Jun 26, 2019

Characterization of Aloe Barbadensis Miller Leaves as a Potential Electrical Energy Source with Optimum Experimental Setup Conditions.

PLOS One

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Working dx.doi.org/10.17504/protocols.io.2yngfve

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ABSTRACT

Electrical energy can be harvested from the living plants as a new potential renewable energy source. Characterization of the electrical signal is needed to enable an optimum energy harvesting setup conditions. In the presentpaper, an investigation is conducted to analyze the characteristic of Aloe Barbadensis Miller (Aloe Vera) leaves in terms of electrical energy generation under specific experimental setups. The experimental results show that 908.39uWelectrical power can be harvested from the Aloe Vera with 24 pairs of electrodes and this energy is capable to be stored in a capacitor. This energy has a high potential to be used to power up a low power consumption device.

EXTERNAL LINK

https://doi.org/10.1371/journal.pone.0218758

GUIDELINES

1. The species of the Aloe plant selected for this experiment is the Aloe Barbadensis Miller, which is more commonly known as the Aloe Vera. Each of the Aloe Vera selected is approximately 3 years old and a fully-grown plant. The size of the selected plant is approximately 50 to 60 cm in height and 50 to 70 cm in diameter from one tip of the leaf to another tip of the leaf. Each of the succulent leaves of the Aloe Vera is about 35 to 40 cm in length, with a maximum width of 6 to 7 cm and with 2 to 2.5 cm thickness.

2. All the experiment setups are performed in an indoor laboratory environment. The room temperature is kept at 25 to 26 degrees Celsius and the indoor relative humidity percentage is kept to be 56% to 61% by the indoor air conditioning system at the same time measured by a DHT 11 temperature and humidity sensor.

MATERIALS TEXT

1. Copper electrode.
2. Zinc electrode.
3. Solder gun station.
4. Wire
5. Crodcodile clip connecting wire.
6. Extech EX540 multi-meter with data logging and wireless PC interface capability
7. Sandpaper
8. Alcohol solution (for cleaning purpose)
9. Aloe Vera plant (size of the selected plant is approximately 50 to 60 cm in height and 50 to 70 cm in diameter from one tip of the leaf to another tip of the leaf)
10. Ruler
11. Pen
12. Solder wire.
13. Capacitor (16V, 1000uF)

SAFETY WARNINGS

1. Wear gloves when handling the process of inserting electrode pairs into the Aloe Vera to prevent the sap of the tree from touching the skin, which might cause allergy.
2. Solder with caution when soldering the electrode-pair together.

1 First, prepare the number of desired electrode pairs, which consist of copper as cathode and zinc as anode electrode. Cut the electrodes into a standard size of 2.5 cm length, 2 cm width, and 1mm thickness.

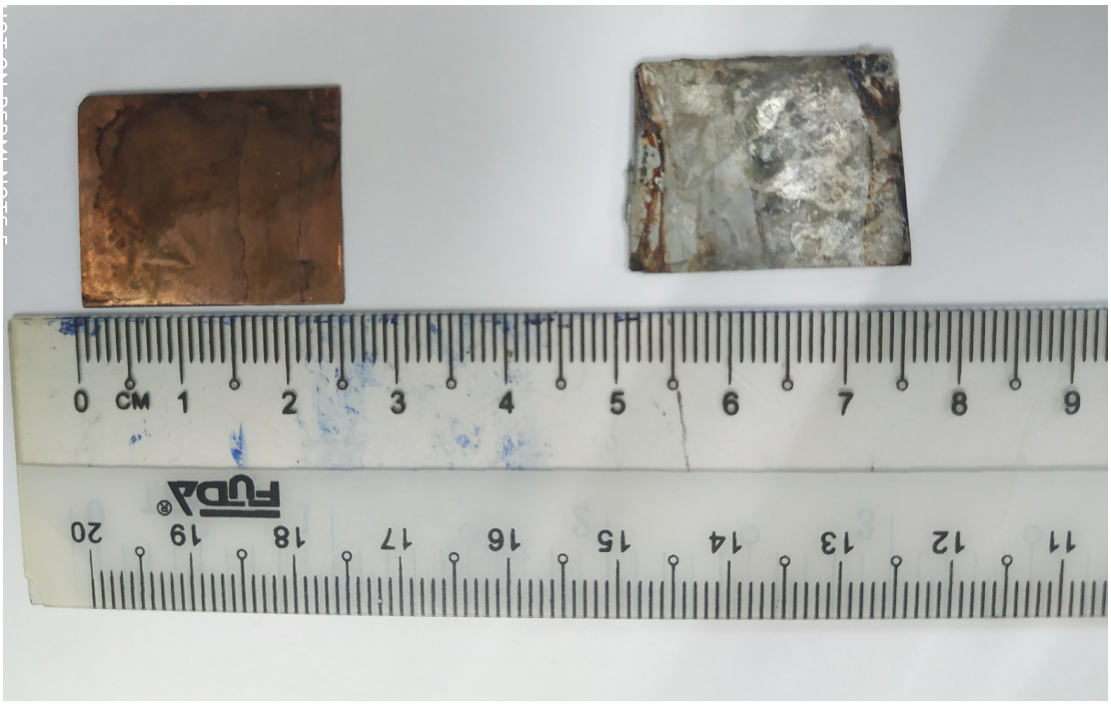

Fig 1: Measurement of copper-zinc electrode size.

