UNIVERSITI PUTRA MALAYSIA

THE EFFECT OF FEEDING GINGER AND TURMERIC PEELS ON GROWTH PERFORMANCE AND CRUDE PROTEIN COMPOSITION IN RED HYBRID TILAPIA

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FATHIN SHAHIRA BINTI JOHARI

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CERTIFICATION

It is hereby certified that I have read this project paper entitled "The Effect of Feeding Ginger and Turmeric Peels on Growth Performance and Crude Protein Composition in Red Hybrid Tilapia", by Fathin Shahira binti Johari 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.

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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, Johari bin Ali

My mother, Sharifah Salwah binti Abu Bakar

My siblings; Ahmad Faisal Ariff, Ahmad Faddli, Faddlin Amaani,

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

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LIST OF ABBREBIATIONS

%	: Percent
O.Mossambicus	: *Oreochromis mossambicus*
O.Nilotocus	: *Oreochromis niloticus*
ºC	: 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 KULIT KUNYIT DAN KULIT HALIA TERHADAP PRESTASI PERTUMBUHAN DAN KOMPOSISI PROTIN MENTAH DALAM IKAN TILAPIA MERAH

Oleh

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2017

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Abstrak

Matlamat utama dalam akuakultur adalah untuk mengurangkan kos pengeluaran terutamanya pada kos pemakanan dan memanjangkan output dalam masa yang singkat. Kunyit dan halia telah digunakan dalam rumusan makanan untuk meningkatkan imuniti terhadap jangkitan dan menyumbang dalam prestasi pertumbuhan kerana sifat antimikrobial dan kandungan protein. Oleh itu, kajian ini bertujuan untuk menentukan kesan kulit kunyit dan kulit halia terhadap prestasi pertumbuhan dan komposisi protein mentah dalam Tilapia Hybrid Merah. Lapan puluh

Tilapia Hybrid Merah juvana telah dibahagikan kepada 4 kumpulan (Kumpulan A: 20% halia kulit + 80% diet komersial; Kumpulan B: 20% kulit kunyit + 80% diet komersial; Kumpulan C: 10% kulit halia kulit + 10% kunyit + 80% diet komersial dan Kumpulan D: kawalan, tiada kemasukan kulit halia atau kunyit). Analisis proksimat menunjukkan bahawa kandungan protein adalah pembolehubah dengan kemasukan yang berbeza kunyit dan halia kulit dalam diet. Keputusan menunjukkan bahawa kemasukan kulit halia ke dalam diet komersial adalah jauh berbeza ($p<0.05$) dalam kumpulan dengan kulit halia berbanding kumpulan rawatan lain yang berkaitan dengan berat badan, panjang, lilitan dan komposisi protin ikan. Sesungguhnya, Kumpulan A, mengandungi protin yang tinggi berbanding dengan kumpulan lain. Oleh itu, kumpulan A adalah lebih cenderung untuk mempunyai prestasi pertumbuhan dan komposisi protin yang lebih baik.

Kata kunci: Ikan Tilapia Merah, kulit halia, kulit kunyit, prestasi pertumbuhan, komposisi protein.

ABSTRACT

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

THE EFFECT OF GINGER AND TURMERIC PEELS ON GROWTH PERFORMANCE AND CRUDE PROTEIN COMPOSITION IN RED TILAPIA

By

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2017

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Abstract

Major aim in aquaculture is to diminish production cost particularly on the feeding cost and extends outputs in the shortest time. Turmeric and Ginger had been used in feed formulation to improve the immunity against infections and contribute in growth performance due to its antimicrobial properties and protein content. Hence, this study was aimed to determine the effect of turmeric peels and ginger peels on growth performance and crude protein composition in Red Hybrid Tilapia. Eighty juvenile

Red Hybrid Tilapia was divided into 4 groups (Group A: 20% ginger peels + 80% commercial diets; Group B: 20% turmeric peels + 80% commercial diets; Group C: 10% ginger peels + 10% turmeric peels + 80% commercial diets and Group D: control, no inclusion of turmeric or ginger peels). Proximate analysis showed that protein content are variables with different inclusion of turmeric and ginger peels in the diet. Result shows that the inclusion of peels into commercial diet is significant in group with ginger peels as compared to control group and other treatment groups in relation to its body weight, length, girth and protein composition in fish. Indeed, group A, contain high protein and fat as compared to other groups. Thus, group A is more likely to have better growth performance and protein composition.

