Aloha International Journal of Health Advancement (AIJHA)
ISSN 2621-8224
Volume 4 Number 3, March 2021 RESEARCH
http://journal.aloha.academy/index.php/aijha DOI: http://dx.doi.org/10.33846/aijha40301

Development of Potential of Biogas Waste and Cow Urine for Organic Liquid Fertilizer

Mujiyono[1 (corresponding author)], Sujangi[2], Beny Suyanto[3],
[1(CA)]Department of Environtmental Health, Poltekkes Kemenkes Surabaya, Indonesia; mujiyonojohn@gmail.com
[2]Department of Environtmental Health, Poltekkes Kemenkes Surabaya, Indonesia; sujangi1960@gmail.com
[3]Department of Environtmental Health, Poltekkes Kemenkes Surabaya, Indonesia; benssuy@gmail.com

Submitted: February 12, 2021 -Revised: February 28, 2021 -Accepted: March 21, 2021 -Published: March 31, 2021

ABSTRACT

Biogas waste (slurry) and cow urine can be processed into fertilizer that has economic value for the community in addition to making the cowshed cleaner. This study aims to process biogas waste and cow urine into organic liquid fertilizer. This experimental study used a randomized design consisting of 5 formulations of organic liquid fertilizer that were treated, namely the ratio of biogas waste and cow urine with a ratio of formula: A (3:1); B (1:1); C (2:1); D (1:0) and E (0:1). Each treatment was replicated 3 times, in order to obtain 15 samples. To speed up the process of making fertilizer, 1% EM4 was added. The process of making fertilizer using aeration and fermentation methods. Assessment of fertilizer maturation results based on physical and chemical parameters. The results of the measurement of chemical parameters are: N (1.03%-1.51%), P (0.78%-1.22%); K (0.15%-4.51%) and C/N ratio (13.9-23.0). The best ratio of biogas waste and urine is 1:1. The results of the measurement of physical parameters are: characteristic odor of fermentation/tape; pH (7.0-8.6); color/texture: dark brown; and this does not violate the limits of the minister of health regulations.
Keywords: biogas waste; cow urine; liquid organic fertilizer

INTRODUCTION

Background

Biogas waste and cow urine have the potential to be developed into liquid organic fertilizer capable of producing C, N, P, K and C/N ratios according to the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70/permentan/SR.140/10/2011 [(1)]. To realize this, it is necessary to design the development of appropriate technology that is easy, inexpensive, and has economic value for the community. By utilizing waste and manure from livestock like this, it is hoped that the environmental sanitation of the cowshed and its surroundings will be better, in the sense that the environment can be maintained always clean and healthy.

Purpose

Based on the above background, this study aims to process biogas waste and cow urine into organic liquid fertilizer that meets health requirements.

METHODS

Design

This type of research was an experimental study, using a post test only design. The researchers made a treatment in the form of utilizing biogas waste and cow urine as liquid organic fertilizer, with the addition of a bacterial fermenter bioinoculant, namely EM4 1%. The comparison between biogas waste and cow urine is divided into 5 formulas, namely: A (3:1); B (1:1); C (1:3); D (1:0) and E (0:1). Each treatment was replicated 3 times to obtain 15 samples.

Working Procedure

a) Prepare 30 liters of biogas slurry/effluent and 10 liters of cow urine (formula 1) and put it in the aerator. This formula is separated into 3 samples.
b) Operate the aerator with the following treatment details
   (1). Setting up the aerator and ensuring that it runs normally.
   (2). Input raw materials: 30 liters of slurry/effluent biogas and 10 liters of cow urine into the aerator
   (3). Turn on the aerator (change it to the On position) and observe the aeration process: the submersible pump will raise the raw materials with a controlled flow rate and will overflow on top of the cascade plate, slowly

Aloha International Journal of Health Advancement (AIJHA)
ISSN 2621-8224
Volume 4 Number 3, March 2021 RESEARCH
http://journal.aloha.academy/index.php/aijha DOI: http://dx.doi.org/10.33846/aijha40301

falling from the top cascade plate, will gradually arrive at the last cascade plate, then into the reservoir drum. This condition will last for 24 hours operation

(4). Carry out the above activities with 3 replications.

(5). The POC raw materials are then fermented

(6). Perform a 7 to 14 day fermentation process by adding POC raw materials to a jirigen and adding 1% fermenter bacteria. The material is stirred until evenly distributed. The next step is to install a hose from the jirigen to a bottle filled with water as a place to discharge gas during the fermentation process. Every 2 days the product is shaken until the sediment at the bottom is mixed with the top. Perform the fermentation by replication 3 times.

(7). Do the same procedure for formula 2

(8). Do the same procedure for formula 3

(9). Perform the same procedure for the formula 4

(10). Perform the same procedure for the 5 formula

c). Observing the physical and chemical parameters for the five formulas as follows:

(1). Observation of physical parameters is carried out after the fermentation process 7 to 14 days with physical characteristics referring to the Regulation of the Minister of Agriculture of the Republic of Indonesia No.70/Permentan/Sr.140/2011 [(1)]

(2). Measurement of chemical parameters to determine the C/N Ratio, N; P and K, which were conducted at the Soil Science Laboratory, Faculty of Agriculture, UNS Surakarta, Indonesia. The measurement results are compared with the Regulation of the Minister of Agriculture of the Republic of Indonesia No.70/Permentan/Sr.140/2011 [(1)].

