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RESEARCH ARTICLE

COMPOST QUALITY ANALYSIS OF VARIOUS VARIATIONS IN GREEN BIOMASS AND SAWDUST WITH THE HOT COMPOSTING METHOD

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ABSTRACT

The household-scale composting process can use the basket or Takakura method. Another concept, Hot composting, is a method that prioritizes the comparison of the balance between wet waste and dry waste in composting. This study uses both methods. The source of wet waste or green biomass comes from kitchen waste while the source of dry or brown waste comes from fine sawdust. The composting process is carried out in a basket with a household scale with an aerobic process and the addition of bio activators of stale rice moles. There are several important parameters related to the quality of compost including organic matter and pH. Organic material is related to its role in improving soil structure physically, chemically, and biologically. Whereas pH is related to the availability of nutrients in the soil and the dissolution of these nutrients to be absorbed by plants. **Methods:** This research is a quasi-experimental. There are 3 variations in the ratio of green biomass and sawdust in this study, namely 3: 3, 3: 4, and 3: 2. The variable observed in this study is the quality of compost produced. Organic material and compost pH are compared with Compost Quality Standards (SNI 19-7030-2004). The other studies are physical characteristics such as texture, composting time, and shrinkage. **Results:** There is a significant difference in compost organic matter content among the three variations of sawdust and green biomass (p value = 0,000). There is a significant difference in compost pH between the three variations of sawdust and green biomass (p value = 0,000). **Conclusion:** Compost with sawdust and green biomass ratios (3: 3) has the lowest organic material content of 29.12%, and the highest is 30.75%, fulfilling the requirements based on SNI 19-7030-2004. Compost with sawdust and green biomass ratios (3: 2) shows a range of pH from 7.32 to 7.72, meeting the requirements based on SNI 19-7030-2004. Depreciation of waste into compost is in the range of 42.86 to 53.33%.

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INTRODUCTION

Waste management efforts consist of reducing and handling waste. Processing is an activity to change the characteristics, composition and or amount of waste, and is part of the effort to handle waste. Composting is part of processing waste (Law of the Republic of Indonesia, 2008). Composting is the acceleration of the process of decomposition of natural organic material with the help of microorganisms at certain temperatures and humidity aerobically or anaerobically with the concept of balance C: N (Carbon: Nitrogen) (Rader, 2017). Takakura is one method of composting aerobically using a basket, it has been widely used by households in various big cities in Indonesia. This method only includes organic waste from kitchen activities only, to speed up the composting process, add a ready or homemade starter (Move Team Indonesia, 2007). *Hot Composting* is also one of the aerobic composting methods, can be done in an open area or using a bin (trash can). This method prioritizes the balance of the composition of the material to be composted. This method prioritizes the balance of the composition of the material to be composted (Atchley K, 2013). Previous important studies for Nitrogen, phosphorus, potassium, organic matter, pH, and compost weight use a ratio of 3: 3 and 3: 2. The event ratio is the amount of waste produced with the amount of green biomass (green waste or wet waste) (Louisa, 2013). The author is interested in modifying the takakura method and hot composting. On the one hand, the composting process is

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carried out using household scale waste baskets such as the takakura method. Comparison of the balance of biomass green and sawdust which is the concept of hot composting on the other side. The source of waste comes from sawdust (sawdust) and green biomass (wet garbage) from kitchen activities or from fresh yard / gardens. Compost material between dry waste and green biomass uses a ratio 3:4, 3:3 and 3:2. The bio activator uses the mole (local microorganism) of rice. The choice of mole rice consideration is easy to obtain, rice is the staple food of most Indonesian people. Rice mole can be made from stale or good rice, so if we use stale rice we indirectly use garbage as a resource. Previous research showed that mole rice had a significant effect on flowering age, first harvest age, and fruit weight per plant.6 The role of sawdust as a carbon (brown) compost material inspired by research on chaff material can increase the temperature during composting process so the process runs fast (Rezagama, 2015). Selection of kitchen waste as Green Biomass because it has a high nitrogen content, while the selection of Sawdust because it has a high carbon content (Atchley K, 2013). The compost quality parameters studied were organic material, pH, and compost weight. Based on SNI 19-7030-2004, the required pH parameters are in the range of 6.80 - 7.49 (Wongso, 2003). The pH condition is safe because it does not risk dissolving unwanted heavy metals that will contaminate the soil or affect soil fertility. As we know that low pH can dissolve heavy metals. The organic material is one of the macro elements in compost quality standards with the requirements of 27–58%. While the weight of compost is related to the quantity of products produced, the hot composting method produces a lot more waste and faster the process compared to cold composting (Rezagama, 2015).

