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THE EFFECT OF DIFFERENT CONCENTRATIONS OF RICE WASHING WATER IN THE COMPOSTING PROCESS WITH THE MAC DONALD METHOD

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ABSTRACT

One way to reduce organic waste is through composting. One composting method that can be used is the Mac Donald method which employs an aerobic system to place raw ingredients in an open box-shaped container. The purpose of this experiment was to observe the object under this study (rice washing water in organic waste composting). Four compost treatments namely P0 (organic garbage and without rice washing water added); P1 (organic garbage and added rice washing water of 35 ml); P2 (organic garbage and added rice washing water of 45 ml) and P3 (organic garbage and added rice washing water of 55 ml). Temperature measurements at the end of the composting process showed that the temperature in all four containers was 29°C. The pH values obtained met maturity requirements for compost as specified by SNI 19-7030-2004, namely with a minimum value of 6.80 and a maximum of 7.49. The observation results of moisture content at the end of composting in the four containers were 40%. The best results were shown in the variation of P2 (by added rice washing water of 45 ml) with a C/N ratio of 19.31 and began to mature in week 3 with levels of C-organic, N-total, P-total and K-total of 34.00%; 1.76%; 0.49% and 1.68% respectively.

Keywords : composting process, mac donald method, C,N,P and K total, C/N ratio

ABSTRAK

Salah satu cara mengurangi sampah organik adalah pengomposan. Salah satu metode pengomposan yang digunakan adalah metode Mac Donald. Metode Mac Donald menggunakan sistem aerobik dengan menempatkan sampah organik dalam wadah berbentuk kotak terbuka yang bertujuan untuk mengamati langsung objek yang diteliti (air cucian beras pada pengomposan sampah organik). Terdapat empat perlakuan variasi kompos, yaitu P0 (sampah organik dan tanpa tambahan air cucian beras); P1 (sampah organik dan tambahan air cucian beras sebanyak 35 ml); P2 (sampah organik dan tambahan air cucian beras sebanyak 45 ml) dan P3 (sampah organik dan tambahan air cucian beras sebanyak 55 ml). Hasil pengamatan suhu yang didapat pada akhir pengomposan menunjukkan bahwa suhu pada keempat wadah, yaitu 29ºC. Hasil pengamatan pH selama proses pengomposan pada keempat didapatkan nilai pH, yaitu 7,4, 7, 7, 6,9. Untuk nilai pH yang didapatkan tersebut telah memenuhi syarat pH untuk kompos matang yang ditentukan SNI 19-7030-2004, yaitu dengan nilai minimum 6,80 dan maksimum 7,49. Hasil pengamatan kadar air pada akhir pengomposan pada keempat wadah, yaitu berkisar antara 40%, 40%, 40%, dan 40%. Hasil terbaik ditunjukkan pada variasi (45 ml) dengan rasio C/N 19,31 dan mulai matang pada minggu ke-3 dengan kadar C-organik, N-total,

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P-total dan K-total masing-masing 34,00%; 1,76%; 0,49% dan 1,68%.

Kata kunci : *proses pengomposan, metode mac donald, C,N,P dan K total, rasio C/N*

Introduction

Large-scale waste production is a significant problem in major cities, posing serious impacts on social, cultural, economic, and environmental aspects of life. Waste is divided into two, namely organic waste and inorganic waste. Organic waste is waste from the remains of living things and nature, for example from animals, humans, plants where decay or weathering occurs (Sulistyani et al., 2017). Compost mixed with dry leaf waste and market waste (vegetable and fruit waste) can be a suitable combination in decomposing market waste and domestic waste that will be disposed of in landfill.

There are several composting methods that can be used, namely the Kranz method, the Indore method and the Mac Donald method. The Kranz and Indore method is a container-less composting method where waste is piled up to 60 cm high and sprinkled with manure on top. Then the waste is stirred so that it can be composted thoroughly. The disadvantage of these two methods is that the waste to be composted is scattered on the ground. The Mac Donald method uses raw materials that are put into an open box using an aerobic system. Composting using the Mac Donald method is done in a place that is protected from both the sun and the rain (Sulistyani et al., 2017).

