

# **PENGARUH VARIASI BAHAN BAKU TERHADAP RASIO C/N DARI POTENSI BIOGAS CAMPURAN KOTORAN AYAM DAN ECENG GONDOK**

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Diajukan Sebagai Salah Satu Syarat Untuk Memperoleh Gelar Sarjana Teknik  
Pada Program Studi Teknik Elektro Fakultas Sains Dan Teknologi



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## Effect of Raw Material Variations on the C/N Ratio of Biogas Potential Mixtures of Chicken Manure and Water Hyacinth

### Pengaruh Variasi Bahan Baku Terhadap Rasio C/N dari Potensi Biogas Campuran Kotoran ayam dan Eceng Gondok

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#### Abstract

Kotoran ayam merupakan salah satu limbah dari peternakan ayam petelur yang menghasilkan sekitar 0,06 Kg per harinya. Limbah ini memiliki potensi untuk diubah menjadi biogas, namun pemanfaatannya kurang optimal karena rasio C/N kotoran ayam 15. Rasio C/N (C/N ratio) penting dalam Fermentasi Anaerob untuk menghasilkan biogas, dimana rasio idealnya berada 20-30. Penelitian ini bertujuan untuk mencapai rasio C/N yang ideal dengan memvariasikan bahan baku, yaitu kotoran ayam dan eceng gondok menggunakan Fermentasi Anaerob. Penelitian ini juga membandingkan penggunaan stater dan tanpa stater dalam menghasilkan biogas dan energi listrik. Hasil penelitian menunjukkan bahwa volume biogas tertinggi tercapai pada rasio C/N 30 dengan komposisi 100 Kg kotoran ayam dan 25 Kg eceng gondok dengan penambahan 18 Kg stater rumen sapi. Produksi biogas dengan penggunaan stater mencapai 31,74 m<sup>3</sup>, meningkat sebesar 11,56% dibandingkan dengan tanpa stater yang menghasilkan 28,68 m<sup>3</sup>. Selain itu, potensi energi listrik yang dihasilkan dari biogas dengan stater mencapai 150 kWh, sedangkan tanpa stater mencapai 135 kWh. Penelitian ini dapat disimpulkan bahwasanya dengan variasi campuran kotoran ayam dan eceng gondok dengan penambahan stater dapat mempengaruhi hasil rasio C/N dan potensi biogas yang dihasilkan dan penelitian ini mengindikasikan bahwa penggunaan campuran kotoran ayam dan eceng gondok dengan stater dalam Fermentasi Anaerob dapat meningkatkan potensi energi listrik yang dihasilkan

**Kata Kunci:** Biogas, Kotoran Ayam, Eceng Gondok, Stater, Rasio C/N, Energi Listrik

#### Abstract

Chicken manure is one of the wastes from laying hen farms that produces around 0.06 Kg per day. This waste has the potential to be converted into biogas, but its utilization is less than optimal because the C/N ratio of chicken manure is 15. The C/N ratio is important in Anaerobic Fermentation to produce biogas, where the ideal ratio is 20-30. This study aims to achieve the ideal C/N ratio by varying the raw materials, namely chicken manure and water hyacinth using Anaerobic Fermentation. This study also compared the use of starters and without starters in producing biogas and electrical energy. The results showed that the highest biogas volume was achieved at a C/N ratio of 30 with a composition of 100 Kg of chicken manure and 25 Kg of water hyacinth with the addition of 18 Kg of cow rumen starter. Biogas production with the use of starters reached 31.74 m<sup>3</sup>, an increase of 11.56% compared to without starters which produced 28.68 m<sup>3</sup>. In addition, the potential for electrical energy produced from biogas with a starter reaches 150 kWh, while without a starter it reaches 135 kWh. This study can be concluded that with variations in the mixture of chicken manure and water hyacinth with the addition of a starter can affect the results of the C/N ratio and the potential of the biogas produced and this study indicates that the use of a mixture of chicken manure and water hyacinth with a starter in Anaerobic Fermentation can increase the potential for electrical energy produced