MATERIALS AND METHODS

The type of research used is a quasi-experimental laboratory scale to be applied in the field. This study used a design before and after one group or Pre-test-Post-test One Group. The steps taken in this study are:

- **Conduct *Hot Composting*, in the following way:**
  - Mix the two types of waste, namely biomass and sawdust green with variations in the ratio of 3: 4, 3: 3, and 3: 2.
  - Enter into household scale waste basket.
  - Put the rice mole bio activator into the centre of the trash.
  - Stir the trash on the 5th day by flipping waste from the outside in and from inside to outside, making sure the moisture is stable.
  - Do the rubbish reversal again (days 6 and 8), the temperature peaked on that day.
  - Take a temperature measurement (day 7-9), the temperature decreases on that day.Revert rubbish again (days 11, 13, 15 and 17)
  - The compost is ready to be harvested on the 18th day with a warm indicator, a dark brown colour, no smell.

Make Mol Rice Bio activator

a. Rice (new or used) is formed round as big as 4 Ping-Pong balls.
b. Let stand for 3 days until the mushrooms are yellow, orange and grey.
c. Mushroom rice balls, then put in an empty bottle (volume of 1.5 litres).
d. Pour one litre of water mixed with 4 tablespoons of sugar into a bottle containing stale rice.
e. Leave the open bottle not closed, let stand for 1 week (the mixture of rice and sugar water will smell sour like tape)

RESULTS

Variation in the Composition of Sawdust and Kitchen Waste (Green Biomass) Against the Percentage of Organic Materials
The quality of compost sourced from sawdust and green biomass can be seen in table1. As a preliminary study, the study of the quality of compost is limited to pH and the macro elements of organic matter can be seen in Table 1.

Table 1. Percentage of Organic Sawdust and Green Biomass Compost

A Treatment	Control	A Treatment	B Treatment	C Treatment
		Ratio (3:3)	Ratio (3:4)	Ratio (3:2)
	%	%	%	%
1	61,70	29,71	25,46	21,63
2	61,61	30,75	24,46	21,14
3	64,63	29,98	25,66	21,02
4	63,05	29,62	25,34	21,73
5	61,84	30,65	24,78	21,38
6	62,41	29,12	23,23	21,01
Rata-rata	62,54	29,97	24,82	21,32

Table 1 shows that the organic content of compost in controls that did not contain sawdust averaged 62.54%. A treatment with a balanced composition between sawdust and green biomass (3: 3) average organic content of 29.97%. The treatment of B green biomass is more (3: 4), the average organic content is 24.82%. C treatment with sawdust composition is more (3: 2), the average organic content is 21.32%. It appears that the highest organic content is in treatment A, the composition of sawdust and green biomass is balanced. Data is not normally distributed so non parametric statistical tests are carried out. The statistical test results showed that there were significant differences in rankings in terms of the percentage of organic compost levels between variations in the composition of sawdust and green biomass, both treatments 1, 2, and 3 (p value = 0,000). Variations in the Composition of Sawdust and Kitchen Waste (Green Biomass) against pH. The following are the results of compost pH measurements from various compositions of sawdust and kitchen biomass.

Table 2. PH Measurement of Sawdust Sourced Compost and Green Biomass

Replication	Ccontrol	A Treatment	B Treatment	C Treatment
		Ratio (3:3)	ratio (3:4)	ratio(3:2)
1	6,54	8,24	8,83	7,72
2	6,42	8,16	8,87	7,32
3	6,58	8,12	8,71	7,67
4	6,53	8,19	8,72	7,70
5	6,51	8,20	8,69	7,35
6	6,53	8,26	8,70	7,34
Average	6,52	8,19	8,75	7,52

Table 2 shows that compost pH in controls that did not contain sawdust averaged 6.52. Treatment A with a balanced composition between sawdust and green biomass (3: 3) averages pH8,19.

