THE UTILIZATION OF *BLOTONG*, MOLASSES, BRAN, AND COCONUT HUSK INTO COMPOST USING MOL OF STALE RICE AND *Trichoderma* sp.

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Abstract

Compost is a solution for dealing with organic waste. Compost with organic material must be mixed according to its elemental composition. Protein and potassium are obtained from bran and coconut husk. *Blotong* contains phosphorus (P), while molasses contains total N and K_2O. Local Microorganisms (MOL) of stale rice is an activator to increase the microbiological decomposition of organic matter and contains *Saccharomyces cerevisiae, Bacillus cereus, and Aspergillus* sp. The addition of *Trichoderma* sp. can speed up the composting process. The aim of the study is to determine the effect of adding *Blotong* and bran on the quality of compost, to obtain the most effective composition of *Blotong*, molasses, bran, and coconut husk for composting using MOL activator of stale rice and *Trichoderma* sp. according to SNI 7763:2018, and to determine the most effective composting time. The ratio of *Blotong*, coconut husk, bran, and molasses for the three variations were 56:10:30:4; 66:10:20:4; and 76:10:10:4 in percent as much as 6 kg calculated with Takakura method. The result of the study showed the three variations had fulfilled SNI 7763:2018 in 18 days, with the most effective composition is the 3rd variation.

Keywords: *compost, Blotong, molasses, bran, coconut husk, activator*

Introduction

The agricultural and plantation sectors in Indonesia reach 15% of the percentage of economic value in Indonesia. This situation has an impact on increasing the need for organic fertilizers (Irawan et al., 2012). By-products from sugar factories can be used as raw materials for compost (Fangohoy & Wandansari, 2017). *Blotong* produced from the sugarcane juice filtering process can pollute the environment because its wet texture can cause a stink. However, *Blotong* contains phosphorus (P) (Siregar, 2017). Phosphorus in plants plays a role in root growth and fruit and seed maturation. Then, molasses is a waste from the sugar crystal decomposition stage. The addition of molasses additives can increase the total N and K_2O content (Liandari, 2017).

The process of reshuffling raw materials for composting will occur if there are elements of Nitrogen, Phosphorus, and Potassium. To complement the elements of carbon and nitrogen, it is necessary to add bran because the bran contains 11.3–14.4% protein (Wizna & Muis, 2021). Furthermore, the coconut husk is added to complement the potassium element in the composting process. Based on data from Agricultural Research and Development (2017), Indonesia produces an average of 1.8 million tons of coconut coir per year. Until now, coconut husk has not been optimal, so it can be used as an alternative to add potassium.

In making compost, an activator is needed. Activator is an additional material to increase the ability of microbiological decomposition of organic matter (Gaur, 1983). One of the activators that can be used is the Local Microorganisms (MOL) of stale rice. MOL of stale rice has similar qualities to activators already on the market (Ardiansyah, 2019).

MOL of stale rice can reduce production costs and utilize stale rice waste. Some of the microbes in MOL of stale rice are *Saccharomyces cerevisiae, Bacillus cereus, and Aspergillus* sp. (Ardiansyah, 2019). In general, the composting process occurs in 3-4 weeks, but the process can be accelerated by adding *Trichoderma* sp. and MOL of stale rice to reshuffle organic matter, that can reduce the composting time (Setyorini et al., 2016). It is hoped that compost with the best quality can be produced by completing the elements needed in the composting process. The aim of this study were to determine the effect of adding *Blotong* and bran on the quality of compost, to obtain the best mixture composition of *Blotong*, molasses, bran, and coconut husk for composting using the MOL activator of stale rice and *Trichoderma* sp. according to SNI 7763:2018, and to determine the best composting time.

Research Methods

Tools and materials

The tools used in this study include Takakura, thermometer, pH meter, and a set of macro elemental analysis tools in the form of Organic C, Total N, Total P_2O_5, Total K_2O, and the C/N ratio of SNI 7763:2018. The Takakura was made of a basket and covered with cloth. The Takakura has three holes on the front side of the Takakura for sampling. The dimensions of the Takakura are shown in Figure 1.

