



pH, Water Content, C-Organic and C/N of Compost Fertilizer Based on Goat Manure with the Addition of Water Hyacinth (*Eichhornia crassipes*) and EM4

Ita Wahju Nursita^{1,*} and Eka Nurwahyuni²

¹Faculty of Animal Science, Universitas Brawijaya, Malang 65145, Indonesia

² Faculty of Animal Science, PSDKU Universitas Brawijaya, Kediri 64111, Indonesia
*nursita@ub.ac.id

Abstract. This research aimed to determine the pH, water content, C-Organic, and C/N of goat manure-based compost fertilizer with the addition of water Hyacinth and Effective Microorganisms and determine which is good according to Minister of Agriculture Decree number 261/2019. The method used was an experimental method designed descriptively with 4 treatments and 3 repetitions; this is only for making composite samples for laboratory analysis. Data will be analysed descriptively for the variables. The treatments given were T0 = 100% goat faeces, T1 = 85% goat faeces + 15% water hyacinth, T2 = 80% goat faeces + 20% water hyacinth, and T3 = 75% goat faeces + 25% water hyacinth. The results showed that the pH of the compost for each treatment ranged from 7-8. Water content ranged from 44.30% - 57.90%. C-Organic content ranged from 12.04% - 15.36%. The N-Total content ranged 2.16 - 3.01%. C/N ratio values ranged from 4.5 – 7.1. Based on research results, adding water hyacinth as a basic ingredient for making compost fertilizer can increase the pH value, water content and total N. The addition of water hyacinth can reduce the value of organic C/N content and the value of C/N ratio. The addition of water hyacinth does not meet the standards of Minister of Agriculture Regulation Number 261 of 2019 concerning several contents such as water content and organic C, so the addition is 15%, 20% and 25% need to be studied further.

Keywords: Decomposition, Animal Waste, Water Weed, Chemical Quality.

1 Introduction

The goat population in 2022 reached 3,897,185 [1]. Along with the increase in the goat population in East Java, it is certainly followed by an increase in the amount of waste produced. In one day, one goat can produce 1.13 kg of waste per day [2]. If not managed properly, this waste can pollute the surrounding environment. One way that can be used to process livestock waste is by utilizing it by processing goat waste into compost.

Water hyacinth (*Eichhornia crassipes*) is a plant that grows in waters such as lakes, swamps, and rivers. The growth rate of this plant is very fast so that this plant can cover the surface of the water. Water hyacinth has a negative impact on water areas such as damaging the ecosystem, affecting the transportation process in the waters, making the

waters quickly shallow, and reducing the beauty due to the presence of old water hyacinth roots [3]. The chemical composition of water hyacinth consists of organic material of 78.47%, organic C 21.23%, total N 0.28%, total P 0.0011% and total K 0.016% so that with the composition of water hyacinth it can be used as organic fertilizer [4].

Ellya's research [5] showed that the C/N ratio content in water hyacinth composting alone was 24.05%. The results of Widyastuti and Arfa's [6] showed that combination of 0.5 kg of water hyacinth + 1 kg of cow dung + 1 kg of rice bran produced organic fertilizer with quality that met the quality standards of the Minister of Agriculture number 261/2019 [7] regarding the technical requirements of organic fertilizer. The study of Napoleon and Sulistyani [8] study aims to determine the quality of compost from a combination of water hyacinth (*Eichornia crassipes* Mart. Solm) and goat manure. The parameters measured in the study were physical quality (smell, moisture content, temperature, particle size and color) and pH. From the research results obtained showed that the best ratio of water hyacinth and goat manure was 50% : 50% in all parameters, both physical properties and pH is in accordance with SNI 19-7030-2004 [9]. The research has not yet obtained data on its C/N ratio which is one of the important parameters of compost quality.

EM4 can be used to accelerate the decomposition of organic waste, to increase growth, to improve the quality and quantity of production [10]. The composition of EM4 consists of 5 main groups, namely photosynthetic bacteria, *Lactobacillus* sp., *Saccharomyces* sp., *Actinomyces* sp., and fermentation fungi [6].

To produce good compost, the nutritional content in it must be in accordance with Minister of Agriculture number 261/2019 [7], including water content, C/N ratio, and pH. Based on the description above, a study will be conducted on the effect of chemical quality on compost fertilizer with goat manure mixed with water hyacinth using the EM4 starter. This study aimed to determine the pH, water content, C-Organic, and C/N of goat manure-based compost fertilizer with the addition of water Hyacinth and Effective Microorganisms and determine which is good according to Minister of Agriculture number 261/2019 [7].

2 Materials and Methods

2.1 Location and Time of Research

This research was conducted at the Sumber Sekar Laboratory, Faculty of Animal Husbandry, Jl. Raya Apel No. 142, Semanding, Sumbersekar, Dau District, Malang, East Java and the analysis of nutrient content was conducted at the Research Center for Various Legumes and Tuber Crops (Balai Penelitian Kacang-kacangan dan Ubi/BALITKABI) Jl. Raya Kendalpayak No. 66, Segaran, Kendalpayak, Pakisaji District, Malang Regency. The duration of the study was 68 days, starting from June 4, 2023 to August 10, 2023.

