# The Effect of Pineapples (*Ananas comosus*) Waste Extract on the Growth Performance of Nile tilapia (*Oreochromis niloticus*) Fingerlings

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## DECLARATION

I hereby declare that the work embodied in this report is the result of the original research and has not been submitted for a higher degree to any universities or institutions.

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Student

Name:

Date:

I certify that the report of this final year project entitled The Effect of Pineapples (*Ananas comosus*) Waste Extract on the Growth Performance of Nile tilapia (*Oreochromis niloticus*) Fingerlings by Nadiatul Aishah Binti Ruslan, matric number F15A0095 has been examined and all the correction recommended by examiners have been done for the degree of Bachelor of Applied Science (Animal Husbandry Science) with Honours, Faculty of Agro-Based Industry, Universiti Malaysia Kelantan.

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**The Effect of Pineapples (*Ananas comosus*) Waste (Peel and Crown) Extract to the Growth Performance of Nile tilapia (*Oreochromis niloticus*) Fingerlings.**

## ABSTRACT

In Malaysia, tilapia is the common and important aquaculture species that are produced for the human daily consumptions. The main purpose of this experiment is to determine the effect of pineapples *(Ananas comosus)* waste (peel and crown) extract on the growth performance of Nile tilapia (*Oreochromis niloticus*). In this experiment, there are four different types of treatments. The first treatment is control (Diet 1) which is only giving the commercial pellet to Nile tilapia. For the second treatment (Diet 2), the Nile tilapias were fed with commercial pellet + 10 % pineapples waste extract (PWE). Then, for third treatment (Diet 3), the Nile tilapias were fed with commercial pellet + 20 % pineapples waste extract. Lastly, for the fourth treatment (Diet 4) Nile tilapia were fed with commercial pellet + 30 % Pineapples waste extract. From the result, Diet 4 showed the weight gain 16.90 g, specific growth rate (SGR) with 2.67 %, feed conversion ratio (FCR) was 4.69 and survival rate was 95.55 %. Then, followed by Diet 3 with weight gain 15.15 g, specific growth rate (SGR) was 2.50 %, feed conversion ratio (FCR) was 3.87 and survival rate was 75.66 %. Diet 2 showed the weight gain 14.68 g, specific growth rate (SGR) was 2.46 %, feed conversion ratio (FCR) was 4.88, survival rate was 81.11 % and followed by Diet 1 with weight gain 13.91 g, specific growth rate (SGR) was 2.42 %, feed conversion ratio (FCR) was 3.35 and survival rate was 67.78 %. In conclusion, the tilapia fed the feed supplemented with 30 % PWE were resulted in the optimum weight gain, optimum SGR, and better survival rate for tilapia fingerlings but for FCR, not in the optimum range. Alternative to improve this experiment is made a new formulation of fish feed by added pineapples waste.

**Keywords:** *Oreochromis niloticus*, Pineapples *(Ananas comosus) Waste*, growth performance, a feed additive.

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**Kesan Sisa (kulit dan mahkota) Nanas (*Ananas comosus*) Ekstrak ke atas Pertumbuhan Anak Tilapia Hitam (*Oreochromis niloticus*).**

## ABSTRAK

Di Malaysia, tilapia adalah spesies akuakultur yang tidak lagi asing dan menjadi menu makanan harian. Tujuan utama eksperimen ini adalah untuk menentukan kesan sisa nanas (*Ananas comosus*) terhadap prestasi pertumbuhan ikan tilapia hitam (*Oreochromis niloticus*). Eksperimen ini mempunyai empat jenis rawatan yang berlainan. Rawatan pertama adalah kawalan (Diet 1) yang hanya memberikan makanan komersial kepada tilapia hitam. Untuk rawatan kedua (Diet 2), tilapia Nil diberi makan makanan komersial + 10 % ekstrak sisa nanas (PWE). Kemudian, untuk rawatan ketiga (Diet 3) tilapia hitam diberi makan dengan makanan komersial + ekstrak sisa nanas 20 %. Terakhir untuk rawatan keempat (Diet 4) tilapia hitam diberi makan dengan makanan komersial + 30 % ekstrak sisa nanas. Keputusan ekperimen menunjukkan, Diet 4 mempunyai peningkatan berat 16.90 g, kadar pertumbuhan spesifik (SGR) sebanyak 2.67 %, nisbah penukaran makanan (FCR) berjumlah 4.69 dan kadar kehidupan adalah 95.55 %. Diikuti oleh Diet 3 dengan peningkatan berat 15.15 g, kadar pertumbuhan spesifik (SGR) adalah 2.50 %, nisbah penukaran makanan (FCR) adalah 3.87 dan kadar kehidupan adalah 75.66 %. Diet 2 menunjukkan peningkatan berat 14.68 g, kadar pertumbuhan spesifik (SGR) adalah 2.46 %, nisbah penukaran makanan (FCR) adalah 4.88, kadar kehidupan adalah 81.11 % dan diikuti oleh Diet 1 dengan peningkatan berat 13.91 g, kadar pertumbuhan tertentu (SGR) adalah 2.42 %, nisbah penukaran makanan (FCR) adalah 3.35 dan kadar kehidupan adalah 67.78 %. Kesimpulannya, tilapia diberi makan makanan tambahan dengan 30 % ekstrak sisa nanas menunjukkan peningkatan berat yang optimum, optimum kadar pertumbuhan tertentu, dan kadar kehidupan yang baik tetapi nisbah penukaran makanan tidak dalam julat yang optimum. Alternatif untuk menambah baik eksperimen ini adalah mencipta perumusan ikan baharu dengan menambah sisa nanas ke dalam makanan ikan tersebut.

**Kata kunci:** Tilapia Hitam (*Oreochromis niloticus*), Sisa Nanas (*Ananas comosus*), prestasi pertumbuhan, makanan tambahan.

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## LIST OF ABBREVIATIONS AND SYMBOLS

### List of Aberrations

| | |
|---|---|
| DO | Dissolve Oxygen |
| FAMA | Federal Agriculture Marketing Authority |
| FCR | Feed Conversion Ratio |
| PWG | Percentage of Weight Gain |
| PWE | Pineapples Waste Extract |
| SGR | Specific Growth Rate |
| SR | Survival Rate |
| WG | Weight Gain |

### List of Symbols

| | |
|---|---|
| G | Gram |
| ˚C | Celsius |
| min | Minutes |

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# CHAPTER 1

# INTRODUCTION

## 1.0 Research background

Nile tilapia (*Oreochromis sp*.) is one of the aquaculture species that commonly easy to found in Malaysia. In 2013, total production of tilapia is 33,437 metric tons and became the second largest freshwater fish in Malaysia as it has the highest demand among consumer. Malaysia provide the supplementary fish for national food security and production of high-value fish for fulfilled the market demand or consumer demand (Arnaud, Guy Benoit, & Abraham, 2017). The main problems of the aquaculture industry are the price source of feed is too expensive. An alternative that can reduce this problem needs to find the best way how to reduce feed consumption of feed but still can increase the demand. Protein is the most expensive component in an aquaculture diet and fish needs to consume fed that rich amount of protein. Fish need a lot of protein sources to increase the rate growth performance and to make sure the fish contains rich with the nutrition values (Ahmad, Abdel-Tawwab, & Khattab, 2004).

The characteristics of tilapia are their tolerance to poor water quality and the fact that they eat a wide range of natural food organisms (Amos, 2013). To reduce the amount of feed intake by fish were modified tilapia feed by adding some supplement. The supplement can be from animals waste or plants sources which is less expensive ingredients (Arnaud et al., 2017). Examples of plant source that contain the highest amount of protein sources are soybean meal, cottonseed meal, groundnut meal, sunflower, rapeseed, sesame seed, copra, macadamia and palm kernel were also evaluated, along with aquatic plants such as *Azolla pinnata*, duckweed (*Lemnaceae*) and single-cell proteins. Then, farmers also can use waste as a supplement in fish feed such as orange peel, banana peel, and mango seeds. The characteristic of supplement in the fish diet should be lower in price, readily available and contains good nutritional values suitable for fish body requirement (Arnaud et al., 2017).

This study was focused on the feeding of Nile tilapia fingerlings with the pineapples (*Ananas comosus*) waste extract to determine the growth performance of tilapia. The aims of this study are to enhance the tilapia growth parameter through dietary strategy. The extraction of pineapples (*A. comosus*) waste was sprayed in a fish diets to observe either this supplement give an efficient rate of growth performance of tilapia. According to Farid Hossain et al. (2015), the extraction of pineapples (*A. comosus*) waste contains the highest amount of glucose, sucrose, and fructose which is can booster the energy level of fish.

