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Effect of Water Holding Capacity on Composting Yield of Organic Market Waste

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ABSTRACT

The increasing volume of market waste that continues to occur makes people think negatively of waste, but on the other hand waste can provide positive things by composting. The purpose of this research is to analyze the content of Water Holding Capacity in organic compost made from market waste. The composting process uses the Open Windrow method with aerobic Composting Bag container media. Composting was carried out for fifteen days with variations in the addition of bioactivators to accelerate the maturation of different composts are 50 ml, 75 ml, 100 ml, 125 ml, and 150 ml with one control compost. The bioactivator used is a type of local microorganism made from market waste. Based on the results of this study, compost with a variation of 150 ml bioactivator addition produced an optimal WHC content of 75%, the best water content of 49.24%, C/N 15.57%, temperature 32.29°C, and pH 7.

Keywords: *Compost, Composting Bag, Mol ,Open Windrow*

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INTRODUCTION

The volume of waste that continues to grow every year makes one of the problems of accumulating waste in the Final Processing Site (TPA). Not a few people think negatively of waste, but on the other hand waste can provide positive things by recycling it. One way to recycle organic waste into useful things is composting (Guo et al., 2020). Waste from the composting results will produce compost.

In general, compost maturation lasts for 1 - 3 months, so to accelerate the maturation of compost using bioactivators. Bioactivators aim to add components to the composting process in order to accelerate maturation without forgetting quality (Sutrisno et al., 2020). Besides being able to be used as compost, waste can also be used as a local microorganism bioactivator (Mol).

Compost with complete maturation can increase the water absorption capacity or called the Water Holding Capacity (WHC) of the soil (Cooper et al., 2020) (Heyman et al., 2019). Significant aggregate formation will improve soil texture so as to increase soil WHC (Ansari et al., 2021). According to (Wijayanti et al., 2015) WHC can be influenced by two factors, namely soil texture and vegetation cover, because these two factors are related to determine the amount of retained soil moisture. Where the structure and texture of the soil also determines the soil water system so that this is related to infiltration and the ability to hold water, while in the type of vegetation if plants grow on different types of soil will provide different rooting depths.

Composting in this study was carried out using the Open Windrow method. Traditional composting that is often done by the community is by stacking organic waste that forms cones or windrows (Guo et al., 2020) (Wang et al., 2017). During the composting process, this research also uses a Composting Bag as a media container.

RESEARCH METHOD

Composting Process. The composting process in this study was carried out aerobically using a Composting Bag. Composting Bag is made from hollow plastic that provides good air exchange and UV resistance that can maintain the stability of compost quality in various weather conditions. The organic waste used in each Composting Bag has two layers, the first layer uses green waste (leaves and twigs) and the second layer uses fruit or vegetable waste. Both layers are repeated until the waste fills the Composting Bag. The length of time for making compost is 6 weeks. During the process, the compost will be identified by checking the temperature and pH, stirring, and adding bioactivator every three days. After that, compost testing was carried out based on C/N, Moisture Content, and WHC in accordance with SNI 19-7030-2004 concerning Specifications for Compost from Domestic Organic Waste at the Environmental Engineering Laboratory of Diponegoro University.

Bioactivator Addition Process. Bioactivators are microorganisms that can help decompose and ferment waste faster, improve soil quality, and improve compost quality (Syawali et al., 2022). Bioactivators have various types, in this study using local microorganisms (Mol) made from organic waste. When identifying compost, the compost will be stirred evenly. When stirring the compost, the addition of Mol will also be done so that it mixes evenly. The treatment of adding Mol in this study will be different for each compost. There are six different treatments, namely:

Table 1. Composting Treatment

Compost	Volume Mol
Compost 1	0 ml
Compost 2	50 ml
Compost 3	75 ml
Compost 4	100 ml
Compost 5	125 ml
Compost 6	150 ml

RESEARCH RESULTS

Compost Test Results. During the composting process, it will be influenced by several factors such as temperature and pH. Temperature and pH measurements are taken every three days using a Soil Meter tool. The observation results will be compared with SNI 19-7030-2004 in the following table 1:

