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WULUH STAR FRUIT (Averrhoa Bilimbi) AS A SOURCE OF ENERGY IN GALVANI CELLS

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Abstract

In this life, electricity is one of the most important things to meet human needs. After basic needs such as food, clothing and shelter, electricity is an important need that cannot be separated from human life, without electricity, of course the three basic needs above will not be fulfilled. Galvani cells are cells that produce electric current, there are three components, namely anode, cathode and electrolyte. Electrolytes canbe acids, salts, or amphoteric compounds. The purposes of this study include (1) to find out how to use starfruit, (2) to determine the effect of the amount of starfruit (Averrhoa bilimbi) on the electric current, and the resulting pH, (3) to determine the electrical conductivity in trials on LED light. The method used is an experimental method using starfruit as the research object. The research results inform that a single Galvani cell system can produce a voltage and electric current of 0.22 volts and 3.04 mA. After conducting research, it can be concluded that starfruit (Averrhoa bilimbi) can be used as an electrolyte solution in the Galvani cell system to produce electrical energy.
Keywords*: Starfruit, electrolyte, galvanic cell*

Abstrak

Dalam kehidupan ini, listrik merupakan salah satu hal yang sangat penting untuk memenuhi kebutuhan manusia. Setelah kebutuhan pokok seperti sandang, pangan dan papan, listrik merupakan kebutuhan penting yang tidak dapat dipisahkan dari kehidupan manusia, tanpa listrik tentunya ketiga kebutuhan pokok diatas tidak akan terpenuhi. Sel galvani merupakan sel yang menghasilkan arus listrik, terdapat tiga komponen yaitu anoda, katoda dan elektrolit. Elektrolit dapat berupa asam, garam, atau senyawa amfoter. Tujuan dari penelitian ini antara lain (1) untuk mengetahui cara penggunaan belimbing wuluh, (2) untuk mengetahui pengaruh jumlah belimbing wuluh (Averrhoa bilimbi) terhadap arus listrik, dan pH yang dihasilkan, (3) untuk mengetahui daya listrik konduktivitas dalam uji coba pada lampu LED. Metode yang digunakan adalah metode eksperimen dengan menggunakan belimbing wuluh sebagai objek penelitian. Hasil penelitian menginformasikan bahwa sistem sel Galvani tunggal dapat menghasilkan tegangan dan arus listrik sebesar 0,22 volt dan 3,04 mA. Setelah dilakukan penelitian, dapat disimpulkan bahwa belimbing wuluh (Averrhoa bilimbi) dapat dimanfaatkan sebagai larutan elektrolit pada sistem sel Galvani untuk menghasilkan energi listrik.
Kata Kunci: Belimbing wuluh, elektrolit, sel galvanic

INTRODUCTION

According to Triatmojo (2018), energy is inseparable from everyday life. The need for energy is increasing every day, and this increase is influenced by many factors, namely lifestyle, endless human satisfaction, more and more advanced human civilization, etc. To meet these energy needs, an unlimited, available, and renewable alternative energy source is needed that can also function as an energy source, as evidenced by the results of research on fruits and other crops. According to Sutikno (2008), the electrolyte in battery stones is acidic, so that acidic fruits can be converted into electrolytes, one of which is an environmentally friendly energy source from vegetable and fruit plants. Star fruit is a type of tamarind star fruit with the Latin scientific name Averrhoa Bilimbi Linn, belonging to the family Oxalidaceae.

Originally from America, this plant grows in tropical climates and in several countries such as Malaysia, Argentina, Australia, Brazil, India, the Philippines, Singapore, Thailand, and Venezuela (Kurniawaty, 2016). The spread of star fruit in Indonesia began in the Maluku Islands then spread throughout Indonesia (Gendrowati, 2010). This plant is known by the local names Limeng, Selemeng, Beliembieng,Blimbing Buloh, Limbi, Libi, Tukurela and Malibi. Its foreign names are bilimbi, cucumber tree and kamias (Savitri, 2014).

Solutions in the form of acid compounds such as sulfuric acid compounds, oxalic acid, formic acid, and citric acid are known to be electrolyte solutions. Electrolytes are used in the Galvani cell system to conduct ions from the anode to the cathode so that it can generate electricity. Star fruit contains a formic acid liquid, so it has the potential to generate electricity. As is known, star fruit wuluh has a highacidity.