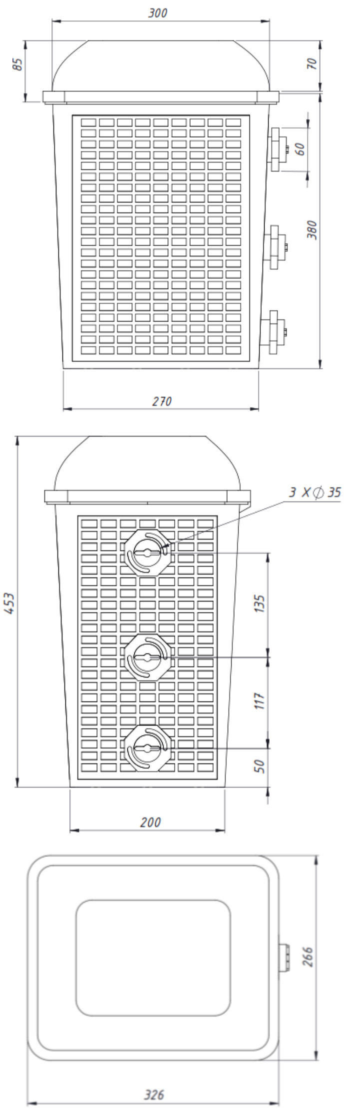

Figure 1. Dimensions of Takakura

The soil thermometer is the Sanfix ST-300A which has a temperature range of -50 °C to 300 °C and a resolution of 0.01 °C. The soil pH meter in range from 3 to 10 and a resolution of 0.1.

The materials used were *Blotong*, coconut husk, molasses, bran, stale rice, bamboo leaves, brown sugar, aquadest, and *Trichoderma* sp.

MOL production

Ardiansyah (2019), in a study done in Indonesia, mentioned the MOL production using stale rice. The MOL production used old newspapers as a base and placed 60 grams of rotted bamboo leaves on top of the newspaper. Then, 200 grams of stale rice was placed on a bamboo leaf and water was added until it is moist. Next, the stale rice was wrapped in a newspaper and put in the shade for 4-5 days. Stale rice that had been overgrown with fungi then was dissolved in a liter of a mixture of water and 100 grams of brown sugar. The solution was stored in a closed state for 4-5 days until it smelled of alcohol.

Composting method

Siregar (2017), in a study done in Indonesia, mentioned a composting method using Takakura as a composter. The composting process was carried out by adding a mixture of 6 kg of raw materials into the composter. The ratios of *Blotong*, coconut husk, bran, and molasses was 56:10:30:4; 66:10:20:4; and 76:10:10:4. The raw materials for *Blotong* and coconut husk must be chopped before mixing. Then, MOL of stale rice and *Trichoderma* sp. were added until the water content reached 55–65%. Stirring variations were carried out in 5 days. Sampling was carried out at the top, middle, and bottom of the Takakura.

Sample analysis

The analysis was carried out before stirring. The analysis includes analysis of water content, pH, temperature, macro content based on SNI 7763:2018. Water content analysis was carried out in 2 times a week using the gravimetric method. pH analysis was carried out in the morning and the evening using a pH meter. Temperature analysis was carried out in the morning and evening using a soil thermometer. Analysis of macro content in the form of Organic C, Total N, Total P_2O_5, Total K_2O, and C/N ratio was carried out at the Agro Chemistry Laboratory. The macro content was analyzed on compost raw materials and when the compost had complied with the characteristics of mature compost. Based on SNI 19-7030-2004, the characteristics of mature compost can be analyzed by compost's temperature, the compost's smell similar to soil's, and the compost's color which has a brown to blackish color.

Results and Discussion

The water content analysis aims to optimize the composting process. The degradation process in compost is characterized by an increase in temperature, which causes an evaporation and a decrease of the water content in the compost. The compost water content profile is shown in Figure 2.