(3). Measurement of pH using a pH meter.

(4) Measurement of temperature using a mercury thermometer during the process. The temperature measured is the temperature in the aeration reactor and the ambient temperature. Measurements were made in the morning, afternoon and evening.

Furthermore, data analysis was carried out using the ANOVA test in order to distinguish the physical and chemical parameters of the five formulas.

RESULTS

Table 1. Observation results of physical parameters of liquid organic fertilizer

Formula	Biogas effluent-Urine ratio	Replication	pH and fermentation time (days)			Odor and fermentation time (days)			Color/texture & fermentation time (days)		
			0	7	14	0	7	14	0	7	14
1	1:0	1	7.9	8	7.5	A	C	D	E	G	G
	1:0	2	8.1	8.1	7.6	A	C	D	E	G	G
	1:0	3	7.9	7.9	7.5	A	C	D	E	G	G
2	1:1	1	8.1	8	7.8	A	B	D	F	G	G
	1:1	2	8.2	8.2	7	A	B	D	F	G	G
	1:1	3	8.2	8	7.7	A	B	D	F	G	G
3	0:1	1	8.5	8.2	8	A	B	D	F	G	G
	0:1	2	8.6	8.3	7.6	A	B	D	F	G	G
	0:1	3	8.5	8.4	8.1	A	B	D	F	G	G
4	3:1	1	8.4	8	7.6	A	B	D	E	G	G
	3:1	2	8.4	8	7.6	A	B	D	E	G	G
	3:1	3	8.4	8	7.5	A	B	D	E	G	G
5	1:3	1	8.1	8.1	7.6	A	C	D	D	G	G
	1:3	2	8.1	8	7.6	A	C	D	D	G	G
	1:3	3	8.2	8	7.5	A	C	D	D	G	G

Information:
A = stinging
B = slightly stinging
C = not stinging
D = typical fermented smell like tape
E = brownish yellow
F = greenish yellow
G = dark brown

Aloha International Journal of Health Advancement (AIJHA)
ISSN 2621-8224
Volume 4 Number 3, March 2021 RESEARCH
http://journal.aloha.academy/index.php/aijha DOI: http://dx.doi.org/10.33846/aijha40301

Table 2. Observation results of chemical parameters of liquid organic fertilizer

Formula	Biogas effluent-Urine ratio	Replication	Levels (%)							
			N Total	Mean	P_2O_5	Mean	K_2O	Mean	C/N	Mean
1	1:0	1	0.97	1.24	1.01	1.00	4.97	4.26	14.57	17.52
	1:0	2	0.98		1.08		4.48		18.42	
	1:0	3	1.78		0.91		3.34		19.56	
2	1:1	1	1.97	1.47	0.85	1.22	4.47	4.51	18.80	19.49
	1:1	2	1.30		0.84		3.63		19.10	
	1:1	3	1.13		1.98		5.44		20.57	
3	0:1	1	1.17	1.13	0.75	0.78	0.16	0.15	17.05	20.87
	0:1	2	1.18		0.73		0.15		20.92	
	0:1	3	1.03		0.86		0.13		24.66	
4	3:1	1	1.72	1.51	0.81	0.85	0.73	0.28	10.94	13.90
	3:1	2	1.16		0.88		0.06		14.56	
	3:1	3	1.66		0.88		0.03		16.20	
5	1:3	1	1.44	1.06	1.13	1.04	0.42	0.22	21.23	23.03
	1:3	2	0.84		0.98		0.21		23.55	
	1:3	3	0.91		1.01		0.03		24.31	

DISCUSSION

Physical Parameter Test Results

pH

Before fermentation, the pH ranged from 7.9-8.6. These conditions did not change much at the time of fermentation for 7 days. However, there were significant changes after the 14-day fermentation process (pH 7-8,1).

The data still meets the requirements of the Regulation of the Minister of Agriculture of the Republic of Indonesia [(1)]. There are indications that the longer the fermentation process, the lower the pH, which means that there is an increase in acid levels during the fermentation process, and more sediment is found in the fertilizer. The unstable pH changes indicate that during the anaerobic fermentation process, nutrients are still available from the fermenter bacteria to become fertilizer. This is in line with the results of other studies that fermented cow urine for 14 hours did not lower the pH. However, cow urine added with brown sugar, the longer the fermentation process, the lower the pH and the more decomposed solids. Cow urine with the addition of molasses, with 8 days of fermentation, the pH decreased. Thus, as long as there is an anaerobic process in fermentation and the availability of materials to be remodeled by fermenter bacteria, changes in pH will always exist.

