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Development of New Biostarter Medium Using Local Raw Materials for Composting of Elephant Feces

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ABSTRACT: The objective of this research is to develop for a new bio-starter medium for composting of elephant feces and knowing the effect on mature compost quality. Research was also designed to observe the elephant feces compost quality made with the addition of biostarter developed in rice bran fermentation (T1), biostarter made from pineapple fermentation (T2), and banana weevil biostarter (T3). The composting process was performed during a month and in every week compost materials were mixed and turned over to maintenance condition of the composting process is always aerobic. Physical parameters of compost quality were measured during 30 days of composting, chemical properties including water content, organic matter, organic carbon, organic nitrogen, organic calcium and C/N ratio were also measured. Biological observation of mature compost was observed by applying compost product on mustard growth, and the microbiological test was measured by Total Plate Count (TPC). Data were analyzed by One-way ANOVA to calculate differences among the treatments. The result showed that, significant differences (P> 0.05) was not observed on water content for all treatment that is T1 58.88%, T2 60.95%, and T3 53.40%. The Reseach parameter of the organic content was found T1 30.39%, T2 34.97%, T3 28.25%. Total organic carbon in treated compost was observed: T1 17.62%, T2 20.28%, T3 16.39%. Total Nitrogen was T1 0.44%, T2 0.43%, T3 0.51%, total P T1 0.20%, T2 0.22%, T3 0.21%, total K T1 0.77%, T2 0.80%, T3 0.88%, C/N ratio T1 39.56, T2 47.24, and T3 32.81. The biological parameters including height, number of leaves, leaf length, leaf width, root length, and weight of the harvest of mustard was also had no significant differences. Total microbial counts on mature compost were T1 9.6 x 10^4, T2 4.6 x 10^4, and T3 4.2 x 10^4 CFU/g.

Keywords: aerobic composting, banana weevil, bio-starter medium, elephant feces, rice brand

INTRODUCTION

Due to the practice of intensive agriculture worldwide, it was impact on the acidic farmland soils and the lower content of organic matter. It is estimated that each hectare requires 20 tons of organic matter per year to supplement decomposition in the field under the good conditions of high temperature, humidity and microbial activity. Compost application is very popular in Agricultural countries as it has the potential to improve soil physical properties, supply plant nutrition, recycle waste materials, and reduce environmental pollution. Many biological materials show active decomposition accompanied by rise in temperature and are considered suitable for composting, such as agricultural by-products, crop residues, animal wastes, vegetable market wastes, waste mushroom media, food processing wastes, and municipal refuse (Zeng *et al.*, 2012). During composting, thermophilic, thermotolerant and mesophilic microorganisms decompose cellulose, hemicellulose and lignin of substrates. The composting process is an exothermal biological oxidation of organic matter carried out by a dynamic and quick succession of aerobic microorganism populations. The heterogeneous organic matter of the raw material is transformed,

after a suitable composting period which includes bio-oxidative and maturation phases, into a stabilized end-product through partial mineralization and humification (Chen *et al*., 2007).

Composting typically denote as aerobic treatment of organic wastes from livestock feces, organic municipal wastes, crop residues, and industrial organic by-products to composts. It is a conventional and centuries-old agricultural technique, which are appreciated and used in agriculture land as bio-fertilizers and soil conditioners. Agricultural uses make the nitrogen (N) content in the compost and land field as an important reference to the quality of composts (Zeng *et al.*, 2012).

During organic wastes composting, mineralization of some organic nitrogen (N_{org}) containing materials such as proteins, amino acids and urea releases considerable free ammonium (NH^+_4/NH_3). For this reason, the mineralization of Norg is also termed as ammonification. This transformation is however bilateral sincepart of NH^+_4/NH_3 can be immobilized in turn by biomass to synthesize Norg (Sasaki *et al*., 2005). Since the ability of ammonification is generally greater than that of immobilization, it causes an accumulation of NH^+_4/NH_3. The accumulated NH^+_4/NH_3 have therefore the potential to be stripped into the atmosphere with the aeration flow. The N losses from composting are mainly due to ammonia (NH_3) emissions, which account, respectively for 24–33% and 46.8–77.4% of the initial N of household wastes and manures. These emissions cause meanwhile series of environmental problems because of their odor, toxicity and contribution to eutrophication and acid rains (Paoli *et al*., 2010).