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## 1.1 Problem statement

In livestock, poultry and aquaculture productions, each of the animals requires enough amount of nutrient requirement and contains the highest percentage of nutrient in their feed diet. This is because good nutrient can enhance and help the growth performance of tilapia. This study is to investigate the effect pineapples waste extract in fish feed to enhance the growth performance of Nile tilapia fingerlings. According to Yuangsoi, Klahan, Charoenwattanasak, & Lin (2018) the pineapple waste was affected the growth performance of fish because pineapples waste rich in rich in cellulose, hemicellulose, carbohydrates, and glucose. Then, the nutrient content of the pineapples waste must be identified and the amount of pineapple waste extract also must compatible with the fish requirement. However, there is a problem occurred where during buy the pineapples, either the seller knows or not about the *Ananas comosus* species.

## 1.2 Hypothesis

$H_0$: The Pineapples (*Ananas comosus*) waste extract not affected the growth performance of Nile tilapia fingerlings.

$H_1$: The Pineapples (*Ananas comosus*) waste extract affected the growth performance of Nile tilapia fingerlings.

## 1.3 Objective

1. To determine the effect of pineapples (*Ananas comosus*) waste extract on growth performance of Nile tilapia *(Oreochromis niloticus)* fingerlings.

## 1.4 Scope of study

To observe and evaluate the optimum percentage of pineapples (*Ananas comosus*) waste extract those were treatment produce higher weight gain toward the Nile tilapia. The Nile tilapias were given a feed with a commercial pellet which sprayed with pineapples (*A. comosus*) waste extract. Pineapples (*A. comosus*) waste extract was being sprayed toward the pallet with different concentration. This experiment was conducted at aquaculture laboratory at Universiti Malaysia Kelantan Jeli Campus. The growth performance of Nile tilapia was determined after eight weeks of the experiment.

## 1.5 Significance of the study

From this study, feed gave an impact for growth performance of Nile tilapia. In Malaysia, farmers usually choose lower cost of feed production, but never a concern at the nutrient content of fish needed in their diet. Nutrient content of the feed is the main factor to be considering in tilapia farming to increase the production of tilapia farming. Then, usually, the farmer fed the fish with the commercial pellet and tilapia in a pond

usually fed phytoplankton and detritus. Then, tilapia species need higher nutrition to reach the optimum growth. The fish feed also can add the supplement to enhance the growth performance of Nile tilapia fingerlings. Waste from the plant such as pineapples (*Ananas comosus*) waste can be extracted and used as a supplement in fish feed.

## 1.6 Limitation of study

There are some limitations in this study such as less information about the effect of using pineapples (*Ananas comosus*) waste on tilapia feed diet as a supplement. Then, the specific amount or percentage of the pineapples waste are suitable to add to the fish feed diet are still unidentified until now. Thus, this research must be run to find out the best percentage of pineapple waste extract that can be added to the fish feed diet and can increase the quality of the tilapia. Most articles have studied the effect of fermented pineapples waste toward growth performance of fish.

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# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Pineapples (*Ananas comosus*)

Pineapple is recognized as one of the fifty plants that changed world history. It was research in America as a cultivated plant by Christopher Columbus in 1492 and who took specimens back to Europe (Wasaka, 1989). *Ananas comosus* is the scientific name of pineapple and it is a tropical plant with an edible multiple a tropical fruit famous for its "thorny crown" and its most widely cultivated plant in the Bromeliaceae family. In Brazil, one of its original native names is nana, from which the scientific name *Ananas* and Malay name nanas have been derived (Amar & Ng, 2015). Usually, pineapple varieties planted in Malaysia is known as Moris, N36, Sarawak, Moris Gajah, Gandul, Yankee, Josephine, Masapine and in Malaysia usually MD species was found. The pineapple was introduced into the Philippines, Hawai, and Guam during the early 16th Century by Spaniards, and reached India and the east and west coasts of Africa at 1548 (Wakasa, 1989).

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Pineapples can be classified using an index with seven levels of maturity based on the green and yellow color of the skin pineapples and each index was have the different characteristic (Asnor, Rosnah, Wan, & Badrul, 2013). To check either the pineapple ripens or not is the skin will change from pale green to a golden or yellowish color. However, nowadays many farmers cannot sure either that pineapple has ripened or not. This is because farmers cannot properly follow the guideline providing by Federal Agriculture Marketing Authority (FAMA) and farmer also lack of knowledge about the technique to handle the plant. If the pineapple has been picked before maturity time, the nutritional value has become lower because it is not ripening yet and the nutritive value of the plant is at a low level.

Pineapple (*Ananas comosus*) has excellent quality, rich in nutrition with special flavour that is favoured by consumers worldwide and it is the third most commercial important tropical fruit (Sun, Zhang, Soler, & Marie-Alphonsine, 2016). Mature fruit contains 14 % of sugar which is a protein-digesting enzyme, bromelain, and good amount of citric acid, malic acid, vitamin A and B (Farid Hossain, Akhtar, & Anwar, 2015). According to Arnaud et al. (2017), the use of pineapple waste as poultry feed is limited due to the high crude fiber and water contents and the low protein content. Net weights of pineapples waste are about 15 % of total pineapple weight and the potential source of important compounds in pineapples waste is sucrose, glucose, fructose, cellulose, fiber, bromelain, and phenolics.

According to Andrianto et al. (2013), the major components of pineapples fruit are containing 81.2 to 86.2 % moisture and 13 to 19 % total solids, of which are sucrose, glucose, and fructose. Then, the carbohydrates contents, 85 % of total solids and fiber is made up for 2 to 3 %. Other than that, organic acids and citric acid have a lot amount of pineapples fruits and pineapple waste. Pineapple waste extracts are the



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good substance to produce an enzyme, single cell proteins, bacterial cellulose and organic acids by process fermented sugar and others nutrients (Dorta & Sogi, 2016). The waste of pineapples such as crown and peel of pineapples has changed to act as an alternative to become sources of energy. Referring to Andrianto et al. (2013), each pineapple fruit total weight is 400 g of which 60 g is of peel wastes. Pineapple fruits were content high moisture, high sugars, soluble solid content ascorbic acid, and low crude fiber.

### 2.1.1 Taxonomy

Pineapple is perennial monocotyledonous plants which have a terminal inflorescence and terminal multiple fruits. *Ananas comosus* is seedling with the flowering plant that becomes fruit from the flower of an ovary. Pollination occurs when the pollen grain moves the sperm from one flower to another flower. Adult pineapple plants are up to 1 m high and 0.5 m wide while adult plants are up to 1.5 m high and 1 m wide and the taxonomy of pineapple (Arnaud et al., 2017).

| | |
|---|---|
| Kingdom: | Plantae |
| Subkingdom: | Viridiplantae |
| Infrakingdom: | Streptophyta |
| Superdivision: | Embryophyta |

| | |
|---|---|
| Division: | Tracheophyta |
| Subdivision: | Spermatophytina |
| Class: | Magnoliopsida |
| Superorder: | Lilianae |
| Order: | Poales |
| Family: | Bromeliaceae |
| Genus: | *Ananas* |
| Species: | *Ananas comosus* |

### 2.1.2 Morphology

The pineapple (*Ananas comosus*) is from family Bromeliaceae which have a perennial, herbaceous monocot and pineapple leaves are spirally organized in a dense rosette, around a short stem. Usually, *A. comosus* species reproduces from vegetative propagules that were developed on the stem which is stem shoots and ground suckers, the peduncle, and the crown. In the commercial fruit, grown as a monoculture of genetically is to identify the identical plants. Normally pineapples are seedless fruit due to a genetic self-incompatibility (Smith, 2003). Usually, to produces one fruit commercial plant need take 14 to 24 month after planting. Figure 2.1 shows the morphology of *Ananas comosus.*