**Keywords:** Biogas, Chicken Manure, Water Hyacinth, Starter, C/N Ratio, Electrical Energy

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## 1. Introduction

Chicken manure waste often causes environmental problems that can disrupt the comfort of life of the community around the farm. The disturbance that usually occurs is an unpleasant odor caused by gas from livestock manure, especially ammonia gas and gas hydrogen sulfide. Prevention that can be done For reduce environmental pollution, namely by processing livestock waste. Chicken manure waste is generally only used directly as fertilizer or compost by farmers, even though its use can also be used to convert it into a potential renewable energy source in the form of biogas [1].

The use of waste from laying hen manure to produce biogas is very widely carried out. Based on research [2], research was conducted on the influence of variations in the type of feces on biogas productivity using anaerobic fermentation. This research found that the efficiency of chicken feces was higher than that of cow feces with 2.5%, but the efficiency of cow feces is 1.875%, this study also found that the calorific value of chicken feces is higher than cow feces with 30262.96, while the calorific value of cow feces is 13052.98. Research [3] conducted research on the development of a portable anaerobic biodigester producing biogas, using materials raw waste from laying hen manure produces 61.5 m<sup>3</sup> of methane gas using raw materials 603 kg for one period using a portable anaerobic biodigester with a capacity of 1,200 L with anaerobic fermentation method. The ratio of chicken manure is 15, with the percentage of carbon (C = 1.417) and the amount (N = 18.564) which has been studied in the study [4]. The C/N ratio in chicken manure is not ideal, because in the formation of biogas the ideal C/N ratio in the formation of biogas ranges from 20-30 [5].

With less than optimal biogas in chicken manure, it is necessary to add organic materials to optimize the biogas results. Based on research [6] discussing the effect of types of organic waste on biogas production from chicken farm waste biomass materials with anaerobic fermentation methods and obtaining results with raw materials of chicken manure and water hyacinth are good results in mixing with a ratio of 1:1 with a biogas result of 0.6 L. After the type of mixing of organic waste can affect the biogas results obtained.

Water hyacinth to be made into biogas is divided into 2, namely fresh water hyacinth and dry water hyacinth and the composition between fresh and dry water hyacinth is different. Research [7] examined the utilization of water hyacinth as an alternative energy using fresh water hyacinth raw materials using anaerobic fermentation method and obtained a result of 0.059 m<sup>3</sup> with raw materials of 70 kg of water hyacinth and cow dung. In research [8] examining the potential of water hyacinth from Rawapening for biogas with variations in the mixture of cow dung obtained results with dry water hyacinth raw materials producing 2,119.61 mL of biogas with raw materials of 1 kg of dry water hyacinth and cow dung. With the composition of fresh and dry water hyacinth, it can be concluded that by comparing the volume of biogas produced by fresh water hyacinth is more optimal in the formation of biogas.

In the mixing of raw materials for the formation of biogas that occurs is influenced by several factors including factors, C/N ratio, and the starter used. Based on research conducted by [8] a study was conducted on the effect of variations in the mixture of water hyacinth and cow rumen contents on biogas production using three composition variations, namely 25%, 50%, and 75% water hyacinth from the total raw material of cow rumen contents. This study used the Anaerobic Fermentation method with the aim of identifying the variation of the mixture that provides the highest biogas production results. The results showed that the variation of the mixture with 25% cow rumen and 75% water hyacinth produced the highest biogas volume. This finding indicates that the composition of raw materials that prioritize water hyacinth is more effective in supporting the anaerobic fermentation process and increasing biogas yields, compared to compositions that contain more cow rumen. Based on research [9] with a study of the effect of the C/N ratio on biogas formation, this study used the Anaerobic Fermentation method and obtained results that the C/N ratio of 20-30 produces ideal biogas in biogas formation. In research [5] with a study of biogas potential by calculating the ideal C/N ratio in biogas production using the Anaerobic Fermentation method and obtaining C/N ratio results ranging from 20-30 gave the best results compared to other C/N ratio values, this study showed a C/N ratio value of 10, indicating worse biogas results, with CH<sub>4</sub> levels at a C/N ratio of 30 of 40%. In research [10] examining the comparison of the potential of cow rumen starter and cow dung in processing fecal sludge into methane gas, this study used the anaerobic fermentation method, this study obtained results that cow rumen has the potential to produce greater methane gas than cow dung starter. In the study [11], this research study examined the concentration of cow rumen starter on biogas from vinasse. This study used the anaerobic fermentation method. This study obtained results that cow rumen concentration has an important role in producing biogas with a volume of biogas produced of 370 mL from the best rumen concentration of 15%.