2.2 Research Materials

The materials used in this study were goat faeces with different proportions then fermented using Effective Microorganism (EM4) with different proportions of water hyacinth. The mature compost was analysed for its nutrient content including pH, Water content, C Organic, and C/N ratio.

2.3 Research Methods

The method used in this research is a field experiment designed with a descriptive method with 4 treatments and 3 replications, so that there are 12 research experimental units. The results of the experiment were then analysed in the laboratory.

The experiments conducted treatments were:

T0: 2,500 g goat faeces + EM4 (100% goat faeces)

T1: 2,125 g goat faeces + 375 g water hyacinth + EM4 or (85% goat faeces + 15% water hyacinth)

T2: 2,000 g goat faeces + 500 g water hyacinth + EM4 or (80% goat faeces + 20% water hyacinth)

T3: 1,875 g goat faeces + 625 g water hyacinth + EM4 or (75% goat faeces + 25% water hyacinth)

2.4 Compost Fertilizer Making

The compost fertilizer making process uses an aerobic composting method. The process of making compost in this study includes:

1. Prepare goat faeces, water hyacinth, and EM4 decomposer that have been weighed according to the treatment
2. Goat faeces and water hyacinth are mixed and homogenized according to each treatment
3. The composition of the decomposer solution consists of 1500 ml of water, 30 ml of molasses, and 30 ml of EM4 microbial culture for all treatments, with the total of all materials in all treatments being 2500 g. The decomposer solution contained is added according to each treatment and homogenized by spraying gradually so that it is perfectly homogeneous.
4. Put all the homogenized materials into the bucket that has been numbered
4. Repeat the 2nd to 4th procedures until all repetitions are complete
5. Ferment for 14 days aerobically until the compost temperature is stable
6. Check the temperature and pH of the compost every day by inserting a thermometer and pH meter from the top of the fertilizer mound
7. The finished compost is then tested for its nutrient content including water content, C-Organic and C/N ratio

2.5 Research Variables

The variables measured in this study were water content, C/N ratio, and pH level of the compost. Data collection on each variable was carried out using a laboratory test.

Water Content. The measurement of the water content of the compost was carried out using the gravimetric method which in principle calculates the weight of the sample before and after being dried using an oven at a temperature of 105-110°C.

C/N Ratio. The measurement of the C/N ratio was carried out by comparing the C-organic value (Walkley and Black method) and total N (Kjedahl method).

Compost pH. The pH measurement was carried out using a pH meter. The measurement of the compost pH was carried out every day during the composting process. Measurements were taken in the afternoon at 15.00 WIB.

2.6 Data Analysis

Data analysis used to find out the use of goat manure with the provision of water hyacinth as compost fertilizer reviewed from pH, water content, organic CC, and C/N ratio using a qualitative descriptive method, namely a type of research that aims to explain and describe conditions or everything related to variables that can be explained using either numbers or words. With this method, researchers hope to obtain accurate and complete data based on facts in the field.

3 Results and Discussion

3.1 Effect of Treatment on Compost Temperature

The temperature measured in this study was the temperature inside the pile of research samples using a soil temperature meter. From the Table 1, on day 1 the average compost temperature showed $T_0 = 30.2 \pm 0.64^\circ\text{C}$, $T_1 = 29.3 \pm 0.23^\circ\text{C}$, $T_2 = 30.5 \pm 1.06^\circ\text{C}$, and $T_3 = 29.6 \pm 0.64^\circ\text{C}$. Temperature measurements on day 2 experienced an increase in temperature, namely $T_0 = 31.0 \pm 0.15$, $T_1 = 30.1 \pm 0.20$, $T_2 = 31 \pm 0.95$, and $T_3 = 30.3 \pm 0.90$. On days 4, 7 and so on, the compost temperature decreased. The increased temperature on the 2nd day indicates that there is microbial activity in the compost pile. According to Idawati et al. [11], a regular increase in temperature in compost indicates that the activity of microorganisms that decompose organic materials is increasing. Microorganisms that decompose organic materials work actively on the second day and begin to decline the following day along with the reduction in organic materials that can be decomposed or utilized as energy by microbes. A picture of the increase and decrease in temperature during the composting process can be seen in the picture below.

Table 1. Average Compost Temperature (°C) in Various Treatments.

Treatment	Day (°C)					
	1	2	4	7	10	14
T ₀	30.2 ± 0.64	31.0 ± 0.15	27.8 ± 0.17	27.3 ± 0.46	27.0 ± 0.44	27.2 ± 0.35
T ₁	29.3 ± 0.23	30.1 ± 0.20	27.7 ± 0.35	27.0 ± 0.15	27.5 ± 0.20	25.5 ± 0.21
T ₂	30.5 ± 1.06	31.0 ± 0.95	28.4 ± 0.15	26.7 ± 0.53	26.8 ± 0.35	27.2 ± 0.25
T ₃	29.6 ± 0.64	30.3 ± 0.90	28.1 ± 0.23	26.4 ± 0.36	26.8 ± 0.25	24.9 ± 0.57

