THE 5th INTERNATIONAL CONFERENCE ON HEALTH POLYTECHNICS OF SURABAYA (ICOHPS)
2nd International Conference of Environmental Health **(ICoEH)**

ANALYSIS OF REDUCTION INDEX AND COMPOST RESULT ON THE PROCESSING OF TOFU DREGS USING LARVA BLACK SOLDIER FLY *(Hermetia illucens)*

Rizal Aziz Nurcahyo[1], Handoyo[2], Aries Prasetyo[3], Sri Poerwati[4CA]
[1,2,3,4]Environmental Health Department of Polytechnic Kemenkes Surabaya
Email: poersripoerwati@gmail.com

ABSTRACT
In the last six years, the production of tofu processing has become the most superior commodity in Kediri City. The tofu waste processing method that can be applied is bioconversion using Black Soldier Fly (BSF). The limitation of the problem in this study is the reduction index of tofu dregs and the measurement of C/N parameters compared to SNI 19-7030-2004. The purpose of this study was to determine the reduction index and compost yield for tofu waste processing using BSF larvae (*Hermetia illucens*). Subjects of variation of tofu dregs were 50, 55, and 60 gr/day with 50 larvae.

The results of this study obtained a reduction index value of tofu waste using the Waste Reduction Index formula in reactor 1 of 25%, reactor 2 of 50.6%, reactor 3 of 50.4%, and reactor 4 of 47.2%. The reduction in reactor 1 was caused by the drying of the tofu dregs. The reduction in reactors 2 and 3 was caused by larval activity with the appropriate amount of feed. In reactor 4 caused by slower larval activity due to excessive amount of feed. In this study, it can be concluded that the highest tofu waste reduction index was found in the variation of feed 50 g/day with larvae and compost produced by the final media of BSF fly larvae, parameters C/N, not according to SNI 19-7030-2004. Suggestions for this research need to do further research on the testing for bacteria in larval feces and controlling humidity in the feed of BSF fly larvae.
Keywords: Tofu dregs, BSF larvae, compos

BACKGROUND
The progress of culture causes the level of human consumption to increase and then causes the production of waste to increase. Apart from cultural progress, a significant increase in population is also the cause of increased waste production. Based on the Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management, it is stated that population growth and changes in people's consumption patterns cause the type, volume, and characteristics of waste to increase. The rest of the tofu processing production has the potential to be the biggest contributor to the accumulation of organic waste in the city of Kediri. Based on data from the Kediri City Statistics Agency, the production of tofu processing has become the most superior commodity for IKM (Small and Medium Industries) in the City of Kediri in the last six years with a high amount of production. The generation of tofu dregs that can be produced by one IKM can reach approximately 230 kg per day, while the number of Tofu Processing IKM in Kediri City is approximately 19 that are still active in production.

So far, the method of processing tofu dregs that is most often used is by reprocessing them for finished products or selling them to farmers to be used as animal feed. Bioconversion is a continuous process that utilizes insect larvae to convert nutrients from organic matter and store them as biomass (Salman *et al*., 2019). The advantages of this method are the organisms used as conversion agents act as catalysts, have high production rates, good reaction conditions to avoid substances that are unstable at pH values in the process (Mujahid *et al*., 2017).

One of the insect larvae or organisms that has the potential and can be used as a catalyst in the bioconversion method is the Black Soldier Fly. Black Soldier Fly (BSF) or in Latin Hermetia illucens is a species of tropical fly from the order Diptera and the family of Stratiomyidae with the genus Hermetia as an excellent decomposer of organic waste. The remaining final media of BSF fly larvae may contain good compost or nutrients for plants with the help of microorganisms or fungi after the larvae stop eating and enter the pre-pupa stage. It is known that compost will be formed from an organic material that degrades over a certain period depending on the influence of other factors such as temperature, humidity, microorganism /bacteria, fungi/mold, and others. (Arikel, 2017). Research journal literature from (Neneng & Indrayani, 2021) explained that a BSF fly larva can spend 0.5 – 0.6 g (grams) per day with a variety of organic waste mixtures such as rice, vegetables, and fish which have high protein. The purpose of this study was to determine the analysis of the reduction index and compost yield on tofu waste processing using BSF fly larvae (*Hermetia illucens*).

RESEARCH METHODS

This type of research is Quasy Experiment with the research design used being Pretest-Posttest Control Group Design. The population in this study were all tofu dregs originating from three IKMs in Jagalan Village, Kediri City District, Kediri City. The sampling technique used in this study is the Composite Place Sample.

