

# The study of tong composter in produced liquid organic fertilizer

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<p><b>Manuscript History</b></p> <p>Received 17-03-2021</p> <p>Revised 08-04-2021</p> <p>Accepted 19-04-2021</p> <p>Available online</p>	<p><b>Abstract.</b> Inadequate processing of waste in household areas has resulted in many people throwing the waste anywhere. Waste generation can be managed by using the composting method; one of them is the Tong Composter. Tong Composter is a composting method that uses a bio-activator; one of the bio activators commonly used is an EM4 bio-activator. <b>Objectives:</b> This research objective is to determine whether the liquid organic fertilizer parameters produced comply with the standard of Ministerial Decree of Agriculture No. 261 of 2019. <b>Method and results:</b> This research using the experimental method with two treatments, the different dosage of EM4 dosage (60 ml and 70 ml) and fermentation time (10 days and 20 days). Toward the liquid organic fertilizer produced, several parameters were analyzed, such as pH, Nitrogen, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O parameter. The laboratory result will be tested using the t-test. Results show that The pH means content obtained in Treatment 1 was 4.085, Treatment 2 was 4.305, Treatment 3 was 5.04, and Treatment 4 was 5.135, indicating that the longer the fermentation time factor and different EM4 dosage used, the higher the pH value. Whereas on the nitrogen mean, the results shown are decreasing with each treatment. In Treatment 1 it was 0.124%, Treatment 2 was 0.108%, Treatment 3 was 0.073%, and Treatment 4 was 0.065%. Then on the phosphorus results, the highest mean value was obtained in Treatment 3 and Treatment 4, respectively 0.0275% and 0.024%. The highest results showed on the 20th day for potassium parameters, namely in Treatment 3 and Treatment 4 of 0.2775% and 0.273%. <b>Conclusion:</b> The t-test result showed that only the pH was complied with the standard, while the Nitrogen, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O parameters have not complied with the standard of Ministerial Decree of Agriculture No. 261 of 2019.</p>
<p><b>Keywords</b></p> <p>Tong Composter; EM4; Liquid Organic Fertilizer; Organic Waste; Household Waste</p>	

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## 1 Introduction

In Indonesia, waste has become a common issue among stakeholders and community groups [1]. The Central Statistics Bureau in 2019 estimated that Indonesia's waste generation reached 67 million tons [2], with the total population reached 268 million people [3]. The waste generation reached 67.8 million tons in 2020 and will continue to rise alongside population growth [6]. If the amount of waste produced is assumed to be the same, the amount of waste that will rise in 2025 will be 5,928,386 tons, with 284.83 million people [4].

The Indonesian Marine Debris Hotspots Rapid Assessment study for 2018 estimated that 63.18% of Indonesian urban waste is dominated by organic waste [5]. Statistical data from the Ministry of Environment and Forestry in 2017 recorded that 57% of waste generation in Indonesia is organic waste such as food waste, twigs, and leaves, 36% of which comes from household waste [6].

In 2017, 66.39% of composition waste was discarded into the landfill and only utilized or managed by just 14 percent [6]. More than half of households use non-environmentally sustainable approaches when handling their waste [7], 53% by burning, 5% throwing in rivers or gutters, and 2.7% throwing in a random spot. It will cause pollution and other environmental damage. It is crucial to encourage more waste management in the household because, eventually, it would reduce the volume of waste disposed of in the landfill [8] to prevent pollution and environmental damage [7].

Referring to Law No 18 of 2008 on Waste Management, the reuse of organic waste into compost effectively reduces the amount of waste produced from its source [9]. The composting process is a decomposition process conducted against organic material by microorganisms [10]. Composting results can be solid compost or leachate. Leachate produced from the composting process can be used in the composting process as a liquid organic fertilizer or recirculated because it provides sufficient nutrition in the composting process for decomposing bacteria [10].