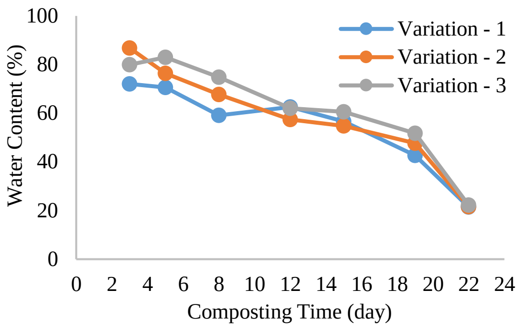

Figure 2. Profile of compost water content

The water content of the three variations decreased significantly with the final water content of 21.41%, 21.57%, and 22.20%. The water content has reached the optimum condition. This is due to the addition of bran into the compost, which is reacted to the decrease of the compost's water content because the bran's water content is 12.84% and can absorb water. Sormin (2017), in a study done in Indonesia, a compost with a mixture of *Blotong*, banana peel, and molasses without the addition of bran with a composition ratio of 76%:20%:4% was occurred in 40 days with the water content is still high reached out 49.26%.

Excess water content induces the closing of the porosity of the compost so that the air volume will decrease. Compost with a water content exceeding 60% induces a leaching of elements that can reduce microbial activity and create anaerobic conditions (Widarti, 2015). Meanwhile, very low humidity can reduce microbial activity due to the lack of water in dissolving organic matter as an energy source (Pandebesie & Rayuanti, 2013). The three variations in this study have met SNI 7763:2018 with water content in the range of 8% to 25%.

As for the pH parameter, the optimum condition for decomposing microorganisms is in pH 6.5 to 7.5 (Suriani et al., 2013). The results of pH measurements in the three variations of compost are shown in Figure 3.

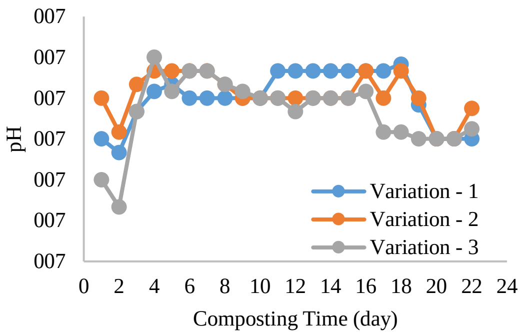

Figure 3. Profile of compost pH

The three variations have a similar pH profile with a difference of 0.1. The initial pH of the three compost variations showed a decrease, then on the second day showed an increase significantly, which then slowly decrease in the pH range of 7.1 to 7.2.

The decrease of pH during the composting process is caused by microbial activity. The microorganisms constructed organic acids from the nitrification process, which released ammonium and hydrogen ions (Ma et al., 2022). Subsequently, the decomposer microorganisms decomposed nitrogen in the form of ammonia (NH_3 or NH_4^+). The ammonification process induced the increase of pH (Sayara & Sanchez, 2021). At the end of the composting process, composts are in the neutral pH range indicating that the nitrogen decomposition has decreased by microbial activity (Krisnawan et al., 2018).

According to Kusuma (2012), the pH is also affected by the nitrogen content in the raw materials because microorganisms will synthesize proteins in organic materials during the composting process. Final pH of three variations compost were 7.10; 7.18; and 7.13 and have complied with SNI 7763:2018, which is in pH 4.0 to 9.0.

The optimum temperature of compost is in the range of 30 °C to 50 °C (Indriani, 2007). Temperatures that exceed 60 °C induces the death of microorganisms (Widarti, 2015). The results of the three variations of temperature measurements are shown in Figures 4 to 6.

