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The Potential of Earthworms (Eudrilus eugeniae) in Vermicompost Production from Vegetable Market of Waste Cabbage and Fruit Skins

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Abstract

Traditional markets are one of the highest contributors to waste. Traditional markets can produce a lot of waste, one of the wastes with a large amount is organic waste. The alternative that can be done to deal with organic waste and can be converted into a product is to make compost using the vermicompost method. The aim of this study was to find out the length of time for composting in the manufacture of compost, to determine the optimal amount of Eudrilus eugeniae in the composting process, and to find out the optimal distribution of waste in composting. The incubation process for compost was carried out for 8 weeks, with sampling at weeks 4, 6, and 8. Sampling was carried out to analyze the macronutrient content consisting of C-Organic, nitrogen, and potassium. Content analysis was carried out using UV/VIS spectrophotometry for analysis of C-Organic content, Kjeldahl method for nitrogen content analysis, and Atomic Absorption Spectrophotometer (AAS) for potassium content analysis. The specifications for compost from organic waste are based on the Indonesian National Standard (SNI 19-7030-2004). This research resulted in C-Organic content of 6.1-8.1%, nitrogen content of 0.32-0.43%, and potassium content of 0.16-0.23%.

Keywords : *Eudrilus euginae;* Market waste; Vermicompost

INTRODUCTION

Inadequate waste management can cause adverse impacts on the environment and public health. The growing population in Indonesia indirectly affects the development of waste production. As for the increase in industrial activities that have an impact on people's consumption patterns. So that the amount, type, and characteristics of waste are increasing(Apriyani et al., 2020).

Waste can be in the form of solid and wet. Waste can be classified into two types, namely inorganic waste and organic waste. Inorganic waste is type of waste that does not have a carbon element in it. Organic waste is waste composed of organic compounds and can be decomposed with the help of other living things, namely microorganisms (Ramadhani & Sianturi, 2021). In overcoming the waste problem completely new innovations are needed that are easy to do at low cost. Processing waste into compost is the right solution in waste treatment [Mashur et al., 2020), [Raraningsih et al., 2017).

Compost is an organic fertilizer with significant benefits, particularly in the agricultural industry. These benefits include enhancing soil structure, boosting the soil's ability to absorb water

and nutrients, improving soil drainage and aeration, facilitating soil weathering processes, and providing protection against plant diseases.[Cahaya & Nugroho, 2019)

Composting is waste processing by utilizing microorganisms in the decomposition process, which will produce compost itself. The addition of oxygen during composting is a sign that composting is going well. This is because the fermentation in composting occurs by oxidation.

There are various composting methods that can be done, one of which is the vermicompost method. Vermicompost is an environmentally friendly composting method which involves worms and microorganisms to convert organic matter into compost which is rich in nutrients, enzymes, and vitamins. Vermicompost uses an aerobic and non-thermophilic process. Vermicomposting is an affordable technological method utilized to convert organic waste into organic fertilizer through the collaborative actions of earthworms and microorganisms during the decomposition of organic materials. [Getachew et al., 2018). Vermicompost can improve the physical, chemical, and biological properties of the soil [Belmeskine et al., 2020). There are many factors influencing the quality of produced vermicompost, which include temperature, oxygen availability, aeration, pH, water and air content of the compost pile, C/N ratio (carbon/nitrogen ratio), the character of the material to be composted, and the addition of microorganisms [Joko et al., 2010). The vermicomposting method can produce compost that has a high nutrient content (N, K, Ca, Mg) when compared to the results of other composting methods [El-Haddad et al., 2014).

Cultivation of earthworms encourages the use of media and feed that is abundantly available in the surrounding environment, such as leaf litter and organic waste. Earthworms (*Eudrilus eugeniae*) eat organic material from compost such as plants, then in the small intestine the food is broken down into useful materials for the body and the rest is excreted in the form of vermicompost. *Eudrilus eugeniae* is commonly knows as African worm or Night crawlers and widely used earthworm for vermicomposting (Sujatha et al., 2021). Kascing is rich in nutrients which are needed by plant growth, besides the positive impact of earthworms is to fertilize agricultural land. The composting process in order to run more quickly and efficiently is done by adding microorganisms that break down organic matter or activators. Earthworms (*Eudrilus eugeniae*) are epigeic earthworms that have high advantages in reproducing and breaking down organic matter as a medium or feed when compared to other species. So that these earthworms can become activators in composting (Hazra et al., 2018), (Wirosoedarmo et al., 2019). This research aims to make as well as know the effective process in the manufacture of liquid organic fertilizer with utilizing organic waste as a raw material and additions to earthworm *Eudrilus eugeniae*. The variables in this study used composting time (4, 6, and 8 weeks), worm weight (100, 200, 300 grams), and feeding (140, 210, 280 g/week) on the content (C,N,K) of compost liquid that will be produced.