Table 2. Compost Parameter

Parameter	Value
Temperature	30°C - 35°C
pH	6,8 – 7,49

Source : *SNI 19-7030-2004*

Temperature. Temperature is an important influential factor in the composting process, during the composting process the temperature will vary significantly (Huang et al., 2021). The initial determination of composting is the air temperature, while during the composting process and the intensity of microbial activity is determined by the temperature in the compost pile. High compost temperature is helpful to kill pathogenic microbes and weed seeds (Xiao et al., 2017 ; Zhang et al., 2019). Briefly, the composting process occurs in three phases (Awasthi et al., 2017). The hot or mesophilic phase is the first phase in composting with the metabolic activity of various microorganisms which causes the temperature to rise to 45°C, this

phase lasts for two to three days. The thermophilic phase or commonly called hygienization will provide high temperatures above 55°C, because in this phase it will help eliminate bacteria of fecal origin (Escherichia coli, Salmonella sp, worm cysts and eggs, phytopathogenic fungal spores and weed seeds) so as to make an increase in hygienic products. The cooling phase requires some time for the maturation of the compost pile until it drops to a temperature level of 20°C-30°C (Meena et al., 2020).

Initial control of compost temperature showed that the compost reached an average temperature of 31°C with the highest temperature of 31.29°C and the lowest temperature of 31°C. Figure 1 shows the occurrence of a hot or mesophilic phase reaching a temperature of 35.5°C on the third day of the composting process. In this phase, good microorganism metabolism occurs in the compost, resulting in bacterial growth, the effect of these fertile bacteria is nitrification oxidation and an increase in nitrates which causes the compost temperature to decrease (Qiu et al., 2021).

On the next day the compost enters the thermophilic phase characterized by an increase in temperature. There was an increase in the peak temperature of this study on day nine with the highest temperature of 56.9°C. Research (Yang et al., 2013 ; He et al., 2014 ; Alkarimiah & Suja, 2019) said that in this phase there was good compost maturation. Temperature plays a very important role in influencing microbial activity and the progress of the composting process, the higher the temperature produced, the higher the decomposition of organic matter (Hosseini & Aziz, 2013 ; Alkarimiah & Suja, 2019).

In the cooling phase, microorganisms in the compost increase again. the cooling phase will also occur in the compost maturation process, during the maturation process the number of bacteria will continue to decrease but their diversity will increase. In addition, this phase also considers fungal activity important (Fuchs, 2010) (Nemet et al., 2021). This research shows that the cooling and maturation phase begins on the tenth day with an average compost temperature value of 33.37°C.

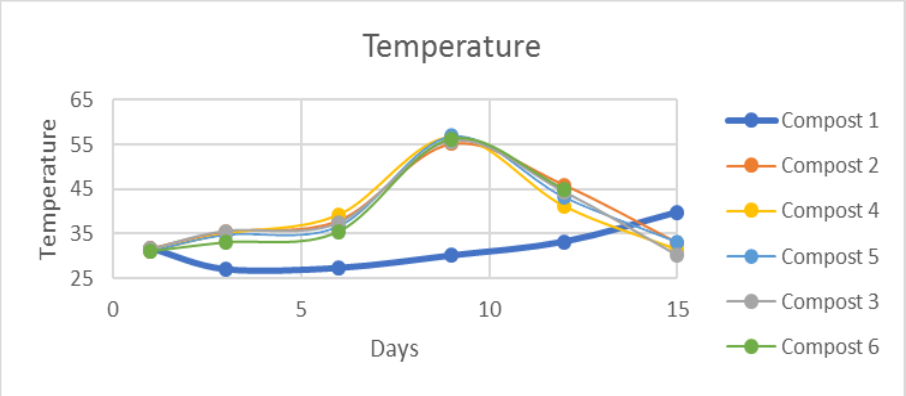

Figure 1. Temperature Value

Based on SNI 19-7030-2004, compost temperature is like groundwater temperature (30°C-35°C) compared to the final results of the study, all composts with the addition of bioactivators are in accordance with SNI. However, compost 1 (control compost) in the absence of the addition of bioactivator has no maturation process or does not comply with SNI standards.

pH. During the composting process (Lalremruati & Devi, 2021) states that the best pH is when the pH is acidic, because most microorganisms are destroyed. Therefore, at the time of compost maturity the pH will be close to neutral. However, in the composting process of course the pH will increase due to bacterial hydrolysis of protein and nitrogen so that the process will lead to the production of ammonia gas. Changes in

pH due to microbial activity since microbial metabolism consumes organic acids in compost (Estrada-Bonilla et al., 2017).

pH control in the initial composting process shows acidic properties of 6.2. Figure 2 shows that there is a decrease in pH from the initial stage of composting to the next day. The pH level from the third day to the twelfth day increases to a maximum pH of 8. The increase in pH is caused by the composting process experiencing an increase in bacterial activity so that the pH becomes alkaline (Dewilda & Darfyolanda, 2017) . However, gradually the pH value begins to decrease until the compost is mature and the value does not exceed the SNI 19-7030-2004 standard. Compost maturity in this study resulted in a pH of 7 – 7.2, which indicates that the compost maturity was normal or neutral. However, this does not apply to control compost.