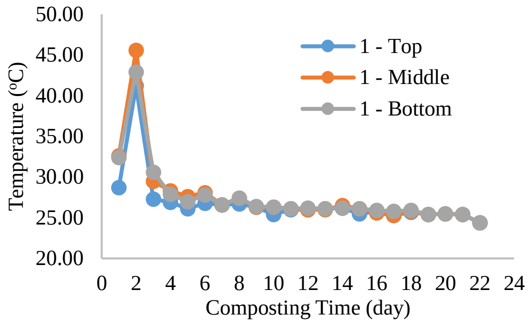

Figure 3. Profile of the 1st temperature variation

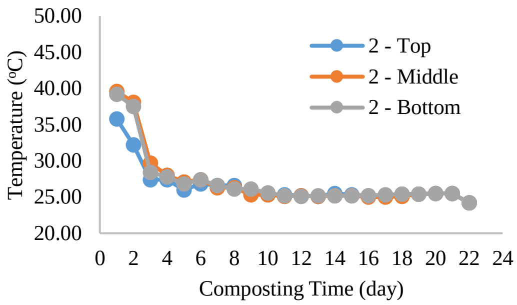

Figure 5. Profile of the 2nd temperature variation

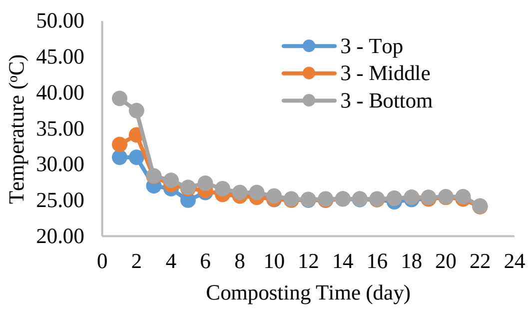

Figure 6. Profile of the 3th temperature variation

The temperature in the middle of Takakura is the highest due to condensation at the top because an increase in temperature. Meanwhile, at the bottom of Takakura, there is a decrease in water from the top of the compost, so it has higher humidity.

The initial temperature of the three variations is around 28 °C. The lag phase or the microbial phase adapts and begins to utilize cellulose, glucose, starch, and amino acids in organic matter for microbial growth (Sekarsari, 2011; Sormin, 2017). On the second day, there was a significant increase in temperature called the active phase where the microbes divide rapidly, which is marked by the rise in temperature. This condition is influenced by pH, nutrient content, and environmental conditions (Wahyuningsih & Zulaika, 2018).

The temperature from the first to the second day experienced a significant increase in temperature indicating the replacement of mesophilic bacteria by thermophilic fungi, thermophilic bacteria, and *actinomycetes* (Woodford, 2009). In this condition, the bacteria utilize oxygen and decompose organic matter into CO_2, water vapor, and heat until all organic matter are decomposed, which is characterized by a decrease temperature (Emadian, et al., 2017). The maximum temperature in the 1st variation was higher than the 2nd and 3rd variation. This was due to the higher C/N ratio in variation 1 so that microbial activity was more significant.

Temperatures on the third to the last day decreased, called the curing phase. It was a compost maturation stage, which was indicated by a decrease in the number of microorganisms and the temperature and the composts were dominated by fungi and bacteria decomposed cellulose (Amanah, 2012).

The temperature profile can be influenced by different C/N content in *Blotong* and bran by 18.66 and 35.45. Variations which have a high C/N ratio will require a longer degradation process until the C/N reaches the C/N of soil. The degradation process is characterized by an increase in the temperature of the compost.

The three variations on the 18th day already showed the characteristics of mature compost with the same temperature conditions as the soil, brown compost color, and soil smells. Therefore, the composting process can be ended on the 18th day.

The macro element content of the raw materials and the three composts are shown in Table 1 and Table 2.

Table 1. Raw materials of compost

Parameter	*Blotong* (%)	Molasse (%)	Bran (%)	Coconut husk (%)
Water Content	12.95	20	12.84	44.70
Organic C	31.72	20.00	46.08	51.42
Total N	1.70	0.46	1.30	0.50
C/N	18.66	43.48	35.38	102.84
P_2O_5	3.73	0.08	1.04	0.22
K_2O	0.47	2.07	0.73	2.11

Table 2. The content of compost

Variasi ke-	Organic C (%)	Total N (%)	C/N	P_2O_5 Total (%)	K_2O Total (%)
1	37.16	1.49	24.9	2.09	1.08
2	34.69	1.58	22.0	2.26	1.11
3	33.14	1.60	20.7	2.98	1.02

Organic C analysis was carried out on compost raw materials and when the compost had complied with the characteristics of mature compost. Reduced levels of Organic C in the sample because microorganisms used carbon (C) as an energy source to degrade organic materials. Microorganisms died because the organic material used as a microbial energy source to decompose organic matter has run out (Afifah et al., 2019). The three variations have complied with SNI 7763:2018 (<15%). Meanwhile, the best compost based on Organic C content is the 3rd variation as the lowest Organic C content compared to variations 1 and 2 can reduce the C/N ratio of compost so that it can produce compost in a faster time (Krisnawan et al., 2018).