Research Steps

1. Taking tofu dregs
2. Preliminary inspection of the dregs knows the parameters of the C/N ratio.
3. Giving larvae to the reactor with variations of tofu dregs feed along with replication used for 20 days.
4. The results of the final larval media compost with C/N parameters and the final weight calculation using the WRI formula on day 20.
5. The results of the final larval media compost with parameters C/N on day 40 were compared with SNI 19-7030-2004.

Hypothesis/H1: there is a difference in the reduction and yield of compost from variations of tofu dregs using Black Soldier Fly (*Hermetia illucens*) larvae. Analysis of the data obtained using analytical analysis with Kruskal Wallis statistical test and the conclusion of the hypothesis for H1 is accepted if the p-value is smaller than (0.05).

RESULT

Tofu Dregs Reduction Index

Measurement of tofu waste reduction index without BSF fly larvae and with BSF fly larvae for 20 days was adjusted from the life cycle of BSF fly larvae. The results of the calculation of the tofu dregs reduction index using the formula Waste Reduction Index (WRI) are presented in the following table :

Table IV.1 Results of Measurement of Tofu Dregs Reduction Index

Reactor	Initial Weight (gr)	Final Weight (gr)	Total Reduction (gr)	Duration (hari)	WRI (% / day)
R1	6000	4504	1496	20 hari	1,25
R2	6000	2963	3037		2,53
R3	6600	3269	3331		2,52
R4	7200	3798	3402		2,36

Information :
R1 = 50 gr/day tofu dregs without BSF fly larvae
R2 = 50 gr/day tofu dregs with 50 BSF fly larvae
R3 = 55 g/day tofu dregs with 50 BSF fly larvae
R4 = tofu dregs 60 g/day with 50 BSF fly larvae

Analyzing Differences in Tofu Dregs Reduction Index

Table IV.2Kruskal Wallis Analysis Differences in Reduction of Tofu Dregs Without BSF Larvae And With BSF Larvae

	Reduction F Correct
Chi-Square	21.704
df	3
Sig.	.000

Based on the analysis table shows that the results of the Chi-Square calculation are 21.704, the standard deviation value is 3, and the significant value is 0.000. The analysis carried out obtained a probability value of p-value smaller than (0.05), so it was concluded that H1 was accepted.

Significant differences between reactors can not be known from the results of the Kruskal Wallis statistical test analysis, so the analysis was carried out again using the Independent Sample T-Test statistical test. The following is a table of further analysis test results to determine the differences between reactors :

Table IV.3 Independent Analysis of Sample T-Test Reactor 1, 2, 3, and 4

Breeding Place	Sig.	Different Description
Reactor 1 with Reactor 2	.000	Significant
Reactor 1 with Reactor 3	.000	Significant
Reactor 1 with Reactor 4	.000	Significant
Reactor 2 with Reactor 3	.000	Significant
Reactor 2 with Reactor 4	.000	Significant
Reactor 3 with Reactor 4	.000	Significant

Based on table IV.3 shows that the significant value between each reactor is 0.000. The analysis carried out obtained a probability value of p-value smaller than (0.05), so it was concluded in the study that H1 was accepted, which means that there is a difference in reduction between each reactor.

Compost of BSF Flies Larvae Final Media Results With Parameters C/N

Compost characteristics from tofu waste produced through the decomposition process using the bioconversion method of BSF fly larvae organisms will be compared with the compost requirements of SNI 19-7030-2004 covering parameters C/N, temperature, humidity, and acidity (pH). The following is a table of the results of the analysis of compost measurements:

Table IV.4Measurement Results of Tofu Dregs Compost Compared with SNI 19-7030-2004

No	Parameters	Compost Day 0	Compost Day 20	Compost Day 40	Quality Standards
1.	C/N ratio	38,1	32,9	23,1	10 - 20
2.	Temperature	21ºC	28ºC	30ºC	Max 30ºC
3.	Humidity	68%	49%	48%	50% - 60%
4.	Acidity (pH)	5,9	6,8	7,1	6,8 - 7,5

