JOURNAL OF WORLD SCIENCE
https://jws.rivierapublishing.id/index.php/jws
Volume 2 No. 2 February 2023
P-ISSN: 2828-8726
E-ISSN: 2828-9307

THE EFFECTIVENESS OF GOAT ANIMAL MANURE AS AN ALTERNATIVE ACTIVATOR FOR MAKING COMPOST FROM HOUSEHOLD ORGANIC WASTE

Diah Navianti[1], Priyadi[2], Khairil Anwar[3]
Politeknik Kesehatan Palembang, Indonesia

diahnavianti@poltekkespalembang.ac.id[1], priyadi@poltekkespalembang.ac.id[2],
khairil@poltekkespalembang.ac.id[3]

ABSTRACT
This study examines the effectiveness of using goat manure activator in making compost from household organic waste. The type of research used was quasi-experimental, with pre-test and post-test control designs, and data were analyzed using the dependent T test to determine the effect of using goat manure activator on chemical parameters in compost and then analyzed again. with independent T-test to determine the effectiveness of manure activator. Animals with EM4 as control. Results of the study For chemical parameters the average moisture content was 2.07%, and the average NPK macro elements in compost with goat manure activator were each 0.46%. 0.45% and 0.76% of the results follow SNI 19-7030-2004 standards. While the average pH of 7.75 exceeds the maximum SNI standard of 7.49. In terms of physical parameters, the resulting compost has a temperature of 280C, is black in color, and has an earthy smell according to SNI. Statistical test results showed the effect of adding goat manure activator on the chemical and physical parameters of compost ($p \leq 0.05$). Furthermore, the results of statistical tests obtained goat manure activator which is effectively used as an activator. The test results showed no difference in yield with control bioactivation ($p \geq 0.05$) and had compost maturity according to SNI with two weeks composting time. Goat manure activator is very well used as an alternative activator in making compost from household organic waste.

Keywords: goat manure, compost, household organic waste, indonesia.

Corresponding Author: Diah Navianti
E-mail: diahnavianti@poltekkespalembang.ac.id

INTRODUCTION

Indonesia produced 67.8 million tons of waste in 2020. Based on KLHK data, the composition of waste is dominated by organic waste, which accounts for 60% of the total waste. The remaining 26% is cloth, metal, plastic, styrofoam, and various leftover packaging (Forestry, 2020). The composition of municipal waste that can flow into the sea and other waters is dominated by 44% organic waste, 21% diapers, 16% plastic bags, and the rest is other waste (Bank, 2019).

The environment's carrying capacity is decreasing due to high pollution, and efforts to handle it have not been optimal. Currently, the level of waste handling nationally has only reached 67% of the total projected waste generation, while the waste reduction rate only reaches 2.26% (Forestry, 2020).

Data on the total quantity of daily waste in South Sumatra Province is 2923.32 tons, and the distribution of daily waste in Palembang City contributes the largest amount of waste in South Sumatra, equal to 1168 tons/day. Meanwhile, according to the source, household waste which is dominated by organic waste from traditional markets, is the largest source, with 799.13 tonnes/year (MLHK, 2021).

Seeing the large amount of organic waste produced by the community and its impact on the environment, it is necessary to have proper processing so that organic waste can be handled properly. Composting is an effective way of managing waste and processing organic waste, which has been converted into compost and biogas (Nofiyanti et al., 2022), (El-mrini et al., 2022), (Reetsch et al., 2020), (Onwosi et al., 2017).

One of the organic wastes that can be used to be processed into fertilizer is organic waste originating from household waste and public places, namely organic waste originating from traditional markets in the form of a mixture of vegetables. The activator used in this study was goat manure. The research results on goat manure have a low C/N ratio to speed up the decomposition process; the lower the C/N value, the shorter the time needed for composting (Fuadi, 2020). From several nutrient analyses for each of the four manures, it turns out that goat manure has better nutrients than other manure (Saridewi, 2019). Analysis of the resulting compost includes physical analysis, including temperature, color, and odor. The chemical analysis includes moisture content, pH, carbon to nitrogen ratio, and macro elements N, P, K. (Rahman et al., 2020), (Bachtiar & Ahmad, 2019), (Katakula et al., 2021).

