



Analysis of C/N Ratio Content in Market Waste Compost Fertilizer

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ABSTRACT

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Garbage, especially organic garbage, is created in higher numbers due to population development, and conventional markets are the main source of waste. Waste that is not managed appropriately will result in environmental pollution. However, compost can be generated from organic waste that comes from market garbage. Compost fertilizer is made by blending balanced components and managing aeration using a compost starter. One of the most important components of the overall nutritional balance is the ratio of organic carbon to nitrogen. This study used various bioactivators to calculate the C/N ratio of market waste. First, as part of the investigation, organic market trash is composted. The C/N ratio in the control, EM4, MOL, and rabbit urine treatments must subsequently be explained in the laboratory. Based on the research findings, C/N was 8 in control treatment and 4.35 in EM4 therapy. In the MOL therapy, the value was 6.69, whereas in the rabbit urine treatment, it was 8.18. None of these four treatments were able to achieve the compost quality parameters according to the regulations.

1. INTRODUCTION

Among the main sources of organic waste are traditional marketplaces. Organizational trash, or “market waste”, shares many components with domestic waste [1]. Improperly managed organic waste can lead to illness, produce pollution, leachate groundwater pollutants, gas that traps methane content to pollute the atmosphere and contribute to global warming, and emit an unpleasant stench [2]. Transforming organic waste into fertilizer is one way to address the issue of its existence. Compost and liquid organic fertilizer are the two types of organic fertilizer itself [3].

A mixture of organic materials breaks down partially or completely to produce compost fertilizer. This process can be intentionally expedited by populations of different bacteria in warm, humid environments that are either aerobic or anaerobic [4]. It will take a long time for compost made simply or naturally — without any additions — to mature. Up to three months may pass, some processes may take up to twelve months. This procedure is done in an environment with controlled humidity and protection from the sun’s and rain’s heat [5]. Compost fertilizer is made by combining well-balanced components, controlling aeration, and adding a compost starter [6].

The C/N or organic carbon to nitrogen ratio, is one of the most crucial elements of overall nutritional balance. The C/N ratio represents the proportion of carbon (C) to nitrogen (N) in an natural substance [7]. Because of the material’s relatively high or different C/N ratio from that of the soil, plants are unable to directly use or use the organic material found in compost [8]. The C/N or organic carbon to nitrogen ratio, is

crucial for giving the soil nutrients. Microorganisms need nitrogen to build proteins and carbon to provide energy [9]. According to the study [10], compost made from vegetables and agricultural wastes typically has a C/N ratio that is fairly close to soil’s C/N ratio, which speeds up the process of turning compost material into compost. An extremely high C/N ratio indicates a slow rate of organic matter decomposition. A sufficiently high C/N ratio suggests that the substance is tough to break down, whereas an excessively low C/N ratio suggests that the material breaks down quickly.

The carbon to nitrogen (C/N) ratio has been extensively studied thus far in a variety of settings. The C/N ratio has been the subject of numerous research, which have included discussions of its impact on the quality of compost produced from organic garbage [11], compost made from cabbage and banana peels [12], and POC made from leaves and goat urine [13]. However, no study has been done that particularly addresses the C/N ratio in compost made from market trash while utilizing various kinds of bioactivators. As a matter of fact, no study has been conducted that focuses on the C/N ratio of compost made from a variety of commercial garbage. Understanding market waste’s potential as a source of organic material for agriculture and its effects on the environment will be made easier with the help of this research.

2. MATERIAL AND METHODS

The garbage used in this study is market compost waste that comes from Hanura Village traditional market, Pesawaran Regency, Lampung Province, Indonesia.

The Integrated Laboratory, Faculty of Agriculture, University of Lampung is where composting is done. Further analysis is done once the compost is deemed safe for usage. The Lampung State Polytechnic Soil Laboratory conducted more analysis.

Compost is mostly made from market waste, with other ingredients including sawdust, coffee skins, and goat manure. The goal of combining sawdust, goat dung, and coffee skins is to add more nitrogen, phosphorous, potassium, and carbon to the compost and speed up the decomposition process [14]. The treatments include: (1) Utilizing compost without the use of bioactivator or stratert (control); (2) Using the bioactivator starter of Effective Microorganism 4 (EM4); (3) Using the bioactivator starter of Local Micro Organism (MOL); and (4) Using the bioactivator starter of rabbit urine. These three forms of bioactivators are the ones that are used in Indonesia, which is the reason why they are being employed [15]. Four repetitions were used for each treatment.