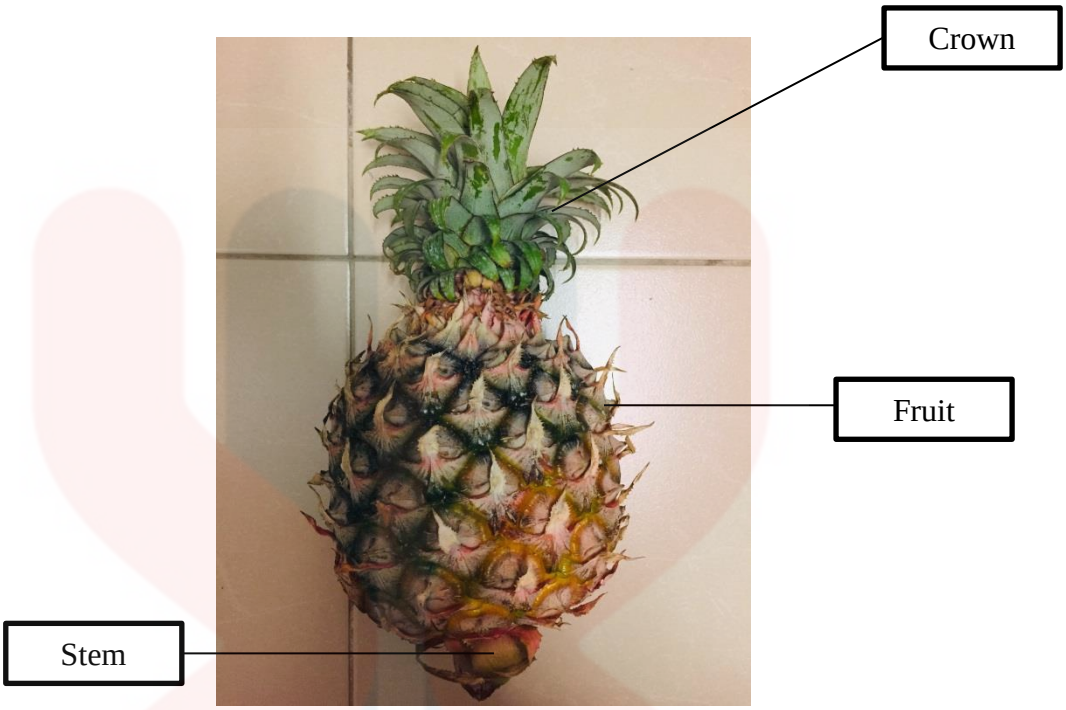


Figure 2.1 The morphology of *Ananas comosus*.

### 2.1.3 Nutritional value

Pineapple fruits are an excellent source of vitamins and minerals. According to Farid Hossain et al. (2015) showed that, main component of pineapple (*Ananas comosus*) have an amount range 81.2 to 86.2 % of moisture and 13 to 19 % total solids concentration of sucrose, glucose, and fructose. Table 2.1 shows the nutrients in 100 g of pineapples (Farid Hossain et al., 2015).

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Table 2.1 The nutrients in 100 g of pineapples.

| Nutrients | Amount |
|---|---|
| **Energy** | 52 calories |
| **Dietary fiber** | 1.40 g |
| **Carbohydrate** | 13.7 g |
| **Protein** | 0.54 g |
| **Iron** | 0.28 mg |
| **Magnesium** | 12 mg |
| **Calcium** | 16 mg |
| **Potassium** | 150 mg |
| **Phosphorus** | 11 mg |
| **Zinc** | 0.10 mg |
| **Vitamin A** | 130 IU |
| **Vitamin B 1** | 0.079 mg |
| **Vitamin B 2** | 0.031 mg |
| **Vitamin B 3** | 0.489 mg |
| **Vitamin B 6** | 0.110 mg |
| **Vitamin C** | 24 mg |

According to Chiet, Zulkifli, Hidayat, & Yaakob (2014), the total phenolic and tannin content present in the pineapples can contribute to the antioxidant capacity of the pineapples. Then, study by Yuangsoi, Klahan, Charoenwattanasak, & Lin (2018), fully digested protein help by enzyme protease and most of the animals cannot digest protein in the feed, but protease enzyme supplementation helps lead to better protein digestion. Other studies by Smith (2003), bromelain contain proteolytic enzyme complex can be



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used as a meat-tenderizer and as a nutraceutical with potential therapeutic activity can cause inflammatory changes, blood coagulation, debridement of severe burns, drug absorption, and tumors.

## 2.2 General waste

In Malaysia year of 2008, per day produced 23,000 tonnes of waste and only 5% of the waste is being recycled. Waste can be formed in solid, liquid or gas. Large quantities or scale of liquid and solid wastes are produced daily by the food processing industry in Malaysia. The waste materials contain biodegradable organic matter and disposal of them creates serious environmental problems and may cause pollution such as flood (Upadhyay, Lama & Tawata, 2010). Sustainable waste management is introduced how to maintain the balance between the environments, social, economic and there are a few aspects through several ways such as acts techniques in managing waste and implementation (Sin, Chen, Long & Hwang, 2012). Waste can be minimizing by reuse, recycling and composting.

Other than that, waste utilization by fruits and vegetable processing industries is one of the important and challengeable jobs around the world because highest the production of the new product based on fruit or plant to fulfill customer demand (Upadhyay, Lama & Tawata, 2010). The process to achieving sustainability in waste management needs time because it needs others cooperation how to handle the waste and must use the suitable technology and method (Sin, Chen, Long & Hwang, 2012). A few methods to decrease the production of waste such as utilized for further industrial

purposes through fermentation, extraction of bioactive components, and extraction of functional ingredients (Upadhyay, Lama & Tawata, 2010).

Then, fruit residues may cause accumulates in the agro-industrial yard and environmental problems without any significant and commercial value (Sin, Chen, Long & Hwang, 2012). In 2010, make feed production by using waste from plant or fruit has become a new industry and utilization of agro-industrial wastes as animal feed seems to mitigate the difficulties of forage shortage during critical seasons (Upadhyay, Lama & Tawata, 2010).

### 2.2.1 Waste of *Ananas comosus*

Waste can be produced through the agriculture industry which is from vegetables and fruit. Pineapples waste products are from core, peel and their crown. At Malaysia, all waste products does not use and normally the consumer just throws the waste product such as pineapples waste, banana waste, and coconut waste directly. All the wastes have specific nutritional value that can replace the expensive substance at the agricultural business (Upadhyay, Lama & Tawata, 2010). Then, pineapple waste contains a valuable nutrient value of simple sugar such as sucrose, glucose, and fructose.

The pineapple waste is either used as animal feed or disposed to the soil as a waste that can cause environmental problems (Roha, 2013). According to Scientiarum et al. (2012), nutritional composition of pineapple waste can be classified as an energetic source because pineapples waste presents a percentage average fewer than

20% of crude protein and fewer than 18 % of crude fiber. The pineapple waste productions as by-products are approximately 75 to 85 % of the production of pineapple peel, crown and core, while the pineapple peel is about 30 to 35 % (Roha, 2013).

Pineapples peel waste contained phenolic compound, folic acid, and vitamin A and C as an antioxidant Andrianto et al. (2013) while according to Inaolaji, (2011), pineapples peel wastes are a highly valuable product, which is the content of antioxidant property, sugar, the phenolic compound, high fiber, protein. Pineapple peel is rich in hemicellulose, cellulose and other carbohydrates. The amount of sugar contains in pineapple waste is different at different stages of pineapples maturity (Roha, 2013). Sucrose is a major sugar present in the pineapples waste especially in core and peel pineapples depend on the levels of maturity of the plant.

Study by Áila et al. (2016), the pineapple peel has highest nutritional content which is content highest dietary fibers and even though the protein and pineapple peel have the higher amount of sugar (9.75 %), non-reducing sugar (8.8 %) and protein content (10 mg). Based on other studies by Micu, Luca, Varga, Butuza-Bumb, & Nagy (2015), the pineapples peel was the content higher amount of total sugar and non-reducing sugar than juice, this was proven by the essential for growth of the microorganism and also found to be higher protein content in waste.

According to Wijana et al. (1991), the pineapple peel contains 81.72 % water contains 20.87 % crude fiber contain 17.53 % carbohydrate contains 4.41 % and 13.65 % of protein and reducing sugar. Then, pineapple peel also contains 8.01 % crude protein which contains 0.95 % of crude fat, while crude fiber contains 20.84 %, 13.52 % and 4405 Kcal/kg (Budiansyah et al, 1999; Raguati et al., 2015).

Pineapples plant also content higher amount of bromelain. Bromelain is a proteolytic enzyme that was found in pineapples plant. Proteolytic enzyme bromelain is functioning as digests food by breaking down protein. Refer to Nadzirah, Zainal, Noriham, & Normah (2016) bromelain treatment was applied to beef cut samples significantly ($P < 0.05$) increased the essential and non-essential amino acids content of beef. The potential of pineapple crown leaf extract has been evaluated in terms of its enzymatic activities related to wound healing, antimicrobial property, and toxicity (Dutta & Bhattacharyya, 2013).