METHODS

Materials and Procedures

The investigation was conducted or performed. in Sekaran, Semarang City as the location for composting and the BPTP Laboratory in Ungaran as a testing site for liquid compost samples, with the implementation time starting from December 2021 to March 2022. The fixed variables used in this study include temperature (27^{o}C) or in a mesophilic state, the type of waste used is vegetable waste (cabbage waste) and fruit skins waste (Figure 1), and the type of worm used is *Eudrilus eugeniae* (Figure 2). The independent variables in this study used composting time (4, 6, and 8 weeks), worm weight (100, 200, 300 grams), and feeding (140, 210, 280 g/week). And for the dependent variable used is the amount of C-Organic, N, and K content in vegetable waste and fruit skins fertilizers using the vermicompost method.

This study uses plastic containers that are arranged into three container traps that are placed outside the room (Figure 3) as it can be seen in the Vermicompost Reactor Illustration (Figure 4). Make air and drainage holes with a diameter of ¼-1/2 inch on the sides and bottom of the container. The reactor tank in the first trap or the top trap contains vegetable waste, fruit skins, soil and earthworm. While the second trap contains soil and worms. For the third trap or the lowest trap, it contains liquid compost so that a faucet is given to make it easier to take vermicompost liquid.

Before composting, there are several pre-treatments that must be carried out on vegetable waste and fruit skins. The vegetable waste was reduced to a smaller size (approximately 3-5 cm). *Eudrilus eugeniae* need to be placed in a reactor that has been given soil beforehand so they can adapt to the

environtment. Mixing is intended while composting and spraying water on media to maintain humidity.

