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Takakura composting method for food waste using local microorganisms activator from tuna fish waste, shrimp waste, coconut coir, and leftover vegetables

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ABSTRACT

Food waste is organic waste, the most significant component in Indonesia, which can be processed as raw material for composting. The composting process can be accelerated by adding an activator. Therefore, this study was conducted that utilized household food waste with the composition of leftover rice, leftover vegetables, and fruit peels as raw materials for composting to compare the compost yield with the addition of a bio activator of local microorganisms (LMO) with effective microorganisms (EM4) using the Takakura method. Composting was carried out in duplicate with five variations, namely, a variation I without the addition of activator, variation II EM4 activator, variation III LMO a mixture of tuna fish waste and shrimp waste plus leftover vegetables, variation IV LMO a mixture of coconut coir and leftover vegetables plus tuna fish waste, and variations V LMO a mixture of tuna fish waste and shrimp waste plus a mixture of coconut coir and leftover vegetables. The results showed that the maturity test (pH, temperature, color, texture, smell, humidity, and time of composting), and the quality test included physical elements (water content, pH, temperature, color, texture, odor) and macro elements (C-organic, nitrogen, C/N ratio, P_2O_5, and K_2O) have complied with compost standards according to SNI 19-7030-2004. The result of the quantity test showed that mass reduction in the range of 46.97–53.46%. Based on the results of the scoring on the analysis of maturity, quality, and quantity, the best variation was found, namely variation V, with the fastest composting time of 11 days, and the compost yield was 4.6 kg from 9.24 kg of the initial weight of compost raw material with a mass reduction rate of 50.22%.

Keywords: maturity, quality, quantity, compost, local microorganism.

INTRODUCTION

Waste is one of the unresolved issues in Indonesia today, despite the fact that human activities generate waste on a daily basis. This issue has a significant impact on current and future lives since as Indonesia's population grows, so will the amount of waste produced (Ningsih, 2018). According to figures from the Ministry of Environment and Forestry (KLHK), Indonesia produced 67.8 million tons of waste in 2020. According to the 2020 National Waste Management Information System (SIPSN), the composition of waste by type, namely 40.1%, came from food waste, while the composition of waste by source, namely 38.3%, came from household waste, implying that household waste processing is required.

One way to deal with this case is through the technology of recycling waste into compost which has high value. Aside from composting, the black soldier fly larvae (BSFL) method is used, which has been shown to produce high-quality compost (Aziz et al., 2023), takakura is the proper composting method to use because this method can be applied to an individual or household scale in a simple, practical way (Wikurendra et al., 2022;

Farumi et al., 2020). Because domestic and non-domestic waste generate significant volumes of organic waste (Dewilda et al., 2023, Fauzi et al., 2022a, Dewilda et al., 2022, Fauzi et al., 2022b; Fauzi et al., 2023a), this strategy is simple to adopt in order to reduce waste entering landfills.

It takes three to four months for organic materials to decompose spontaneously (Lubis, 2020). Meanwhile, takakura composting without an activator lasted approximately 28 days, and with EM4 for 19 days (Ramaditya et al., 2017). Decomposing microorganisms that can be utilized as composting activators are required. Aside from the commercial EM4, several decomposing microbes found in nature can be employed as activators in the composting process (Kurniawan, 2018). These bacteria are known as local microorganisms (LMO), and they can be grown with a variety of organic matter sources (Suwatanti & Widiyaningrum, 2017).

Vegetable waste, according to Utama et al. (2013), is a favorable medium for the development of decomposing microorganisms and can be utilized as a bio activator in composting. Lactic acid fermentation is used to turn the sugar in vegetables into lactic acid, which inhibits the growth of dangerous microbes. According to Nur and Lay (2016), the most beneficial biomass from coconut plants is coconut coir. With a moisture content of 53.83%, 0.28% N, 0.1 ppm P, 6.726 ppm K, 140 ppm Ca, and Mg 170 ppm, coconut coir can be used as an activator for composting (Sidiq et al., 2019).

According to research by Mursalim et al. (2018), tuna (*Euthynnus* is related) contains high nutrition, is complete with up to 26% protein, and contains nitrogen, which plays an important role as leaf fertilizer. Fish waste can be used as organic fertilizer material because there are organic values of nitrogen, phosphate, and potassium, as well as good microelements for compost (Nur & Tjatoer, 2011). The by-products of shrimp waste processing in the form of shrimp heads, shells, and tails can be used as fertilizer because they contain high levels of nutrients and nitrogen. The addition of shrimp waste in the fermentation process causes more nitrogen to be degraded, causing the fermentation results to increase the total N-value, which is good for plants (Purba et al., 2013).

