The Use of Earthworms and Household Organic Waste Composting Length of Time

Penggunaan Cacing Tanah dan Lama Waktu Pengomposan Sampah Organik Rumah Tangga

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Abtract

Composting with earthworms is composting process by involving earthmacroorganism. Cooperation between earthworms and microorganisms may impact on decomposition process done by the microorganisms as assisted by the existence of earthworms. Because any materials to be decomposed by microorganisms had been decomposed by earthworms earlier, microorganisms would work more effectively and quickly. This study aimed to determine effects of using earthworms toward household organic waste composting length of time by using experimental design of study. The object of study was all organic waste taken randomly from one household. Variable of study was composting length of time measured after addition of earthworms and composting process completed. Tools used in this study were measuring tape, calendar, hygrometer and smelling sensory (organoleptic). Statistical analysis used differ test. Results of study showed data was normally distributed, equality of variance and no difference found between composting length of time with or without using earthworms. In conclusion, there is no relation found between the use of earthworms and the household organic waste length of time.

Keywords: Composting, earthworm, organic waste

Abstrak

Pengomposan dengan cacing tanah merupakan proses pembuatan kompos dengan melibatkan organisme makro cacing tanah. Kerja sama antara cacing tanah dengan mikroorganisme dapat memberi dampak pada proses penguraian yang dilakukan oleh mikroorganisme tersebut dibantu dengan keberadaan cacing tanah. Oleh karena bahan-bahan yang akan diurai oleh mikroorganisme telah diurai lebih dahulu oleh cacing, maka kerja mikroorganisme lebih efektif dan lebih cepat. Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan cacing tanah terhadap lama waktu pengomposan sampah organik dari rumah tangga dengan menggunakan desain penelitian eksperimen. Objek penelitian adalah seluruh sampah organik dari rumah tangga yang diambil secara acak pada satu rumah tangga. Variabel penelitian adalah lama waktu pengomposan yang diukur setelah penambahan cacing tanah dan proses pengomposan selesai. Alat yang digunakan dalam penelitian berupa meteran, kalender, higrometer, dan penciuman (organoleptik). Analisis statistik menggunakan uji beda. Hasil penelitian menunjukkan bahwa data terdistribusi secara normal, kesetaraan varians, dan tidak ada perbedaan antara lamanya waktu pengomposan dengan menggunakan atau tanpa menggunakan cacing tanah. Disimpulkan bahwa tidak terdapat hubungan antara penggunaan cacing tanah dan lamanya waktu pengomposan sampah organik rumah tangga.

Kata kunci: Pengomposan, cacing tanah, sampah organik

Introduction

Factors that highly influence public health level are environment and behavior. Therefore, these two factors have to be seriously taken into account. Healthy behavior is expected to be able to maintain and raise people's health as well as protect them from disease threats. Meanwhile, through healthy environment, it is hoped that conducive and pollution-free environment as well as healthy residences and healthy waste management can be created.[1]

Nowadays in Indonesia, household waste remains a main problem. Every day, waste generating from households tend to be increasing along with the escalating

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number of products and consumption pattern among the community.[2] The size of population as well as variety of activity in Indonesian cities affect the emergence of problem in municipal infrastructure services, such as waste problem.[3] The provision of final disposal in each city is another problem, meanwhile the amount of unmanageable waste will cost more. This condition leads to the treatment effort in form of sanitary landfill is rarely found in the final disposal existing in Indonesia. Therefore, continuing efforts for handling waste problem is a must.