Figure 1. Fruit Skin Waste

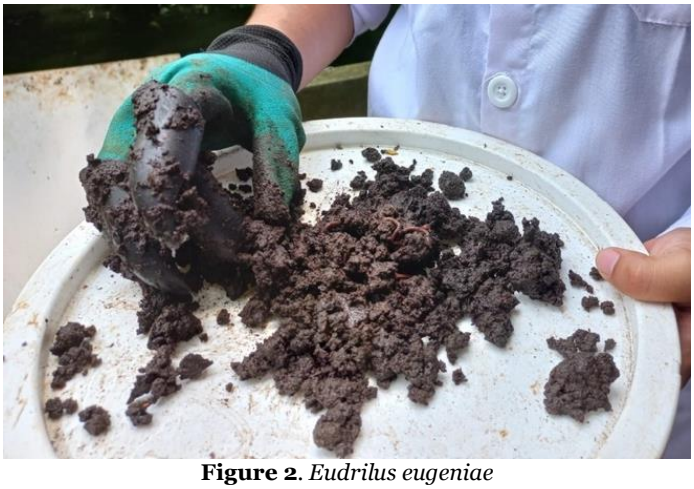

Figure 2. *Eudrilus eugeniae*

Figure 3. Vermicompost Reactor

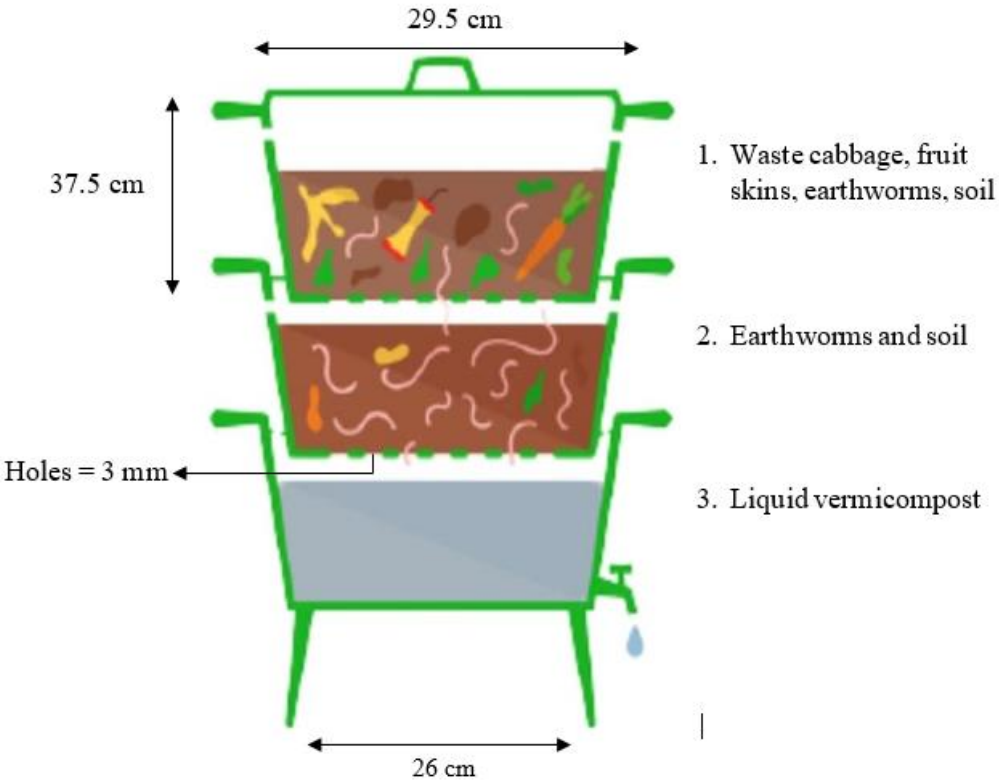

Figure 4. Vermicompost Reactor Illustration

Before composting, there are several pre-treatments that must be carried out on vegetable waste and fruit skins. The vegetable waste was reduced to a smaller size (approximately 3-5 cm). *Eudrilus eugeniae* need to be placed in a reactor that has been given soil beforehand so they can adapt to the environtment. Mixing is intended while composting and spraying water on media to maintain humidity.

Chemical analysis of vermicompost for organic C was determined by using spectrophotometry, Total Potassium was determined by using atomic absorption spectrophotometer (AAS), and for total N (Nitrogen) was determined by Kjeldahl method. The Kjeldahl method is a simple method for the determination of total nitrogen in amino acids, proteins and nitrogen-containing compounds. Determination of nitrogen content in liquid fertilizer using the Kjeldahl method through three main processes, namely the destruction process, the distillation process, and the titration process. The quality of vermicompost used measurement standarts based on SNI 19-7030-2004. (Table 1)

Table 1. SNI 19-7030-2004

Parameter	Minimum
Carbon	9,8
Nitrogen	0,4
Potassium	0,2

RESULTS AND DISCUSSION

In this study testing the content of C, N, K in samples of vermicompost fertilizer showed that the best results were taken on the number of weeks, worm weight, and the highest feed weight. To determine the content of nitrogen elements can use the analytical method, namely the Kjeldahl method, while for the content of C-organic elements can use the analysis method using spectrophotometry. Then knowing the elemental content of potassium can use the analysis method using AAS (*Atomic Absorption Spectrophotometry*).

Figure 5. The Result of Vermicomposting

Effect of Time on Nutritional Content

This study used a sample weight of worms with the same feed weight to determine the effect of vermicompost time on the nutrient content of liquid fertilizer (C, N, K). The worms used in this study were 300 grams, with a feed of 280 grams/week.

The results of the analysis of variance for the effect of vermicompost time on nutrition contents are presented in Figures 6-8. These results indicated that composting time at week 8 gave the highest vermicompost yield. The content of C is 6.14%, N is 0.4%, and K is 0.2%. This shows that the longer the time of vermicompost, the results of the content of C, N, K will continue to increase.

Figure 6 illustrates the findings of this study, which indicate that the C-Organic content declines with the progression of composting time. This is due to the decomposition process of C-organic material used by microorganisms as an energy source. In the decomposition process, microorganisms use C-Organic as an energy source to form new cells and for the growth of the microorganisms themselves (Witasari et al., 2021). According to Prayitno (2013), Fermentation accompanied by worm incubation reduced the levels of carbon elements in each treatment. This is presumably because the element carbon is absorbed by the worms as a source of energy . Based on Figure 7, the N content in liquid compost increased with increasing composting time. The more microorganisms that grow, the more N content in liquid compost (Akbari, 2015).