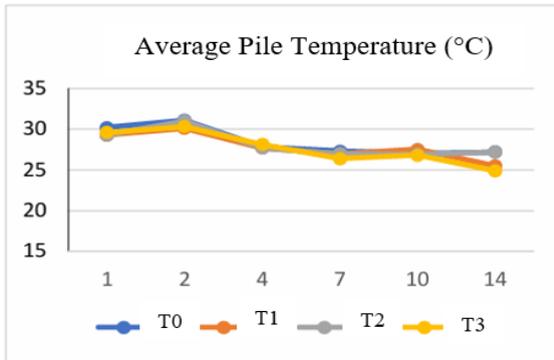


Fig. 1. Average Compost Temperature Graph (°C)

The image above shows the results of compost temperature measurements that experience fluctuations. On day 1, the compost temperature was 29.3-30.2°C and increased on day 2 to 30.1-31.1°C for all treatments. On day 2, the temperature increased due to the activity of compost-decomposing microbes which decompose organic matter into CO₂, water vapor, and heat. After day 4, 7 and onwards, the compost temperature decreased because most of the organic matter in the compost had decomposed. According to Sahwan [12] stated that increasing temperature indicates that microorganisms are working, in the process of respiration with organic matter that is being decomposed. According to Yulianto et al. [13] when there is a very active decomposition of organic matter, the microbes in the compost will decompose the organic matter into ammonia (NH₃), CO₂, water vapor, and heat. After most of the organic matter has been decomposed by microorganisms, the temperature will decrease to reach normal temperatures like soil. Changes also occur in the colour of the compost, which starts out light brown and changes to blackish brown. Changes in texture and smell like soil. This indicates that the compost is mature and can be tested in the laboratory. According to Idawati et al. [11], mature compost has the characteristics of a brownish black colour, loose structure, and a compost smell that resembles soil. From the results of research observations, it can be concluded that the temperature, colour, texture, and odour of the compost have met the requirements of SNI 19-7030-2004 [9] which states that the maturity of the compost is in accordance with the groundwater temperature ranging from 25-28°C, blackish in colour, texture and odour like soil.

3.2 Effect of Treatment on pH Compost

The success of the composting process is determined by several factors, one of which is the degree of acidity (pH). The average measurement of the compost pH for each treatment can be seen in the table below.

Table 2. Average pH of Compost in Various Treatments.

Treatment	Day						Standard pH 4-9
	1	2	4	7	10	14	
T ₀	7.0 ± 0.00	7.0 ± 0.00	8.0 ± 0.00	7.0 ± 0.00	7.1 ± 0.17	7.0 ± 0.00	√
T ₁	7.1 ± 0.26	7.1 ± 0.00	7.7 ± 0.29	7.2 ± 0.23	7.2 ± 0.23	7.7 ± 0.58	√
T ₂	7.3 ± 0.12	7.3 ± 0.00	8.0 ± 0.00	7.1 ± 0.17	7.2 ± 0.23	8.0 ± 0.00	√
T ₃	7.1 ± 0.12	7.1 ± 0.00	7.7 ± 0.58	7.1 ± 0.23	7.1 ± 0.17	7.7 ± 0.58	√

√: According to the pH of the 14th day with Minister of Agriculture number 261/2019 [7]

Based on the research data above, we can see that the average pH of the compost on day 1 experienced an increase in acidity until day 4. The average pH of the compost on day 1 showed pH values, namely, T₀ = 7 ± 0.00, T₁ = 7.1 ± 0.26, T₂ = 7.3 ± 0.12, and T₃ = 7.1 ± 0.12 increased on the 4th day, namely, T₀ = 8 ± 0.00, T₁ = 7.7 ± 0.29, T₂ = 8 ± 0.00, and T₃ = 7.7 ± 0.58 then decreased again on the 7th day, namely, T₀ = 7 ± 0.00, T₁ = 7.2 ± 0.23, T₂ = 7.1 ± 0.17, and T₃ = 7.1 ± 0.23. The pH value will increase in the organic material decomposition process. The increase in compost pH is caused by the activity of microorganisms in the process of breaking down organic materials into ammonia, the increase in pH is caused by ammonia which has basic properties. According to Dewilda and Darfyolanda [14] stated that the increase in pH occurs because the composting process will produce ammonia and nitrogen gas. According to Putro et al. [15] stated the process of decomposition of organic material by microorganisms which causes an increase in humic acids, H⁺ ions and phenols produced from the process of decomposition of organic materials. An illustration of the increase and decrease in compost pH can be seen in the picture below.

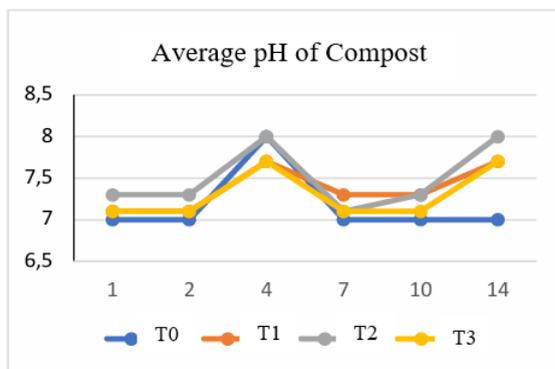


Fig. 2. Average Compost pH Graph

Based on the image above, it shows the results of measuring the compost pH which fluctuated in all treatments. The increase in compost pH for T0, T1, T2, and T3 occurred on the 4th day, then decreased again the next day. At the end of the composting process, it was found that the compost pH value for each treatment was T0 = 7, T1 = 7.7, T2 = 8, and T3 = 7.7. This indicates that the compost is mature, because it is in accordance with the quality standards of the Minister of Agriculture number 261/2019 [7] which states that good compost must have a degree of acidity (pH) with a minimum limit of 4 and a maximum limit of 9. According to Indriani [16], in the composting process, organic acids will become neutral, and the compost will be mature if it reaches a pH with a minimum limit of 6 and a maximum limit of 8.

