Compost quality analysis of in addition bioactivator effective microorganism 4 (EM4), molase and EM4+molasses in composting organic Waste at TPST 3R Melong Asih-Cimahi City

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Abstract

Background: Waste by most people is considered dirty, there is useless. Various types of waste one which is organic waste. Organic waste is waste that can improve while decomposttion to increase composting that is needed by bioactivator. Other functions of bioactivators include getting compostting and getting better quality of fermentation products. This research to learn more about the differences quality of compost to addiction bioactivator effective microorganism 4 (EM4), molasses, and EM4+molasses. This research is an experimental study with the design of Postest Only Control Group Design. Tested on Bioactivator (EM-4) and molasses in composting organic waste about the quality of compost. The data is analysis by univariate and compared test with SNI 19-7030-2004. The results of this study indicating optimal quality of compost, in terms of quality from the addition of bioactivator EM4 mixed with molasses resulting neutral pH (7.2), water content (35.55%), nitrogen content (1.18%), C-organic content (22.31%) and C/N ratio (18.9). The results of comparative with SNI 19-7030-2004 mean that there are differences in bioactivator (EM-4) and molasses in composting organic waste with aerob technique about the quality of compost. Need more research by adding other testing parameters that referring to SNI 19-7030-2004 regarding of specifications of the compost from organic waste and need repeating in each parameter measurement to produce better results.

Aims: This research to learn more about the differences quality of compost to addiction bioactivator effective microorganism 4 (EM4), molasses, and EM4+molasses. Settings and Design: This research is an experimental study with the design of Postest Only Control Group Design. Methods and Material: Bioactivator effective microorganism 4 (EM4), molasses, and EM4+molasses. Statistical analysis used: The data is analysis by univariate and compared test with SNI 19-7030-2004. Results: The results of this study indicating optimal quality of compost, in terms of quality from the addition of bioactivator EM4 mixed with molasses resulting neutral pH (7.2), water content (35.55%), nitrogen content (1.18%), C-organic content (22.31%) and C/N ratio (18.9). The results of comparative with SNI 19-7030-2004 mean that there are differences in bioactivator (EM-4) and
molasses in composting organic waste with aerobe technique about the quality of compost. 

**Conclusions:** Need more research by adding other testing parameters that referring to SNI 19-7030-2004 regarding of specifications of the compost from organic waste and need repeating in each parameter measurement to produce better results.

**Keywords:** Composting of Organic Waste, Bioactivators, Aerobe EM4 and Molasses

**Key Massages:**

It can be concluded that bioactivator of EM4 and molasse addition to composting with aerobe can produce stable compost which is not too alkaline or too acid with the level between 6.80-7.49. It achieves SNI 19-7030-2004 standard about compost specification from domestic organic waste. Then this research shows that by adding bioactivator of EM4 result of C/N Ratio, pH, water level, and temperature has fulfilled SNI 19-7030-2004 standard of compost specification domestic organic compost. The last, bioactivator molase addition produces high C/N ratio compared with the treatment to EM4 and EM4+molasse. The result shows that those which given bioactivator molase does not fulfil SNI 19-7030-2004 standard of compost specification from domestic organic waste.

**Introduction**

Waste still becomes classic problem for every country especially Indonesia. Big cities also have main problems. One of them is waste. There are kinds of waste, that is, organic, un-organic, and B3. Organic waste comes from human, animal and plant. The other sources of waste come from housing, markets, stalls, offices, public buildings, industries. Based on data from Cimahi city, the potency of organic waste in 2018 is about 783 m³/day or 153 ton/day. The big proportion of waste comes from housing that is about 63%. Actually, waste can be managed through some ways. One of them is through making an organic compost from organic waste. Organic compost does not give negative impact to the environment because it uses bioactivator process. This makes quick process and does not spread bad smell [2].

Besides that, compost can maintain the fertilizer of soil. Decomposition from organic waste produces rich elements needed by plant. It is good for fertilizer and recovery of soil condition compared with chemical compost. Viewed from its characteristics, waste in Cimahi Regency has enough potency which providing organic compound to build energy power and compost materials. In order to improve the fertility of soil, compost should contain good quality of microorganism. Organic waste does not directly change into compost. It is because the chain structure requires long process to be simple components. Therefore, natural compost needs times for about 2-3 month, even; 6-12 depends on the basic materials.
Composting process of organic material used as TPST 3Rcompost management. It applies open windrow as open system and gives natural oxygen without adding bioactivator and weathering process until to be compost which requires 6 months. To make quick composting, it needs bioactivator selection [3]. Bioactivator can be applied to accelerate plant decomposition process or organic materials used in making compost.

