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The Effect of Mahogany Leaf Litter (*Swietenia Mahagoni* (L.) Jacq.) on The Quality of Organic Fertilizer Through Vermicomposting

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ABSTRACT
Mahogany leaf litter (Swietenia mahagoni (L.) Jacq.) has high levels of lignin and C/N ratio, sothe decomposition speed is longer and can cause accumulation of litter waste. The purpose of this research was to determine the effect of applying different amounts of mahogany (Swietenia mahagoni (L.) Jacq.) leaf litter on the quality of organic fertilizer through vermicomposting. This study used acompletely randomized design (CRD) with the amount of mahogany leaf litter in each treatment was 0 g, 100 g, and200 g. Vermicomposting was carried out for 4 weeks, then the results were compared with SNI 7763:2018 and analyzed using LSD. The results showed that the addition of different amounts of mahogany leaf litter had nosignificant effect on the levels of total-N, P2O5 , C-organic, and C/N ratio but had a significant effect on the levels of K2O, and weight produced through vermicomposting. The p3 treatment with a total of 200 gof mahogany leaf litter was the most significant composition in meeting the chemical and physical quality parameters of vermicompost. This is due to the ideal balance of the C/N ratio in the material, so that vermicomposting runs optimally.

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1. INTRODUCTION

Mahogany leaf litter (Swietenia mahagoni (L.) Jacq.) is litter with a longer decomposition rate because it has a high lignin content of 19.46% (Kusumawati & Prayogo, 2019). Lignin has a function as a natural adhesive binding fiber cell to keep them together. The presence of lignin in the cell wall provides rigidity to cells, minimizes dimensional changes and reduces degradation of cellulose. The amount of lignin content will inhibit the decomposition process because lignin is a complex compound that is difficult to decompose by soil microorganisms (Devianti & Tjahjaningrum,. 2017).

In 2014 there was research related to mahogany leaf litter which had the highest C/N content, which was 39.22%, so the composting or material decomposition process took longer. The natural decomposition time of leaf litter to become compost that is ready to be used by plants or other organisms around it, takes about 4 months. The leaf decomposition time is slower than the leaf drop time, causing the accumulation of litter waste.

Abundant mahogany leaf litter can be used as an alternative for making fertilizer organic. Organic fertilizer is made by composting. One alternative to organic waste management for mahogany leaf litter is composting with the help of earthworms or also known as vermicomposting. Vermicomposting is anorganic waste processing process that involves earthworms to degrade waste (Marlina et al., 2017).

Earthworms have a symbiont of microorganisms in their gut that help break down organic matter (Wijana & Mudita, 2017). Utilization of organic carbon by earthworms is used for the respiration process with the result of waste in the form of, the process of excretion with the result of waste in the form of vermicompost (Fadilah et al., 2017). Earthworms excrete excrement in the form of granular aggregates which can improve and maintain soil structure, as well as fertilize the soil by producing feces that contain nutrients for plants. (Waluyo, 2018).

Utilization of mahogany leaf litter which is increasingly abundant and difficult to decompose as feed in vermicomposting can produce organic fertilizer. From the explanation of the background above, a study was conducted to determine the effect of mahogany leaf litter (*Swietenia mahagoni* (L.) Jacq.) on the quality of organic fertilizer through vermicomposting.

2. RESEARCH METHOD

This type of research is experimental. This research was conducted in two places. The first place is the vermicomposting process at the Bajulmati Villagehouse in November 2022. The second place is a laboratory test on the chemical content of vermicompost at the Jember State Polytechnic Bioscience Laboratory in December 2022. The tools used in the process of making vermicompost are a wooden box, a 0-50 kg digital scale, a hoe, a 10-mesh soil sieve, a digital camera, a pH meter, a soil temperature thermometer, and a sprayer. The materials used were mahogany leaf litter (*Swietenia mahagoni* (L.) Jacq.), earthworms (*Lumbricus rubellus* Hoff.), loose soil media, limousine cow manure, water, lime pests.

