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EFFECTIVENESS OF GRAY WATER MUD AND COW DUNG WEIGHT VARIATIONS AS ACTIVATORS FOR ORGANIC WASTE DECOMPOSITION

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ABSTRACT

Organic waste from household activities and traditional markets causes large volumes of waste to be generated every day at the Mamuju landfill. To reduce the volume of organic waste, efforts need to be made to minimize generation through innovation. This research aims to determine the effectiveness of differences between variations of gray water mud and cow dung on physical quality of compost (pH, temperature, humidity), macro elements (Nitrogen, Carbon, Phosphorus, C/N ratio , Kalium) in the decomposition of organic waste. This research involves conducting quasi experimental research on organic waste using bioactivators made from gray water sewer mud and cow dung. This research consisted of 6 (six) treatments and 1 control, so 7 (seven) composters were made. The final result of composting after analyzed for N content after 28 days are K (0,54), GW100(0,6), GW200(0,53), GW300(0,62), KS100(0,61), KS200(0,59), KS300(0,58). For P content are K(0,14), GW100(0,15), GW200(0,2), GW300(0,18), KS100(0,18), KS200(0,20), KS300(0,23). For K content are K(0,36), GW100(0,26), GW200(0,47), GW300(0,4). KS100(0,44), KS200(0,42), KS300(0,51). C/N ratio are K(70,7), GW100(58,06), GW200(87,1). GW300(56,54), KS100(60,85), KS200(58,87), KS300(60,08). And for C Organic content are K(38), GW100(35), GW200(46), GW300(35), KS100(37), KS200(35), KS300(35). The final results of composting showed that the quality of the compost with the addition bio activator of gray water mud and cow dung for 28 days is not eligible of SNI 19-7030-2004. This is due to husks have a fairly high carbon value, so 28 days is not enough to decompose into good quality compost.

Kata Kunci:

Sampah domestic;
Lumpur grey water;
Kotoran sapi;
Bioaktivator;
Kompos

ABSTRAK

Sampah organik yang berasal dari aktivitas rumah tangga dan pasar tradisional menyebabkan timbulan sampah dengan volume yang besar setiap harinya di TPA Mamuju. Untuk menekan volume sampah organik perlu dilakukan upaya meminimalisir timbulan dengan inovasi. Penelitian ini bertujuan untuk mengetahui efektivitas perbedaan variasi lumpur grey water dan kotoran sapi terhadap kualitas fisik kompos (pH, tekstur, suhu, kelembaban), unsur makro (Nitrogen, Karbon, Phosfor, C/N ratio, Kalium) pada penguraian sampah organik. Jenis penelitian ini adalah penelitian eksperimental dengan melakukan uji coba pada sampah organik dengan bioaktivator lumpur selokan grey water dan kotoran Sapi. Penelitian ini terdiri dari 6 (enam) perlakuan dan 1 kontrol, sehingga dibuat 7 (tujuh) komposter. Hasil akhir setelah dilakukan pemeriksaan laboratorium setelah 28 hari kandungan N yakni ; K (0,54), GW100(0,6), GW200(0,53), GW300(0,62), KS100(0,61), KS200(0,59), KS300(0,58). Untuk kandungan P : K(0,14), GW100(0,15), GW200(0,2), GW300(0,18), KS100(0,18), KS200(0,20), KS300(0,23). Untuk kandungan K yakni ; K(0,36), GW100(0,26), GW200(0,47), GW300(0,4). KS100(0,44), KS200(0,42), KS300(0,51). Sedangkan C/N rasio adalah K(70,7), GW100(58,06), GW200(87,1). GW300(56,54), KS100(60,85), KS200(58,87), KS300(60,08) dan untuk kandungan C organic adalah K(38), GW100(35), GW200(46), GW300(35), KS100(37), KS200(35), KS300(35). Hasil akhir pengomposan diperoleh bahwa kualitas kompos dengan penambahan bioaktivator lumpur *grey water* dan kotoran sapi belum memenuhi syarat SNI 19-7030-2004. Hal ini disebabkan sekam padi memiliki nilai karbon cukup tinggi, sehingga waktu 28 hari tidak cukup untuk terurai menjadi kompos yang berkualitas baik.