According to Suryaningsih (2016), star fruit is often called vegetable star fruit or star fruit because of its sour taste, often used as a cooking spice or herbal preparation and contains a lot of tannins, saponins, sulfur glucose, formic acid peroxides, and flavonoids, and triterpenoids. Formic acid is one of the electrolyte solutions, the electrolyte solution is used in the galvanized cell system to carry ions from the anode to the cathode to generate electricity.

According to Siregar (2017) A voltaic or galvanic battery is an electrochemicalcell consisting of two electrodes that can produce electrical energy due to the spontaneous redox

reaction that occurs in both electrodes. Oxidation reactions occur atthe anode and reduction reactions occur at the cathode. Electrons flow from thecathode to the anode. There is a salt bridge to balance the ions in the solution resulting in the change of chemical energy into electricity.

Based on this, star fruit wuluh qualifies as an alternative energy source becauseit is widely available in Indonesia, easy to be able to, acidic so that it can become electrolyte and can produce electricity.

The objectives of this study include (1) To find out how the use of star fruit,
(2) To determine the influence of the number of star fruit (Averrhoa bilimbi) on the voltage of electric current, and the pH produced, (3) To determine the electricalconductivity in trials on LED lamps.

The expected benefits in this study include (1) Providing insight into knowledge and information about the use of star fruit to provide innovative alternative sources of electrical energy, (2) Providing knowledge to the community, (3) Providing knowledge about the processing of star fruit as an alternative material to replace batteries.

MATERIALS AND METHOD

The star fruit used is fresh star fruit that is old or green obtained from the Medan area of North Sumatra, while the data collection technique used is an observation technique, which is a direct observation technique of what happens in the field. The first stage carried out in the implementation of this research is the preparatory stage, namely identifying problems and searching for libraries. The second stage is designing research, while the third stage is the experimental stage and reporting results that previously needed to be carried out data collection and data analysis.

The tools and materials used in this study are: Tools and Materials:

Tools and Materials :

NO	Material Name / Tool	Number
1.	Zinc plate size 3 x 2 cm	5 pcs
2.	Yellow coins (Copper Plate Replacement)	4 pcs
3.	Plastic Cups	5 pcs
4.	Crocodile tongs	5 pcs
5.	Plastic Bowl	1 pcs
6.	Measuring Cup	1 pcs
7.	Cutter	1 pcs
8.	Scissors	1 pcs
9.	Tape	1 pcs
10.	Blender	1 pcs
11.	Belimbing Wuluh	2 kilograms
12.	Sieve	1 pcs
13.	Cable	3 meters