Then, a pineapple leaf extract is nontoxic, which contains enzymes can prevent and treat from damage tissue repairing, wound healing and possibly prevents secondary infections from microbial organisms. Studies by Roha (2013), sucrose was not detected in the crown extract this is because of few factors such as the extraction used the ethanol from different concentration. Usually, to maintain the nutrient contain the distilled water is used as their solvent.

## 2.3 Tilapia feed

Commercial feed is the common feed that farmer used to feed their fish. It is because the commercial feed was easy and also as modern feed which contains balanced nutrition needed by the fish. The ingredients of commercial feed were vegetable proteins, cereal grains, vitamins, and minerals. Commercial feed usually in pellet form with round or cylinder shape. Wheat and oil is the example of binder for mixed all the ingredients (Almatar & James, 2007). The different type of commercial feed will influence the growth performance of fish. Usually, the commercial pellet has a rich



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amount of protein called amino acid source which rich sources of vitamin B-complex especially cobalamine (B12), niacin, choline, pantothenic acid and riboflavin (Omran et.al, 2017). Excess amount feed given to fish can cause highest amount of ammonia and the excess pellet will cause the fish excreted a lot amount of nitrogenous product (Omran et.al, 2017). In the aquaculture industry, farmers usually give fed to shrimp and fish with commercial pellet because of it easy to get, nutritious, and contain digestible feed ingredient.

Tilapia diets were different based on the different stages of fish which are fry, fingerling, and adult. According to Almatar & James (2007), new hatched tilapia with long 0.25 to 0.75 inches are eat detritus and neuston which organisms that float on the top water, fingerling or juvenile with long 0.75 to 1.5 inches commonly fed with detritus and periphyton which a complex mixture of algae and the last stage of tilapia is adults usually fed algae, bacteria, detritus, and other plants. Other studies by Omran et al. (2017), fry require the smaller size of feed that contain enough nutrients, fingerlings can be feed with formulated feeds that contain fats and protein to help in growth and for an adult can eat pellet diet that contains all nutrients.

## 2.4 Nile tilapia (*Oreochromis niloticus*)

In Malaysia, the production of Nile tilapia is highest, because tilapia contains the highest source of protein and easier consumer to get the sources. Malaysia was located in the middle of Southeast Asia which is the strategic location to make fishery product, important producer source of fish and market the product based on fish. Aquaculture industry and fishing activity can be developed in Malaysia because Malaysia is the

country free from natural disaster and have good climatic conditions. Tilapia is easy to farming and takes a short duration to become maturity. Tilapia also is the cheap sources of protein different with the price of beef. Then, tilapia farming will bring great benefit to Malaysia country because from tilapia farming the export and trading activities occurred (Trosvik et al., 2013).

Malaysia increased from 28,401 in 2005 to 38,642 tonnes in 2010 in aquaculture production of tilapia (Hamzah et al., 2014). The farmer increases the production of tilapia rapidly to fulfill the customer demand. Compare to all the tilapia species, Nile tilapia is one of the species that consider the most essential in the aquaculture sector throughout the world (Fitzsimmons, 2004).

Nile tilapia with the scientific name (*Oreochromis niloticus*) is one of the most-cultured fish in the world because tilapia has herbivorous and omnivorous feeding habits and tilapia also easy to get. Nile tilapias are a generally omnivorous or herbivorous habit and usually in fish diets contain high percentages of plant protein ingredients, such as soybean meal (Trosvik et al., 2013). Tilapia culture produced widely which is have 100 countries have run the production of farmed tilapia has increased the production from 383,654 mt in 1990 to 1,505,804 mt in 2002 (El-Sayed, 2011).

Each animal has their maturity time and usually, the maturity stage depends on the animals' size, age animals and environmental conditions (Popma & Lovshin, 1995). The tilapia species different with other species, which tilapia will fertilize eggs, nest builders are guarded in the nest by brood parent. For *Sarotherodon* species either male or both male and female are mouth brooders but for *Oreochromis* species, the females practice mouthbrooding (Popma & Lovshin, 1995).

The good potential of a few species tilapia culture cause increase the demands of tilapia between the worldwide (Fattah & El-sayed, 1999). According to El-Sayed, (2011) to increase the Nile tilapia productions the quality of fed must rich content of nutrition for the fish growing well.

Figure 2.2 *Oreochromis niloticus* fingerling

In range, 50 % of the problem that occurs from feeding which are the costs of aquaculture feed is too expensive for the farmer to purchase. Aquaculture sources of feed diet must contain a higher amount of protein content to fulfilled the nutrient requirement of the species. Other than that, tilapia also need to be fed with containing the high amount of dietary sources such as larval fish, detritus and zooplankton (Mjoun, Rosentrater, & Brown, 2010).

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### 2.4.1 Taxonomy

Tilapia is from a genus of cichlid fishes and usually adapt to the freshwater habitats. Tilapia is the species have a large amount of genus including all species with the common name of tilapia. *Oreochromis niloticus* is the specific name of Nile Tilapia. All of the tilapia species are nest builders and the fertilized egg in the nest is guard by brood parent. The taxonomy of Nile tilapia is starting with kingdom and end with ITIS (2017).

| | |
|---|---|
| Kingdom: | Animalia |
| Subkingdom: | Bilateria |
| Infrakingdom: | Deuterostomia |
| Phylum: | Chordata |
| Subphylum: | Vertebrata |
| Infraphylum: | Gnathostomata |
| Superclass: | Osteichthyes |
| Class: | Actinopterygii |
| Subclass: | Neoptergii |
| Order: | Perciformes |

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Suborder: Labroidei

Family: Cichlidae

Genus: *Oreochromis*

Species: *Oreochromis niloticus*

### 2.4.2 Tilapia Culture

Environmental condition is one of the factors for fish to growth such as different water quality had the different performance of fish. Tilapia species usually tolerate with the extreme conditions such as highest dissolve oxygen, highest salinity, temperature, pH and ammonia level.

Table 2.2 The limits and optimum of water quality parameter for tilapia. (Mjoun, Rosentrater & Brown, 2010).

| Parameter | Range | Optimum for fish growth |
|---|---|---|
| **Salinity, part per thousand** | Up to 36 | Up 19 |
| **Dissolve oxygen, mg/L** | Down to 0.1 | > 3 |
| **Temperature, ˚C** | 8 to 42 | 22 to 29 |
| **pH** | 3.7 to 11 | 7 to 9 |
| **Ammonia, mg/L** | Up to 7.1 | < 0.05 |

In generals, tilapia can highly tolerant of low dissolved oxygen concentration even though the concentrations down to 0.1 mg/L and temperature for optimum growth is between range 22˚C and 29˚C (Mjoun et al., 2010). Factors that influence the reproduction, digestion, and growth of fish is temperature. According to Amos (2013), the optimum range of temperature is about 23 to 30℃ and the ideal temperature of the surrounding water should range 26 to 28℃.

For growth stage well saline for tilapia is up to 15 ppt perform better at salinities below 5 ppt and the Nile tilapia is the least saline tolerant of the commercially important species (Hamzah et al. 2014). To achieve the good development, growth or reproduction of tilapia, the temperature must at the suitable range from 25 to 30℃ (El-Sayed, 2011).

### 2.4.3 Nutrient requirement and feeding behavior

Tilapia usually need enough protein requirements this is because tilapia provides a lot of protein sources toward the consumer and help their growth to fulfill the demand. In Malaysia, the farmer usually mixed the fish diet either with animal's protein sources or plant protein sources to lower the cost fish diet (Ahmad, Abdel-Tawwab, & Khattab, 2004). Tilapia is one of the species that tolerance to low water quality and quite impervious to disease (Ahmad, Abdel-Tawwab, & Khattab, 2004). The farmer needs to control the feed given of tilapia because tilapia had small stomach and tilapia species also are categorized by non-stop feeding behaviour (Davis, 2009).

Many studies indicated that protein requirement for maximum performance of tilapia during larval stages or fry is relatively high range 35 to 50 % (El-Sayed, 2011)

and protein requirement for tilapia juveniles or fingerlings is range from 30 to 40 %. Normally for tilapia need, average from 32 to 38 % amount of protein level and carnivorous fish need the highest amount of protein level than herbivores fish and omnivorous fish (Davis, 2009). Tilapia fish with average weight from 5 to 25 g required 25 to 35 % of protein while 1 to 5 g fish needs 30 to 40 % of protein (Ahmad, Abdel-Tawwab, & Khattab, 2004).