Based on this description, research must be conducted to compare the results of composting with the addition of LMO and EM4 activators with the method of adding waste that is used every day to determine the best activator from local microorganisms a mixture of animal and vegetable waste originating from tuna waste, shrimp waste, coconut coir, and vegetable waste so that it is useful as a sustainable technology for environmental preservation, human safety, and food safety.

MATERIALS AND METHODS

This study used samples for composting from household food waste around the Pasar Baru residential area, Pauh District, Padang City. Takakura composting is carried out at the Solid Waste Laboratory, Department of Environmental Engineering. Sample analysis was carried out at the Research Laboratory and Solid Waste Laboratory, Department of Environmental Engineering, Universitas Andalas, Padang City. Composting uses a basket measuring 36 × 26 × 47 cm, as shown in Figure 1.

Material preparation includes the preparation of raw materials consisting of household food

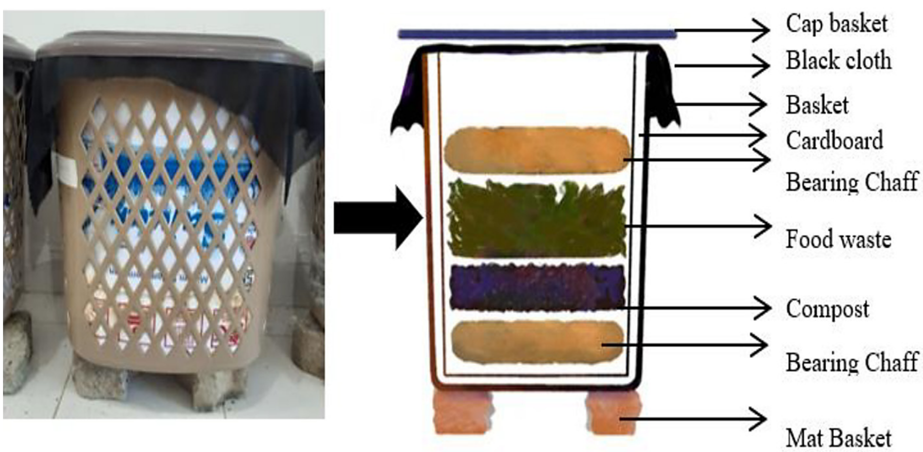

Figure 1. Takakura basket components

waste, raw materials for making local microorganisms, and EM4. The number of raw materials needed to make a local microorganisms solution can be seen in Table 1.

Preparation of local microorganism solution is done by cutting tuna waste, shrimp waste, coconut fiber, and remaining vegetables into small pieces and then putting them into a container containing rice washing water as carbohydrates and palm sugar as glucose, and then the container is covered and labeled, according to the specified variable. During the fermentation process, the lid of the container is opened every day for 5 minutes until it smells of tamarind and has a brownish-yellow color.

The EM4 and LMO doses used were 9.24 mL. The food waste is given a mixture of EM4 and water with a ratio of 1:5 (Widikusyanto, 2018). Based on data from Putri (2021), the raw material for compost added was 1.32 kg daily, with the percentage of vegetable residue at 59.76%, fruit peel at 28.41%, and rice residue at 11.83%. The composting step begins with enumerating the compost's raw materials before being put into the composter. Compost was made in 5 variations, by means of waste with the same weight and composition for each basket which had been chopped manually as much as 1.32 kg, and mixed with an activator according to a predetermined variation. Then, put it into each takakura basket. The composting process using the takakura method is carried out by adding waste to the basket daily (Dian et al., 2023).

The addition of waste to the basket is halted until the basket is full, or for seven days. Compost is mixed once every 24 hours to provide oxygen to the microorganisms in the compost and aid in the decomposition process (Hibino et al., 2020). After the compost has developed, maturity tests and compost quality testing are performed during the composting process. The test variations were performed in duplo, with each treatment performed in two Takakura baskets with the addition of an activator for each variation. The treatment of adding compost raw materials and activators can be seen in Table 2.