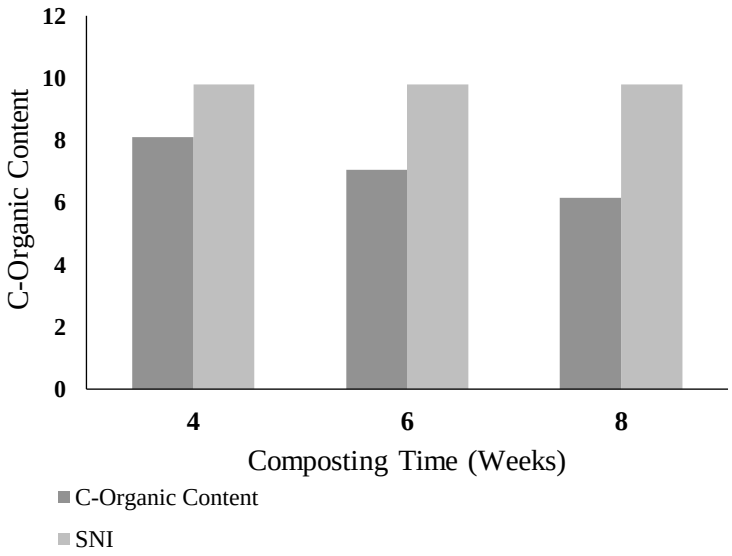

Figure 6. Effect of Vermicompost Time on C-Organic Content (Worm weight = 300 grams; feeding rate = 280

gram/week)

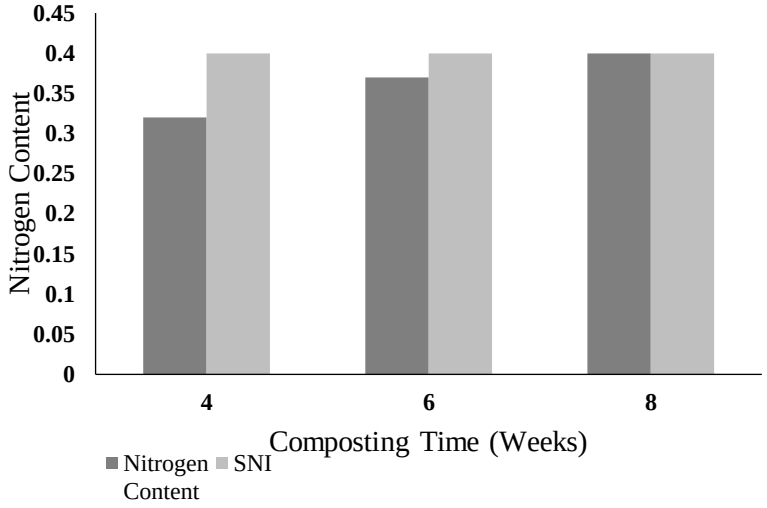

Figure 7. Effect of Vermicompost Time on Nitrogen Content (Worm weight = 300 grams; feeding rate = 280 gram/week)

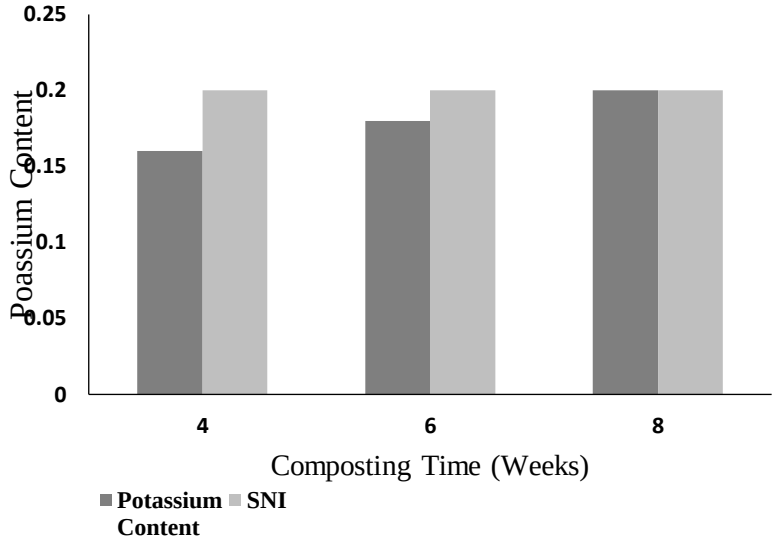

Figure 8. Effect of Vermicompost Time on Potassium Content (Worm weight = 300 grams; feeding rate = 280 gram/week)

In Figure 8, it can be seen that the K content in liquid compost increases with increasing composting time. This happens because of the mineralization process that occurs in the composting process. The mineralization process occurs due to physical and chemical activities carried out by microorganisms. Thus, the K content will increase along with the amount and duration of activity carried out by microorganisms (Hidayati et al., 2021).