The fish cannot achieve the optimum growth performance, if the fish lack of protein requirement. Usually in aquaculture field, tilapia normally needs average from 32 to 38 % of protein level and at the fingerlings level usually, tilapia need enough amount of protein to increase their body weight (El-Sayed, 2011). Protein and lipid or fat contents in the whole fish body were affected by the fish size and dietary protein level (Ahmad et al., 2004). In other hands, fish also need enough amino acid requirements for their growth performance (El-Sayed, 2011).

According to El-Sayed (2009), the salinity of the culture system must be observed to influence metabolism, homeostatic processes in fish and may be influenced by the feeding behaviour of fish. Other than that, the growth performance of Nile tilapia also depends on a few factors such as season, water temperature, dissolved oxygen level and the water quality in the aquarium (Davis, 2009).

Fingerlings need a lot of nutrients to compare to adult tilapia. The increasing of Nile tilapia size, the frequency of tilapia feeding may be decreased (El-Sayed, 2011). According to El-Sayed (2004), juvenile fish with range weight 0.02 to 10.0 g require a diet higher in protein, lipids, vitamins and minerals and lower in carbohydrates. Sub-adult fish with range weight 10 to 25 g require more energy from lipids and carbohydrates for metabolism and a lower proportion of protein for growth. An adult

fish with the range weight highest than 25 g required less dietary protein for growth and can utilize even higher levels of carbohydrates as a source of energy.

### 2.4.4 Stoking density of fish

Stocking density is the amount or stoking rate of fish depend on amount or body weight of fish per unit of water area. Stocking density is one of the factors that influence the behavior of the fish, growth rate of fish and feed consumption between the fish. The optimum nutrition value and optimum water quality are when the tilapia stoked at an equivalent size (Popma & Lovshin, 1995). Each fish does not get sufficient natural food, so if tilapia fed with the nutritionally incomplete diet and the growth performance of tilapia might be slow. The rate of feed consumption by feed will affect the sub-optimal water temperature and feed excess might cause toxic to water quality (Amos, 2013).

Usually tilapia with the low density in the aquarium wills growth at the optimal rate and the stocking density increase the food supply becomes limited and the growth performance low. Usually, farmer need check the optimum stocking density to each aquarium to produce a higher yield of fish with the good size development (Popma & Lovshin, 1995). According to Bjornsson (1994), fish will be stress and less eating when the stoking density is too crowded. Weight gain, condition factor and food utilization of Nile tilapia also affect the stocking density (Amos, 2013).

According to Popma & Lovshin (1995), the tilapia take a long time to reach marketable size, fish yield will be low and greater the risk of disease if the stocking

density is higher. Then, producers have other three alternatives to reduce the period of growth cycle which is reduced the stocking density, improved feed quality and modified the environmental conditions such as increase the aerator. According to Amos (2013), the effect of stocking density were it was significantly on the growth and profitability of Nile tilapia in terms of daily weight gain, food utilization, condition factor, specific growth rate and yield.

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# CHAPTER 3

# METHODOLOGY

## 3.1 Feed preparation

The pineapples (*Ananas comosus*) waste (Peel and Crown), were collected at Jeli, Kelantan. Pineapples waste was cleaned up to get off the dirt. The pineapples wastes were weighting by using the digital balance (Sartorius) and were ground using an electric blender (Milux). The samples were dried into the oven (JeioTech) to dry the samples at temperature 40˚C for 24 hours. The commercial feed (Dolphin's brand) was bought at the market area Jeli as control treatment.


Figure 3.1 The waste (peel and crown) of *Ananas comosus.*

### 3.1.1 Feed extraction

The dry pineapples wastes were undergone extraction process by using the soxhlet extraction apparatus (Laboff). Distilled water was used for the extraction process. The dried of pineapples waste was mixed with distilled water (250 ml / 50 g of pineapples waste) in soxhlet apparatus and extracted for 60 min (method modified from Sivakumar and Santhanam, 2011). The solvent and the cycle might constant and the temperature must follow the boiling point of distilled water which is 100 ˚C.

After the extraction process, the pineapples extract was concentrate by using the vacuum rotary evaporator at a temperature of 80 ℃ or lower (method modified from Sivakumar and Santhanam, 2011). All the extraction was stored in the refrigerator at - 80℃ until the next experiment.

### 3.1.2 Spray dry method

The extraction of pineapples waste sprayed on the commercial pellet to test the efficiency of the pineapples waste on the growth performance of *Oreochromis niloticus*. The results were show which treatments reach the best result for this study.

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Table 3.1 The percentage of pineapples (*Ananas comosus*) waste (peel and crown) extract with commercial pellet.

| Treatment | Description |
|---|---|
| **Diet 1** | 100 % Commercial feed |
| **Diet 2** | Commercial feed + 10 % of Pineapples (*Ananas comosus*) Waste (Peel and Crown) extract |
| **Diet 3** | Commercial feed + 20 % of Pineapples (*Ananas comosus*) Waste (Peel and Crown) extract |
| **Diet 4** | Commercial feed + 30 % of Pineapples (*Ananas comosus*) Waste (Peel and Crown) extract |

Diet 1= 0 % Pineapples Waste Extract (PWE), Diet 2= 10 % PWE, Diet 3= 20 % PWE, Diet 4= 30 % PWE

## 3.2 Fish culture

This experiment was conducted at Aquaculture Laboratory Universiti Malaysia Kelantan Jeli Campus. The Nile tilapia fingerling was bought from the supplier at Gual Ipoh, Tanah Merah. Total of 12 rectangular aquarium tanks with the size of 0.6m x 0.43m x 0.43 was used and filled with 25 L of dichlorine water to fill with stocking density of 30 fingerlings per aquarium. For this experiment, the average initial weight is 5 ± 1 g per fish. Three aquariums were used for a control that fish feed with 100% of the commercial pellet and another nine aquaria were treated with the different treatments. For the first treatment fish was fed with commercial pellet + 10% pineapples (*A. comosus*) waste extract. Then, for second treatment fish was being fed with commercial

pellet + 20% pineapples (*A. comosus*) waste extract. Lastly for third treatment, fish was feed with commercial pellet + 30% Pineapples (*A. comosus*) waste extract.

The Nile tilapias were fed twice per day between 8.30 am to 9 am and 4 pm to 5 pm. The amount of feed given according to 5% of body weight throughout the experiment period (Bhilave, Bhosale, & Nadaf, 2010). The leftover and tilapia feces for each aquarium were been taken out every day by using the sieve. The culture water also was changed every week to maintain the water quality of fish culture. The Nile tilapia were sampling per week between 8.30 am to 9 am.

The water quality parameter was checked for each aquarium. The dissolved oxygen and the temperature has been measured by using the multiparameter. The water pH was measured by using the pH meter. The ammonia and nitrate also were checked important to ensure the continued health of tilapia by using the ammonia test. Monitored freshwater is at temperature the 27 ± 1˚C, pH 7 to 8 and dissolved oxygen (DOC) of 7.1 to 8.1 mg L-1 (El-Sheriff & El-Feky, 2009a; El-Sheriff & El-Feky, 2009b).

### 3.3 Data collections and analysis

The data growth performance of tilapia was recording throughout eight weeks. The tilapia was randomly selected to be determined the fish average weight by using the electronic balance. The aquarium has been checked every day to remove dead fish and floating materials. The tilapia weight gains, specific growth rate (SGR), feed conversion ratio (FCR) was determined by Bhilave, Bhosale, & Nadaf (2010). The amount of fed

given according to 5% of body weight throughout the experiment period and the fish will be feed twice per day. The formulas were used in this experiment are:

a) Weight gain = Final weight of tilapia – Initial weight of tilapia

   Percentage of weight gain (MWG) in gram = (W2 – W1 / N) x 100

   Where,

   W1 = Initial weight of tilapia

   W2 = Final weight of tilapia

   N = Number of weeks

b) Specific growth rate (SGR) formula:

$$\text{SGR (\% per day)} = \frac{(\text{In W2} - \text{In W1})}{(T2 - T1) \times 100}$$

   Where,

   W1 = Initial weight of tilapia

   W2 = Final weight of tilapia

   T1 = Initial duration (time)

   T2 = Final duration (time)

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c) Feed conservation ratio (FCR). This calculation is according to feed intake and weight gain tilapia.

$$FCR = \frac{[\text{Total feed consumed by fish (g)}]}{[\text{Weight gain by fish (g)}]}$$

## 3.5 Statistical analysis

All the data were analyzed using the Software Program (SPSS), Version 24.0 for Windows follows by Duncan multiple range tests with significance of ($P < 0.05$).