There are many benefits of using liquid organic fertilizers compared to solid organic fertilizers, including [11]:

1. Application simpler
2. More quickly, plants absorb the nutrients
3. It includes seldom occurring microorganisms in solid organic fertilizers

A tool that can be made liquid organic fertilizer is called a composter. The household scale can use a composter with a capacity of 20-60 liters [12].

*Tong* Composter is one of the composter methods to minimize the organic household waste that becomes liquid organic fertilizer [13]. In the *Tong* Composter method, solid organic fertilizer (compost) and liquid organic fertilizer (leachate) are the products of the composting process [13]. Bio-activator is the essential material in the *Tong* Composter; bio-activator acts as an inhibitor of soil pest and plant disease growth and improves the quality of organic fertilizers produced [14].

EM4 is a form of bio-activator widely used in the composting process of organic fertilizer [14]. EM4 is a mixture of microorganisms that are beneficial [15]. Agricultural EM4 also promotes the production of other microorganisms beneficial to plant growth, such as nitrogen-fixing bacteria, phosphorus-limiting bacteria, and microbes, in addition to decomposing organic matter [16].

At least 60 types of nutrients are required by plants, of which three components or compounds are macro-nutrients essential for plants to grow, such as Nitrogen, Phosphorus ( $P_2O_5$ ), and Potassium ( $K_2O$ ) [17].

According to the Minister of Agriculture Decree Number 261 of 2019, the quality liquid organic fertilizers is as follows [18]:

**Table 1.** Standard of Liquid Organic Fertilizer

No.	Parameter	Unit	Liquid Organic Fertilizer
1.	C-organic	%	minimum of 10
2.	Macronutrient N + P <sub>2</sub> O <sub>5</sub> + K <sub>2</sub> O	%	2 – 6
3.	N-organic	% (w/v)	minimum of 0.5
	Micronutrient		
	Fe total	ppm	90 – 900
	Mn total	ppm	25 – 500
4.	Cu total	ppm	25 – 500
	Zn total	ppm	25 – 500
	B total	ppm	12 – 250
	Mo total	ppm	2 – 10
5.	pH	–	4 – 9

The waste used in each *Tong* Composter consists of 1 kg of fruit waste and 1 kg of vegetable waste. This research's objective was to determine whether the liquid organic fertilizer parameters produced comply with the standard of Ministerial Decree of Agriculture No. 261 of 2019.

## 2 Method

### 2.1 Population and Sample

This research's population is liquid organic fertilizer, with the samples are liquid organic fertilizer from *Tong* Composter. The research uses the quantitative approach, with an experimental method, and the sampling method used for collecting the liquid organic fertilizer is random. A random sample is a sub-set of units that are selected randomly from a population [19].

### 2.2 Data Collection Method

This research uses primary data. The collection of primary data of liquid organic fertilizer quality was taken through an experimental method by performing laboratory experiments. Experiments are defined as an investigation in which a hypothesis is scientifically tested [21]. The experimental period was conducted in November 2020.

In this research, the method used refers to previous research methods [20]. The research focuses on the quality of liquid organic fertilizer, especially in the essential macronutrient parameter for plant growth as fertilizer. The macro-nutrient parameter measured, such as Nitrogen,  $P_2O_5$ ,  $K_2O$ , and physical parameters such as pH [21]. Simultaneously, the independent variables of this experiment are the dosage of EM4 and the fermentation time.

### *2.2.1 Determine of Experimental Method*

Determining the experimental method is the first step in this research. This experiment has two treatments: the different variations of EM4 dosage (60 ml and 70 ml) and fermentation time (10 days and 20 days). To analyze the liquid organic fertilizer production, put 2000 g of organic waste in each *Tong*, then add the fermentation results of the bio-activator EM4, and 600 ml of brown sugar water solution. In each experiment, organic waste was added with different EM4 doses and carried out twice the experiment. In the first experiment, samples from each *Tong* were taken at 10<sup>th</sup> days with a dose of EM4 in treatment 1 is 60 ml, and treatment 2 is 70 ml For treatment 3 and 4, a dose of EM4 in treatment 3 is 60 ml, and in treatment 4 is 70 ml; each treatment was analyzed on the 20<sup>th</sup> day. The weight of organic waste, type of organic waste, and the volume of brown sugar water solution used in each treatment is kept the same so that the effect of different EM4 doses and fermentation time can be seen. The details of each experiment are shown in **Table 2**.