Many people perceive that all waste are dirty and have to be disposed or burned. A study of Marleni,[4] showed that public support in organic waste management was only 48 %. The main constraint of public involvement in waste management, particularly for domestic waste, is the difficulty for the implementation of paradigm of sorting and waste utilization instead of waste disposal. That way of thinking has to be reformed because substantively, waste still has additional value if it is appropriately and correctly treated.[5]

One source of waste generating is household. All of household members must possess proper knowledge and behavior in order to play a role in domestic waste management. However, a study concerning housewives in plastic waste management showed that only around 43.2% housewives had good knowledge and 39.2 % had proper behavior.[6] In public places, the improper habits are reinforced by the lack of available cleaning facilities for people.[7] Meanwhile, in general, people also still do not understand and aware that the waste they produce are potential to impact public health.[8]

The average percentage of waste carried and disposed to its final disposal is 41.28%, burned 35.59%, buried 7.97%, carelessly thrown (onto rivers, drainage, streets, etc) 14.01% and processed (composted and recycled) is only 1.15 %.[9] Efforts to solve waste problem can be started at waste generating phase in household level. Managing household waste needs practical and simple methods, so it does not need extensive area and disturb public health and aesthetics as well. One of practical and simple organic waste management methods at household level that may give additional value is composting.[10] Other than converted into compost, organic waste can also be used as cattle feed.[11]

Actually, compost can be formed naturally. However, this natural process of composting is too long and slow. To accelerate the composting process, many technologies have been developed, either at high, middle or low level. Basically, the development of composting technology depends on the natural decomposition of organic substances. The decomposition process is optimised in such a way that makes the composting can run faster and more efficient.

Composting technologies now is very important, especially for solving organic waste problems, such as handling waste problem in big cities, industrial organic waste as well as in forms of agricultural and horticultural waste.[12] Any effort for composting agricultural waste is already implemented elsewhere.[13,14]

There are various composting technologies for waste, either aerobically or anaerobically as well as with or without involving activator. Aerobic composting is the most widely used because it is easy and cheap, also it does not need too complicated processing control. The decomposition of substance is carried out by microorganisms within the substances and supported by air. On the other hand, anaerobic composting utilizes microorganisms that do not need air for degrading the organic compounds.[10]

High organic content in household waste is very potential for composting process. Up to now, waste generated from each household are collected individually, then for a whole they are transported to temporary final waste disposal. Furthermore, by using bigger vehicles, the domestic waste are disposed to the final disposal.

The conventional composting method relies on microorganisms which can be gained through Effective Microorganisms 4 (EM4) addition. EM4 is a mix culture in liquid medium that has yellowish brown color, smell of sour, and consists of microorganisms used for soil fertility. *Lactobacillus sp*, Leavened, *Actinomycetes* and *Streptomyces* are examples of microorganisms contained in EM4.[10]

The composting time is expected to run more quickly. One of the actions that can be implemented is through the use of macroorganism aimed to decompose pieces of organic waste which are still a bit chunky. Earthworm is one of macroorganisms that can be used. Earthworms are invertebrate and there are almost 3,600 species in the world which simply can be classified into two types, i.e. burrowing and non-burrowing. Examples of the burrowing type are *Pertimaelongata* and *Pertimaasiatica* that live far beneath the soil, meanwhile for the latter type are *Eiseniafoetida* and *Eudriluseuginiae* that live on outer layer of soil surface.[15]

Technology in using earthworms for composting is a process of organic waste handling and becomes an alternative approach for waste management.[16] However, this study aimed to understand the relation between the use of earthworms and the time needed to compost household organic waste. The hypothesis proposed was there is a relation between the use of earthworms and household organic waste composting length of time.

Method

This study was an experiment (posttest only control group design) conducted to examine the relation between the earthworm use and the duration of the household organic waste composting.[17] The experiment used two groups of bin in which each group consisted of four plas-

tic bins. Organic waste were then placed into all the bins. Then earthworms were added into one group, meanwhile the other group was treated as control. The composting time was decided when the composting process was supposed to be complete as signed with blackish in the color and soil-like smell. Every day in each group, the temperature, humidity, pH, odor, and color of the waste were measured. The waste was also slowly turned over repeatedly and sprinkled by water if it looked dry.

The object of the experiment was all waste generated from one household. The waste samples were taken during eight-day waste generation from the selected household. The independent variable of this study was the use of earthworms, meanwhile the dependent variable was the composting duration. The experiment was conducted at Health Housing Complex of Banjarbaru on August and September 2014.

