Effect of Sugar Cane Addition on Rabbit Food Quality from Restaurant and Vegetable Waste with Fermentation Technology

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Abstract. This study aims to determine the effect of sugar cane drop variations on composting time of food waste and vegetable waste in terms of the C/N ratio with the addition of environmental bioactivators. This research consists of 6 variations of treatment, namely the addition of Sugar Cane Drops of 0 ml, 20 ml, 40 ml, 60 ml, 80 ml and 100 ml in waste food remnants: vegetable waste of 2.5 kg: 2.5 kg with the addition of 100 grams of environmental bioactivator. Composting is carried out aerobically with a single manual stirring system every day until the compost is declared to meet the requirements of SNI 19-7030-2004. The results showed that the best results in variations of sugar cane drops 60 ml resulted in a C / N ratio of 10.79 on day 7, produced compost with nutrient content on day 7, namely C-Organic content of 33.55%, Content of N-The total is 3.11%, the total P-level is 0.161%, the total K-level is 1.357%. While the water content is 48.71%, the pH is 6.90, the temperature is 330C, it is brownish-black, smells of soil, and the particle size is ± 10 mm with volume shrinkage of 63.64%.

Keyword: **food waste; vegetable waste; sugar cane; composting**

1 Introduction

Semarang City in 2017-2018 has a daily waste generation amounting to 1270.13 tons/day. 31.60% of the total daily waste generation in the form of food waste and 12.36% in the form of wood waste, twigs, and leaves. With a total percentage of organic waste of 43.96%. 250 tons/day processed with composting, 50 tons / day processed as fuel and 1 ton/day processed as Biogas, but as much as 100 tons/day of unmanaged waste [1]. This unmanaged waste can potentially pollute the environment such as protection, the emergence of vectors of disease and odor. The management of organic waste such as food waste from household activities and vegetable waste from market activities can reduce the volume of waste and convert organic waste into something more useful by composting.

Compost made from organic waste from household and market activities is expected to be a cheap and environmentally friendly organic fertilizer and can improve soil properties. The composting time depends on the material to be composted and the method used in composting, as well as the addition of composting activator. Naturally composting will take several weeks to 2 years until the compost is fully cooked [2], because composting naturally takes several weeks to 2 years, the composting process is accelerated so that compost from organic waste can be utilized faster than it should be. Strategies to accelerate the composting process that can be done in various ways, such as manipulating the conditions/factors that influence composting or adding organisms that can accelerate the composting process or a combination of the two strategies [3].

The strategy is to accelerate the composting process which can be done by adding organisms that can accelerate the composting process, one of which is the addition of Environmental Bio-activators. Environmental bio-activators are activators in the form of leftover MOL flour containing various microorganisms. Bio-activator in this environment contains bacteria that have the ability to remove odors from these wastes and are able to degrade cellulose [4]. In the composting process, microorganisms need nutrients for activity and growth. Carbon (C) is an energy source for microorganisms. In the composting process, the largest portion of C which is equal to 2/3 of the parts contained in organic material will be used as a source for the growth of microorganisms [5] while Nitrogen (N) is needed by microorganisms as a food source for the formation of body cells [6].To meet the nutrient requirements of microorganisms so that the composting process can run optimally, you can add Sugar Cane or Waste by-products from the cane sugar industry which still contains sugar. Sugar and nitrogen contained in Sugarcane Drops can be used as an energy source and build body cells of microorganisms in the process of growth and decomposition of organic matter in waste. The average sugar composition in Sugar Cane Drops or called Cane Molasses is 62%. The chemical composition of sugar cane drops in 100 g contained 20 g of water, 76.5 g

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of organic matter, 58.9 g of total sugar (38.4 g of saccharose and 21.6 g of invert sugar), 0.5 g of total nitrogen and 3, 5 g ash (carbonate free) [7].