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INTRODUCTION

Waste is the result f human activity. Every human activity undoubtedly generates waste. Waste is simply classed as organic or inorganic waste, discarded by people in numerous locations around a community. It is estimated that Indonesia produces 64 million tons of waste yearly. Based on data collected by the Ministry of Environment and Forestry in 2022, the amount of waste generated in Indonesia is 68.7 million tons/year with the waste composition dominated by organic waste, especially food waste which reaches 41.27%. Approximately 38.28% of this waste comes from households (Kementerian Lingkungan Hidup dan Kehutanan, 2023). The massive production of organic waste in Indonesia, especially in Mamuju, certainly has a detrimental effect on the environment and human health; home waste accounts for the majority of organic waste production in Mamuju. According to the Head of the Environmental Hygiene Division, DLHK Mamuju, the average monthly waste transportation is 648.11 tons, equivalent to 1.6 tons per day. The majority of this waste consists of household waste and organic waste, such as grass and tree twigs (Ramli, 2022).

Excessive production of organic waste has negative impacts on the environment such as; soil pollution, damaging environmental aesthetics, polluting groundwater sources and causing foul odors that pollute the air. Beisde it, the presence of organic waste that is not managed properly will cause of disease problems for humans and develop as environmental-based diseases in society through animal vectors that land on the waste and then carry disease agents to food that will be consumed by humans. The natural composting process can take several months or even years to complete. Compost is designed to manage and control this natural process, allowing compost to form faster (Subandriyo et al., 2012). This procedure involves balancing materials, supplying sufficient water, controlling aeration, and adding compost activator. Decomposer materials may accelerate the composting process. According to other the research that lignocellulosic fibrous material decomposer can accelerate the decomposition process by a period of 1-2 weeks, as shown in various plot demonstrations (Rasti & Pratana, 2017). For instance, the utilization of mud generated by household waste in sewers or the byproducts of fecal waste processing plants as a decomposer. Cow dung can be utilized as a bioactivator due to its chemical composition, which includes nitrogen (0.4 - 1%), phosphorus (0.2 - 0.5%), potassium (0.1 – 1.5%), water content (85 – 92%), and several other components (such as calcium, magnesium, manganese, iron, copper, and zinc). In addition, the pH of cow dung ranges from 4.0 to 4.5. Consequently, the production of a high-quality bioactivator necessitates the inclusion of supplementary components (Cahyadhi, 2016). Previous studies have shown that including cow dung as a bioactivator can enhance the efficiency of composting in traditional systems, namely through methods like agitation and aeration, within 28 days (Mirwan M, 2012). In light of earlier studies on the application of mud bioactivators to convert organic waste into compost, the researchers were interested to investigate the "Effectiveness of gray water mud and cow dung weight variations as bioactivators for organic waste decomposition."

METHOD

Types of Research

This research involves conducting quasi experimental research on organic waste using bioactivators made from gray water sewer mud and cow dung.

Reasearch Location and Time

The research was conducted at the Department of Environmental Health Workshop within 28 days, specifically from August 2nd to August 29th, 2023. The compost content testing was conducted at the Soil Laboratory of the South Sulawesi Agricultural Instrument Standards Determination Center in Maros Regency. The compost content testing was conducted at the Center for Testing Standards for Agricultural Land Resources South Sulawesi, Maros Regency.