Effect of Worms Weight on Nutritional Content

This study used a sample test of the effect of time with the same weight of feed to determine the weight of vermicompost worms on the nutrient content of liquid fertilizer (C, N, K). This research was conducted for 6 weeks with a weight of feed is 210 grams/week. It can be seen in the image below. The effect of the content of C, N, K on the effect of the number of worms.

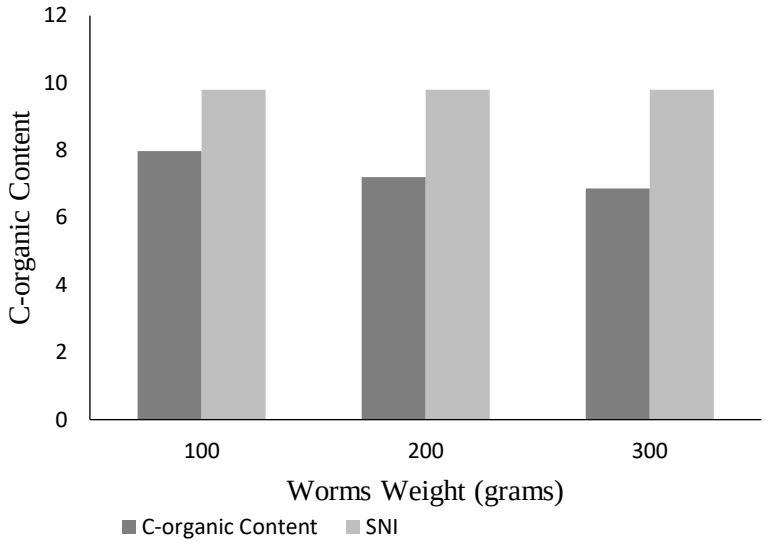

Figure 9. Effect of Worm Weight on C-organic Content (Time = 6 weeks; feeding rate = 210 gram/week)

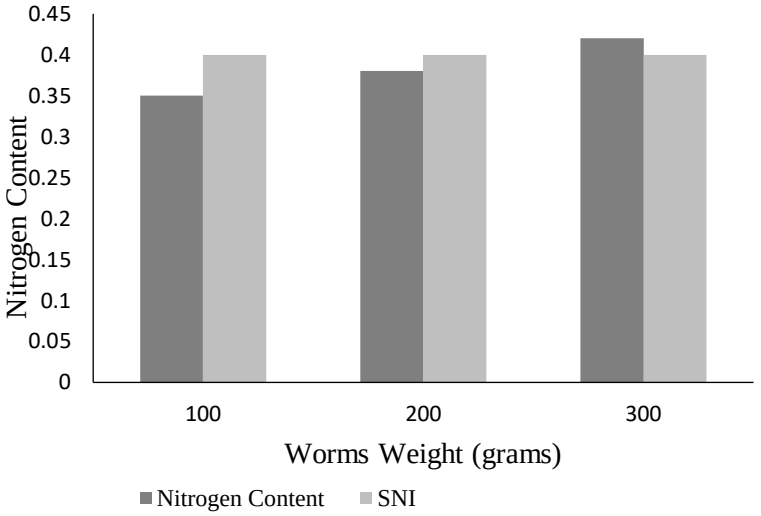

Figure 10. Effect of Worm Weight on Nitrogen Content (Time = 6 weeks; feeding rate = 210 gram/week)

