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The Effect of Media on Nutritional Content of Black Soldier Fly (BSF) Larva in SITTI Technology System (Integration System – Plant – Livestock – Fish)

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ABSTRACT
Maggot is known to be able to become a bioconversion agent with three by-products, including the main product is Black Soldier Fly (BSF) larvae which can be used as animal feed because it contains protein. The second product is liquid from larval activity which can be used as liquid fertilizer. The last product is dry organic waste which can be used for plant fertilizer. Based on several explanations, research can be carried out on the feed media given to BSF maggots from various organic wastes. The media used are organic household waste, chicken manure, and a mixture of the two. This study used a completely randomized design (CRD) with 3 treatments consisting of 3 replications. Factors influencing the type of growth media are 100% chicken manure, 50% chicken manure + 50% organic household waste, and 100% organic household waste. Based on observations, the highest maggot weight and length treatment was found in the 50% Chicken Manure + 50% Household Waste treatment where the average weight was 0.0474 gr and the maggot length was 13,29091 mm.

Keywords: *maggot, Black Soldier Fly larvae, media, composition, nutritional content.*

1. INTRODUCTION

Indonesia is an agrarian country where most of the Indonesian population has a livelihood as farmers or farming. Agriculture is a benchmark for a country's economic progress and also as a support for meeting human needs in the form of food. Along with the increasing population in Indonesia which is increasingly pushing to produce more waste produced from household activities (organic waste), agriculture and animal husbandry. The increasing consumptive behavior of the community, the government will face problems regarding waste management. According to the Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management , waste is the residue of human daily activities and/or natural processes in solid form[2].

Garbage has become a serious environmental problem faced by the people of Indonesia and the world. It can be said that humans produce countless amounts of waste, including organic waste and inorganic waste. The government is trying to find a sustainable and integrated waste management system, one of which is by recycling organic waste. Utilization of the waste aims to become a high-value product, but organic waste is usually only considered as leftovers without any economic value. This is due to the small value of profit that can be obtained from organic waste management.

To deal with these conditions, it is necessary to make efforts to utilize organic waste with high economic value. One of the efforts made is to use the *Black Soldier Fly* (BSF) with the Latin name *Hermetia illucens*, another term known as "maggot". BSF fly is a kind of insect that can decompose organic waste well. Waste originating from household activities is included in waste that is easily decomposed by natural activities because it will be helped by the presence of decomposing microorganisms. The potential for using

maggot larvae or larvae from *Black Soldier Fly* (BSF) is to be able to decompose organic waste by bioconversion.

Maggot is known to be able to become a bioconversion agent with three by-products, including the main product is *Black Soldier Fly* (BSF) larvae which can be used as animal feed because it contains protein. The second product is liquid from larval activity which can be used as liquid fertilizer. The last product is dry organic waste which can be used for plant fertilizer. Based on several descriptions, it can be done research on the modification of the feed media given to BSF maggots from various organic wastes in order to determine and analyze the nutritional content in the maggot body and the effect of media composition on the maggot breeding process. The method of utilizing BSF larvae can be used as an effort to improve the degradation process of household organic waste which is currently a problem as food for maggot.

Human life that runs continuously will definitely produce waste or waste in every activity. The increase in the volume of waste is proportional to the increase in the consumption value of goods or materials that are used and processed daily. The definition of waste according to the *World Health Organization* (WHO) is something that is no longer used, used, liked even something that is just thrown away from several human activities and cannot occur or form itself [1].

Black Soldier Fly (BSF) with the Latin name *Hermetia illucens* is a fly originating from the American continent[4]. BSF has also been found in Indonesia as a natural breeding ground for BSF. This fly is more commonly known as the black soldier who has a black body. The order of taxonomic levels of BSF flies is as follows:

Figure 1. *Black Soldier Fly* [3]

Kingdom : Animalia

Phylum : Arthropods

Class : Insecta

Order : Diptera

Family : Stratiomyidae

Genus : Hermetia

Species : Hermetia illucens [5]

According to Popa and Green (2012), it is known that the optimum temperature of the BSF larval breeding process is approximately 30 C - 36 C. BSF is expected to die if the temperature is less than 7 C and more than 45 C. The ability to decompose organic matter makes This fly began to be cultivated by the community. These flies can extract nutrients and energy from food scraps, kitchen waste (vegetables and fruit peels), wastewater, and animal carcasses.

2. METHODOLOGY

This research was carried out from July to September 2021 at the Faculty of Agricultural Technology, Gadjah Mada University, Yogyakarta. This research can be regarded as an experimental study which aims to determine the effect of media composition, the effect of the content of the media used, and the effect of the media on the nutritional content of BSF larvae. The parameters observed were weight, length, and condition of the maggot growing media. The parameter data is processed and analyzed using ANOVA analysis. The data that has been obtained is processed using a computerized method, namely the Microsoft Office Excel program.

Some of the tools used in this study include maggot boxes, shovels, digital scales, manual scales, cups, containers, plastic bags, stationery, and rulers. The research materials include household waste and chicken manure. The research design used is an experimental method using a Completely Randomized Design (CRD) with 3 levels of treatment, each treatment carried out 5 times.