Smell and/or texture

The biogas effluent that has been fermented for 21 days in the digester has a slight odor. However, cow urine that has not undergone fermentation has a distinctive pungent smell of urine. The 2 x 24 hour aeration process of the 4 formulas in this study showed a reduction in odor and texture. During the process, more sediment was found than before the aeration process. The odor categories in the fermentation process of this study were sequentially: pungent, slightly pungent not pungent, and the distinctive odor of fermentation (tape odor) is a process that takes place during fermentation. The longer the fermentation process takes place, the better the fertilizer results will be.

Color

The results of color observations of the 4 fertilizer formulas after aeration at the beginning of the fermentation started with a brownish yellow color, then greenish yellow and followed by blackish brown. If dark chocolate has been created, this indicates that the fermentation has been going well and the sediment in the fermenter will be more and more.

Chemical Parameter Test Results

Nitrogen (N)

The results showed that there were differences in chemical parameters between the formulas. The highest total N is in formula 2, namely the ratio of biogas effluent and cow urine = 1:1, which is 1.47%. While the lowest total N is formula 5 (3:1) which is 1.06%. The process of N formation in this study was due to the activity of anaerobic bacteria in reducing biogas effluent and cow urine during 14 days of fermentation. The composition of different ingredients will result in a synergy of total N formation during fermentation of 1% EM4 and bacteria that were previously present in cow urine and biogas effluent.

Aloha International Journal of Health Advancement (AIJHA)
ISSN 2621-8224
Volume 4 Number 3, March 2021 RESEARCH
http://journal.aloha.academy/index.php/aijha DOI: http://dx.doi.org/10.33846/aijha40301

In comparison, the nitrogen (N) content of POC effluent biogas with goat urine with a ratio of 1:1 was able to increase from 0.9% to 1.8% [(2)].

Total N above can meet the requirements of the Regulation of the Minister of Agriculture of the Republic of Indonesia [(1)], namely 3%-6%. For this reason, other efforts are needed to use the same ingredients and with special treatment so that they are able to meet the regulatory requirements including fermentation time, addition of other ingredients, appropriate methods and duration of aeration.

Phosphorus (P)

Formula 2 (1:1) gives the best P. These results indicate that the synergy between these mixtures in producing phosphorus. The formation of these elements cannot be separated from the role of anaerobic bacteria in EM 1% and bacteria that already exist in the POC material. Different formulas turned out to produce different levels of P. However, it should be noted that this parameter P does not meet the requirements of the Regulation of the Minister of Agriculture of the Republic of Indonesia [(1)]. The solution offered is how to use the right method so that the materials for making the fertilizer can be reduced to fertilizer that meets the requirements.

Previous studies reported the manufacture of fertilizer with a formula of 500 grams of vegetables and 5 liters of water with 350 ml of EM4 fermented for 25 days with 26.66% C-organic and 0.88% Nitrogen. Phosphorus decreased by 1.98%, while Potassium increased by 0.85%. The decrease in Phosphorus and the increase in Potassium is due to microbial activity in decomposing organic matter [(3)].

The results of this study indicate that different formulas produce different P. The aeration treatment of fertilizer material indicated that it would increase the P content and included the length of the aeration process.

Potassium (K)

K with the best results is in formula 2 (1:1), above the other four formulas. This increase in K is due to microbial activity in decomposing organic matter even though the aeration and fermentation processes are the same. Under anaerobic conditions, microbes in fermentation will decompose organic matter and assimilate some of the elements carbon, nitrogen, phosphorus, sulfur and other elements needed to synthesize the protoplasm of these microbial cells.

Previous research reported that the manufacture of fertilizer with a formula of 500 grams of vegetables and 5 liters of water with 350 ml of EM4 fermented for 25 days was able to produce K of 0.85%. And the increase in K was due to microbial activity in decomposing organic matter [(3)].

The results of this study indicate that K levels have not been able to meet the requirements of the Regulation of the Minister of Agriculture of the Republic of Indonesia [(1)].

C/N ratio

The C/N ratio based on the Regulation of the Minister of Agriculture of the Republic of Indonesia is 15-25. The results of this study indicate that there is one formula with C/N not meeting the requirements with a ratio of 13.9 in formula 4 (3:1).

CONCLUSION

The process of aeration for 2 x 24 hours and fermentation for 14 days, produces physical parameters of liquid organic fertilizer that meet the requirements of the Minister of Agriculture of the Republic of Indonesia; as well as chemical parameters: K in the ratio of biogas effluent and cow urine 1:1; C/N ratio in comparison (3:1) and (1:1). Meanwhile, P does not meet the requirements.

REFERENCES

1. Kementan RI. Peraturan Menteri Pertanian Republik Indonesia No. 70/Permentan/SR.140/10/2011 tentang TENTANG PUPUK ORGANIK, PUPUK HAYATI DAN PEMBENAH TANAH. Jakarta: Kementan RI; 2011.
2. Nurjannah N, Arfah N, Fitriani N. Pembuatan Pupuk Organik Cair dari Limbah Biogas. Journal of Chemical Process Engineering. 2018;3(1):43-46.
3. Siboro ES, Surya E, Herlina N. Pembuatan Pupuk Cair dan Biogas dari Campuran Limbah Sayuran. *Jurnal Teknik Kimia*. 2013;2(3):40-43.