**Table 2.** Composition of Different Experimental Treatments.

Treatment	Organic Waste	Brown Sugar Water	EM4 Dosage	Fermentation Time
1	2000 g	600 ml	60 ml	10 days
2	2000 g	600 ml	70 ml	
3	2000 g	600 ml	60 ml	20 days
4	2000 g	600 ml	70 ml	

### 2.2.2 Preparation for Composting

There are two main preparations in this research, such as materials preparation and *Tong* Composter preparation. Material preparation includes collecting waste, buying the EM4, and deactivated EM4. At the same time, *Tong* Composter preparation is the design and setting up the *Tong* Composter before being used.

The organic waste was collected from Telaga Murni Residence because the waste from Telaga Murni Residence is not specific, but the waste used is unique from household waste. After collecting organic waste, organic waste is separated into fruit waste and vegetable waste. For each treatment, fruit and vegetable waste that has been collected is weighed each fruit (1000 g) and vegetables (1000 g). The waste is then cut into small pieces using a knife to facilitate the composting process.

The bio-activator used was EM4 from PT. Songgolangit Persada Jakarta, which is sold commercially as a bio-activator [22]. The newly purchased EM4 is still in a dormant state, activated by providing food and water. Activation is done by adding water and brown sugar (molasses) in each treatment. Heat 600 ml of water into a pot until it boils, and add 300 grams of brown sugar. Stir until the brown sugar dissolves, then cooled, filtered, and put into a bottle. Then the solution of EM4 and brown sugar water is fermented for five days at room temperature [23].

This study uses a composting method known as *Tong* Composter. *Tong* Composter is made of plastic; it has two sides separated by a bulkhead in it, which functions to separate solid waste from liquid organic fertilizer. When the liquid drips

into the lower chamber, the scent of garbage will be wasted through the ventilation holes gradually around the bottom side. Waste fermentation in the room does not cause a pungent odor when assisted by bio-activators to decompose the waste [13].



Fig. 1. Tong Composter

The *Tong* Composter was made by preparing four plastic *Tong* with a capacity of  $\pm 20$  liters, pipe  $\frac{1}{2}$  inch, hubcap  $\frac{1}{4}$  inch, hubcap 4 inch, hubcap  $\frac{1}{2}$  inch, four cable ties, bulkhead, and taps. The inside of the barrel is divided into two compartments with separated perforated fibers, the lower  $\frac{1}{3}$  as a container for the resulting liquid organic fertilizer, and the upper  $\frac{2}{3}$  as a place for the anaerobic decomposition of organic waste see in **Fig. 1**. [24]. In a  $\frac{1}{2}$  inch pipe, make a small hole to drain the methane gas. Make a hole in the middle of the composter *tong* to take the ripe, solid compost; the hole's diameter is made for a 4-inch hubcap. Approximately 5 cm from the top of the *Tong*, make holes on the left and right sides with the  $\frac{1}{4}$  inch pipe diameter using a drill. Followed by making four holes in the bottom  $\frac{1}{3}$  of the *Tong* with a pipe diameter of  $\frac{1}{4}$  inch; at the bottom of this, small holes are also made around the walls of the *Tong* to allow free oxygen needed by microorganisms in the liquid organic fertilizer solution, so that the lower compartment conditions are semi-aerobic [24]. On one side of the lower compartment, a tap is installed as an outlet for liquid organic compost with a size of 1 inch. This outlet is installed at the height of 10 cm from the bottom of the lower compartment [37]. Connect the bottom

support pipe with ½ inch pipe and polycarbonate as a separator. Then attach the 4-inch hubcaps, and attach the appropriate hubcaps to each of the pipes. After all the pipes and hubcaps are entirely assembled, clean the *tong* composter, and then dry it, and the *tong* composter is ready for use [25].

