# Addition of Local Microorganisms (MOL) Organic Waste as Compost Bioactivator

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# Addition of Local Microorganisms (MOL) Organic Waste as Compost Bioactivator



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**Abstract.** Waste is a crucial problem because it causes serious impacts in terms of social, economic, cultural, and environmental aspects. With the dominance of organic waste in the composition of waste in Indonesia, there is a potential to recycle organic waste into useful products, namely compost. Composting occurs naturally so it takes a long time and is slow, therefore bio activators such as local microorganisms (MOL) are needed that can accelerate the decomposition of organic waste. The purpose of this study was to determine the effect of the use of MOL on the quality of the compost. This research method is experimental with two treatments, the first treatment with the addition of MOL and the second treatment without MOL. The results showed that the quality of compost with the addition of MOL were temperature 30ºC, pH 7.4, moisture content 47.01%, C/N ratio 9.55%, phosphate 0.208%, potassium 0.027%. Meanwhile, the quality of compost without the addition of MOL were temperature 31ºC, pH 7, water content 63.49%, C/N ratio 10.54%, phosphate 0.080%, potassium 0.015%. Compost with the addition of MOL was better because it met the criteria set by SNI No. 19-7030-2004 compared to compost without MOL.

## 1. Introduction

Waste production that continues to increase along with population growth, inefficient processing technology, and limited landfill are the main problems in big cities in Indonesia. Waste can be sourced from households, offices, commerce, markets, and public facilities. According to SIPSN data in 2021, the composition of the types of waste mostly came from food waste at 30.01% (45.843,121 tons), followed by plastic at 15.73% (24,031,572 tons), wood and twigs at 12.5% (19,096). 400 tons), paper/cardboard 11.93% (18,226,625 tons), metal 6.33% (9,671,948 tons), fabric 6.04% (9,227,635 tons), glass 5.9% (9,015. 705 tons), rubber/leather 3.29% (5,025,214 tons), and others 8.27% (12,636,054 tons) [1]. From these data, it can be seen that organic waste dominates the composition of waste types.

Processing of solid waste in the form of vegetables needs to be done, one way to treat solid waste is by making compost. Compost is organic fertilizer, the use of organic fertilizer is very widely used because it has 3 advantages, namely: benefits for the environment, soil, and plants. Compost is very helpful in solving environmental problems, especially waste. The raw material for composting is garbage, so the problem of house waste and municipal waste could be overcome [2].

Composting is the process of weathering organic materials biologically by microbes. The success of making compost can be judged by the length of time of composting, the faster the compost is produced the higher the success rate. Compost can form naturally, but it will take quite a long time, which is 2-3 months. Some reach 6-12 months, depending on the organic material used. Therefore, various treatments need to be applied to speed up the composting time [3]. Several things must be considered to accelerate the composting process, including the selection of bio activators.

One of the bio activators in composting is Local Microorganisms (MOL). MOL is a liquid made from natural organic ingredients. MOL contains a collection of microorganisms that help speed up the process of decomposition of organic matter to shorten the composting time. This type of microbe can be cultured using various sources of organic matter. Vegetable waste can be a source of organic matter and a good medium for the proliferation of decomposing microorganisms and can be used as a bio activator [4]. Making a MOL is done by adding brown sugar as a source of glucose/bacterial energy and rice washing water as a source of carbohydrates. The materials are stirred until homogeneous and placed in a closed bath. Then fermented for 14 days in an aerobic process [5].