Keywords: Red Hybrid Tilapia, ginger peels, turmeric peels, growth performance, protein composition.

1.0 INTRODUCTION

1.1 Study Background

The fishery sector has for decades been playing an important role as a major supplier of animal protein to the Malaysian population. The demand for an affordable and inexpensive source of protein for daily consumption has been rising day by day due to consistent growth of human population. In 2007 the total fishery production of the country amounted to 1 563 942 tonnes.

The fisheries are generally considered to consist of two major components, namely marine capture fisheries and aquaculture. Aquaculture which is a major food industry with more than 45.5 million ton/year of fish production globally is bracing itself up to face the challenges on this front (FAO, 2006). 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 (Day, 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, et al., 2011)

1.2 Justification

1. Ginger peels and turmeric peels are potentially source of low cost protein for animal feed.
2. Limited data on ginger peels and turmeric peels utilization in aquaculture and its feeding impact on Red Hybrid Tilapia.

1.3 Objectives

1. To determine the effect of turmeric peels and ginger peels on the growth performance and crude protein composition of Red Hybrid Tilapia.
2. To compare the effect of ginger peels and turmeric peels on the growth performance and crude protein composition of Red Hybrid Tilapia.

1.4 Hypothesis

Ho: The inclusion of ginger peels and turmeric peels into fish diet may not affect the growth performance and crude protein composition in Red Hybrid Tilapia

Ha: The inclusion of ginger peels and turmeric peels into fish diet may affect the growth performance and crude protein composition in Red Hybrid Tilapia

2.0 LITERATURE REVIEW

2.1 Current trend in aquaculture in Malaysia

The fishery sector has for decades been playing an important role as a major supplier of animal protein to the Malaysian population. The demand for an affordable and inexpensive source of protein for daily consumption has been raising day by day due to consistent growth of human population.

The current trend in aquaculture industries in Malaysia are consumption of freshwater fish and also inclination of demand throughout the time. The consumption

of freshwater fish can provide source of protein that are still considered cheap and affordable for human utilization.

Of the commercially cultured freshwater species, Nile tilapia (Oreochromis niloticus), which was first introduced in 1944 from Indonesia (Ang et al, 1989), accounts for 44.7 percent of the total freshwater aquaculture production, followed by catfish (36.7 percent) and carps (10.08 percent). In terms of value of production, tilapia contributes 49.37 percent, followed by catfish (37 percent) and carps (10 percent). In terms of value, red tilapia yields the highest value of USD 27 million. The black nile tilapia, which was introduced in the 1950's, did not indicate well, due to its colour compared with the red hybrid tilapia which was introduced from Thailand some time in 1979 (Ang, et al, 1989).

The marine capture fisheries are further sub-divided into coastal fisheries and the offshore sub-sector. Production from the marine capture fisheries was estimated to be 1 381 423 tonnes in 2007 (FAO, 2009). The contribution from the coastal fisheries has remained approximately around 1.0 million tonnes. It is generally well accepted that the coastal fishery resources have been fully exploited. There is possibly some extent of overfishing. Over the years, the Department of Fisheries (DOF) has tried various measures to reduce the coastal fishing effort. Further expansion of capture fisheries would need to come from the offshore sub-sector, namely the South China

Sea. Given the present level of landings, the scope for an increase in landings is quite limited.

Aquaculture is among various culture systems, the traditional culture of cockle on coastal mudflats on the west coast of Peninsular Malaysia has dominated, with cockle landings amounting to more than half the total aquaculture production excluding seaweeds until 1999. In 2007, cockle production was 49,620 tonnes, followed by aquatic plants (30,000 tonnes), tilapia (26,409 tonnes), banana prawn (23,738 tonnes), Clarias catfish (21,892 tonnes) and giant tiger prawn (11,435 tonnes).

Mud flat culture (of cockles) is the most common production method, followed by freshwater pond culture, brackishwater pond culture, long-line culture of seaweed, and several other minor culture systems including marine cage culture of fish, raft culture of mussel and oyster, mining pool culture of freshwater fishes, freshwater cage culture, and tank culture of freshwater fishes - in that order. Shrimp culture in brackishwater pond contributes most in terms of value.