This research is important to do because the organic waste in Semarang City has not been managed as a whole so that it can potentially pollute the environment. One way to manage organic waste is through composting by managing food waste and vegetable waste on a household scale, so that composting can reduce the volume of waste and convert waste food waste and vegetable waste to organic fertilizer that can improve soil properties. Natural composting takes several weeks to 2 years, so the composting process is accelerated so that compost from organic waste can be utilized faster than it should be. The strategy is to accelerate the composting process which can be done by adding organisms that can accelerate the composting process, one of which is the addition of Environmental Bioactivators. Microorganisms need nutrients so that the decomposition process runs optimally in meeting the nutrient needs of microorganisms so that the composting process can run optimally added by Sugar Cane or Waste by-products from the sugar cane industry which still contains sugar. The content of sugar and nitrogen in Sugar Cane Drops can be used as an energy source and build body cells of microorganisms in the process of growth and decomposition of organic matter in waste.

2 Methodology

This study uses an experimental method, which is observation under artificial conditions, where the conditions are made and arranged by the researcher. The aim is to examine whether there is a cause-effect relationship and how much the cause-effect relationship is by giving certain treatments to several experimental groups and providing control as a comparison. The stages of the research carried out are divided into three, namely the Preparation Phase, the Compost Making Phase, and the Sample Analysis Phase.

The Preparation Phase consists of three stages, namely the Literature Study Phase which is carried out at the beginning of the research phase so that researchers can better understand the tools and materials to be used, how to make Environmental Bioactivators (Bioling), reactors to be used and how to make compost. Then the second step is the Making of Environmental Bioactivator (Bioling), which is an activator in the form of ripe compost flour from food waste compost material (leftover food MOL) containing various other microorganisms from raw Bioling powder [4]. Microorganisms added during the process of making environmental bio-activators consisted of a mixture of star bio, EM4 and aspergillus niger. Star bio can be taken from the hull contents of a cow that was previously dried to remove water content. Star bio is able to decompose faster and can cause odor. Aspergillus niger serves to accelerate the integration of cellulose. EM4 is a mixture of bacteria used for fermentation (Lactobacillus, fermented mushrooms, Actinomycetes, photosynthetic bacteria, phosphate solubilizing bacteria, and yeast) [4]. Making this Bioling is 15 kg of leftover food waste and 15 kg of vegetable waste added with 300 grams of Environmental Bioactivator flour put into the reactor. Then the composting process is carried out for 15 days or half of the normal composting process is then dried and mashed. The third stage is the Preparation Phase of the Reactor which will be used in the form of cylinders or barrels made of plastic with a height of 30 cm and a diameter of 40 cm.

The Compost Manufacturing Phase is food waste and vegetable waste that has been collected and then placed in the reactor, then added environmental bio activator then given 6 variations of Sugarcane Drops, namely 0 ml (Control), 20 ml, 40 ml, 60 ml, 80 ml, and 100 ml. The composting process is carried out for 14 days until the compost is completely cooked and meets the requirements of SNI 19-7030-2004. During the composting process, stirring is carried out once a day until the compost is declared cooked. The ingredients composition in the Compost Making Phase are as follows:

Table 1. Material Composition in the Compost Making Phase

Name	Food Waste	Vegetable Waste	Sugar Cane	Environmental Bioactivator
	kg	kg	ml	gram
T0	2.5	2.5	0	100
T20	2.5	2.5	20	100
T40	2.5	2.5	40	100
T60	2.5	2.5	60	100
T80	2.5	2.5	80	100
T100	2.5	2.5	100	100

The Sample Analysis Phase is the sample analyzed by parameters of Temperature, pH, Water Content, Organic Carbon Content (C-Organic), Total Nitrogen Level (N-Total), Total Phosphorus Level (P-Total), Total Potassium Level (K-Total) , C / N ratio, Color, Odor, Particle Size and Volume Depreciation.