Based on the raw material filling system, digesters are divided into two, namely batch systems and continuous systems. Several studies have conducted experiments using batch and continuous type digesters. In the study [12], a comparison of batch type digesters and continuous type digesters was obtained, the results showed that batch type digesters were higher in producing biogas volume, but lower in terms of CH<sub>4</sub> content quality compared to continuous type digesters. In the study [13], a study was conducted on biogas production using batch type digesters



in the anaerobic process of coffee processing liquid waste, producing a stable volume of biogas. Because continuous digesters have the risk of air entering the digester when filling raw materials, it is different from the batch type where after the raw materials are entered, the digester will be opened until the biogas production runs out.

The amount of electrical energy that can be produced by biogas depends on the volume of biogas. Studies on the potential for electrical energy that can be produced by biogas have been widely studied before. Based on research [14], it was found that biogas produced from all the feces of 8 livestock commodities totaling 19,183,779 heads on the island of Bali has the potential to produce 246,130.81 m<sup>3</sup> of biogas per day and if converted into electrical energy of 1.16 GWh/day.

From the problem of chicken manure that is not utilized and made into biogas, chicken manure has a less than ideal C/N ratio in the formation of biogas produced in research [3] [4]. In research [6] with variations in organic waste with raw materials of chicken manure, water hyacinth is the optimal mixture in the formation of biogas. In research [8] to obtain the ideal C/N ratio, variations need to be made to obtain high biogas results, in the formation of biogas and then the parameters that need to be considered to optimize biogas results include the calculation of the C/N ratio in its mixing, in research [5] the ideal C/N ratio in the formation of biogas ranges from 20-30. The next parameter is the addition of a starter in the formation of biogas which is very influential, in research [10] the cow rumen is the optimal starter in the formation of biogas, for the variation of the cow rumen to be added, in research [11] the variation of the good cow rumen starter in the formation of biogas is 15% of the raw material. And the digester used is a batch type digester because the batch type produces a stable volume of biogas which has been studied in research [12].

This study will utilize the mixing of chicken manure and water hyacinth with the addition of cow rumen starter into biogas. In this study using fresh water hyacinth in the formation of biogas and then This study calculates the C/N ratio the reason for choosing the calculation of the C/N ratio is because in mixing in the formation of biogas the C/N ratio affects the biogas produced, calculating the potential of biogas using anaerobic fermentation with the help of superpro designer simulation by varying the mixing of chicken manure and water hyacinth with starter and without starter the reason for this variation of raw materials is to get the ideal C/N ratio. And this study also calculates the potential for electrical energy generated from the potential of biogas which has a variation of the ideal C/N ratio, This study will also examine the potential for electrical energy generated from mixing chicken manure and water hyacinth with the addition of starter and without starter from the ideal C/N ratio. This study aims to obtain the potential of biogas from a mixture of chicken manure and water hyacinth with the addition of cow rumen starter and without starter by varying the raw materials to find the ideal C/N ratio in the formation of biogas using the anaerobic fermentation method with the help of *superpro designer simulation*. And the second objective of this study is to obtain the potential for electrical energy generated from the potential biogas produced.