This study aimed to determine the effectiveness of adding a goat manure activator in making compost from organic waste originating from household waste.

METHODS

The Health Polytechnic of the Indonesian Ministry of Health funded this research. This research is a quasi-experimental research with pre-test and post-test control design, namely knowing the effect of goat manure activator on chemical and physical parameters measured before and after adding an activator to the treatment group. In contrast, the control group was treated with the addition of Effective Microorganism-4 or EM-4 activator, which is an inoculant mixture of microorganisms (Lactobacillus, yeast, photosynthetic bacteria, actinomycetes, and cellulose decomposing fungi) which can accelerate the maturity of organic fertilizers in the composting or decomposition process of organic matter and added molasses and water, the EM4 content used is 1.6% (Miller et al., 2020).

The chemical parameters measured in this study were Nitrogen, Phosphorus, and Potassium levels. This parameter is measured after the compost reaches maturity, after two weeks of adding the activator and processing it anaerobically. Tests were carried out at the Testing Laboratory of the Rubber Research Center, owned by PT Prestasi Perkebunan Nusantara. Measurement of the levels of this parameter using a Spectrophotometer 15.

Physical parameters measured in this study were water content, pH, and temperature. This parameter is measured after the compost reaches maturity, after two weeks of adding the activator and processing it anaerobically. Tests were carried out at the Testing Laboratory of the Rubber Research Center, owned by PT Prestasi Perkebunan Nusantara. Measurement of water content with the Gravimetric method, pH is measured with a pH meter and temperature with a thermometer. The researcher directly observed the organoleptic of the compost.

Household organic waste was divided into three parts: the group without treatment, the treatment group with goat manure activator, and the control group. There are 6 samples per group. The composting process was carried out for two weeks. Statistical analysis to see the effect of goat

manure activator with the t-dependent test. Furthermore, to see the effectiveness of the goat manure activator, an independent t-test was carried out (Murphy & Morrison, 2014).

RESULTS AND DISCUSSION

This study uses household organic waste, namely vegetable waste, and fruit peels. Garbage is given goat manure activator with a ratio of 30 goat manure and 70% household organic waste. The results of laboratory analysis of macro element levels in organic waste compost without an activator can be seen in table 1, and for goat manure with the activator in table 2, as follows:

Table 1. Distribution of Descriptive Statistical Content of Macro Elements in Compost Without Activator

Macro element	Means Median	SD	Min - Mak	95% CI
Nitrogen	2.05 2.06	0.38	1.58 – 2.51	1.45 – 2.66
Phosphorus	1.20 1.20	0.08	1.09 – 1.29	1.06 – 1.30
Potassium	1.55 1.52	0.07	1.43 – 1.68	1.43 – 1.68

The results of the analysis obtained an average of 2.05 Nitrogen (95% CI: 1.45 – 2.66), a median of 2.06 with a standard deviation of 0.38. The lowest Nitrogen content is 1.58, and the highest Nitrogen is 2.51. From the results of interval estimation, it can be concluded that 95% is believed to have an average Nitrogen Level between 1.45 and 2.66. The results of the analysis obtained an average Phosphorus of 1.20 (95% CI: 1.06 – 1.30), a median of 1.20 with a standard deviation of 0.08. The lowest Phosphorus content is 1.09, and the highest Phosphorus is 1.29. From the interval estimation results, it can be concluded that 95% is believed to have an average Phosphorus content between 1.06 and 1.30. The results of the analysis obtained an average of 1.55 Potassium (95% CI: 1.43 – 2.68), a median of 1.52 with a standard deviation of 0.07. The lowest Potassium content was 1.43, and the highest Potassium was 1.68. From the results of interval estimation, it can be concluded that 95% is believed to have an average potassium level between 1.43 and 1.68.