3.3 Effect of Treatment on Water Content

Based on Table 3, the highest water content on day 1 is found in T3, which is 53% with the use of goat faeces of 1875 g (75%) and water hyacinth of 625 g (25%) and the lowest water content is found in treatment T0, which is 41.70% with the use of goat faeces of 2500 g (100%). The water content on day 1 is in accordance with the requirements. According to Hastuti et al. [17] the water content in the composting process that is below 40% will cause a decrease in microorganism activity, while the water content exceeding 60% will also result in reduced aeration so that the composting process will produce an unpleasant odour and nutrients will dissolve. This is in line with Kurnia et al. [18] which states that the compost water content exceeds 60%, then the air volume decreases, the odour is unpleasant, and the decomposition process is hampered.

Table 3. Compost Water Content (%) on Days 1 and 14.

Treatment	Water Content (%)		40-60%	10 - 25%
	Days 1	Days 14	Hastuti et al. [17]	Reg. No. 261/2019
			Days 1	Days 14
T ₀	41.70	44.30	–	–
T ₁	51.20	54.90	√	–
T ₂	50.40	52.70	√	–
T ₃	53.00	57.90	√	–

(√): In accordance with Hastuti et al. [17] or Regulation No. 261 of 2019

(–): Not in accordance with Hastuti et al. [17] or Regulation No. 261 of 2019

Based on the research results, it is known that the highest water content on the 14th day is found in T3, namely 57.90% with the use of goat faeces of 1875 g (75%) and water hyacinth of 625 g (25%) and the lowest water content is in the T0 treatment, namely 44.30% with the use of goat faeces of 2500 g (100%). The results of this research and observation do not comply with the quality standards of the Minister of Agriculture number 261/2019 [7] which states that compost enriched with good microbes has a water content with a minimum limit of 10 and a maximum limit of 25. The provision of water hyacinth causes high water content. Based on the research results of Wulandari et al. [19] that the water content of composting from water hyacinth has a higher water

content compared to composting from manure, this is because water hyacinth has a high-water content. The dynamics of the water content in compost can be seen in the picture below.

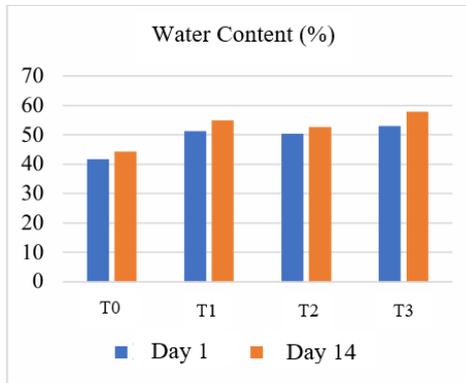


Fig. 3. Dynamics of Compost Water Content on Days 1 and 14.

Based on the image above, we can see that the water content on day 14 is higher than on day 1. The difference in values is caused by the storage environment being too humid, lack of turning, and the water hyacinth raw materials used in this study are still not in accordance with the ideal conditions for the composting process. According to Rasyid et al. [20] who stated that the water content in compost that is too high needs to be dried first and the compost will be blackish grey, have a crumbly structure, and have high absorption capacity.

The need for turning during the composting process so that air enters the pile and dries the material [18]. At the end of the composting process, it was found that the water content of the compost for each treatment was T0 = 44.30%, T1 = 54.90%, T2 = 52.70%, and T3 = 57.90%. Based on the results of observations of water content, it shows that the provision of water hyacinth is not in accordance with the compost standards that have been set by Minister of Agriculture number 261/2019 [7].

3.4 Effect of Treatment on C – Organic

Based on Table 4, the research results show the organic C elements on day 1 as follows T0 = 32.91%, T1 = 29.19%, T2 = 25.85%, and T3 = 25.15%. The results of this research and observation show that in the T0 treatment, namely 32.91%, it is in accordance with the ideal organic C elements, while in the treatment with water hyacinth, namely T1 = 29.19%, T2 = 25.85%, and T3 = 25.15%, it is not in accordance with the ideal organic C elements. The organic C elements from water hyacinth are lower compared to the organic C content in goat faeces. According to Setiawan [21], the organic C content of compost from water hyacinth and manure with the addition of EM4 is smaller than that of compost from water hyacinth with the addition of EM4. The high organic C content

will slow down the composting process. This is in line with Ismayana et al. [22] who stated that high organic C causes the slow composting process.

Table 4. C-Organic Content (%) of Compost on Day 1 and Day 14.

