The effect of percentage of tofu dregs as a medium grows against the number of maggot populations (Hermetia Illusence)

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Abstract. Currently, the volume of waste is organic waste continues to increase. This prompted researchers to study, locate and identify cheaper and environmentally friendly waste treatment alternatives. One alternative is to cultivate Black Soldier Fly (BSF). BSF egg (Hermetia illucens) used with the right solution to decompose organic waste well, produce fertilizer and can be used as animal feed. This research aims to know how optimal amount as medium grow to egg weight and to know the optimal percentage of tofu dregs weight of maggot herbs. The analysis in this study used one way ANOVA and LSD test with a 95% confidence level. This research uses 5 observations with different percentage of tofu dregs. The results showed that the best percentage of tofu dregs in the form of wet weight and weight on medium 2, which use the medium of tofu and 2.4 kg of fish meal flour 200 gram. While the LSD test results show there is an average amount of egg weight with different treatment, and average weight average with different treatment. Treatment 5 uses the least knowing dregs media ie 0.6 kg and 200-gram fish meal.

1. Introduction
Currently, the volume of waste is organic waste continues to increase. This prompted researchers to study, locate and identify cheaper and environmentally friendly waste treatment alternatives. One alternative is to cultivate Black Soldier Fly (BSF). BSF (Hermetia illucens) is able to decompose organic waste well, where each tail averages 500 maggots (larvae) in one life cycle. If there are 20 tails, there will be 10,000 maggots. In one day, 10,000 maggots were able to decompose 1 kilogram of household waste (food waste) within 24 hours and leave 200 grams of decomposed garbage commonly referred to as former maggot or kasgot. [13] The Black Soldier Fly (BSF) is a cosmopolitan insect that can be found in the whole world, is a flower insect that sucks nectar and flowers [1,2,6]. BSF is included in the Kingdom of Animalia, Arthropod philosophy, Insecta class, Diptera order, Stratiomidae family, Hermetian genus, found mostly in organic wastes and no spread of disease. [12] The success of Black Soldier Fly cultivation (BSF) is largely determined by the media grow. High-quality media will produce more maggots because they provide enough nutrients for maggot growth and development [8,9]. Not all media can be spawned because Black Soldier Fly flies (BSF) are perfectly distinctive media scents. Although the nutrient media content is quite good, if the aroma of the media cannot attract flies to nest,
then the cultivation of maggot will not work [8-11,14]. Maggot can be effectively cultivated on dregs of tofu by adding fish that work to attract flies to spawn on the medium. The addition of salted fish cannot exceed 50% of the weight of tofu waste. The most effective update is made when the composition of salted fish is 20% by weight of tofu waste. [7,9]. The tofu is a waste of tofu making, is important and still contains 23.55% protein, 5.54% fat, 26.92% carbohydrate, 17.03% ash, 16.53% crude fiber, 10.43% air, lysine amino acids and methionine and calcium are quite high [7,9]. The addition of fish flour to the maggot growing medium is expected to increase the amount of maggot. The problem in this research is how the percentage of tofu and fish meal dregs optimal to the weight of egg fly (Hermetia illucens) and how the percentage of tofu and fish meal dregs optimum to wet weight of maggots Hermetia illucens)

2. Research methods

2.1. The research stages are as follows:

2.1.1. Preparation of cage and maggot wiculture media

The cage of flies is made of box-shaped wood with tissue, while the medium for cultivation of larvae/maggot is a mixture of tofu and fish meal flour which is placed in a plastic bucket as a container. Previously the media was fermented for 3 days. The treatments made are as follows:

Treatment 1: The tofu knows 3 kg
Treatment 2: The tofu knows 2.4 kg and 200 gram of flour
Treatment 3: Biofuels know 1.8 kg and 200 gram Fish Flour
Treatment 4: The tofu bag 1.2kg and Fish Flour 200 grams
Treatment 5: The tofu knows 0.6 kg and the flour 200 grams

Prepare the media in a container according to the treatment and prepare the wood that has been prepared as a place to fly to perch and lay eggs. Population and sample in this research is hermetic egg illucens and maggot

2.1.2. The process of getting eggs

To get the fly, put the pupa into the cage. The pupa will hatch into a fly within 1 week and the fly is ready to mate and lay eggs. Observe and harvest eggs daily for 8 days. Harvested eggs are then weighed, inserted and placed in places containing organic waste that has been fermented and functioning as a growing medium. The egg will eat and decompose the garbage and eventually become maggot within 2 - 3 weeks.

