Advances in Biological Sciences Research, volume 19
Proceedings of the 2nd International Conference on Smart and Innovative Agriculture (ICoSIA 2021)

The Effect of Feed Variations on the Mutiara Catfish (*Clarias gariepinus*) Growth Performance in the Integration Farming Technology System

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ABSTRACT
The main factor influencing catfish farming activities is the use of feed. Catfish feed in the form of fish pellets has a relatively expensive price, thereby reducing profits in catfish farming, so alternative feeds are needed. An alternative feed that has the potential to be used in catfish farming is BSF (Black Soldier Fly) maggot. This BSF maggot has a high nutritional content, namely 42-45% protein, 31-35% fat, 20% ash residue. The purpose of this study was to determine the impact of using a mixture of BSF maggot and pellets on the growth of catfish. The feed given to catfish is fish pellet, a mixture of fish pellet with BSF maggot, and BSF maggot. This study used a completely randomized design method (CRD) with 4 different treatments of BSF maggot percentage, each treatment had 5 replications with. The variations used were 0% BSF maggot and 100% fish pellet, 25% BSF maggot and 75% fish pellet, 75% BSF maggot and 25% fish pellet, and 100% BSF maggot. Feeds are given 3% of total body weight of the fishes. The results showed that feed variations with 0% BSF maggot and 100% fish pellet is the best feed for increasing length and weight with 2,467 cm and 12,67 gr growth but has a low survival rate with only 20% thus making the EFU value 16,72% which is relatively low. On the other hand feed variation with 25% BSF maggot and 75% fish pellets is the second best for increasing length and weight with 2,3 cm and 10,8 gr growth and has a really high survival rate with 90% thus making the EFU highest value 64,15%.

Keywords: *catfish, fish pellets, BSF Maggot, protein, nutrition, fish growth*

1. INTRODUCTION

Indonesia is a country with a high population growth rate from year to year. This causes the level of need for protein consumption from fish to increase. One of the fishery commodities that are very prospective to be cultivated on an industrial and household scale is catfish (Clarias sp.). In Indonesia, catfish has several regional names, including kalang fish (Padang), deadly fish (Gayo, Aceh), pintet fish (South Kalimantan), rivet fish (Makassar), cepi fish (Bugis), catfish or leachate (Javanese)[1]. Four color variations of catfish are traded, namely black, white, red and striped. Catfish are usually black and gray in color, while those that are white, red and striped are generally traded as ornamental fish[2].

Catfish is one of the aquaculture products which ranks at the top in the amount of production produced. So far, catfish accounted for more than 10 percent of national aquaculture production with a growth rate of 17 to 18 percent. The Ministry of Maritime Affairs and Fisheries has determined catfish as one of the leading freshwater fish cultivation commodities in Indonesia. Catfish is a freshwater aquaculture commodity that has a fairly high market absorption rate, both in the domestic and export markets. The development of catfish

production over the last five years has shown a very significant result, which is 21.82 percent per year. The average increase every year is 39.66 percent. In 2010, catfish production increased very significantly, from production of 144,755 tons in 2009 to 242,811 tons in 2010 or an increase of 67.74 percent [3].

Growth is closely related to the availability of protein in feed. Protein in feed with high biological value will stimulate the body's protein accumulation to be greater than protein with low biological value. Protein is a nutrient required in large amounts in fish feed formulations. Seeing the important role of protein in the body of fish, protein feed needs to be given continuously with adequate quality and quantity. The quality of feed protein is mainly determined by its essential amino acid content, the lower the essential amino acid content, the lower the protein quality[4].

There are two kinds of fish feed, namely artificial feed and natural feed. Artificial feed is food made from a mixture of natural ingredients and processed materials which are then processed and made in a certain form so as to create an attraction (stimulate) for fish to eat them easily and voraciously[5]. Pellet flour feed contains 40% protein, 5% fat, 30% carbohydrates. Natural food is food that is available in nature. The advantages of natural feed include having a fairly high nutritional content, easy to digest, the movement of the feed attracts the attention of fish and fairly cheaper than artificial feed. One of the natural feeds that can be used as an alternative to artificial feed is BSF maggot (Hermetia illucens) in Integration Farming Technology System.