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# CHAPTER 4

# RESULT AND DISCUSSION

## 4.1 Effect of Pineapples (*Ananas comosus*) Waste Extract on the Growth Performance of Nile tilapia (*Oreochromis niloticus*) Fingerlings

After eight weeks of the experiment, Weight Gain (WG), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Survival Rate (SR) and Environmental Condition was collected. Table 4.1 showed result for Weight Gain (WG), Percentage of Weight Gain (PWG), Specific Growth Rate (SGR), and Feed Conversion Ratio (FCR). The first treatment is control (Diet 1) which is only giving the commercial pellet to Nile tilapia. For the second treatment (Diet 2), the Nile tilapia fed with commercial pellet + 10 % pineapples waste extract (PWE). Then, for third treatment (Diet 3) the Nile tilapia were fed with commercial pellet + 20 % pineapples waste extract and for the fourth treatment (Diet 4) Nile tilapia were fed with commercial pellet + 30 % pineapple waste extract. Nile tilapia fed with (PWE) showed better growth than those fed with Diet 1 (control) feed.

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Table 4.1 Result for Weight Gain (WG), Percentage of Weight Gain (PWG), Specific Growth Rate (SGR), and Feed Conversion Ratio (FCR).

| Treatment | Initial Weight (g) (Mean ± SD) | Final Weight (g) (Mean ± SD) | Weight Gain (g) (Mean ± SD) | Percentage of Weight Gain (%) (Mean ± SD) | Specific Growth Rate (%) (Mean ± SD) | Feed Conversion Ratio (Mean ± SD) | Survival Rate (%) (Mean ± SD) |
|---|---|---|---|---|---|---|---|
| **Diet 1** | 5.01 ± 0.10[a] | 18.92 ± 0.02[a] | 13.91 ± 0.11[a] | 277.54 ± 8.07[a] | 2.42 ± 0.04[a] | 3.35 ± 0.54[a] | 67.78 ± 21.17[a] |
| **Diet 2** | 5.14 ± 0.25[a] | 19.82 ± 0.80[b] | 14.68 ± 0.17[b] | 286.39 ± 17.79[a] | 2.46 ± 0.08[a] | 4.88 ± 0.04[c] | 81.11 ± 8.39[ab] |
| **Diet 3** | 5.12 ± 0.14[a] | 20.27 ± 0.14[c] | 15.15 ± 0.28[c] | 296.50 ± 13.96[a] | 2.50 ± 0.06[a] | 3.87 ± 0.05[b] | 75.56 ± 15.03[ab] |
| **Diet 4** | 5.06 ± 0.74[a] | 21.96 ± 0.19[d] | 16.90 ± 0.22[d] | 334.44 ± 7.84[b] | 2.67 ± 0.03[b] | 4.69 ± 0.02[c] | 95.55 ± 3.85[b] |

Diet 1= 0 % Pineapple Waste Extract (PWE), Diet 2= 10 % Pineapple Waste Extract, Diet 3= 20 % Pineapple Waste Extract, Diet 4= 30 % Pineapple Waste Extract

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The initial weight of fish for all treatment is range 5 ± 1 g and the end of the experiment the weight is range 18 to 21 g at Diet 4. Based on the data, Diet 4 contains 30 % of PWE showed the highest weight gain with 16.90 g. Then, the results were followed by Diet 3 with weight gain 15.15 g and Diet 2 which is 14.68 g. Diet 1 (control) showed lower weight gain with 13.91 g. From the result, weight gain and percentage of weight gains were showed there have significantly different between all the treatments ($P < 0.05$).

Based on the previous study by Yuangsoi, Klahan, Charoenwattanasak, & Lin (2018), Nile tilapia fed with feed supplemented with 1 % PWE resulted in the optimum protein digestibility, growth, and feed utilization ($P < 0.05$) and shows there are no significant differences between all the diets. From this study showed Nile tilapia fed with feed supplemented with 30 % PWE reach better growth performance, optimum specific growth rate and better survival rate but the feed conversion ratios not reach optimum range. From the previous study, the experiment was used the fermented waste pineapples different with novel experiment and cause there are differences at the result.

After eight weeks of the experiment, the data showed that, the growth performance for each treatment increase consistently. Diet 4 that contains 30 % of pineapples waste extract (PWE) showed a good performance between other treatments. According to Yuangsoi et al. (2018) and Singh et al. (2011), carp diets supplemented with 2 % PWE had the highest growth rate compared with the control data. Pineapple waste extract contains protease enzyme hydrolyzes to release short peptides in the diet and key factor for increasing protein digestibility and fast absorption, improving growth factors (Yuangsoi et al., 2018).

Based on the data, the maximum specific growth rate of Nile tilapia at Diet 4 had the largest value with 2.67 % compared to Diet 1 with 2.42 %, Diet 2 with 2.46 %, followed by Diet 3 with 2.50 %. From the result, specific growth rate was showed there have significant different between all the treatments ($P < 0.05$). The previous study by Yuangsoi et al., (2018), results specific growth rate show a statistically significant difference ($P < 0.05$) for specific growth rate and Nile tilapia fed with fermented pineapples waste were improved growth over those fed the control diet.

Feeding fish with protease enzyme supplementation results in complete protein digestion. Other studies by Singh et al. (2011), the data showed that, carp fish had the highest specific growth rate with 2.86 % in diets supplemented with 2 % papain compared data control treatment. The higher value of papain help breaks proteins down into smaller protein fragments because contain the proteolytic enzyme.

A study by Hassan et al. (2018), the data showed that, feed conversion ratio of tilapia was significant different ($P < 0.05$) with average amount of FCR is 3.16 to 2.71 in turmeric, rosemary and thyme groups compare to the control group. Different herbal plants improve the nutrient utilization of better growth of the fish. Table 4.1 shows differences between Diet 1, Diet 2, Diet 3, and Diet 4 for feed conversion ratio. Diet 2 showed the highest value of FCR 4.88 compare to Diet 4 with FCR 4.69, followed by Diet 3 with FCR 3.87 and Diet 1 with FCR 3.35. However, the FCR showed there have significant difference between the treatments ($P > 0.05$).

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The study by Yuangsoi et al. (2018) have proved that, Nile tilapia range 6.25 ± 0.17 g fed with 1% PWE supplementation had the optimum fish growth but showed the lowest FCR with 1.13 value ($P < 0.05$). According to Kumar (2011), fish size range 8.76 ± 0.17 g has the optimum amount of feed conversion ratio (FCR) is range 1.1 to 1.8. These results may be attributed to a fast metabolism in fish that are fed PWE supplemented the diet, which would shows result in better FCR. Other than that, the lower of the feed conversion ratio also showed the highest weight gain that normally obtained from the feed. In this study, all treatment had the highest value of FCR, that's mean fish used the highest energy for movement and total feed intake by fish was being wasted (Kumar, 2011).

Factor that influence feed conversion ratio (FCR) are management practices, environmental conditions, feed quality, inherent genetic factor and physiological condition of the fish (Eriegha & Ekokotu, 2017). The lower value of FCR is more efficient because fish used less energy for movement (Hassan et.al, 2018).

Based on Table 4.1, the survival rate of the Nile tilapia showed that Diet 4 have the highest survival rate which is 95.56 % compare to Diet 2 with the survival rate of 81.11 %. However, the lower range of survival rate was found in Diet 1 with 67.78 % and followed by Diet 3 with 75.56 %. From the result, survival rate was showed there have significant different between all the treatments ($P < 0.05$). This is because diet supplement with pineapple waste extract that contains protease enzyme can increase the growth rate of Nile tilapia (Yuangsoi et al., 2018).

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According to Yuangsoi et al. (2018) found that, 100 % of survival rate on Diet 1 which is control diet and Diet 2 which contain 1% of PWE. Other than that, the survival rate in this study was not 100 % survive because of cannibalism between the Nile tilapia fish.

Study by Fessehaye, Kabir, Bovenhuis & Komen (2006) showed that, factor that affect the behavior of cannibalism is food availability, feeding frequency, water parameter, and environmental condition. Other studies by Asase (2013) showed that, increase size of fish may increase the rate of cannibalism and higher stocking density may increase the rate of mortality. The fish have higher competition during feeding time and lead to a struggle to eat the feed.