Many studies regarding the use of MOL as a bio activator in composting. Among them is a study conducted by Suwatanti et al (2017), with the title "Utilization of Vegetable Waste MOL in the Compost Making Process". The results of the study showed that the physical quality of the compost in both treatments (MOL vegetable waste and EM4) had a blackish color category, a soil-like odor, and a fine texture according to the criteria of SNI 19- 7030-2004. However, the C/N ratio of compost using MOL vegetable waste is better because it meets the criteria set by SNI compared to compost using EM4 [4]. There is another study conducted by Sipayung (2019), entitled "Composting Using Garden Waste and Goat Manure with Vegetable Waste Mole". The results of this study indicate that the addition of MOL to vegetable waste has a significant effect on the performance and yield of composting. This was indicated by the compost that was ripe in the MOL addiction treatment with a C/N ratio that met SNI 19 – 7030 – 2004, while in the treatment without the addition of MOL (control) the compost was immature and did not meet SNI 19 – 7030 – 2004 [6]

From the description above, it is necessary to research the addition of fruit waste-based MOL bio activator in composting organic waste. The purpose of this study was to compare the parameters of the compost quality with the addition of MOL with the quality standards of SNI 19-7030-2004 concerning Compost Specifications from Organic Waste.

## 2. Methodology

### *2.1. Tools and Materials*

The tools needed are used cardboard, plastic, shovels, mineral water bottles, knives, cutting boards, basins, paint buckets, blenders, measuring cups, scales, and wooden storage. While the materials used are 8 liters of rice washing water, 2 liters of coconut water, 2 ounces of brown sugar, and 2 kg of organic waste as the basic ingredients for making local microorganisms (MOL), as well as husks and other organic waste as the main composting material.

### *2.2. Preparation Stage*

The stages in the manufacture of a local microorganism (MOL) bio activator are as follows:

#### *2.2.1. Preparation stage*

1) Prepare the tools and materials needed.
2) Chopping 2 kg of organic waste, then smoothing the chopped organic waste with a blender.
3) Chop 2 ounces of brown sugar with a knife and cutting board.
4) Measure 2 liters of coconut water and 2 liters of rice water using a measuring cup.

#### *2.2.2. Stage of manufacture*

1) Put the crushed organic waste into the paint bucket.

2) Put the chopped brown sugar into the paint bucket.
3) Put 2 liters of coconut water and 8 liters of rice water into the paint bucket.
4) Stir all ingredients by hand to mix evenly.
5) Close the paint bucket tightly so that no air enters.
6) Open the paint bucket every day for 2 weeks to release the fermented gas from getting trapped in the bucket.

*2.3. Organic Waste Treatment*

After the manufacture of local microorganisms (MOL) is completed, local microorganisms (MOL) will later be mixed with husks and other organic waste as the main ingredients for composting in wooden storage. The composting material is mixed in layers, the first layer is compost and the second layer is filled with chopped waste. The collected waste is then stirred until smooth. Then, a local microorganism (MOL) was added as a bio activator to speed up the compost decomposition process and stir until smooth. After thoroughly mixed, then the garbage is covered with a layer of husk so that the garbage does not cause a strong odor.

The analysis and observations carried out in this study were the physical quality of the compost which included color, odor, texture, determination of pH, temperature, and percentage of water content, as well as the chemical quality of the compost which included fluctuations in the content of C/N, phosphorus, and potassium.

## 3. Result and Discussion

*3.1. Compost Physical Quality*

Observation of the physical quality of compost refers to the criteria of SNI: 19-7030-2004, namely compost produces an odor like the smell of earth because it already contains soil nutrients, black color due to the impact of stable organic matter, and smooth compost texture due to the decomposition of microorganisms.

**Table 1.** Compost Physical Quality

| Treatment | Color | Smell | Texture |
|---|---|---|---|
| Control | Black | Earthy Smell | Smooth |
| Local Microorganism (MOL) | Black | Earthy Smell | Smooth |

At the beginning of composting, the compost is blackish green and over time it will resemble the color of black soil. The color in the composting process of vegetable waste without and with the addition of MOL is in accordance with the established standard, namely SNI 19-7030-2004, which is black. During observations, reversal and watering were carried out every 3 days to keep the decomposing bacteria alive. Entering the 2nd week, the color of the compost with the addition of MOL is dark brown, the texture is loose, loose, and smells of earth. Meanwhile, organic fertilizer without the addition of MOL bio activator is brown, has an earthy smell, and has a crumb texture but is coarser.