The vermicomposting process begins with collecting and soaking mahogany leaf litter, preparing earthworm live media, preparing earthworms, preparing vermicomposting baskets, inoculating earthworms on research media, feeding, maintaining earthworm live media, and harvesting. The second stage is a laboratory test related to the content of total-N, P2O5, K2O, C-organic, and pH in the vermicomposting results. In addition, observations of the physical properties of the vermicompost consisted of temperature, odor, color, and weight of the vermicompost produced.

The test method used a completely randomized design consisting of 2 treatments and 1 control with 3 replications each, so that the total wooden baskets used in vermicomposting were 3 × 3 = 9 wooden baskets. The media used in all treatments were the same (500 g of soil + 1000 g of cow manure) and the difference was the amount of litter in each treatment. p1 (control) = 0 g mahogany leaf litter; p2 = 100 g of mahogany leaf litter; p3 = 200 g of mahogany leaf litter.

3. RESULT AND DISCUSSION

Chemical Content of Vermicompost

Nitrogen

The total N element in compost is obtained from the degradation of compost organic matter by microorganisms and organisms that degrade compost material. The results of the One Way ANOVA test analysis obtained a significance value of 0.889 ($p>0.05$), which means that the three treatments giving the amount of mahogany leaf litter had no significant effect on the N-total vermicompost content. N-total level average data is listed in the following table.

Table 1. Analysis Results of Average N-Total Levels

No.	Total Treatment Mahogany Leaf Litter	N-Total Level
1.	p1 (0 g litter)	0.79233 ± 0.149018 a
2.	p2 (100 g litter)	0.76400 ± 0.109421 a
3.	p3 (200 g litter)	0.80733 ± 0.046608 a

Based on the results of the average analysis, it showed that the difference in the amount of mahogany leaf litter had no significant effect on the N-total vermicompost content. If p1 is compared to p2, the treatment that produces the highest total N level is p1with an average N-total of 0.79233%. But if p1 is compared to p3, the treatment that produces the highest total N level is p3 with an average obtained of 0.80733%. This shows that treatment 3 with a litter composition of 200 g + media (500 g of soil and 1000 g of cow manure) is the most influential composition but not significant with the total N number through vermicomposting.

Based on table 1, it shows that the total N-level of vermicompost does not meet the quality requirements of solid organic fertilizer from SNI 7763: 2018, which is at least 2%. This is due to incomplete decomposition process of organic matter for 4 weeks. The high content of lignin compounds which are difficult to decompose in mahogany leaf litter causes the rate of mineralization of nitrogen nutrients to be relatively slow.

The increase in N concentration due to nitrobacteria as a changer from ammonia to nitrate will increase due to the presence of mucus in the worms which enriches the number of nitrobacteria. The more mucus produced; the more bacteria will be contained in the substrate so that the nitrogen content in the material will increase (Huang & Fu, 2014). The increase in total N content in the application of organic matter was due to the presence of a nitrogen source derived from organic matter and the mineralization of the organic matter given. At p3 produces the highest levels of N-total. Apart from providing the highest amount of mahogany leaf litter, there was also additional cow manure as a vermicomposting medium which already contained a certain amount of nitrogen. So that the greater the amount of organic matter, the nitrogen content derived from mahogany leaf litter increases and the total N increases.

The rate of litter decomposition is influenced by the initial N and lignin content of the litter. High decomposition if it has a high N content, a low C/N ratio, a high content of compounds that are easily decomposed or a low content of compounds that are difficult to decompose (e.g. lignin) (Nurjanto et al., 2016). Mahogany leaf litter is of low quality because it has a low N content, C/N > 25, lignin content >15, significantly inhibits release, formation and potential nitrification (Putri et al., 2022). So that the difference in the amount of organic matter

given does not seem to contribute significantly to vermicomposting, so that the total N level of vermicompost at the end of vermicomposting is not significantly different between p1 and p2 and p3.

Organic materials that contain more N will decompose more quickly and release the N they contain than those that contain little N, because microorganisms decomposing compost materials require nitrogen for their development (Ani et al., 2016). Thus at the time of vermicomposting, the form of N produced in the mahogany leaf litter treatment already experienced denitrification and volatilization, as a result, much of the N produced by mahogany leaf litter was lost so that the total N content was not significantly different.