2.1.3. Harvest maggot

Maggot can be harvested after 2 - 3 weeks on growing media. Separate maggots from the growing medium by washing the maggot with water, filtering it with a filter. Sampling is by weighing maggot at harvest to get wet weight.

![Figure 1. Wood spot flies](image1)

![Figure 2. Egg bred](image2)

![Figure 3. Age maggot](image3)

Spawn in waste media 1 week
2.1.4. Harvest maggot
Maggot can be harvested after 2 - 3 weeks on growing media. Separate maggots from the growing medium by washing the maggot with water, filtering it with a filter. Sampling is by weighing maggot at harvest to get wet weight.

2.2. Data analysis method
The method of analysis in this research is using one way ANOVA, which aims to test the difference in mean of egg weight and maggot wet weight of the five treatments. The assumption that must be fulfilled in one way ANOVA is the population to be tested to be normally distributed, the variance of the population is the same and the sample is independent. If there is an average difference in egg weight, and the magical wet weight of the five treatments then Fisher's LSD test is used to know which treatment is different. The confidence level used is 95%.

3. Results and discussion

3.1. Results can be seen in tables 1 and 2 below:

Table 1. The weight of harvested eggs for 8 days (grams)

| Treatment | Date of egg harvest | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 |
|-----------|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| T1        | 11.80               | 10.20   | 13.65   | 3.82    | 3.56    | 7.62    | 12.32   | 15.77   |
| T2        | 7.11                | 15.58   | 13.51   | 8.51    | 3.90    | 5.51    | 23.18   | 21.15   |
| T3        | 11.40               | 16.61   | 11.60   | 8.25    | 3.30    | 5.53    | 18.11   | 15.51   |
| T4        | 13.22               | 6.82    | 6.68    | 10.59   | 9.24    | 5.82    | 5.05    | 0.28    |
| T5        | 1.82                | 4.72    | 2.14    | 4.11    | 5.38    | 9.72    | 4.40    | 0.42    |

Table 2. Wet maggot weight (kg)

| Treatment | Maggot generated | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 | 2017030 |
|-----------|------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| T1        | 23.60            | 20.40   | 27.30   | 7.64    | 7.12    | 15.24   | 24.64   | 31.54   |
| T2        | 14.22            | 31.16   | 27.02   | 17.02   | 7.80    | 11.02   | 46.36   | 42.30   |
| T3        | 22.80            | 33.22   | 23.20   | 16.50   | 6.60    | 11.06   | 36.22   | 31.02   |
| T4        | 26.44            | 13.64   | 13.36   | 21.18   | 18.48   | 11.64   | 10.10   | 0.56    |
| T5        | 3.64             | 9.44    | 4.28    | 8.22    | 10.76   | 19.44   | 8.80    | 0.84    |

3.2. Analysis of Variance
Since all assumptions in anova have been met then analyzed variance. Here's the result of variance analysis at 5% alpha level:

3.2.1. Variance analysis results for egg weight (table 3)
Previous hypothesis proposed for egg weight is:
Ho: There is no difference in the mean egg weight of the five media treatments
H1: There is at least one difference in the mean egg weight of the five media treatments

Table 3. Analysts results weight egg variance

| Egg weight (gram) | Sum of squares | df | Mean square | F     | Sig. |
|-------------------|---------------|----|-------------|-------|------|
| Between groups    | 353.451       | 4  | 88.363      | 3.558 | .015 |
| Within groups     | 869.283       | 35 | 24.837      |       |      |
| Total             | 1222.734      | 39 |             |       |      |