**2. Method**

This study examines the utilization of a mixture of chicken manure and water hyacinth by varying the raw materials to find the ideal C/N ratio value and comparing the results of starter and non-starter biogas treatments to optimize the biogas results produced using the superpro designer simulation method. The study began by collecting the content of chicken manure, water hyacinth waste and starter, then varying the raw materials to obtain the ideal C/N ratio, then designing the components needed in the simulation in the formation of biogas. After the components are designed. Then the calculation of the biogas produced and the calculation of the potential electrical energy from the biogas produced are carried out.

**2.1 Collection Data**

The data used in the biogas formation process is data that helps in the application of biogas formation simulations. Chicken manure has nutrients and organics consisting of protein, fat, fiber, calcium, phosphorus, BETN, ash, and water. Fresh water hyacinth contains water, ash, crude fiber, carbohydrates, fat, protein, phosphorus, potassium, chloride and alkaloids and the content of cow rumen consists of protein, fat, fiber, calcium, phosphorus, BETN, ash and water which are presented in table 1.

**Table 1.** Contents Dirt Chicken [15], Contents Water hyacinth Goiter [16], Contents Rumen Cow [17].

Compound	% rate		
	Chicken manure	Water hyacinth	Cow Rumen
Protein	39.09%	0.16%	8.42%
Fat	3.32%	0.35%	2.60%
Fiber	16.50%	2.09%	28.20%
Calcium	2.10%	-	0.53%
Phosphorus	1.44%	0.97%	0.55%

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BET	13.12%	-	30.24%
Ash	14.73%	0.44%	18.54%
Water	9.70%	92.6%	10.92%
Chloride	-	0.26%	-
Carbohydrate	-	0.17%	-
Alkonoid	-	1.44%	-
Calcium	-	1.52%	-
Total	100%	100%	100%

In finding biogas potential, it is necessary to calculate the C/N ratio of the raw materials used by varying the raw materials to find the ideal C/N ratio in the formation of biogas. The data used is the variation of the raw materials used.

**Table 2.** Material Variations Baku Which Used For Formation Biogas Without Starter and addition of starter

Chicken manure	Water hyacinth	Cow Rumen
100 Kg	25 Kg	15%
100 Kg	50 Kg	15%
100 Kg	75 Kg	15%
100 Kg	100 Kg	15%
100 Kg	125 Kg	15%
100 Kg	150 Kg	15%

Table 2 is the raw material used by varying the composition of the raw material to produce biogas. The first column shows the amount of chicken manure used, the second column shows the amount of water hyacinth used, and in the third column with the addition of 15% cow rumen starter. And the third column is the cow rumen starter which will be added as much as 15%. Based on research [11] that the addition of 15% can optimize the biogas produced. The first purpose of varying these raw materials is to determine the ideal C/N ratio to produce optimal biogas and analyze the effect of variations in the composition of raw materials on the C/N ratio. And the second purpose of adding this starter is to optimize the biogas results and determine the ideal C/N ratio from variations in the composition of raw materials to produce optimal biogas and analyze the effect of the starter from varying the composition of raw materials on the volume of biogas produced.

**Table 3.** C/N Ratio of Raw Materials

Compound	Organic C (%)	N Total (%)	C/N ratio
Chicken manure	1,417%	0.09%	15
Water hyacinth	18.56%	0.53%	35.0
Cow Rumen	34.7%	0.91%	38.1

Table 3 shows the C/N ratio of raw materials; chicken manure has an organic C of 1,417% and a total N of 0,09% with a C/N ratio of 15 [4]. Then, in water hyacinth, there is an organic C of 18,56% and a total N of 0.28% with a C/N ratio of 35 [18]. Moreover, organic C in the cow rumen is 34.7% and 0.91%, with a C/N ratio 38.1 [19]. After obtaining organic C and total N, the next step is to calculate the C/N ratio of the mixture of chicken manure and water hyacinth with the addition of a cow rumen starter.

