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Comparative Evaluation of Compost Quality, Process and Organic Materials and Adoptability Potential to Complement By Compost Quality Index (CQI)

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Abstract. Compost is natural fertilizer, which is organic matter that been decomposed in a process called composting. The end of result composting is an accumulation of partially decayed organic matter called humus. In this study, type of compost that have been chosen are Empty Fruit Bunch (EFB) compost, Goat Dung (GD) compost, Food Waste (FW) compost, compost using bio-decomposer (FWB), and vermicompost (VC). This study aim to identify the stability and maturity of compost that been collected and to identify the quality of compost by using Compost Quality Index (CQI). Study revealed that comparable values obtained in terms of physical properties, chemical properties, stability, maturity and phytotoxicity status. Based on this study, it reveal that EFB and FWB and stable compost while FW and VC are in matured compost. However, FWB showed better results in terms of microbial population, the highest of the values obtained for the other types of compost studied and the germination index value of this compost was higher than the other types of compost. Therefore, it can conclude that using the bio-decomposer can give more quality for compost.

1. Introduction

Compost is natural fertilizer which is organic matter that has been decomposed in a process called composting. The end result of composting is an accumulation of partially decayed organic matter called humus. In order to guarantee the safety of compost during its use in agriculture, or as an amendment in degraded soils, certain quality criteria should be fulfilled. These contribute to the pathogens material, heavy metals, organic matter, nutrient content, stability and maturity [1]. Selection type of compost is necessary when to ensure the minimize affect to the environment and to ensure the good recycling into compost quality in terms of good, moderate, poor can make the producer get any idea to choose type of compost better be use [2]. Hence, this study was taken up to identify the comparative evaluation of different type of compost on their stability and maturity, and compare the quality of different type of compost by using Compost Quality Index (CQI).



2. Experimental

2.1. Sample Collection

This project contains five sample from different type of compost that collected from various source. The first sample obtained from Value Tree Sdn. Bhd. that sells bio-fertilizer that compost by empty fruit bunch from palm oil mill effluent. The second sample is food waste compost that collected from SMK Sanglang. For the third sample, farmyard manure compost, which is from goat dung. While the fourth sample is compost-using bio-decomposer that been collected at Felda Chuping. Lastly, the fifth sample is a vermicomposting that obtained from School of Bioprocess University Malaysia Perlis (UniMAP) which is from lecturer that carried out a project on vermicomposting in that school.

2.2. Parameter of Compost Sample

All the compost sample that been collected analyzed for physical characteristic, which were pH value, moisture content, and organic matter, chemical characteristic, which were nutrient value (N, P, K) and C/N ratio, microbial population, stability, maturity, and phytotoxicity status. The nutrient value of compost was determined by using AAS machines while CHONS analyzer determined C/N ratio. The microbial population of compost was determined using Most Probable Number (MPN) method [3]. Test that been used to determine phytotoxicity status was using compost extract test [4] to identify the germination index. For stability, condition was determined by using some parameter, which are moisture content, colour, odor, and C/N ratio while for maturity condition was determined by pH value and germination index value of compost.

3. Results and Discussions

3.1. Physical Characteristic of Compost Sample

The pH value in EFB, GD, FW, FWB, and VC were 10.85, 9.22, 7.82, 9.61, and 7.40 respectively as shown in table 2. The pH value of compost for good quality and mature compost should in range 7.2 to 8.5 [5]. So in this case only FW and VC that in the range of pH value. For the moisture content value of each compost, average moisture content in compost sample from 18.57 to 62.14%. The moisture content value should in range 15-25% [6] for the high quality compost, which is only in case of FWB and EFB that stipulated in the range as value are given in table 2. The last parameter for physical characteristic that been tested was organic matter. For the average organic matter that content in all the compost samples ranged between 17.40 to 61.41 percent while the high quality compost is in range (25-80%) [6], so in this case, from the value in table 2 only FW and VC does not in the range.

3.2. Chemical Characteristic of Compost Sample

These values of chemical characteristic were determined by referring some journal because of having some technical problem. One of the chemical characteristics of compost sample was nutrient content which were include total nitrogen (N), total phosphorus (P), total potassium (K). The range of total nitrogen in the compost sample are from 1.01 to 2.09 percent while for the range of total phosphorus of compost sample are between 0.443 and 1.25. So all the compost sample were in ranged the high quality compost for both nutrient that stated the nitrogen content should in range between 0.4 to 3.5 percent while the phosphorus content should in range 0.2 to 1.5 the content of phosphorus percent in compost [6]. For the total potassium, total potassium percent should in range between 0.4 and 1.5 percent as the chemical properties of a high quality compost [6]. The total potassium percent in compost are in range between 0.68 and 4.27. So in this case, only VC and GD compost sample in the properties of high quality compost. The other parameter of chemical characteristic were C/N ratio. The value of C/N ratio for the all compost samples are in range between 15 and 26.2. The C/N ratio for the stable compost varied from 8 to 29 [7]. In this case, the compost sample that ideal condition is EFB only while for the stable condition are all of the compost sample. These values of chemical characteristic shown in table 2.

3.3. Microbial Population of Compost Sample

The microbial population value in the EFB, GD, FW, FWB, and VC were 7.92×10^{11} cfu/g, 1.17×10^{12} cfu/g, 4.45×10^{11} cfu/g, 1.16×10^{12} cfu/g, and 8.38×10^{11} cfu/g respectively. Based on table 2, by using Log_{10} value, it show that total of bacteria much higher than total of fungi and total of actinomycetes. This because bacteria are nutritionally and responsible for the most of initial decomposition and heat generation in [5].