An activator is needed in composting to accelerate the process. Activators can include local microorganisms, animal manure or rice washing water. Rice washing water contains microorganisms such as Lactobacillus and Khamir, which help speed up decomposition (Mifbakhuddin et al., 2022). According to Citra et al. (2012) in rice washing water there are a lot of nutrients dissolved in it, such as 80% vitamin B1, 70% vitamin B3, 90% vitamin B6, 50% manganese, 50% phosphorus, and 60% iron. Research related to the provision of rice washing water on the composting process of organic waste with the Takakura method has been carried out by Wulandari et al. (2021). The results showed that giving 45 ml rice washing water, matured on the 19th day, in a temperature of 30-37℃, humidity 55-71%, pH 7.5-7.9. Fruit and vegetable waste was used. Dried leaves from the yard were utilized in this study along with the fruit and vegetable waste (market waste). This attempts to lessen the amount of dried leaf litter on the lawn.

Methods

The Mac Donald method is made from wood and bamboo with dimensions of 35 cm x 35 cm and a height of 100 cm (Figure 1) because the materials used tend to be dry so as to minimize material loss (Zaman and Sutrisno, 2007).

The pile of raw materials is tried to be up to 1 m high with the provision that every 20 cm of the height of the pile is given an activator could develop. The compost material was divided into 4 containers, 1 container for control and 3 containers containing a mixture of market waste and dry leaf waste with varied rice washing water activators added.

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Table 1 Compost Variation Treatment

Treatments	Market waste (fruits and vegetables)	Dry Leaf Waste	Rice Washing Water
P0	4 kg	3,5 kg	0 ml
P1	4 kg	3,5 kg	35 ml
P2	4 kg	3,5 kg	45 ml
P3	4 kg	3,5 kg	55 ml

Figure 1 Mac Donald Container

The compost material that has been added with rice washing water was composted for 46 days. The length of time for composting is calculated based on the physical characteristics of the compost, namely color, smell and texture. Then the compost is sieved then aerated and weighed the final weight, this is done to get mature compost that you want to compare with SNI 19-7030-2004. Sample analyses include measuring water content, pH, temperature, and macro nutrients, including Carbon (C), Nitrogen (N), Phosphorus (P), Potassium (K).

Results and Discussion

Composting Times

Throughout the composting process, observations of color, texture and odor were made every three days. Decomposition of the compost material began on day 40 in P0, day 25 in P1, day 22 in P2 and day 19 in P3. Compost begins to mature on day 43, while for treatment P1, P2 and P3 on day 37. Mature compost will have soil-like odors, this happens because the compounds it contains already have soil

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nutrients. The blackish color is formed due to the influence of stable organic matter. Meanwhile, the smooth texture of compost occurs due to the decomposition of compost materials by microorganisms that live in the composting process. The data analysis on composting process duration/time from varying concentrations activators can be seen in Table 2.

Table 2 Results of Compost Fertilizer Analysis by Mac Donald method

Treatments	Composting Time	The Averange of			Macronutrients				
		Temperature (°C)	Moisture content (%)	pH	C-organic (%)	Nitrogen (%)	Phosphor (%)	Potassium (%)	C/N ratio
P0	More than 30 days	28 - 32	40	7.4	31.78	1.56	0.67	2.09	20.37
P1	25 days	28 - 32	40	7	30.78	1.40	0.43	1.66	21.98
P2	22 days	28 - 32	40	7	34.00	1.76	0.49	1.68	19.31
P3	19 days	28 - 32	40	6.9	34.33	1.53	0.47	1.46	22.43
SNI 19-7030-2004		Groundwater temperature	Minimum : -	Minimum : 6.80	32	0.40	0.10	0.20	Minimum : 10
			Maximum : 50	Maximum: 7.49					Maximum : 20

Temperature, Moisture content and pH

Daily temperature data of the four treatments during the composting process from the beginning to the 46th day of composting ranged from 28-32ºC (Figure 2). The temperature obtained is in accordance with the composting temperature based on SNI 19-7030-2004, which is the temperature in soil water that can be absorbed by plant roots in an aerobic atmosphere and not more than 30ºC.