The data measured is an analysis of compost maturity tests (temperature, pH, color, texture, odor, humidity, and composting time) which are carried out during the composting process until the compost is ready, then compost quality tests consist of physical elements (moisture content, temperature, and pH), as well as color, texture, and odor. Moreover, macro elements (C-organic, nitrogen, C/N ratio, phosphorus, and potassium) were obtained through laboratory analysis. The compost quantity test was measured based on the

Table 1. Comparison variation of local microorganism composition

LMO raw materials	Variation	Raw material comparison		
		Sample	Palm sugar (gram)	Rice water (mL)
Without adding activator	I	-	-	-
EM_4	II	-	-	-
(Tuna fish waste + shrimp waste) + leftover vegetables	III	(50:50):100	200	1000
(Coconut coir + leftover vegetables) + Tuna fish waste	IV	(50:50):100	200	1000
(Tuna fish waste + shrimp waste) + (Coconut coir + leftover vegetables)	V	100:100	200	1000

Table 2. Addition of composting raw materials and activators

Variation	Raw material weight (kg)		Activator (mL)			
	FW	C	EM4	TFW+SW+LV	CC+LV+TFW	(TW+SW)+ (CC+LV)
I	9.24	2	-	-	-	-
II	9.24	2	55.44	-	-	-
III	9.24	2	-	55.44	-	-
IV	9.24	2	-	-	55.44	-
V	9.24	2	-	-	-	55.44

Note: SW – shrimp waste, TFW – tuna fish waste, CC – coconut coir, VW – leftover vegetable.

weight of the compost yield and the degree of reduction. The standard used is SNI 19-7030-2004 concerning compost specifications from domestic organic waste.

RESULTS AND DISCUSSION

Maturity and analysis

The parameters monitored in the maturity test are fluctuations in pH, temperature, color, texture, odor, humidity, and composting time.

pH analysis

pH measurements are carried out every day using a pH meter until the compost is said to be ripe. Based on Figure 2, the pH was reasonably constant for all fluctuations from the start of composting until day 4, namely in the range of 6–6.5. The pH dropped to 5–5.5 on the fourth day in many versions. The fall in pH peaked on the seventh or final day, when trash was added to the basket until it reached a pH of 4.5. The pH began to rise after the garbage was removed on the seventh day. For VA and VB variations, the largest increase in pH occurred on days 12–13 and gradually returned to neutral on day 10. Each variation reached a neutral pH of 7 on the 14th day.

According to Suwatanti & Widiyaningrum (2017), the stages of changing the pH of compost which initially had a slightly acidic pH were due to the formation of simple organic acids in the compost. At the beginning of the composting process, all treatments were in acidic conditions, then changed to neutral pH conditions for each treatment which varied considerably. Changes in pH conditions increased during further incubation due to proteins' decomposition and ammonia's release. Increases and decreases in pH are also markers of the activity of microorganisms in decomposing organic matter (Suwatanti & Widiyaningrum, 2017).

The peak of acid conditions occurred on the seventh day while adding food waste to the Takakura basket in variations IB and IIA, namely variations without the addition of an activator and the addition of an EM4 activator with a pH value of 4.5. This result is in line with the results of research by Siagian et al. (2021), which has the lowest pH in the 4–5. The pH value has decreased due to the activity of microorganisms in the waste. The temperature will rise and eventually produce organic acids, which cause the pH value to decrease. According to Rahmadanti et al. (2019), at the beginning of the decomposition process in organic acids, these conditions will decompose lignin and cellulose in compost raw materials.

Changes in pH increased after adding waste was stopped on the seventh day. The pH of the compost slowly increases to neutral, namely in the range of 7–7.5 on the 10th day, indicating that the compost is ripe and meets the pH range of 6.8 to 7.49 based on SNI 19-7030-2004. According to Suwatanti & Widiyaningrum (2017), an increase in the pH value to alkaline is caused by the activity of microorganisms that convert nitrogen in compost raw materials into ammonia.

