Elements Content In Inked Paper And Vegetable Waste Mixture Compost Using Rumen Liquor Bioactivator

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ABSTRACT

The compost of inked paper and vegetable waste mixture is a result of the process of degradation of the components of lignin and cellulose. The process was activated by cellulolytic bacteria from rumen liquor. The aim of this study to know the compost quality of the inked paper and vegetable waste mixture. The content of by-products of compost studied were the levels of N, P, K, and Pb heavy metals. The composting process in this study was carried out by anaerobic. The N test used the Kjeldahl method, the P and K test used the Bray 1 method, and the Pb test used the AAS method (Atomic Adsorption Spectrophotometer). The data were analyzed using Manova statistical tests with LSD post hoc tests. From the observations, it was known that the addition of rumen liquor had a significant effect on the levels of P with the most optimal concentration of 50%, while for N and K levels and Pb heavy metals content was not significantly different. However, the average level of nutrient elements N (0.87% to 1.1%), P (0.2% to 0.5%) and K (0.52% to 0.58%) and Pb heavy metals (0.61ppm to 4.09 ppm) fulfill SNI 19-7030- 2004 standard.

Introduction

The decomposition of complex organic wastes produces compost, this process is assisted by the activity of microorganisms (Fatmawati, 2018). Organic waste for compost contains fats, carbohydrates, proteins, and water content which will be used by decomposing microorganisms as their energy source (Suwatanti & Widiyaningrum, 2017). The elements N, P, and K in compost are primary macronutrients obtained from the degradation of complex organic compounds by microorganisms (Hapsoh *et al*., 2018). These nutrients can be used as a standard of the quality of compost because plants have a very important need for this nutrient (Mading *et al*., 2021).

The composting process is needed to overcome various environmental problems caused by the presence of waste, especially organic waste (Suwatanti & Widiyaningrum, 2017). Inked paper waste and vegetable scraps are waste that is generated almost daily by modern society today (Rahmawati *et al*., 2017b). In Indonesia, the existence of this waste has not been handled properly, only relying on the collection and transportation pattern of waste or its unproper use that breaking regulations (Rahmawati *et al*., 2021). The consumption of used paper with

ink, for example as food wrappers of baked goods, causing health problems due to the Pb content in the ink (Kahar & Rappe, 2020). Besides, vegetable scraps that are thrown away carelessly can pollute the environment.

The inked paper waste contains organic components in the form of cellulose, hemicellulose, and lignin from wood as its raw material of paper. The organic content in the inked paper waste can be degraded through the fermentation process (Rahmawati *et al*., 2017). However, lignin, cellulose, and hemicellulose in inked paper waste causing the natural degradation process needs a very long time (Saraswati & Praptana, 2017), so it is necessary to add vegetable waste which is easy to rot. Also, rumen liquor needs to be added because it contains activator bacteria that optimize the composting process (Aditya, 2014).

The rumen liquor is waste from the slaughterhouse which is disposed of directly in the process of slaughtering animals. This waste comes from the rumen of ruminants. Also, in the rumen of ruminant animals, there are solid-state waste namely food remains that have not been completely digested. Digestion of ruminant involves microbes in the form of a group of bacteria, fungi, and protozoa (Wandra *et al*., 2020). Groups of bacteria that live in the rumen of ruminants belonging to cellulolytic bacteria produce cellulase enzymes to break down cellulose. There are about 109 cellulolytic bacteria in every cc (centimeter cubic) of rumen liquor, while for protozoa about 105 to 106 per cc (Omed *et al*., 2000; Rahmawati *et al*., 2017a; Yogyaswari *et al*., 2016).

A study on the use of rumen liquor waste has been carried out to degrade durian rind waste which has high cellulose and lignin content (Aditya, 2014). The composting process of organic waste using various starters has been carried out, including using EM4 to know primary macronutrient content (N, P, and K) in compost (Nur *et al*., 2016). The lead (Pb) content in the used inked paper in food wrappers has been studied (Kahar & Rappe, 2020). Previous research has been carried out with a focus on the nutritional content of paper mill sludge (Beauchamp, Charest, & Gosselin, 2002; Hazarika *et al*, 2017; Purwati *et al*, 2017), methane products from waste paper fermented using rumen liqour and L-cysteine hydrochloride monohydrate (Yutaka *et al*, 2016), but the content of by-products of composting using rumen on used paper untils now there is still lacking information. In this study was conducted to analyze the quality of the compost that is the content of primary macronutrients (N, P, K) and lead (Pb).

Materials and Methods

A completely randomized design (CRD) was used in this study. Various concentrations of rumen liquor were used as a bio-activator for the composting process of a mixture of inked paper waste and vegetable scraps (compost material) the study was conducted.

The rumen liquor was obtained directly from the slaughterhouse in the Jenu Tuban area and added with a pH 7.0 phosphate buffer. The ratio of the volume of rumen liquor and pH 7.0 phosphate buffer solution added was 1: 1. Then fermented in a closed container for one week at room temperature and protected from direct sunlight. The inked paper waste was cut into small pieces and then immersed in an aquadest for 3 days. Reducing the size was also conducted on the remaining vegetables that will be used as compost.

The compost material was placed into a closed container and then was added with various concentrations of rumen liquor (0%, 20%, 30%, and 50%) which has been previously diluted with aquadest. Furthermore, the compost was incubated for 8 weeks at room temperature. Every week they were opened for stirring.