DISCUSSION

BSF Flies Larva as Bioconversion Organism in Reducing Tofu Dregs

The advantage of the bioconversion method is that the organisms used as conversion agents act as catalysts with high production rates and good reaction conditions to avoid substances that are unstable at pH values in the process (Mujahid *et al*., 2017). One type of insect that has the potential in this bioconversion method is the Black Soldier Fly (BSF), which in Latin is Hermetia illucens, a tropical fly species from the order Diptera and the family from Stratiomyidae with the genus Hermetia. The life cycle of the BSF fly is divided into 4 phases, namely the egg phase, larval phase, pupa phase, and the fly phase which lasts approximately 44 days depending on the food or the environment in which it lives (Nur *et al*., 2018). The size of the adult BSF fly is relatively larger than other flies and does not have a significant mouth structure and does not have the potential to cause environmental-based diseases because in the fly phase it is only used for breeding while in the larval phase it is only used for feeding.

This study used the larval phase of BSF flies which lasted for approximately 20 days. The selection of this phase was based on the nature of the larvae that only eat activity and the larvae of this BSF fly have a fairly voracious eating habit so that they can decompose organic matter very optimally. The final media produced by larvae or larvae feces has the possibility of good nutrient content for plants with the help of decomposing bacteria after the larvae stop eating.

Reduction of Tofu Dregs Without BSF Flies Larvae

The results obtained from research on Reactor 1 containing 50 gr/day tofu dregs feed without larvae showed a reduction in the final weight of tofu dregs caused by drying of tofu dregs. This makes the average value considered an F Correction. Obtaining a high standard deviation value from the data normality test shows that Reactor 1 has an abnormal data distribution.

Drying of tofu dregs is not done intentionally but occurs at room temperature. This indicates that the drying of tofu dregs is caused by the reduction of the water content contained in it accidentally because it does not use heat energy but only at room temperature. The water content contained in tofu dregs can reach 87% (Purnamasari &

Muhlison, 2021).

The tofu dregs in Reactor 1 dry only at the edges, for the middle it remains wet and moist. The edge of the dried tofu dregs is visible on the 20th day when the final weight of the reactor will be weighed. The texture of the dregs which was originally soft, slightly runny, and whitish became stiff, rough, yellowish in color, and overgrown with fungus on the dry dregs and even the pungent smell disappeared. The center of the tofu dregs did not experience drying or changes in texture, color, and odor. The final weight of tofu dregs in Reactor 1 was reduced by approximately 25% of the total initial weight of tofu dregs due to drying.

Reduction of Tofu Dregs with BSF Fly Larvae Using Feed Variations of 50 gr/day and 55 gr/day

The results obtained from research on reactors 2 and 3 containing 50 gr/day and 55 gr/day tofu dreg feed with 50 larvae showed a reduction in the final weight of tofu dregs. Obtaining a high standard deviation value from the data normality test shows that Reactors 2 and 3 have abnormal data distributions. The results of F Correction are obtained from the reduction value which is reduced by F Correction due to the influence of Reactor 1 which occurs when the tofu dregs are dried. These results mean that during the process of BSF fly larvae in decomposing organic matter, they also experience a reduction in the water content of the tofu dregs which affects the reduction value.

The reduction values found in reactors 2 and 3 came from the weighing process carried out on day 20 after the larvae entered the pre-pupa stage and stopped eating. This is also adapted to the life cycle of BSF flies in the larval stage where the larvae will only eat or decompose organic matter. Tofu dregs are ideal feed for BSF fly larvae because they are not too wet and not too dry and the particles are small so they are easily digested by the larvae. After entering the pupa stage, the feeding process will stop and only larval manure remains which can be used as compost.

The reduction that occurs in tofu dregs to become compost is caused by feeding activities carried out by BSF fly larvae (Makkar *et al.*, 2014). During the reduction process, there was a significant change in the color, texture, and smell of the tofu dregs that the larvae began to eat. From the observations of the researchers, it was known that the color of the tofu dregs changed from whitish to light brown within approximately one hour after the tofu dregs were added. For changes in texture which were originally smooth and moist became like breadcrumbs but still moist within approximately one hour after the sample was added. The smell, which was originally tofu dregs smelled quite pungent, it became less pungent after about an hour from the inclusion of the sample. Furthermore, within the period of entering the 10th day, the media of tofu dregs in the reactor as larvae feed began to dry and turn brown but still had a slight smell. After the 20th day, the media started to change in texture to a slightly rough texture, changed color to dark brown, and no longer had a strong odor. Other changes occurred during the weighing process and obtained the final total weight of tofu dregs in Reactors 2 and 3 which reduced by approximately 50% of the total initial weight of tofu dregs.