Prof. Teruo Higa from Universitas Ryukyus Japan found EM4 (Effective microorganism 4). This EM4solution contains effective fermentation microorganism to accelerate fermentation in organic materials. This microorganism gives good influence to compost quality. Meanwhile, the supply of nutrient elements in compost is very influenced by long time needed by bacteria to degrade waste and has power to maintain nutrient element in the soil.

Microorganism needs nutrition to live which molasse contains high nutrition for microorganism need. This can be used as an alternative material for energy in fermentation media. Energy source is beneficial to microorganism cell growth[4]. Material variation addition of bioactivator needs a comparison to give appropriate quality of compost based on SNI19-7030-2004 standard.

Composting can use an easier cheaper efficient technology. One of them is waste recycle technology to make high valuable compost fertilizer using Takakura method. This method is composting process with aerobe technique. It also has some excellences compared with other method. This research to learn more about the differences quality of compost to addiction bioactivator effective microorganism 4 (EM4), molasses, and EM4+molasses

Subjects and Methods

This is an experiment research of posttest only control group design. This study used aerobic composting methods using tatakura baskets. By providing 4 composters to be researched in the form of 1 composter as a control (without treatment) control experiment (KK) and 3 composters given the addition of bioactivators (EM4, Molasses and EM4+molasses) Experiment 1 (K1), Experiment 2 (K2), Experiment 3 (K3).

The sample of this research is housing organic waste at TPST 3R Melong Asih Cimahi collected from society. It is done through some steps, namely preparation by providing materials and tools, experiment implementation that is observation and last step by giving experiment result to Laboratorium Argo Kimia Lembang.
Results

Table 1: Compost pH

<table>
<thead>
<tr>
<th>Group</th>
<th>pH (6.80-7.49)</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>KK</td>
<td>7.57</td>
<td>Ineligible</td>
</tr>
<tr>
<td>K1</td>
<td>6.86</td>
<td>Qualify</td>
</tr>
<tr>
<td>K2</td>
<td>7.34</td>
<td>Qualify</td>
</tr>
<tr>
<td>K3</td>
<td>7.16</td>
<td>Qualify</td>
</tr>
</tbody>
</table>

Based on Table 1 of compost pH measurement results it was found that control group is not appropriate with SNI 19-7030-2004 standard, with a pH of 7.57 is more alkaline than the pH measurement of compost in the groups Experimental 1 (K1), groups Experimental 2 (K2) and Experimental 3 (K3).

While the results of the analysis of fermentation shows that the addition of bioactivator EM4 (K1), the addition of molasses bioactivators experiment group2 (K2) and the addition between EM4+molasses experiment group3 (K3) to the degree of timeness (pH) exerts an influence. Where during the initial pH monitoring process composting shows a low pH where the pH indicates that the pH is acidic and over time shows a near-neutral pH.

Table 2: C/N Ratio

<table>
<thead>
<tr>
<th>Group</th>
<th>C-Organic (9.8-32%)</th>
<th>Nitrogen (0.4%-∞)</th>
<th>C/N Ratio (10-20)</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>KK</td>
<td>35.66</td>
<td>1.32</td>
<td>27.01</td>
<td>Ineligible</td>
</tr>
<tr>
<td>K1</td>
<td>24.16</td>
<td>1.23</td>
<td>19.64</td>
<td>Qualify</td>
</tr>
<tr>
<td>K2</td>
<td>30.82</td>
<td>1.37</td>
<td>22.49</td>
<td>Ineligible</td>
</tr>
<tr>
<td>K3</td>
<td>22.31</td>
<td>1.18</td>
<td>18.90</td>
<td>Qualify</td>
</tr>
</tbody>
</table>

The results of the measurement of the C/N ratio of the compost based on Table 2 data of the results of C/N compost content creation above, the result of K1 (experiment 1) with result 19.64 and K3 (experiment 3) with a yield of 18.90% where the result of index (Qualify) which is on SNI 19-7030-2004.