### *2.2.3 Composting Processes*

The composting process is carried out for 20 days. It started by mixing chopped fruit waste (1000 g) and vegetable waste (1000 g) in a container. Furthermore, the mixed waste is put into a *Tong* Composter while spraying a mixture of active EM4 and a solution of brown sugar water. Stir everything until well blended, and cover the *Tong* Composter until it is tight. Label each *Tong*, keep the *Tong* in a cool place, and keep it out of the sun. Every day, loosen the *tong* composter lid periodically to release gas produced by bacterial activity [26].

### *2.2.4 Parameter Analysis*

In this research, the difference in EM4 dosage and time variation is a treatment that will become an independent variable. After the composting process is complete, samples were taken on each treatment. Then, measurements were taken at the PT. Sucofindo Cibitung for chemical parameters such as Nitrogen, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O. Meanwhile, physical parameters [21] such as pH will be measured in the Environmental Engineering Laboratory of President University.

## **2.3 Data Analysis Method**

The experimental laboratory results from pH, Nitrogen, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O will be analyzed with a t-test. Laboratory test results of liquid organic fertilizer parameters will be analyzed to prove that laboratory measurements of liquid organic fertilizer produced fulfill the Minister Regulation of Agriculture No. 261 of 2019.

The null hypothesis for the t-test in this study is that the population mean must be higher than or equal to the minimum parameter standard in the Ministerial

Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. The detail of the hypothesis for Nitrogen, Phosphorus ( $P_2O_5$ ), and Potassium ( $K_2O$ ) are:

### 1. *pH*

In the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019, the minimum standard of pH for liquid organic fertilizers is 4.

$$H_0: \mu \text{ pH} \geq 4$$

$$H_a: \mu \text{ pH} < 4$$

### 2. *Nitrogen*

In the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019, the minimum standard of nitrogen for liquid organic fertilizers is 2%.

$$H_0: \mu \text{ Nitrogen} \geq 2\%$$

$$H_a: \mu \text{ Nitrogen} < 2\%$$

### 3. *Phosphorus*

In the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019, the minimum standard of phosphorus for liquid organic fertilizers is 2%.

$$H_0: \mu \text{ Phosphorus} \geq 2\%$$

$$H_a: \mu \text{ Phosphorus} < 2\%$$

### 4. *Potassium*

In the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019, potassium's minimum standard for liquid organic fertilizers is 2%.

$$H_0: \mu \text{ Potassium} \geq 2\%$$

$$H_a: \mu \text{ Potassium} < 2\%$$

The test will give a  $P(T \leq t)$  one-tail value. This  $P(T \leq t)$  one-tail value must be compared with alpha ( $\alpha = 0.05$ ). The  $P(T \leq t)$  one-tail value must be less than alpha ( $\alpha = 0.05$ ) to reject the null hypothesis. If the null hypothesis is rejected, each parameter's population mean is not comply with Ministerial Decree of Agriculture No. 261 of 2019.

### 3 Results and Discussion

#### 3.1 pH

The pH results in each treatment are shown in **Table 3**.

**Table 3.** pH result of each treatment

Trial	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
1 <sup>st</sup>	4.02	4.44	4.6	4.92	4 – 9
2 <sup>nd</sup>	4.15	4.17	5.48	5.35	

As seen in **Table 4** on the 10<sup>th</sup> day in the EM4-60 ml (Treatment 1), the pH mean obtained was 4.085, while in the EM4-70 ml (Treatment 2), the pH means obtained was 4.305, lower than the next day. It is due to several microorganisms that convert organic matter into organic acids [27]. Then on the 20<sup>th</sup> day, it can be seen in the EM4-60 ml (Treatment 3) the pH mean obtained was 5.04, while in the EM4-70 ml (Treatment 4), the pH means obtained was 5.135 the pH content was obtained higher than this last time is due to other microorganisms changing the organic acids that have formed so that the pH will rise closer to neutral pH [27]. It can be seen that the longer the fermentation time and the more EM4 doses used, the closer to the neutral pH obtained.