3 Results and Discussions

3.1 Temperature

At the beginning of composting, the temperature of each reactor varies, this is because the waste taken has begun to experience a process of shortening organic matter and when mixing the ingredients it is possible that the ingredients are not evenly mixed. On Day 0 the highest temperature is found in the reactor T20 and T100 of 400C and the lowest temperature in the reactor T0, T60, and T80 are 37.5^{0}C. From day 0 to day 1 there is an increase in this temperature in accordance with the mesophilic phase where the temperature of the compost pile starts to increase because at the beginning of the composting process easily degraded compounds will be utilized by mesophyll microorganisms [3]. At the size of the compost pile that is sufficient to isolate heat due to the formation of CO2 gas from the activity of microorganisms, an increase in temperature will occur [3]. On day 1 the temperature reaches the highest temperature, the highest temperature on day 1 is in the T40 reactor with a temperature of 52^{0}C and the lowest temperature is in the T100 reactor with a temperature of 43.5^{0}C. On this 1st day almost all reactors reach the thermophilic phase except T5 with a temperature of 43.5^{0}C where when the temperature reaches 45^{0}C, mesophilic microorganisms die. The reactor temperature cannot reach 60^{0}C because the stack height cannot maintain the temperature until it reaches a high temperature. Decomposition process On day 1 continued by thermophilic microorganisms which work in the temperature range of 45-70^{0}C to decompose organic acids produced in mesophilic phlegm, complex carbohydrate compounds and proteins [3]. In this phase, the number of actinomycetes will continue to increase because these bacteria are resistant to heat. Some of these bacteria are able to remodel cellulose. While thermophilic fungi that live at a temperature range of 40-60^{0}C will overhaul hemicellulose and cellulose. At optimum conditions, the temperature can reach 60-70^{0}C and at this temperature range should be able to be maintained for 24 hours so that weed seeds and pathogenic bacteria die [8]. On the second to the 14th day, there is a cooling phase resulting in a decrease in temperature. This decrease in temperature is due to a decrease in microorganism activity. The T20 and T40 reactors on Day 11 have reached compost quality standards according to SNI 19-7030-2004 temperature standards such as groundwater temperature or 300C. Whereas the reactors T0, T60, and T80 reach groundwater temperature standards on day 12 and T100 reaching the standard groundwater temperature on day 13. Overall compost quality standards according to SNI 19-7030-2004 temperature standards such as groundwater temperature or 30^{0}C have achieved all reactors on day 14.