Elephants are the largest mammals on land which identical with intelligent, human friendly, and easy to control, imply on many attractions that can be performed by this animal to attract the visitors at the zoo or other amusement park. Including in Borobudur Temple, elephant has used as stable. Elephants have big bodies, are able to produce about 110 kg feces per day. The appropriate processing is needed to avoid environmental problems for visitors and residents around the location due to this huge number of feces. Utilization of elephant feces as a compostable material is one of the appropriate processing methods to resolve the problem.

The process of composting can be accelerated by using biostarter. Biostarter containing microbial which degrade of organic material can improve acceleration of the composting process. Commercial Biostarter has been widely found in the market. Even so, it would be better if farmers are able to make their own biostarter. Utilization of local raw materials as biostarter can accelerate the composting process without having to high additional costs so that farmers can made independently. The objective of this research is to develop for a new bio-starter medium from local materials for composting of elephant feces and knowing the effect on mature compost quality.

MATERIALS AND METHODS

Method for making biostarter medium

Biostarter medium from banana weevil. One and half kg of banana weevils was chopped and continued by mashed process. A total of 300 g of molasses was dissolved in 3 liters of washing rice water. Banana weevils that has been destroyed, furthermore mixed into molasses and water in the anaerobic fermentor which provided with pipes connected to the bottle that has been filled with water. The mixture is fermented for 10 days and then filtered, the liquid used as an ingredient in the manufacture of compost (Trubus, 2012). Data of pH measurements were taken in every day. Biostarter medium from pineapple.Tree kg of chopped pineapple was mashed processed. A total of 300 g of molasses dissolved in 3 liters of coconut water. Pineapple that has been destroyed was then mixed into molasses and water in anaerobic fermentor which provided with pipes connected to the bottle that has been filled with water. The mixture is fermented for 10 days and then filtered.

The liquid is used as an starter in the manufacture of compost (Trubus, 2012). pH measurements were taken in every day.

Biostarter medium from rice bran. In a total of 3 liters of boiling water was input 600 grams of bran, 150 grams of shrimp paste, and 600 grams of molasses. The mixture was stirred and wait into cold condition, after cold liquid inserted rod which has a rotten banana. The mixture is placed in a closed bucket for 5 days. Mix was opened on the sixth day and stirred for 10 minutes and not too tightly closed. Stirring is performed every day until the 10th (Wahyono, *et al.*, 2010). PH measurements were taken every day.

Composting

Aerobic composting is performed in a dry place and protected from the rain. Compost is made by mixing 100 kg of elephant feces and 1 liter biostarter. Compost mixed using a hoe into homogeneous condition. The adding of water was performed if the compost is too dry. The compost is then closed using a covers. There are three treatments in the study and each treatment using three replication. Each pile consist of 100 kg materials with a maximum height of 1 meter in every piles. In order to maintenance water contain and moisture, reversal of compost is performed once a week during four weeks.

Statistic Analysis

Non-parametric (descriptive) analysis will be performed on the data of sensoris observation of conpost. Arithmetic means, standard deviations and ANOVA which continued with Duncan Multiple Range Test (DMRT) has been employed on the data for physical, chemical, and biology parameters, for their significance.

RESULTS AND DISCUSSION

The biostarter medium that fermented for 10 d resulted the low pH condition at about 4. The color was about light brown with the smell of acid. The number of microbes in the medium made from rice brand was 6.7 x 10^5 cfu/ml, 24 times higher than the number of microbes' presence at medium mad from pineapple of banana weevil. It was suggested due to the high nutrient content of rice brand would be useful for starter during the composting period.

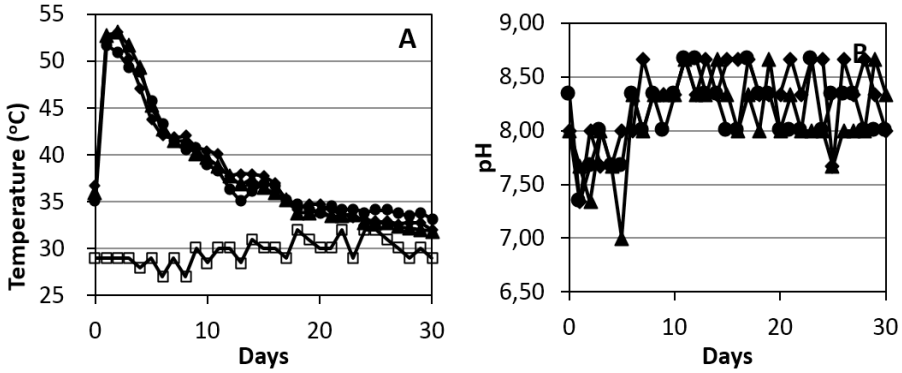

Fig. 1. The Changes in (A) temperature and (B) pH of the compost over the treatment period; triangle representative for rice brand compost, circle representative for pineapple, and diamond representative for banana weevil compost.