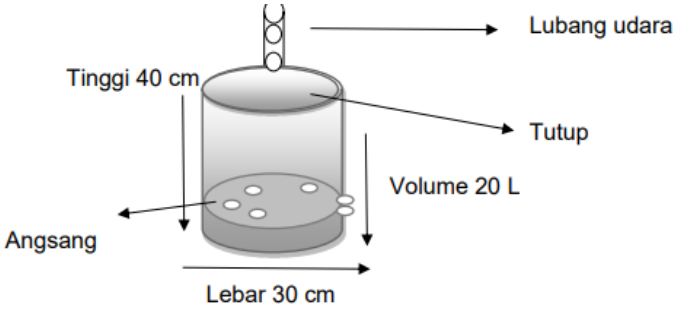
Research Methodology

The samples used in this research consisted of organic waste that was exposed to air after the addition of 100 grams, 200 grams, and 300 grams of sewer mud (grey water) and cow dung. The theoretical ratio for the C/N balance concentration is 31 (1:2), which is comprised of rice husks and vegetable detritus.

The research process began by making a composter of 7 (seven) buckets. First, the composter is made using a bucket that is modified according to the design (figure 1). Next, the ingredient preparation stage is that the remaining vegetables are chopped into small pieces using a knife, then weigh 2 kg of chopped vegetables and 1 kg of rice husks. Put these materials into each composter. The final stage, enter the bioactivator into each composter according to the dose to be tested. The composition of the test composter is follows:

Table 1 Sample Composition with Weight Variation of Gray Water and Cow Dung

No.	Sample	Composition	Bioactivator	
1	Control	2 Kg vegetable detritus + 1 Kg rice husks	EM4	
2	GW100	2 Kg vegetable detritus + 1 Kg rice husks	100 gr	grey water
3	GW200	2 Kg vegetable detritus + 1 Kg rice husks	200 gr	grey water
4	GW300	2 Kg vegetable detritus + 1 Kg rice husks	300 gr	grey water
5	KS100	2 Kg vegetable detritus + 1 Kg rice husks	100 gr	cow dung
6	KS200	2 Kg vegetable detritus + 1 Kg rice husks	200 gr	cow dung
7	KS300	2 Kg vegetable detritus + 1 Kg rice husks	300 gr	cow dung



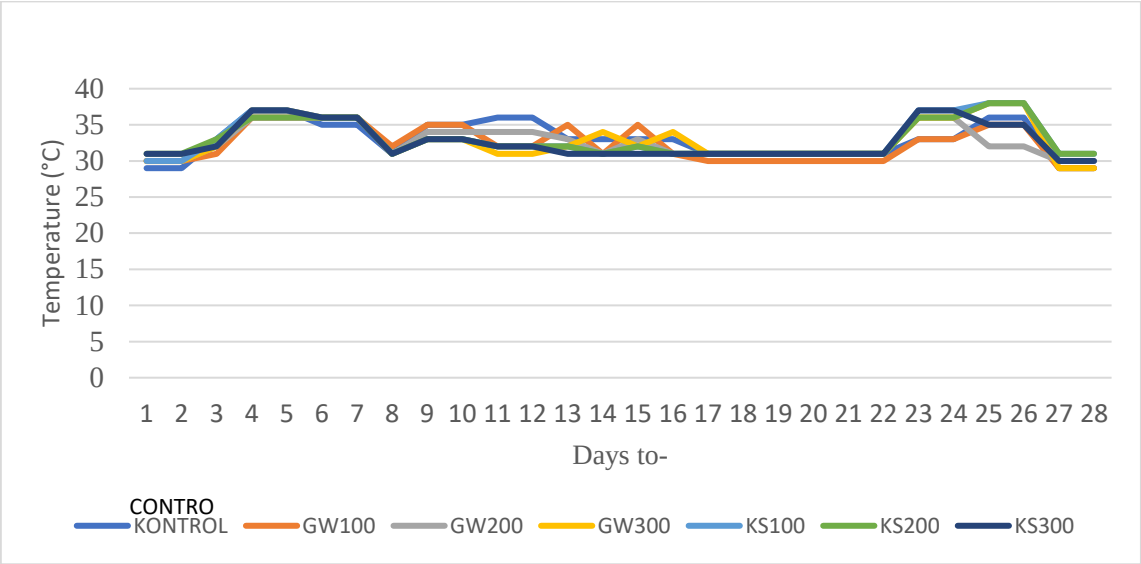
Picture 1 Composter Design

The pH, humidity, and temperature parameters of the compost samples were monitored and recorded daily for 28 days. Following that, the samples are packed separately in 1 kg each and sent to the laboratory for examination of the levels of phosphorus (P), nitrogen (N), potassium (K), carbon-to-nitrogen (C/N) ratio, and organic carbon content in the compost.