### *3.2. Compost Chemical Quality*

#### *3.2.1. Determination of pH, Temperature, and Percentage of Moisture Content*

**Table 2.** Temperature, pH, and Percentage of Moisture Content in Compost

| Date | Variable | pH | Temperature (°C) | Moisture Content |
|---|---|---|---|---|
| May 31st, 2022 | Control | 8.6 | 29 | 92.04 |
| | MOL | 6.2 | 30 | 80.78 |
| June 2nd, 2022 | Control | 6.8 | 29 | 67.27 |
| | MOL | 6.9 | 29 | 77.4 |
| June 6th, 2022 | Control | 7 | 29 | 71.85 |
| | MOL | 7.3 | 29 | 66.41 |
| June 8th, 2022 | Control | 7.4 | 31 | 65.05 |
| | MOL | 7.3 | 30 | 42.06 |
| June 10th, 2022 | Control | 7 | 30 | 61.17 |
| | MOL | 7.3 | 30 | 60.94 |
| June 13th, 2022 | Control | 7 | 31 | 63.49 |
| | MOL | 7.4 | 30 | 47.01 |

In the composting process without the addition of MOL, the first measurement has an alkaline pH, while the composting with the addition of MOL is acidic. The pH during composting increases from acid/base to neutral. The increase and decrease in pH is a marker of the activity of microorganisms in the decomposition of organic matter. At the beginning of composting, acid-forming bacteria will lower the pH so that the compost is more acidic. Furthermore, microorganisms begin to convert inorganic nitrogen into ammonium so that the pH increases rapidly to become alkaline. Some of the ammonia is released or converted into nitrate and nitrate is denitrified by bacteria so that the pH of the compost becomes neutral [7]. The pH measurement results on the 14th day reached the pH value of the compost with the addition of MOL of 7.4, while the pH value of the compost without the addition of MOL was 7. It could be concluded that both of them had met the SNI standard. 14-7030-2004, namely the pH value of 6.8-7.49 [8].

The temperature in the composting process of vegetable waste without the addition of a MOL bio activator and with the addition of a MOL bio activator always changes throughout the measurement. This situation indicates that the decomposition process has begun because several bacteria convert organic waste into simpler materials that are easily absorbed by plants, where the higher the temperature, the more oxygen consumption and the faster the decomposition process of waste. Furthermore, in the next measurement, the temperature decreased because the organic matter described in the compost had begun to decrease and began to shrink. During the aerobic composting process there are 2 phases consisting of a mesophilic phase that occurs at a temperature of 23°C-45°C and a thermophilic phase at 45°C-65°C. The ideal temperature for a compost heap is 55°C-65°C because at that temperature the optimal proliferation of microorganisms so that the population is good and produces the most effective enzymes in the decomposition of organic matter. Meanwhile, according to the criteria of SNI 14-7030-2004, the ideal temperature for the composting process has a maximum value of 50°C. Based on the above criteria, it can be seen that the composting process in this study has not yet reached the ideal stage in the formation of compost because the temperature that occurs is only between 29°C-31°C. In this composting process, the two treatments did not reach the temperature for the thermophilic phase which

could be caused by the amount of organic matter that was not high enough and affected the temperature of the compost pile.

The highest humidity occurs in composting with MOL reaching 80,78%. Humidity greater than 60% will decrease oxygen supply and nutrients are leached, consequently, microbial activity will also decrease. Decreased microbial activity will cause the composting process to run slower. However, this can be overcome by reversing the compost pile, so that air can supply oxygen for the composting process and reduce the moisture of the material [9]. In the following days, from 80,78% to 66,41% on the 7th day, and likewise on the following days, the humidity drops until the compost has matured. In the second week, compost with MOL reached a moisture content of 47.01% while compost without MOL reached a moisture content of 63.49%. It can be concluded that only compost with MOL meets the standards of SNI 14-7030-2004, namely the maximum moisture content of 50%.

