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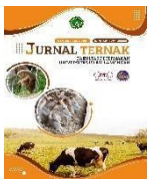

The Effect of Using Catfish Feed, Pollard Flour, and Rice Bran as a Hatching Substrate of Black Soldier Fly Larvae

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ABSTRACT

BSF larvae have become a concern of researchers because it is a source of protein that can be used as an alternative feed. It also benefits the environment in the food cycle process and waste reduction. These various potentials must be balanced with an optimal BSF larvae cultivation process, using suitable materials to produce good and quality BSF larvae. Therefore, it is necessary to know the composition of good BSF larvae hatching media, considering that hatching is the initial stage of BSF larvae cultivation which determines the growth process of BSF larvae. This study aims to choose the best medium between a mixture of catfish feed with pollard flour and rice bran. By knowing the optimal media for the growth of BSF larvae, optimal BSF larvae results will be obtained so that the provision of BSF larvae can be achieved economically. The method used is experimental method by applying two treatments and six replications. The parameters measured were the average body weight of the BSF larvae and the body length of the 8-day-old BSF larvae. The results then was analyzed using an independent statistical t-test. The results showed that the second treatment of a mixture of 250 grams of catfish feed with 250 grams of pollard flour was the best medium for maggot cultivation, with the results of 7,607 ± 1,505 body length and 0.153 ± 0.582 body weight.

1. Introduction

Hermetica illucens, commonly known as larvae of Black Soldier Fly (in this manuscript will be state as BSF larvae), is an insect that has attracted many researchers as a promising protein source [1]. BSF larvae demonstrated their nutritional value and suitability as a source for animal feed and human food. Several studies and among others, also show applications for recycling food and biowaste [2]. Insects are natural food sources for poultry and are considered a fundamental protein source for poultry in the wild [3]. Animal feed derived from insects is environmentally friendly and highly valued economically [4]; it also does not compete with humans [5].

BSF larvae have high protein, which can be used as an animal protein feed source. BSF larvae have a higher amino acid content than soybean meal and contain a higher percentage of essential amino acids, which is 29.46%, compared to non-essential amino acids, which are only 28.22%. Specifically, BSF larvae have higher rates of the essential amino acids lysine, arginine, phenylalanine, tryptophan, and valine. Regarding protein quality, BSF larvae were comparable to meat, bone, and fish and superior to soybean meals [6], [7].

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There is a considerable variation in the nutrient composition of BSF larvae meals reported in the literature. This variation may not be unconnected with the type of fly attractant and substrate used during the production process. The protein contained by BSF larvae is sourced from proteins found in growing media because BSF larvae utilize the protein present in the media to form proteins in the body [8]. This variation is inseparable from the type of fly attractant and the substrate used during the production process. BSF larvae compensate for low food quality by consuming more food to get the specific amount of nutrients needed. If the nutrients are not adequate, it will prolong the harvest period [9]. Feed media containing high levels of protein and carbohydrates accelerate the growth of BSF larvae from the beginning of hatching to the harvest period. Besides the media type, media weight variation also affects the growth of daily specific weight and a daily specific length of BSF larvae [10]. The use of proper hatching substrate can affect the development of BSF larvae. BSF eggs will hatch and grow optimal if the medium used has a high protein and carbohydrate value [11]. Low nutrition of the hatching substrate impacts the growth of BSF larvae. The balance of nutrients in the growing medium determines whether or not the development of early-phase BSF larvae is good [12]. The quality of an excellent growing substrate will positively impact the BSF larvae's nutritional quality [13].

Common commercialized feed for catfish has high nutrient content, such as protein, lipid, and fiber. It is used as the primary source of protein for growing catfish. The average protein content in fish feed is 65% crude protein, but it may vary from 57-70% depending on the fish species. Another study found that the protein content in fish meals is 30% - 38% [14]; 35%-45% [15]. The high protein content in catfish feed meal can be a substrate for hatching BSF larvae and affect the BSF larvae produced. BSF larvae grow well on fish feed media with a higher protein content [10].

Pollard flour also can be the media to cultivate BSF larvae. Nutritional content of pollard meal media is dry matter 88, 40%, protein 79,45%, fat 5,1%, ash 24%, mineral 11,60%, crude fiber 8,8%, and BETN 45% (Azizah et al., 2019). Rice bran is feed ingredients that work as energy sources. Rice bran nutrition contents are 8,56 crude protein, 10,87 crude fat, 32,62% crude fiber, and gross energy of 3988,20 kalori/g (Prasetiyono et al., 2007). Using pollard flour and rice bran as media resulted in the highest BSF larvae production compared to PKM and tofu dregs (Silmina et al., 2011).