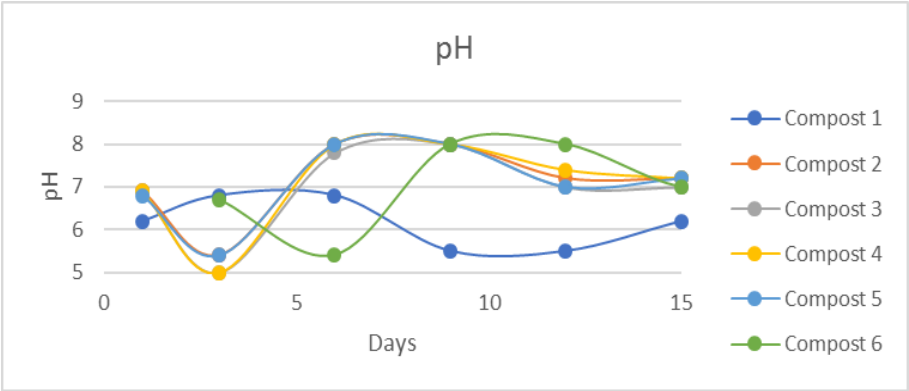

Figure 2. Temperature Value

Identification of Compost Test Results

C/N Ratio. C/N is the ratio between carbon and nitrogen elements. During the composting process C/N is very important because it plays a role in microbial growth. The C/N value changes according to the composting base material used, with a continuous reduction from 35:1 to 15:1 (Meena et al., 2020). A high C/N is not conducive to compost maturity because there is a decrease in the activity of microorganisms so that it requires several cycles for the degradation of organic matter which causes it to slow down decomposition and give the effect of low quality compost. Meanwhile, low C/N will cause a lot of nitrogen loss because microorganisms cannot be assimilated and will be lost through volatilization as ammonia (Utomo & Nurdiana, 2018).

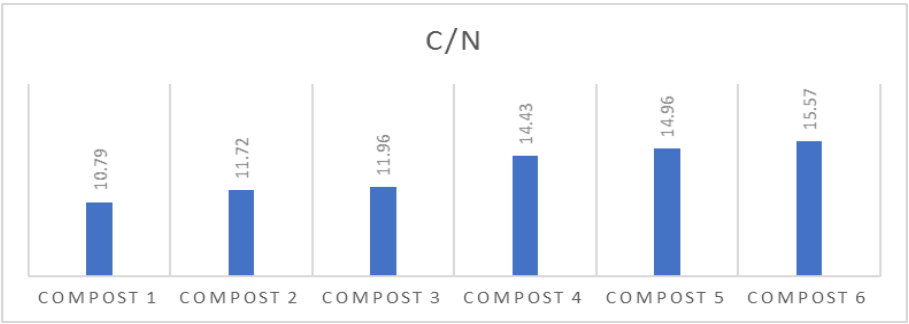

Figure 3. Result of C/N Value

The results of C/N maturation of compost in this study can be seen in Figure 3. This study shows the results that the more bioactivators added produce compost maturity with high C/N. The C/N value in SNI 19-

7030-2004 is a minimum of 10% and a maximum of 20%, so it shows that the C/N value in this study has met the standard and can be used.

Moisture content. The moisture content contained in compost is no less important than other parameters. Compost with good quality must maintain a moisture content of 40% - 60% (Wahyudin & Nurhidyatullah, 2018). Figure 4 shows the results of observations of moisture content with the lowest value of 45.53% and the highest of 49.24%, this is influenced by the weight of the market waste used. Because the amount of moisture content in compost can be influenced by the weight of the compost base material, the more the addition of waste will produce a higher moisture content (Dewilda & Darfyolanda, 2017). In this study, the weight of the basic waste material used was not weighed, but the results of the moisture content in this composting have achieved SNI 19-7030-2004.