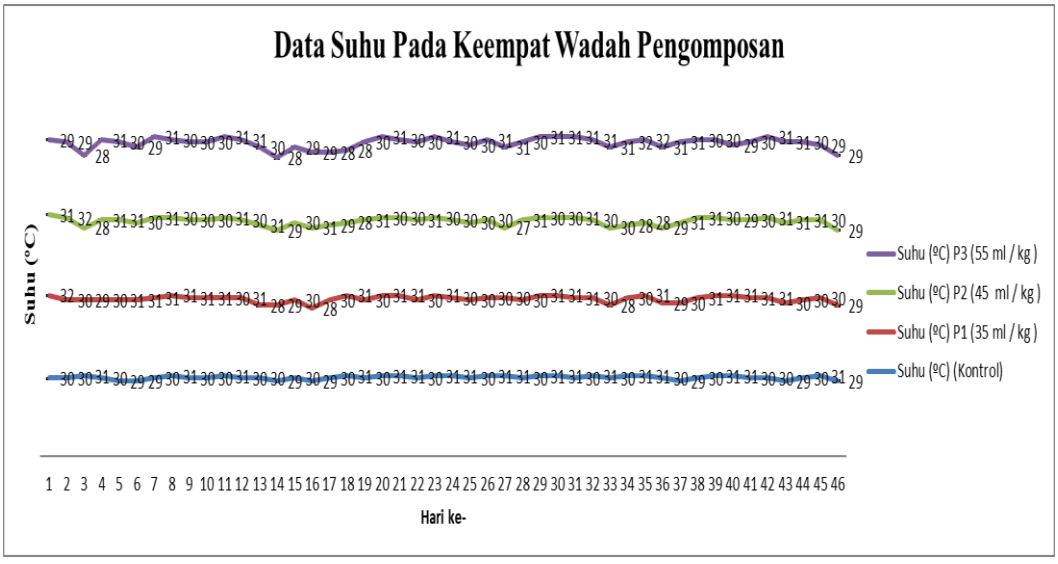

Figure 2. Temperature data of composting process

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The results of pH measurement during the composting process on the 46th day, in the P0, P1, P2 and P3 treatments obtained pH values, namely 7.4; 7; 7 and 6.9. This result is in accordance with SNI 19-7030-2004 which states that the pH of compost is 6.8-7.49. The pH of compost serves as an indicator of the compost decomposition process. Microbes will work in neutral to slightly acidic pH conditions. According to Yuwono (2017), the occurrence of pH differences in each treatment of making organic fertilizer is caused by microbial metabolic activity in the process of breaking down complex compounds such as carbohydrates, proteins and fats into simpler compounds that produce organic acid.

The value of water content obtained during the composting process is 40% to 60%. In this study for weeks 1 and 2, the water content of composting increased but was still within the quality standard threshold. The increase in water content is thought to be due to microbial activity in decomposing organic matter in the composting process. This result is reinforced by the opinion of Rani et al. (2021) which states that, the increase in water content is due to microbial activity which produces water vapor, heat and carbon dioxide during composting then decreases due to evaporation into the air. According to SNI 19-7030-2004 the maximum moisture content for mature compost is 50%. Moisture content at the end of composting of the four treatments ranged in 40%.

C-Organics

Measurement of C-organic content in compost was measured after the 46th day of composting. C-organic values at the end of composting were P0 (31.78%), P1 (30.78%), P2 (34%) and P3 (34.33%) (Figure 3).