Treatment	C Organic (%)		30-40%	> 15%
	Days 1	Days 14	Putro et al. [15]	Reg. No. 261/2019
			Days 1	Days 14
T ₀	32.91	15.36	√	√
T ₁	29.19	13.99	–	–
T ₂	25.85	14.32	–	–
T ₃	25.15	12.04	–	–

(√): In accordance with Putro et al. [15] or Regulation No. 261 of 2019

(–): Not in accordance with Putro et al. [15] or Regulation No. 261 of 2019

Based on the results of the study, the organic C content on the 14th day was as follows: T₀ = 15.36%, T₁ = 13.99%, T₂ = 14.32%, and T₃ = 12.04%. According to the quality standards of the decree of the Minister of Agriculture number 261/2019 [7] it states that good compost enriched with microbes has an organic C content with a minimum limit of 15%. The results of this research and observation show that the T₀ treatment, which is 15.36%, is in accordance with the standards set by the Regulation of the Minister of Agriculture number 261/2019 [7], while the treatment with the provision of water hyacinth, namely T₁ = 13.99%, T₂ = 14.32%, and T₃ = 12.04%, has not reached the standards set by the Regulation of the Minister of Agriculture number 261/2019 [7]. The reduction in organic C elements is used as an energy source for microorganisms through the oxidation process, producing heat. Changes in compost by microorganisms include the decomposition of cellulose, hemicellulose, and other contents into CO₂ and water vapor.

According to Sukmawati [23], the decrease in organic C levels in compost is caused by the continuous biochemical reaction of carbohydrate changes used as an energy source by decomposing microorganisms. This is in line with Bachtiar and Ahmad [24] who stated that in the composting process, organic compounds will decrease and there will be a release of CO₂ caused by the activity of microorganisms so that it can affect the organic C content of the resulting compost. The dynamics of organic C content in compost can be seen in the following image.

Based on the image below, we can see that the C-organic element on day 14 has a lower value compared to day 1. The difference in C-organic elements in compost occurs because microorganisms during the composting process use C-organic elements as an energy source to decompose organic materials. According to Gunawan et al. [25], in the early stages of composting, microorganisms carry out metabolism to develop cell size, then use C-organic elements as an energy source to reproduce and decompose organic materials. One of the factors that cause the excessive decrease in C-organic elements in this study is caused by external factors, namely the long testing time. This causes the excessive decrease in C-organic elements.

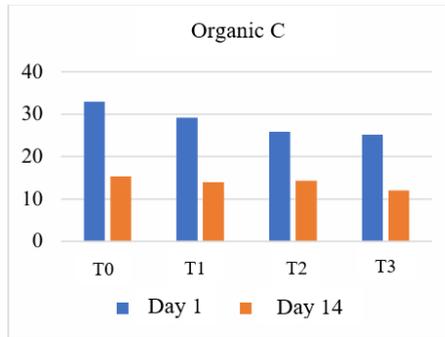


Fig. 4. Dynamics of Compost C-organic Content on Day 1 and Day 14.

According to Sari and Yusmah [26], storing compost for too long can reduce the organic C content, because organic materials decompose over time. Based on the results of observations, the decrease in organic C elements is influenced by high water content. According to Hermansen et al. [27], organic C content has a negative relationship with water content, where the water content increases, the organic C decreases. At the end of the composting process, it is known that the organic C elements of the compost for each treatment are T0 = 15.36%, T1 = 13.99%, T2 = 14.32%, and T3 = 12.04%. Based on the results of observations, it shows that the provision of water hyacinth is not in accordance with the compost standards set by Regulation of the Minister of Agriculture number 261/2019 [7].

3.5 Effect of Treatment on Total N

Macronutrients are nutrients that are needed by plants that function as growth, development, and physiological functions. One of the macronutrients is Nitrogen (N) which plays a role in vegetative plant growth. The N element is needed by microorganisms for their growth in the composting process. The initial composting process requires ideal N elements with a maximum limit of 1% [15]. The following total N-compost content can be seen in the table below.

Based on table 5, the research results show the total N elements on day 1 as follows T0 = 2.35%, T1 = 2.37%, T2 = 2.38%, and T3 = 2.05%. This shows that the total N elements are not in accordance with the ideal composting process. In contrast to the research results on day 1 conducted by Trivana et al. [28], fertilizer from goat manure has a total N value on day 1 of 1.41%, while in the study of Tawa et al. [29] the total N produced from cow manure on day 1 was 2.59%. Too high total N at the beginning of composting can cause the C element to decrease and the N element to increase, which causes the C/N ratio to be lower.

According to Bachtiar and Ahmad [24], the higher the total N element causes organic matter to decompose quickly, because the total N is used as the development of microorganisms. The ideal C/N ratio for composting is 30:1, while the total N element obtained is 2%, so the organic C that must be obtained is around 60%. According to Ismayana et al. [22], the C/N ratio for the beginning of good composting is 30:1. Based

on the research results, the total N elements on the 14th day were as follows: T0 = 2.16%, T1 = 2.67%, T2 = 3.01%, and T3 = 2.69%. According to the quality standards of the Minister of Agriculture number 261/2019 [7], good compost enriched with microbes has a total N element with a minimum limit of 2%. The results of this research and observation show that all treatments are in accordance with the standards set Regulation of the Minister of Agriculture number 261/2019 [7].

Table 5. Total N Elements of Compost Day 1 and Day 14.