*3.2.2. Fluctuations of C/N Content*

The following are the results of laboratory tests for fluctuations in the C/N content of the compost samples taken on June 6 and 13, 2022. The C/N ratio describes the maturity level of the compost. The higher the C/N value, the higher the amount of ammonia and nitrogen trapped in the pores of the compost pile so that the compost is declared to have not decomposed completely.

**Table 3.** C/N Fluctuations in Compost

| C/N Fluctuations | | |
|---|---|---|
| Date | Control (%) | Local Microorganism (MOL) (%) |
| June 6th, 2022 | 12.900 | 10.54 |
| June 13th, 2022 | 9.76 | 9.55 |

The higher the value of the C/N ratio in the compost indicates the compost has not decomposed completely or has not yet matured, due to a large amount of ammonia and nitrogen trapped in the pores of the compost pile. Based on the laboratory data and observations above, all samples of pure compost and those using local microorganism activator (MOL) have met SNI number 19-7030-2004 with a percentage below 20%, but compost using local microorganism activator (MOL) has the lowest percentage occurred on the 14th day, which was 9.55%, which means that it experienced a more complete decomposition.

*3.2.3. Fluctuations of Phosphorus Content*

The following are the results of laboratory tests for fluctuations in phosphorus content of compost samples taken on June 6 and 13, 2022. Based on the SNI 19-7030-2004 document regarding compost specifications from domestic waste, the quality standard for phosphorus content in compost is that it has a higher percentage value of 0,1%. This is because the weathering or decomposition process that occurs in the compost material causes the phosphorus content to be high. At the compost maturation stage, the microbes will die and the phosphorus content in the microbes will be mixed with the compost material, thereby increasing the phosphorus content in the compost.

**Table 4.** Phosphorus Fluctuations in Compost

| Phosphorus Fluctuations | | |
|---|---|---|
| Date | Control (%) | Local Microorganism (MOL) (%) |
| June 6th, 2022 | 0.080 | 0.080 |
| June 13th, 2022 | 0.584 | 0.208 |

On day 14, the laboratory results stated that the two compost samples were in accordance with the quality standard of phosphorus in the compost which indicated that decomposition had occurred with higher concentrations. The highest phosphorus content was found in control samples or in composting without an additional activator. Meanwhile, the compost sample with a local microorganism activator (MOL) has phosphorus content with the lowest percentage concentration of 0.208%.

*3.2.4. Fluctuations of Potassium Content*

The following are the results of laboratory tests for fluctuations in the phosphorus content of compost samples taken on June 6 and 13, 2022. Based on the SNI 19-7030-2004 document regarding compost specifications from domestic waste, the quality standard for potassium content in compost is that it has a higher percentage value of 0,2%. The microbes in the starter use potassium for their activities and the decomposition process of organic matter is simpler during the composting process and will produce elemental potassium.

**Table 5.** Potassium Fluctuations in Compost

| Potassium Fluctuations | | |
|---|---|---|
| Date | Control (%) | Local Microorganism (MOL) (%) |
| June 6th, 2022 | 0.007 | 0.015 |
| June 13th, 2022 | 0.035 | 0.027 |

It can be observed that from the laboratory data on day 7 and day 14 there is no calculation of the potassium concentration in the compost sample that reaches the quality standard. With the final result, the smallest percentage of potassium concentration is in the compost sample using a local microorganism activator (MOL) which is 0.027% and the highest percentage of potassium concentration is in the pure compost sample or without an activator, namely 0.035%.

Compost with the addition of MOL made for 14 days showed a change in color, texture, and smell of the compost that had started to cook according to SNI 19-7030-2004 which was blackish brown, textured, and smelled like dirt, the ratio of C/N was 9,55% which is greater than compost without MOL. This is in accordance with previous research by Suwatanti et al (2017) which had the same research results with a C/N ratio of 14.13%. This shows that the organic waste compost product with the MOL of fruit waste in this study is still in the quality range which is not much different from the results of other studies.