In this study, the liquid organic fertilizers were in the form of fruits and vegetables, most of which were acidic. The laboratory results show that pH in all treatments complies with the Ministerial Decree of Agriculture No. 261 of 2019. **Table 3** shows the results alongside the national standard criterion. The national standard for pH is 4 – 9; therefore, the P ( $T \leq t$ ) one-tail value will be used to check the t-test result.

**Table 4.** T-Test Result for pH

	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
Mean	4.085	4.305	5.04	5.135	
Variance	0.0085	0.0365	0.3872	0.0925	
t Stat	1.30769	2.25926	2.36363	5.27907	Minimum 4
P(T<=t) one- tail	0.20781	0.13264	0.12740	0.05959	
t Critical one- tail	6.31375	6.31375	6.31375	6.31375	

**Table 4** shows the result from the t-test. According to the results, the P (T<=t) one-tail value is higher than alpha ( $\alpha = 0.05$ ). Therefore the null hypothesis is accepted. It is shown that the mean pH is higher than or equal to the minimum pH standard in the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. Because  $H_0$  is accepted, it is proved that all treatments' on pH parameters have complied with the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. By comparing each treatment's mean, Treatment 4 had the highest pH of 5.135, followed by Treatment 3 with 5.04.

### 3.2 Nitrogen

The nitrogen-test results in each treatment are shown in **Table 5**.

**Table 5.** Nitrogen result of each treatment

Trial	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
1 <sup>st</sup>	0.129%	0.107%	0.074%	0.065%	
2 <sup>nd</sup>	0.118%	0.109%	0.071%	0.065%	2 – 6%

From **Table 5** the laboratory testing results showed that all treatments, nitrogen-test results ranged from 0.065% - 0.129%. The nitrogen means content in liquid organic fertilizer decreases with the length of the fermentation process; this is due to microorganisms reaching equilibrium, namely the number of microbes produced is the same as the number of dead microbes, and there will be a decrease in volume and biomass of the material [15]. The highest nitrogen means content found in the EM4-60 ml (Treatment 1) of 0.124%, while in the EM4-70 ml (Treatment 2) is 0.108%. It is due to metabolism, which causes nitrogen to be assimilated and lost through volatilization as ammonia or lost due to denitrification. Another factor that is thought to cause differences in some of these samples' nitrogen mean content could be an incomplete decomposition process [28].

The laboratory results show that each treatment's nitrogen does not comply with the Ministerial Decree of Agriculture No. 261 of 2019. **Table 5** shows the results from the laboratory alongside the national standard criterion. The national standard for nitrogen is 2 – 6%; therefore, the  $P(T \leq t)$  one-tail value will be used to check the t-test result.

**Table 6.** T-Test Result for Nitrogen

	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
Mean	0.1235%	0.108%	0.0725%	0.06495%	
Variance	6.05E-05	2.00E-06	4.50E-06	2.45E-07	
t Stat	-341.18182	-1892	-1285	-5528.71429	Minimum 2%
P(T<=t) one-tail	0.00093	0.00017	0.00025	0.00006	
t Critical one-tail	6.31375	6.31375	6.31375	6.31375	

**Table 6** shows the result from the t-test. According to the results, the  $P(T \leq t)$  one-tail value is less than alpha ( $\alpha = 0.05$ ). Therefore the null hypothesis is rejected,

and  $H_a$  is accepted. The mean of nitrogen is less than the minimum nitrogen standard in the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. Because  $H_0$  is rejected, it is proved that all treatments' on nitrogen parameter has not complied with the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. Higher nitrogen content is preferable as it is a form of nutrient for the plants. Treatment 1 had the highest nitrogen of 0.124% by comparing each treatment, followed by Treatment 2 with 0.108%.