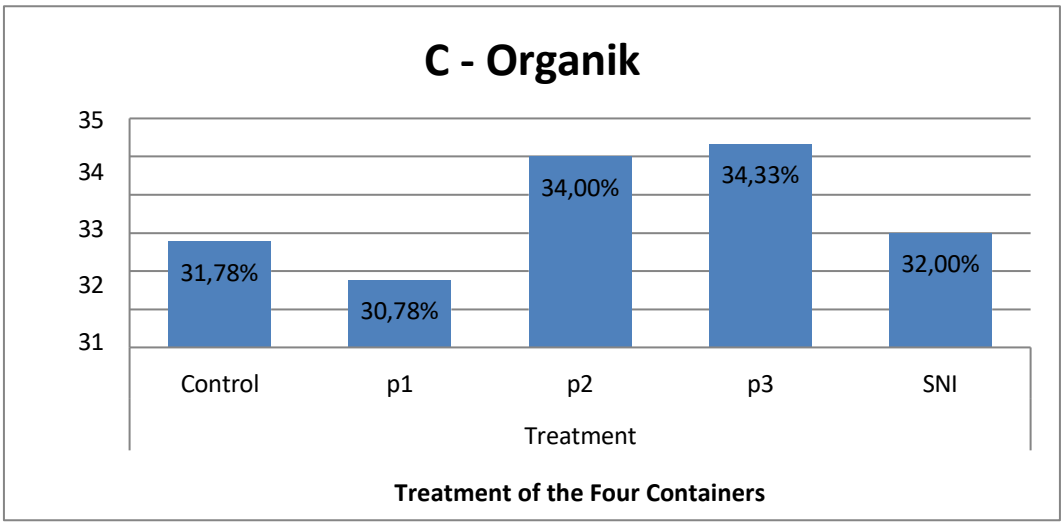

Figure 3. C-Organics measurement data

The treatments of P2 and P3 have not met the requirements of mature compost. This is probably because microorganisms are unable to break down organic

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matter into carbon dioxide (CO_2) due to environmental factors or amount of organic matter composted. This is in accordance with the opinion of Susanti et al. (2021), which states that C-organic increases allegedly due to microbial activity which continues to decline and experience death which then turns into biomass.

N-Total

The N-total values in the P0, P1, P2, and P3 were 1.56%, 1.40%, 1.76%, and 1.53%. When compared with SNI 19-7030-2004 N-total at the end of composting meets the standard of more than 0.4%. The increase in N-total levels is thought to be because microorganisms are able to produce ammonia during the degradation process. After the decomposition process is complete, nitrogen is released back as one of the components contained in the fertilizer. Nitrogen is the main nutrient for plant growth, which is needed for the formation or growth of the vegetative parts of the plant as a whole, especially the growth of roots, stems and leaves, plays a role in the formation of leaf green substances (chlorophyll) which are very important for photosynthesis, and plays a role in the formation of proteins, fats and various other organic compounds (Dewi et al., 2016).

P-Total

The average test results of total P-total composting in control, P1, P2, and P3 fulfil SNI 19-7030-2004 which is >0.1%. At the compost maturation stage, the microorganisms will die and the P content in the microorganisms will be mixed in the compost material which will directly increase the P content in the compost. Phosphorus is the most important nutrient for plants after nitrogen. Phosphorus compounds also have a role in cell division, stimulating early growth in roots, fruit ripening, energy transport in cells, fruit formation and seed production (Kurniawan dkk.,2017).

Potassium Total

The average values of Potassium-total in the P0, P1, P2, and P3 were 2.09%, 1.66%, 1.68%, and 1.46%. This research has fulfilled SNI 19-7030-2004 which is > 0.2%. The highest Potassium-total in the P0 was 2.09% and the lowest in P3 was 1.46%. Potassium-total levels in P1 and P2 were 1.66% and 1.68%. The high potassium content in the compost is thought to be due to the difference in the amount of the type of compost material used in the composting process of each treatment. In addition, it is thought to be due to the length of composting time. This result is reinforced by the opinion of Muhammad et al. (2017), which states that the increase in potassium-total levels is also due to the longer the composting time is carried out, the more microbes will grow and decompose the potassium contained in the compost material.

C/N Ratio

The analysis of C/N ratio levels in each treatment were the P0 (20.37), P1 (21.98), P2 (19.31), and P3 (22.43). The C/N ratio levels obtained in the control, P1

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and P3 treatments do not meet the compost quality standards based on SNI 19-7030-2004. According to Gunawan (2015), if compost with a high C/N ratio is applied to the soil, microorganisms can grow by using the available N in the soil to produce protein in the microorganism's body. If the C/N ratio is very high, microbes may lack N for protein synthesis, delaying the composting rate and causing the composting atmosphere to be too acidic.

Conclusion

Based on the research that has been done, it can be concluded that the addition of rice washing water as an activator can accelerate composting time and improve compost quality. The achievement of temperature, pH, and moisture content, C-organic, N-total, P-total and K-total values is due to microorganisms successfully breaking down organic matter in the composting process. The best results were shown in the P2 with a C/N ratio of 19.31% and began to mature on day 22 with levels of C-organic, N-total, P-total and K-total of 34.00%; 1.76%; 0.49% and 1.68% respectively.

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