The treatment levels of this research include:

a) Treatment A : 100% household waste

b) Treatment B : 100% chicken manure

c) Treatment C : 50% household waste + 50% chicken manure

3. RESULTS

3.1. Larval Weight and Length on Feeding 100% of Household Waste

The results of observations from several treatments gave mixed results. The following are the results of observations of larval weight and length on feeding 100% of household waste, which are presented in Figure 2.

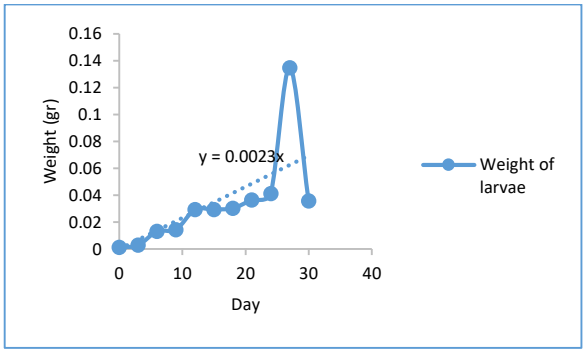

Figure 2. Weight of larvae with growth medium 100% Household Waste

The graph shown in Figure 2, can show that the weight of the larvae increased with increasing days. This can be seen from the weight of the maggot increased every day and the average weight of the larvae during observation was 0.033542 g. The growth rate of y = 0.0023x was obtained and the observations were carried out for 30 days or 1 month.

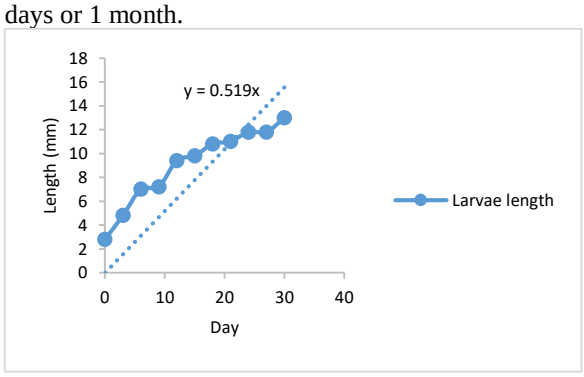

Figure 3. Larvae length with growth media 100% Household Waste

While the results of the increase in larval length are presented in Figure 3. This can be seen from the length of the larvae which has increased every day. The average length of the larvae during observation was 9.03636 mm and the growth rate was y = 0.519x.

3.2. Larval Weight and Length on Feeding 100% of Chicken Manure

The following are the results of observing the weight and length of larvae on feeding 100% of Chicken Manure, which are presented in Figure 4.

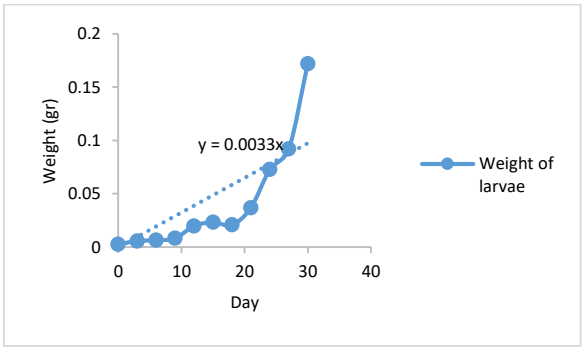

Figure 4. Weight of larvae with growth media of 100% Chicken Manure

Based on the graph shown in figure 4, the weight of the larvae increases faster than using only household waste. This is influenced by the content of chicken manure which contains a lot of crude protein which is quite high but has a low energy content so that a fermentation process is needed first. This content makes the growth of larvae increase. The average weight of the larvae was 0.04194 g and the growth rate was y = 0.0033x.

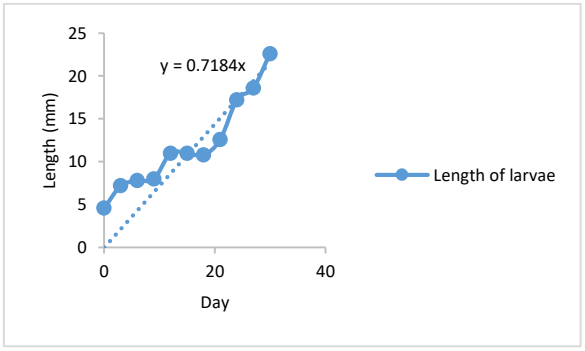

Figure 5. Length of larvae with growth media of 100% Chicken Manure

While the results of the increase in the length of the larvae are shown in Figure 5. This can be seen from the length of the larvae which has increased every day. The average length of the larvae during observation was 11.94545 mm and the growth rate was y = 0.519x.

3.3. Larval Weight and Length on Feeding 100% of 50% Chicken Manure + 50% Household Waste

Following are the results of observations of larval weight and length on feeding 50% Chicken Manure + 50% Household Waste presented in Figure 6.