Table 2. Descriptive Statistical Distribution of Macro Element Levels in Compost with Goat Manure Activator

Macro element	Means Median	SD	Min - Mak	95% CI
Nitrogen	0.50 0.40	0.20	0.40 – 0.73	0.22 – 0.74
Phosphorus	0.45 0.27	0.45	0.13 – 1.12	0.27 – 1.17
Potassium	0.76 0.77	0.18	0.56 – 0.93	0.47 – 1.05

The results of the analysis obtained an average of 0.5 Nitrogen (95% CI: 0.22 – 0.74), a median of 0.40 with a standard deviation of 0.20. The lowest nitrogen content is 0.22, and the highest Nitrogen is 0.74. From the results of interval estimation, it can be concluded that 95% is believed to have an average Nitrogen Level between 0.22 and 0.74. The results of the analysis obtained an average Phosphorus of 0.45 (95% CI: 0.27 – 1.17), a median of 0.45 with a standard deviation of 0.45. The lowest phosphorus content was 0.13 and the highest Phosphorus was 1.12. From the interval

estimation results, it can be concluded that 95% is believed to have an average Phosphorus content between 0.47 and 0.74. The results of the analysis obtained an average Potassium of 0.76 (95% CI: 0.47 – 1.05), a median of 0.77 with a standard deviation of 0.18. The lowest Potassium content was 0.56, and the highest Potassium was 0.93. From the results of interval estimation, it can be concluded that 95% is believed to have an average potassium level between 0.47 to 1.05. Furthermore, the water content and pH in the compost were measured without the activator shown in table 3 and with the activator in table 4 as follows:

Table 3. Distribution of Descriptive Statistical Moisture Content and pH in Compost Without Activator

Variable	Means Median	SD	Min - Max	95% CI
Water content	4,34 4.39	0.91	3.20 – 5.40	2.89 – 5.79
pH	7.90 7,75	0.68	7, 3 – 8, 9	6, 8 – 9, 0

The analysis results obtained an average moisture content of 4.34% (95% CI: 2.89 – 5.79), a median of 4.39 with a standard deviation of 0.91. The lowest water content is 2.89 and the highest water content is 5.79. From the results of interval estimation, it can be concluded that 95% is believed to have an average Moisture Content between 2.89 to 5.79. The analysis results obtained an average pH of 7.90 (95% CI: 6.8 – 9.0) and a median of 7.75 with a standard deviation of 0.68. The lowest pH is 7.3, and the highest pH is 8.9. From the interval estimation results, it can be concluded that 95% is certain average pH between 6, 8 to 9, 0.

Table 4. Distribution of pH Descriptive Statistics in Compost with Goat Manure Activator

Variable	Means Median	SD	Min - Max	95% CI
Water content	2.07 2,10	0.29	1.70 – 2.39	1.60 – 2.54
pH	7.7 7.9	0.52	7.0 – 8.1	6.9 – 8.5

The results of the analysis obtained an average Moisture Content of 2.07% (95% CI: 1.60 – 2.54), a median of 2.10 with a standard deviation of 0.29. The lowest water content is 1.70, and the highest is 2.39. From the results of interval estimation, it can be concluded that 95% is believed to have an average Moisture Content between 1.60 and 2.54. The analysis results obtained an average pH of 7.75 (95% CI: 6.9 – 8.5) and a median of 7.9 with a standard deviation of 0.52. The lowest pH is 7.0, and the highest pH is 8.1. From the interval estimation results it can be concluded that 95% is believed to have an average pH between 6.9 to 8.5. The results of physical observations of compost after 2 weeks showed that compost without an activator had a blackish-green color with a rotten odor at a temperature of 27 ^{0}C. Meanwhile, for compost with an activator, goat manure had a black color, smelled of soil, and had a temperature of 28 ^{0}C. The results of compost without an activator are seen in table 5 below:

Table 5. Physical Observation Results of Compost Without Activator and With Goat Manure Activator

Use of activators	Color	Smell	Temperature (^{0}C)
No activator	Blackish green	Bad odor	27 ^{0}
Goat Manure Activator	Black	earthy smell	28 ^{0}C

The statistical test results for the average macro elements, water content, and pH are based on activators, as shown in table (6).