2.2 Red Hybrid Tilapia

Table 1: 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	*Oreochromis*
Species	Red Hybrid (*O.Niloticus x O.Mossambicus*)

Characteristic of Red Hybrid Tilapia

Red Hybrid Tilapia is from crossing the species of *Oreochromis Niloticus* and *Oreochromis Mossambicus*. In Malaysia, Red Tilapia contributes approximately 90% of the total tilapia production. The species Oreochromis sp. in general is widely cultured in ponds, cages and tanks as well as in pen culture systems. One of the commonest interests in fish farming worldwide is how to diminish production cost and extends outputs in the shortest time. 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 fingerling 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).

Besides that, Red Hybrid Tilapia (*Oreochromis sp*.) is chosen to be used in this project because this fish has high demand among consumer

2.3 Utilization of agricultural by product in Aquaculture

Agricultural by product can be defined as a secondary result, unintended but inevitably produced in doing or producing something else. Some of the by product can be utilize and apply for other benefits. From using by product there are lots of

conveniences that can be gained. This is due to its availability because most of the by product is not utilize by human thus showing less competition with human population. Besides that it also can reduce the price of feeding towards fishery and aquaculture sector.

For instant, soy waste is mostly dump and burn in normal practice due to lack of proper usage. However, it has been widely used as feed for ruminants due to its high nutritional value and excellent functional properties (Rahman et al.,2014) Other than that, it also had been used in Red Hybrid Tilapia as a source of protein (Haziq, 2016).

2.4 Potential use of ginger and turmeric as feed in aquaculture

Turmeric and Ginger peels are one of the locally available feed ingredients waste products. Turmeric which is an indication that can improves the immunity and aids disease resistance in the experimental fishes. It can be concluded that turmeric improves the growth performance (Saamola et. al, 2016). Ginger also contains lipids, proteins, vitamins, amino acids, minerals and other terpene. Beyond that, ginger has the potential to promote overall health, but the data is limited.

Turmeric peels and ginger peels are mostly dump and burn in normal practice due to lack of proper usage. It's also used as feed for Laying Hens due to its high in nutritional value and excellent functional properties (Moeini et. al, 2011).

There were previous experiments done on effect of turmeric (Curcuma longa) Root Powder (TRP) on the growth performance of African Catfish (Clarias gariepinus). Based on those findings, this research is conducted by using the turmeric

peels and ginger peels which are the waste products of ginger and turmeric as it is more cost effective than those rhizomes plants. Other than that, there were few studies showing the turmeric and ginger had been used in feed formulation to improve the immunity against infections and contribute in growth performance due to its antimicrobial properties and protein content.

Based on those findings, this research is conducted by using the turmeric peels and ginger peels which are the by-products of ginger and turmeric as it is more cost effective than those rhizomes plants. Other than that, there were few studies showing the turmeric and ginger had been used in feed formulation to improve the immunity against infections and contribute in growth performance due to its antimicrobial properties and protein content. However, there are limited data on turmeric peels and ginger peels waste utilization in aquaculture and its feeding impact on fish species (e.g. Red Tilapia) suggested that there are still several gaps to be filled as for the use of peels waste in fish feeding.

3.0 MATERIALS AND METHOD

3.1 Experimental Design

A transportation plastic bags containing juvenile Red Hybrid Tilapia were took from Taman Pertanian Universiti Puchong and brought back to Faculty of Veterinary Medicine, UPM. After that, eighty juvenile Red Hybrid Tilapia were selected and divided into four different groups (n= 20) according to their different experimental formulation of feeds. The group we labelled as A, B, C, and D (control group).

The feed ingredients and composition of the experimental diets was illustrated in Table 2. The feeding trial lasted for 21 days where initial growth measurement was taken at the beginning of the study and ongoing growth were measured at 7th, 14th, 21st day of the 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 fish were sacrificed for determining its crude protein composition.

3.2 Experimental Diets

Table 2 shows different composition feed formulation in the experimental diets and all diets were analysed for its nutrient composition. Group A was fed with 20% ginger peels and 80% commercial feed; Group B was fed with 20% turmeric peels and 80% commercial feed; Group C was fed with 10% ginger peels, 10% turmeric peels and 80% commercial feed; and Group D was a control group which were given 100% commercial tilapia feed and no inclusion of ginger peels and turmeric peels.

Table 2: Composition of feed formulation

Group	Waste feed	Commercial Diet
A	20% ginger peels	80%
B	20% turmeric peels	80%
C	10% ginger peels, 10% turmeric peels	80%
D	0%	100%

3.3 Feed Analysis

3.3.1 Sample collection

Commercial pellet was taken from Aquatic lab feed store and ginger and turmeric were bought from nearby supermarket and the peeled.