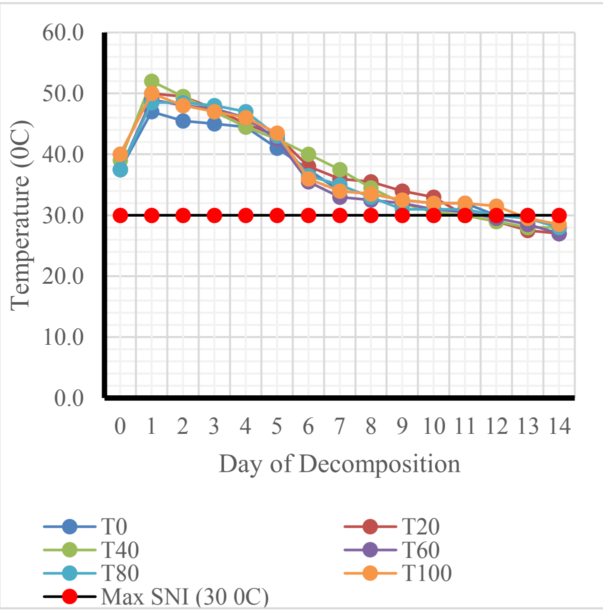

Fig. 1. Temperature changes during composting

3.2 pH

The pH in this study is in a fluctuating pH. At the pH of day 0, the highest pH was obtained T0 and T40 with pH 4.1, while the lowest pH was obtained T20, T60, T80 and T100 with pH 4.0. On day 1 there is a decrease in pH. This is in accordance with the revelation of a number of microorganisms that will convert organic waste into organic acids so that the degree of acidity will always decrease. However, in the next process, the degree of acidity will increase gradually, namely in the maturation period, because some types of microorganisms eat the organic acids formed [9]. In measuring the pH of this study T100 reactor pH on day 6 of 6.8 fulfilled SNI 19-7030-2004 compost quality requirements pH 6.80-7.49, while T0 reactor was 7.3, T20 was 6.9, T60 at 6.9 and T80 at 6.9 fulfill the requirements on day 7, while the T40 reactor at 6.9 fulfills the requirements on day 8. Overall the pH of all reactors meets the requirements of SNI 19-7030-2004 on day 8. On days 8 to 14 an increase in pH to pH did not meet SNI 19-7030-2004 requirements for compost quality pH 6.80-7.49.

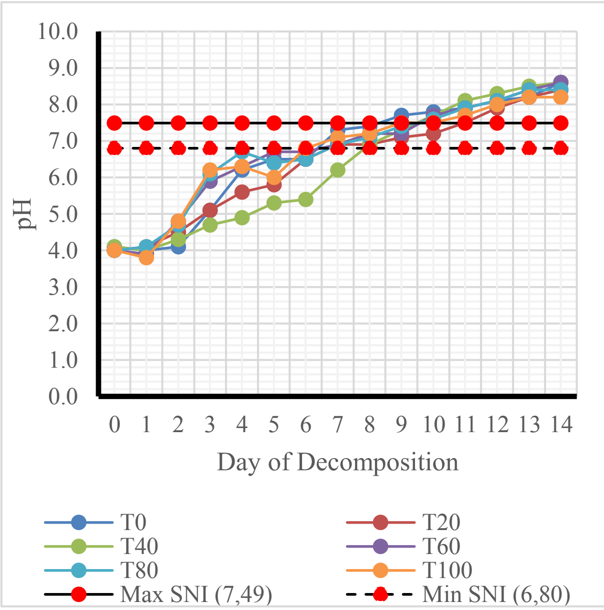

Fig. 2. pH changes during composting

3.3 Moisture

The moisture content of the test results found that each reactor decreases water content on day 0 to day 14 and at each reactor has different water content. In general, the highest water content is on day 0. Composition of leftover food waste such as stale rice, tea pulp, bone, leftover meat, rotten tempeh, vegetable stems, fruit peels, and others, and garbage from vegetables such as cucumber, mustard greens, cabbage, spinach, kale, tomatoes, coconut grated pulp and others have high water content. On day 0 the highest percentage of water content in T80 was 80.1% and the lowest percentage of water content at T20 was 65.6%. Water content has decreased until day 14. According to SNI 19-7030-2004 compost quality standards on parameters of maximum water content of 50%, from this study, T20 has met compost quality standards on day 6 with a value of 50.0%, all of them met compost quality standards on day 7. The highest water content in T100 was 49.7% and the lowest water content in T20 was 40.6%.

