



## Biogas Effectiveness Test from Household Waste (Vegetable Waste) with Cow Dung Starter and EM<sub>4</sub>

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### ABSTRACTS

This research focuses on finding solutions to get around the energy crisis. This study aimed to know the effectiveness of household waste (vegetable waste) biogas using a starter mixture of cow dung and EM<sub>4</sub>. What is new from this research is the use of household waste as biogas energy. The research method used is the study of literature from various journals and articles, accurate and reliable. Various journals and conceptual articles were obtained from google scholar and the liputan6.com website page. From the experimental results, the more the composition of vegetable waste, the higher the pressure, but the less the flame. Based on the research results, it can be concluded that biogas made from vegetable waste alone is quite effective to be used as a solution to the energy crisis problem (to replace LPJ gas, to be precise) because of the large amount of methane produced. However, if we are want to be an innovation for successful village development, biogas from household waste (vegetable waste) can be used by adding cow dung as the main ingredient. So that methane is produced in large quantities according to the amount of material used.

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## 1. INTRODUCTION

Energy has a very important role in human life. Energy use increases rapidly in line with population growth and increases (Azhar & Satriawan, 2018). Based on the above statement, it is understandable that all forms of human life will not be able to run without energy, the human economy will also be destroyed when the energy crisis arrives so that the existence of energy needs to be maintained. This indicates that we as humans cannot deny the fact that energy is a very basic need (Widayana, 2012).

Coal is a fossil fuel that is cheap, abundant, and the most polluting (Co<sub>2</sub>, SO<sub>2</sub> and NO<sub>x</sub> gas) (Perera, 2018; Vohra *et al.*, 2011; Perera, 2017) Coal remains the most reliable source of energy to generate electricity worldwide (Dubinin & Mavrin, 2014). Even the UN has warned that coal has started to run low, not to become a crisis that mankind will regret (Jacob, 2017). To overcome this problem, it requires renewable energy that is easy to make and efficient to use, one of which is the manufacture of biogas from cow dung and vegetable waste. One of the actions that will be taken to obtain biogas is by utilizing fruit and vegetable waste and other food waste mixed with livestock waste (such as cow dung).

Organic vegetable and fruit waste such as livestock manure is the best substrate for producing biogas (Qiao *et al.*, 2007). Vegetable waste has a high C: N ratio compared to livestock manure so it needs to be added as a nitrogen source (Bouallagui *et al.*, 2003). The anaerobic process can break down complex organic matter into simpler organic matter (Mani *et al.*, 2016). The end product of anaerobic bioconversion is biogas, a mixture of methane and carbon dioxide that are useful as renewable energy sources (Karthikeyan & Visvanathan, 2013). The potential for methane gas in large quantities can be used as a substitute for fossil fuels. Biogas provides a solution to the problem of providing energy cheaply and without polluting the environment (Dach *et al.*, 2014; Lăzăroiu *et al.*, 2017; Villadsen *et al.*, 2019). In addition to reducing fossil energy pollution, biogas solutions from vegetable waste can also be a solution for the use of organic waste more wisely. Reporting from The Economist Intelligence, Indonesia is the second largest contributor of food waste in the world in 2016 with a percentage of organic waste of 57% (Meidiana & Gamse, 2010).

The main objective of our study is to know the effectiveness of household waste (vegetable waste) biogas using a starter mixture of cow dung and EM4. The research method we use is to study research papers from several trusted journals and articles.

## 2. METHODS

This conceptual article uses research papers from several sources, namely google scholar and the website liputan6.com to explore various data and information related to what is being sought, namely the effectiveness of household waste (vegetable waste) biogas using a starter mixture of cow dung and EM4. The research method we use is to study research papers from several trusted journals and articles.

### 3. RESULTS AND DISCUSSION

#### 3.1 The Effectiveness of Biogas from Household Waste (Vegetable Waste)

##### 3.1.1 Gas Pressure Test Results

The following is the average pressure data generated from vegetable waste biogas using a starter cow dung and EM4 on a 150-liter digester drum (Widyastuti & Suyantara, 2017):

It can be seen in **Table 1** that the highest gas pressure was achieved in sample D-3 (Digerter3) with a composition of 18 kg vegetable waste of 27.83 cm. This increase in gas production can occur due to several factors. The volume of material is more than Another variation. This result shows that the increasing number of organic waste will affect the more significant gas pressure. The difference in elasticity between the biogas reactors, which in this study uses three reactors, is made of plastic drums that can expand when exposed to a high enough temperature or heat to affect the pressure difference. Biogas also contains water vapor, whose amount depends on air temperature. If the air temperature rises, the water vapor content in the biogas will increase, and vice versa, the organic waste contains much moisture to increase evaporation when the temperature is hot (He *et al.*, 2013).

##### 3.1.2 Flame Test Results

Accompanying is the data flame test result generated from vegetable waste biogas using a starter cow dung and EM4 on a 150-liter digester drum (Widyastuti & Suyantara, 2017):

From **Table 2**, it can be seen from the results of the flame duration test, if the composition of vegetable waste is getting more, the longer the flame is getting shorter. Biogas contains water vapor whose amount depends on air temperature. When the air temperature rises, the water vapor content in the biogas will increase, and vice versa. Besides containing water vapor, biogas also contains hydrogen sulfide (H<sub>2</sub>S) and carbon dioxide (CO<sub>2</sub>). H<sub>2</sub>S gas, which is not more than 2% comes from the decomposition of the organic substrate by microbes. CO<sub>2</sub> gas can interfere with the combustion process reducing fuel per unit volume, so it needs to be disposed of to increase the value of biogas fuel (Lombardi & Carnevale, 2013).

**Table. 1** Data average pressure from the research results

Digester	Vegetable Composition	Average Pressure (cm)
1.	10 kg	27, 73
2.	14 kg	20, 67
3.	18 kg	27, 83

**Table 2.** Data flame test results

Digester	Vegetable Composition	Average Flame
1.	10 kg	78 second
2.	14 kg	38,06 second
3.	18 kg	23,23 second

Besides, organic vegetable waste produces less methane gas composition because vegetable waste contains many celluloses and makes it difficult for bacteria to break down (Ahmed et al., 2020). Thus, from the experimental results, biogas only from vegetable waste alone is not effective enough to substitute gas LPJ, except when mixed with cow dung. Because the characteristics of cow dung have a balanced C:N substrate ratio between macronutrients and micronutrients, it will support the formation of enzymes for metabolism. The balance of the ratio needs to be considered because if this ratio is too high (lots of C and not much N), the metabolism becomes inadequate, which means that the carbon in the substrate is not entirely converted, so that maximum methane yield will not be achieved. In the opposite case, the nitrogen surplus can lead to the formation of excessive amounts of ammonia (NH<sub>3</sub>), which even in low concentrations will inhibit bacterial growth and, in the worst-case scenario, can lead to the collapse of the entire population of microorganisms and the process of respiration will not proceed properly (Ratnaningsih et al., 2009; Yenigün & Demirel, 2013).

#### 4. CONCLUSION

Based on the research results, it can be concluded that biogas made from vegetable waste alone is not effective enough if it is used as a solution to the energy crisis problem (to replace LPJ gas to be precise) because of a large amount of methane produced. too small so that the flame is also only briefly. However, if we want to be an innovation for prosperous village development, biogas from household waste (vegetable waste) can be used by adding cow dung as the main ingredient. So that methane is produced in large quantities according to the amount of material used.

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#### 5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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