The Total N analysis was carried out using the Kjeldahl method, which consisted of three stages, namely the stages of destruction, distillation, and titration. In the destruction stage, the sample is heated in concentrated sulfuric acid so that the elemental nitrogen turns into ammonium sulfate $(NH_4)_2SO_4$. In the second stage (distillation), the ammonium sulfate $(NH_4)_2SO_4$ split into ammonia (NH_3) with the addition of NaOH, so it reached the alkali environment and was heated because the reaction cannot take place in an acidic environment. In the third stage, titration, titration is carried out using boric acid, which has reacted with ammonium using 0.05 N H_2SO_4 until the color was changed to pink (Indrawan et al., 2016).

The Total N content in the three compost variations has complied with the quality standard of SNI 7763:2018 with the macronutrient content of N, P_2O_5, and K_2O at a minimum of 2%. The analysis of the Total N content showed that the addition of *Blotong* increased the Total N content in the sample compared to the addition of bran because the *Blotong* contained a higher Total N than the bran. This is in accordance with research conducted by Faridah et al. (2013), that adding raw materials with a higher Total N content can increase the higher Total N content in the resulting compost. Meanwhile, the best quality compost based on Total N content is 3rd variation because with a high nitrogen content, it can produce compost in a faster time and lower the C/N ratio of compost.

The measurement of the C/N ratio in the composting process aims to determine the balance of total nutrients in the compost. The C/N ratio of compost is based on SNI 7763:2018 concerning Organic Fertilizers, with a maximum value of 25. The greater rate of Total N and the lower rate of Organic C in the compost, the lower the C/N ratio. The results of the total C/N analysis showed that the addition of *Blotong* affected to the decrease in the C/N ratio during the decomposition process. The more *Blotong* added, the lower the C/N ratio, so the faster the composting time. This is in accordance with research conducted by Fanny et al. (2013), in which the adding of *Blotong* affects the speed of decomposition of raw materials and affects the C/N ratio during the decomposition process.

Compost with the best C/N ratio is the 3rd variation with the lowest C/N ratio compared to other samples. However, the three variations have complied with the C/N ratio in a relatively short 22 days. It is due to the use of stale rice MOL and organic matter bio activator as *Trichoderm*a sp. It is in accordance with research conducted by Setyorini et al. (2006), which proved that the bio activator in the form of *Trichoderma* sp. is able to speed up the compost decomposition process.

Phosphorus (P) plays a role in the plant's growth and production, which is absorbed in the form of H_2PO_4 ions 0.1% to 0.5% (Rina, 2015). Phosphorus in compost has a positive impact on the growth of plant roots and the maturation of the fruit. The following phase is a decomposition phase of organic matter into phosphorus (Saraswati et al., 2006).

Organic Matter → H_3BO_3 → $Ca(HPO_4)$

Variations with more *Blotong* composition and less bran provide high phosphorus content. Research by Pambudi et al. (2017) proved that adding *Blotong* in compost can increase the phosphorus content in soil and sugarcane plants.

Potassium (K) analysis was carried out on the compost raw material and when the composts have complied with the characteristics of mature compost. Three variations of compost have complied with the quality standard of SNI 7763:2018 with the macronutrient content of N, P_2O_5, and K_2O at a minimum of 2%. The results of the analysis the total K_2O content also showed that the addition of *Blotong* had no significant effect on the potassium content of the sample. It is due to the low total K_2O content in *Blotong*, which is 0.47%. This is in accordance with research conducted by Faridah et al. (2013), in which adding raw materials with a higher total K_2O content can increase the total K_2O content which is higher in the compost produced.

Conclusion

The three variations of compost from *Blotong*, molasses, bran, and coconut husk materials using MOL stale rice and *Trichoderma* sp. had complied with SNI 7763:2018. The composting process had been going on for 18 days, with the best composition at the 3rd variation.

Suggestion

For further research, It is necessary to carry out periodic analysis of the compost content to determine changes in the sample content and to do some researches on the types of plants that are most suitable for the compost.

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