Composting takes thirty days to complete. One stirring is completed every seven days. Stirring is done to ensure the compost is mixed evenly. Laboratory analysis of the compost continues after it is deemed suitable for use. Values for organic

C content, total N, and supporting analysis were carried out, namely to measure the pH of the compost. The C/N ratio is computed subsequent to laboratory analysis.

3. RESULTS AND DISCUSSION

The requirements of the Ministry of Agriculture and SNI determine the quality of fertilizer in the country. Standards of the Indonesian Ministry of Agriculture derived from National Standard of Indonesia (SNI) 19-7030-2004 and No. 70 of 2011. The purpose of standards is to ensure that compost from Indonesia is safe, high-quality, and compliant with laws. It may be claimed that these two criteria serve as a guide for compost firms in Indonesia, helping to ensure that their products are safe, of good quality and comply with all applicable legislation.

One really significant factor for figuring out compost skin is C-organic content. The breakdown of microorganisms throughout the composting process is shown by the C-organic content. Values for the C-organic content derived from laboratory analysis are shown in Table 1.

Table 1. Analysis of the C-organic content of market waste compost

No.	Handling	Mark	SNI Guidelines		Standards Ministry of Agriculture	
			min	max	min	max
1.	Control					
	1	51				
	2	51.8				
	3	50				
	4	52				
	Average	51.20				
2.	EM4					
	1	54				
	2	53.4				
	3	54.2				
	4	54.6				
	Average	54.05				
3.	MOL					
	1	48				
	2	48				
	3	47.1				
	4	47.22				
	Average	47.58	9.80	32	15	-
4.	Rabbit Urine					
	1	36				
	2	35				
	3	36.4				
	4	36.66				
	Average	36.01				

The market waste organic waste compost from four treatment variations' outcomes of the laboratory analysis of the C-organic components content were found to not meet the SNI 19-7030-2004 standard, where the C-organic content for all treatments was above the maximum value, namely 32%. Similar findings were also made [3], whose investigation revealed that market waste compost's C-organic concentration was higher than the quality standard limit of 39.08%. On the other hand, according to the Ministry of Agriculture Standards, all treatments' C-organic content has surpassed the minimum threshold of 15%, meaning they satisfy the requirements for organic fertilizer quality.

In the EM4 treatment, the C-organic value was 54.05%, while in the control treatment, it was 51.20%. The amount of C-organic in the treatment including rabbit pee was 47.58%,

whereas it was 36.01% in the treatment that did not include rabbit urine. The rabbit urine treatment had the lowest value and the carbon content that was closest to the second standard value out of the four treatments. This is due to the fact that adding rabbit pee would increase the number of microorganisms that decompose organic market waste. The cellulose and starch included in compost materials are broken down into glucose monomers in part by cellulolytic and amyolytic bacteria [16]. This is consistent with Narendra's claim [17] that cellulolytic bacteria can lower the amount of carbon in cellulose by breaking it down into smaller molecules. In the meantime, the EM4 treatment had the highest carbon value out of the four compost treatments. This is consistent with the findings [18], which reported that adding the bioactivator EM4 causes the carbon content of compost to rise.

Because microorganisms in the compost will change the long chain polysaccharide content into short chain saccharides, which plants may take more quickly, the C-organic value also depends on the condition of the bacteria in the compost [19].

Microbes in the fermentation process greatly depend on organic C in compost fertilizer to aid in the breakdown of organic material [20]. Microorganisms will perish if organic C needs are not supplied. Meanwhile, organic C breaks down into CO₂, which is released into the atmosphere, causing a rise in organic C content [11]. The study [12] suggests that the utilization of microbes as an energy source for material degradation is what is responsible for the rise in organic C. Furthermore, the biological stuff it contains satisfies the needs of bacteria for living, which contributes to the high levels of C-organic [13].

Variations in the C-organic values of compost are influenced by the duration of the composting process,

according to the studies [14]. This is due to the fact that decomposing bacteria use solid organic C as a source of energy for metabolic functions and cell growth, converting it both aerobically and anaerobically into CO₂, NH₃, and H₂O. Since the goal of organic fertilizer is to enhance soil organic matter, the C-organic content is actually a crucial component [21]. Organic matter can be particularly important to agriculture and forestry since it can control different soil properties, act as a buffer for plant nutrient delivery, and affect soil structure. The application of a high C-content organic fertilizer can enhance the nutrient cycle services that are supplied to the soil during fertilization [7].

When composting, N content is one of the factors that must be taken into account (Table 2). Since plants create a lot of nitrogen, the nitrogen content of compost can aid in providing plants with the nitrogen they require to flourish.