The determination of nitrogen content in compost was carried out by the Kjeldahl method while the test for the Phosphorus and potassium contents were conducted using the Bray 1 method, the contents of lead (Pb) were tested using the AAS (Atomic Absorption Spectrophotometer) method. The data were analyzed statistically using Manova. For significant results, a post hoc test was carried out with the LSD test to determine the optimal

treatment in N, P, K, and Pb contents in compost.

Results and Discussion

The bio-activator from rumen liquor can be used for the composting process of inked paper waste and vegetable scraps. The liquid contents of the cattle rumen usually disposed of directly so that it pollutes the environment and causes eutrophication of water bodies, smells bad, and invites flies (Basri, 2017). This is because the contents of the rumen contain nutrients in the form of protein of 8.86%, 2.60% fat, 28.78% crude fiber, 0.55% phosphorus, 18.54% ash, 10.92% water, and microorganisms such as protozoa, bacteria, and fungi (Basri, 2017; Purbowati *et al*., 2014). The effect of each treatment after composting for 8 weeks was shown in the table 1:

Table. 1 Content of N, P, K, and Pb in inked paper and vegetable waste mixture compost after 8 weeks of composting

Treatments	N (%)	P (%)	K (%)	Pb (%)
0%	0.97[a]	0.20[a]	0.52[a]	2.61[a]
20%	1.07[a]	0.30[b]	0.56[a]	2.58[a]
30%	1.10[a]	0.32[b]	0.52[a]	4.09[a]
50%	0.87[a]	0.51[c]	0.58[a]	2.73[a]

Note: different notations in the same column indicate a significant difference in the LSD.

The study (Table 1) showed that the content of N in inked paper and vegetable waste mixture compost both in the control and treatment (20%, 30%, and 50%) has met the SNI 19-7030-2004 standard, namely > 0.4%. The highest average of N content was produced at 30% treatment while the lowest mean of total N content was at 50% of treatment. However, the addition of rumen liquor at various concentrations did not have a significant effect. This insignificant effect occurs due to the decomposition rate of compost relatively the same between control and treatment. Aditya (2014), stated that the addition of rumen liquor insignificantly increase on the total N content in durian rind compost. In the composting process, total N consisting of organic N and inorganic N is converted by bacteria into ammonia (NH3) which is then converted into a more stable form of nitrogen, namely Nitrite (NO2) and Nitrate (NO3-), this nitrogen contents can exist in two forms, namely amino acids and methane (NH4 +) (Aditya, 2014; Harahap *et al*., 2015; Rini *et al*., 2015).

The content of phosphorus (P) in this study as a whole has met the SNI 19-7030-2004 standards, which is more than 0.10%. Meanwhile, based on the manova test, treatment by addition rumen liquor had a significant effect on the P nutrient content in compost. In each treatment (Table 1), it can be seen that the control (0%) is significantly different from the treatment (20%, 30%, 50%), and in the treatment 50% is significantly different from the treatment of 20% and 30%. The highest P content was in the treatment of 50% rumen liquor. The high P content in compost was caused by the breakdown of organic matter from the compost material with the help of bacteria in the rumen liquor. The higher the percentage of rumen liquor, the higher the phosphorus content in compost, presumably due to the increase of microorganisms. This is similar to Yulianingrum *et al*., (2020), study which stated that the addition of local microorganisms made from rumen liquor can increase the organic P content in rice straw compost, this happens because P content from rice straw decomposition got mixed P content from dead microorganism material in the ripening compost that increasing the P content of the compost. The organic P comes from the breakdown of nucleic acids, chitin, and phospholipids (Hartono *et al*., 2017).

The results in Table 1. show that the average potassium content in the control and all treatments has a value that follows the SNI 19-7030-2004 standard, which is more than 0.20%. However, there was no significant difference between control and treatment (20%, 30%, and 50%) due to the same rate of bacteria activity in degrading compost organic matter in the control and treatment. Dewilda & Maryam (2017), reported that the potassium content in compost made from market waste with a mixture of rumen liquor is not significantly different from the potassium content in market waste compost without rumen liquor. By the time of the composting process, the average content of

potassium in the compost was increasing. Most of the organic potassium can be leached from plant debris. Although the element potassium is not a structural component of cells, the presence of this element is abundant in the cell cytoplasm, plant tissue, and xylem and phloem. The compost in the form of fresh vegetable scraps contains potassium. So, the degradation of organic matter in compost by microorganisms causes the decomposition of organic matter to produce potassium. The element potassium in plants is needed to help maintain cell turgor pressure, helps active transport, helps the photosynthesis process, the formation of protein and cellulose (Hartono *et al*., 2017).

The lead (Pb) content in compost in all treatments (Table 1.) was following SNI 19-7030-2004 standards which is less than 150 ppm. Based on statistical tests of various concentrations of rumen liquor (0%, 20%, 30%, and 50%) there was no significant effect on the Pb content in compost. Pb in compost comes from compost raw material, namely inked paper waste. Ink on used paper contains lead (Pb) (Kahar & Rappe, 2020). Bacteria in rumen liquor were not able to degrade Pb content, even the bacterial group was very sensitive to the presence of Pb (Azadbakht, Khadem, & Norouzian, 2017). According to Rahmawati (2017b), Pb can hamper the development of bacteria and even kill bacteria in the cow's rumen because it reacts with amino acids and bacterial enzymes. As a result, respiration in mitochondria and the cellular metabolic system will be disrupted (Yutaka *et al*., 2016).

Conclusion

The various concentrations of rumen liquor that containing cellulolytic bacteria did not significantly affect the N, K, and Pb content of compost from the inked paper and vegetable waste mixture but the concentration of 50% gave the most optimal P content. All treatment results met SNI 19-7030-2004 standards.

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