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VEGETABLE WASTE AS FEED ON THE GROWTH OF TILAPIA (OREOCHROMIS NILOTICUS)

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ABSTRACT

Because of its quick development, effective use of natural feed, propensity to take a variety of supplemental feeds, herbivorous nature, resistance to infection and handling, ease of reproduction, and excellent tolerance for environmental conditions, tilapia is a top priority in tropical aquaculture. Depending on the size of the fish, the amount of natural feed available, and other elements like the quality of the protein and energy levels, different fish have different nutritional needs. Feed plays a crucial role as a source of energy for an organism's survival, growth, and reproduction. Due to Indonesia's continued reliance on imports for the supply of raw materials like fish meal and soybean meal, the cost of feed must be high. The selling price of fish, which has increased very little, is inversely linked to the price of feed, which continues to rise sharply. On the other hand, a variety of leftovers and waste products from human activity upset the environment greatly and have the potential to damage it. Waste from conventional markets is one that can be used as fish feed. This restaurant waste may take the form of vegetables (such as pakcoy, water spinach, lettuce, and spinach), fruits, or other materials. Through the use of suitable vegetable waste, this study aims to identify alternate source materials for fish feed. When maintained for 10 weeks, some Tilapia showed good absolute growth, gaining 83.24 grams. Additionally, feeding fish vegetable waste yields almost the same values for feed conversion, specifically between 20.92 and 26.01.

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1. INTRODUCTION

Tilapia is a top priority in aquaculture in the tropics because of its fast growth, efficient use of natural feed, tends to consume a variety of supplementary feeds, is herbivorous, resistant to disease and handling, easy to reproduce, and has a high tolerance for environmental conditions [1]. Red tilapia is classified as a voracious animal/plant-eating (omnivorous) fish. When still a seed, likes zooplankton (Rotifer, Moina and Daphnia) in addition to algae or mosses and other aquatic plants. Fish can also be given artificial feed/pellets [2]. The nutritional requirements of fish differ depending on the size of the fish, the amount of natural feed available and other factors such as protein quality and energy levels. Tilapia requires 10 amino acids, including: arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine [1].

Tilapia (*Oreochromis niloticus*) is a freshwater fish species that has high economic value and is widely cultivated to meet consumer demand for animal protein needs. [3], reports that Indonesia occupies the second position as the largest producer in tilapia aquaculture production with total production reaching 1.12 million metric tons (MMT) after the People's Republic of China which is the largest producer which occupies the top position in producing tilapia (1.78 MMT) and the third largest producer of tilapia is Egypt (0.88 MMT), with global tilapia production reaching ±6.4 million metric tons (MMT) [4].

Figure 1. Tilapia (*Oreochromis niloticus*)

The manufacture of feed for non-intensive aquaculture can be done in aquaculture by fish farmers (on farm feed) so that cheaper feed can be obtained. Production costs in the on-farm feed system are cheaper because they can utilize local materials that are widely available around the cultivation site, including agricultural waste. Feed has an important role as a source of energy for the survival, growth and reproduction of an organism [5]. Only 10% of the feed consumed by fish is used for growth and the rest is used for body maintenance, replacing damaged cells, healing wounds and a source of energy for movement [6].

[7] states that the amount of feed given to fish must be in accordance with the needs of the fish. If too little feed is given, competition will arise in taking feed, so that growth becomes slow and individual sizes are not uniform. Conversely, if excessive feeding becomes inefficient and there are residues that are not eaten by fish. This residual feed can reduce water quality, which can interfere with the survival and growth process of fish. The nutritional content needed by fish in feed to achieve maximum growth is protein, carbohydrates, fat, vitamins and minerals [8].

Fish farming activities will spend relatively large production costs for the provision of feed [9]. Provision of feed is one of the determining factors for the success of fish farming activities. The high cost of feed that must be incurred is due to the fact that Indonesia is still dependent on imports for the supply of raw materials such as fish meal and soybean meal. The price of feed continues to experience a sharp increase but is inversely proportional to the selling price of fish, which has a relatively small increase. On the other hand, various wastes and leftovers resulting from human activities are very disturbing to the environment and have the potential to pollute the environment. One that can be used as fish feed is waste from traditional markets. This restaurant waste can be in the form of vegetables (kangkong/water spinach, lettuce, spinach, pakcoy, mustard greens, etc.), leftover food, bones, meat, fish, eggs and others. Market waste contains 26.55% protein, 1.10% crude fiber, 1.16% fat, 0.11% calcium and 0.17% phosphorus [10]. Meanwhile, vegetable waste contains 2.11-2.71% protein, 1.08% fat, 14-15% fiber content, 89-9-% water content and contains calcium and minerals [11].