3.4. Stability, Maturity, & Phytotoxicity of Compost Sample

Phytotoxicity can represented by germination index. The standard value of phytotoxic affect is in range from 0.8 to 1.0. While for the value of germination index that less than 0.8 is does not have phytotoxicity [8]. Based on the result that obtained by germination index test that shown in table 2, only EFB and GD were does not have phytotoxicity.

For the stability condition, one of the parameter that can measure the stability of compost is moisture content. Moisture content of the compost should be less than 35%, while the colour should in almost black for stable compost [9], and its odor should be earthy. While the C/N ratio for the stable compost varied from 8 to 29 [7]. The case show that only EFB and FWB are all in stable condition while for VC, it show that non-stable compost by each parameter that been measured. The parameter that need consider measuring the maturity of the compost is pH value and GI. pH value of matured compost should in range of 7.2 to 8.5 [5]. While for the GI should in range of 0.8 and 0.9 for mature compost while the GI values that more than 0.9 is state as highly mature [10]. Based on the result, it show that only FW and VC are in mature condition while EFB and GD, both are in immature condition. Table 1 present a grouping of stability and maturity by each parameter for each of compost samples.

Table 1. Grouping of all samples with respect to each parameter.

Type of Compost Sample	Stability Parameter				Maturity Parameter	
	Moisture	Colour	Odour	C/N ratio	pH	GI
EFB	S	S	S	S	IM	IM
GD	S	NS	S	S	IM	IM
FW	NS	S	NS	S	M	HM
FWB	S	S	S	S	IM	HM
VC	NS	NS	NS	S	M	HM

Notes: S = stable, NS = non-stable, M = matured, IM = immature, HM = highly matured

Table 2. Quality parameter for compost sample.

No.	Parameter	Empty Fruit Bunch (EFB) compost	Goat Dung Compost	Food Waste compost	Food waste + bio-decomposer compost	Vermicompost
Physical Parameters						
1.	pH value	10.85	9.22	7.82	9.61	7.40
2.	Moisture Content (%)	20.26	27.29	62.14	18.57	49.33
3.	Organic Matter (%)	59.02	33.94	18.03	67.26	13.95
Chemical Parameter (by referring journal)						
4.	Total Nitrogen (%)	1.9 [11]	1.01 [12]	2.09 [13]	1.67 [14]	1.55 [15]
5.	Total Phosphorus (%)	0.91 [11]	0.433 [12]	0.98 [13]	1.25 [14]	1.17 [15]
6.	Total Potassium (%)	4.27 [11]	1.299 [12]	1.55 [13]	1.98 [14]	0.68 [15]
7.	C/N Ratio	21 [11]	18.04 [12]	15 [13]	26.2 [14]	13.62 [15]
Microbial Parameter (cfu g-1)						
8.	Total bacterial count	73 x 10 ¹⁰	11.3 x 10 ¹¹	43 x 10 ¹⁰	11.2 x 10 ¹¹	83 x 10 ¹⁰
9.	Total fungal count	90 x 10 ⁴	78 x 10 ⁵	40 x 10 ⁶	50 x 10 ⁴	49 x 10 ⁶
10.	Total actinomycetes count	62 x 10 ⁹	37 x 10 ⁹	15 x 10 ⁹	43 x 10 ⁹	83 x 10 ⁸
Maturity & Phytotoxicity Parameters						
11.	Germination index (phytotoxicity bioassay)	0.235	0.512	2.072	3.672	1.276

3.5. Formulation of Compost Quality Index (CQI)

The formulation of CQI consist four specific quality parameters. The formulation of CQI are as follows [2]:

$$\text{Compost Quality Index (CQI)} : \frac{\text{NV}_{\text{NPK}} \times \text{MP} \times \text{GI}}{\text{C/N ratio}} \quad (1)$$

Where:

- NVNPK = Total nutrient value in term of total (NPK) percent.
 MP = Log10 value of total microbial population in terms of total bacteria, total fungi, total actinomycetes
 GI = Germination Index

Classification of compost as per Compost Quality Index [2].

Compost Quality Index (CQI)	Compost Quality Classification
> 2.00	: Poor
2.00 – 4.00	: Moderate
4.00 – 6.00	: Good
6.00 – 8.00	: Very Good
8.00 – 10.00	: Extremely Good

For the result that use equation (1) which was to identify CQI of compost sample that have been collected, EFB compost sample obtain CQI: 2.27 that indicate the moderate quality while for GD compost sample also indicate moderate quality as its CQI value is 2.30. For the FW compost sample is indicate in very good quality as well its CQI value are 7.43 while foe FWB is in extremely good quality because of the CQI value is 8.29. For the last compost sample which is VC that obtain CQI: 5.43 that represented as good quality status.

4. Conclusions

Comparative evaluation of five compost sample that have been collected were have been measured their stability, maturity, and their quality by using formulation of CQI. In this study was shows that only EFB and FWB are stable in all parameter that been measured. For the maturity, only FW and VC are in matured condition for both condition while EFB and GC are immature condition for both condition. So can concluded that the stable compost not necessarily be the mature compost. Besides that, the quality of compost have been obtained by using formulation CQI, compost sample that in moderate quality were EFB and GD while in good quality was VC. For the FW, it was in very good quality classification of compost and lastly compost sample was FWB was in extremely good quality compost. This is because, from the result of testing, it showed FWB was the highest compost sample that in ranged of high quality compost from the parameter that have been measured. The uses of bio-decomposer also can improve the quality of compost even though it also help to accelerate the process of composting.

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