3.3.2 Sample preparation

The ginger peels, turmeric peels and commercial pellet samples were dried in the oven at 60°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 ginger peels, turmeric peels and commercial feed. A total of 100g samples 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 then was kept in labelled air tight plastic container before proceed 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 composition of feeds which includes the following: dry matter, crude protein, crude fibre and ash. All

analysis was carried out according to certification procedures outlined by the Manual of Laboratory Technique, Universiti Putra Malaysia.

3.3.3.1 Dry matter (DM) and moisture content

Labelled porcelain crucible was dried in an oven for 30 minutes at 105°C. Then, the crucibles were cooled in desiccator for 20 minutes and the empty labelled crucibles were weighed. A total of 3g of each experimental diet was weighed and placed inside respective crucible according to their label. The samples 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 desiccator 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 crucible containing ash were cooled down in desiccator for 30 minutes and later were weighed for ash determination by using formula below:

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

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, 1 g of samples was weighed and placed into Kjeldahl flask together with Kjeldahl catalyser tablet (3.5g K_2SO_4 + 0.4g $CuSO_4$ x $5H_2O$). 20 ml of sulphuric acid (98%) was poured into 250 ml Kjeldahl flask and shake gently. Kjeldahl 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 solutions become clear ($_{\text{bluish}}$/greenish) in colour.

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

Sample = $H_2SO_4 \rightarrow (NH_4)_2SO_4 + H_2O + CO_2$

Whilst the samples are being digested, acid standardization was done to determine the acid normality of a previously prepared 0.1 M 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 75 ml of 2% Borid 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 15 ml 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 ammonium, which is collected by the Boric acid (2%) at the distillation set via following reaction:

$$(NH_4)_2SO_4 + 2NaOH \rightarrow NH_2SO + 2NH_3 + H_2O +$$

$$2NH_3 + H_2O \rightarrow NH_4OH \text{ (collected by boric acid)}$$

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

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

Crude Protein (%) = % nitrogen x Protein factor

Where; Blank Value = % Nitrogen x Protein factor

Acid Normality = 0.0955

Protein Factor = 6.25

3.3.3.4 Crude Fiber

The crude fibre 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 desiccator for 20 minutes. Each fiberbags were weighed and inserted with a fiber glass before 3g of samples 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 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 desiccator 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 crucible left to cool down inside a desiccator before being weighed. The amount of crude fibre was calculated via the following formula:

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

3.3.3.5 Ether extract

Empty labelled round bottom flasks 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 them 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 was allowed to be cooled inside desiccator before weigh. Crude fat determination as carried as follow:

$$\text{Crude Fat (\%)} = \frac{\text{Dried flask after evaporation weight} - \text{Empty flask weight} \times 100}{\text{Weight of sample}}$$

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 body length was measured by determining the fish body diameter by using rubber band and the rubber band that measuring the fish body diameter is marked and measure the rubber band using ruler.

3.5 Crude Protein Composition of Red Hybrid Tilapia

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 the flesh was collected and separated according to their groups. After that the flesh sample was dried in oven in 60°C for 1 day. Later the sample was grinded and triplicate test was done to all three groups for determination of crude protein composition.

3.6 Statistical analysis

All the statistical analysis was 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 3: Proximate Analysis results of all feed formulation

Mean of percentage (%)	Feed A	Feed B	Feed C	Feed D (Control)
Dry Matter	94.3	93.4	93.8	92.49
Ash	9.16	9.68	9.26	10.09
Crude Fiber	8.64	4.43	5.26	4.68
Crude Fat	4.65	4.60	4.35	4.47
Crude Protein	17.46	15.45	16.01	15.85

*Feed A: 20% Ginger Peels + 80% Commercial Diets
**Feed B: 20% Turmeric Peels + 80% Commercial Diets
***Feed C: 10% Ginger Peels + 10% Turmeric Peels + 80% Comm. Diets
**** Feed D (Control): 100% Commercial Diets

The results for proximate analysis were tabulated in Table 3. Result obtained revealed that all the elements were higher for Feed A except for Ash content which higher in Feed D. The crude protein which was 17.46%, crude fat; 4.65% and crude fibre; 8.64% were all highest in the Feed A compared to other groups showing the feed was high in nutritional content that are aid for growth performance.