## 4.2 Water quality of fish culture.

Table 4.2, showed the average of water parameter. Data showed that the temperature of 30 aquariums were range from 26.0 to 28.5℃. According to Amos (2013) showed that, the temperature surrounding water within 26 to 28 ℃ was very stable temperature and an optimum range of temperature was about 23 to 30℃ and if the temperature reaches 37 ℃ or 38 ℃ the tilapia become a problem which are stress-induced disease and mortality.

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Table 4.2 Average of water quality parameter culture of Nile tilapia fingerlings.

| Water parameter | Experiment data recorded |
|---|---|
| **Temperature** | 26.0 to 28.5 ˚C |
| **Dissolve oxygen** | 4.14 to 5.74 mg / l |
| **pH** | 7.10 to 7.50 |

Dissolved oxygen in this study showed that all aquariums were range from 4.14 to 5.74 mg / l. For the best result were in a standard range of dissolve oxygen species is below than 2 mg / l because the fish not get sufficient oxygen (Amos, 2011). The study by Ross (2000) the concentrations of dissolved oxygen are stable and ideal at a range greater than 3 mg / l at optimum growth for *Oreochromis niloticus* and other studies by Kumar (2011) said that, the optimum dissolve oxygen above 5 mg / l.

Then, pH reading in this study was at range 7.10 to 7.50. The more feed excessive, the higher the temperature and can cause the fish stress (Amos, 2011). As mention by (El-Sheriff & El-Feky, 2009), pH level 7 to 8 were more suitable to Nile tilapia fingerlings with the average initial weight of 19.0 ± 1.0 g for optimum growth performance and increase the survival rate. According to Ross (2000), *Oreochromis niloticus* can adapt with pH lower than 5, however, *O. niloticus* were stable in growth with pH range between 7 to 9. The study by Yuangsoi et al., (2018) throughout the experiment the level of water quality parameters had been measured every three days including pH value that is 7.87 ± 0.27, dissolve oxygen 6.05 ± 0.38 mg $L^{-1}$ and temperature 22.88 ± 0.89 ˚C.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATION

## 5.1 Conclusion

As a conclusion, pineapples (*Ananas comosus*) waste extract was an effect on the growth performance of Nile tilapia. The overall result about the different diet among the treatment is Diet 4 that contains 30 % pineapples waste extract (PWE) showed the best growth performance with the good performance weight gain that was 16.90 g. Diet 4 also showed the best specific growth rate (SGR) with 2.67 % / day, feed conversion ratio (FCR) 4.69 among other. Diet 4 had better percentage of survival rate which is 95.56 % compared to other treatment. The result in this study showed diet 4 had the lower rate of mortality and the weight gain also increase consistently. The environmental condition such as temperature, dissolved oxygen, and pH was in the average value and support the growth performance of Nile tilapia.

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## 5.2 Recommendation

In this study, the method was added or spray the pineapples waste extract (PWE) toward the commercial pellet as a supplement added to feed showed either it help on the growth performance of Nile tilapia. For the further study, the method of spraying the extraction on the commercial pellet can be changed to the made a new formulation of fish feed by added pineapples waste. The expectation for the suggestion is the feed more nutritious because all an ingredient binds perfectly. The different method will show the different value of nutrient and acceptation of fish toward the feed also different.

Then, from this study handling time when taking sampling method need to do carefully in order to get the good result. The size of Nile tilapia are not uniform in each of the tank because there is competing in each of the aquariums when came to feeding. As the result, some fish were having more weight compared to other fish. For further study, choosing the fish that are larger can improve the method of sampling the fish. For the stocking density, fish were having great growth performance if the space for them in the tank wider. The fish need more space so that the population in the tank were having less stress and less cannibalism detected. So for the further study, rearing the fish with a larger tank will result in a good growth performance as it will result in good survival rate also.

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## APPENDIX A

Table A.1 One-way ANOVA.

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Initial Weight | Between Groups | .028 | 3 | .009 | .375 | .774 |
| | Within Groups | .201 | 8 | .025 | | |
| | Total | .229 | 11 | | | |
| Final Weight | Between Groups | 14.580 | 3 | 4.860 | 291.966 | .000 |
| | Within Groups | .133 | 8 | .017 | | |
| | Total | 14.713 | 11 | | | |
| Weight Gain | Between Groups | 14.483 | 3 | 4.828 | 113.314 | .000 |
| | Within Groups | .341 | 8 | .043 | | |
| | Total | 14.824 | 11 | | | |
| Percentage Weight Gain | Between Groups | 5645.145 | 3 | 1881.715 | 11.799 | .003 |
| | Within Groups | 1275.881 | 8 | 159.485 | | |
| | Total | 6921.026 | 11 | | | |
| SGR | Between Groups | .113 | 3 | .038 | 11.180 | .003 |
| | Within Groups | .027 | 8 | .003 | | |
| | Total | .140 | 11 | | | |
| FCR | Between Groups | 4.605 | 3 | 1.535 | 20.970 | .000 |
| | Within Groups | .586 | 8 | .073 | | |
| | Total | 5.190 | 11 | | | |
| Survival Rate | Between Groups | 1236.874 | 3 | 412.291 | 2.172 | .169 |
| | Within Groups | 1518.770 | 8 | 189.846 | | |
| | Total | 2755.644 | 11 | | | |

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Table A.2 Post Hoc Analysis using Duncan Multiple Test for Final Weight.

**Final Weight**

Duncan

| Treatment | N | Subset for alpha = 0.05 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Diet 1 | 3 | 18.923233 | | | |
| Diet 2 | 3 | | 19.817233 | | |
| Diet 3 | 3 | | | 20.265900 | |
| Diet 4 | 3 | | | | 21.956600 |
| Sig. | | 1.000 | 1.000 | 1.000 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.3 Post Hoc Analysis using Duncan Multiple Test for Weight Gain.

**Weight Gain**

Duncan

| Treatment | N | Subset for alpha = 0.05 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Diet 1 | 3 | 13.909467 | | | |
| Diet 2 | 3 | | 14.680700 | | |
| Diet 3 | 3 | | | 15.151400 | |
| Diet 4 | 3 | | | | 16.901867 |
| Sig. | | 1.000 | 1.000 | 1.000 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.4 Post Hoc Analysis using Duncan Multiple Test for Percentage of Weight Gain.

**Percentage Weight Gain**

Duncan

| Treatment | N | Subset for alpha = 0.05 | |
|---|---|---|---|
| | | 1 | 2 |
| Diet 1 | 3 | 277.537568 | |
| Diet 2 | 3 | 286.391521 | |
| Diet 3 | 3 | 296.503595 | |
| Diet 4 | 3 | | 334.442764 |
| Sig. | | .116 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.5 Post Hoc Analysis using Duncan Multiple Test for Specific Growth Rate.

**Specific Growth Rate (SGR)**

Duncan

| Treatment | N | Subset for alpha = 0.05 | |
|---|---|---|---|
| | | 1 | 2 |
| Diet 1 | 3 | 2.415180 | |
| Diet 2 | 3 | 2.456332 | |
| Diet 3 | 3 | 2.503829 | |
| Diet 4 | 3 | | 2.670520 |
| Sig. | | .110 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.6 Post Hoc Analysis using Duncan Multiple Test for Feed Conversion Ratio.

**Feed Conversion Ratio (FCR)**

Duncan

| Treatment | N | Subset for alpha = 0.05 | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Diet 1 | 3 | 3.351083 | | |
| Diet 3 | 3 | | 3.874934 | |
| Diet 4 | 3 | | | 4.690683 |
| Diet 2 | 3 | | | 4.883914 |
| Sig. | | 1.000 | 1.000 | .407 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Table A.7 Post Hoc Analysis using Duncan Multiple Test for Survival Rate.

**Survival Rate (SR)**

Duncan [a]

| Treatment | N | Subset for alpha = 0.05 | |
|---|---|---|---|
| | | 1 | 2 |
| Diet 1 | 3 | 67.7767 | |
| Diet 3 | 3 | 75.5567 | 75.5567 |
| Diet 2 | 3 | 81.1100 | 81.1100 |
| Diet 4 | 3 | | 95.5533 |
| Sig. | | .288 | .127 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

## APPENDIX B

Figure B.1 *Ananas Comosus* waste (peel and crown).