Treatment	C Organic (%)		$\leq 1\%$	$> 2\%$
	Days 1	Days 14	Putro et al. [15] Days 1	Reg. No. 261/2019 Days 14
T ₀	2.35	2.16	–	√
T ₁	2.37	2.67	–	√
T ₂	2.38	3.01	–	√
T ₃	2.05	2.69	–	√

(√): In accordance with Putro et al. [15] or Regulation No. 261 of 2019

(–): Not in accordance with Putro et al. [15] or Regulation No. 261 of 2019

Research conducted by Trivana et al. [28] N-total on the 14th day increased to 2.24% and research conducted by Tawa et al. [29] N-total produced from cow manure on the 14th day also increased to 2.85%. The increase in N-total in the composting process is caused by the decomposition process of compost materials by microorganisms which convert N into ammonia (NH₃) into nitrate (NO₃⁻). According to Aldrich and Bonhotal [30] who stated that organic N during composting is formed into ammonia, some of which is formed into ammonium (NH₄⁺) which then becomes nitrate (NO₃⁻). Total N absorption by plants is usually in the form of ammonium and nitrate. This is in line with Arisanti [31] who stated that N is absorbed by plants in the form of nitrate and ammonium, which accelerates carbohydrate synthesis. The dynamics of total N content in compost can be seen in the following figure:

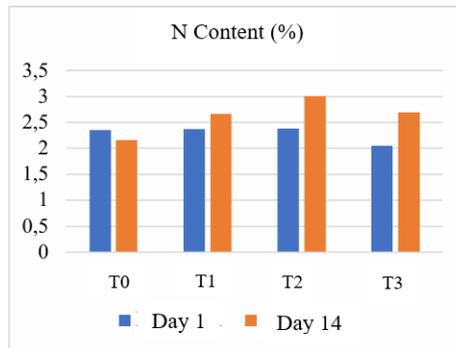


Fig. 5. Dynamics of Total N Content on Day 1 and 14

Based on the image above, we can know that the total N element in treatments T1, T2, and T3 on day 14 has a higher element compared to day 1, different from treatment P0 which experienced a decrease in total N elements on day 14. According to Muhammad et al. [32] stated that the decrease in total N occurs in the composting process of organic nitrogen being converted into volatile ammonia. At the end of the composting process, it was found that the total N-element of the compost for each treatment was T0 = 2.16%, T1 = 2.67%, T2 = 3.01%, and T3 = 2.69%. Based on the results of observations of the total N-element, it showed that the provision of water hyacinth was in accordance with the compost standards that had been set by Regulation of the Minister of Agriculture number 261/2019 [7].

3.6 Effect of Treatment on C/N Ratio

Based on Table 6, the C/N ratio on day 1 is as follows: T0 = 14.00, T1 = 12.32, T2 = 10.82, and T3 = 12.27. The C/N ratio on day 1 has not reached a good C/N ratio value for the start of composting. The low C/N ratio at the start of composting causes microorganisms to produce ammonia, which is easily evaporated, which results in a decrease in the nitrogen content of the compost. This is in line with the opinion of Ismayana et al. [22] who stated that a C/N ratio that is too low will form ammonia gas, so that nitrogen easily evaporates into the air. Based on the research results, the C/N ratio on the 14th day was as follows: T0 = 7.1, T1 = 5.2, T2 = 4.8, and T3 = 4.5. According to the quality standards of the Minister of Agriculture number 261/2019 [7] which states that good microbially enriched compost has a C/N ratio with a maximum limit of 25. The results of this research and observation show that all treatments are in accordance with the standards set by the Minister of Agriculture's Decree. The C/N ratio decreased because microorganisms used the C content as an energy source and the N content for growth. This is in accordance with the opinion of Widiarti et al. [33] who stated that the decrease in the C/N ratio in compost was caused by the amount of carbon used as an energy source for microorganisms to decompose organic materials. The dynamics of the C/N ratio content in compost can be seen in the following figure.

Table 6. C/N Ratio of Compost on Day 1 and Day 14.

Treatment	C Organic (%)		30-40	≤ 25
	Days 1	Days 14	Putro et al. [15]	Reg. No. 261/2019
			Days 1	Days 14
T0	14.00	7.1	–	√
T1	12.32	5.2	–	√
T2	10.82	4.8	–	√
T3	12.27	4.5	–	√

(√): In accordance with Putro et al. [15] or Regulation No. 261 of 2019

(–): Not in accordance with Putro et al. [15] or Regulation No. 261 of 2019

Based on the Figure 6, we can see that the C/N ratio on day 14 has lower elements compared to day 1. The difference in C/N ratio in compost occurs because the amount of C element tends to decrease, and the N element is relatively constant. The low value of the C/N ratio can be seen that the compost is mature. The process of making compost using EM4 decomposer has proven effective in accelerating the decrease in the C/N ratio compared to conventional methods. This is in line with Yuniwati [34] who stated that the composting process using EM4 decomposer has proven effective in accelerating the reduction of the C/N ratio compared to conventional methods, the C/N ratio is faster and ideal until it quickly blends with the soil.

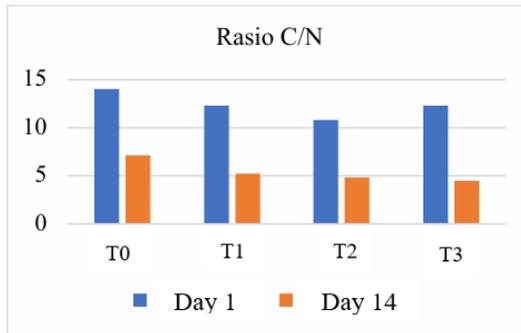


Fig. 6. Dynamics of C/N Ratio Value of Compost on Day 1 and Day 14.