The nutritional needs of fish depend on the type and level of stadia. Fish at an early stage need more protein than fish at an advanced stage (adult) to maintain life and for growth. The physical properties and the form of the feed given also depend on the stage of the fish. According to [8], red tilapia are omnivores with a tendency to eat plants (herbivores). The purpose of this study is to find alternative raw materials for fish feed through the use of appropriate vegetable waste. It is hoped that the results of this research will be useful, both among the government, in efforts to handle waste, and at the user level to increase aquaculture production economically.

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2. MATERIALS AND METHOD

The location of this research activity is in the Ciparanje Experimental Pond, Faculty of Fisheries and Marine Sciences, Padjadjaran University and the Laboratory of Animal Feed Analysis, Faculty of Animal Husbandry, Padjadjaran University. The materials used in this study consisted of Test Fish namely tilapia. The average weight of tilapia used was 1.3 grams of 500 fish. Tilapia seeds were obtained from the Sukabumi Freshwater Aquaculture Development Center (BBPBAT). In addition to the test fish, other materials used are test feed in the form of vegetable waste consisting of: water spinach waste, mustard greens, and a mixture of water spinach and mustard waste. The feed was obtained from the Cileunyi market, Bandung Regency. The instruments used in the study were as a Experimental Container in the form of a ground pond measuring 3x7 m^2 as many as 6 units.

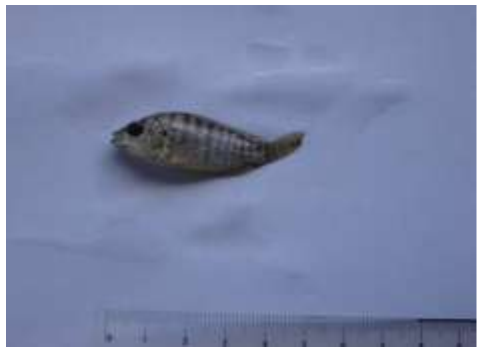

Figure 2. Tilapia Fry

The research was conducted in several stages, including physical identification of raw materials and biological tests. At physical identification of raw materials stage, activities include collecting data on waste products, types and physical forms of waste, alternative methods of processing and use. This stage is done by collecting secondary data using the survey method. The results obtained are then presented in a descriptive analysis. The stages of biological test research consist of growth and feed conversion tests. Activities are carried out in stages:

Pond Preparation

The pond to be used must first be cleaned of grass and weeds. The pond was dried for 3 days, then fertilized using organic and inorganic fertilizers. The organic fertilizer used is dry chicken manure, while the inorganic fertilizer is urea.

Trial Pond Tile Layout Settings

The experimental pond is a soil-based pond that is limited by a net in each plot. Layout settings are done randomly.

Maintenance of Test Fish to Determine Initial Weight (W_o)

The procedure for this stage includes:

a. Each test fish is weighed,
b. The test fish were put into the experimental pond plots with a density of 100 fish/pond,
c. Fish are fed about 75 grams of vegetable waste per day. The feed given previously has been withered, chopped, and mixed homogeneously,
d. Feeding is done once a day at 08:00 AM
e. Sampling weighing biomass weights is carried out once a week for 3 months of maintenance. Feed adjustments were made after weighing the fish.

Parameters

Observation parameters in this study include absolute growth and feed conversion [12]

3. RESULTS AND DISCUSSION

Absolute Growth

Under conditions of unrestricted feed, an increase in temperature can increase food intake so as to increase the growth rate. Energy used for growth comes from feed in addition to energy lost to feces or other excretory products. Growth is influenced by several factors, namely fish size, fish body weight, speed of digestion and metabolism. Growth is the increase in length and weight over time. Fish growth is one of the most important criteria in measuring response in feed research. The growth of an animal can be defined as an increase in the structure of the body's organs [13]. Growth is a change in length, volume, or wet or dry weight. Growth can be divided into absolute growth, namely the average size of an animal at a certain age, and relative growth, namely the length or weight achieved in a certain time period associated with length or weight at the beginning of that period [14]. Growth is influenced by internal and external factors. Internal factors include: heredity, growth speed, ability to utilize food and resistance to disease. External factors include: water temperature, amount of feed, chemical composition of water and space for movement. Meanwhile, according to [14], the number and size of an organism are factors that affect growth. Growth can be considered as the result of two processes, namely a process that tends to reduce the body's energy and a process that begins with the intake of food and ends with the preparation of the body's elements [15].