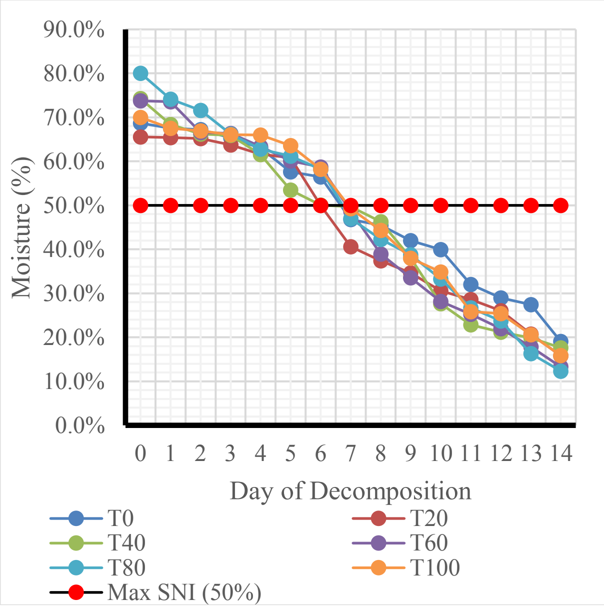

Fig. 3. Moisture content changes during composting

3.4 Carbon Organic Concentration

The overall C-organic level has decreased. On Day 0, the highest C-Organic content was obtained T100 with 50.17% and the lowest C-Organic content was obtained T0 with 38.75%. This decrease is in accordance with the statement of the mechanism of changes in nutrients into organic or energy compounds called metabolism. In the process of composting carbon compound it will also break down into CO2 into the air. This situation causes carbon to decrease during the composting process [10]. Decreasing levels of organic C is due to microorganisms degrading organic matter contained in compost materials such as carbohydrates, proteins, fats into simpler forms such as glucose, amino acids, and fatty acids. Decreasing C-Organic in all variations of ingredients and doses occurs because C-Organic in compost material serves as an energy source for microorganisms for their metabolic activity and decomposes in the form of CO2 into the air so that the amount will continue to decrease. A decrease in the activity of microorganisms will cause carbon content to increase. Increased levels of C-Organic are caused by increased biomass from dead microorganisms [11]. According to SNI 19-7030-2004, the standard of compost quality in C-organic parameters is 9.80-32%. On the 7th day, the T0 reactor was 26.68%, T20 was 31.97%, T80 was 29.39% and T100 was 30.82% which met the standard, while the T40 reactor was 30.30% met the standard on the day 10 and T60 of 29.58% met the standard on day 14. Overall all reactors met SNI 19-7030-2004 compost quality standards on day 14.

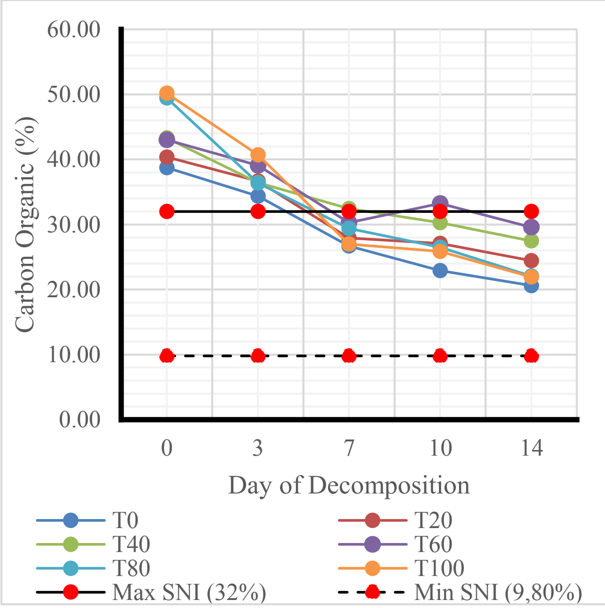

Fig. 4. C-organic changes during composting

3.5 Total Nitrogen Concentration

Overall testing of N-Total levels has increased. The highest N-Total level on day 0 in the T100 reactor with 1.19% and the lowest N-Total content in the T0 reactor with 0.89%. The N-Total value has increased during the composting process. In accordance with the statement that the overall nitrogen content in the mature compost of each composter has increased. Nitrogen levels are needed by microorganisms to maintain and form body cells. The more nitrogen content, the faster the organic matter decomposes, because the microorganisms that decompose the compost material require nitrogen for its development [12]. On day 0 all reactors meet the requirements of SNI 19-7030-2004 in the N-Total parameter of at least 0.4%. On the 14th day the highest total N-level at T60 is 3.18% and the lowest at T0 is 1.81%. Overall, all reactors meet SNI 19-7030-2004 compost quality standards on day 14.