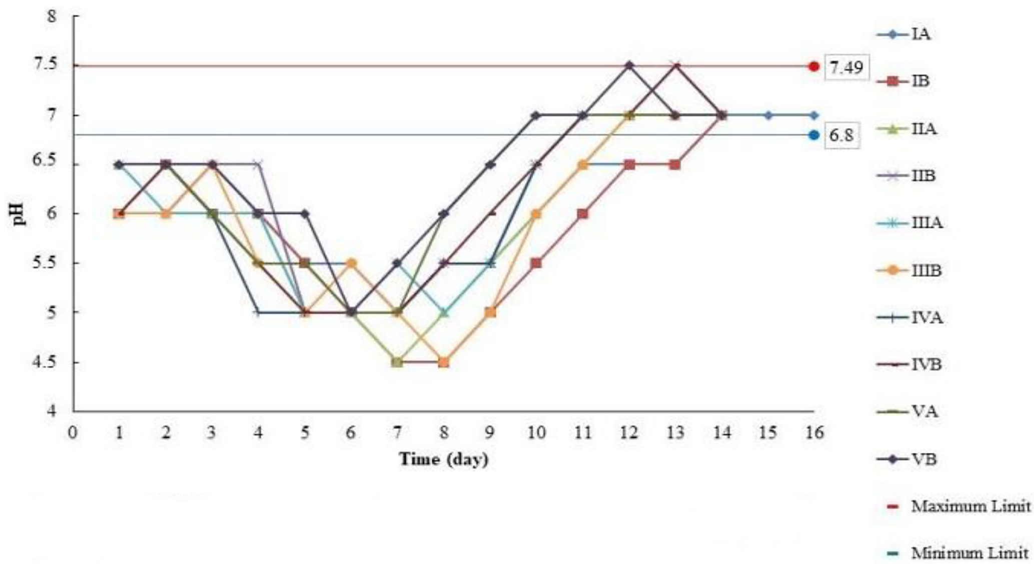

Figure 2. pH fluctuations during the composting process

Temperature analysis

Temperature measurements were carried out using a thermometer with units of degrees Celsius (°C) every day from when the waste was put in until the compost was ripe. As shown in Fig. 3, compost temperature continued to increase with the addition of waste on the seventh day and decreased gradually when no additional waste was added. The decrease in temperature in this study began gradually on the 10th day until the compost matured according to SNI 19-7030-2004 which was marked by a temperature that had reached groundwater temperature, namely ≤ 30 °C where the temperature at the end of composting showed for all variations, which ranged from 27 °C to 30 °C.

These results follow the research of Nurdini et al. (2016), where the temperature on the first day of composting was 24–28° C, where no decomposition process had occurred. It became optimum on the sixth day with a temperature of 38 °C, then decreased gradually until it reached a constant temperature with temperatures in the range of 26–28 °C.

Based on Figure 3 at the beginning of composting, namely when food waste was added on the first day, all variations showed almost the same temperature, which was around 26–28 °C, this was because the decomposition process had not yet taken place. The temperature of all variations began to increase slowly in the mesophilic state. It reached a maximum temperature of 35 °C to 37 °C on the seventh day for all variations with the addition of an activator. The control variation without activator addition peaked on the eighth day at 35 °C to 36 °C.

The decrease in temperature is caused by the decrease in microbial activity in decomposing the available organic matter content and indicates that the compost has entered the maturity phase. During the composting process, no compost reaches a high-temperature rise, so the active microbes are mesophilic from 20 °C to 45 °C. The activity of microorganisms during the decomposition process is to take oxygen in the compost pile until it reaches the maximum temperature and produces heat and carbon dioxide (Kartika, 2021).

The compost temperature in each variation only reached its peak at temperatures of 35 °C to 38 °C. This condition was due to the low compost heap. This result follows the research of Widarti et al. (2015). A too-low pile will cause the compost raw material to lose heat faster, so higher temperatures cannot be achieved. Conversely, suppose the pile of compost material is too high. In that case, the materials will compact and the temperature will be too high, so the air at the bottom of the pile is reduced, which can stimulate the growth of anaerobic bacteria and cause odor (Murbandono, 2010).

Analysis of color, texture, and smell

The color observation was carried out by observing the color change of the compost raw