From the output above the sig value, (0.015) < alpha (5%) then Ho is rejected and concluded that there
is at least one difference in the average number of maggot populations of the five media treatments. Because Ho is rejected then tested LSD or further test to see which treatment is different from the five treatments above. (treatment test result can be seen in table 4)

Table 4. LSD test result of egg weight

| (I)/Treatment | (J) Treatment | Mean difference (I-J) | Std.error | Sig. | 95% Confidence interval |
|---------------|---------------|-----------------------|-----------|------|-------------------------|
| Treatment 1   | Treatment 2   | -2.46375              | 2.49182   | .330 | -7.5224 - 2.5949        |
| Treatment 3   | Treatment 1   | 1.44625               | 2.49182   | .565 | -6.5049 3.6124          |
| Treatment 4   | Treatment 1   | 2.63000               | 2.49182   | .298 | -2.4287 7.6887          |
| Treatment 5   | Treatment 1   | 5.75375               | 2.49182   | .027 | .6951 10                |
| Treatment 2   | Treatment 1   | 2.46375               | 2.49182   | .330 | -2.5949 7.5224          |
| Treatment 3   | Treatment 2   | -1.01750              | 2.49182   | .686 | -4.0412 6.0762          |
| Treatment 4   | Treatment 2   | 5.09375               | 2.49182   | .049 | .0351 10.1524           |
| Treatment 5   | Treatment 2   | 8.21750               | 2.49182   | .002 | 3.1588 13.2762          |
| Treatment 3   | Treatment 1   | 1.44625               | 2.49182   | .565 | -3.6124 6.5049          |
| Treatment 2   | Treatment 3   | -1.01750              | 2.49182   | .686 | -6.0762 4.0412          |
| Treatment 4   | Treatment 3   | 4.07625               | 2.49182   | .111 | -9.824 9.1349           |
| Treatment 5   | Treatment 3   | 7.20000               | 2.49182   | .007 | 2.1413 12.2587          |
| Treatment 4   | Treatment 1   | -2.63000              | 2.49182   | .298 | -7.6887 2.4287          |
| Treatment 2   | Treatment 4   | -5.09375              | 2.49182   | .049 | -10.1524 -.0351         |
| Treatment 3   | Treatment 4   | -4.07625              | 2.49182   | .111 | -9.1349 .9824           |
| Treatment 5   | Treatment 4   | 3.12375               | 2.49182   | .218 | -1.9349 8.1824          |
| Treatment 5   | Treatment 1   | -5.75375              | 2.49182   | .027 | -10.8124 -6.6951        |
| Treatment 2   | Treatment 5   | -8.21750              | 2.49182   | .002 | 13.2762 -3.1588         |
| Treatment 3   | Treatment 5   | -7.20000              | 2.49182   | .007 | -12.2587 -2.1413        |
| Treatment 4   | Treatment 5   | -3.12375              | 2.49182   | .218 | -8.1824 1.9343          |

From the above output it is seen that treatment 5 is different from other treatment. Seen from the value of sig <alpha 0.05. This is because the medium of tofu waste is used very little compared to other treatments, although the amount of fish meal is the same. This proves that the quality of the tofu dregs as a growing medium is determined not only by its composition, but also by its amount. Fly eggs are present in treatment 2. Figure 4 shows the mean of egg weight in the five treatments

Figure 4. Mean of egg weight (gram)
From the picture above shows that the average egg weight in treatment 2 is higher than other treatments. This is because the amount of tofu waste medium used is the most compared to the treatment of 3.4 and 5 although the amount of fish meal is the same, thus allowing more flies to settle. The dregs medium knows in treatment 1 more than treatment 2, but because it does not use additional fish meal which attracts hermetia illucens fly, the flies are settling less, resulting in less number of eggs.