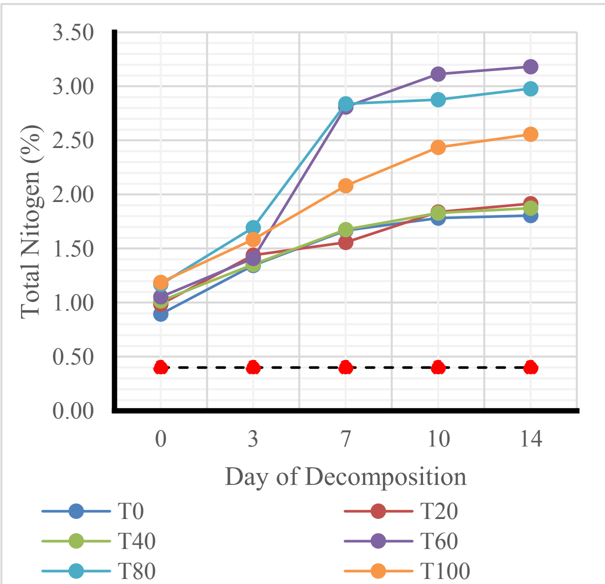

Fig. 5. N-total changes during composting

3.6 Total Phosphorus Concentration

Overall P-Total levels have increased. On Day 0 the largest P-Total level is obtained by T60 of 0.062% and the lowest is obtained by T0 of 0.011%. The phosphorus content is also influenced by the high nitrogen content, the higher the nitrogen contained, the multiplication of microorganisms that overhaul phosphorus will increase so that there is an increase in phosphorus content. Phosphate solvent bacteria generally can dissolve potassium elements in organic matter [13]. On the 3rd day, there were 2 reactors that fulfilled the requirements of SNI 19-7030-2004 on the P-Total Content parameter of 0.1%, namely the T60 reactor at 0.123% and the T80 reactor at 0.116%. On the 7th day of the reactor that fulfills the T20 reactor is 0.118%, T40 is 0.104%, T60 is 0.161%, T80 is 0.133% and T100 is 0.127%. While the T0 reactor fulfills the requirements on day 10 of 0.100%. Overall, all reactors meet the requirements of SNI 19-7030-2004 on the 10th day.

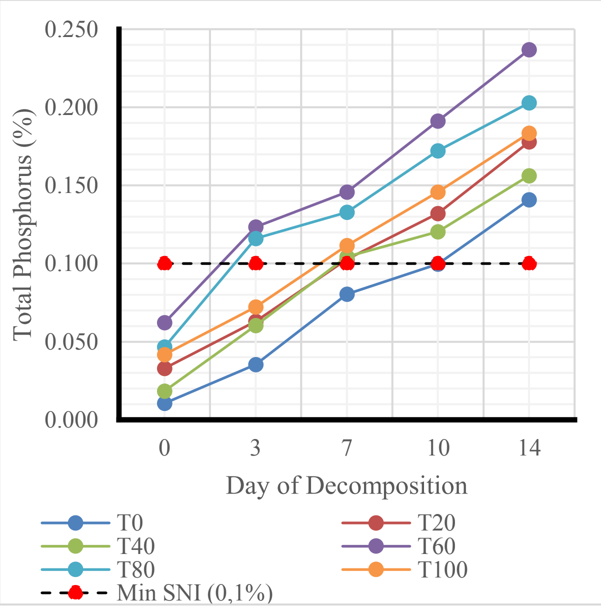

Fig. 6. P-total changes during composting

3.7 Total Potassium Concentration

Overall K-Total levels have increased. On Day 0 all reactors have met the requirements of SNI 19-7030-2004 in the K-Total Content parameter of 0.2%. On day 0 the highest K-total level was obtained by T80 of 0.989% and the lowest was obtained by T0 of 0.459%. Potassium (K) contained in mature compost, during the composting process the potassium value in mature compost increases [14]. On the 14th day, all reactors meet the requirements of SNI 19-7030-2004. On the 14th day, the highest K-Total level at T60 is 1.848% and the lowest is T0 of 1.047%.