4.2 Body Length Result

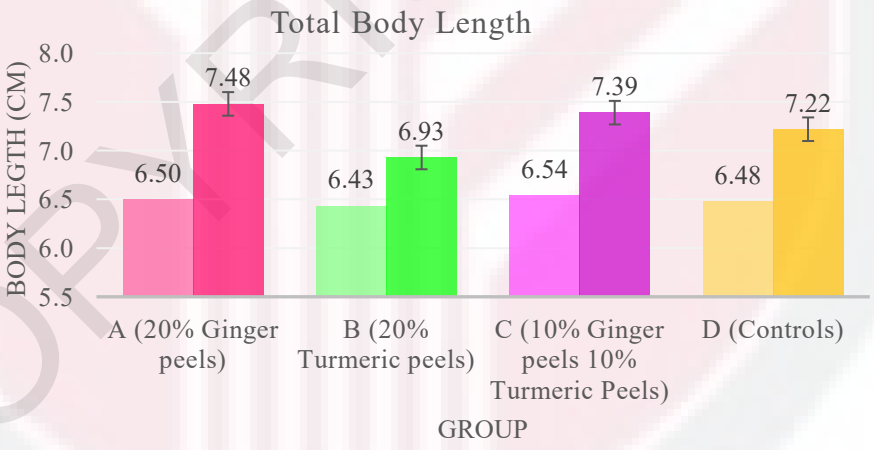

Figure 1: Mean body length graph.

The graph shows the initial body length of fish from respective groups. After 3 weeks being fed with different formulated feed, the body length is again measured and indicated as final length. The difference between the final and initial length show the increment which reflects the growth performance of each groups. Highest increment which is the final length was 7.48cm and the initial length was 6.50cm is seen in group

A which is fed with 20% ginger peels followed by group C where 10% ginger peels and 10% turmeric peels in cooperated into their feed, the final length was 7.39cm and the initial length was 6.54cm. Next is group D which is fed with 100% commercial feed and the final length was 7.22cm and the initial length was 6.48cm. And the least increment is shown by group B where 20% turmeric peels include in their feed had the final length of 6.93cm and the initial length of 6.43cm.

Based on the results, it shows that Group A have the highest mean on body length gain in three weeks' time. Thus, one experimental group A shows significant value as compared to others.

4.3 Total Body Girth

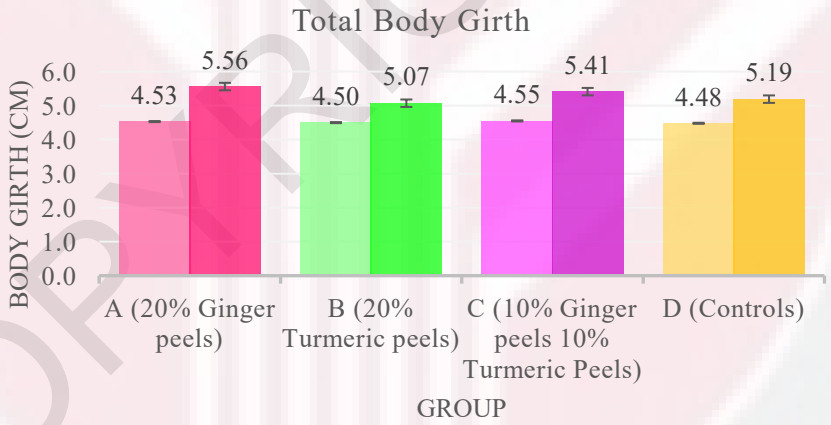

Figure 2: Mean body girth graph.

The graph shows the initial body girth of fish from respective groups. After 3 weeks being fed with different formulated feed, the body length is again measured and indicated as final length. The difference between the final and initial length show the increment which reflects the growth performance of each groups. Highest increment which is the final length was 5.56cm and the initial length was 4.53cm is seen in group

A which is fed with 20% ginger peels followed by group C where 10% ginger peels and 10% turmeric peels in cooperated into their feed, the final length was 5.41cm and the initial length was 4.55cm. Next is group D which is fed with 100% commercial feed and the final length was 5.19cm and the initial length was 4.48cm. And the least increment is shown by group B where 20% turmeric peels include in their feed had the final length of 5.07cm and the initial length of 4.50cm.

Based on the results, it shows that Group A have the highest mean on body girth length in three weeks' time. Thus, one experimental group A shows significant value as compared to others.