2 Brush the electrodes surface with sandpaper to remove any contaminant and oxidant. Then, wipe the surfaces with alchohol to further remove any micro-contaminant.

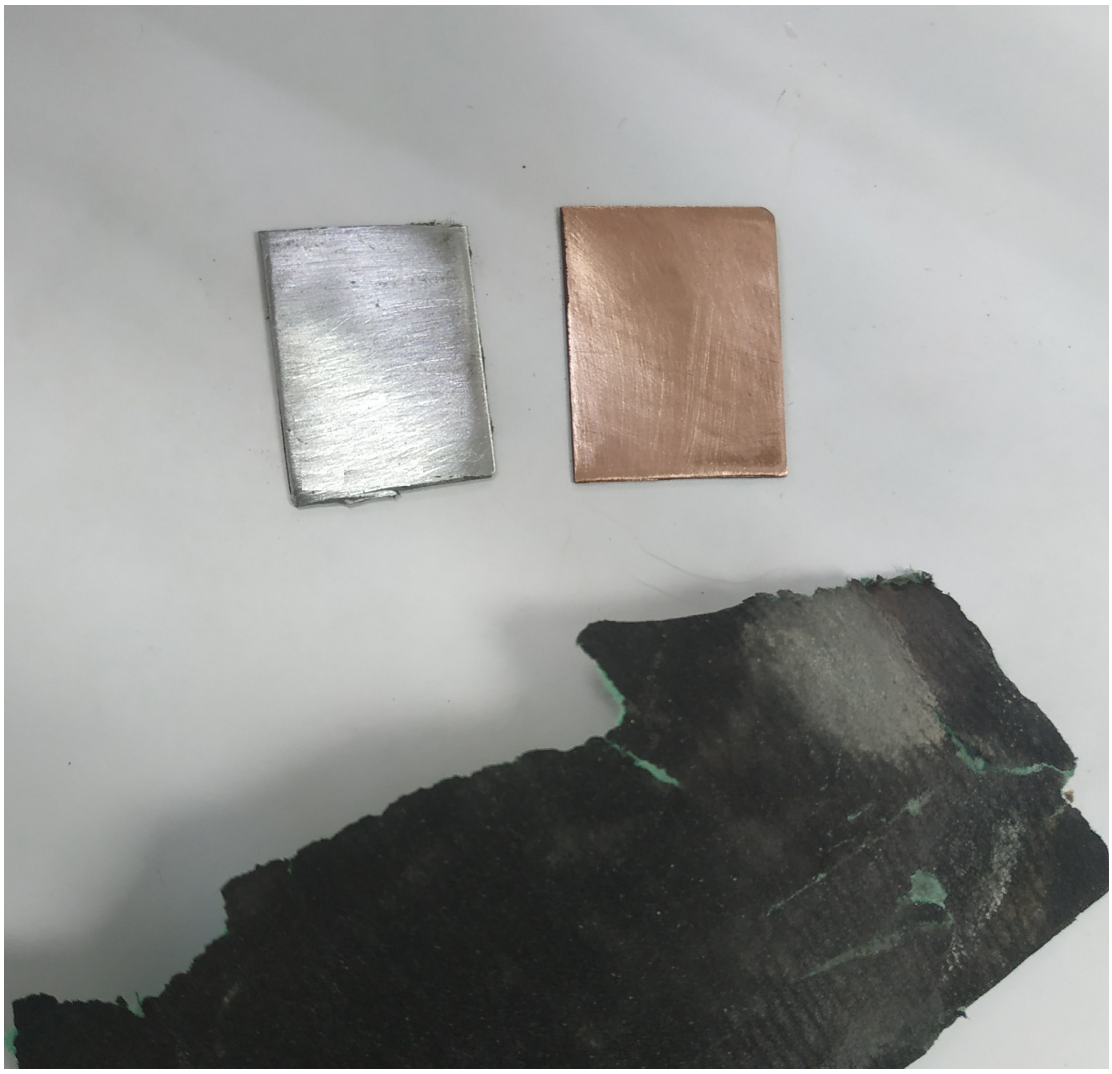

Fig 2: Electrodes after been cleaned with sandpaper and alcohol. .