Data Analysis Process

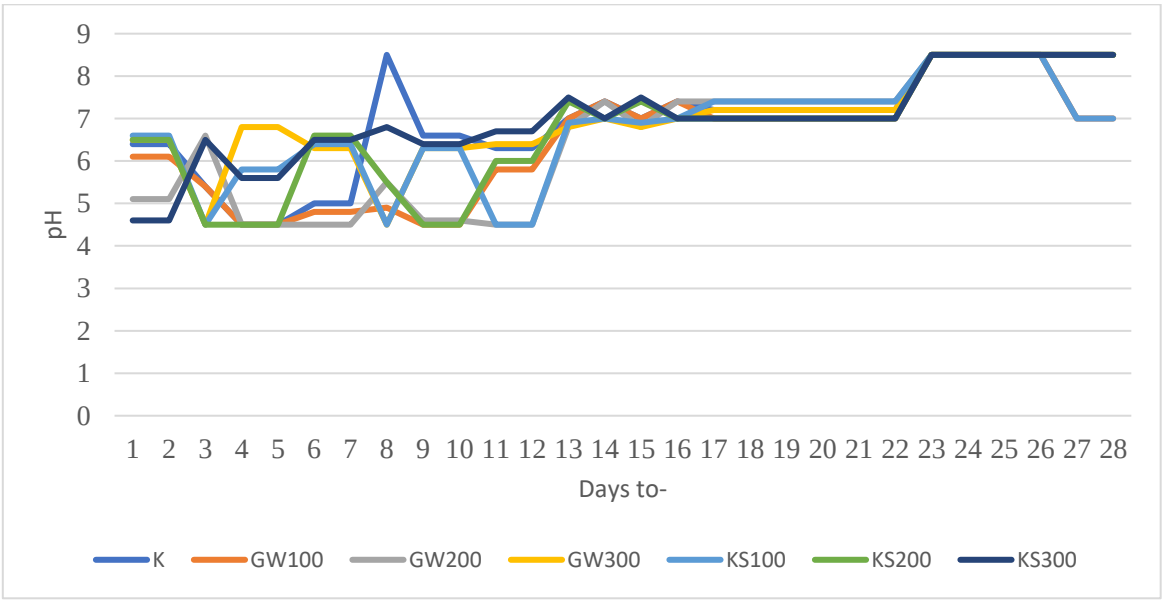
The research utilized the microsoft excel data to processing data to get result extract the maximum and minimum parameter values for each sample.This allowed for the presentation of data on variations in the weight of bioactivators using gray water and cow dung in the form of narratives, tables, and graphs.