**2.2 C/N Ratio Calculation**

Theoretically, the ideal C/N ratio for biogas formation is around 20-30, meaning that for every 1 gram of nitrogen, 20 to 30 grams of carbon are needed to produce optimal biogas [4].

After knowing the total organic C and N content and varying the raw materials used, the next step, before carrying out the biogas formation process, is to calculate the C/N ratio so that the biogas produced is maximized by using equation 1 as follows [20].

$$Rasio \frac{C}{N} = \frac{(K(KS) \times C(KS)) + (K(EG) \times C(EG)) + (K(RS) \times C(RS))}{(K(KS) \times N(KS)) + (K(EG) \times N(EG)) + (K(RS) \times N(RS))} \tag{1}$$

Description:

- K = Portion of Substrate component (%)
- C = Carbon content in the substrate
- N = Nitrogen content in the substrate
- KS = Chicken manure
- EG = Water hyacinth
- RS = Cow rumen

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In the Anaerobic Digester using the Anaerobic Fermentation method, in this digester 13 reaction processes occur to process raw materials into methane gas and carbon dioxide, presented in table 5.

**Table 5.** Reaction, Which Needed A Reactor Anaerobic Digester To Produce Biogas [17].

The reaction that occurs	Reactants		Products	
	Component	Mass Coef	Component	Mass Coef
Hydrolysis Carbohydrate	Carbohydrates	147.6	Glucose	295.2
	Water	147.6		
Hydrolysis Fat	Fat	147.6	Glycerin	36.8
			Oleic Acid	110.7
Hydrolysis Protein	Proteins	147.6	Cystine	147.6
Acidogenesis Cystine	Cystine	164,1678	Lactic Acid	90,0878
			Propionic Acid	74.08
Acidogenesis Oleic Acid	Oleic Acid	0.6875	Acetic Acid	1
			Butyric Acid	1
			Ethyl Alcohol	1
Acidogenesis Glucose	Glucose	106,122	Acetic Acid	60,053
			Ethyl Alcohol	46,069
Acidogenesis Glycerin	Glycerin	0.8044	Propionic Acid	1
Acetogenesis Ethyl Alcohol	Ethyl Alcohol	62,0729	Acetic Acid	60,053
			Hydrogen	2,0199
Acetogenesis Lactic Acid	Lactic Acid	90,0788	Acetic Acid	60,053
			Carbon Dioxide	28,0098
			Hydrogen	2,016
Acetogenesis Butyric Acid	Butyric Acid	88,106	Acetic Acid	60,053
			Carbon Dioxide	28,053
Acetogenesis Propionic Acid	Propionic Acid	74.08	Acetic Acid	60,053
			Carbon Dioxide	12,011
			Hydrogen	2,016
Methanogenesis Acetic Acid	Acetic Acid	60,053	Carbon Dioxide	30
			Methane	30,053
Methanogenesis Carbon Dioxide	Carbon Dioxide	1	Methane	1.74
	Hydrogen	1	Water	1

Table 5 Reactions needed by reactor anaerobic digester in produce biogas contains 13 reactions required from mixing chicken manure and water hyacinth and cow rumen starter, including carbohydrate hydrolysis, fat hydrolysis, protein hydrolysis, Acidogenesis cystine, acidogenesis Oleic Acid, Acidogenesis Glucose, Acidogenesis Glycerol, Acetogenesis Ethyl Alcohol, Acetogenesis Lactic Acid, Acetogenesis Butyric Acid, Acetogenesis Propionic Acid, Methanogenesis Acetic Acid, Methanogenesis Carbon Dioxide.

**2.4 Simulation Validation**

Validation Which done on study This is with do comparison with study [3] which has a discussion topic on the use of chicken manure to make biogas using the anaerobic fermentation method.