Reduction of Tofu Dregs with BSF Flies Larvae Using Feed Variations 60 gr/day

The results obtained from research on Reactor 4 containing 60 gr/day tofu dregs fed with 50 larvae showed a reduction in the final weight of tofu dregs. Obtaining a high standard deviation value from the data normality test shows that Reactor 4 has an abnormal data distribution. The results of F Correction are obtained from the reduction value which is reduced by F Correction due to the influence of Reactor 1 which occurs when the tofu dregs are dried. These results mean that during the process of BSF fly larvae in decomposing organic matter, they also experience reduced water content from tofu dregs and affect the reduction value.

The results in the table are from the weighing process carried out on day 20 after the larvae entered the pre-pupa stage and stopped eating. This is also adjusted to the life cycle of the BSF fly in the larval stage where the larvae will only carry out the process of eating or decomposition (Suciati &Faruq, 2017). In places where food has high light intensity and contains high humidity until the feed media becomes runny, it will cause larvae to move or look for new food sources that are not too wet because BSF fly larvae are quite sensitive to moisture and light (Alvarez, 2012). After entering the pupa stage, the feeding process will stop and only larval manure remains which can be used as compost.

The reduction that occurs in tofu dregs to become compost is caused by feeding activities carried out by BSF fly larvae (Makkar *et al.*, 2014). During the reduction process, there was a significant change in the color, texture, and smell of the tofu dregs that the larvae began to eat. From the results of the researchers' observations, it was known that the color of the tofu pulp in all of Reactor 4 had changed from whitish to light brown approximately one hour after the sample was inserted. For changes in texture which were originally smooth and moist became like breadcrumbs but still moist within approximately one hour after the sample was added. The smell of tofu dregs that was originally smelled quite pungent, but it still smelled about an hour after the tofu dregs were added. In all of Reactor 4, the condition of the tofu dregs media was quite moist and wet because the number of larvae was not proportional to the amount of feed given/excessive so the feeding process became slow and less effective. Larvae also tend to climb to the reactor walls even to the point that some are out of the reactor within a few days. Entering the 14th day, the tofu dregs media in the reactor began to dry and turn brown but still had a slight odor, the process tends to be slower because some larvae came out/up to the reactor wall. After day 20, the media started to have a rough texture, changed color to dark brown, and no longer had a strong odor. Another change occurred in the final total weight of tofu dregs in Reactor 4 which reduced by approximately 40% of the total initial weight of tofu dregs as a result of the suboptimal feeding process by BSF fly larvae.

Tofu Dregs Reduction Index Without Larvae And With BSF Flies Larva Using WRI Formula

Based on the results of table IV.1 show that there is a decrease in the weight of tofu waste in reactors 1, 2, 3, and 4. The data is processed using the Waste Reduction Index formula. The recording process is calculated to obtain the following results :

1. In Reactor 1, the tofu dregs reduction index is 1.25%/day, which means that during the 20-day process of adding tofu dregs, there is a weight reduction of 25% at the time of weighing.
2. Reactor 2 produces a tofu waste reduction index of 2.53% / day, which means that during the 20-day process of entering tofu dregs there is a weight reduction of 50.6% at the time of weighing.
3. Reactor 3 produces a tofu waste reduction index of 2.52% / day, which means that during the 20-day process of entering tofu dregs there is a weight reduction of 50.4% at

the time of weighing.

4. Reactor 4 produces a tofu waste reduction index of 2.36% / day, which means that during the 20-day process of entering tofu waste there is a weight reduction of 47.2% at the time of weighing.

The use of the WRI formula is intended to determine the percentage reduction resulting from each reactor. Reactor 1 as the control treatment got the smallest percentage because the reactor was not given larvae so the weight reduction process was not so significant and tended to dry out. Reactor 2 which was treated with 50 BSF fly larvae by feeding tofu dregs as much as 50 g/day got the highest percentage because the larvae and the amount of feed were suitable so that the media in the reactor was not too humid and the larvae did not come out/up on the reactor wall. Reactor 3 has relatively the same conditions as Reactor 2 although in feeding tofu dregs the amount is different, namely as much as 55 g/day with 50 BSF fly larvae. Reactor 4 treated with 50 BSF fly larvae by feeding tofu dregs as much as 60 g/day got a smaller percentage than Reactor 2 and 3 because the larvae often came out/up to the reactor wall as a result of the condition of the media inside the reactor being quite humid.