At the end of the composting process, it was found that the C/N ratio of compost for each treatment was T0 = 7.1, T1 = 5.2, T2 = 4.8, and T3 = 4.5. This is different from the results of research conducted by Wulandari et al. [19] that the best C/N compost ratio with a comparison of cow manure (50%) with the provision of water hyacinth (50%) with a result of 15.54. Based on the results of observations of the C/N ratio, it shows that the addition of water hyacinth is in accordance with the compost standards set by Regulation of the Minister of Agriculture number 261/2019 [7].

4 Conclusion

Based on the research results, the provision of water hyacinth (25%) as the additional material for making compost fertilizer for pH, N-total, and C/N ratio has met the standards of Regulation of the Minister of Agriculture number 261/2019, while C-organic and water content have not met the standards. This shows that the provision of water hyacinth as an additional material for making compost as much as 15%, 20% and 25% needs to be studied further.

Acknowledgment. We would like to thank our student Vieri Novialdy for assisting in the technical implementation of the research in the field.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

References

1. Badan Pusat Statistik Jawa Timur, 2023. Populasi Kambing Menurut Propinsi, 2022-2023. Jawa Timur: Badan Pusat Statistik.
2. Santoso, M. C., I. A. D. Giriantari, dan W. G. Ariastina. 2019. Studi Pemanfaatan Kotoran Ternak Untuk Pembangkit Listrik Tenaga Biogas di Bali. *Jurnal Spektrum*. 6(4): 1-20.
3. Feni, R., E. Marwan, dan N. Kesumawati. 2022. Sosialisasi Manfaat dan Pembuatan Pupuk Kompos Eceng Gondok Bagi Kelompok Wanita Tani Desa Kungkai Baru Kabupaten. *Jurnal Pengabdian Masyarakat Bumi Rafflesia*. 5(2): 918-923.
4. Juliani, R., R. F. R. Simbolon, W. H. Sitanggang, dan J. B. Aritonang. 2017. Pupuk Organik Eceng Gondok Dari Danau Toba. *Jurnal Pengabdian Kepada Masyarakat*. 23(1): 220-224.
5. Ellya, Hikma, Ronny Mulyawan dan Novianti Adi Rohmana, 2020, Potensi Tumbuhan Lahan Rawa Sebagai Pupuk Organik, *Agrisains: Jurnal Budidaya Tanaman Perkebunan Politeknik Hasnur 2020*, 6(1), 13-17 ISSN 2503 3239
6. Widyastuti, S. dan R. S. Arfa. 2021 Pupuk Organik Padat dari Eceng Gondok, Kotoran Sapi, dan Dedak Padi dengan Effective Microorganisme (EM4). *Al-Ard: Jurnal Teknik Lingkungan*. 7(1): 1-20. 4
7. Minister of Agriculture Decree Number 261/2019, Keputusan Menteri Pertanian Nomor 261/KPTS/SR.310/M/4/2019 tentang Persyaratan Teknis Minimal Pupuk Organik, Pupuk Hayati, dan Pembenh Tanah, Kementrian Pertanian, Jakarta, Indonesia.
8. Napoleon, A., & Sulistyani, D. P. (2021, August). Test of Physical Quality Compost and PH of Combination of Water Hyacinth (*Eichornia Crassipes* Mart. Solm) and Goat Manure Using Rument Liquid Mol as Activator. In *IOP Conference Series: Earth and Environmental Science* (Vol. 810, No. 1, p. 012003). IOP Publishing.
9. SNI 19-7030-2004, Spesifikasi Kompos dari sampah organic domestic, Badan Standarisasi Nasional.
10. Niaga, M. S. A., Asnani, A., & Jaya, M. (2020). Pengaruh Penambahan Em4 Yang Berbeda Terhadap Komposisi Hara Pupuk Organik Cair Berbahan Baku Limbah Kepala Udang Jenis *Litopenaeus vannamei*. *Jurnal Fish Protech*. <https://doi.org/10.33772/jfp.v3i2.15445>.
11. Idawati, I., R. Rosnina, J. Jabal, S. Sapareng, Y. Yasmin, dan M.S. Yasin. 2017. Penilaian kualitas kompos jerami padi dan peranan biodekomposer dalam pengomposan. *Journal Tabaro Agriculture Science*. 1(2): 127-135.
12. Sahwan, F. L. (2010). Kualitas produk kompos dan karakteristik proses pengomposan sampah kota tanpa pemilahan awal. *Jurnal teknologi lingkungan*, 11(1): 79-85
13. Yulianto, A., Hakim, L., I. Purwaningsih, dan V. A. Pravitasari. 2009. Pengolahan limbah cair industri batik pada skala laboratorium dengan menggunakan metode elektrokoagulasi. *Jurnal Teknologi Lingkungan Universitas Trisakti*. 5(1): 1-6.
14. Dewilda, Y., dan F. L. Darfyolanda. 2017. Pengaruh komposisi bahan baku kompos (sampah organik pasar, ampas tahu, dan rumen sapi) terhadap kualitas dan kuantitas kompos. *Jurnal Dampak*, 14(1): 52-61.
15. Putro, B.P., S. Ganjar dan D. N. Winardi. 2016. Pengaruh penambahan pupuk NPK dalam pengomposan limbah organik secara aerobic menjadi kompos matang dan stabil diperkaya. *Jurnal teknik lingkungan*. 5(2): 1-10.
16. Indriani, Y. H. 2007. Membuat Kompos Secara Kilat. Penebar Swadaya. Jakarta.