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**Table 6.** Validation Results Simulation

Parameter	Research [3]	Validation
Raw material	Chicken manure	Chicken manure
Composition	Protein 39.09%, Fat 3.32%, fiber 16.50%, Calcium 2.10%, Phosphorus 1.44%, BETN 13.12%, Ash 14.73%, Water 9.70%	Protein 39.09%, Fat 3.32%, fiber 16.50%, Calcium 2.10%, Phosphorus 1.44%, BET 13.12%, Ash 14.73%, Water 9.70%
Input Value	603 Kg	603 Kg
Output Value	61.5 m <sup>3</sup>	63.91 m <sup>3</sup>

Table 6 obtained validation of simulation results that refer to in research [3] with input 603 kg of raw material Chicken manure. The results of the superpro simulation in the reference study produced biogas with a volume of 63.91 m<sup>3</sup>, and the results of the reference research produced biogas at 61.5 m<sup>3</sup>. From the results of the comparative validation volume, It is known that the error value of the biogas occurred at 3.92%. This study can be said to be valid because it does not have an error value of more than 10%.

**2.5 Biogas Conversion and Its Uses**

The calculation of electrical energy that can be produced by biogas is available in Table 7.

**Table 7.** C/N Ratio of Raw Materials [14] .

Its use	1 m <sup>3</sup> Biogas
Lighting	60-100 W lamp for 6 hours
Cook	Cooking 3 types of food for 5-6 people
Power	Running a 1 hp motor for 2 hours
Electricity	4.7 kWh of electrical energy

The potential for biogas produced by mixing chicken manure and water hyacinth and adding a starter to produce electrical energy is generated using equation 2.

$$Q = P \times L \tag{2}$$

Description:

- Q = Electrical Energy (kWh)
- P = Biogas Potential (m<sup>3</sup>)
- L = Electricity In 1 m<sup>3</sup> (kWh)

In Equation 2, the electrical energy generated from the biogas potential is calculated using the following parameters: Q is the electrical energy generated, P is the biogas potential, and L is the electrical energy generated from 1 m<sup>3</sup> of biogas. It is known that 1 m<sup>3</sup> of biogas generates 4.7 kWh of electrical energy.

**3. Analysis And Discussion**

variations of raw materials used using equation (1).

**Table 8.** C/N Ratio Results From Raw Material Variations Without Starter

Chicken manure	Water hyacinth	C/N ratio
100 Kg	25 Kg	27
100 Kg	50 Kg	30
100 Kg	75 Kg	31
200 Kg	100Kg	32
200 Kg	125 Kg	33
300 Kg	150Kg	34

From table 8 the results of the C/N ratio with variations in raw materials. In raw materials of 100 kg of chicken manure and 25 kg of water hyacinth, the ideal C/N ratio was produced with a C/N ratio of 27 and in raw materials of 100 kg of chicken manure and 50 kg of water hyacinth, the ideal C/N ratio was produced with a C/N ratio of 30. This ratio is ideal compared to other variations. Based on research [5] , the ideal C/N ratio ranges from 20-30. This study produced varying C/N ratios. It can be concluded that the influence of the composition of the raw materials used can affect the resulting C/N ratio.

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important role in increasing the efficiency of the biogas production process, which depends not only on the amount of raw materials, but also on the composition that supports more effective fermentation.