Table 2. Analysis of the N (nitrogen) content of market waste compost

No.	Handling	Mark	SNI Guidelines		Standards Ministry of Agriculture	
			min	max	min	max
1.	Control					
	1	6.37				
	2	6.45				
	3	6.42				
	4	6.36				
	Average	6.40				
2.	EM4					
	1	12.4				
	2	12.6				
	3	12.52				
	4	12.2				
	Average	12.43				
3.	MOL					
	1	7.2				
	2	7				
	3	7.4				
	4	6.88				
	Average	7.12	0.40	-	4	-
4.	Rabbit Urine					
	1	4.6				
	2	4.5				
	3	4.4				
	4	4.1				
	Average	4.40				

According to the findings of the analysis of the N-Total element content in market waste organic waste compost from four different types of treatment, every treatment type meets the requirements of Minister of Agriculture Regulation No. 70 of 2011 (the N-Total levels for all treatments were above 0.4% and 4%), as well as SNI 19-7030-2004 standards. In EM4, the N-Total value attained was 12.43%, whereas the N-Total content value in the control treatment was 6.40%. Next, the N-Total value in the rabbit urine treatment was 4.40%, while the N-Total value in the MOL treatment was 6.88%. These findings showed that the compost treated with EM4 had the highest N-Total levels, whereas the compost treated with rabbit urine had the lowest N-Total values.

The mechanism by which microorganisms break down compost material and convert ammonia into nitrite is what causes the rise in the proportion of N-Total during the composting period. In addition, microbes provide a variety of single-cell proteins that are produced during fermentation. When the decomposition process is over, nitrogen is released once more and is one of the ingredients in compost fertilizer.

As a result of the breakdown, some nutrients, particularly nitrogen, become bound in the bodies of microbes, which will subsequently revert to being microorganisms [22]. Microorganisms in the soil use nitrogen as an energy source, and this process is crucial for the weathering of organic matter. The process of photosynthesis requires this nitrogen [23]. The higher the nitrogen level, the faster organic material will decompose since the microbes that break down compost material need nitrogen for growth [24]. A more thorough breakdown process is the reason for the significant quantities of nitrogen that are available [25].

The release of nitrogen oxide bonds to become free nitrogen, which raises the N-Total content in the compost heap as a result of microorganisms breaking down organic matter, is another factor contributing to the increase in N-Total levels [26]. The easier it is for the basic composting material to break down and create a larger overall N content of compost, the higher its N content. The activity of the microorganisms in the compost has an impact on the rise in nitrogen content during the composting process [19].

The primary nutrient for plant growth is nitrogen, which is also the most important nutrient for the development of vegetative organs including leaves, stems, and roots. However, excessive nitrogen levels can prevent plants from flowering and bearing fruit. The organic components used in the market waste processing process, specifically the leftovers of decaying vegetable trash, provide the nitrogen content. Compost creation has occurred when weathering takes

occurring. Nitrate (NH_3^-) and ammonium (NH_4^-) ions are the two types of nitrogen that plants take; together, they are referred to as N [27].

The C/N ratio is a comparison between nitrogen and carbon. Because it breaks down the organic material in compost, the C/N ratio is essential for composting (Table 3). An overly high C/N ratio will prevent the compost from breaking down properly.

Table 3. Analysis of the C/N ratio content of market waste compost

No.	Handling	Mark	SNI Guidelines		Standards Ministry of Agriculture	
			min	max	min	max
1.	Control					
	1	8.2				
	2	8				
	3	8				
	4	7.8				
	Average	8				
2.	EM4					
	1	4.5				
	2	4.3				
	3	4.4				
	4	4.2				
	Average	4.35				
3.	MOL					
	1	6.56				
	2	6.7				
	3	6.7				
	4	6.8				
	Average	6.69	10	20	15	25
4.	Rabbit Urine					
	1	8.4				
	2	8.2				
	3	8.12				
	4	8				
	Average	8.18				

The C/N ratio in the control treatment was 8, EM4 was 4.35, MOL was 6.69, and rabbit urine had an 8.18 test result. None of the four treatments was able to meet the second criteria for compost quality. The SNI 19-7030-2004 standard specifies a minimum value of 10 and a maximum value of 20 for the C/N ratio. In the meantime, the C/N ratio has a minimum value of 15 and a maximum value of 25 according to Minister of Agriculture standard No. 70 of 2011. The values obtained in the four forms of therapy do not reach the minimum value and fall short of the standard based on these two standards. The control treatment and rabbit urine have the C/N ratio values that are most similar to the two standards, according to the laboratory analysis results. Similar findings were also made, and the research yielded a C/N ratio of 12.29 for compost made from household garbage, which was still below the SR Ministry of Agriculture's compost criterion. Despite this, SNI 19-7030-2004 compost criteria are still met (140/10/2011).