The primary data was the duration of composting in each treatment group. The data was collected using observation method, for example, by measuring and recording the data about temperature, humidity, pH, odor and color of the compost. The instruments used were thermometer, hygrometer, pH meter, smelling and sight sensories. The data concerning the composting duration were then derived by calculating the time difference between the starting and the finishing points of the composting.

The collected data was analyzed using paired t-test in order to compare the average of composting duration between the organic waste groups with and without earthworms. The error level (α) used was 5%.

Results

Weight, volume, temperature, humidity, and pH of the compost was used as controlling factor measured from the beginning of the process until the compost was formed. The units of measurement were gram for weight, liter for volume, celcius degree for temperature and relative percentage for humidity. Results of those measurements can be seen in Table 1.

By using smelling and sight sensories, odor and color of compost were observed since the beginning of the waste processing until the compost were yielded. The result of the observations was presented in Table 2.

The composting length of time was defined from the beginning of the original waste was treated until the compost were ripe. The composting duration for both groups with and without using earthworms could be seen in Table 3.

Based on Table 3, the composting duration for earthworm addition treatment was ranged between six and seven days by an average of 6.8 days (SD = 0.50 days). Meanwhile, the duration for without earthworm addition treatment was ranged between seven and eight days by an average of 7.5 days (SD = 0.58 days). Test of normality resulted that the data were normally distributed, and the test of variance equality resulted that the variance of both groups of treatment were similar. The p value gained from the t-test was 0.097.

Discussion

Characteristics of Compost

The weight of the household organic waste converted into compost either with or without earthworms was lighter if compared to the initial weight. The declining percentage of compost weight calculation for both earthworm groups was quite similar. Such declining weight occured because the water contained in organic waste which at the beginning had big quantity became very little at the end of composting process.

Volume of the domestic organic waste processed into

Table 1. Weight, Volume, Temperature, Humidity and pH of Compost

Parameter	Groups of Treatment			
	With Earthworms		Without Earthworms	
	Mean	SD	Mean	SD
Weight	2.41	1.16	2.47	1.11
Volume	6.16	2.57	6.18	2.39
Temperature	29.19	4.16	29.69	4.04
Humidity	74.34	14.59	74.63	14.33
pH	6.31	0.25	6.31	0.23

SD = Standard Deviation

Table 2. Odor and Color of Compost

Day	Groups of Treatment			
	With Earthworms		Without Earthworms	
	Odor	Color	Odor	Color
1	Smell of waste	Color of waste	Smell of waste	Color of waste
2	Smell of waste	Color of waste	Smell of waste	Color of waste
3	Somewhat smell	Color of waste	Somewhat smell	Color of waste
4	Somewhat smell	Color of waste/ somewhat blackish	Somewhat smell	Color of waste
5	Smell of soil	Somewhat blackish	Somewhat smell	Somewhat blackish
6	Smell of soil	Somewhat blackish/ blackish	Somewhat smell/ smell of soil	Somewhat blackish
7	Smell of soil	Blackish	Smell of Soil	Somewhat blackish / blackish
8	Smell of soil	Blackish	Smell of Soil	Blackish

Table 3. Composting Length of Time

Treatments	Length Time (days)		p value[a]
	Mean	SD	
With earthworms	6.75	0.50	0.097*
Without earthworms	7.50	0.58	

SD= Standard Deviation
[a] t-test
* > 0.05 = no difference

compost either with or without earthworms was lighter if compared to the initial weight. The volume of compost from household organic waste added by earthworms had declining percentage bigger than without added by earthworms. The declining volume occured because the water contained in organic waste which at the beginning had big quantity also became very little as the composting process completed.