**Table 11.** Results of C/N Ratio of Raw Material Variations with Starter Addition

Chicken manure	Water hyacinth	Cow Rumen	C/N ratio	Biogas Results
100 Kg	25 Kg	18 Kg	30	32 m <sup>3</sup>
100 Kg	50 Kg	22 Kg	33	25 m <sup>3</sup>
100 Kg	75 Kg	26 Kg	33	26 m <sup>3</sup>
100 Kg	100 Kg	30 Kg	34	26,22 m <sup>3</sup>
100 Kg	125 Kg	33 Kg	34	26,59 m <sup>3</sup>
100 Kg	150 Kg	35 Kg	35	27 m <sup>3</sup>

Table 11 is the biogas yield from the raw materials used with the addition of starter, this table shows the biogas production yield from a variety of raw materials consisting of chicken manure, water hyacinth, and cow rumen with the addition of starter, and varying C/N ratios. The highest biogas yield was obtained at a C/N ratio of 30, with a combination of 100 kg of chicken manure, 25 kg of water hyacinth, and 18 kg of cow rumen, which produced 32 m<sup>3</sup> of biogas. However, increasing the C/N ratio above that number, namely in a combination with a C/N ratio of 33 to 35, caused a decrease in biogas yield, with a volume ranging from 25 to 27 m<sup>3</sup>. This finding indicates that although the addition of starter can support the biogas production process at a higher C/N ratio, optimal biogas production efficiency tends to occur at a C/N ratio of around 30 to 33. Therefore, the C/N ratio in this range can be considered as a more supportive condition for maximum biogas production in the fermentation process.

From the simulation results using Superpro Software with Mixing Chicken Manure and Water Hyacinth with the Addition of Cow Rumen Starter with input of 100 kg of chicken manure, 25 kg of water hyacinth and 18 kg of cow rumen starter, it can produce the highest volume of other raw material variations with a volumetric flow of 32 m<sup>3</sup> with a mass composition of 88.40 % gas methane And 11.59 % carbon dioxide. or methane gas produced as much as 28,288 m<sup>3</sup> and Carbon Dioxide as much as 3.7 m<sup>3</sup>.

Then it can be concluded that from the results of the addition of cow rumen starter, the volume of biogas produced is higher than without a starter with a percentage increase in biogas yield of 11.56%, this occurs because the cow rumen contains various microorganisms, including methanogenic bacteria that play an important role in biogas production. Cow rumen starter is rich in these microorganisms, so adding it to the biogas raw material can increase the amount of biogas volume produced.

### 3.2 Potential Energy Electricity From Biogas Conversion

The calculation to find the amount of electrical energy that can be produced by biogas from chicken manure and water hyacinth using a starter and without a starter is carried out using equation 2. The electrical energy produced is presented in table 12.

**Table 12.** Potential of Electrical Energy

Treatment	Electrical Energy
Without Stater	135 kWh
Stater Addition	150 kWh

If the electrical energy that can be produced by the starter addition treatment is 150 kWh, while the electrical energy produced by the treatment without a starter is 135 kWh. The production of biogas volume greatly affects the electrical energy produced, so that from this study it was found that by adding a starter in the mixture of chicken manure and water hyacinth has a large electrical energy compared to without a starter in the formation of biogas. With a capacity of 150 kWh, biogas from mixing chicken manure with water hyacinth with the addition of a starter can be used as a renewable energy source.

### 4. Conclusion

The results showed that biogas production in a digester without the addition of a starter with a variation of the ideal C/N ratio between 27 and 30 produced the highest biogas volume of 26.89 m<sup>3</sup> and 28.68 m<sup>3</sup>, which is equivalent to 135 kWh of electrical energy. Meanwhile, in a digester with the addition of a starter, the use of an ideal C/N ratio of 30 produced the highest biogas production of 31.74 m<sup>3</sup> and 150 kWh of electrical energy. The increase in biogas production with the addition of a starter compared to without a starter was recorded at 11.56%. These results indicate that variations in raw materials that affect the C/N ratio are very significant in the formation of biogas, where a non-ideal C/N ratio will inhibit the efficiency of the fermentation process and reduce the volume of biogas produced. In addition, the use of a mixture of chicken manure and water hyacinth with the addition of a cow rumen starter provides the potential for higher biogas and electrical energy production compared to without the addition of a starter, which shows the important role of the starter in increasing the efficiency of biogas production.

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