How to Make

1. Before use, star fruit is first washed and cleaned, then puree using a filtered blender and extractedjuice.

2. Then a plastic bowl is taken and put in a plastic bowl as a result of the screening of the star fruit.

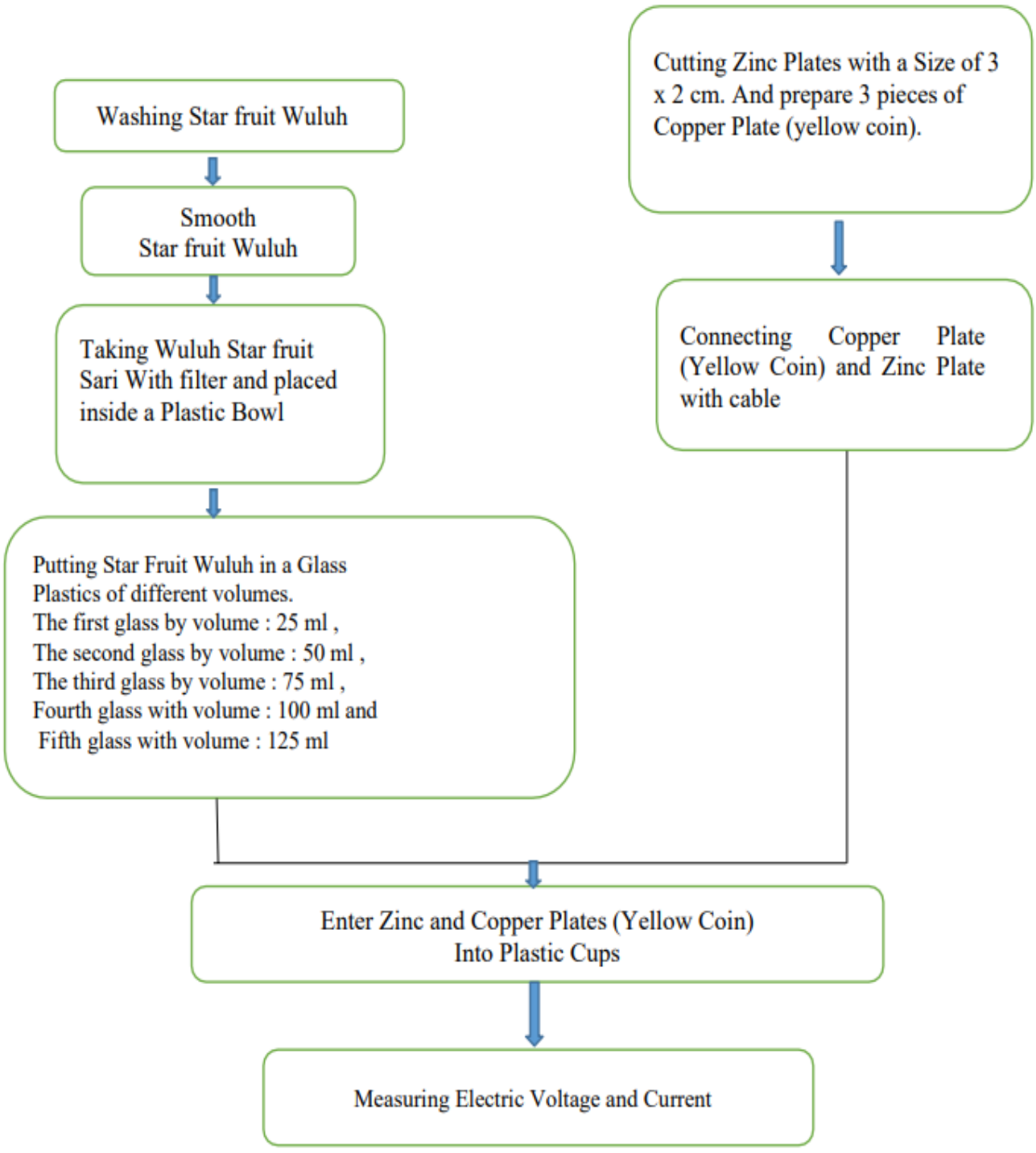
3. Then a plastic cup and a measuring cup are taken, each plastic cup is inserted with a star fruitsolution with a different volume. The first glass with volume : 25 ml , the second glass with volume
   : 50 ml , the third glass with volume : 75 ml , the 4th glass with volume : 100 ml , and the fifth glasswith volume : 125 ml .

4. The zinc plate needed with a size of 3 x 2 cm with 5 pieces each.

5. Then each Copper Plate (Yellow Coin Money) is connected to the Zinc Plate by means of a 3 cmlong cable. While on the other hand, the other plate is connected by a 15 cm long cable.

6. Each series of copper plates (coins) and zinc is put into a plastic cup that has contained star fruitjuice.

The scheme of the experimental procedure is as follows:



7. In the first experiments, measurements of voltage and electric current were carried out in each system using an analog multimeter. The wires connected to the zinc plate are the positive pole, while the wires connected to the copper plate (yellow coin) are the negative pole.

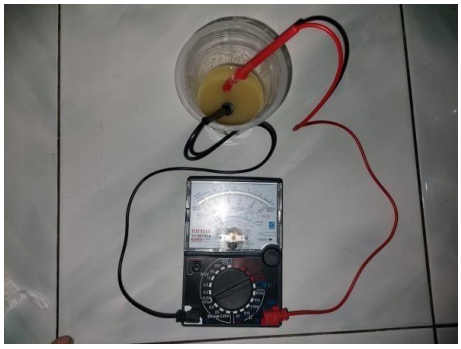


Figure 1 : First Attempt

Before taking measurements, the measuring instruments used are calibrated first so that the measurement results are more accurate. Then the positive pole of the system is connected with the red wire on the multimeter, while the negative pole is connected with the black wire. The first measurement is the measurement of voltage, followed by the measurement of electric current.