RESEARCH RESULT



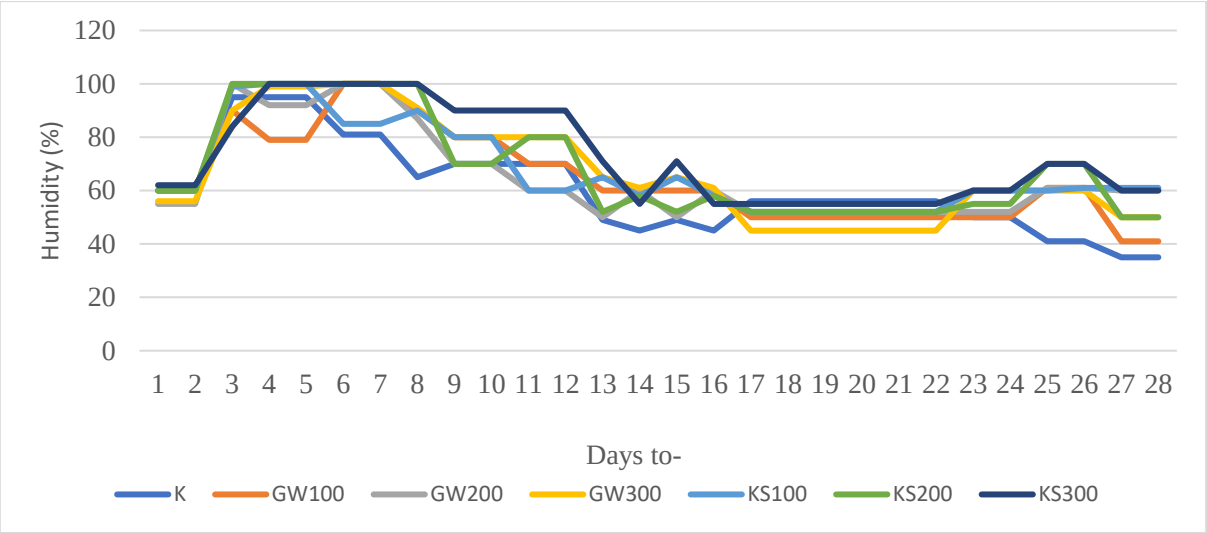
Graph 1 Temperature Measurement of the Composting Process Using Bioactivator Gray Water and Cow Dung in Various Dosage Variations

Graph 1 displays the temperature changes in several sample variation treatment up to 28 days. The KS300 sample has a maximum temperature of 37°C, but the GW300, KS100, and KS200 samples reach a temperature of 38°C. Whereas GW100, GW200 only achieves a maximum temperature of 36°C during the composting process, which lasts for 28 days.



Graph 2 pH Measurement of the Composting Process Using Bioactivator Gray Water and Cow Dung in Various Doses

Graph 2 shows that the pH increased from the first day of decomposition to the 28th day. In addition, there is a noticeable variation in pH between week 1 and week 2. On the 28th day, the samples GW200, GW300, KS200, and KS300 showed the highest pH level of 8.5, indicating an alkaline/base.



Graph 3 Humidity Measurement in the Composting Process Using Bioactivator Gray Water and Cow Dung in Various Doses

Graph 3 shows that there were no major shifts seen in the sample from day 1 to day 28 of composting. However, the KS100 sample showed a reduction in humidity of 31.67%, which sets it apart from the current situation. The maximum humidity in all samples reached 100%.

Tabel 2 Results analysis of the quality of compost content using gray water and cow dung in various dosage

Sample Code	Parameter				
	P	N	K	C/N Ratio	C-Org
K	0,14	0,54	0,36	70,7	38
GW100	0,15	0,6	0,26	58,06	35
GW200	0,2	0,53	0,47	87,1	46
GW300	0,18	0,62	0,4	56,54	35
KS100	0,18	0,61	0,44	60,85	37
KS200	0,2	0,59	0,42	58,87	35
KS300	0,23	0,58	0,51	60,08	35
SNI	0,10-Max	0,40-Max	0,20 - Max	10 -20	27 – 58

Source : Primary data

Information :
K = Control
GW100 = Grey Water 100 gr
GW200 = Grey Water 200 gr
GW300 = Grey Water 300 gr
KS100 = Cow Dung 100 gr
KS200 = Cow Dung 200 gr
KS300 = Cow Dung 300 gr

The compost analysis results, using gray water mud bioactivator and cow dung (Table 2), indicate that the compost's quality does not match the requirements stated in SNI 19 7030 2004. The

analysis results for parameters P, N, K, and C-Org fulfilled the requirements, contradicting the analysis results for parameter C. The nitrogen (N) ratio remains higher in all treatments, regardless of whether gray water mud bioactivator or cow dung is used.