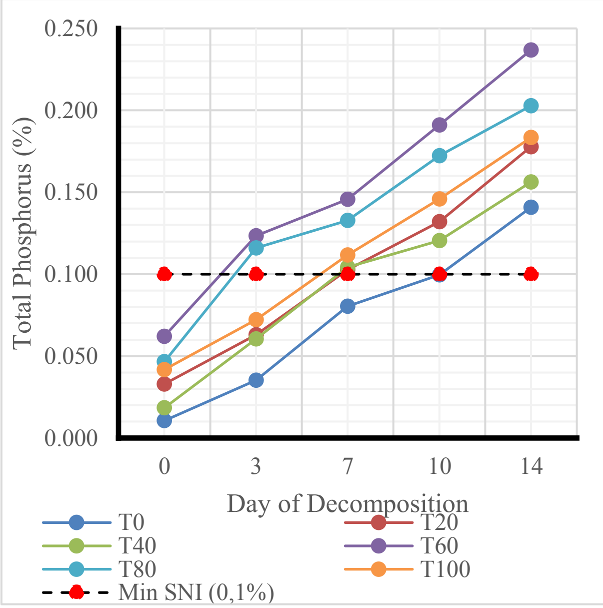

Fig. 7. K-total changes during composting

3.8 C/N Ratio

Overall the C / N ratio has decreased. On Day 0 the largest C / N ratio is obtained by T0 of 43.33 and the lowest is obtained by T60 of 40.86. This decrease is in accordance with the statement that for the formation of biomass, every ten parts of carbon requires one part of nitrogen, so this results in a decrease in the ratio of C / N to organic matter. By composting the ratio of C / N to organic materials can reach 20-15[15].On the 7th day the reactors T0, T20, T60, T80, and T100 meet the requirements of SNI 19-7030-2004 in the parameter C / N ratio of 10-20.

On the 7th day the highest C / N ratio on T40 is 19.37 so it does not fulfill the C / N ratio requirement and the lowest at T80 is 10.35. In T40 does not meet the compost quality requirements this is because the C-Organic Content of T40 on day 7 is 32.46% and N-Total Content is 1.68% so that the results of the C / N ratio obtained do not meet the standards. The T4 reactor meets the standard C / N ratio on the 10th day, while on the 10th day the T80 reactor does not meet the standard because the C / N ratio is too small at 9.21. This is because the N-Total T80 level is 2.84% so the C / N ratio becomes lower than SNI 19-7030-2004.

The standard compost ratios of C / N in SNI 19-7030-2004 are 10-20, so 1 digit C / N ratio of 10 with a range of $10 \leq x < 11$ is chosen which is considered the optimum result for compost that is considered mature, according to a statement to minimize the release of gas of this compound N, the stack must be adjusted to have a minimum C / N ratio of 10: 1 [16]. Therefore the reactor T0, T20, T40 has not received a C / N ratio of 10 to 14. The T60 gets a C / N ratio of 10.79 and T80 gets a C / N ratio of 10.35 on day 7 while the T100 gets The C / N ratio is 10.62 on the 10th day. So that the length of composting time from the C / N ratio of 10, the reactors T60 and T80 are the fastest variations of Sugarcane Drops when composting from all reactors is 7 days.