8. In the second experiment, voltage and current measurements were carried out by manipulating the number of systems to be measured for voltage and current.

First measure the voltage and current in one system, then measure the voltage and current in two systems arranged in series, and so on until the measurement of voltage and current in five systems arranged in series. The following is a picture of measuring the voltage and electric currentin star fruit liquid.

Figure 2: Voltage Large designation

Figure 3 : Illuminated Light Experiment

RESULTS AND DISCUSSION

In the first experiment, measurements of voltage and electric current werecarried out in each Galvani cell system containing 25 mL of star fruit solution.Measurements are carried out using an analog multimeter. The results obtained are presented in Table 2.

Based on the data of the results of the first experiment it is known that four glasses produce the same electrical voltage of 0.2 volts. Then the fifth glass produces the same electrical voltage of 0.3 volts.

Table 2. Data on the results of electrical tension measurement experiments

No	Volume (mL)	Volt (V)
1	25	0,2
2	50	0,2
3	75	0,2
4	100	0,2
5	125	0,3

Based on the data of the results of the experiment it is known that each glass hasa different electric current. In the first glass containing a star fruit solution of 25 mL, an electric current of 0.9 mA was obtained, at a volume of 50 mL an electric currentof 1.2 mA, at a volume of 75 electric current of 2.3 mA, at a volume of 100 mL an electric current of 3.8 mA and at a volume of 125 mL an electric current of 7 mA was obtained.

After calculating the electrical voltage in each volume of star fruit provided, a graph of the relationship of the amount of electrical voltage to the volume of star fruit solution is given which can be seen in Figure 4.

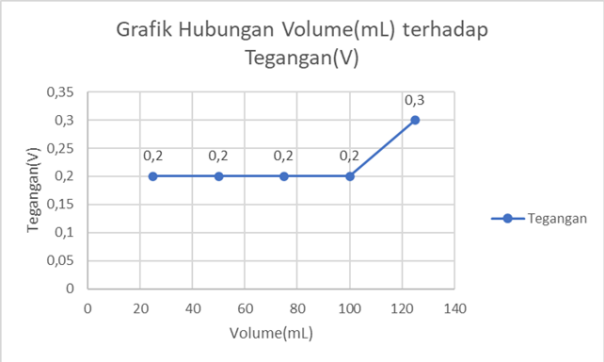


Figure 4. Graph of the relationship of voltage(V) to volume(ml)

Based on the chart above, it is obtained that the electrical voltage generatedby each solution with different volumes does not have a high enough difference.Each star fruit solution has the same voltage of 0.2V but has a slight difference in the solution with a volume of 125mL having an electrical voltage of 0.3V.

Table 4. Data on the results of electric current measurement experiments

No	Volume (mL)	Current (mA)
1	25	0,9
2	50	1,2
3	75	2,3
4	100	3,8
5	125	7

The data from the first experiment have proved that star fruit solution can function as an electrolyte in the Galvani cell system by using zinc plates as anodes and copper coins as cathodes. The negative ions on the zinc plate flow through thestar fruit solution to the copper coin, resulting in electrical energy. Then for one Galvani cell system with zinc plates and copper coins and star fruit solution with volumes of 25, 50, 75, 100 and 125 mL can produce an average voltage of 0.22 volts and an average current of 3.04 mA.

You can see a graph of the relationship between volume (mL) to electriccurrent (mA).

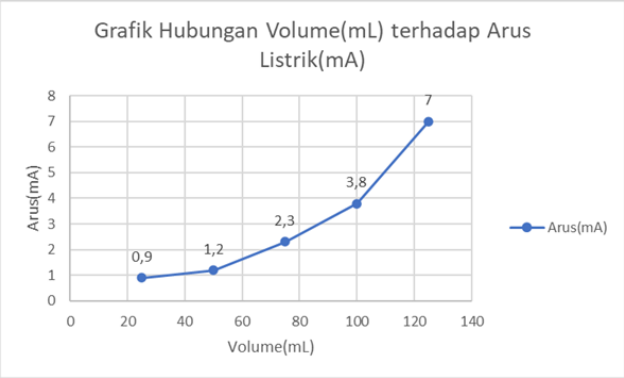


Figure 5. Graph of the relationship of volume(ml) to current(mA)

From the chart above, it can be seen that the higher the volume of star fruit solution, the greater theelectric current generated.