Table 6. Distribution of average levels of Chemical and Physical Parameters according to the use of Activators

Variable	Means	SD	SE	P Value	N
Nitrogen Levels					
- Compost without activator	2.05	0.40	0.20	0.004	12
- Compost with Kohe activator	0.46	0.20	0.10		
Phosphorus Levels					
- Compost without activator	1.19	0.08	0.04	0.032	12
- Compost with Kohe activator	0.45	0.45	0.22		
Potassium Levels					
- Compost without activator	1.55	0.08	0.04	0.001	12
- Compost with Kohe activator	0.76	0.18	0.09		
Water content					
- Compost without activator	4,34	0.91	0.45	0.014	12
- Compost with Kohe activator	2.07	0.29	0.15		
pH					
- Compost without activator	7,92	0.68	0.34	0.661	12
- Compost with Kohe activator	7.75	0.52	0.26		

The average nitrogen content in compost without an activator is 2.05%, with a standard deviation of 0.40%. In compost with the Kohe activator, the average nitrogen content was 0.45%, with a standard deviation of 0.45%. The mean difference between compost without an activator and compost activator is 0.74, with a standard deviation of 0.40. Statistical test results obtained p = 0.004, so the addition of the goat activator has a significant effect on nitrogen levels in organic waste compost.

The average Phosphor content in compost without an activator is 1.19%, with a standard deviation of 0.04%. In compost with the Kohe activator, the average phosphorus content was 0.45% with a standard deviation of 0.%. The mean difference between compost without an activator and compost activator is 1.60, with a standard deviation of 0.40. Statistical test results obtained p = 0.032, so the addition of the goat activator has a significant effect on phosphorus levels in organic waste compost.

The average Potassium content in compost without an activator is 1.15%, with a standard deviation of 0.08%. In compost with the Kohe activator, the average Potassium content was 0.0.76% with a standard deviation of 0.18%. The mean difference between compost without an activator and compost activator is 0.79 with a standard deviation of 0.13. Statistical test results obtained p = 0.001, so the addition of the goat activator has a significant effect on Potassium levels in organic waste compost.

The average water content in compost without an activator is 4.34%, with a standard deviation of 0.91%. The average water content in compost with the Kohe activator was 2.07%, with a standard deviation of 0.29%. The mean difference between compost without an activator and compost activator is 2.27 with a standard deviation of 0.87. Statistical test results obtained p = 0.014, so adding goat come activator has a significant effect on the water content in organic waste compost.

The average pH of compost without an activator is 7.92 with a standard deviation of 0.68. In compost with the Kohe activator, an average pH of 7.75 was obtained with a standard deviation of 0.52. The mean difference between compost without an activator and compost activator is 0.17, with a standard deviation of 0.72. The statistical test results obtained p = 0.661, so there was no significant effect of the addition of goat kohe activator on pH in organic waste compost.

The effectiveness test of goat manure activator with effective microorganism bioactivation (EM 4) plus molasses was obtained, as shown in table (7).

Table 7. Average Distribution of Macro Elements, Moisture Content, and pH in compost According to Activator Type (Goat Manure Activator and Bioactivator as Control)

Variable	Means	SD	SE	P Value	N
Nitrogen Levels					
- Kohe activator compost	0.46	0.18	0.09	0.004	6
- Compost with Bioactivator	3.04	0.72	0.36		6
Phosphorus Levels					
- Kohe activator compost	0.45	0.45	0.22	0.533	6
- Compost with Bioactivator	0.26	0.35	0.17		6
Potassium Levels					
- Kohe activator compost	0.76	0.18	0.09	0.000	6
- Compost with Bioactivator	1.77	0.18	0.09		6
Water content					
- Kohe activator compost	2.07	0.29	0.14	0.065	6
- Compost with Bioactivator	6.01	2.77	1.38		6
pH level					
- Kohe activator compost	7.75	0.52	0.26	0.597	6
- Compost with Bioactivator	7.95	0.49	0.25		6

The average nitrogen content of compost with animal manure activator is 0.46% with a standard deviation of 0.18%. Whereas for compost with bioactivation, the average nitrogen content is 3.04% with a standard deviation of 0.72%. Statistical test results obtained p = 0.04. Then there is a significant difference in average nitrogen levels between compost and animal manure activator and compost and bioactivation.

The average Phosphor content of compost with animal manure activator is 0.45% with a standard deviation of 0.45%. Whereas for compost with a bio activator, the average Phosphor content is 0.26% with a standard deviation of 0.35%. Statistical test results obtained p = 0.533. So there is no significant difference in the average Phosphorus content between compost and animal manure activator and compost with bioactivation.