3 Measure 1.5cm from the tip of each electrode and mark it by using a pen. This shows the depth of electrode penetration into the leaf, which

is set at 1.5 cm.

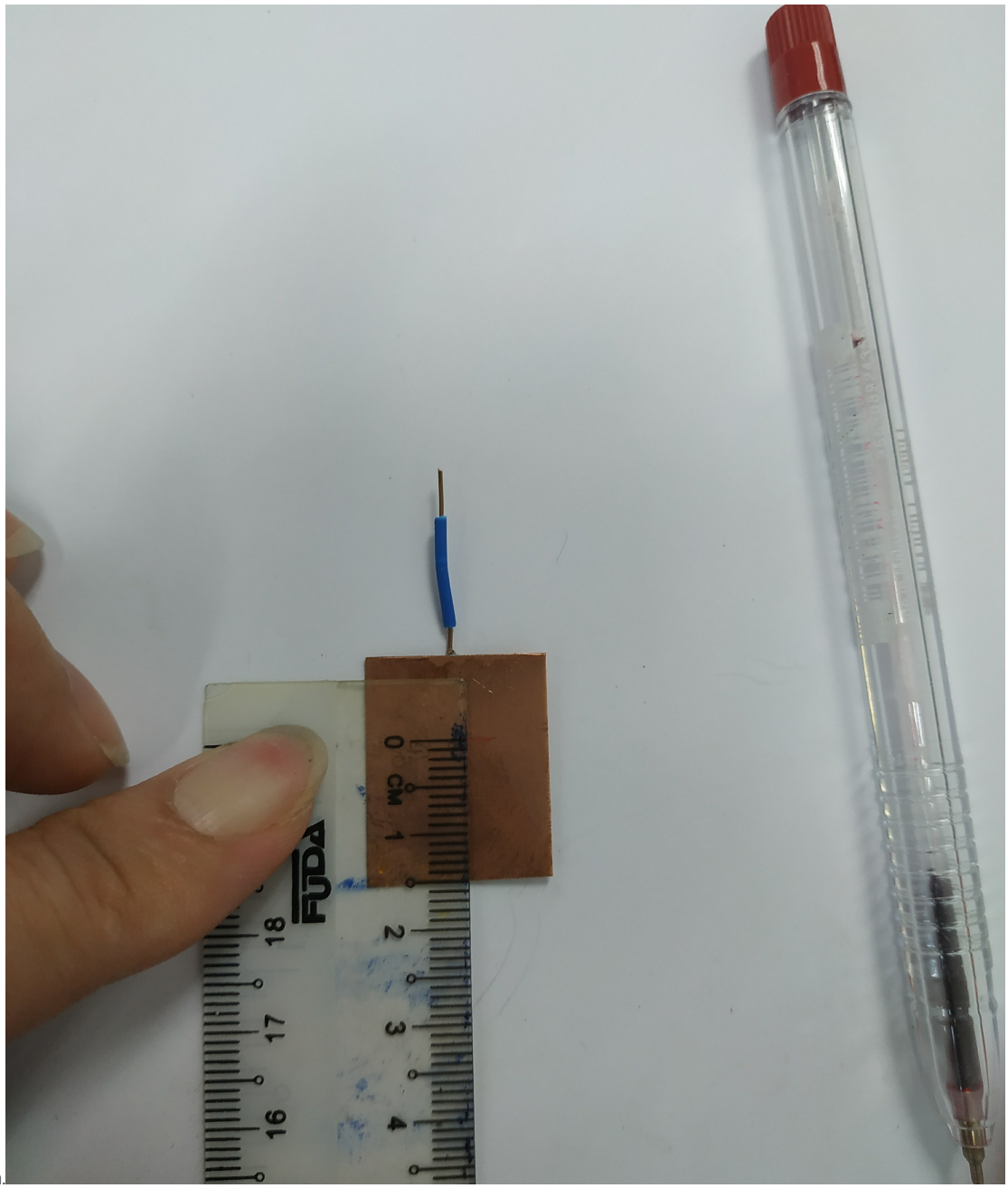

Fig 3: Marking 1.5cm from the tip of electrode to signify the depth of electrode penetration into the leaf.

4 Solder both the copper and zinc electrode into an electrode pair. Connect them by using a 3cm wire. Make sure the solder contact of the wire and the electrode surface is intact. Use a multi-meter to check the connectivity of each electrode pairs. Prepare the desired number of

electrode pairs.