The Integration System Technology consisting of Plants – Livestock – Fish is a system that minimizes input from the outside of the system and is designed in an organic environment, meaning; constituent components or flow of inputs, processes and outputs as well as the internal environment of the system is free from non-organic materials that have destructive behavior to the environment, both physically and non-physically[6]. Each sub-system of this Integration System Technology will produce outputs that can be utilized by other sub-systems, such as BSF maggot (Hermetia illucens). BSF maggot (Hermetia illucens) can be used as an alternative natural feed because of its high protein content. The nutritional content of BSF maggot (Hermetia illucens) is 42-45% protein, 31-35% fat, 20% ash residue[7]. By using other sub-system outputs as the other sub-system's input, the hope is that it can reduce the financial cost needed in order to cultivate the system even further as a step to achieve a sustainable food production.

The purpose of this research is to find out the effect the use of a combination of natural feed BSF maggot with fish pellet on the growth of Mutiara catfish (Clarias gariepinus). This research is expected to provide scientific information for students and cultivators regarding the optimal feed combination between the natural feed of BSF maggot (Hermetia illucens) and fish pellet on Mutiara catfish (Clarias gariepinus) growth.

2. METHODOLOGY

2.1. Fish sample

Fishes that are used in this research are baby Mutiara catfish (*C. gariepinus*) obtained from catfish farmer in Brayut, Sleman, DIY. Catfish babies size are 12,5 $\pm$ 0,34 cm with average weight 14 $\pm$ 0,33 gr each with fish srocking density 50 fishes in 100 L. Media that is used to keep the fish is fiber drum with 100 L capacity, with total of 4 drums. Drums are completed with aerator system which can supply oxygen to drums' water.

2.2. Feed sample

Feed that are used in this research are human made pellets and BSF maggot. Feeds are given 3% from total catfish masses. Feeds are bought from their respective seller. Feeds are given twice a day in the morning and afternoon in 10 am and 5 pm.

2.3. Research Model

This research conducted in July – September 2021 in Laboratory of Biological Physics of Agricultural and Biosystem Engineering, Universitas Gadjah Mada, Jogjakarta. Research done as laboratorium experiment with compeletly randomized design with 4 treatments of BSF maggot percentage and 5 replications. The treatments are described below:

A. 0% BSF maggot 100 % fish pellet
B. 25% BSF maggot and 75% fish pellet
C. 75% BSF maggot and 25% fish pellet
D. 100% BSF maggot and 0% fish pellet

Observations are done once in 6 days to do measurement of weight and height with the catfishes. Feeds that are given will be matched with catfish weight. Variables that are tested are feed utilization efficiency, absolute weight growth, absolute length growth and survival rate.

2.4. Data Analysis

2.4.1. Efficiency of Food Utilization

Efficiency of Food Utilization (EFU) can be counted with Tacon formula[8]:

$$EFU = \frac{Wt-Wo}{F}\ x\ 100\% \quad (1)$$

Information:

EFU = Efficiency of Food Utilization (%)
Wt = Fish sample biomass at the beginning (g)
Wo = Fish sample biomass at the end (g)
F = Total feeds that are given to fish sample (g)

2.4.2. Absolute Length Growth

Daily length measurements cover the total length of the fish from the tip mouth to tip of the fish tail using ruler. Sampling is done as much as taking 5 fishes from fish sample. Absolute length growth is calculated by Arifin dan Rupawan[9]:

$$L = Lt - Lo \quad (2)$$

Information:

L = Length Growth (cm)
Lt = Fish length at *t* time (cm)
Lo = Fish length at the beginning (cm)