Judging from the results of the study, composting with fruit waste-based MOL is effective in accelerating the composting process, which in this study. Compost forms naturally, but it will take quite a long time, which is 2-3 months. However, using this fruit waste-based MOL, composting can be shortened, and in this study, the fastest time obtained was 14. However, even so, the quality of compost produced from composting with MOL is good and in accordance with SNI 19- 7030-2004.

## 4. Conclusion

In this study, local microorganisms (MOL) were used as activators in making compost. A local microorganism bio activator (MOL) is useful for accelerating the decomposition process, improving compost quality, and providing additional nutrients for plants. The materials used in the manufacture of local microorganisms (MOL) are a mixture of 8 liters of rice washing water, 2 liters of coconut water, 2 ounces of brown sugar, and 2 kg of organic waste.

The addition of local microorganisms (MOL) to compost according to laboratory tests proved that local microorganisms (MOL) were proven to be effective in compost decomposition as evidenced by an odor like the smell of earth because it already contained soil nutrients, blackish color due to the impact of stable organic matter, and a good texture of compost. smooth due to the decomposition of microorganisms.

The addition of local microorganisms (MOL) also makes the compost sample contain phosphorus in accordance with quality standards which illustrates that decomposition has occurred with higher concentrations. In addition, local microorganisms (MOL) also caused a more complete decomposition of ammonia and nitrogen in the compost, which was indicated by the compost sample added with local microorganisms (MOL) reaching the lowest percentage of C/N content at day 14 of 9.55%. Meanwhile, in the potassium content test, neither the control sample nor the sample with the addition of local microorganisms (MOL) matched the quality standard, which had a percentage value higher than 0.2%. The compost sample using a local microorganism activator (MOL) was 0.027% and the highest percentage of potassium concentration was found in pure compost samples or without a bio activator, namely 0.035%.

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**References**
[1] SIPSN 2021 *Sistem Informasi Pengelolaan Sampah Nasional* Menlhk
[2] Febria F A, Rahayu S 2021 *Development of Local Microorganism from Organic Waste as an Alternative Product for EM4* IJPSAT 30(1) 98-105
[3] Suwahyono U 2018 *Cara Cepat Buat Kompos Dari Limbah (3rd Ed)* Penebar Swadaya: Jakarta Timur
[4] Suwatanti E P S, Widiyaningrum P 2017 *Pemanfaatan MOL Limbah Sayur pada Proses Pembuatan Kompos* J MIPA 40(1) 1-6
[5] Said M I et al 2020 *Quality of Compost Produced from Different Types of Decomposer Substrate and Composition of Straw* IOP Conf. Ser.: Earth Environ. Sci. 492 012088
[6] Sipayung H D 2019 *Pembuatan Kompos Menggunakan Sampah Taman Dan Kotoran Kambing Dengan Mol Limbah Sayur* USU Repository Skripsi Sarjana: Sumatera Utara
[7] Astari L P, Salundik, Siagian P H 2011 Kualitas pupuk kompos bedding kuda dengan menggunakan activator mikroba yang berbeda IPB Repository Undergraduate Thesis: Bogor
[8] BSN 2004 *Spesifikasi Kompos dari Sampah Organik Domestik* SNI 19-7030-2004
[9] Yulianto A B, Ariesta A, Anggoro D P, Heryadi H, Bahrudin M, and Santoso G 2009 *Buku Pedoman Pengolahan Sampah Terpadu : Konversi Sampah Pasar Menjadi Kompos Berkualitas Tinggi* Yayasan Danamon Peduli: Jakarta
[10] Surtinah 2013 *Pengujian Kandungan Unsur Hara Dalam Kompos yang Berasal Dari Serasah Tanaman Jagung Manis (Zea mays saccharata)* J Ilm Pertan 11(1): 16-26

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