EFFECTS OF POST-COMPOSTING ON VERMICOMPOST OF SPENT MUSHROOM SUBSTRATE

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INTRODUCTION

Vermicomposting is cost effective and natural method alternative with shorter duration needed to accomplish. According to Gunadi et al. (2002), vermicomposting is aerobic, bioxidation and stabilization non-thermophilic process of organic waste decomposition that depends upon earthworms to fragments, mix and promoter microbial activity.

Whereas composting is the process of biological decomposition of semi-dry organic waste by microorganisms under controlled aerobic conditions. Composting is undertaken both in the presence and absence of oxygen. Neither process will destroys the organic matter contained in biodegradable waste but they utilize micro-organisms to convert degradable organic matter into humus known as compost, commonly referred to as a soil conditioner (Department of Local Government, 2006).

Utilization of spent mushroom substrate either in vermicomposting or composting is still new in Malaysia. This high nutrient organic waste especially sawdust base spent mushroom substrates (Kwak et al., 2008) usually directly decomposed through open burning or sent to landfills. The successful utilization of spent mushroom substrate in vermicomposting has been documented by Tajbakhsh et al. (2008).

Accordingly, this study was conducted to determine the effects of post-composting on vermicompost of spent mushroom substrate by looking at the changes of macronutrient contents in compost produced.

MATERIALS AND METHODS

Five treatments of different ratios of cow dung and spent mushroom substrate were prepared as feed materials with four replicates for each treatment namely; 80:20 (T1), 60:40 (T2), 50:50 (T3), 40:60 (T4) and 20:80 (T5). The use of cow dung in each treatment is only for bedding material at early stage before the earthworms can adapt with the treatments given the high content of N in cow dung (Loh et al., 2005).

Started at three weeks of pre-composting is to avoid exposure of earthworms to high temperature during the initial thermophilic stage (Nair et al., 2006), the experiment is then continued with seven weeks of vermicomposting. Sixty weighted matured earthworms were introduced in each replicate as adapted from Kaviraj and Sharma (2003). The moisture content of each replicate was maintained at 50-60% by spraying the surface with water.

After seven weeks, the earthworms were sorted manually from the vermicompost produced. The vermicompost was sampled and determined for its macronutrient
contents. In the absence of earthworms in vermicompost, post composting was continued for another twenty weeks and the compost produced were sampled for macronutrient contents.

Organic carbon in vermicompost produced was determined by the partially-oxidation method (Walkley & Black, 1934). Total N content was determined by Kjeldahl digestion. P content was determined by using colorimetric method and K was measured by ignition method using atomic absorption spectrophotometry. Lastly, C/N ratio was analyzed through the calculation.

Statistical analysis was carried out using SPSS 11.0.1 (Standard Version) computer software package. Relationships of macronutrients contents (organic carbon, N, P, K and C:N ratio) and vermicompost produced in week 10 and composting in week 30 were analyzed by using regression coefficient.

RESULTS AND DISCUSSION

Table 1: The nutrient contents of vermicompost and compost in different treatments and durations

<table>
<thead>
<tr>
<th>TREATMENT / DURATION</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10th WEEKS</td>
<td>10th WEEKS</td>
<td>30th WEEKS</td>
<td>30th WEEKS</td>
<td>30th WEEKS</td>
</tr>
<tr>
<td>C (%)</td>
<td>16.88</td>
<td>23.51</td>
<td>23.96</td>
<td>19.66</td>
<td>32.14</td>
</tr>
<tr>
<td>N (%)</td>
<td>1.90</td>
<td>1.46</td>
<td>1.75</td>
<td>0.94</td>
<td>0.87</td>
</tr>
<tr>
<td>P (%)</td>
<td>0.57</td>
<td>0.38</td>
<td>0.46</td>
<td>0.24</td>
<td>0.23</td>
</tr>
<tr>
<td>K (%)</td>
<td>2.74</td>
<td>1.43</td>
<td>1.39</td>
<td>0.67</td>
<td>0.40</td>
</tr>
<tr>
<td>C:N</td>
<td>8.9</td>
<td>16.1</td>
<td>13.7</td>
<td>20.9</td>
<td>36.9</td>
</tr>
</tbody>
</table>