The low C/N ratio of organic fertilizer is caused by the presence and activity of microorganisms in it. The longer the fermentation process takes, the lower the C/N ratio gets. This is because microorganisms use the C content of organic fertilizer-making materials as a source of food or energy, which has resulted in a significant decrease in C content. However, the process by which microorganisms break down organic fertilizer components has raised the nitrogen content by generating nitrogen and ammonia in the right proportion [28]. The compost's maturity stage can be determined by looking at its C/N value [29]. The research claims that because the C/N ratio value influences the compost's nutrient

availability, it defines the compost's quality [30].

The C/N ratio is the ratio of the microbial energy supply to the nitrogen needed for protein synthesis. The most important aspect influencing compost's C/N ratio is its total compost N content [31]. The C/N ratio is the proportion of carbon (C) to nitrogen (N) components that are present in an organic substance [9]. Carbon and nitrogen are essential for the survival of microorganisms. The C/N ratio affects the nutrients' availability. Because the two have an inverse relationship, a high ratio indicates that there is little nutritional content accessible for plants, while a low ratio indicates that there is a high availability of nutrients and that plants can satisfy their daily demands. High N content materials can also result in a low C/N ratio [32].

By examining the pH of the compost, one can ascertain whether or not composting was successful (Table 4). Since the pH of compost generally reflects maturity and readiness for use, monitoring the compost's pH was an extra component of this study.

The market waste organic waste compost's ultimate acidity level (pH) after all four forms of treatment is greater than 9, surpassing both the SR Ministerial Decree's maximum standard and the maximum SNI standard for mature compost, which is 7.49. 140/10/2011, or 4-9, and the value is significantly higher than the pH of soil. The pH values of all the treatments are generally similar, falling between 9.3 and 9.4, with the MOL and rabbit urine treatments having the highest pH values.

Table 4. Analysis of the pH content of market waste compost

No.	Handling	Mark	SNI Guidelines		Standards Ministry of Agriculture	
			min	max	min	max
1.	Control					
	1	9.2				
	2	9				
	3	9.6				
	4	9.4				
	Average	9.3				
2.	EM4					
	1	9.6				
	2	8.8				
	3	9.5				
	4	9.3				
	Average	9.3				
3.	MOL					
	1	8.9				
	2	9.58				
	3	9.6				
	4	9.52				
	Average	9.4	6.80	7.49	4	9
4.	Urine Kelinci					
	1	9.45				
	2	9.2				
	3	9.49				
	4	9.46				
	Average	9.4				

The composting process can occur over a wide pH range. The optimal pH range for the composting process is between 6.5 and 7.5. The organic material and the substance's pH will alter as a result of the composting process. For instance, the release of acid, either locally or temporarily, will result in a pH drop (acidification), whereas early composting stages will see a pH increase due to ammonia synthesis from nitrogen-containing molecules. Mature compost often has a pH that is fairly near to neutral [33].

The degree of acidity, or pH value, also referred to as hydrogen ion activity, describes the acidity, neutrality, or alkalinity of organic waste. The pH value, represented as $-\log(\text{H}^+)$, indicates the concentration of H^+ ions in organic waste. When determining pH, organic waste and water solvent are compared in a transparent solution [34]. The growth of decomposing microorganisms is significantly influenced by the pH level throughout the composting period. The nitrogen components in the compost material will convert to ammonia (NH_3) at a pH level that is too high. However, a pH level that is too low will kill some of the microorganisms that break down, which can stop the composting process. The pH of the compost rises as a result of the organic material's proteins breaking down and ammonia being released throughout the composting process [35].

4. CONCLUSION

Overall, the compost created from organic market waste still has a poor C/N ratio value. This figure does not meet the required standards, as per SNI 19-7030-2004 and Minister of Agriculture Regulation No. 70/Permentan/SR.140/10/2011.

The treatment that included rabbit pee came the closest to the minimal standard value out of the four treatments (control, EM4, MOL, and rabbit urine).

5. RECOMMENDATION

The research findings indicate that, in comparison to the compost quality guidelines, the compost quality is still not up to grade. Therefore, in order to refine future study, more investigations on the usage of organic market waste with different activators must be conducted.

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