DISCUSSION

Effect of Varying Doses of Gray Water Mud and Cow Dung on pH

Through the analysis of multiple samples, it was seen that almost all of them showed an increase in pH levels, reaching 8.5 by the 28th day. This pH value indicates an alkaline/basic classification. On the 28th day, samples GW100 and KS100 had a pH of 7, although the highest increase during the process occurred at pH 8.5. This happens when bacteria use organic acid, which raises pH. Other species of bacteria then use the organic acid, bringing pH back to neutral (Andriany et al., 2018). Referring to SNI 19 7030 2014, this value fulfills the standard requirements for compost pH quality, which are 6.8 – 7.49 (BSN, 2004.). The pH levels in samples GW200, GW300, KS200, and KS300 remained high, which is at 8.5, until the 28th day, which did not comply with the requirements stated in SNI 19 7030 2014. In line with study on evaluating the quality of compost generated from a temperature-controlled aerobic composter and aeration at a household level (Case Study in Argosari Village, Malang Regency), it was observed that the pH level of the produced compost did not comply with the requirements outlined in SNI 19 7030 2014, which sets the quality standards for organic compos (Nugroho, 2017).

Effect of Varying Doses of Gray Water Mud and Cow Dung on Temperature

Overall, all samples, including the controls, underwent temperature variations until the second week of our research. The decomposition of organic materials is facilitated by the activity of mesophilic and thermophilic microorganisms (Himawarni & Nuraini, 2022). During the initial week, the sample temperature peaked at 37°C, signifying the starting point of microbial activity in the decomposition of the waste. Mesophilic microorganisms thrive within a temperature range of 10°C-45°C. Their main job is to decrease the size of organic materials, hence increasing the material's surface area and accelerating the composting process (Lasmi & Syamsi, 2021). The temperature of the compost sample on the 28th day, which was measured to be between 29°C and 31°C, closely matches the groundwater temperature required in the SNI 19 7030 2004 compost quality standard (BSN, 2004))

Effect of Varying Doses of Gray Water Mud and Cow Dung on Humidity

The amount of water or humidity has a significant impact on microbial metabolism (BD Tawa, YR Tnunay, S Suwari, 2020). The humidity levels of all samples on the 28th day varied between 41% and 60%. On the 28th day, samples GW200, KS100, and KS300 were found to have a moisture level of 61%, which exceeds the permitted maximum humidity of 50% specified in SNI 19 7030 2004 for compost made from organic waste. When the humidity reaches 60%, nutrients will be washed out, the air volume will drop, leading to a decrease in microbial activity and the occurrence of anaerobic fermentation, which produces an unpleasant smell. When microbial activity reduces, the quality of the compost degrades and the waste decomposition process slows down (Firda, 2014).

Effect of Varying Doses of Gray Water Sludge and Cow Manure on Nitrogen (N), Phosphorus (P), Potassium (K), C-Organic and C/N Ratio Contents

Nitrogen serves as a fuel for microorganisms in the soil and plays a crucial part in the breakdown of organic matter throughout the weathering process. The analysis of all samples revealed that the nitrogen concentration in the compost surpassed 0.40%, which is in line with the compost quality requirement (BSN, 2004) specified in SNI 19 7030 2004. This is because gray water sludge and cow dung, which contain rich macro components, have the ability to break down organic waste through decomposition. Haryanta et al., (2022) found that urban sludge waste has a significant concentration of nitrogen (N), phosphorus (P), and potassium (K) elements. Greywater is rich in easily decomposable organic compounds and several essential elements that are primarily generated from houses. These nutrients consist of nitrate and its derivatives, phosphorus and its derivatives. Additionally, xenobiotic organic chemicals are also found (Fatta-Kassinos et al., 2011). In Yulianto (2017), study on the impact

of organic cow dung fertilizer on the quality of compost from dry leaf waste at the Universitas Diponegoro TPST (tempat pembuangan sampah terakhir), discovered hat the nitrogen value of the compost could be enhanced by the addition of organic cow dung fertilizer.

