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The Effect of Comparison of Soybeans and Coconut Water on Bio-Battery Electrical Power for Education

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ABSTRACTS

The world is currently facing an energy crisis. This research was conducted to create alternative energy by utilizing abundant biomass in nature. The novelty of this study: (1) Use of soybean biomass with coconut water as an electrolyte paste, (2) Testing of bio-battery resistance to wall clocks, and (3) Comparison of the composition of the two materials. In this study, an electrolyte paste made from soybeans (SBs) and coconut water (CWs) with a ratio of 7/1, 6/2, 5/3, 4/4, 3/5, 2/6, and 1/7. To support the analysis, an electrical voltage test and a battery resistance test for wall clocks were carried out. The experimental results show that the composition of coconut water increases the value of the electric voltage on the bio-battery. The composition of coconut water serves to activate the ions in the paste. Meanwhile, more soybean content will increase bio-battery life. It was found that the bio-battery with electrolyte paste of soybeans and coconut water can be used as alternative energy. The results of this research are expected to offer renewable alternative energy for world energy security.

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1. INTRODUCTION

The world is currently facing an energy crisis. In addition, the large amount of battery waste is dangerous and underutilized. Bio-battery is a battery with paste that is made of natural materials (Sumajaya *et al.,* 2019). Electrolyte paste is one of the most important parts of a bio-battery because a quality electrolyte paste will produce good durability. Along with the times, researchers have developed bio-batteries derived from environmentally friendly organic materials. So that the resolution of conventional batteries that do not damage the environment is bio-batteries, besides bio-batteries are the answer to people's concerns about the impact of battery waste which is very dangerous for the environment (Siddiqui & Pathrikar, 2013).

In making bio-batteries, we can utilize natural materials, including banana peels (Pulungan *et al.,* 2017), durian peels (Khairiah & Destini, 2017), orange peels (Salafa *et al.,* 2020), pineapple peels (Atina, 2015), and cassava peels (Sumanjaya *et al.,* 2019). However, there is no bio-battery manufacture using soybeans and coconut water. Soybeans contain minerals such as potassium, calcium, and phosphorus which are electrolytes that are capable of ionizing and conducting electricity (Suryaningsih, 2016). Whereas coconut water contains natural electrolytes such as nitrogen, phosphorus, potassium, chlorine, sulfur, iron, calcium, and magnesium. The mineral content of potassium in young coconut water is the highest (Parsena *et al.,* 2016).

This research was conducted to create alternative energy by utilizing abundant biomass in nature. In this study, an electrolyte paste made from soybeans (SBs) and coconut water (CWs) with the ratio of 7/1, 6/2, 5/3, 4/4, 3/5, 2/6, and 1/7. To support the analysis, an electrical voltage test and a battery resistance test for wall clocks were carried out. The main novelties of this study are (1) use of soybean biomass with coconut water as an electrolyte paste, (2) testing of bio-battery resistance to the wall clock, and (3) comparison of the composition of the two materials.

2. METHODS

2.1 Bio-battery manufacture

The flow chart of the experimental method is shown in Figure 1. Soybeans and young coconut were obtained from Bandung, Indonesia. The soybeans were mashed using a blender. To determine the effect of the composition on the characteristics of the bio-battery, mixing of soybeans (SBs) and coconut water (CWs) with the ratio of 7/1, 6/2, 5/3, 4/4, 3/5, 2/6, and 1/7. After that, the electrolyte paste on the used 1.5 volt battery is removed until the battery is clean. An empty battery is filled with electrolyte paste from soybean and coconut water and then closed the battery.

2.2 Bio-battery testing

2.2.1 Electrical Test

Batteries from soybeans and coconut water were tested with a voltmeter to determine the voltage generated. The voltage is recorded and then compare with conventional batteries.

2.2.2 Endurance test

Bio-battery with electrolyte paste derived from soybeans and coconut water was tested on the wall clock. The length of time the clock can move is recorded (time in minutes).

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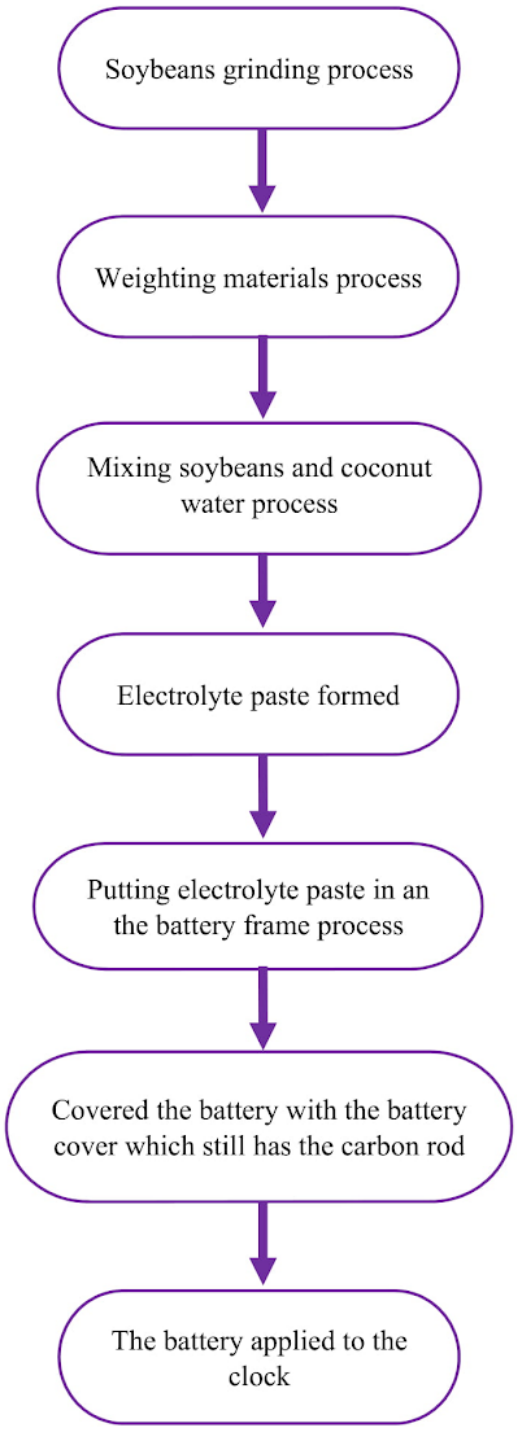

