Gas production in the digester with the addition of different organic materials

by J Mustabı

Submission date: 04-Apr-2023 06:56PM (UTC+0700)
Submission ID: 2055568103
File name: J_Mustabı_Gas_production_in_the_digester.pdf (451.75K)
Word count: 1562
Character count: 8359

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Cite as: AIP Conference Proceedings 2534, 020008 (2022); https://doi.org/10.1063/5.0105753
Published Online: 06 December 2022

Jamila Mustabi, Try Sukma Utami Taufan, Anie Asriany, et al.

Gas Production in The Digester with The Addition of Different Organic Materials

Jamila Mustabi[1, a)], Try Sukma Utami Taufan[1, b)], Anie Asriany[1, c)] and Agustina Abdullah[1, d)]

[1]*Hasanuddin University, Nutrition and Feed Department, Faculty of Animal Science, Makassar, 90245 Indonesia*

[a]Corresponding author: jamila@unhas.ac.id
[b]trysukmautaufan@unhas.ac.id, [c]anieasriany@unhas.ac.id, [d]agustina.abdullah@unhas.ac.id

Abstract. Biogas is a gas production process from organic material with the help of bacteria. Biogas that uses raw material for cow feces from 3-4 heads is able to produce biogas equivalent to 3 liters of kerosene per day. This study aims to determine the effect of raw material for digester stuffing from cow feces added with rice straw and hyacinth (*Eichhornia crassipes*) on gas production. This study consisted of 4 treatments and 4 replications. The raw materials for the digester are: P1: cow feces and water; P2: cow feces, hyacinth and water; P3: cow feces, rice straw and water; P4: cow feces, hyacinth, rice straw and water. The design used is a completely randomized design. The results of statistical analysis showed that the digester material had a very significant effect ($P<0.01$) on biogas production. Biogas production in each treatment: P1 = 4262.5 ml; P2 = 4127.5 ml; P3 = 3962.5 ml and P4 = 4320 ml. The conclusion is that the more diverse the organic materials that fill the digester, the higher the biogas produced. The highest gas production was obtained from the addition of organic matter of cow feces, rice straw and hyacinth.

Keywords: Biogas, Cow Feces, Rice Straw and Hyacinth.

INTRODUCTION

Organic compounds derived from humans, plants, and animals are organic waste that can be decomposed easily through the fermentation process and produce gas as fuel. The type of gas fuel produced by organic waste undergoes an anaerobic process into a gaseous form that can be used as an energy source. Energy is the most basic human need. Energy is used in various fields to support various activities of daily life. The most widely used energy in meeting human needs is energy derived from petroleum [1]. Energy has an important role in human life. Non-renewable energy sources such as oil, gas, minerals and coal, which if used in excess can cause an energy crisis. One of the efforts to overcome the energy crisis is to find alternative energy sources from the utilization of livestock waste using biogas technology as renewable energy. Biogas technology provides opportunities for rural communities who have livestock businesses, both individually and in groups.

Cow feces is the most suitable substrate as a source of biogas production because it contains methane-producing bacteria found in the stomachs of ruminant animals [2], [3]. One kilogram of cow dung can produce 360 liters of biogas. The raw material for producing methane gas comes from all organic materials, both solid and liquid. One example of organic matter that is easily digested and contains cellulose are rice straw and hyacinth (*Eichhornia crassipes*). Rice straw agricultural wastes that are widely available during the harvest season. Rice straw is often considered as crop residue that interferes with tillage and rice cultivation, therefore farmers burn the straw on the spot after harvest. The use of straw is still limited as animal feed and compost. Rice straw contains approximately 66.8% cellulose and 15.04% hemicellulose. Hyacinth (*Eichhornia crassipes*) is an aquatic plant whose existence is quite disturbing to the community. The use of hyacinth is still not optimal, it is only processed as compost. The chemical composition of hyacinth has 17% cellulose, 43% hemicellulose and 17% lignin, so it has the potential to be developed

2nd International Symposium of Earth, Energy, Environmental Science and Sustainable Development 2021
AIP Conf. Proc. 2534, 020008-1–020008-4; https://doi.org/10.1063/5.0105753
Published by AIP Publishing. 978-0-7354-4284-9/$30.00

as a basic material for biogas production [4]. Biogas production is influenced by filler material, acidity (pH), temperature, and humidity of the digester. Digester stuffing is the main factor that affects the gas content in the biogas. This means that if the filling material does not meet the requirements, then the metagonic bacteria cannot live which will have an impact on the biogas formation process.