Table 1. Average Absolute Growth (g) Tilapia with Different Types of Feed

Absolute growth (g)		
Water Spinach (I)	**Mustard Greens (II)**	**Mixed (III)**
9.30	9.35	9.10

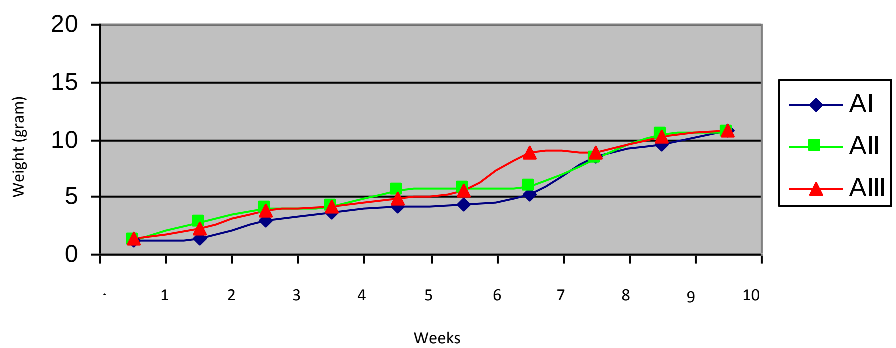

Figure 3. Tilapia Growth Chart for 10 weeks

Figure 3 showed that there was a fairly high growth for tilapia, which grew by 83.24 g. The high crude fiber in vegetables given to fish is not an absolute obstacle for the absolute growth of fish, because the fish that are cultivated are herbivores. This means that the digestive juices and fish enzymes are prepared to metabolize crude fiber in vegetables, besides that crude fiber can be converted into fat deposition through the process of lipogenesis. The nutritional content needed by fish in feed to achieve maximum growth is protein, carbohydrates, vitamins and minerals [8]. The needs of essential amino acids (cannot be synthesized by the body and must be supplied from outside, such as arginine and histidine) and non-essential (can be synthesized by the body, such as alanine, aspartic acid and cystine) are very much needed by fish. Fish that contain less essential amino acids will experience slow growth [15].

[16], stated that feed is a source of energy for fish to move, grow and survive against disease. [17], stated that the factors that influence the growth of fish include environmental conditions, size, age, stock density and the feed provided. The addition of tilapia weight is influenced by nutrition which is absorbed by fish and used as a source of energy to grow and develop. Fish weight growth occurs due to the fish's body metabolism that works well after the fish consumes feed [18]. The daily growth function is to calculate the percentage of fish weight growth per day. Growth as weight gain in a certain time [19].

Growth is strongly influenced by the amount of feed that can be absorbed by the body and the energy contained in the feed. The energy obtained from feed will be used for growth, after the needs for daily fish activities are met. [15], said that the density will affect the growth of individual fish so that the number of fish must be proportional to the rearing place, because the high density is not adapted to the rearing place there will be oxygen competition. Stocking density depends on seed size. The larger the size of the fry sown, the less dense the density is, and vice versa, the smaller the fry sown, the greater the density.

Protein is the main source of nitrogen and essential amino acids in animals. Protein is a more expensive source of energy in the manufacture of food. Naturally, carnivorous fish consume a diet containing 50% protein with a highly efficient excretory system for nitrogenous waste from protein [20]. Meanwhile, according to [1], the minimum dietary levels of amino-protein acids for optimal growth in natural feeds are close to 50% for tilapia seeds and decrease by about 35% until fish are 30 g. The protein requirements of larger fish are 25-35% in the diet and vary depending on fish size, amount of natural feed and feed factors such as protein quality and energy levels. Feeds that contain high protein are not harmful, but maintain the proportion of protein requirements until the optimum levels are needed for good growth and feed conversion. Protein has a metabolic energy level of ± 4.5 kcal/g in fish. Protein requirements will be higher in the fry (larvae) and begin to decrease with increasing fish size. To achieve maximum growth, younger fish need about 40-60% protein in the diet. The need for protein is influenced by water temperature, body size, density, oxygen level and the presence of toxins (poisons). The decrease in water temperature causes the body temperature to decrease and consequently the metabolic rate decreases. At lower temperatures, feeds containing more than 40% protein can stress fish due to excess ammonia. Omnivorous and herbivorous fish do not necessarily need lower protein, even grass carp fish need protein equivalent to salmon and trout [20].