17. Hastuti, S. M., G. Samudro, dan S. Sumiyati. 2017. Pengaruh Kadar Air terhadap Hasil Pengomposan Sampah Organik dengan Metode Composter Tub. *Jurnal Teknik Mesin (JTM)*. Vol 6: 114-118
18. Kurnia, V. C., S. Sumiyati, dan G. Samudro. 2017. Pengaruh Kadar Air Terhadap Hasil Pengomposan Sampah Organik Dengan Metode Open Windrow. *Jurnal Teknik Mesin Mercu Buana*. 6(2): 119-123.
19. Wulandari, D. A., Linda, R., & Turnip, M. (2016). Compost quality from a combination of water hyacinth (*Eichornia crassipes* Mart. Solm) and cow manure with *Trichoderma harzianum* L.
20. Rasyid, H. A., U. Hasanudin, dan R. Rakhdiatmoko. 2015. Potensi Pemanfaatan Limbah Organik Dari Pasar Tradisional Di Bandar Lampung Sebagai Bahan Baku Pembuatan Kompos Dan Biogas. *Jurnal Kelitbangan*. 3(1): 1-12.
21. Setiawan, E., 2009, Pengaruh Empat Macam Pupuk Organik Terhadap Pertumbuhan sawi (*Brassica juncea* L.). *Jurnal Embryo*. 6(1): 27- 34
22. Ismayana, A., N. S. Indrasti, Suprihatin, A. Maddu, dan A. Fredy. 2012. Faktor Rasio C/N Awal Dan Laju Aerasi Pada Proses Co-Composting Bagasse Dan Blotong. *Jurnal Teknologi Industri Pertanian*. 22 (3):173-179
23. Sukmawati, S. 2012. Budidaya pakcoy (*Brassica chinensis*. L) secara organik dengan pengaruh beberapa jenis pupuk organik. *Karya Ilmiah Politeknik Negeri Lampung*. 1(1): 9-25.
24. Bachtiar, B. dan A. H. Ahmad. 2019. Analisis Kandungan Hara Kompos Johar Cassia Siamea Dengan Penambahan Aktivator Promi. *Bioma: Jurnal Biologi Makassar*. 4(1): 68-76.
25. Gunawan et al. (2015)
26. Sari, R., dan R. A. Yusmah. 2023. Penentuan C Organik Pada Tanah Untuk Meningkatkan Produktivitas Tanaman dan Keberlanjutan Umur Tanaman dengan Metoda Spektrofotometri UV VIS. *Jurnal Teknologi Pertanian*. 12(1): 11-19.
27. Hermansen, C., P. Moldrup, K. Müller, P. W. Jensen, C. van den Dijssel, P. Jeyakumar, dan L. W. de Jonge, (2019). Organic carbon content controls the severity of water repellency and the critical moisture level across New Zealand pasture soils. *Geoderma*. 338(1): 281-290.
28. Trivana, L., A. Y. Pradhana, dan A. P. Manambangtua. 2017. Optimalisasi waktu pengomposan pupuk kandang dari kotoran kambing dan debu sabut kelapa dengan bioaktivator EM4. *Jurnal Sains dan Lingkungan*. 9(1): 16-24.
29. Tawa, B. D., Tnunay, Y. R., Suwari, S., & Nitbani, F. O. (2020). Pengaruh komposisi bioaktivator kotoran sapi dan daun gamal (*Gliricidia sepium*) dengan nutrisi ubi jalar terhadap kualitas kompos. *Chemistry Notes*, 2(2), 44-56.
30. Aldrich, B., and J. Bonhotal. 2006. Aerobic composting affects manure's nutrient content. *Northeast Dairy Business*. 1(1): 18-20.
31. Arisanti, D. 2021. Ketersediaan Nitrogen dan C organik pupuk kompos asal kulit pisang Goroho melalui optimalisasi uji kerja kultur bal. *Jurnal Vokasi Sains dan Teknologi*, 1(1): 1-8.
32. Muhammad, T. A., B. Zaman, dan P. Purwono. 2017. Pengaruh Penambahan Pupuk Kotoran Kambing Terhadap Hasil Pengomposan Daun Kering di TPST UNDIP. *Doctoral dissertation, Diponegoro University*. 1(1): 1-10.
33. Widiarti, A. W., Siregar, H., & Andati, T. (2015). The determinants of bank's efficiency in Indonesia. *Bulletin of Monetary Economics and Banking*, 18(2), 129-156.
34. Yuniwati, M., dan A. Padulemba. 2012. Optimasi kondisi proses pembuatan kompos dari sampah organik dengan cara fermentasi menggunakan EM4. *Jurnal Teknologi*. 5(2). 172-181.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