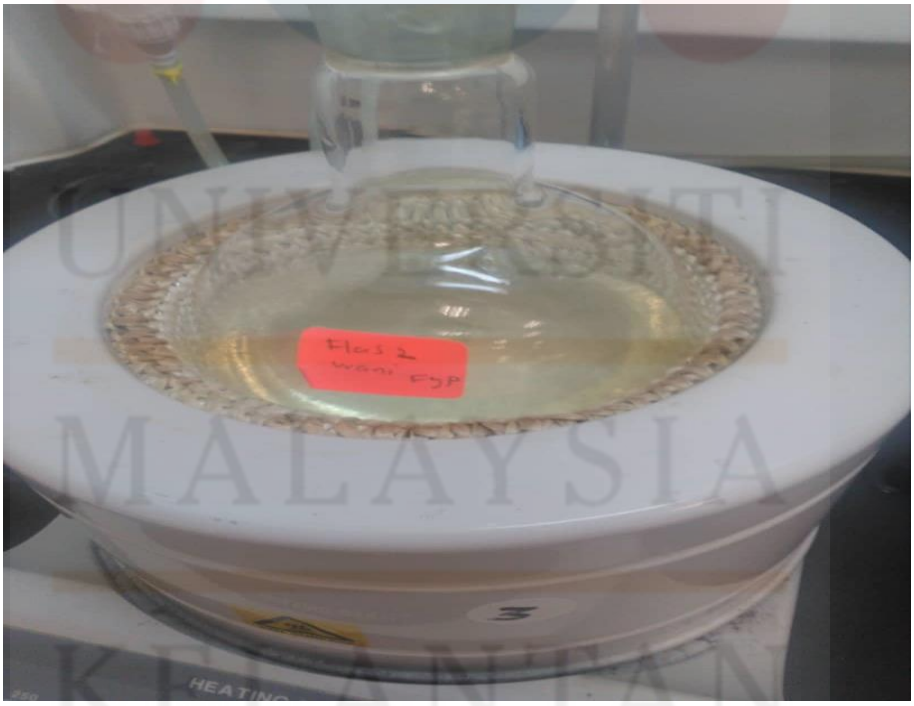

Figure B.2 Extraction process by using soxhlet apparatus.

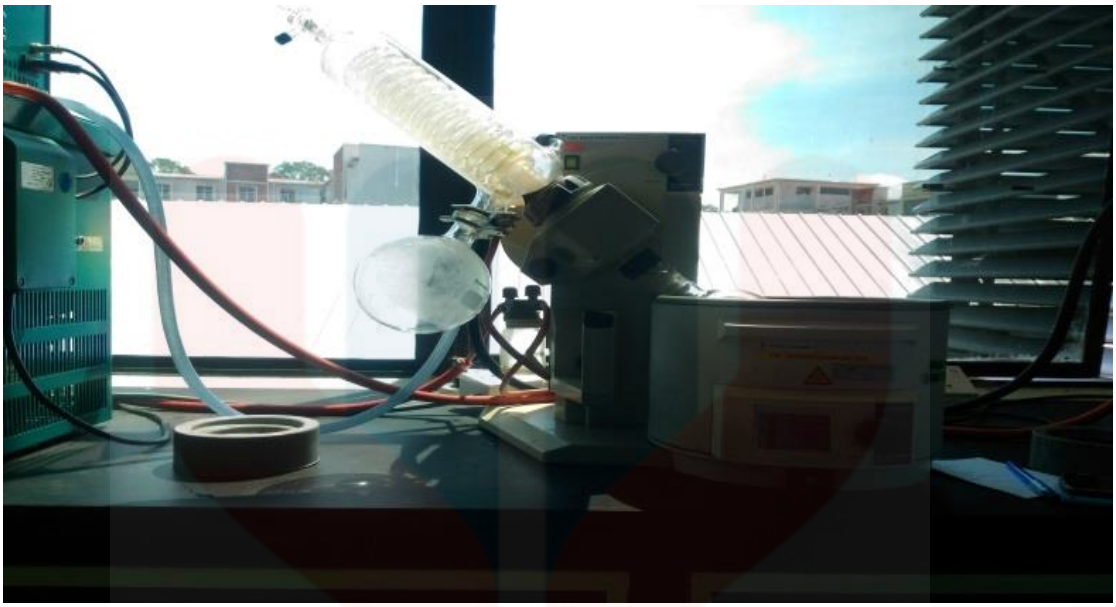

Figure B.3 Rotary machine.

Figure B.4 Rotary evaporator in progress.

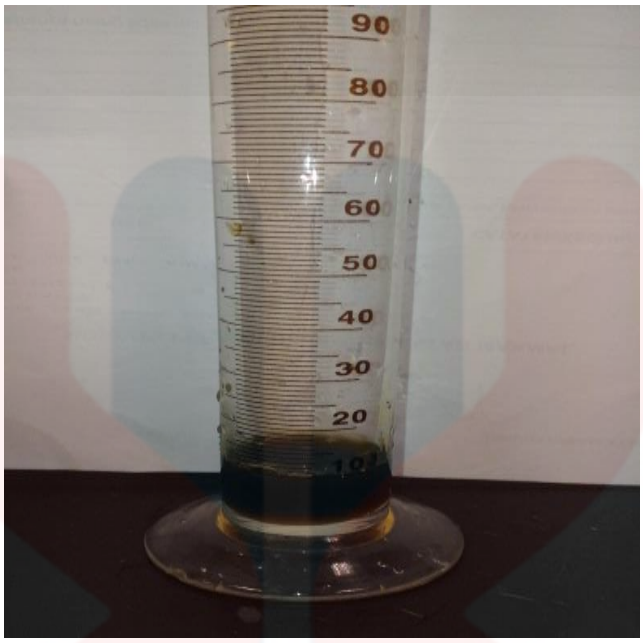


Figure B.5 Crude extract.

Figure B.6 Spray commercial with pineapples waste extract.

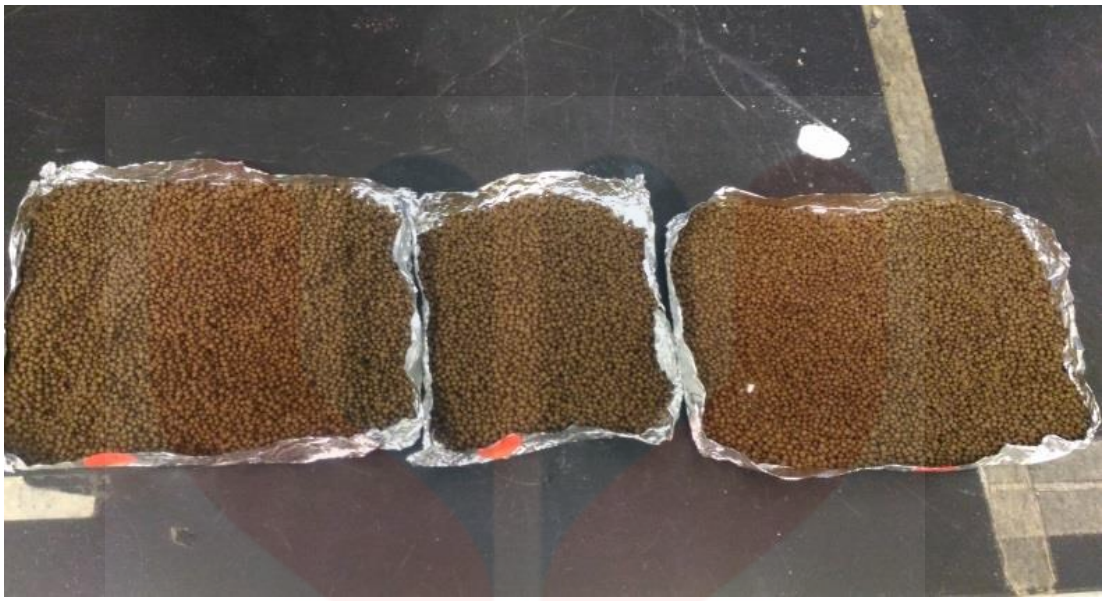

Figure B.7 Experimental design.

Figure B.8 Aquarium preparation.

Figure B.9 Check water parameter.

Figure B.10 *Oreochromis niloticus* sample.

Figure B.11 Died fish because of cannibalism.

Figure B.12 Sampling preparation.


Figure B.13 Weight balance to do sampling.

Figure B.14 Located fish at the big tank during assimilation week.