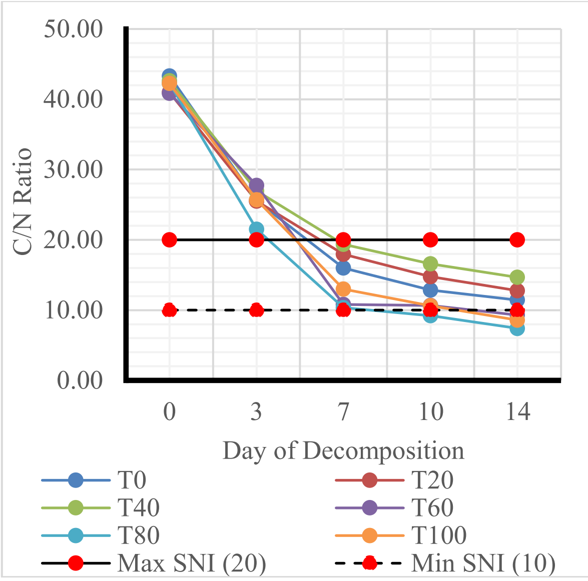

Fig. 8. C/N ratio changes during composting

3.9 Volume Reduction

Reduction of compost material in the pile is caused by the composting process of composting material changes by a number of microorganisms in which the microorganisms change the compost material in the form of organic material into metabolic products in the form of carbon dioxide (CO2), water (H2O), humus and energy. The final ripe compost material will decrease in volume or weigh more than 60% of the initial weight [17].

Table 2. Volume shrinkage during composting

Reactor	Days-				
	D-0	D-3	D-7	D-10	D-14
T0	0,00%	45,45%	45,45%	54,55%	72,73%
T20	0,00%	45,45%	45,45%	63,64%	72,73%
T40	0,00%	36,36%	45,45%	72,73%	81,82%
T60	0,00%	36,36%	63,64%	81,82%	81,82%
T80	0,00%	45,45%	63,64%	81,82%	86,36%
T100	0,00%	45,45%	63,64%	81,82%	90,91%

During the composting process, the volume and biomass will shrink. The compost volume/weight shrinks along with the compost maturity. The amount of shrinkage depends on the characteristics of the raw material and the level of compost maturity. Depreciation of compost material for each pile is due to the composting process when there is a change of compost material by a number of microorganisms, in which the microorganisms change the compost material in the form of organic matter into metabolic products in the form of carbon dioxide (CO_2), water (H_2O), humus and energy. The final ripe compost material will decrease in volume or weigh more than 60% of the initial weight [17]. The largest volume depreciation occurred at T100 at 90.91% while the smallest volume depreciation occurred at T0 and T20 at 72.73%. All reactors meet volume shrinkage requirements of more than 60% of the initial volume [17].

3.10 Colour, Smell dan Particle Size

The color, smell and size of compost particles meet SNI 19-7030-2004 on day 14. Soil smelling compost on day 7. While for compost color changes in accordance with SNI 19-7030-2004 because the color has been brown-black in the day 14. The color of compost contained in SNI 19-7030-2004 is blackish in color which is formed by the influence of stable organic matter. Compost has a smell like soil because the material it contains already has soil nutrient and blackish color formed due to the influence of stable organic matter. Meanwhile, fine compost texture occurs due to decomposition of living microorganisms in the composting process [2]. The compost particle size stated in SNI 19-7030-2004 is 0.55-25 mm, in all reactors on day 14 has a particle size of ± 5mm but there are still materials that are difficult to decompose like small leaf branches.

4 Conclusion

Based on the research above, it can be concluded that:

1. C / N ratio in T60 reactor with variations in composition of left over food waste 2.5 kg: 2.5 kg vegetable waste with the addition of 60 ml Sugarcane Drops and 100 grams Environmental Bioactivator meet the requirements of the C / N Ratio SNI 19-7030-2004 for 10 on the 7th day with a C / N T60 ratio of 10.79, when compared to the control on day 14 it did not meet the C / N ratio requirement, then the addition of 60 ml of sugar cane had an effect on the time of compost maturity.
2. The T60 reactor produces compost with nutrient content on the 7th day of C-Organic content of 33.55%, N-Total Content of 3.11%, P-Total Content of 0.161%, K-Total Level of 1.357%. While the water content of 48.71%, pH of 6.90, a temperature of 330C, brownish-black color, smelling of soil, and particle size ± 10 mm with shrinkage volume of 63.64%. From these data the reactor with the addition of 60 ml Sugarcane Drops fulfills SNI 19-7030-2004 concerning the Specifications of Compost from Domestic Organic Waste, but the C-Organic Content and temperature do not meet the requirements.

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