Note: T1 - Cow dung : Spent mushroom (80:20)
T2 - Cow dung : Spent mushroom (60:40)
T3 - Cow dung : Spent mushroom (50:50)
T4 - Cow dung : Spent mushroom (40:60)
T5 - Cow dung : Spent mushroom (20:80)
* - vermicomposting
** - composting

The macronutrient contents in vermicompost and compost from five different types of treatment are presented in Table 1. The organic content in all vermicomposts were reduced due to 20 weeks of post composting. According to Sangwan et al. (2008), organic carbon loss was more in worm inoculated vermicomposters than wormless units appropriate to loss of organic carbon as CO₂ (Tajbakhsh et al., 2008). The presence of earthworms in seven weeks vermicomposting promote such microclimatic condition in vermireactors (Suthar, 2006) which enhanced the loss of organic carbon from substrate through microbial respiration that might be continued in 20 weeks of post composting.

In contrast, the total N content of all compost were reduced after twenty weeks of post-composting compared to the N content in the previous vermicompost. According to Forster et al. (1993), deficit of N resulted from a flush of water soluble material,
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which may have phytopathogenic properties to carry high pollution load and their most undesirable effect is the immobilization of N in the microbial biomass. Orozco et al. (1996), stated the fall in N levels noticed on days 56 and 77 was probably due to the increased demand for this element by the microorganisms, which needed it for growth, thus immobilizing it and extracting it from the substrates; vermicompost.

As a result, it increased the C:N ratio especially in $T_2$ and $T_3$. The C:N ratio is important because the plants cannot assimilate mineral nitrogen unless this ratio is in range of 20:1 or less (Edwards and Bohlen, 1996). However, according to Morais & Qeda (2003), C:N ratio in compost of $T_1$, $T_3$ and $T_4$, were not effected as the ratio still in the range of preferable maturity when C:N ratio below 20 is indicative of acceptable maturity while ratio of 15 or lower being preferable.

P and K contents were lesser in the all compost than in vermicompost after 20 weeks of composting. This finding is supported by Elvira et al. (1998) in vermicomposting of paper pulp mill sludge and Orozco et al. (1996) from vermicomposting of coffee pulp where both resulted in the reduction of K. The reduction might be due to leaching of soluble elements by excess water (Sangwan et al., 2008).

Table 2: Paired samples correlations of macronutrient concentrations in different duration

<table>
<thead>
<tr>
<th>Macronutrient elements</th>
<th>Mean</th>
<th>n</th>
<th>Std Deviation</th>
<th>Std Error Mean</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C week 10th - C week 30th</td>
<td>4.3300</td>
<td>5</td>
<td>3.17233</td>
<td>1.41871</td>
<td>.932</td>
<td>.021</td>
</tr>
<tr>
<td>N week 10th - N week 30th</td>
<td>.40000</td>
<td>5</td>
<td>.290947</td>
<td>.130115</td>
<td>.899</td>
<td>.038</td>
</tr>
<tr>
<td>P week 10th - P week 30th</td>
<td>.07800</td>
<td>5</td>
<td>.075961</td>
<td>.033971</td>
<td>.959</td>
<td>.010</td>
</tr>
<tr>
<td>K week 10th - K week 30th</td>
<td>.51200</td>
<td>5</td>
<td>.410207</td>
<td>.183450</td>
<td>.972</td>
<td>.005</td>
</tr>
<tr>
<td>C/N week 10th - C/N week 30th</td>
<td>-1.8600</td>
<td>5</td>
<td>6.93996</td>
<td>3.10364</td>
<td>.864</td>
<td>.059</td>
</tr>
</tbody>
</table>

Note : n (number of treatment; $T_1$, $T_2$, $T_3$, $T_4$ & $T_5$)

Statistically, there is a significant correlation of all the macronutrient contents (organic carbon, N, P, K and C:N ratio) between vermicompost in week 10 and compost in week 30 (Table 2), indicating that post-composting after 10 weeks of vermicomposting reduced the macronutrient contents. Therefore, obliquely? decrease the quality of compost produced.

CONCLUSION

Vermicomposting of cow dung and spent mushroom substrate in seven weeks is sufficient to produce better vermicompost than continuing the process up to twenty weeks of post-composting. Although longer duration would enhance the reduction of organic carbon content, but similarly the total N will also influence the quality of vermicompost produced which is related to its maturity as reflected by the C:N ratio. Therefore, it can be concluded that the duration and quality of vermicomposting is better than continued composting particularly in vermicompost production.

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REFERENCES