Phosphor

The level of phosphorus (P) produced is in the form of the compound (diphosphorus pentaoxide). The results of the One Way ANOVA test analysis obtained a significant value of 0.235 (p>0.05), which means that the three treatments giving the amount of mahogany leaf litter had no significant effect on the level of vermicompost. Data on average levels can be seen in the following table.

Table 2. Analysis Results of Average P2O5 Level (%)

No.	Total Treatment Mahogany Leaf Litter	P2O5 Level (%)
1.	p1 (0 g litter)	1,00367 ± 0.091947 a
2.	p2 (100 g litter)	0,97767 ± 0.035105 a
3.	p3 (200 g litter)	0,89467 ± 0.077365 a

Based on the results of the average analysis, it shows that the difference in the amount of mahogany leaf litter has a significant effect not significantly different from the P205 level of vermicompost. If p2 is compared to p3, the treatment that produces the highest P205 content is p2 with an average of 0.97767%. But if p2 compared to p1, the treatment that produced the highest levels of P205 was p1 with 0 g of litter and the a verage obtained was 1.00367%. This shows that treatment 1 with a litter composition of 0 g + media (500 g of soil and 1000 g of cow manure) is the most influential composition but not significant to the amount of P205 through vermicomposting. Earthworms are able to secrete enzymes in the form of alkaline phosphatase which can hydrolyze organic phosphate into a form available to plants. The vermicompost from worm digestion will then experience further phosphorus mineralization by the microflora and phosphate-dissolving bacteria that grow in vermicompost media so that the phosphorus content increases (Arohaman et al., 2023).

The increase in phosphorus content is affected by the length of vermicomposting time (Trivana & Pradhana, 2017). At p2 and p3 produce the lowest levels of P2O5, because it is decomposed by mahogany leaf litter and the media, so it takes a long time. Whereas p1 produces the highest P2O5 content, because there is only media, so the time to decompose is faster.

The difference in the amount of organic matter given has not significantly contributed P2O5 to vermicomposting. This is caused by the P2O5 content in mahogany leaf litter. The low P2O5 content in vermicompost is due to the phosphorus contained in the raw materials used and the large number of microorganisms involved in composting (Husain et al., 2015). Microorganisms absorb phosphorus for cell formation, and this phosphorus will be returned when the microorganism dies. The overhaul of organic matter and the process of assimilation of phosphorus occurs due to the presence of phosphatase enzymes produced by some microorganisms. If the number of microorganisms in the compost is less, the decomposition of organic matter and the process of assimilation of phosphorus by microorganisms is also less so that the phosphorus in the compost is not utilized.

Potassium

Potassium (K) levels are produced in the form of compounds (potassium oxide). The results of the One Way ANOVA test analysis showed a significant value of 0.041 (p<0.05) for the content. This shows that the three treatments with different amounts of mahogany leaf litter had a significant effect on vermicompost levels. Then a further test can be carried out, namely the LSD test to determine the treatment that has a significant effect on levels of vermicompost mahogany leaf litter. LSD test results can be seen in the following table.

Table 3. Analysis Results of Average K2O Level (%)

No.	Total Treatment Mahogany Leaf Litter	K2O Conten (%)
1.	p1 (0 g litter)	0.44000 ± 0,08718 a
2.	p2 (100 g litter)	0.37133 ± 0,048850 a
3.	p3 (200 g litter)	0.37167 ± 0,04619 a

The LSD test results showed that the p2 and p3 treatments had the same letter notation and p1 had a different letter notation. This means that the p3 treatment and the p2 treatment showed significantly different levels when compared to the p1 treatment. Meanwhile, if p2 is compared to p3, it shows levels which are not significantly different. This shows that the p1 treatment with a composition of 0 g litter + media (500 g of soil and 1000 g of cow manure) is a composition that has a significant effect on the amount of through vermicomposting.

Based on table 3, the content of vermicompost does not meet the SNI 7763:2018 solid organic fertilizer quality requirements, namely at least 2%. This is due to incomplete decomposition of organic matter for 4 weeks. The high content of lignin compounds which are difficult to decompose in litter causes the mineralization rate of potassium to be relatively slow.