Effect of Varying Doses of Gray Water Mud and Cow Dung on P (Phosphorus) Content

The research findings indicated that the phosphorus (P) concentration in all treatments fell within the range of >0.10%, thereby fulfilling the standards outlined in the SNI 19 7030 2004 compost quality standard. The variation in phosphorus level in the compost can be explained to the substantial phosphorus found in the raw materials and the significant presence of microorganisms during the composting process (Yulianto, 2017). The gray water mud contains a high concentration of essential nutrients, such as phosphorus, and comes from household liquid waste, including wastewater from washing, kitchen, and bathroom waste, excluding feces. According to a study conducted in Juliani (2018), cow dung has a phosphorus content ranging from 0.20% to 0.50%.

Effect of Varying Doses of Gray Water Mud and Cow Dung on K (Potassium) Content

The potassium component in compost originates from organic substances, specifically plants, which serve as growth substances (Yulianto, 2017). The testing results of the potassium content in all compost samples indicated values exceeding 0.20%, regardless of whether gray water mud bioactivator or cow dung was used. The reason for this is that the research uses organic vegetable materials and rice husks, which are rich in potassium. Consequently, even after the composting process, the potassium level remains quite high.

Effect of Varying Doses of Gray Water Sludge and Cow Manure on the C/N Ratio Content

The C/N ratio in the compost defines its maturity level; the higher the C/N ratio, the less degraded the compost is (Surtinah, 2013). Upon final testing, the C/N ratio content in all compost samples was found to be relatively high, ranging from 56.54% to 58.06%, in comparison to the 10% to 20% compost quality requirement specified in SNI 19 7030 2004. Similarly, the ultimate C/N ratio for the control sample utilizing EM4 was 70.7. This is because, given that the organic materials utilized in the compost include rice husks and vegetable waste, the composting period of only about 28 days is not enough. Rice husks possess a waxy surface and a significant amount of silica, resulting in a decrease in water retention capacity and the potential to restrict microbial degradation. A study in NE Argentina on composting rice husks and sawdust with poultry dung. The research revealed that it took around 180 days for both carbon-rich wastes to reach compost stability (Leconte et al., 2009).

Effect of Varying Doses of Gray Water Sludge and Cow Manure on C-Organic Content

The analysis of all treatment samples revealed that the C-organic value ranged from 35% to 46%, indicating conformity with the compost quality requirement specified in SNI 19 7030 2004. The C-organic content in composting material is crucial when determining the effectiveness of composting. In other research, comparing several organic compost materials and it was found that cabbage had the lowest C-organic value. The lower the C-organic content of the compost indicates the better the decomposition process carried out by microorganisms during the composting process (Wati, 2019). The C-organic content of mature compost decreases in the C-organic content of the starting compost material, due to the breakdown process that occurs during composting. In the process of decomposing waste, microbes require high levels of nutrients (Nitrogen) to break down organic carbon. This indicates that the choice of compost combination also plays an important role in the success of compost making.

That the results of this research can provide input for other research in the field of waste management in improving the use of cow dung and gray water sludge as composting bioactivators. Some deficiencies in this research such as ;

1. The research design only uses 1 experiment, making it possible for data errors to occur.
2. The data collection process is limited to only 28 days, so the waste decomposition stage is not completely completed.
3. Data analysis did not use statistical test instruments, because the amount of experimental data was less than 30 samples.

CONCLUSION AND RECOMMENDATION

According to the research findings, it was found that the use of gray water mud and cow dung in various dosage combinations did not match the compost quality standards specified in SNI 19 7030 2004, specifically in terms of the C/N ratio parameter, as it remained relatively high. The use of gray mud as a bioactivator has successfully fulfilled the necessary standards for physical factors such as temperature, pH, and humidity, as well as for phosphorus (P), nitrogen (N), and potassium (K) levels. However, it did not meet the requirements for the C/N ratio criterion. Similarly, in the experiment involving the use of cow dung as a bioactivator.

Some recommendations for relevant studies are as follows:

1. Substituting the mixture of organic waste with a lower carbon content, such as dry leaves, straw, and grass, instead of rice husks, will accelerate the decomposition process of waste in compost production.
2. For those who intend to conduct comparable research, it is recommended to increase the dosage of gray water mud and cow dung.
3. It is unnecessary to frequently add water to the sample when the humidity level reaches 60%.

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