METHODS

The process of making biogas in this study used a 100 ml reagent bottle as a digester. Cow feces, rice straw, hyacinth and water were mixed according to the ratio in each treatment. Then they are put into the digester and stirred until homogeneous and put into a shaker with a temperature of 30°C. The hose in the digester bottle is connected to a plastic container filled with water to determine the volume of biogas produced. Biogas production is measured based on the volume of water that comes out of the plastic container. Determination of the ratio of cow feces, rice straw, water hyacinth and water in the digester is calculated using the formula according to [5] as follows:

$$\frac{(Digester\ size\ \times A)}{100} = a \quad (1)$$

$$\frac{(a\ \times 100)}{(DM\ of\ Stuffing)} = b \quad (2)$$

$$Digester\ size - b = c \quad (3)$$

A = Dry matter of desired treatment
a = Initial calculation results
b = Amount of stuffing, and
c = Amount of water into the digester

This study used a completely randomized design, with four treatments and four replications. Digester filler materials are:

P1 = cow feces and water
P2 = cow feces, hyacinth and water
P3 = cow feces, rice straw and water
P4 = cow feces, hyacinth, rice straw and water

The parameters measured are: Gas production, namely: measurement of gas production obtained from the amount of water that comes out of the plastic container due to the pressure from the gas produced by methane-producing bacteria that enters through the digester bottle hose into the plastic container.

RESULTS AND DISCUSSION

Observations of the measurement of total gas production and daily production for each treatment can be seen in **FIGURE 1** and **FIGURE 2**. **FIGURE 1** shows that the highest total gas production was in treatment P4 (cow feces, rice straw and hyacinth) which was 4320 ml, and the lowest was in treatment P2 (cow feces and hyacinth). This shows that the addition of hyacinth and rice straw which is given simultaneously with cow feces is the best digester filler in increasing biogas production, when compared to other treatments. This is in accordance with the opinion [6] which states that the more organic matter used in the digester, the more microbes that play the role in increasing biogas production.

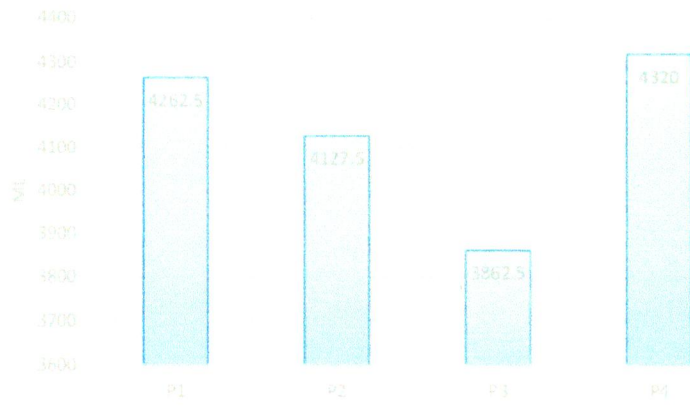

FIGURE 1. Total biogas production at P1 (cow feces), P2 (cow feces and rice straw), P3 (cow feces and hyacinth), and P4 (cow feces, rice straw and hyacinth)

FIGURE 2 shows that the highest daily biogas productions at P2 and P3 were achieved on the 17th day, while P1 and P4 were on the 18th day. This shows that the presence of bacteria in the digester produces acid and methane gas so that biogas production is more optimal. This is in accordance with the opinion [7] which states that the stage of biogas formation starts from the hydrolysis stage where organic matter is degraded and insoluble material is converted to soluble. According to [8], the formation of methane gas in the digester will become acidic due to the absence of air entering the digester, the formation of methane gas is divided into three stages, namely polymer breakdown (hydrolysis), at this stage, the dissolution of complex organic materials becomes simple. Then the formation of acid (acidogenesis) is the formation of acid from simple compounds formed in the hydrolysis stage and will become food for acid-forming bacteria. Methane formation (methanogenesis) is anaerobic bacteria that play a role in breaking down organic compounds into biogas compounds with the help of methanogenic microorganisms.

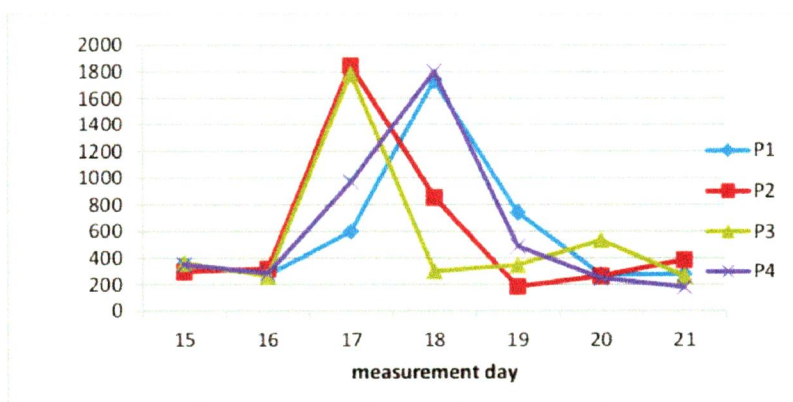

FIGURE 2. Daily biogas production at P1 (cow feces), P2 (cow feces and rice straw), P3 (cow feces and hyacinth), and P4 (cow feces, rice straw and hyacinth)

CONCLUSION

Based on the results and discussion, it is concluded that the more diverse organic materials that fill the digester the higher the biogas produced. The highest gas production was obtained from the addition of organic matter of cow feces, rice straw and hyacinth.

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