Vermicompost that has been half decomposed while passing through the digestive system of earthworms will mix with mucus containing enzymes and microorganisms, so that it can stimulate the growth of beneficial microorganisms such as microflora. Microflora growing on vermicompost increases potassium mineralization in vermicompost media, acids produced by microflora are the main mechanism for dissolving insoluble potassium in vermicompost substrate (Aryonugroho & Lestari, 2021).

Variations in the value of potassium levels are partly caused by differences in the speed of microorganisms in decomposing organic matter (Mulyadi & Yovina, 2014). The p1 decomposition time was 4 weeks longer because it only decomposed the media resulting in the highest content. The longer the composting time, the more microbes will grow and decompose the potassium contained in the compost material.

At p2 and p3 produce the lowest content. This is due to the less time to decompose the media and litter for 4 weeks. In addition, it is caused by turning and spraying during vermicomposting maintenance. The greater the amount of litter given, the higher the need for water to maintain temperature and humidity. Thus, this causes a decrease in p2 and p3 in the value of potassium due to the carrying of potassium by water and is supported by the effect of stirring during the vermicomposting process. The more times you turn, the potassium level in the vermicompost will decrease.

The longer the stirring, the bound potassium will be released again. In addition, the lowest p2 and p3 values, due to decomposition by bacteria into K formed cannot last long because the nature of K itself is easily soluble in water and elemental K can easily bind to other compounds which causes K in its form to be lost. The element potassium (K) is a nutrient that easily compounds with other substances, for example Ca and Mg (Maesaroh et al., 2014).

C-Organic

The results of the One Way ANOVA test analysis obtained a significant value of 0.818 (p>0.05), which means that the three treatments giving the amount of mahogany leaf litter had no significant effect on the C-organic content of vermicompost. Data on the average C-organic content are shown in the following table.

Table 4. Analysis Results of Average C-organic Level (%)

No.	Total Treatment Mahogany Leaf Litter	C-organic Level (%)
1.	p1 (0 g litter)	8.03500 ± 1,296845 a
2.	p2 (100 g litter)	7.54133 ± 1,238618 a
3.	p3 (200 g litter)	7.99933 ± 0,245351 a

Based on the results of the average analysis, it showed that the difference in the amount of mahogany leaf litter had no significant effect on the C- organic content of vermicompost. If p3 is compared to p2, the treatment that produces the highest organic C content is p3 with an average of 7.99933%. But if p3 is compared to p1, the treatment that produces the highest C-organic content is p1 with 0 g of litter and the average obtained is 8.03500%. This shows that treatment 1 with a litter composition of 0 g + media (500 g of soil and 1000 g of cow manure) is the most influential composition but not significant to the amount of C-organic through vermicomposting.

C-organic vermicompost describes the overall organic matter content in vermicompost. Lignin and cellulose are the main organic components that produce C-organic, so the levels of these two compounds affect the C-organic content of vermicompost (Nurida et al., 2007). Lignin content and the C/N ratio are parameters that affect the decomposition of organic matter, where in the early stages, the decomposition of organic matter depends on the C/N ratio, while the decomposition in the later stages is controlled by lignin content (Canqui & Lal, 2014).

Mahogany leaf litter contains 19.46% lignin (Kusumawati & Prayogo, 2019). Organic materials with <15% lignin content is classified as low. So that the lignin content of mahogany leaf litter is high because it is more than 15%, causing the decomposition rate to run slowly. The fibrous texture of the media can cause earthworm experience difficulties in consuming feed (Liberty et al., 2022). This is because the earthworm (*Lumbricus rubellus* Hoff.) does not have teeth to consume it. Crude fiber which is quite high in feed ingredients is difficult to degrade because more and more lignin compounds wrap the cellulose and hemicellulose components.

Organic matter undergoes gradual decomposition, due to the use of carbon content by microorganisms and earthworms in obtaining energy for their lives through the process of respiration. This has an impact, the C-

organic content increases in the treatment as the composting period increases. At p1 obtained the highest organic C content, because only the media was decomposed so that the time given was longer compared to p2 and p3 the time given was less. The greater the amount of litter, the more severe the activity of decomposing microorganisms and the longer it takes to decompose. So, this is what causes the difference in the amount of organic matter given not to produce a significant C-organic content of vermicompost.