The temperature of composting immediately increased as it was low at the early phase. This condition occurred in both groups of treatment and was a sign that decomposition of the organic waste by macroorganisms or microorganisms inside the waste occurred. At the final phase of composting, the temperature approached the surrounding temperature level. The temperature increased in composting process and the faster rise of the temperature occured inside the pile of the compost.[10] This condition is similar to a study conducted by Nagavallema,[15] i.e. at the beginning of the composting process, the temperature was higher (32 – 33° C) compared to the outside temperature (26 - 30° C). Afterwards, the temperature decreased gradually to the minimum level about 24° C. However, the temperature constantly remained at 60° C.[10]

The humidity of composting at early phase was high, but by slow degree it got more decreased until the end of the process. This condition was observed in both of the study groups of earthworms. The same indication was also found for temperature in the two groups of treatment. The optimal humidity for composting process was ranged between 40 – 60%. Humidity below 40% causes the reduction of microbe activities, so that anaerobic fermentation will occur. On the other hand, humidity higher than 60% might cause the nutrients washed away from the compost, therefore the microbe activities would also decrease.[10]

Household waste resulted unpleasant odor. In experiment using earthworms, this condition only occurred in about two days. As the time went by, the odor of waste then turned into soil-like smell. On the fifth day, compost originated from household waste as added by earthworms already had such soil-like smell. This smell was one of indicators of the ripeness of the compost.[18] In term of compost color, the waste color was the present color at the early phase, yet in the fourth day it started to change becoming somewhat blackish. This blackish color is an indicator that the composting process already completed. A whole blackish color was obtained started from the seventh day. This result showed the same perspective with the theory stating that a good compost should have color range from dark brown to soil-like black.

Composting Length of Time

The composting experiment without using earthworms also occurred in about two days. As the time went by, the smell of waste was turned into soil-like smell. On the seventh day, the compost originated from household organic waste without earthworms already had the soil-like smell as one of indicators the compost was done. For the compost color, from the color of waste shown at the beginning of the process, it started to turn into somewhat blackish at the fifth day indicating that the composting process was done. A whole blackish color was gained started from the seventh day.

According to Table 3, the composting length of time with earthworms was ranged between 6 – 7 days by an average of 6.8 days. Meanwhile, the time observed from without earthworms was between 7 – 8 days by an average of 7.5 days. This length of time was in accordance with the result of another study.[19] This showed that the composting process of household organic waste had shorter duration. The t-test used to analyze the disparity in time between those two study groups concluded that the difference was not statistically significant. It meant that in this study, the addition of earthworms in the composting of household organic waste maight not significantly shorten the time needed for composting process as the addition of earthworms as macroorganism was one of the strategies to accelerate it.[10]

Basically, earthwormed-compost or familiar as 'casting' is a composting process involving macroorganisms such as earthworms. The cooperation between earthworms and microorganisms provides a good impact to the decomposition process. Most decomposition activity was carried out by microorganisms. Nonetheless, the existence of earthworm is considered able to support the process because the material which is going to be decomposed by microorganisms has been decomposed by earthworms in advance. Therefore, the work of microorganisms is more effective and faster.

The compost obtained from both treatments can be used for various purposes. The compost fulfilled the standard quality, i.e. having the same temperature with the surrounding, containing 65% humidity and pH was about 7, having soil-like smell and description of a ripe one that its color changed to be blackish-brown, soft in texture, and having no stink odor.[20,21] To dry the com-

post if it is still wet, the compost should be exposed to the air in order to gain a good quality compost. The natural composting time will be lasted from several weeks to two years for reaching a total ripeness.[10]

Household waste should be properly managed. The organic one is the biggest part of this type of waste (94.24%).[1] Household organic waste can be easily processed into something beneficial. If every household does not manage and treat their organic waste in situ, microorganisms will grow luxuriantly inside the waste stack, furthermore it can spread diseases to people.[22]

The limitation of this study was that the use of earthworms was applied since the beginning of the composting process. The initial temperature of composting process should be importantly taken into account since it must be quite high. According to Khairuman & Amri,[23] the ideal temperature for earthworms to live is about 25° C. Therefore, Nagavallema suggests that the most appropriate time to release the earthworms into the organic residue is when its temperature around 25° C.[15]

Conclusion

Organic waste from households can be processed into compost within seven to eight days. To produce compost from household organic waste, the addition of earthworm is not needed. The treatment of household organic waste for compost will reduce the place for agents and vectors of diseases to live and breed, so at the end, it may prevent people from getting diseases or health problems.

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