3.2.2. Results analysis of variance for maggot wet weight
For the wet weight of the proposed hypothesis maggot is:
Ho: There is no difference in the average maggot wet weight of the five media treatments
H1: There is at least one difference in the average maggot wet weight of the five media treatments

| Table 5. Analysts results of maggot wet weight variance ANOVA |
|-------------------------------------------------------------|
| Sum of squares   | df  | Mean square | F      | Sig. |
|------------------|-----|-------------|--------|------|
| Between groups   | 1413.803 | 4           | 353.451 | 3.558 | .015 |
| Within groups    | 3477.134 | 35          | 99.347  |       |      |
| Total            | 4890.937 | 39          |        |      |

From the output above the sig value (0.015) < alpha (5%) then Ho is rejected and concluded that there is at least one difference in the average maggot wet weight of the five media treatments. Because Ho is rejected then the LSD test or further test to see which treatment is different from the five treatments above (table 6)

| Table 6. Wet maggot weighted LSD test results multiple comparison |
|---------------------------------------------------------------|
| Dependent variable : wet maggot weighted (gram) LSD           |
| (I)Treatment (J) Treatment | Mean difference (I-J) | Std.error | Sig. | 95% confidence interval |
| Treatment 1 | Treatment 2 | -4.92750 | 4.98364 | .330 | -15.448 | 5.1898 |
| Treatment 2 | Treatment 1 | 4.92750 | 4.98364 | .330 | -15.448 | 5.1898 |
| Treatment 3 | Treatment 1 | 2.03500 | 4.98364 | .686 | -8.0823 | 12.1523 |
| Treatment 4 | Treatment 1 | 10.18750 | 4.98364 | .049 | 0.072 | 20.3408 |
| Treatment 5 | Treatment 1 | 16.43500 | 4.98364 | .002 | 6.3177 | 26.5523 |
| Treatment 3 | Treatment 2 | -2.03500 | 4.98364 | .686 | -12.1523 | 8.0823 |
| Treatment 4 | Treatment 2 | 8.15250 | 4.98364 | .111 | -1.9648 | 18.2698 |
| Treatment 5 | Treatment 2 | 14.4000 | 4.98364 | .007 | 4.2827 | 24.5173 |
| Treatment 3 | Treatment 4 | -5.26000 | 4.98364 | .298 | -15.3773 | 4.8573 |
| Treatment 4 | Treatment 4 | -10.18750 | 4.98364 | .049 | -20.3048 | -0.072 |
| Treatment 5 | Treatment 4 | -8.15250 | 4.98364 | .111 | -18.2698 | 1.9648 |
| Treatment 5 | Treatment 5 | 6.24750 | 4.98364 | .218 | -3.8698 | 16.3648 |
| Treatment 5 | Treatment 1 | -11.50750 | 4.98364 | .027 | -21.6248 | -1.3902 |
| Treatment 5 | Treatment 2 | -16.4350 | 4.98364 | .092 | -26.5523 | -6.3177 |
| Treatment 5 | Treatment 3 | -14.4000 | 4.98364 | .007 | -24.5173 | -4.2827 |
| Treatment 5 | Treatment 4 | -6.24750 | 4.98364 | .218 | -16.3648 | 3.8698 |
From the above output, it is seen that treatment 5 is different from other treatment. Seen from the value of \( \text{sig} < \alpha \), 0.05. The maggot's wet weight at treatment 5 corresponds to the number of eggs produced, ie less than the other treatments because of the amount of media used slightly. Figure 5 is the average graph of maggot's wet weight on all five treatments.

![Figure 5. Average weight wet maggot](image)

From the picture above shows that the average wet weight of maggot on treatment 2 is higher than the others. This corresponds to the number of eggs produced in treatment 2, which is more than the other treatments.

4. Conclusions

The results showed that the optimal percentage of tofu pulp in yielding egg weight and maggot wet weight was found in treatment 2, which used the medium of knowing 2.4 kg and 200-gram fish meal. While the result of LSD test showed there was a difference of mean of egg weight with different treatment 5, and there was a difference of average maggot wet weight with different treatment 5. Treatment 5 uses the least knowing dregs media ie 0.6 kg and 200-gram fish meal.

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