Test the electrical content of singi fruit (*Dillenia serrata* Thunb.) as a source of electrical energy

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**Abstract.** One of the trees that has fruit with high acid content that has the potential to be used as an alternative energy source is the acid contained in Singi (*Dillenia serrata* Thunb.) fruit. Therefore, this study aims to test the ability of the singi fruit to turn on the LED lights and determine the value of voltage, current and electrical power in the fruit. This research was conducted at the Laboratory Ministry of Forestry, Faculty of Forestry and Environmental Sciences, Halu Oleo University. In June-July 2019 using an experimental method for 5 days by measuring the acidity (pH) value of voltage, current and electric power. The results showed that the LED was on until the 5th day but the value of the electricity content tended to decrease, namely the first day with a power value of 7.533 watts and the fifth day 1.722 watts. While the acidity (pH) of the singi fruit which is decreasing over time affects the value of the electrical content contained in the solution of the singi fruit.

1. **Introduction**

The development of sustainable energy in the future, especially for sustainable development requires the modernization of bioenergy and biomass has the potential to become an energy source [1]. As a result, each region will mobilize the supply of biomass on a large scale to meet energy needs [2]. Several countries in the world have begun to develop several potentials of biomass as a source of electricity, such as China with its biomass potential, capable of producing electricity with a capacity of 30 GW [3]. Likewise in the European Union region, even the demand for biomass raw materials exceeds the supply capacity that can be provided for power generation needs [4].

Alternative energy can be obtained from biomass-derived from forest vegetation. Biomass is one of the potential energy sources in Indonesia that comes from natural wealth in the form of tropical forest vegetation. Biomass can also be converted into electricity or heat through advanced technological processes [5]. However, currently, most of the biomass used from the forest only comes from wood.

In addition to timber forest products, there are also non-timber forest products that can be used as alternative energy. Various non-timber forest products that can be used as bioenergy (bioethanol, biofuel, biogas) include neem, (*Azadirachta indica*), forest saga (*Adenanthera pavonina*), mangapari (*Pongemia pinnata*), starur (*Calophyllum* sp.), kesambi (*Schleiria oleosa*) [6]. The utilization of non-timber forest products as alternative energy can also come from the fruit it produces. From various studies on alternative electrical energy from fruits, it can be explained that, based on chemistry, almost all acidic fruits contain electrolytes [7].
One of the trees that has fruit with high acid content that has the potential to be used as an alternative energy source is the acid contained in Singi (*Dillenia serrata* Thunb.) fruit. Singi/simpur is a plant that is widely found in Indonesia, namely in Sumatra, Java, and Kalimantan [8]. Singi is also one of the local fruits from Southeast Sulawesi which is widely distributed in the districts of Muna, Buton, Konawe, and Kendari City. Singi is currently widely used both from wood, bark, leaves to the fruit. One of them is from the fruit, which has an acidic compound in the form of vitamin C more than 84% which is good for consumption by the body [9]. In addition, the extracts isolated from this plant under the names of dillenic acids A, B, and C belong to the triterpenoid acid compound oleanene [7]. The fruit of this plant has not been officially cultivated because its existence only grows in the wild and has not been widely used by local people. Therefore, in this study, the electrical content of Singi fruit was tested.

2. Method
Singi fruit was collected from the singi tree in the Education Forest, Faculty of Forestry and Environmental Sciences, Halu Oleo University, Abeli District, Tobimeita Village, Kendari. The collection is done by collecting or picking fruit from the tree as much as 3 kg. Singi fruit that has been collected is separated from the outer skin and then mashed using a blender. Singi fruit that has been mashed is put into a plastic container measuring 1,500 ml, then poured into six plastic containers each measuring 250 ml.

![Figure 1. The circuit model used](image)

Installing an anode (+) and cathode (−) circuit in a plastic container containing a solution, each container will contain one zinc plate (Zn) acting as an anode or positive pole and one copper plate (Cu) as a cathode or negative pole using a series circuit, so that each container has a positive and negative pole. The form of the circuit can be seen in Figure 1.