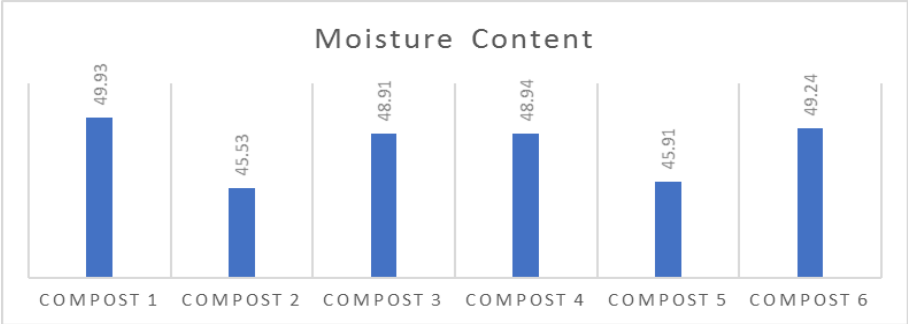

Figure 4. Result of Moisture Content

Water Holding Capacity (WHC). Water Holding Capacity (WHC) is the ability of soil to hold its own water or additional water during the application of force, pressure, centrifugation or heating(Gyawali & Ibrahim, 2016). In this study using the percolation method. The percolation method uses a method by pouring water into the compost pile so that the water absorbs through the composting substrate with the help of gravity (Fan et al., 2021). The advantage of using this method if using a large scale is that it can preserve microorganisms and nutrients and increase microbial activity in compost (Roy et al., 2018) (Zheng et al., 2020). Meanwhile, the disadvantage of using this method is that it is difficult to control the retention time during the percolation process and can make the compost moist (Fan et al., 2021). The sample used to calculate WHC is 10 grams with watering water as much as 20 ml. After filtering, the remaining water will be calculated using the formula:

$$WHC = \frac{V1 - V2}{W} X\ 100\%$$

Description:
V1 = volume of water poured (ml)
V2 = volume of water that settles in the container (ml)
W = sample weight (g)

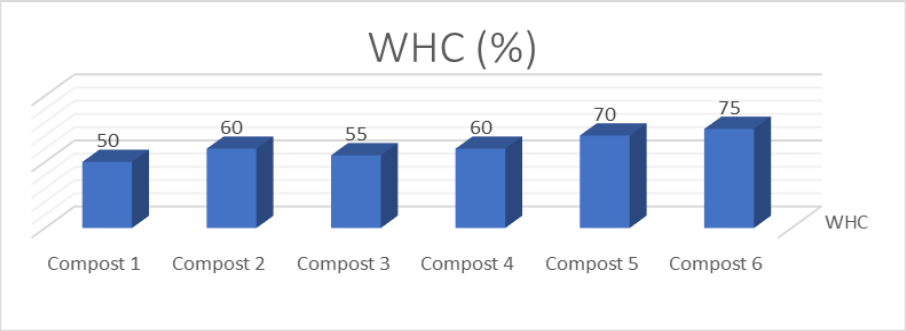

Figure 5. Result Of WHC

Figure 5 shows the WHC calculation results obtained in this study. The WHC results show that the greater the water that can be absorbed by the soil the better because water that cannot seep into the soil pores can create puddles that result in low soil permeability. While water permeability is one of the important factors for plant growth (Kurniawati et al., 2019). Organic matter has an important role in soil properties, such as being able to increase water binding capacity and increase the amount of water for plant needs (Jumin, 2002) (Intara et al., 2011). Organic matter can help increase clay granules to form larger bonds so that the air space between the bonds will enlarge (Schjønning et al., 2007). The more organic matter that is in the soil, the more water content in the soil will be, because organic matter in the soil is able to absorb water 2-4 times its weight which plays a role in water availability. In addition to organic matter in composting must pay attention to the type of soil used, because the amount of water that the soil will receive depends on the type and ability of the soil (Intara et al., 2011).

CONCLUSION

The conclusion that can be made as result of this research is that compost with the addition of 150 ml bioactivator has the best moisture content of 49.24% with C/N of 15.57%, temperature of 32.29°C, pH of 7, and WHC of 75%. In addition, weighing the weight of basic composting waste can affect the water content during the composting process, so that later it will affect the identification of compost results.

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