Tablee 3. Results of Compost Characteristic Examination

Sample Code	Temperature (Day) °C			Humidity (Day-) %			Composting Duration (Day)	Depreciation (%)	Texture
	5	9	14	5	9	14			
1	26,2	24,4	24,2	72	74	67	>18	77,50	Soft, watery / wet
2	23,6	24,5	23,3	63	68	64	14	53,33	Soft, dry
3	25,1	24,7	24,2	62	70	67	18	42,86	Soft, dry
4	23,7	24,8	24,1	62	70	71	21	45,71	Soft, dry

The treatment of B green biomass is more (3: 4), the average pH is 8.75. C treatment with more sawdust composition (3: 2) average pH 7.52. It appears that the lowest pH (tending to be acidic) is in controls that do not contain sawdust. Data is normally distributed so anova statistical tests are carried out. Statistical results showed that there were significant differences in the mean compost pH between variations in the composition of sawdust and green biomass, both treatments 1, 2, and 3 (p value = 0,000). The following table 3 is the result of the examination of other compost characteristics as supporting data in this study:

DISCUSSION

Kitchen compost without sawdust or sawdust, has organic ingredients as low as 61.61%, and the highest is 64.63% Compost with the ratio of sawdust and green biomass or wet waste from the kitchen (3: 3) has the lowest organic matter 29,12 %, and the highest 30.75% Compost with the ratio of sawdust and green biomass (3: 4) having the lowest organic matter content 23.23%, and the highest 25.66% Compost with the ratio of sawdust and green biomass (3: 2) having content the lowest organic matter is 21.01%, and the highest is 21.73%. Compost with the ratio of sawdust and green biomass (3: 3), has an organic content that meets the requirements based on SNI 19-7030-2004 concerning Compost Quality standards required in the standard is 27-50%. A balanced ratio between the elements of carbon and nitrogen has an effect on the speed of decomposition process and the adequacy of the compost organic matter produced. Kitchen compost without sawdust mixture produces high organic matter which is in the range of 61.61-64.63%. This indicates that the decomposition process of garbage has not run perfectly, the water content of compost is still very high.

Organic matter has an important role in the physical, chemical and biological properties of the soil. Land requirements as a growing medium require good physical and chemical conditions. Good soil physical condition if it can guarantee the growth of plant roots and is capable of being an aeration site which is all related to the role of organic matter. The biggest role of organic matter in soil physical properties includes structure, consistency, porosity, and water binding power, and increased erosion resistance. Addition of organic matter to heavy clay soils makes the soil smoother and not coarse, making it easier to process. The addition of organic soil to the soil makes the granular soil form into a lump shape, and makes the soil that was originally unstructured (solid) into a crumbly or well-structured soil. The influence of organic matter on other physical properties of the soil is an increase in soil porosity. Soil pores will determine the ratio of air conditioning and good water management. Addition of organic matter to sandy soil will increase the pore of medium size and reduce the macro pore. Addition of organic matter to clay soil will increase the pore that can be filled with air and reduce the pore filled with water, resulting in improved aeration.

Soil aeration is often associated with respiratory microorganisms in the soil and roots of plants. Thus soil aeration will affect the microbial population in the soil. As we know the role of microbe is very important in the process of decomposition of organic waste. The more microbes involved in the decomposition process the faster the process runs. The effect of organic matter on soil chemical fertility includes the Cation Exchange Capacity (CEC), anion exchange capacity, soil pH, soil buffer capacity. Addition of organic material will increase the negative charge so that it will increase the cation exchange capacity (CEC). Compost as an artificial topsoil resulting from the decomposition process of organic matter is a source of negative soil charge. Compost as an organic fraction in the soil will potentially reduce the content of pesticides with ion exchange mechanisms. The role of organic materials on soil biology is as an energy source for both macro and micro soil fauna. The addition of organic matter in the soil will increase the activity and population of microorganisms in soil. Micro and macro fauna of land that play a role in decomposition of organic matter include fungi, bacteria, actinomycetes, protozoa, nematodes, and earthworms (Wongso, 2003). The results showed that the ratio of balanced compost material (3: 3) between sawdust and green biomass with organic matter content in the range of 29.12% -30.75% can play a good role in improving the physical, chemical, and biological quality of the soil later.