4.4 Total Body Weight

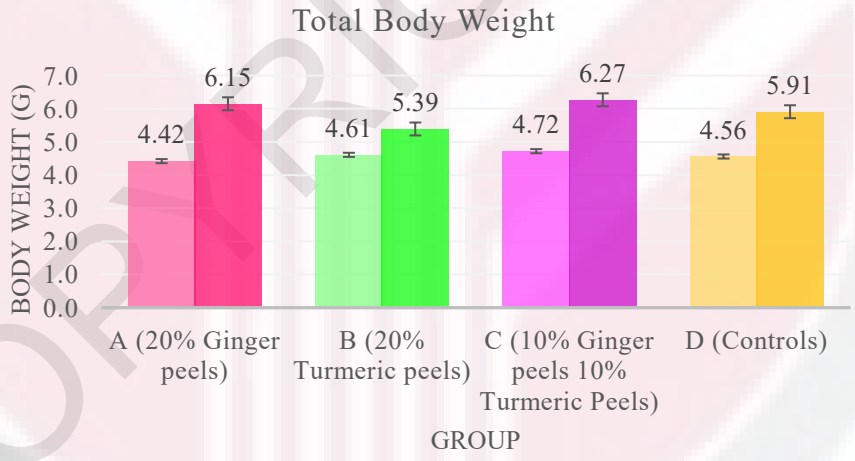

Figure 3: Mean body weight graph.

The graph shows the initial body weight of fish from respective groups. After 3 weeks being fed with different formulated feed, the body weight was again measured and indicated as final weight. The difference between the final and initial weight show the increment which reflects the growth performance of each groups. Highest increment which is the final weight was 6.15g and the initial weight was 4.42g is seen

in group A which is fed with 20% ginger peels followed by group C where 10% ginger peels and 10% turmeric peels in cooperated into their feed, the final weight was 6.27g and the initial weight was 4.72g. Next is group D which is fed with 100% commercial feed and the final weight was 5.91g and the initial weight was 4.56g. And the least increment is shown by group B where 20% turmeric peels include in their feed had the final weight of 5.39g and the initial weight of 4.61g.

Based on the results, it shows that Group A have the highest mean on body weight gain in three weeks' time. Thus, one experimental group A shows significant value as compared to others.

