ROTTEN SWEET POTATO (*Ipomoea batatas* L.) AS AN ALTERNATIVE SOURCE OF ELECTRICAL ENERGY

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ABSTRACT

This research was aimed to find an alternative source of electrical energy from natural materials that are renewable and environmentally friendly. One of them that is potentially to be used as the source of energy is rotten sweet potato. Sweet potatoes (*Ipomoea batatas* L.) grow in mountainous areas and highlands and are usually used as a carbohydrate replacement of rice by some people. This research was conducted to prove whether sweet potato can be used as alternative energy source or not. The research was begun by slicing rotten sweet potato into small pieces, then crushed using a blender to make an extract of rotten sweet potato. Rotten sweet potato is an electrolyte compound that functions like a battery. To prove the ability as a source of electrical energy, it is necessary to perform redox reaction test. Electrodes used were copper coins and iron tacks. Copper and iron electrodes which were immersed in the sweet potato electrolyte compound caused a redox reaction to be a source of electric current. The results showed that 1 block (3 series circuit) of rotten sweet potato electrolyte can generate 1.5 electric voltage which is equivalent to small batteries. By processing in such a way, the energy of rotten sweet potato can be developed to become a source of electricity for lighting a house. This can certainly be useful for villagers who have a high enough level of sweet potato consumption resulting abundant sweet potato waste that can be utilized.

Keywords: *Electric Current, Electrode, Redox Reaction, Electrolyte Compound, Rotten Sweet Potato*

1. INTRODUCTION

Energy is one of the needs of the current world crisis. There are two types of energy namely renewable energy and non-renewable energy. The research on renewable energy began to be encouraged to meet the world's energy needs. Sweet potato (*Ipomoea batatas*) is one of the largest crops in Indonesia in term of productivity. Sweet potatoes are also used as staple food in several regions in Indonesia. Currently, the utilization of sweet potatoes is not proportional to the abundant crop yields causing increased waste of rotting sweet potatoes. In addition to food sources, sweet potatoes can also be used as an energy source. Given this phenomenon, we made the breakthrough by turning rotten sweet potato into a source of energy. The experiments were conducted by using LED lights to prove that these rotten sweet potatoes can function as insulators that produce energy.

The purpose of this experiment was to find out one alternative renewable energy source. Rotten sweet potato can be used as an alternative source of electrical energy considering that during this time rotten sweet potatoes are wasted. Utilization can be in the form of making an energy generating device with cheap raw material, in this case sweet potato, that is accessible for people.

Sweet potatoes are a good source of carbohydrates. According to Soenarjo (1984), the chemical composition of sweet potato is influenced by variety, location, and planting season. In the dry season, the same varieties will produce higher levels of flour than the rainy season.

Table 1. The chemical composition of sweet potatoes in average

Parameters	Composition
Water content (%)	71.1
Energy (kJ / 100 g)	457
Protein (%)	1.43
Starch (%)	22.4
Sugar (%)	2.38
Food fiber (%)	1.6
Fat (%)	0.17
Ash (%)	0.74
Minerals (mg / 100 g)	
Ca	29
P	51
Mg	26
Na	52
K	260
S	13
Fe	0.49
Zn	0.59
Al	0.82
Vitamin (mg / 100 g)	
Vitamin A	0.01

Thiamin	0.09
Riboflavin	0.03
Nicotinic acid	0.60
Vitamin C	24
Anion (mg / 100 g)	
Oxalate	81
Malat	116
Citric	81
Limiting amino acids and chemical scores	
Lys	
Leu	70
	80
Tripsin inhibitor (TIU / g)	13.4
Chymotrypsin inhibitor (CIU / g)	0 – 1

From the table, it can be seen that there are various substances other than carbohydrates including potassium, iron, and so forth. Based on the data obtained, it can be hypothesized that the rotten sweet potato has the potential to contain electrolyte compound. It is based on the nature of rotten sweet potatoes that have an acidic pH. Acid can trigger electrolyte and produce electricity. To prove this, further experiments are needed to ensure that the data obtained are valid.

2. EXPERIMENTAL METHODS

2.1 Tools and Materials

The tools and materials used to test the alternative electrical energy sources of sweet potato include: Rotten sweet potatoes (taken from wonokromo market, Surabaya), Aquades, Scissors, Small cable and 7 Crocodile clamps, Blender / Pounder, Multimeter , 4 Iron nails, 4 Copper coins, 1 Plate, 4 Small glasses, and 5 LED Lights.

2.2 Procedures

First, prepare all materials and tools that must be assembled first such as cables associated with crocodile clamps. Then blend the rottem sweet potatoes and add enough aqua destillata to facilitate the process of blending. Make sure that the cable has been connected to both ends with crocodile clip. Clamp on Cu electrode (IDR 500 yellow coin) and Fe electrode (iron tack). Prepare the used glass and LED lamp as the indicator. Arrange the device into series electrical circuit with an arrangement of Cu-Fe-Cu-Fe-Cu-Fe-Cu-Fe. Enter the blended rotten sweet potato and observe how many series needed to be able to turn on the LED lights. If the light is on then calculate the current, voltage, and resistance with multimeter.

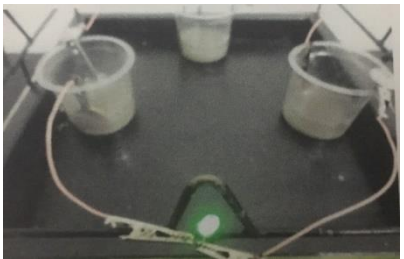

Figure 1. **experiments on LED lights**

2.3 Creating Prototype

In the manufacture of the prototype, we used a used battery containing manganese oxide that has been taken out of the battery. The cleaned battery shell then was filled with blended rotten sweet potato paste that has been mixed with manganese oxide from the battery. After that, re-measure the battery.

Figure 2. **Prototype of rotten sweet potato battery**

3. RESULT AND DISCUSSION

The carbohydrates contained in the sweet potato can be split into glucose. The glucose will be fermented into ethanol within a few days. Then, ethanol will eventually oxidize to ethanoic acid or acetic acid which is one type of electrolyte substances. The presence of this substance was confirmed after the solution was measured using universal pH indicator which showed 4-5 pH. Other electrolytes contained in sweet potatoes are potassium and chloride which can react to form potassium chloride salts. This salt is ionized in the water so it can conduct electricity.

The electric current can flow because the IDR 500 coin (copper) acts as a cathode (positive) attracting negative ions and the tack (iron) acts as anode (negative) attracting positive ions. When the rotting sweet potato electrolyte was in contact with the copper and iron, there was an ionization reaction in the solution resulting electrons which caused the electric current to flow. If the two electrodes are connected to the lamp, the current will flow from the anode to the cathode, and the lamp lights up.

Table 2. **The measurement result using Sunwa YX360TR Multimeter**

Number of circuits	**Voltage (Volt)**	**Electric Current (mA)**
1	0.5	0.35
3 (series circuit)	1.5	1.05

The durability or electrical conductivity of 1 block (3 series circuit) rotten sweet potato electrolyte series was long enough. It turned on 1 LED light for ± 12 days. On day 13, the electrolyte solution was too dry that the electric current no longer flows.

4. CONCLUSION

The result of this experiment is that LED lamps can be turned on by assembling 1 block (3 series circuit) of rotten sweet potato electrolyte circuit. Thus, it can be concluded that rotten sweet potato can be used as alternative energy source. The voltage generated from 1 block of electrolyte circuit was 1.5 Volt which is equivalent to the common battery's voltage, and it can flow a current of 1.05 mA. This research suggests that sweet potatoes can be used as a source of renewable energy.

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