2. State of the Art

Research conducted by Maulana et al. (2021) examined the effect of the media on the water, protein, and fat content of BSF larvae and also looked at the growth results of fresh BSF larvae. The results showed that tofu dregs with a protein content of 26.82% and crude fat of 13.72% were the best growing medium to produce the highest fresh weight of BSF larvae (380.67 ± 43.11 g).

Other studies have shown that BSF larvae can grow on media through tofu dregs and chicken manure. In an experiment conducted by providing growth media in the form of tofu dregs, a mixture of tofu dregs, and chicken manure, it was concluded that the combination of tofu dregs and chicken manure (1:1) is the most optimal medium for the growth of BSF larvae. Cultivation of BSF larvae on the growing media produced a dry matter mass of 43.82 g with crude protein 18.29 g, crude fat 14.63 g, and crude fiber 4.62 g [16].

In experiments using tofu dregs media, coconut pulp, restaurant waste media, and rice bran media, the best growth results were obtained in restaurant waste media. The yield on the media reached 182.7 g with a maintenance time of 10 days. Restaurant waste media contained sufficient nutrients to stimulate the growth of BSF larvae. The high organic matter in the media will increase the number of bacteria and the number of organic particles decomposed by bacteria and increase the amount of food material in the media so that it can affect the increase in BSF larvae production [17].

The experiment of breeding BSF larvae with cloth obtained the highest average value in fishery waste media, followed by tofu dregs, chicken blood, and coconut dregs media. The highest daily growth of pupae was also obtained on the same medium [10].

In chicken blood media, fish waste, tofu dregs, to oil palm cake, the highest crude protein content of BSF larvae (41.18±0.42%) was obtained, then the crude protein content of BSF larvae was significantly lower. Successively, namely, BSF larvae were produced in fish waste media

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(31.96±0.56%); (31.96±0.56%); on tofu dregs media (28.65±0.45%); and the lowest was in oil palm cake media (25.50±0.30%). This follows the high and low protein content of BSF larvae growing media. Meanwhile, the fat content of BSF larvae was 47.73±1.47% in fish waste media, respectively; by 43.51 ± 1.41% on tofu dregs media; 43.18±1.52% in chicken blood media; and 38.54 ± 1.46% in oil palm cake media [13].

In the experiment of tofu dregs, chicken manure, rice bran, and the addition of EM4, the best results were obtained in a mixture of 50% tofu dregs; rice bran 25%; 25% chicken manure, and the addition of EM4. The biomass produced in the media composition has a total production of 41.19 g because the growing media has good nutritional content for the growth of BSF larvae. Based on the results of observations, the entire data obtained for the average length of BSF larvae show that the difference in composition is not significantly different from the height of BSF larvae. This study concluded that there was no effect of differences in the composition of the media [18].

Mass production of BSF larvae needs to be encouraged because of its great potential as an alternative high protein animal feed. Previous studies have studied more about the growth media for BSF larvae until the harvest period. Hatching eggs is an essential stage in cultivating BSF larvae because it determines whether they will live, reproduce, or die. So, hatching eggs become crucial, especially when dealing with small to medium-scale enterprises. Therefore, knowing the most suitable medium for hatching BSF larvae is essential, considering that the media required differs from the media in development. Based on the various explanations above, this study aims to reveal further the potential mixed media, namely Catfish feed with pollard flour or rice bran, for the cultivation of BSF larvae.

3. Method

The BSF eggs used in this study were 60 grams, obtained from Alex Farms, East Java. The BSF eggs were divided into 12 bio ponds, measuring 40 x 60 cm. Each bio pond contained 5 grams of BSF eggs. Determination of 5 grams of maggot eggs in each biopon was due to enlargement of maggot maximum growth so that biopon requires 5 grams of eggs. The hatchery media was a mixture of catfish feed with pollard flour and rice bran—the catfish feed with pollard flour and rice bran from an animal feed store in East Java.

This research is experimental by applying two treatments and six replications. The results of the observations was then analyzed using the independent t-test statistical test. If the independent t-test had a significant effect, further testing would be carried out using the LSD test.

1. Preparation of Hatching Media

In this study, there were two treatments, namely P1, a mixture of 250 grams of Catfish feed with 250 grams of rice bran. Treatment P2 was a mixture of 250 grams of Catfish feed with 250 grams of pollard flour. Each treatment was added with 400 ml of water and mixed homogeneously.

2. Parameter Measurement

The parameters measured in this study were the average body weight of the BSF larvae and the body length of the 8-day-old BSF larvae. The results of the parameter measurements was then analyzed using an independent statistical t-test.