In Reactor 2 and 3, the tofu dregs media that feed the larvae began to dry slowly from day 10 after the first feeding, but for Reactor 4 the tofu dregs media began to dry slowly on day 14. The amount of feed influenced the performance of fly larvae. BSF is in the process of eating its food because if it is excessive it can cause the condition of the media to become moist and the larvae to come out of the reactor. The BSF fly larvae will leave their food media which has moist conditions, has high light intensity, and is no longer nutritious after being eaten by the larvae themselves because in the larval phase which for approximately 20 days will only carry out the eating process and stop eating at pupa phase (Suciati & Faruq, 2017). Humidity is an influential factor in the process of reducing tofu dregs because the results shown from Reactor 4 are less than 50%.

Tofu Dregs Reduction Index Without BSF Larvae and With BSF Larvae Using Kruskal Wallis Statistical Test Analysis

Based on table IV.2 the statistical analysis of the Kruskal Wallis test can be seen as follows the chi-square value is 21.704, the standard deviation value is 3, and the significant value is 0.000. The significant value of 0.000 is smaller than (0.05). The analysis carried out obtained a probability value of p-value smaller than (0.05) so that it can be concluded that in this study H1 is accepted, and there are differences in the reduction and compost yield from variations in tofu dregs using Black Soldier Fly (Hermetia illucens) fly larvae.

Further analysis of the Kruskal Wallis test was to determine the significant difference between reactors so that further tests were carried out in the form of Independent Sample T-Test statistical tests. The results obtained based on table IV.3 show that all significant values between reactors are 0.000. The analysis carried out obtained a probability value of p-value smaller than (0.05) so it can be concluded that in this study H1 was accepted, which means there is a significant difference in the reduction value between reactors.

Compost of BSF Flies Larvae Final Media Results With Parameters C/N

Good compost is compost that can improve the structure of the soil to be looser, increase water absorption, improve soil pores, add plant nutrients, help decompose mineral material in the soil, and provide food for microorganisms that benefit plants (Monita *et al.*, 2017). Based on the results of table IV.4 show the characteristics of the compost from tofu dregs

produced through the decomposition process using the bioconversion method of BSF fly larvae. The measured compost quality was compared with the characteristics of SNI 19-7030-2004 compost which included parameters of C/N ratio, temperature, humidity, and degree of acidity (pH).
The C/N parameter is considered as the nutrient content in the compost that will be very beneficial for plants. The quality standard of C/N in compost ranges from 10-20 according to SNI 19-7030-2004 (Badan Standardisasi Nasional, 2004). In this study, laboratory testing of C/N parameters obtained the results in table IV.4 showing a change from compost on day 0 of 38.1 which decreased on day 20 to 32.9 due to the activity of larvae, then compost decreased again on day 20. day 40 was 23.1 due to the activity of the bacteria after the larvae stopped eating.

The ideal temperature for compost is the groundwater temperature which does not exceed 30ºC (Badan Standardisasi Nasional, 2004). In this study, it was carried out in a room with a room temperature of approximately 28ºC so that during the composting process the temperature was relatively normal. The results obtained in table IV.4 show that the increase in compost temperature from day 0 to day 20 is quite high because the larvae activity continues to eat tofu waste, while the increase in compost temperature from day 20 to day 40 is not too high because the larvae stop eating and continue to eat. by the activity of microorganisms that do not produce too high a temperature.

Humidity is also one of the factors of the feasibility of compost with an ideal value between 50% - 60%. There was a relatively high decrease in humidity from day 0 to day 20 compost due to larval activity and drying of the moisture content in the tofu dregs, while on day 20 to day 40 compost there was a low decrease.

The degree of acidity (pH) of compost is used in the agronomic value so it must have a normal value, which is between 6.8 – 7.5 (Badan Standardisasi Nasional, 2004). Compost on day 0 is relatively slightly more acidic because the tofu waste still contains vinegar from the residue of tofu processing, but there is a decrease in compost on day 20 because the activity of larvae that eat tofu waste can also improve the pH value to become more normal. The 40th-day compost already has a normal pH value due to the continued activity of microorganisms in the composting process.