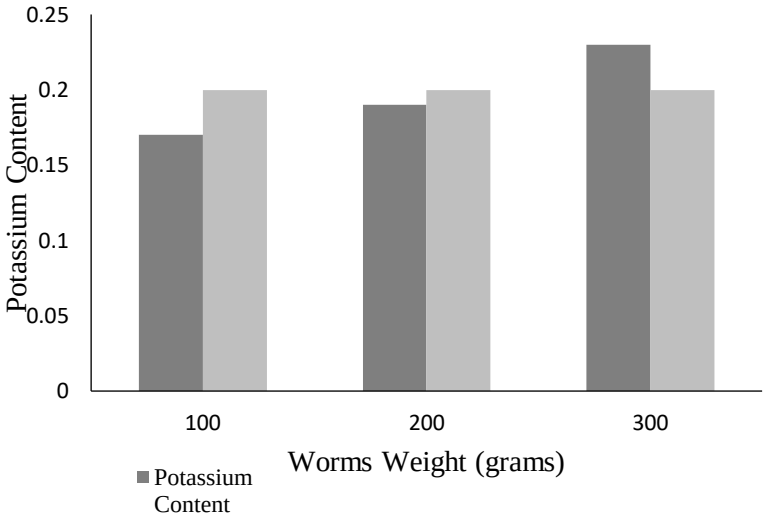

Figure 11. Effect of Worm Weight on Potassium Content (Time = 6 weeks; feeding rate = 210 gram/week)

The results of the analysis of variance for the effect of vermicompost time on nutrition contents are presented in Figures 9-11. These results indicated that the content of C is 6.87%, N is 0.42%, and K is 0.23%. This shows that the higher the weight of vermicompost worms, the results of the content of C, N, K will continue to increase.

Earthworm *Eudrilus Euginae* is an epigeic earthworm which is considered the most efficient composting agent in the tropics, because it grows faster and has a higher appetite than red worms, it is stated that earthworms eat organic matter equivalent to body weight per day. Which, worms can be used as superior vermicompost producers (Hazra et al., 2018). Thus the addition of worms in the composting process can increase compost production (Rahmawati & Herumurti, 2016).

Effect of Feed Weight on Nutritional Content

This study used a sample test of the effect of time with the same weight of worms to determine the weight of feed (vegetable waste, fruit waste) on the nutrient content of liquid fertilizer (C, N, K). In this study, worms weighed 300 grams and composted for 8 weeks.

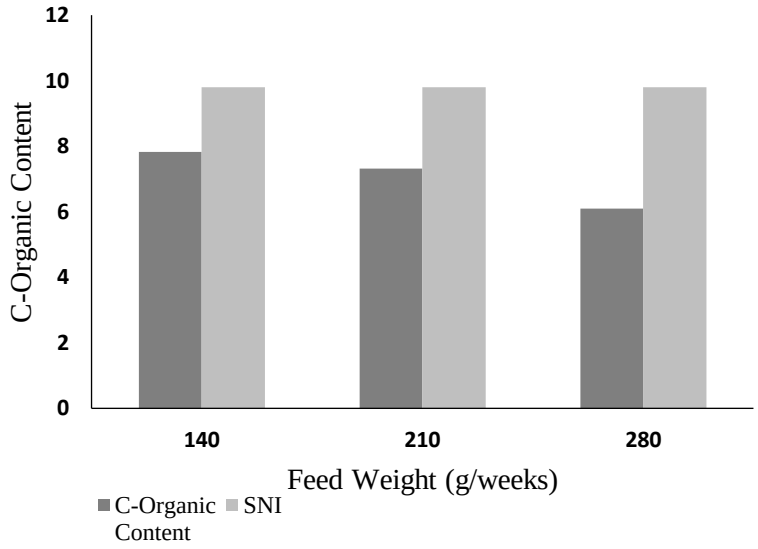

Figure 12. Effect of Feed Weight on C-organic Content (Time = 8 weeks; worms weight = 300 grams)