C/N Ratio

The results of the One-way ANOVA test analysis obtained a significant value of 0.842 (p>0.05), which means that the three treatments giving the amount of mahogany leaf litter had no significant effect on the C/N ratio of vermicompost. The average C/N ratio data is shown in the following table.

Table 5. Analysis Results of Average C/N ratio

No.	Total Treatment Mahogany Leaf Litter	C/N ratio
1.	p1 (0 g litter)	10.17500 ± 0,340369 a
2.	p2 (100 g litter)	9.86700 ± 0.776379 a
3.	p3 (200 g litter)	9.99300 ± 0,780677 a

Based on the results of the average analysis, it showed that the difference in the amount of mahogany leaf litter had no significant effect on the C/N ratio of vermicompost. If p3 is compared to p2, the treatment that produces the highest C/N ratio is p3 with an average of 9.99300%. But if the p3 treatment is compared to p1, the treatment that produces the highest C/N ratio is p1 with 0 g of litter and the average obtained is 10.175000%. This shows that treatment 1 with a litter composition of 0 g + media (500 g of soil and 1000 g of cow manure) is the most influential composition but not significant to the C/N ratio through vermicomposting.

The element carbon (C) is a source of energy for microorganisms, while nitrogen compounds (N) is used as a source for building body cell structure. The activity of earthworms and microorganisms that utilize the elements of carbon and nitrogen contained in the material causes the C/N ratio of compost to decrease. The low C/N ratio on p2 and p3 was caused by the incomplete decomposition process of organic matter for 4 weeks. The C/N ratio is highly dependent on the C and N content of the material to be composted. Lignin and cellulose are organic compounds in plants that produce C-organic where lignin is a compound that is difficult to decompose, while cellulose is easier to decompose (Septiningsih & Haryanti, 2015).

In terms of C and N nutrient content, mahogany leaf litter contains the highest levels of C (49.42%) but contains the lowest N (1.26%), as a result the ratio of mahogany leaves is high (Ghaisani, 2014). The content of C in cow manure is lower than mahogany leaves, namely C (21.85%) while N (0.82%) (Pranata, et al. 2022). The principle of composting is to reduce the C/N ratio of organic matter to the C/N of soil (<20). So that the higher the C/N ratio of organic matter on p2 and p3, the longer the process of decomposing the material.

Whereas at p1, the C/N ratio of the material is lower, resulting in a faster decomposition process and a near-perfect C/N ratio, so that 4 weeks of media decomposition is sufficient. A C/N ratio of organic matter that is too high causes the vermicomposting process to take place slowly, this condition is caused by the microorganisms involved in the vermicomposting process lacking nitrogen (N) while a ratio that is too low causes loss of nitrogen in the form of ammonia which will then be oxidized (Purnomo et al., 2017).

pH

The results of the One Way ANOVA test analysis showed a significant value of 0.01 (p <0.05) for pH. This shows that the three treatments of giving different amounts of mahogany leaf litter had a significant effect on the pH of the vermicompost. This underlies the need for a further test, namely the LSD test to determine the treatment that has a significant effect on the pH of mahogany leaf vermicompost litter. LSD test results can be seen in the following table.

Table 6. Analysis Results of Average pH

No.	Total Treatment Mahogany Leaf Litter	pH
1.	p1 (0 g litter)	$9.24000 \pm 0{,}158745^{b}$
2.	p2 (100 g litter)	$8.20667 \pm 0{,}005774^{a}$
3.	p3 (200 g litter)	$7.99000 \pm 0{,}017321^{a}$

The results of the LSD test showed that the p3 and p2 treatments had the same letter notation and p1 had a different letter notation. This means that p3 and p2 show the effect of pH vermicompost which was significantly different when compared to p1. Meanwhile, if p2 is compared to p3, it shows that the effect of vermicompost pH is not significantly different. This shows that p1 with a litter composition of 0 g + media (500 g of soil and 1 000 g of cow manure) is a composition that has a significant effect on the amount of pH through vermicomposting.