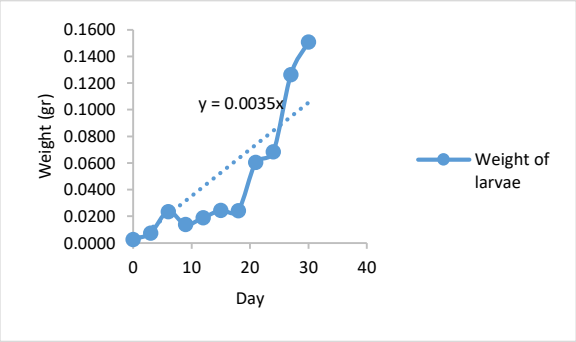

Figure 6. Weight of larvae with growth media 50% Chicken Manure + 50% Household Waste

Based on the calculation of the production of larval weight, the graphic results shown in Figure 6. It can be seen in the figure that the weight of the larvae increases faster than using only household waste and chicken manure. This is because animals need several nutrients such as carbohydrates, fats, proteins, vitamins, minerals, water and inorganic elements. Some of the nutrients needed by these animals are found in chicken manure and household waste. The average weight of the larvae was 0.0474 g and the growth rate was y = 0.0035x.

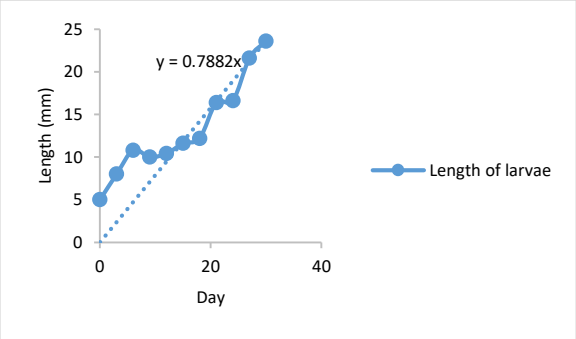

Figure 7. Length of larvae with 50% chicken manure + 50% household waste

While the results of the increase in the length of the larvae are shown in Figure 7. This can be seen from the length of the larvae which has increased every day. The average length of larvae during observation was 13.29091 mm and the growth rate was y = 0.7882x.

4. DISCUSSIONS

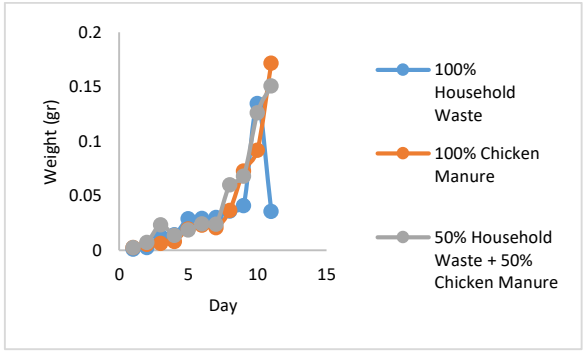

Figure 8. Weight of larvae with growth media 100% Household Waste, 100% Chicken Manure, 50% RT Waste + 50% Chicken Manure

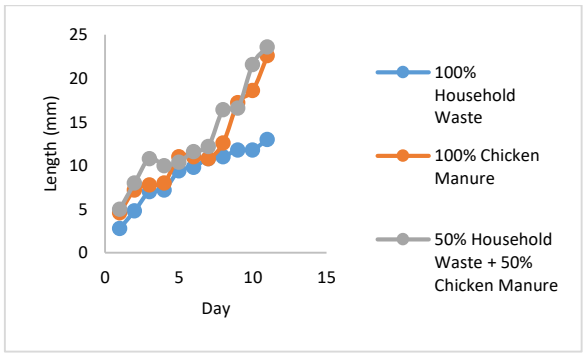

Figure 9. Larval length with growth media 100% Household Waste, 100% Chicken Manure, 50% RT Waste + 50% Chicken Manure

The fastest growth is produced through the media of 50% Chicken Manure + 50% Household Waste as shown in Figure 8 and Figure 9. It can be seen that some household waste comes from activities in the kitchen where there is a lot of vegetable and fruit waste. The nutrients contained in the waste have the potential to be used as maggot feed. Metabolically, proteins and various nutrients contained in the waste will be converted into maggot biomass. It is known that the larvae will reduce the nutrients contained in the media by 50-70% [6].

Maggot growth media in the treatment of 100% household waste is classified as having a water content that is too high, this can be seen in the household waste media in the form of rice used is still wet. These conditions can inhibit the growth of larvae on the media, therefore the treatment of 100% Household Waste resulted in slow and low growth.

5. CONCLUSION

1. Household waste and Chicken Manure can be degraded by *Black Soldier Fly* (BSF) larvae. The

ability of the larvae is very high in breaking down as a medium for growth and development.

2. The highest maggot weight and length treatment was found in the 50% Chicken Manure + 50% Household Waste treatment where the average weight growth was 0.0474 g and the maggot length was 13.29091 mm. while for the production of the lowest weight and length found in the 100% waste treatment with a weight of 0.033542 g and a length of 9.03636 mm.
3. There is an influence from the condition of the media used, including oily, too wet and watery media that can cause maggots to not develop properly.

AUTHORS' CONTRIBUTIONS

1. Annisa Widyaswara: Collected the data, perfomed 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

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