4. Results and Discussion

The larvae were successfully grown in all combination media (P1 and P2). BSF larvae hatching using different hatching media produces other biomass (BSF larvae weight and length). The detailed observation data are described in the table as follows:

Table 1. Research Results Application of Hatching Substrate to the Growth of BSF Larvae

Treatment	BSF larvae weight (grams)	BSF larvae height (mm)
P1	0,097 ± 0,012	6,833 ± 1,471

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P2	0,153 ± 0,582	7,667 ± 1,505

Source: primary data processed 2022

The observational data showed that the treatment using different media resulted in various weights and lengths of BSF larvae. Observational measurements were carried out when the BSF larvae were eight days old after hatching.

BSF larvae body length

The observations showed that using different media in hatching BSF eggs obtained the highest BSF larvae length in the combined media of Catfish feed with pollard, which was 7.607 ± 1.505. Data analysis using independent t-tests showed that the use of different media in BSF larvae hatching had no noticeable effect on the length of the BSF larvae's body. Although it did not provide a significant difference, the observational data showed that the hatching substrate of the combination of Catfish feed and pollard flour gave the best results.

BSF larvae body weight

In the P2 treatment (Catfish feed and pollard flour), the results showed the highest value of BSF larvae weight at eight days which was 0.153 ± 0.582. Data analysis using independent t-tests showed that different media combinations had a natural effect ($P< 0.05$) on the weight of BSF larvae. Using Catfish feed combined with pollard flour results in maximum growth of BSF larvae. The high content of proteins and carbohydrates in the medium promotes the growth of BSF larvae biomass.

Based on the experimental results, it was found that the optimal growth was seen in P2, which were hatched on mixed media between catfish feed and pollard flour. Not only was the growth of BSF larvae in length, but the weight of BSF larvae was also more optimal than the length and weight of BSF larvae in P1. Compared to rice bran, the high content of carbohydrates and protein in pollard media gave better results in body length and weight gain. Catfish feed is one of the hatchery media that has a high enough protein content, while pollard is an energy source for animal feed. It strengthens the findings of Pebrina & Nyata, (2012); at the age of 1-14 days, BSF larvae require culture media with high protein and carbohydrate content to promote growth.

BSF larvae growth after hatching is influenced by the nutrient levels of the hatching media used. In this study, the best culture medium was a mixture of Catfish feed and pollard, where the nutrients of this mixture were higher than those of Catfish feed and bran feed. It follows Saragi and Bagyo (2015), who state that the availability of nutrients in the feed media affects the increased body length of BSF larvae. The nutrients contained in the media affect the productivity and quality of BSF larvae. The content of protein and carbohydrates in the feed media determines the weight and size of the BSF larvae [17].

The quality and quantity of fly larvae development media dramatically affect the body's nutrient content and the larvae's survival in each instar and subsequent metamorphosis stages [19]. De Haas et al. (2006) stated that the quality of the larval development media was positively correlated with the length of the larvae and the percentage of survival of adult flies. The number and type of media that lack nutrients can cause pupae to weigh less than usual; as a result, pupae cannot grow into adult flies. Post-hatching BSF larvae growth affects BSF larvae growth in the growing period. The high nutrient content in the media causes the volume of feed consumed by BSF larvae to be low because the nutrients needed for growth have been fulfilled to increase feed requirements' efficiency. Gobbi et al., (2013) said the quality and quantity of feed media digested by BSF larvae affect larvae' growth and development time. Maximum BSF larvae development is caused by the nutrient content of the digested media [20]. The higher the digested substrate, the greater the BSF larvae biomass produced.

B/C Analysis

The B/C Ratio is a comparison of the value of benefits to costs. The greater the comparison between benefits and costs, the more profitable a business will be.

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Cost

based on known market prices,
Catfish feed : Rp. 7,500
Pollard flour : Rp. 4,500
Rice bran : Rp. 4,200

Treatment	Estimated cost/bipond	
P1	25% x (Rp. 7,500 + Rp. 4,500)	100%
P2	25% x (Rp. 7,500 + Rp. 4,200)	97%

Benefit

Treatment	BSF larvae weight		BSF larvae height (mm)		Mean
P1	0,097 ± 0,012	63%	6,833 ± 1,471	89%	76%
P2	0,153 ± 0,582	100%	7,667 ± 1,505	100%	100%

B/C Ratio P1 : $\frac{76}{100} = 0{,}76$

B/C Ratio P1 : $\frac{100}{97} = 1{,}03$

*B/C Ratio > 1 : Feasible

In terms of costs and benefits, based on the B/C analysis above, P2 media (a mixture of catfish feed media and pollard flour) that has a higher cost than P1 (a mixture of catfish feed media and rice bran) is more feasible due to BSF larvae promising growth.

5. Conclusions

The best media for hatching BSF larvae eggs is a mixture of catfish feed media and pollard flour (P2). This was indicated by the BSF weight of 8-day-old larvae, which was higher than the mixed media of catfish and rice bran. Economically, P2 is also more feasible because the value of the B/C ratio is better.

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