The pH value in the vermicomposting process greatly influences the activity of the development of

earthworms and microorganisms, which will greatly affect the quality of the vermicompost produced. A pH that is too high can cause the nitrogen element in the compost material to turn into ammonia, whereas in acidic conditions it will cause microorganisms to die (Veronika et al., 2019)..

The pH value is affected by the process of protein breakdown which produces NH_3, and then binds to water to form basic NH_4OH. The change in compost pH starts from a slightly acidic pH due to the formation of simple organic acids, then the pH increases in further processing due to the decomposition of proteins and the release of ammonia (Rosalina et al., 2020).

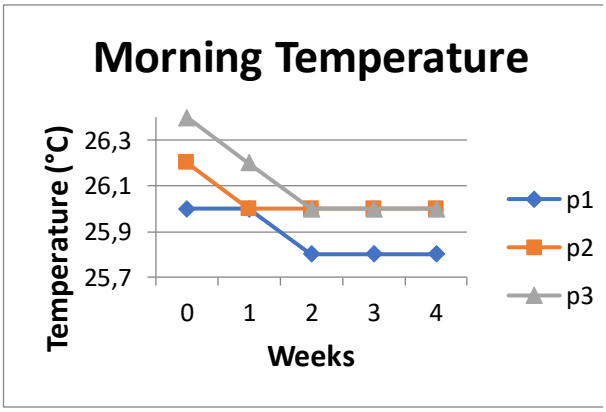
The high pH value at p1 is caused by earthworms only decomposing cow manure which contains large amounts of nitrogen. Cow manure has a C/N ratio of 26.65, which is low because it is <30 (Pranata et al., 2022). Therefore, cow manure can be mixed with plant waste that has a high C/N for an ideal balance of C/N ratio during vermicomposting so that it runs optimally (Rakhmawati et al., 2019). A C/N ratio that is too small at p1 causes the release of ammonia and makes the compost alkaline.

At p2 and p3, the pH of the vermicompost obtained met the quality requirements for organic fertilizer. This is caused by cow manure with low C/N mixed with mahogany leaf litter which has high C/N so as to obtain an ideal balance. Carbon will absorb nitrogen and form an odorless mixture (Setyorini et al., 2016). So that the high carbon content in mahogany leaf litter will absorb nitrogen in cow manure and the pH will decrease. So that the more the amount of mahogany leaf litter is given to the vermicomposting media at p2 and p3, the resulting pH decreases.

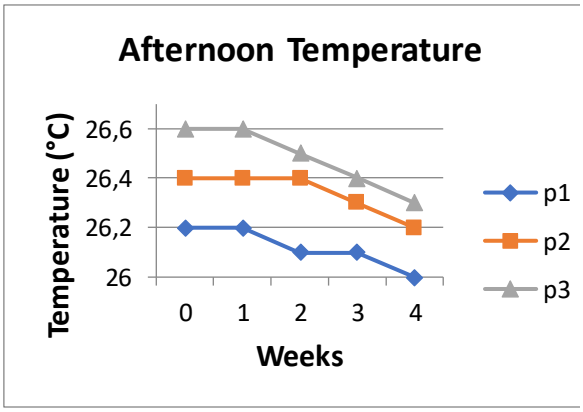
Physical Content of Vermicompost

Temperature

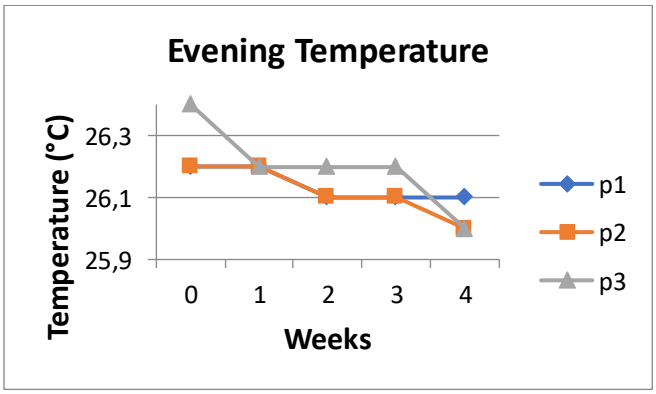
Optimum earthworm growth media will produce good quality vermicompost. One of the indicators that can be used to determine the ideal conditions of a medium for the growth of earthworms is temperature. Optimum temperature for the growth of earthworms is 25-28ºC [12]. This is relevant to the results of measuring the temperature of earthworm living media at week 0 to week 4 in the following figure.