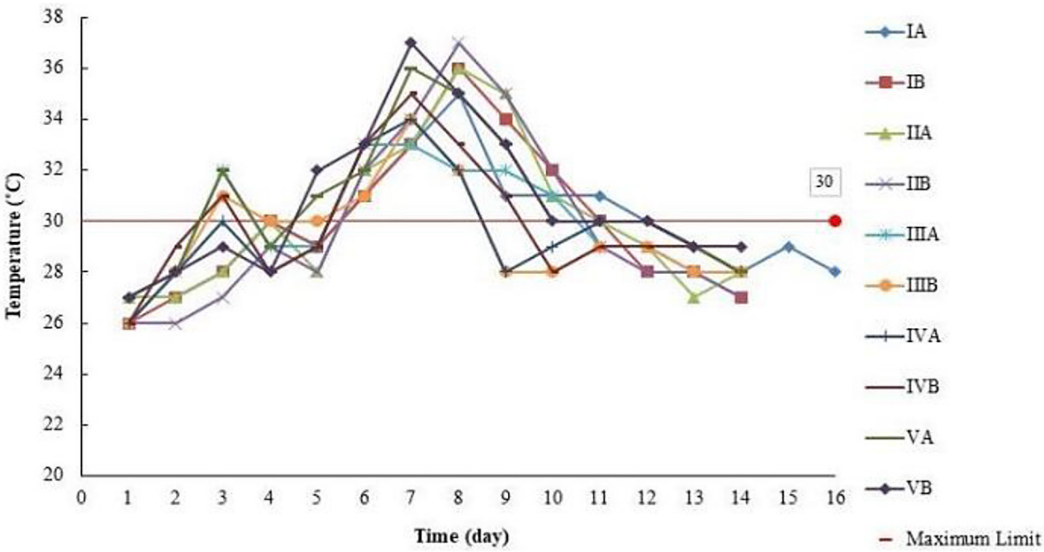

Figure 3. Temperature fluctuations during the composting process, 1 = control; II = EM4; MOL of tuna fish waste + shrimp wasteland leftover vegetables; IV = coconut fiber + left over vegetables and tuna fish waste; V = MOL of tuna fish waste + shrimp waste + coconut fiber and left over vegetables

material from the commencement of composting, which is greenish to blackish, similar to the color of the soil. Texture is seen by looking at and squeezing the texture of the compost at the beginning of the composting process, which is still roughly textured and has not decomposed into a texture like soil or crumbs (Fig. 4). Odor observations were conducted using the sense of smell, specifically detecting compost from the start of composting, which still smells of food waste, to smell like soil.

According to the findings of the research, the compost variation that changes the most quickly is the VB variation on the 10th day with the inclusion of an activator combined with tuna waste and shrimp waste, as well as a blend of coconut fiber and vegetable residue. The control IA without an activator on the 14th day, on the other hand, is the most extended variant that alters the color. This state is caused by a lack of activator addition, which results in a slower breakdown process. According to Puspita (2020), changes in the color of compost depend heavily on the mixed ingredients used, materials that have not been completely decomposed have a C/N ratio value that is still very high, causing the color to not change or to retain the original color of the raw material.

Changes in compost texture during the composting process can be seen in Figure 4, where at the beginning of the addition of composting raw materials, all variations were still rough-textured because the decomposition process had not yet occurred. Changes in compost texture during the composting process Figure 4 showed that the composting variation that reached soil-like texture conditions the fastest was the VB variation on the 10th day with the addition of an activator mixed with tuna waste and shrimp waste plus a mixture of coconut coir and vegetable residue, while the variation that experienced the most prolonged change in texture was the IA variation without the addition of activator on the 16th day. This result follows the research of Larasati & Puspikawati (2019), which states that the natural composting process without the addition of bio activators will take longer when compared to compost using the addition of bio activators because the microorganisms in the control variation work naturally without the help of other microorganisms so that the organic matter lasts longer unraveled.

The variation that experienced the fastest change in odor was the VB variation, where on the 10th day, it smelled of earth or complied with the maturity requirements. In contrast, the IA variation experienced a long change in smell, which already smelled of earth on the 15th day. This condition is due to the absence of an activator added to these variations, which causes the decomposition process to be slower and impacts changes in odor as an indicator of compost maturity. Changes in the odor of the compost indicate that there has been a decomposition process in the raw material. The odor of the waste produced at the beginning of composting will gradually decrease until it becomes an earthy smell indicating that the compost has matured. Ripe compost smells like soil because its material resembles soil and has a blackish-brown color formed from stable organic matter (Ismayana et al., 2012).

Moisture analysis

Moisture in composting has an essential role in decomposing compost raw materials. The compost should be matured in a non-humid condition.