Figure 1. Flow chart of the experimental method

3. RESULTS AND DISCUSSION

3.1 Bio-battery electric voltage

The bio-battery electric voltage is shown in **Figure 2**. It can be seen that the more coconut water composition in the bio-battery causes the battery voltage to be higher. This is because the electrolytes produced in coconut water are in the form of minerals. Coconut water contains one of which is potassium and chloride (Parsena *et al.,* 2016). The reaction between the potassium and chloride salts produces the potassium chloride salt. In water, the

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potassium chloride salt can conduct electricity because it ionizes. The ionization reactions that occur are as follows: (Singgih & Ikhwan, 2018)

$$KCl \rightarrow K^{+} + Cl^{-}$$

Thus, the more ions produced, the greater the electric current produced and as a result, the conductivity of the electrolyte solution is also greater. Conversely, if fewer ions are produced, the resulting electric current will also be smaller and consequently, the electrical conductivity will also be smaller (Purnomo, 2010).

3.2 Bio-battery electrical life

The duration of the movement of the clockwise by the bio-battery is shown in **Table 1**. In the ratio 7/1, 6/2, and 5/3 (SBs / CWs) were unable to move the clock hand. This is because the electric current generated is not sufficient. As in **result 3.1**, it is shown that the less coconut water composition in the paste, the smaller the electric current produced by the battery. Whereas in the ratio of 3/5 it can move clockwise for the longest which is 328 minutes. This shows that the soybean content in the paste affects how long the battery lasts. With a sufficient amount of coconut water to conduct electricity, the more soybeans content in the paste, the more resistance it is to the battery. This is because soybeans contain minerals such as potassium, calcium, and phosphorus as well as vitamins A and B. Potassium, calcium, and phosphate ions can conduct electric current (Suari, 2019).

3.3 Comparison of bio-battery samples with conventional batteries

Conventional batteries have an electric voltage of 1.5 volts, with the same size batteries that use soybeans and coconut water with a ratio of 1/7 can produce an electric voltage of 1.2 volts (based on **Figure 2**). This shows that this bio-battery can be used as renewable alternative energy. Meanwhile, the bio-battery life still needs to be improved again, because the bio-battery with electrolyte paste is only able to move the wall clock hands for the longest 328 minutes.

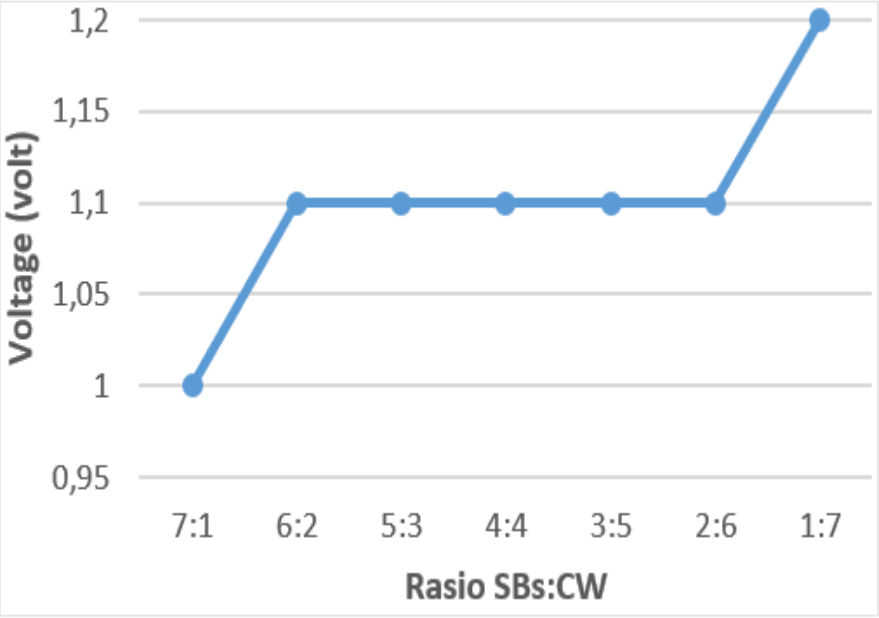

Figure 2. Bio-battery voltage

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Table 1. Time the wall clock moves

Ratio SBs:CWs	Times (Minute)
7:1	-
6:2	-
5:3	-
4:4	22
3:5	328
2:6	279
1:7	198

4. CONCLUSION

The effect of the comparison of soybean and coconut water on the quality of the bio-battery was tested. The coconut water content in the paste functions not only as an electrolyte solution itself, but also helps in ionizing the soybeans. The more coconut water composition in the electrolyte paste, the greater the bio-battery voltage. While the composition of soybeans affects the bio-battery life, where the more soybeans at the right water composition, the more battery life will be.

5. ACKNOWLEDGEMENTS

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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. Further research of bio-battery made by soybeans and coconut water solution is needed in order to optimizing the quality of bio-battery

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