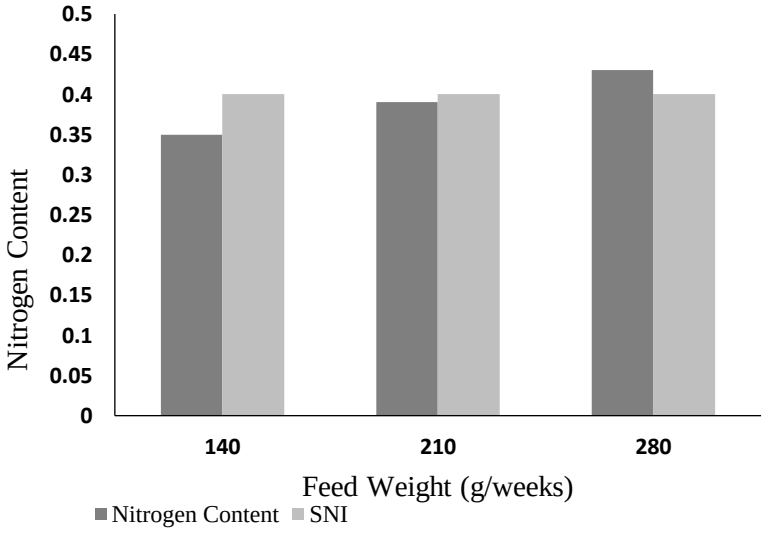

Figure 13. Effect of Feed Weight on Nitrogen Content (Time = 8 weeks; worms weight = 300 grams)

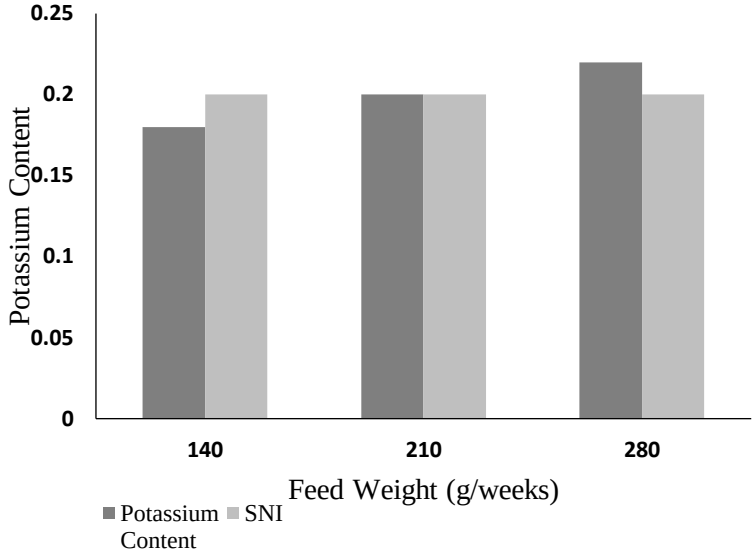

Figure 14. Effect of Feed Weight on Potassium Content (Time = 8 weeks; worms weight = 300 grams)

The results of the analysis of variance for the effect of vermicompost time on nutrition contents are presented in Figures 12-14. These results indicated that the content of C is 6.1%, N is 0.43%, and K is 0.22%. This shows that the higher the total weight of the vermicompost feed, the lower the C content, as shown in Figure 12. Meanwhile, the content of N and K will continue to increase as shown in Figure 13 and Figure 14.

The high application of organic matter in the soil with high doses will increase the activity of organisms and will increase the nutrient content in the soil (Hazra et al., 2018).Worms will eat organic material using their organs and then will pass through the surface of the substrate which causes increased activity of microorganisms, this plays a role in degrading the substrate due to aerobic conditions (Rahmawati & Herumurti, 2016).

CONCLUSION

The longer the composting time, the C-organic content in the fertilizer will decrease, this indicates that the decomposition process has occurred and worms are used as an energy source. Thus, the C-organic content at week 8 was 6.14%. Meanwhile, the nitrogen and potassium content will increase with the length of the composting time. The highest content was at week 8 with N of 0.4%, and K of 0.2% where the content of N and K had met the minimum standards set by the government in SNI 19-7030-2004, namely for N 0.4% , K 0.2%. Meanwhile, organic C does not meet the requirements with a minimum standard of 9.8% organic C.

The higher the weight of the worms, the N, K content in the sample will continue to increase and the C-organic content will decrease. The content of 300 grams of worms with organic C is 6.87%, N is 0.42%, and K is 0.23% where the N and K content has met the minimum standards set by the government in SNI 19-7030- 2004 that is for N 0.4% , K 0.2%. Meanwhile, organic C does not meet the requirements with a minimum standard of 9.8% organic C.

The higher the weight of the feed given (vegetable waste, fruit) then the N, K content in the sample will continue to increase and the C-organic content will decrease. The content of the feed weight is 280 grams with C-organic of 6.1%, N of 0.43%, and K of 0.22% where the content of N and K has met the minimum standards set by the government in SNI 19-7030- 2004 that is for N 0.4% , K 0.2%. Meanwhile, organic C does not meet the requirements with a minimum standard of 9.8% organic C.

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