In the research that has been done, observing the humidity in the composting process shows that the humidity changes the fastest from moist to not humid, namely in the VB variation on the 11th day and VA on the 12th day with the addition of the LMO activator, a mixture of tuna waste and shrimp waste plus a mixture LMO of coconut coir and vegetable residue (Fig. 5). In contrast,

Figure 4. Changes in color and texture of compost raw materials; (a) early composting, (b) after composting

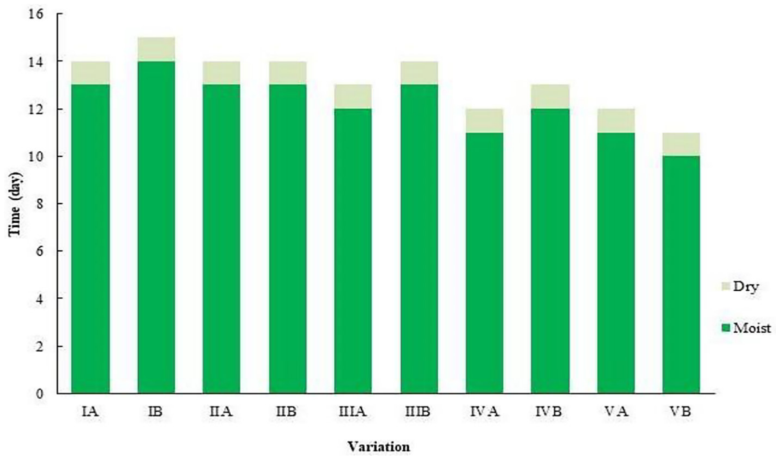

Figure 5. Observation of humidity during composting, 1 = control; II = EM4; MOL of tuna fish waste + shrimp wasteland leftover vegetables; IV = coconut fiber + left over vegetables and tuna fish waste; V = MOL of tuna fish waste + shrimp waste + coconut fiber and left over vegetables

the most extended change in humidity occurred in the IB variation, namely on day 15, without adding activators or control variations. Optimum compost humidity is in the range of 40–60%. Humidity that is too high will reduce the air volume. If the compost is too wet, stirring is done more frequently (Murbandono, 2010).

Composting duration analysis

The determination of the composting time for household food waste using the Takakura method is based on the parameters observed every day during the maturity test, namely pH, temperature, color, texture, smell, and humidity of the compost. Based on SNI 19-7030-2004, the criteria for mature compost are a temperature similar to soil temperature, namely ≤ 30 °C, containing a pH of 6.8–7.49, having a blackish color, texture, and smelling like soil.

The analysis results on the composting time showed differences in the composting time for variations with adding a bio activator and without a bioactivation (Figure 6). This result is in line with the research of Nurullita & Budiyono (2012), where there are differences in the length of composting time for the various types of LMO used because each type of LMO has different microorganisms, where LMO and EM4 contain more microorganisms so they degrade faster. Organic matter is compared to variations without the addition of activators or control variations because microorganisms from compost seeds work naturally without the help of other microorganisms.

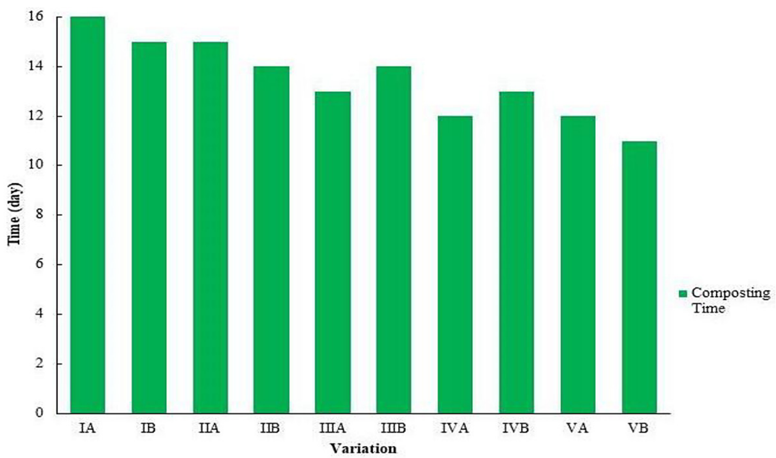

Figure 6. Compost maturity time, 1 = control; II = EM4; MOL of tuna fish waste + shrimp wasteland leftover vegetables; IV = coconut fiber + left over vegetables and tuna fish waste; V = MOL of tuna fish waste + shrimp waste + coconut fiber and left over vegetables

Quality analysis

Compost quality test analysis conducted in this study consisted of physical elements (moisture content, temperature, pH, color, texture, and odor) and macro elements (carbon, nitrogen, phosphorus (P_2O_5), potassium (K_2O), and C/N ratio) based on SNI 19-7030-2004 concerning specifications for compost from domestic organic waste.