Picture 1 Graph of Morning Medium Temperature



Picture 2 Graph of Afternoon Medium Temperature



Picture 3 Graph of Evening Medium Temperature

The temperature on the media is affected by the environment. If the ambient temperature is high, heat will be absorbed by the media and will raise the temperature of the media. During vermicomposting, it was found that week 0 and 1, in the morning, afternoon and evening measurements produce the highest temperature. This explains that there is a process of warming the feed and the start of the decomposition process by mesophilic bacteria. In the anaerobic composting process there is a warming stage (mesophilic stage) which has a temperature

ranging from 10ºC – 35ºC (Sumekto, 2016). Mesophilic microorganisms work to change the size of organic matter to be small so that the material will become soft and easily digested by earthworms. The temperature dropped in the 2nd week and continued to decrease in the 4th week. The rate of increase in temperature was different for each treatment. The amount of organic matter will make earthworms and microbes in the media carry out activities and affect the rate of decomposition. A smaller amount will cause the decomposition to run faster (Hazra et al., 2018).

The media temperature at higher p2 and p3 is caused by the presence of microorganisms and the availability of organic carbon which is not digested aerobically is degraded by microorganisms and produces heat (Nagar et al., 2018). Whereas at p1 the temperature is lower because there is no pile of litter in the media. In the pile, the microbes around the earthworms carry out activities that generate energy in the form of heat. Some of the heat will be stored in the pile and some will be used for the evaporation process. The bigger the pile, the heat generated in the pile is increasingly difficult to escape and the temperature of the pile becomes hotter. Meanwhile, a pile that is too low will make the material lose heat faster (Djuarnani et al., 2015).

This high activity was indicated by an increase in temperature until week 2, there was still a change in composting temperature from all treatments, while in week 3 a cooling phase began which was marked by a decrease from peak temperature to stability. In week 4, temperature stability began to occur which varied in each treatment which was measured in the morning, afternoon and evening, which ranged from 25.8-26.2ºC. This temperature is the same as the soil temperature and is in accordance with the requirements of mature compost.

Colour

To make the color classification of vermicompost more accurate, it is based on the soil color categories listed in Munsell's book. Vermicompost color can be seen in the following table.

Table 7. Colour of Vermicompost

No.	Total Treatment Mahogany Leaf Litter	Colour	Code
1.	p1 (0 g litter)	Dark Brown	7.5 YR 3/2
2.	p2 (100 g litter)	Very Dark Brown	7.5 YR 2.5/2
3.	p3 (200 g litter)	Black	7.5 YR 2.5/1

Based on the observations, each amount of mahogany leaf litter showed the same hue (hue 7.5 YR), but had different values and chroma. This is caused by differences in the amount of litter used as food by earthworms and microorganisms during vermicomposting. The difference in the color of the compost at the end of the observation indicated the degree of maturity of the vermicompost.

The results of measurements of the color of vermicompost in each amount of mahogany leaf litter showed a change from the initial brownish yellow color (i.e. the color of the media in the form of soil and cow manure and mahogany leaf litter) to blackish brown (vermicompost results). This indicates that the color of vermicompost complies with the SNI 7763:2018 standard which states that mature compost has a black color. The color change is caused by the loss of nitrogen caused by the decomposition process that occurs in composting. The following are the results of color changes before and after vermicomposting:

Picture 1 Before Vermikomposting

Picture 2 After Vermicomposting

The addition of different mahogany leaf litter had an effect on the color change of the vermicompost. The amount of mahogany leaf litter 200 g produces a blacker color compared to 0 g and 100 g. This is caused by differences in organic matter content, the higher the organic matter content, the darker the vermicompost color will be.

Smell

Observation of the smell of vermicompost is carried out using the sense of smell and carried out after the end of composting. The results of odor observations can be seen in the following table.