The average potassium content of compost with animal manure activator is 0.76% with a standard deviation of 0.18%. Whereas for compost with bioactivation, the average Potassium content is 1.77% with a standard deviation of 0.18%. Statistical test results obtained p = 0.000. So,

there is a significant difference in average Potassium levels between compost and animal manure activators and compost and bioactivation. The average water content of compost with animal manure activator is 2.07% with a standard deviation of 0.29%.

Meanwhile, the average water content for compost with a bio activator is 6.01%, with a standard deviation of 2.77%. Statistical test results obtained p = 0.065. So, there is no significant difference in the average water content between compost and animal manure activator and compost and bioactivation. The average pH of compost with animal manure activator is 7.75 with a standard deviation of 0.52%. As for compost with a bio activator, the average pH is 7.95, with a standard deviation of 0.49. Statistical test results obtained p = 0.597. So, there is no significant difference in the average Potassium content between compost and animal manure activator and compost and bioactivation.

This study showed that goat manure influenced the chemical and physical parameters of the compost produced for two weeks. The results are 0.46% Nitrogen, 0.45% Phosphorus, and 0.76% Potassium. While the average water content is 2.07% and pH is 7.75. From the results of statistical tests, it was found that there was an effect of adding animal manure activator to the chemical parameters of compost, including Moisture Content and NPK Macro Elements ($p \leq 0.05$). The results of this study are in line with other studies with the results that the average cow manure compost contains P of 0.21%, K of 0.44%, and a C/N ratio = 20 (Ekawandani & Alvianingsih, 2018) (Zhu et al., 2021). This result is also in line with other studies which show goat manure has a low C/N ratio so that it can speed up the decomposition process; the lower the C/N value, the shorter the time needed for composting. From several nutrient analyses for each of the four manures, it turns out that goat manure has better nutrients than other manure (Saridewi, 2019); (Cundari et al., 2019). However, the results of this study are not in line with other studies which show that cow manure is more suitable for use as an activator for making compost from organic waste anaerobically (Dhamodharan et al., 2015). The study results found that chemical parameters such as Phosphorus content, potassium content, and C/N ratio of compost with goat manure activator complied with SNI 19-7030-2004 compost quality standards. Meanwhile, the pH value, one of the criteria for the agronomic value of compost, has a slightly higher value than the maximum limit with a difference of 0.26. However, the pH is still in the Neutral category (National Standardization Agency, 2004).

The research results for the physical parameters of compost with goat manure activator have a temperature of 28 ^{0}C with a blackish compost color and smell of earth. Meanwhile, compost with an EM4 activator was obtained at a temperature of 28 ^{0}C with a blackish color and foul-smelling compost. This result is in line with other studies that state that goat manure has a low C/N ratio so it can speed up the decomposition process, the lower the C/N value the shorter the time needed for composting. So that the results of compost with goat manure activator undergo the decomposition process faster than the results of compost without activator or compost results with EM4 activator as a control (Saridewi, 2019); (Muhammad et al., 2017); (Muhammad Hatta & Yudi Firmanul Arifin Forestry Study Program, 2021)

Test results for the effectiveness of using a goat manure activator found no significant difference between compost's chemical and physical parameters with a goat manure activator compared to compost with an EM4 bio activator as a control. This result is in line with previous research, which showed that compost made with goat manure had better nutrients than compost

made with other animal manure and contained valuable microbial populations (Saridewi, 2019); (Das et al., 2011); (Sofa et al., 2022).

The composting process was carried out for two weeks, and the results obtained for the physical parameters of goat manure compost with better temperature, color, and smell than the control compost (EM4). Maturity compost with goat manure activator has a C/N ratio of 20:1 with a temperature according to groundwater temperature, and the color of the compost is black and has an earthy smell (National Standardization Agency, 2004). This is also supported by other studies which show that a low C/N ratio can speed up the decomposition process; the lower the C/N value, the shorter the time required for composting (Saridewi, 2019).

CONCLUSION

This study shows that the use of goat manure activator affects chemical parameters (macro NPK elements) and physical parameters such as temperature, color, and smell and is effectively used as an activator in making compost from household organic waste. This technology of using goat manure can be used as a very high-quality fertilizer and can be used as a cultivation business for the wider community in the future.

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