Moiture content analysis

The quality of compost that can be used as organic fertilizer based on SNI 19-7030-2004 has a moisture content of no more than 50%.

Based on the graphic in Figure 7, the moisture content in each variation of compost is in the range of 19.232% to 24.702%, so it meets the quality standards according to SNI 19-7030-2004. The results showed that there was no significant difference between the addition of LMO activator, EM4, or not (control) on the moisture content of the compost. The moisture content of the compost in each variation in this study decreased compared to the initial addition of raw materials. This result is in line with the results of research by Ratna et al. (2017) that the reduced compost moisture content from the first day was due to an increase in temperature which indicated microbial activity. Moisture content affects the decomposition rate and temperature because decomposing microorganisms require optimal moisture content to decompose organic matter.

Macro analysis

Parameters of mature compost macro elements according to SNI 19-7030-2004 include carbon, nitrogen, phosphorus (P_2O_5), potassium (K_2O), and the C/N ratio. Based on the analysis in Table 3, the C/N ratio values for all composting variations range from 11.128% to 19.574%. Based on SNI 19-7030-2004, the value of the C/N ratio for compost quality is almost the same as that of soil, namely 10-20. The compost produced in this study has met the requirements for the C/N ratio value of compost. The resulting C/N ratio value can be considered optimum and has met the specified C/N ratio criteria. This result is in line with research by Ratna et al. (2017), which states that good composting will experience a decrease in the C/N ratio caused by a decrease in the organic C content and an increase in total N in the compost. The biological process using microorganisms also proves that the decrease in the C/N ratio is due to a decrease in organic C (Fauzi et al., 2023b).

The results of the analysis of phosphorus content obtained for all variations ranged from 0.211% to 0.459%. All composting variations have met the quality standards of phosphorus parameter compost based on SNI 19-7030-2004, namely for the minimum value of phosphorus content is 0.1%. The difference in phosphorus levels in the compost is insignificant. The variation with the highest phosphorus content was variation IIB with the addition of the EM4 activator, while the variation with the lowest phosphorus content was variation IIIB with the addition of the LMO activator mixed with tuna waste and shrimp waste plus the rest of the vegetables. According to Kaswinarni & Nugraha (2020), high phosphorus levels in the composting process are caused by weathering of the organic compost

Figure 7. Compost moisture content, 1 = control; II = EM4; MOL of tuna fish waste + shrimp wasteland leftover vegetables; IV = coconut fiber + left over vegetables and tuna fish waste; V = MOL of tuna fish waste + shrimp waste + coconut fiber and left over vegetables

Table 3. Compost quality analysis summary

No.	Parameter	Water content	C-organic	Nitrogen	C/N ratio	Phosphor	Potassium
	Quality standards	< 50 (%)	9.8–32 (%)	> 0.4 (%)	10–20	> 0.1 (%)	> 0.2 (%)
1	IA	22.775	13.940	0.793	17.576	0.244	1.075
2	IB	23.457	14.746	0.818	18.016	0.301	1.139
3	IIA	23.381	15.662	0.854	18.288	0.425	1.287
4	IIB	22.692	16.132	0.937	17.214	0.474	1.255
5	IIIA	24.702	10.137	0.553	18.327	0.255	1.421
6	IIIB	23.001	10.643	0.586	18.151	0.218	1.558
7	IVA	19.240	10.869	0.576	18.856	0.312	1.234
8	IVB	19.232	10.942	0.559	19.574	0.259	1.350
9	VA	21.945	10.628	0.955	11.128	0.399	1.626
10	VB	21.305	10.848	0.921	11.783	0.259	1.544

material, where microorganisms will die at the maturity stage of the compost which causes the phosphorus levels contained in the microorganisms to mix with the organic compost material which can This causes an increase in phosphorus levels in the compost.

The analysis results of potassium levels from composting for all composting variations are in the range of 1.075% to 1.624%. The results obtained from this compost have met the potassium requirements based on SNI 19-7030-2004, namely a minimum of 0.2%. The variation with the highest potassium content is variation V with the addition of the LMO of a mixture of tuna and shrimp waste plus the LMO of a mixture of coconut coir and vegetable residue with a total potassium content of 1.626% and 1.544%. The variation with the lowest potassium content is that IA without adding a bio activator is 1.075%. Potassium is one of the nutrients needed by plants in large enough quantities, in which potassium can be helpful for the process of photosynthesis and cell development, while potassium levels that are too low will have a negative impact on plants causing a decrease in the amount of Mg and Ca and the plant becomes fast wither (Soeryoko, 2011).