Kitchen compost without sawdust or sawdust, has the lowest pH of 6.42 and the highest of 6.58. Compost with the ratio of sawdust and green biomass or wet waste from the kitchen (3: 3) has the lowest pH of 8.12, and the highest is 8.26. Compost with the ratio of sawdust and green biomass (3: 4) has the lowest pH of 8.69, and the highest is 8.87. Compost with the ratio of sawdust and green biomass (3: 2) has the lowest pH of 7.32, and the highest is 7.72. The results showed that the pH range that met the requirements based on SNI 19-7030-2004 (6.80-7.49) on Compost Quality Standards was compost without sawdust dry waste and compost with sawdust and green biomass ratio (3: 2). pH is also one of the key parameters for soil. Compost as artificial humus will be returned to the environment / soil where the pH element will play its role in providing nutrients. Existing nutrients will be closely related to soil fertility. Managing soil pH indirectly has managed soil nutrition. The macronutrient elements such as K, Ca, Mg, and S at low pH conditions will be very tightly bound to the soil surface so that the availability for uptake by plants in solution form is very little. On the other hand, in conditions of high pH or low concentrations of H +, macronutrients are not very bonded to the surface of the soil so that it still allows availability for uptake by plants, and more availability compared to low pH conditions (McCauley, 2017). The results showed that the ratio of balanced compost material (3: 3) between sawdust and green biomass with a pH range of 8,12-8,26 can play a good role in providing macronutrients such as K, Ca, Mg, and S for plant uptake. The compost without sawdust mixture with a pH range of 6.42-6.58 is only able to

provide relatively fewer macronutrients than balanced variations in compost material. The highest solubility level is the ratio of compost material (3: 2) between sawdust and green biomass with a pH range of 7.32-7.72 compared to the other two variations (3: 3 ratio and 3: 4 ratio). Easy solution in low pH conditions sometimes has a negative impact on the plants themselves, such as Aluminium and Manganese content will be toxic at pH below 5.5. The presence of nitrate (NO3) is always available because it is not influenced by pH conditions and is not strongly bound to the surface of the soil. The fastest composting time in this study for compost made from a mixture of sawdust and green biomass which added stale rice bio activator was 14 days, at most 21 days. Other research shows that composting time is 6 weeks with the same bio activator, namely moles of stale rice and compost ingredients are leaves. The addition of sawdust and stale rice mole accelerated the composting process in this study. Depreciation of waste into compost in this study is in the range of 42.86-53.33%. While other studies showed a shrinkage of 26% in leaves of rubbish added by stale rice mole.11 Shrinkage of waste into compost, was greater in a mixture of sawdust and green biomass waste which was added to the stale mole of rice compared to waste consisting of only leaves and added stale rice mole.

Conclusion

- Compost with the ratio of sawdust and green biomass (3: 3) has the lowest organic matter content of 29.12%, and the highest is 30.75%, fulfilling the requirements based on SNI 19-7030-2004 concerning Compost Quality Standards. Compost with a ratio (3: 4) has the lowest organic matter content of 23.23%, and the highest is 25.66% and the ratio (3: 2) has the lowest organic matter content of 21.01%, and the highest is 21.73%, both of which have not meet the requirements based on SNI 19-7030-2004 concerning Compost Quality Standards.
- Compost with the ratio of sawdust and green biomass (3: 3) has the lowest pH of 8.12, and the highest is 8.26. Compost with a ratio (3: 4) has the lowest pH of 8.69, and the highest is 8.87. Compost with the ratio of sawdust and green biomass (3: 2) has the lowest pH of 7.32, and the highest of 7.72. Compost with the ratio of sawdust and green biomass (3: 2) shows the pH range that meets the requirements based on SNI 19-7030-2004 about Compost Quality Standards
- Depreciation of sawdust mixture and green biomass into compost in this study is in the range of 42.86-53.33%.
- There is a significant difference in rank in terms of the percentage of organic compost levels between variations in the composition of sawdust and green biomass, both treatments 1, 2, and 3 (p value = 0,000).
- There is a significant difference in the pH of compost between variations in the composition of sawdust and green biomass, both treatments 1, 2, and 3 (p value = 0,000).

Suggestion

- It is necessary to test the use of dry or brown elements that are easily available other than sawdust as a compost mixture.
- Laboratory tests are needed to ensure that the pH range of compost from sawdust and green biomass mixtures which tend to be alkaline can provide more macronutrient elements than micronutrient elements.

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