WasteKk (Control experiment) and K2 (experiment 2) group is Ineligible showed high C/N ratio. The high C/N ratio indicates that the carbon value in the compost is still high. The high carbon value indicates that the composting process has not been completed. When the composting process is completed, the value of carbon will decrease as carbon is degraded due to the use of nutrient sources by bacteria to process other organic materials. The decrease in the carbon value will affect the C/N ratio, so the lower the carbon value; the lower the C/N ratio will also be lower, because the value of the carbon with the value of the C/N ratio is directly proportional. Must be taken down. The speed at which an ingredient becomes composting is influenced by the C/N content the closer C/N the soil then the faster the material becomes compost. Good farmland contains Element C and a balanced one. Each organic ingredient has a different C/N content [5].
If the C/N ratio is high, the activity of microorganisms will decrease. In addition, several cycles of mycism are required to complete the degradation of compost material so that the composting time will be longer and the resulting compost will be of low quality. A higher C/N ratio will be composting rates to decrease. a higher C/N ratio can cause the concentration of nitrogen elements in the soil to decrease as the activity of soil organisms tends to consume nitrogen for its growth.

Table 3: Compost Water Level

<table>
<thead>
<tr>
<th>Group</th>
<th>Water Level (0-50%)</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>KK</td>
<td>10,45</td>
<td>Qualify</td>
</tr>
<tr>
<td>K1</td>
<td>32,27</td>
<td>Qualify</td>
</tr>
<tr>
<td>K2</td>
<td>30,66</td>
<td>Qualify</td>
</tr>
<tr>
<td>K3</td>
<td>35,55</td>
<td>Qualify</td>
</tr>
</tbody>
</table>

Based on table 3 the results of the compost water content measurement results of the control group (KK) is 10.45% where these results were lower than the Experimental group 1 (K1 group ) with 32.27%, result experimental group 2 (K2 ) with a result of 30.66% and Experiment group 3 (K3) with a result of 35.55% where these results appropriate with SNI 19-7030-2004 standard specification of compost from domestic organic waste.

The water content in the compost has met the SNI standard where the water content of the treatment in this study shows the water content without treatment tends to be the lowest in control treatment (KK) which is 10.45% compared to other treatments. While the highest water content in experiment3 (K3) treatment was 35.55%. The range must be maintained to obtain the largest number of microorganism populations, because the larger the population the faster the decomposition process. When water levels increase to more than 50% the process becomes anaerobic. The anaerobe process will produce compounds such as organic acids, ammonia and H2S will produce an unpleasant odor.

Decreased water content in compost according to Alpandari (2015) decreased water content during composting process due to evaporation of water into gas due to the activity of microorganisms[6].

Table 4: Compost Temperature

<table>
<thead>
<tr>
<th>Group</th>
<th>Temperature &lt;30°C</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>KK</td>
<td>23,5</td>
<td>Qualify</td>
</tr>
<tr>
<td>K1</td>
<td>26,1</td>
<td>Qualify</td>
</tr>
<tr>
<td>K2</td>
<td>24,4</td>
<td>Qualify</td>
</tr>
<tr>
<td>K3</td>
<td>25,8</td>
<td>Qualify</td>
</tr>
</tbody>
</table>

Based on table 4. of the compost temperature measurement data above, the results of the control group (KK) were obtained with results of 23.5°C where these results were lower than the K1 group experimental group 1 (K1) with results of 26.1°C, Experimental group 2 (K2) with results of 24.4°C and Experiment group 3 (K3) with results of 25.8°C where these results appropriate with SNI 19-7030-2004 standard specification of compost from domestic organic waste.
In this study the lowest temperature was at the beginning of composting because the microbes that existed have not shown their activity also occurred at the end of the decomposition because microbes have already decumulated most of the organic material. The temperature of mature compost is close to the temperature at the beginning of composting, from the results of the study obtained the temperature and the final temperature of composting is close so it can be concluded that the compost is physically mature. The rate of temperature rise varies with each treatment. The bio activator will make the microorganisms in the compost more active. High activity is shown by the increase in temperature, At the end of composting there is a temperature stability that ranges from 26-27°C. This temperature is the same as the soil temperature and has complied with the requirements of mature compost.

In the event of the decomposition of highly active organic matter, the microbes in the compost will decipher the organic matter into NH moisture and heat through the metabolic system with the help of oxygen. After most of the material has decomposed, the temperature will gradually decrease until it reaches normal temperatures such as soil [7].