Quantity analysis

Quantity analysis of compost is done by calculating the reduction rate of composting raw materials and the final result of compost.

Reduction rate

Reduction in volume or weight of compost occurs along with the composting process until the compost is mature. The raw materials' weight after composting is measured after the compost has matured according to the compost maturity

Table 4. Raw material reduction rate

Variation	Raw material weight (kg)		Reduction rate (%)
	Before composting	After composting	
IA	9.24	4.9	46.97
IB	9.24	4.8	48.05
IIA	9.24	4.7	49.13
IIB	9.24	4.8	48.05
IIIA	9.24	4.4	52.38
IIIB	9.24	4.3	53.46
IVA	9.24	4.5	51.30
IVB	9.24	4.5	51.30
VA	9.24	4.5	51.30
VB	9.24	4.6	50.22

criteria (Table 4). The results of the reduction rate obtained in this study follow Marlina et al. (2017), that the mature composting process reduces compost volume by up to 60.5%. The results also follow Moqsud et al. (2011), that shrinkage during composting reaches 50–70%. Although the results obtained have a reasonably high reduction rate, they can provide benefits in reducing waste generation. These results are in line with the study of Lubis (2017), which states that compost with the addition of a LMO activator has a higher reduction rate than the reduction rate of compost without the addition of an activator (control) where the addition of LMO to a mixture of tuna waste and shrimp waste plus vegetable residue has a higher percentage reduction rate of 53.46%, while the variation that has the lowest reduction rate is the variation without activator addition with a percentage of 46.97%.

Compost results

Based on Table 5, the compost yield is not too different for each composting variation. The result of the compost with the most weight is the IA variation without adding an activator. This condition is because no activator speeds up the composting process, so the activity of microorganisms in the compost is getting slower.

Determination of optimum compost variation

A scoring system is used to identify the optimal compost variety. The best variation is the one with the highest score. According to Table 6, the composting of food waste with the VB variation with the addition of the LMO of a mixture of tuna waste and shrimp waste plus the LMO of a mixture of coconut fiber and vegetable residue had the highest score or the most optimum compost yield, with a score of 12. So, it can be concluded that the compost in variation V, namely the addition of the LMO activator, a mixture of tuna and shrimp waste, plus the LMO of a mixture of coconut coir and vegetable scraps, is the best variation in composting food waste using the Takakura method.

Table 5. Weight of compost results

Variation	Raw material weight (kg)	Compost seeds (kg)	Compost results (kg)
IA	4.9	2	6.9
IB	4.8	2	6.8
IIA	4.7	2	6.7
IIB	4.8	2	6.8
IIIA	4.4	2	6.4
IIIB	4.3	2	6.3
IVA	4.5	2	6.5
IVB	4.5	2	6.5
VA	4.5	2	6.5

Table 6. Compost maturity scoring

Variation	Temperature	pH	Color	Texture	Odor	Humidity	Composting time	Total
IA	1	1	1	1	1	1	1	7
IB	1	1	1	1	1	1	2	8
IIA	1	1	1	1	1	1	2	8
IIB	1	1	1	1	1	1	3	9
IIIA	1	1	1	1	1	1	4	10
IIIB	1	1	1	1	1	1	3	9
IVA	1	1	1	1	1	1	5	11
IVB	1	1	1	1	1	1	4	10
VA	1	1	1	1	1	1	5	11
VB	1	1	1	1	1	1	6	12

CONCLUSIONS

Based on the results of research that has been carried out regarding the analysis of maturity, quality and quantity tests of compost originating from household food waste using the Takakura method using EM4 activators and local microorganisms from tuna waste, shrimp waste, coconut fiber and vegetable residue, it can be concluded that based on the composting results of household food waste using the Takakura method with the addition of EM4 and LMO activators it meets the SNI 19-7030-2004 quality standards for maturity analysis and compost quality, while for compost quantity analysis it produces the same scoring value for each variation. Furthermore, based on the scoring method, composting household food waste using the Takakura method with the addition of EM4 and LMO activators yielded the best results with the highest scoring value, namely the LMO activator with a mixture of tuna waste and shrimp waste plus a mixture of coconut fiber and vegetable residue. For further research, a quality analysis of the micronutrients in the compost produced in accordance with SNI 19-7030-2004 is required.

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