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Teaching concept of bio-battery material: Use of Sweet Potato Peels and Lime Juice Solution

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ABSTRACTS

Wasted sweet potato peel waste is a classic problem in Indonesia, therefore the use of sweet potato peel as biomass for bio-battery production can be used as a solution to this problem. This study aimed to determine the benefits of sweet potato peels and orange solution as biomass for bio-battery production. The main novelties in this study are (1) Used sweet potato peels as bio-battery Material that have never been used in previous studies. (2) Used sweet potato peel as fixed variable and lime juice as independent variable, and (3) Tested the sweet potato peel and lime juice pasta into the clock. This method is done by smoothing the skin of the sweet potato with the addition of 40 mL of lime solution to form a paste. The lime solution used in this study was 0; 5; 10; 15%. Then measure the voltage of the bio-battery and test the wall clock with the bio-battery. The experimental results showed that the sweet potato peel paste with a lime solution produced the same voltage as an ordinary battery at a concentration of 10% with a value of 1.47 V. The bio-battery with the highest concentration variation is not necessarily the best, that's because the pH value affects the current and voltage. The conclusion of this research is that sweet potato peel and lime solution can be used as electrolytes in bio-battery production with optimal variation of 5 and 10%. This study demonstrates the utilization of sweet potato peel waste as an alternative biomass for bio-battery production.

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1. INTRODUCTION

The main of this study is to demonstrate the use of agro-waste as an alternative to biomass for the manufacture of bio-batteries. Biomass as renewable energy is a solution in reducing the use of fossil fuels. This is because they are cleaner and have fewer negative effects. Renewable energy produces only small levels of carbon emissions and therefore, helps battle climate change caused by fossil fuel burning. Renewable energy produces only a small amount of carbon emissions; therefore, it can help prevent climate change caused by it burning fossil fuels (Shahzad, 2012).

There are some studies that are relevant with this study, such as research conducted by Nupearachchi (2017) which uses banana pith as Electrolytic Media for Bio-Batteries. Muske (2007) who studied lemon cell batteries for high power applications. Togibasa (2019) who studied characterization of bio-battery which made from tropical almond paste. Thanrasu (2018) also studied uses of waste leather as carbon nanoparticle and electrolyte in bio-batteries. However, there is no study about uses of sweet potato peel and lime juice as electrolyte media paste for bio-batteries.

Purpose of doing this study are to see the effect of sweet potato (*Ipomoea batatas L.*) peel and lime (*Citrus aurantifolia*) juice as electrolyte of bio-battery production, also to introduce the uses of sweet potato peel and lime juice as material for making bio-batteries. In our research, we calculated the voltage and battery life to see the bio-battery quality. The main novelties in this study are (1) we used sweet potato peels that have never been used in previous studies. (2) we used sweet potato peel as fixed variable and lime juice as independent variable, and (3) we tested the sweet potato peel and lime juice pasta into the clock.

2. METHODS

Figure 1 shows the flow diagram of the process of making a sweet potato skin bio-battery with various concentrations of lime juice. The skin of the sweet potato that has been cleaned and cut into small pieces is weighed as much as 25 grams then mashed with lime juice with a concentration variation of 0; 5; 10; and 15% as much as 40 ml.

The mashed paste is put into a used 1,5 V dry cell battery that has been cleaned from its electrolyte. Replace the carbon conductor, then measure the voltage and the current of the battery. Also, to find out whether the battery can turn on the clock or not and to test the battery life, place the battery into the clock. The repetition is done by twelve times and the battery is tested using multitester.

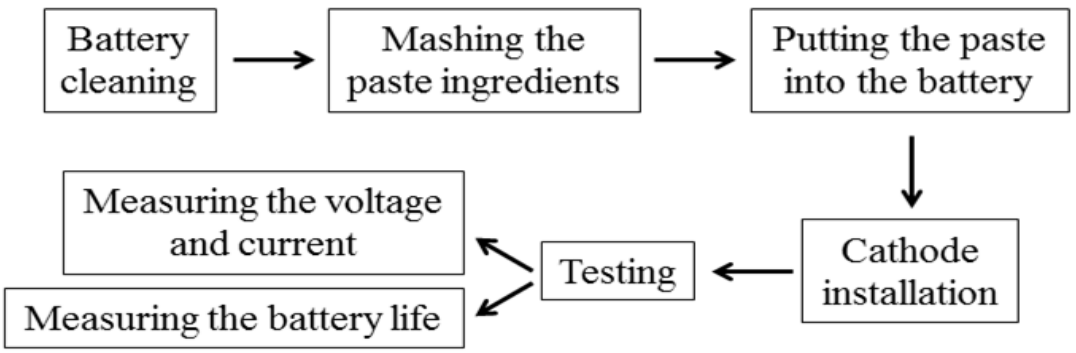

Figure 1. Flow diagram of the making of bio-battery.

