1975, Vol. 5. Government of Kenya and the Ministry of Overseas Development, London. 1357-1368. pp.

Chapman, F. A. (2006). Culture of Hybrid Tilapia: A reference profile. CIR 1051. <http://edis.ifas.ufl.edu>

José L. Balcázar, Aníbal Aguirre, Geovanny Gómez and Walter Paredes. (2005). Culture of Hybrid Red Tilapia (*oreochromis mossambicus* x *oreochromis niloticus*) in marine cages: Effects of stocking density on survival and growth. *University of Zaragoza*, 1:1-5.

A. Che Rohani, O. Normah, T. Zahrah, C.M. Che Utama and I. Saadiah. (2009). Quality of fish fillet from pond-raised red tilapia and its utilisation in the development of value-added product. *J. Trop. Agric. and Fd. Sc.* 37(2)(2009): 153–161.

Mohammad Mijanur Rahman, Toshinori Nakagawa, Ramli Bin Abdullah,
Wan Khadijah Wan Embong and Ryo Akashi. (2014). Feed intake
and growth performance of goats supplemented with soy waste.
Pesq. agropec. bras., Brasília, v.49, n.7, p.554-558. DOI:
10.1590/S0100-204X2014000700008.

Florida fish and wildlife conservation commission. (2015). *How to Measure
Fish*. Retrieved 30 December, 2015, from
<http://myfwc.com/fishing/freshwater/fishing-tips/measure/>