2.4.3. Absolute Weight Growth

Sampling is done as much as taking 5 fishes from fish sample. Absolute weight growth is calculated by Arifin and Rupawan[9]:

$$W = Wt - Wo \quad (3)$$

Information:

W = Weight Growth
Wt = Fish weight at *t* time (gr)
Wo = Fish weight at the beginning

2.4.4. Survival Rate

Survival rate is a percentage of total fish that live and total fish that were used in research, can be calculated by Effendie formula [10] as:

$$SR = \frac{Nt}{No} x\ 100\% \quad (4)$$

3. RESULTS

3.1. Efficiency of Food Utilization

Efficiency of food utilization value of Mutiara catfish shows that EFU value differs in each treatments with the highest value in treatment B is 64,15% and the lowest value in treatment A which is 16,72% because almost all the catfish dead, the data can be seen in Figure 1. Increasing in EFU value shows that feeds that were consumed have good quality so can be processed efficiently to be catfish meat.

3.2. Absolute Length Growth

Based on observations and sampling that had been done every 6 days during 24 days of keeping the catfish. Mutiara catfish grows length from 12,16 – 12,7 cm to 14,375 – 15,16 cm. Feed variations of pellets and BSF maggot can increase the length growth as can be seen in Figure 2. In each sampling that had been done shows that the highest length growth is in treatment A with 2,467 cm and following from high to low are treatment C, B and D with 2,33 cm, 2,3 cm, and 1,7 cm.

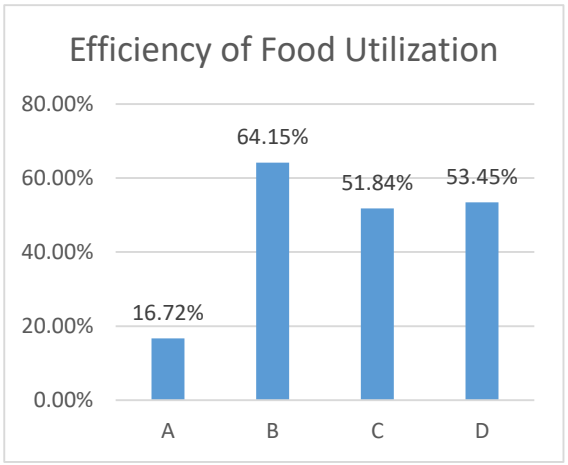

Figure 1. Efficiency of Food Utilization (%)

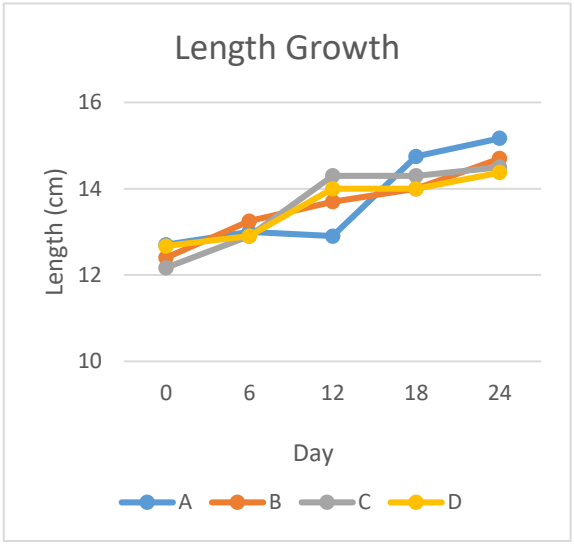

Figure 2. Length Growth Mutiara Catfish

3.3. Absolute Weight Growth

Based on observations and sampling that had been done every 6 days during 24 days of keeping the catfish. Mutiara catfish grows length from 13,67 – 14 gr to 22,8 – 26,67 gr. Feed variations of pellets and BSF maggot can increase the weight growth as can be seen in Figure 3. In each sampling that had been done shows that the highest weight growth is in treatment A with 12,67 gr and following from high to low are treatment B, C and D with 10,8 gr, 9,133 gr, and 9 gr.