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3. RESULTS AND DISCUSSION

Figure 2 shows the battery structure of bio battery with sweet potato skin and lime juice paste. The use of sweet potato peels is to provide glucose. glucose with oxygen, and other enzymes that can act on the glucose to further produce hydrogen ions and electrons. Besides, sweet potato skin contains nine minerals (phosphorus (P), calcium (Ca), magnesium (Mg), potassium (K), iron (Fe), zinc (Zn), copper (Cu), Boron (B), manganese (Mn). On the other hand, the use of lime juice solution is to soften the texture of sweet potato peel into a paste and activate chemical reactions in order to produce electrical energy.

3.1. Voltage and Battery Life Test Result

Table 1 shows the average voltage of every variations of bio-battery. Based on the data in **Table 1**, bio-batteries with a variation of 5% and 10% have the highest average. This means that these variations have the highest voltage. In addition, based on the data in **Table 2**, only batteries with 5% and 10% variations can turn on the clock. This means that the bio-battery with a variation of 5% and 10% is the best among the variations. the higher the voltage the bio-battery has, the more likely it will be to turn on the clock. The bio-battery with the highest concentration variation is not necessarily the best. Based on research conducted by Fauzia, et al (2019) shows that pH is inversely proportional to current and voltage. The lime solution contains citric acid which can affect the pH of sweet potato skin paste, the higher the concentration given, will affect the current and voltage biobattery.

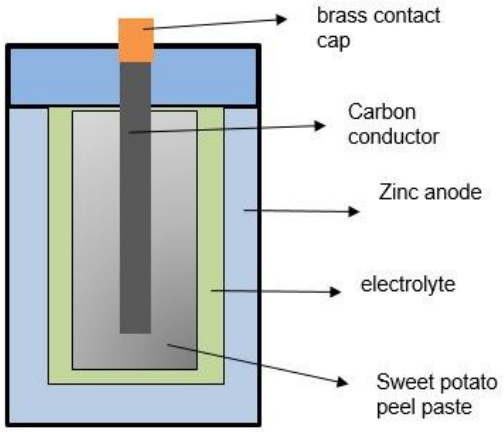

Figure 2. Structure of bio-battery with sweet potato skin and lime juice paste.

Table 1. Average voltage of sweet potato bio-battery.

Battery Variation	Average Voltage
Without lime juice	0.933 V
Sweet potato peel + 5% lime juice	1.454 V
Sweet potato peel + 10% lime juice	1.475 V
Sweet potato peel + 15% lime juice	1.035 V

Table 2. The ability of bio-battery to turn on the clock.

Battery Variation	Can turn on the wall-clock
Without lime juice	No
Sweet potato peel + 5% lime juice	Yes
Sweet potato peel + 10% lime juice	Yes
Sweet potato peel + 15% lime juice	No

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As shown on **Table 1**, the bio-battery paste made by sweet potato peel with 5 and 10% lime juice provides 1,454 and 1,475 V, which is the highest voltage among the other variations. Although the voltage of the bio-battery is lower than standard 1,5 V dry cell battery, the bio-battery can still be considered for use. Further research of bio-battery made by sweet potato peel and lime juice solution is needed in order to optimizing the quality of bio-battery.

4. CONCLUSION

Sweet potato peels and lime juice can be used as electrolytes in bio-battery production. With an appropriate concentration ratio of lime juice, bio-batteries from sweet potato peels and lime juice can be used to operate simple tools. Based on the data obtained from the methods, the optimal variation of bio-battery is the sweet potato peel with 5 and 10% lime juice solution variation.

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6. 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 sweet potato peel and lime juice solution is needed in order to optimizing the quality of bio-battery.

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