Each container containing a solution of singi fruit was measured for its acidity using a pH meter, carried out every day at the same time for five days to determine the effect of acidity on the electrical content contained in the fruit. Measurements were continued with a multimeter to determine the value of power, voltage, and electric current, while the time used was the same as measuring acidity. Each time the measurement is seen the state of the LED lamp being tested, if with a certain acid level what is the value of power, voltage, and electric current, and the state of the lamp every day.

3. Result and discussion
The ability of a solution of Singi fruit (*Dillenia serrata* Thunb) to conduct electricity using LED lights can be seen in Figure 1. The electrical power produced by Singi fruit with a very sour taste is significantly large enough that it can be used to turn on LED lights. On the first day, the Singi fruit solution had a very bright light on the 1st day, but on the 4th day, the light started to dim but was still able to light up on the 5th day. When compared with citrus fruits which are only able to light up for
18.14 hours [9]. Then the Singi fruit has a higher electrical content because until the fifth day the LED lights are still able to light up (Figure 2).

![LED Light Source from a Solution of Singi Fruit](image)

**Figure 2.** LED light source from a solution of Singi fruit (*Dillenia serrata* Thumb.)

The ability of the Singi fruit solution to conduct electricity with the strength of light that changes every day is influenced by the increasing value on day 4. Fruit solution has a small acidity level (larger pH) it will conduct a smaller electric current [10,11] (Figure 3).

![Acidity Value (pH) of Singi Fruit from Day 1 to Day 5](image)

**Figure 3.** Acidity value (pH) of singi fruit from day 1 to day 5

Changes in light The LED lights that are on for 5 days and the light turns dim on the 5th day can be seen in relation to the values of voltage, current, and power in Figure 4. Figure 4 shows that the results of measuring voltage, current, and power on the first day were 5.16 volts, 1.46 amperes, and 7.5 watts, respectively. This value decreases until the fifth day the voltage is 3.25 volts, current, 0.53, and power is 1.7 Watts, this value continues to decrease along with the decrease in the value of the degree of acidity [12].

![Changes in Light](image)

Previous research used an averhoa bilimbi with a series circuit, then with Cu-Zn electrodes, it produced a voltage of 1.0 volts and a current of 49 A. [7] While this study in the first measurement with a volume of 1200 ml of singi fruit solution produced a difference of 5.16 volts and 1.46 Ma = (1460 A) This may be due to differences in the content (pH) of star fruit wuluh and singi fruit and differences in the volume of the solution and the size of the electrodes used. Meanwhile, the research that used oranges with a volume of 250 ml with Cu-Zn electrodes produced a current of 0.45 mA, and in this study, if the volume of the solution was reduced by 4.8 times, the resulting current was 0.30 mA [13].
Figure 4. Voltage average(current), current strength average (amperes), and power average(watts) of singi fruit from day 1 to day 5.

Several previous studies have shown the value of the electrical content, including mangoes having a voltage of 1.63 volts and a current of 71 A [14]. Similarly, limes (*Citrus x aurantifolia*), Pontianak oranges (*Citrus nobilis*), koprok oranges (*Citrus reticulata*) current strength has current strength of only 1.22 mA, 0.93 mA, 0.67 mA, 0.04 mA [15]. When compared to Singi fruit, Singi fruit has a higher electrical content. from several other types of fruit, because the measurement on the first day of the resulting voltage value was 5.16 volts and a current of 1.46 mA. The difference in voltage and the current strength of some fruits depended on the acidity and volume of the fruits [16].

4. Conclusion

The solution of Singi fruit can turn on the LED lights from the first day to the fifth day. The average voltage value (V) on the first day of measurement is 5.16 volts, current strength (I) is 1.45 mA and electric power (P) is 7.533 watts. decrease until the fifth day to V = 3.25 volts, I = 0.53 mA and P = 1.722 watts. This shows that the higher the voltage and current, the higher the electric power (wattage) of the solution.

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