### 3.3 Phosphorus ( $P_2O_5$ )

The results of the phosphorus test in each treatment are shown in **Table 7**.

**Table 7.**  $P_2O_5$  result of each treatment

Trial	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
1 <sup>st</sup>	0.019%	0.02%	0.022%	0.022%	2 – 6%
2 <sup>nd</sup>	0.017%	0.023%	0.033%	0.026%	

From **Table 7** the laboratory testing result showed that each treatment's phosphorus test results ranged from 0.019% - 0.033%. The data shows that the phosphorus test results in each treatment increase gradually. On the 10<sup>th</sup> day, in the EM4-60 ml (Treatment 1), the phosphorus means obtained 0.018%, and in the EM4-70 ml (Treatment 2), the phosphorus means obtained 0.0215%, lower than the next day. The composition of waste varies so that the composting process is slow; the availability of nutrients also increases according to the length of fermentation time [28]. Then, on the 20<sup>th</sup> day, the EM4-60 ml (Treatment 3) can be seen in the phosphorus mean obtained is 0.0275%, while in the EM4-70 ml (Treatment 4), the phosphorus mean is 0.024%. In fermentation, microorganisms' growth occurs in the initial phase; cell mass can change without changing its number.

Furthermore, the growth period of microorganisms moves towards an exponential phase where the number of cells undergoes rapid division. It is what

causes the levels of phosphorus obtained to increase [15]. In (Treatment 4) compared to (Treatment 3), the phosphorus content in the EM4-60 ml is greater than the phosphorus content in the EM4-70 ml; it could be due to sampling so that the phosphorus and microbial content decreases along with the reduction in volume. Liquid organic fertilizer samples [28].

The laboratory results show that each treatment's phosphorus does not comply with the Ministerial Decree of Agriculture No. 261 of 2019. **Table 7** shows the results from the laboratory alongside the national standard criterion. The national standard for phosphorus is 2 – 6%; therefore, the P ( $T \leq t$ ) one-tail value will be used to check the t-test result.

**Table 8.** T-Test Result for  $P_2O_5$

	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
Mean	0.018%	0.0215%	0.0275%	0.024%	
Variance	2.00E-06	4.50E-06	6.05E-05	8.00E-06	
t Stat	-1982	-1319	-358.63636	-988	Minimum 2%
P( $T \leq t$ ) one- tail	0.00016	0.00024	0.00089	0.00032	
t Critical one- tail	6.31375	6.31375	6.31375	6.31375	

**Table 8** shows the result from the t-test. According to the results, the P ( $T \leq t$ ) one-tail value is less than alpha ( $\alpha = 0.05$ ). Therefore the null hypothesis is rejected, and  $H_a$  is accepted. It is shown that the mean of phosphorus is less than the minimum phosphorus standard in the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. Because  $H_0$  is rejected, it is proved that all treatments' on phosphorus parameter has not complied with the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. Higher phosphorus content is preferable as it is a form of nutrient for the plants. Treatment 3 had the

highest phosphorus of 0.0275% by comparing each treatment, followed by Treatment 4 with 0.024%.

### 3.4 Potassium ( $K_2O$ )

The results of the potassium test in each treatment are shown in **Table 9**.

**Table 9.**  $K_2O$  result of each treatment

Trial	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
1 <sup>st</sup>	0.216%	0.236%	0.272%	0.271%	2 – 6%
2 <sup>nd</sup>	0.22%	0.228%	0.283%	0.275%	