In the second experiment, an acid-base property test was carried out using universal indicators, theresults were obtained that the star fruit solution is a strong acid with a pH of 1

. **Table 6. pH measurement**

No	Volume (mL)	pH
1	25	1
2	50	1
3	75	1
4	100	1
5	125	1

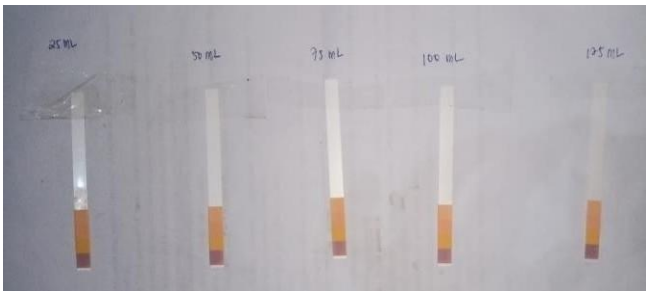


Figure 6. pH trial of star fruit solution

The next experiment is to turn on the LED lights by compiling a star fruit solution in series. Each anode and cathode are connected to each star fruit solution of different volumes. Then it is connected to an LED lamp for a flame test. Afterexperiments, results were obtained that the LED lamp was brightly lit which indicates that the star fruit solution when connected in series will produce a strong electrolyte solution.

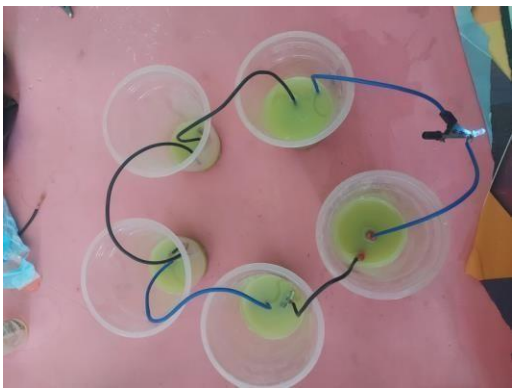


Figure 7. Star fruit solution arranged in series

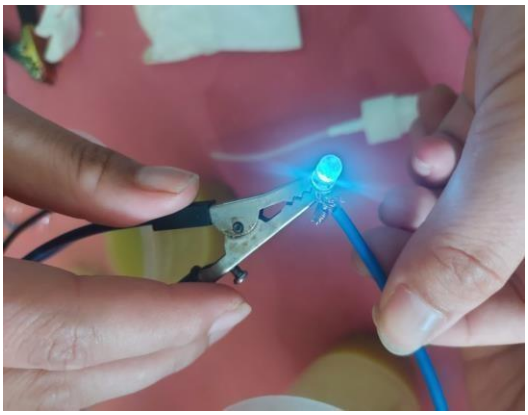


Figure 8. Lights on brightly

Star fruit liquid functions like an electrolyte solution contained in a battery. In the liquid, there are many positive ions and negative ions. Electric current occurs when the positive pole and the negative pole are connected by wires, then iron atoms will release electrons. Such electrons flow from the negative pole to the positive pole through the wire.

Iron atoms that release electrons are called positive iron ions. Then the positive ions of iron will combine with the negaif ions in the star fruit liquid. While the positive ions in star fruit liquid will attract free electrons that possessed by copper atoms. So that's an illustration, the occurrence of electric current that is influenced by the flow of electrons in star fruit.

CONCLUSION

a. The method of utilizing star fruit as an electrolyte solution in Galvani cells to produce electrical energy is carried out through the Galvani cell system experiment consisting of zinc plates as anodes and copper plates as cathodes.
b. The ratio of the amount of star fruit and electrical energy generated from 25 mL, 50 mL, 75 mL, 100 mL, and 125 mL of star fruit solution as an electrolyte can produce an average voltage of 0.22 volts and an average electric current of 3.04 mA;
c. Each addition of one Galvani cell system assembled in series will add a stronger electric current so that it can turn on the LED lights that light up brightly.

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