Discussion

Based on table1 data of compost pH measurement result above, it is collected from control group shows that does not fulfil compost quality standard (ineligible) with the result pH 7.57. This number is not appropriate with SNI 19-7030-2004 standard about compost specification from domestic organic waste. The control group does not fulfil the requirement because decomposition process of organic waste still in the process. It is too alkaline to be compost because it is still raw. In high pH, it happens nitrogen loss because of volatilization. This is the result of simple organic acids from former decomposition converted into methana dan CO2 by bacteria forming methana [9]. pH from control group becomes too alkaline which does not get treatment. Meanwhile, the theory explains that if the soil has alkaline (pH>7.0) usually it contains high calcium, so it happens fixation to fosfat and plant in alkaline soil often experiences deficiency P. If solution increase, in other sides Pospor will be supplied for plant between 6,0 hingga 7,0 pH.

Meanwhile, the analysis result from bioactivator EM4 (the first group), bioactivator molase (the second group) addition and affition between EM4+molase (the third group) to the acid level (pH) gives influence. During observation process early pH of composting shows low pH which means acid approaching to neutral level. The compost experience reduction of pH in the early composting process so that pile pH becomes acidic. This happens because in the early composting there is material decomposition of complex organic material that is reactive like sugar, powder, carbohydrate, fat to be simple organic acid.

The result of content measurement of C/N Compost N ratio from the result of control group is about 27, 01. However, the second experiment group gives result 22, 49. It means that the result is higher which categorized as unfulfillment standard (Ineligible). It can be compared with the first experiment group with the result 19,64. The last, the third experiment group shows result 18,90which achieves standard (qualify) refers to SNI 19-7030-2004 of compost specification from domestic organic waste. The Control experiment group and the second experiment group show high C/N Ratio.
The value of high C/N ratio indicates that carbon level in the compost is still high. The height of carbon value shows that composting process does not finish. When the composting process finished the carbon value slowly reduced. The carbon is degraded as the result of becoming nutrient source by bacteria to cultivate other organic material. According to Sudrajat, carbon level will influence C/N ratio, so that the lower carbon value the lower C/N ratio. Carbon value is comparable with the of C/N ratio which should be reduced. The acceleration of material to be compost influenced by C/N content close to soil C/N. These materials will be quicker to be compost. Good soil contains balanced C element. Every organic material has different C/N contents [5].

Otherwise, if C/N ratio is high, microorganism activity will reduce. Besides that, it needs some microorganism cycle to solve degradation of compost material in order to be long composting and low quality. Higher C/N ratio will cause composting process decrease. Those which have higher C/N ratio can cause nitrogen element concentration in the soil reduced because soil organism activity tends to spend nitrogen to grow.

Based on table 3 above, data of the study of compost water level show that the result from control group is 10.45% which is lower than the first experiment group, that is, 32.27%. The second experiment group is 30.66%, and the third experiment group is 35.55% which fulfill standard refers to SNI 19-7030-2004 of compost specification from domestic organic waste.

Water contents in compost has fulfilled water level of compost which has fulfilled SNI standard. The treatment in this research shows that water content without treatment tends to be the lowest in control group namely 10.45% compared with other treatment. Meanwhile the highest level of water content in the treatment of the third group (EM4+molase) is about 35.55%. The number should be maintained to get amount of the biggest microorganism population. That is why, the bigger population the quicker decomposition process. If the water content increases to be more than 50%, the process will become anaerobe. Anaerobe process will produce compound like organic acids, ammonia and H2S which give bad smell. According to Alpandari (2015), the decrease of water level in compost during the composting process is caused by water evaporation to be gas as a result of microorganism activity [6].

From table 4 it can be seen data of the result of compost temperature from control group, that is, 23.5°C which means lower than the first experiment group namely 26.1°C. The second experiment group is 24.4°C, and the third experiment group is about 25.8°C. The results fulfill standard refers to SNI 19-7030-2004 of compost specification from domestic organic waste.

In this research, the lowest temperature happens in the early composting because the existence of microbe has still not shown its activity yet. It is the same with the end of composting because the microbe has composted most part of organic materials. The ripe/ready compost temperature closes to early composting time. From the result of the research it shows that early temperature and last one of composting is close. It means that the compost has been ready to use. The up-down level of temperature differs in every treatment. The existence of bio activator will influence microorganism more active. The high activity shows the increase of temperature. At the end of composting, there is stability of temperature between 26-27°C. This temperature is the same with soil temperature which has been appropriate with ripe/ready compost.
During active composting of organic material, the microbas in compost will compose organic material to be NH water evaporation and hot through metabolism systems with the oxygen help. After most part of material has been composted, so the temperature will slowly reduce back into normal as soil [1].

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