Table 8 Smell of Vermicompost

No.	Total Treatment Mahogany Leaf Litter	Smell
1.	p1 (0 g litter)	Slightly pungent smell
2.	p2 (100 g litter)	Smells like earth
3.	p3 (200 g litter)	Smells like earth

Based on table 8, the smell of vermicompost from p2 and p3 meets SNI standards. According to SNI 7763:2018, the characteristics of mature compost are criteria smell like soil. This is due to the presence of mahogany leaf litter which has a high C/N mixed with cow manure which has a low C/N content so as to obtain an ideal balance for vermicomposting.

At p1 it produces a slightly pungent odor (smell of cow manure) even though the media has been reversed. This slightly pungent smell is due to the fact that there is only cow manure which has a low C/N. The composting process has a lot of nitrogen, so the amount of nitrogen content mixed with hydrogen will form ammonia (Setyorini, 2016). So that to neutralize odors, you can add a compost composition that contains carbon (in the form of litter), as in giving the amount of mahogany leaf litter 100 g and 200 g.

Weight of Vermicompost Produced

The results of the One Way ANOVA test showed a significance value of 0.030 <0.05, so there was a significant difference in the weight of vermicompost in mahogany leaf litter due to differences in treatment. This underlies the need for a follow-up LSD test to determine the treatment that has a significant effect on the weight of vermicompost in mahogany leaf litter. LSD test results can be seen in the following table.

Table 6. Analysis Results of Average Weight of Vermicompost Produced

No.	Total Treatment Mahogany Leaf Litter	Weight (g)
1.	p1 (0 g litter)	1173.67 ± 266.766 a
2.	p2 (100 g litter)	1445.33 ± 91.566 ab
3.	p3 (200 g litter)	1689.67 ± 104.184 b

The results of the LSD test showed that the p2 and p3 treatments had the same letter notation, meaning that the two treatments had no significantly different effect. Treatment p2 when compared to p1 has the same letter notation meaning that the two treatments have an effect that is not significantly different. Treatment p3 when compared to p1 has a different letter notation meaning that the two treatments have significantly different effects. This shows that the p3 treatment with a litter weight of 200 g has a significant effect on the quality of organic fertilizer through vermicomposting. At p3 compared to p1 the results were significantly different, because at p1 the amount of mahogany leaf litter was 0 g. So that worms on p1 get organic matter from the media while earthworms on p3 get organic matter from the media and mahogany leaf litter. At p3 it produced more vermicompost than the other treatments. As is well known, in addition to the media, p3 also contains 200 g of decomposed mahogany leaf litter, and the time given for 4 weeks to decompose is less so that the shrinkage rate is only small, unlike p1 and p2. According to Marlina et al, (2017) shrinkage is an indicator of compost maturity. In waste management, high shrinkage provides an advantage in reducing waste volume.

The greater the shrinkage, the better the microorganisms decompose organic matter into compost (Nurdiana, et al. 2017). The p1 treatment resulted in less vermicompost weight, because the time given for 4 weeks to decompose was longer because it only decomposed vermicompost media, so the shrinkage was large. The process of overhauling organic matter also causes a decrease in the volume of organic matter. Volume shrinkage occurs due to changes in the size of the organic matter particles which are getting smaller, the greater the volume shrinkage of organic matter, the less organic matter will be produced. Volume shrinkage occurs due to changes in organic matter particles and the release of carbon compounds, water, and organic acids that are easily evaporate. organic carbon compounds from organic fertilizer materials are used by heterotrophic microbes as a source of energy for their life.

4. CONCLUSION

The p3 treatment with a composition of 200 g of mahogany leaf litter + media (1000 g of cow manure and 500 g of soil) + 200 g of earthworms (*Lumbricus rubellus*) was the composition that had the most significant effect on meeting the parameters consisting of macronutrients (N-total, P2O5, and K2O), C- organic, C/N ratio, and weight through vermicomposting. This is due to the ideal balance of C/N content in the material so that vermicomposting runs optimally. Vermicompost can be a product that people rely on because it is more environmentally friendly, so it can improve environmental quality and preserve natural resources.

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