4.5 Crude Protein Composition of Red Hybrid Tilapia

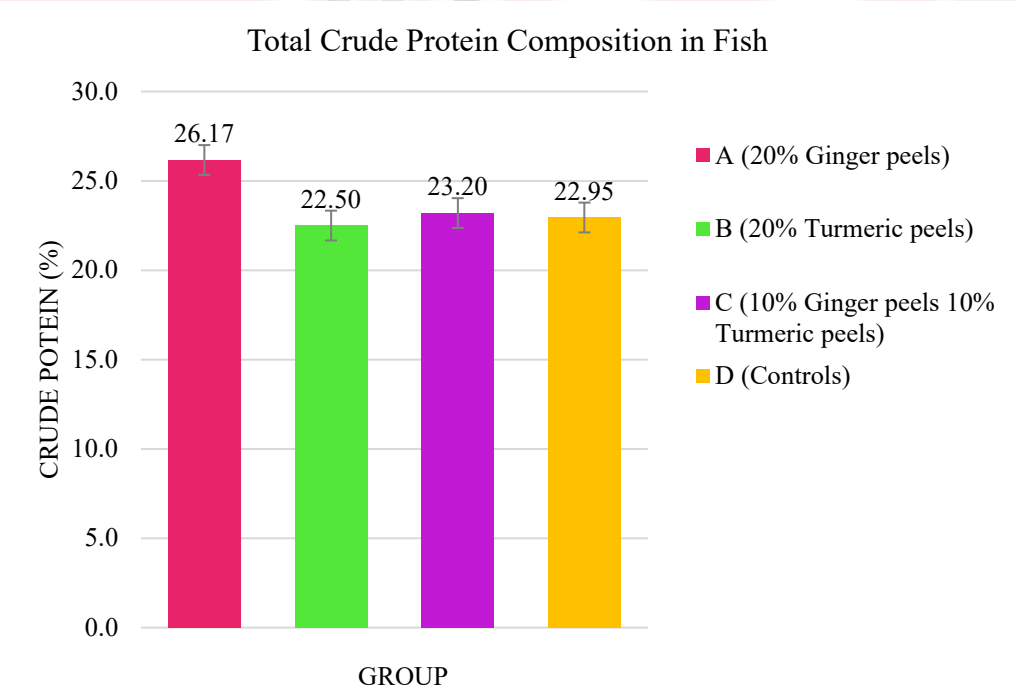

Figure 4: Crude Protein composition of fish

Crude protein composition of the fish in each group is demonstrated in Graph 4. From the graph, Group A fish that acquire 1=20% ginger peels show highest crude protein composition which is 26.17%. Followed by the group fish that acquire both peels record the second highest crude protein composition which is 23.20%. Next followed by group D that acquired 100% commercial diet shows protein composition of 22.95%. Lastly, group B acquired 20% turmeric peels fish recorded least value of crude protein composition among all group tested which is 22.50%.

5.0 DISCUSSION

Fish growth can be measured by determining its body weight, total length and girth (diameter) by Florida Fish and Wildlife Conservation Commission. Based on these 3 parameters, performance of fish that acquire Feed A (20% ginger peels) shows a good increment of growth compared to fish in control and Group B which were fed with commercial diet and turmeric peels. These may be due to high protein, fat and fiber content in feed A compared to other groups. Those components are essential in promoting growth of Red Hybrid Tilapia.

Ginger and turmeric are rich in mineral and nutritional content. Ginger contains lipids, proteins, vitamins, amino acids, minerals and other terpene. There were also shown in other studies that ginger was used as feed for Laying Hens due to its high nutritional value and excellent functional properties. Based on Saamola *et. al*,

2016, Turmeric improves the immunity and aids disease resistance in the experimental fishes. It can be concluded that turmeric improves the growth performance.

The peels used in this study because it is locally available waste products. By product should be fully utilize. By doing this it will helps to reduce emission of global warming. Next, it also can reduce the feeding cost as it is cheaper than commercial feed. At the same time, it can reduce competition with human population that use them as a part of daily life especially in cooking.

Other studies had shown that, there were significant increase in growth which means that ginger diet acted as an appetizer led to increase the digestibility and in turn the energetic benefits enhanced the growth rate. Other than that, the positive growth promoting effects of ginger may be due to their chemical and physical properties; their positive immunostimulating effect or stimulates digestion as it influences positively the terminal enzymes of digestive process and improving protein and fat metabolism.

On top of that, ginger also contains allicin, which promotes the performance of the intestinal flora, thereby improving digestion, and enhancing the utilization of energy. This may lead to improve the growth performance of fish. It also help rise in muscle free amino-acid contents which lead to an enhancement in protein synthesis. There were also studies in Nile Tilapia that support the statement of increasing growth performance enhances normal retention of protein during growth.

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 (protein). In addition, soy wastes are easily available, and cheap, and cause no harm to fish.

Tilapia that fed with only commercial diet were analyzed to have 22.8 - 25.2% crude protein (A. Che Rohani *et al*., 2009). In this study, tilapia that fed with only commercial diet (control) were analyzed to have 22.95% crude protein. However, fish fed with Feed A which was inclusion of 20% ginger peels in the diet have better result on its crude protein level which is 26.17%. High protein diet will affect high protein level in fish itself.

There is 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 hemoglobin (FAO, 2006).

In other study, tilapia that fed with only commercial diet were analysed to have 22.8 - 25.2% crude protein (A. Che Rohani et al., 2009). In this study, tilapia that fed with only commercial diet (control) were analysed to have 22.95% crude protein. However, fish fed with Feed A (inclusion of 20% ginger peels in the diet) have better result on its crude protein level which is 26.17%. High protein diet will affect high protein level in fish itself.

The crude protein in group A which the inclusion of 20% of ginger peels in the commercial feed were signicantly higher ($p<0.05$) than other groups. Based on the other study, showed that crude protein composition for the whole body of Benni Fish

fed with experimental diet 3% white ginger for 8 weeks were lower than group A. This result might be due to different kind of species that have different metabolism and nutrient requirement.

6.0 CONCLUSION

In the nutshell, this study has shown that inclusion of ginger peels up to 20% into the fish diet has a potential to enhance growth performance such as body weight, length and girth as well as increasing its protein composition in the fish meat.

7.0 RECOMMENDATIONS

For future recommendation, the feed formulation can be tested to different tilapia life stages such as fingerling and adult or/and to other fish species because of the same biological and physiological condition and function. Further fish meat analysis can be conducted such as texture and taste analysis. Lastly, larger sample size with larger aquarium or tanks is recommended for better and significant results.

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