The results obtained showed that there was a composting process carried out by the larvae and after the larvae stopped eating there was also a composting process by microorganisms either from bacteria or fungi in the reactor. The composting process will also not be separated from the activity of bacterial or fungal microorganisms in decomposing organic matter under aerobic conditions. This is evidenced by changes in the parameters of the C/N ratio, temperature, and degree of acidity (pH) due to bacterial activity in the compost after the absence of larvae from day 20 to day 40. These results also indicate that only temperature and acidity parameters (pH) comply with the compost requirements of SNI 19-7030-2004. During the composting process on day 0 to day 20, there was a reduction in weight made by BSF fly larvae, while compost on day 20 to day 40 was decomposed by bacterial or fungal microorganisms so that there could be a decrease in weight/quantity back in the compost that occurred. during the process.

CONCLUSION

1. Tofu dregs reduction index obtained a value on the variation of feed 50 g/day without

larvae by 25%, on the variation of feed 50 g/day with larvae by 50.6%, on the variation of feed 55 g/day with larvae by 50.4%, and the variation of feed 60 g/day with larvae of 47.2% for 20 days adjusted from the life cycle of BSF flies in the larval stage.
2. The compost produced by the final media for BSF fly larvae with C/N parameters is not by the compost requirements of SNI 19-7030-2004.
3. There is a difference in the reduction and yield of compost from the variation of tofu dregs using Black Soldier Fly (Hermetia illucens) fly larvae.

RECOMMENDATION

1. Further research is needed on the quantity of compost from day 20 to day 40.
2. It is necessary to test the bacteria in the larvae's feces which helps the composting process after the larvae stop eating.
3. It is necessary to optimize the reduction of tofu waste by controlling the humidity in the feed of BSF fly larvae.

REFERENCES

Alvarez. (2012). *The Role of Black Soldier Fly, Hermetia illucens (L.) (Diptera: Stratiomyidae) in Sustainable Management in Northern Climates. The University of Windsor. Ontario.*

Arikel, I. (2017). Pemanfaatan MOL Limbah Sayur pada Proses Pembuatan Kompos. *Jurnal Mipa*, *40*(1), 1–6.

Badan Standardisasi Nasional. (2004). Spesifikasi kompos dari sampah organik domestik. *Badan Standardisasi Nasional*, 12.

Makkar, H. P. S., Tran, G., Heuzé, V., & Ankers, P. (2014). State-of-the-art on the use of insects as animal feed. *Animal Feed Science and Technology*, *197* (November 2017), 1–33.

Monita, L., Sutjahjo, S. H., Amin, A. A., & Fahmi, M. R. (2017). Pengolahan Sampah Organik Perkotaan Menggunakan Larva Black Soldier Fly (Hermetia illucens). *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management)*, *7*(3), 227–234.

Mujahid, M., Amin, A. A., Hariyadi, H., & Fahmi, M. R. (2017). Oil Palm Empty Bunches Bioconversion Using Trichoderma sp. and Black Soldier Fly Larvae As Poultry Feed Composition. *Jurnal Ilmu Produksi Dan Teknologi Hasil Peternakan*, *5*(1), 5–10.

Neneng, S., & Indrayani, R. (2021). *Analisis Konsumsi Umpan Dan Indek Pengurangan Sampah Organik Menggunakan Manggot (Hermetia Illucens)*. *2*(2016), 227–235.

Nur, L., Maggot, T., Media, P., Fanani, A., & Husein, M. S. (2018). *Jurnal Inovasi Penelitian*. *2*(2).
Purnamasari, L., & Muhlison, W. (2021). *Biokonversi limbah ampas tahu dan limbah sayur dengan menggunakan agen larva Black Soldier Fly (Hermetia illucent)*. 105–111.

Salman, N., Nofiyanti, E., & Nurfadhilah, T. (2019). Pengaruh dan Efektivitas Maggot Sebagai Proses Alternatif Penguraian Sampah Organik Kota di Indonesia. *Jurnal Serambi Engineering*, *5*(1), 835–841.

Slansky, F., & Scriber, J. M. (1982). Selected Bibliography and Summary of Quantitative Food Utilization by Immature Insects. *Bulletin of the Entomological Society of America*, *28*(1), 43–56.

Suciati, R., & Faruq, H. (2017). Efektivitas Media Pertumbuhan Maggots Hermetia illucens (Lalat Tentara Hitam) Sebagai Solusi Pemanfaatan Sampah Organik. *Biosfer : Jurnal Biologi Dan Pendidikan Biologi*, *2*(1), 0–5.