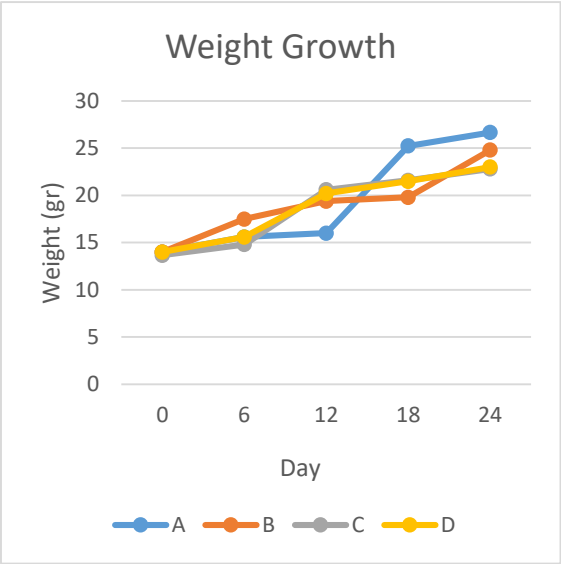

Figure 3. Weight Growth Mutiara Catfish

3.4. Survival Rate

Survival rate indicates how much fish can survive from the beginning of research to the end of it. Highest survival rate in treatment B and C are 90%, treatment D is 86% and the lowest survival rate in treatment A which is 20% the data can be seen in Figure 4.

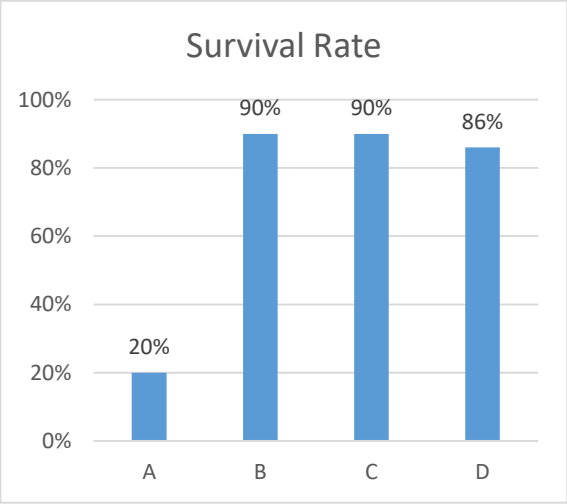

Figure 4. Survival Rate Mutiara Catfish

4. DISCUSSIONS

4.1. Efficiency of Food Utilization

This research shows that highest EFU value is 64,15% in treatment B and lowest EFU value is 16,72% in treatment A. Different in EFU value in each treatment shows different quality in feeds that were used. Quality, quantity of feeds and condition of the fish affecting Mutiara catfish growth and the EFU value of the feeds. Arief [5] said that feeds that give a good growth needs minimal of 50% in EFU value or closer to 100%. The more the efficient and high EFU value means that the more feeds that are given convert into fish weight, so high efficiency feeds mean efficient feed usage so only a little of the protein convert into energy and the other used for fish's growth. As Arief[5]said that the higher feed efficiency means better response from the fish to feeds so there will be better fish growth.

In treatment B variation of 75% pellet and 25% BSF maggot gave the highest EFU value, this result treatment B can give more nutrition value that are needed to the catfish than other treatmenst because of BSF maggot that contains high protein so can sufficient catfish nutrition needs. In treatment A variation of 100% pellets and 0% BSF maggot gave the lowest EFU value, this can happen because all the catfish are dead so there is no more catfish to farm. Treatment D variation of 100% BSF maggot also did not have a high EFU value, with this result we can say that having a high protein feeds did not actually increase efficiency in feeds utilization.