Carbohydrates are a source of energy for aquaculture animals which are abundant and cheaper. Carbohydrates consist of parts that are easily digested (sugar groups) to those that are difficult to digest (complex cellulose). The assimilation ability depends on the enzymatic activity that produces the amylase enzyme. In herbivorous fish, amylase is found in the digestive tract. Carbohydrate levels up to 25% in the feed become as effective as a source of energy as well as fat. Besides providing energy, carbohydrates have a physical function in the texture of artificial feeds and as a binder in the manufacture of artificial feeds [20].

Tilapia requires several minerals for tissue formation, metabolism and osmotic balance between body fluids and water [1]. Calcium and phosphorus play a role in metabolism, especially in bone formation and maintaining acid-base balance. Fish can obtain calcium from food and also from the freshwater environment through their gills and fins. Phosphorus is generally abundant in food, while in fresh water and sea water is usually very low in phosphate [20]. Phosphorus is required by red tilapia for good growth and mineralization is normally 0.9% [1].

Feed Conversion

Increasing the conversion value and efficiency of fish feed can be done with a time allocation which is known as feeding frequency [21]. Feeding frequency is the number of repetitions of feeding in one day. The feeding schedule should be adjusted to the fish's appetite with a frequency of 4-5 times a day, feeding time can be morning, afternoon, evening, and night [22]. As stated by [23], that the feed conversion value is used to determine the good or bad quality of the feed given for fish growth. The low feed conversion means the higher the feed efficiency and conversely the higher the feed conversion value, the lower the efficiency.

Table 2. Average Conversion of Tilapia Feed with Different Types of Feed

Feed Conversion		
Water Spinach	**Mustard Greens**	**Mixed**
25,78	26,01	20,92

Feed conversion is the ratio between the amount of feed given to the total weight of the fish produced. The smaller the feed conversion value means the efficiency level of feed utilization is better, on the contrary if the feed conversion is large, the efficiency level of feed utilization is not good. The feed conversion value shows how much feed is consumed into fish body biomass. [24], stated that the value of the feed conversion ratio was influenced by feed protein, feed protein that was in accordance with the nutritional needs of fish resulted in more efficient feeding.

Protein is the main energy source for fish life in water, then fat and carbohydrates. The energy needs of each individual vary depending on the type, age and size of the weight so that the ability to utilize energy also varies. Thus, the growth of fish is largely determined by the number of nutrient sources in the feed. Small fish require a relatively larger source of nutrients compared to large fish [25]. Protein consumed in the digestive tract will be metabolized into simpler forms, namely amino acids. Once absorbed in the small intestine, these amino acids will be deposited into body proteins. With a low protein content, vegetables do not mean low protein deposition, because even carbohydrates can be converted into body protein, especially for herbivorous fish that were tested in this study (koan, tilapia, tawes, and tambakan) [26].

Fish in utilizing its energy source depends on the quality of the feed provided. To find out the quality of feed is determined by the growth of the fish that eat it by comparing the total amount of feed given to the resulting body weight gain which is expressed as FCR (Feed Conversion Ratio) or feed conversion. The smaller the feed conversion value, the better the feed quality, but if the feed conversion value is high, the fish feed is not good [25]. Energy needs in fish must be met by providing food, in a process the digested food is mashed into suitable molecules for absorption in the bloodstream. One of the factors that affect the energy requirements of fish is body size. Smaller fish have a higher metabolic rate than larger fish.

Conclusion

The absolute growth of some Tilapia showed good results, i.e., 83.24 grams during maintenance for 10 weeks. In addition, vegetable waste given as fish feed gives relatively the same results to feed conversion, namely between 20.92-26.01. To accelerate growth, vegetable waste should not be given alone, but combined with other feed ingredients so that the nutritional content is more complete. Moreover, to reduce the conversion value of feed, it is better to use dried vegetable waste

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