From **Table 9** result from laboratory testing, the potassium test results in each treatment ranged from 0.216% - 0.283%. The effect of fermentation time and EM4 dosage on the potassium content obtained. On the 10<sup>th</sup> day, in the EM4-60 ml (Treatment 1), the potassium means obtained 0.218%, while in the EM4-70 ml (Treatment 2), the potassium mean was 0.232%, lower than the next day. Microorganisms use potassium in the substrate as a catalyst in bacteria's presence, and its activity will significantly affect the increase in potassium [29]. Then on the 20<sup>th</sup> day, it can be seen in the EM4-60 ml (Treatment 3), the potassium means obtained 0.2775%, while in the EM4-70 ml (Treatment 4), the potassium means obtained 0.273%, this happens because of complete cell division [28]. However, when compared to the mean yield of potassium content in (Treatment 3) is greater than the mean content of (Treatment 4), this is because this element of potassium will also be utilized by microbes in the decomposition process so that the more EM4 dosage, the more it will be the utilization of potassium by microbes [28].

The laboratory results show that each treatment's potassium does not comply with the Ministerial Decree of Agriculture No. 261 of 2019. **Table 9** shows the results from the laboratory alongside the national standard criterion. The national standard

for potassium is 2 – 6%; therefore, the P ( $T \leq t$ ) one-tail value will be used to check the t-test result.

**Table 10.** T-Test Result for  $K_2O$

	Treatment 1 EM4 60 ml, 10 <sup>th</sup> days	Treatment 2 EM4 70 ml, 10 <sup>th</sup> days	Treatment 3 EM4 60 ml, 20 <sup>th</sup> days	Treatment 4 EM4 70 ml, 20 <sup>th</sup> days	Minister of Agriculture No. 261 of 2019
Mean	0.218%	0.232%	0.2775%	0.273%	
Variance	8E-06	3.2E-05	6.05E-05	8E-06	
t Stat	-891	-442	-313.18182	-863.5	Minimum 2%
P( $T \leq t$ ) one-tail	0.00036	0.00072	0.00102	0.00037	
t Critical one-tail	6.31375	6.31375	6.31375	6.31375	

**Table 10** shows the result from the t-test. According to the results, the P ( $T \leq t$ ) one-tail value is less than alpha ( $\alpha = 0.05$ ). Therefore the null hypothesis is rejected, and  $H_a$  is accepted. It is shown that the mean of potassium is less than the minimum potassium value in the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. Because  $H_0$  is rejected, it is proved that all treatments' on potassium parameter has not complied with the Ministerial Decree of Agriculture of the Republic of Indonesia Number 261 of 2019. Higher potassium content is preferable as it is a form of nutrient for the plants. Treatment 3 had the highest potassium of 0.2275% by comparing each treatment, followed by Treatment 4 with 0.273%.

### 3.5 Discussion

In previous studies, the weight loss during the composting process of fruit and vegetable waste using the Tong Composter method and EM4 bio activator had a percentage of 65.86%, with 26.457 L of the leachate produced [14]. The parameter values of nitrogen, phosphorus, and potassium value are minimal and do not comply with the standard. The main content of organic fertilizers is organic matter. Besides

that, it also has nitrogen, phosphorus, and potassium nutrients, and it is just that the composition of nutrients (substances) contained by organic fertilizers is not fixed, depending on the volume of the material, the type of material, and the composting method. Therefore, the factors that are thought to cause differences in the content of nitrogen, phosphorus, and potassium in some samples made from organic waste can be due to an incomplete decomposition process. Each variable uses different types of organic waste even though they are the same. The same comes from the types of fruit and vegetables [28].

#### **4 Conclusion**

From the discussion above, it can be concluded that one parameter complies while other parameters do not comply with the Ministerial Decree of Agriculture No. 261 of 2019. The pH parameters complied with the standard, while the results of Nitrogen, Phosphorus, and Potassium still do not comply with the Ministerial Decree of Agriculture No. 261 of 2019. It is also evident from the t-test statistics results that only pH parameters complied with the Ministerial Decree of Agriculture No. 261 of 2019. Simultaneously, the t-test statistics result on Nitrogen, Phosphorus ( $P_2O_5$ ), and Potassium ( $K_2O$ ) parameters did not comply with the standards.

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