High digestibility in catfish have an impact on increasing the value of efficiency of feed utilization by Mutiara catfish, that feed digestibility is one of the indicator that can be used to assess the level of feed efficiency given to fish. The higher the value of digestibility feed, the more feed nutritions are used by the fish. According to Arief et al the bigger value of feed efficiency resulting in better fish response to the feed that indicated by fast fish growth[5].

4.2. Mutiara Catfish Growth

Regarding the research results of length and weight growth the highest value in treatment A with 2,467 cm and 12,67 gr. Lowest growth in treatment D with 1,7 cm and 9 gr. Length and weight increased are caused by total nutrition from feed that are completed. Anggraeni and Abdulgani[11] said that fish growth closely related with protein in feeds, because protein is energy source for catfish and highly needed for growth. Protein contains in feed are affected by energy non protein such as carbohydrate and fat. Catfish needs for protein ranged between 28-32 percent[12].

Treatment A has the best length and weight growth for the catfish, it is because the fish pellet was designed to be an optimum fish feed. Aritificial feed can be a complete or just supplemental for fish diet. Complete diets must supply all necessary for the optimal growth ingredients that catfish need including (protein, carbohydrate, fats, vitamins, and minerals)[13]. Treatment D has the worst length and weight growth because it is just BSF maggot that were used as fish feed. There is some reasons why treatment D has the worst length and weight growth, BSF maggot can't fully feed the catfish

despite having a really high protein. Proximate analysis of BSF maggot contained 41.1–43.6% crude protein (CP), 15.0– 34.8% ether extract (EE), 7.0% crude fibre (CF), 14.6–28.4% ash and 5278.49 kcal/kg gross energy (GE) on DM basis[14]. The other reason is the BSF maggot size are bigger than the size of fish pellet so the catfish can't eat all of the feed and resulting to waste of energy from the fish feed.

4.3. Survival Rate

The level of fish life during the study showed that the amount of feed given it is enough to support the basic needs of fish because at a high level of life it has a positive impact on growth. According to Yurisman and Heltonika[15], things that can affect the survival rate of an organism is a biotic and abiotic factor. Biotic factors include competitors, population density, age and ability of organisms with environment while abiotic factors such as temperature, dissolved oxygen, pH and ammonia content.

Survivality rate is low because of high rate of mortality. Mortality can happen because the fish is not given enough feed, resulting in not receiving enough energy for growth and movement. Survival rate of Mutiara catfish during the research varies from 20% - 90%, with the highest survival rate in treatment B and C following from high to low is treatment D with 86% and treatment A with 20%. Treatment A has the lowest survival rate because the fish pellet easily dispersed in water surface. The dispersed feed accumulated and making the water toxic resulting in many catfishes deaths[16]. During the research duration there are several deaths in all treatment, this thing mostly happen from day 1 until day 7 of research. Allegedly the catfish stress because it can't adapt with the new environment.

4. CONCLUSIONS

1. Feed variations with 0% BSF maggot and 100% fish pellet is the best feed for increasing length and weight with 2,467 cm and 12,67 gr growth but has a low survival rate with only 20% thus making the EFU value 16,72% which is relatively low. On the other hand feed variation with 25% BSF maggot and 75% fish pellets is the second best for increasing length and weight with 2,3 cm and 10,8 gr growth and has a really high survival rate with 90% thus making the EFU highest value 64,15%.

2. BSF maggot (*Hermetia illucens*) can't substitute fish pellets for Mutiara catfish (*C. gariepinus*) feeds, however it can be an addition to increase Mutiara catfish (*C. gariepinus*) growth performance.

AUTHORS' CONTRIBUTIONS

1. Ignatius Jovantheo: Collected the data, performed the analysis, wrote the paper.
2. Umi Hapsari: Conceived and designed the analysis, supervisor
3. Yudha Dwi Prasetyatama: Conceived and designed the analysis
4. Lilik Soetiarso: Conceived and designed the analysis

ACKNOWLEDGMENTS

We would like to thank Directorate of research Universitas Gadjah Mada for funding this research through RTA (Rekognisi Tugas Akhir) Program.

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