The effect of biostarter medium supplementation on the compost temperature, and pH is shown in Fig. 1. Typically, compost remained at maximum temperature for 3 days, which indicated

the decomposition condition occurred. The maximum temperature reached 53°C for composting made by the addition of rice brand medium, 50°C from pineapple medium, and 53.11°C. The pH increased slowly from about 7 to 8 from the first day to the day 5th. Furthermore, rice brand which has higher nutrition content suggested increased the activities of thermophilic bacteria in compost.

Table 1. Physiochemical characteristics of mature compost made from elephant feces with the addition of various biostarter mediums with 30 days of composting period (dry weight basis determined from triplicate samples)

Variable	Biostarter Medium		
	Rice bran	Pineapple	Banana Weevil
Water Content (%)ns	58.88 ± 3.39	60.95 ± 4.82	53.40 ± 2.02
Organic Content (%)ns	30.39 ± 6.10	34.97 ± 4.44	28.25 ± 0.37
C Organic (%)ns	17.62 ± 3.54	20.28 ± 2.57	16.39 ± 0.12
N Total (%)ns	0.44 ± 0.03	0.43 ± 0.03	0.51 ± 0.03
P Total (%)ns	0.20 ± 0.02	0.22 ± 0.01	0.21 ± 0.01
K Total (%)ns	0.77 ± 0.20	0.80 ± 0.20	0.88 ± 0.20
C/N Ratio ns	39.56 ± 5.31	47.24 ± 3.66	32.81 ± 2.10

ns: not significant

Table 1 shows us the chemical properties of mature compost treated with various biostarter medium. The physiochemical properties of mature compost did not show significant differences between each treatment. The highest water content was observed in compost treated with pineapple medium, followed by the rice bran compost and banana weevil compost. Good compost has a range of water content about 40-65% (USDA, 2007). The organic content of compost from all treatments observed appropriate with the standard of range 27-58% (SNI, 2004). Standard for physiochemical characteristics of compost according to SNI 2004 for organic carbon, Nitrogen, Phosphate, Potassium, and C/N ratio are 9.8-32%, minimum 0.5%, minimum 0.10%, minimum 0.2%, and 10-20, respectively. In means that all the parameters of compost are appropriate with SNI standard.

Table 2. The 28 days growth of mustard, planted in soil with the addition of treated compost from elephant feces using various biostarter mediums.

Variable	Biostarter Medium		
	Rice bran	Pineapple	Banana Weevil
Plant Height ns	10.24 ± 1.03	9.23 ± 2.44	9.08 ± 1.52
Leave Number ns	4.22 ± 0.55	4.22 ± 0.73	4.67 ± 0.01
Leave Length ns	3.90 ± 0.49	3.15 ± 0.99	3.13 ± 0.77
Leave Wide ns	2.16 ± 0.39	1.72 ± 0.55	1.73 ± 0.43
Root Length ns	7.50 ± 1.42	6.06 ± 1.00	6.17 ± 0.87
Harvest Weigh ns	0.58 ± 0.24	0.55 ± 0.32	0.50 ± 0.16

ns: not significant

The biological parameters of mature compost was observed by the addition into the media for planting mustard. The data was shown in Table 2. By the addition of rice brand compost, the growth of mustard showed higher compare to the other treatments in almost all parameters.

Table 3. Microbiology parameter of treated compost with various biostarter medium

Biostarter Medium	Number of microbes ($x10^4$ cfu/g)
Rice Bran	9.6
Pineapple	4.6
Banana Weevil	4.2

Table 3 shows the number of microbes in rice brand compost that observed twice higher comparing to pineapple and banana weevil compost. Bacteria, actinomycets, and fungi usually dominate microbial population in compost. The higher nutrient content of rice brand medium was suggested become the reason for the acceleration for microorganisms in compost for growing.

CONCLUSION

Elephant feces is an organic material that is quite difficult to composted. Due to the higher fiver content, elephant feces could not be composted during one month. The addition of various biostarter medium on elephant feces during composting does not give a significant difference on the quality of the physical, chemical, and biological characteristics. The physical characteristics and levels of C/N ratio of compost not yet meet the standards of SNI 19-7030-2004. The water content of the compost meets the standards of compost according to the USDA , the levels of organic matter, organic C, total N, total P, and K total of the compost has appropriate to the standard of SNI 19-7030-2004.

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