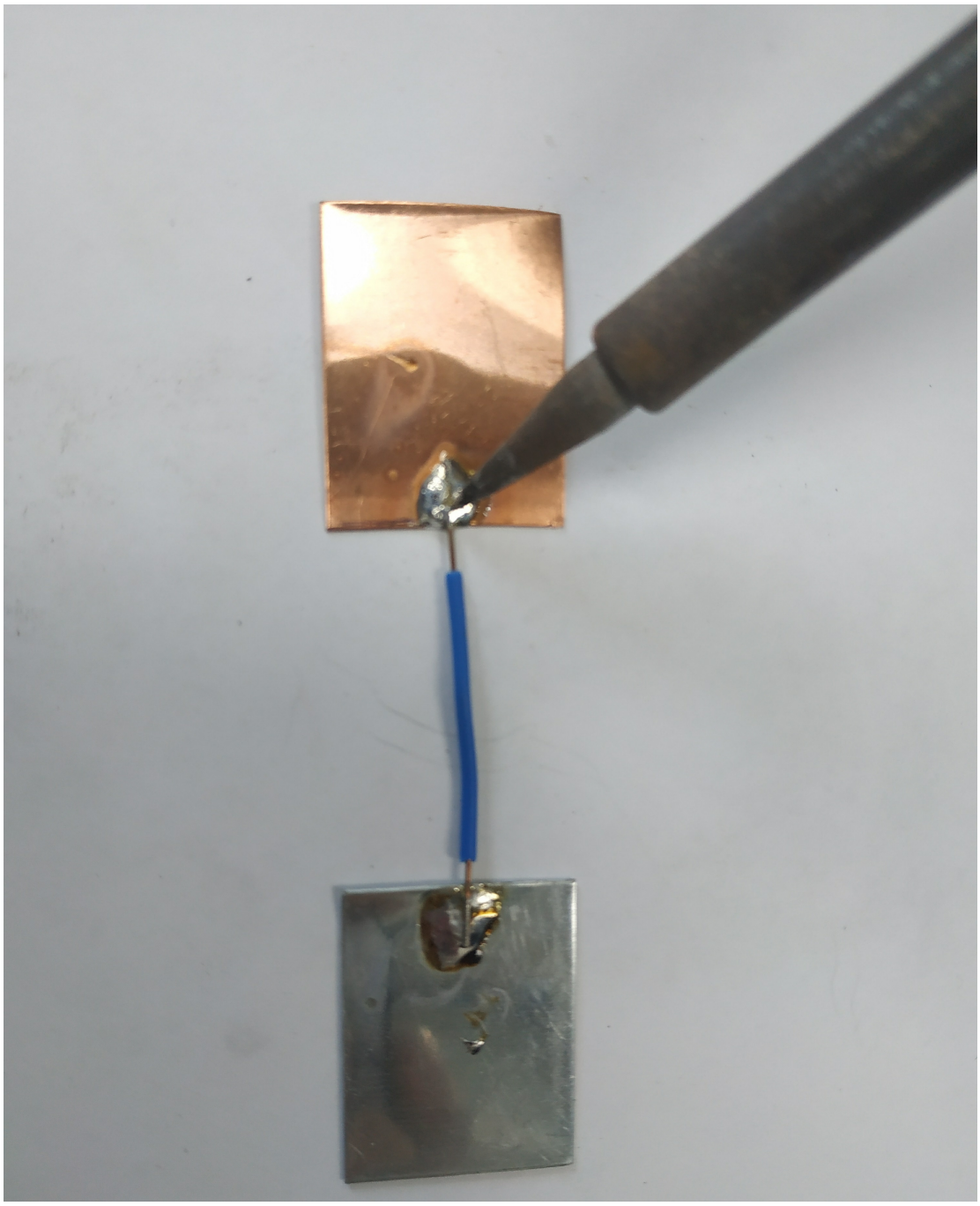

Fig 4: Preparation of copper-zinc electrode pair.

5 Next, choose the Aloe Vera leaves to be inserted with the electrode pairs. Each of the Aloe Vera selected is approximately 3 years old and a fully-grown plant. The size of the selected plant is approximately 50 to 60 cm in height and 50 to 70 cm in diameter from one tip of the leaf to another tip of the leaf. Each of the succulent leaves of the Aloe Vera is about 35 to 40 cm in length, with a maximum width of 6 to 7 cm and with 2 to 2.5 cm thickness.

Fig 5: Selection of Aloe Vera leaves to be inserted with electrode-pairs.

6 Mark the leaf surface to signify the distance between each electrode is at 1cm starting from the end of the leaf near the stem of the plant towards the tip of the leaf.

Fig 6: Marking distance of 1 cm between each electrode on the leaf.

7 Insert the first copper electrode into first scale mark on the leaf.

Fig 7: Inserting first copper electrode into the leaf.

8 Insert the next electrode pair . Make sure the zinc of the new inserted electrode pair is facing the first inserted copper electrode previously. Each of this will make a cell consists of copper-zinc electrode pair which generate voltage and current.

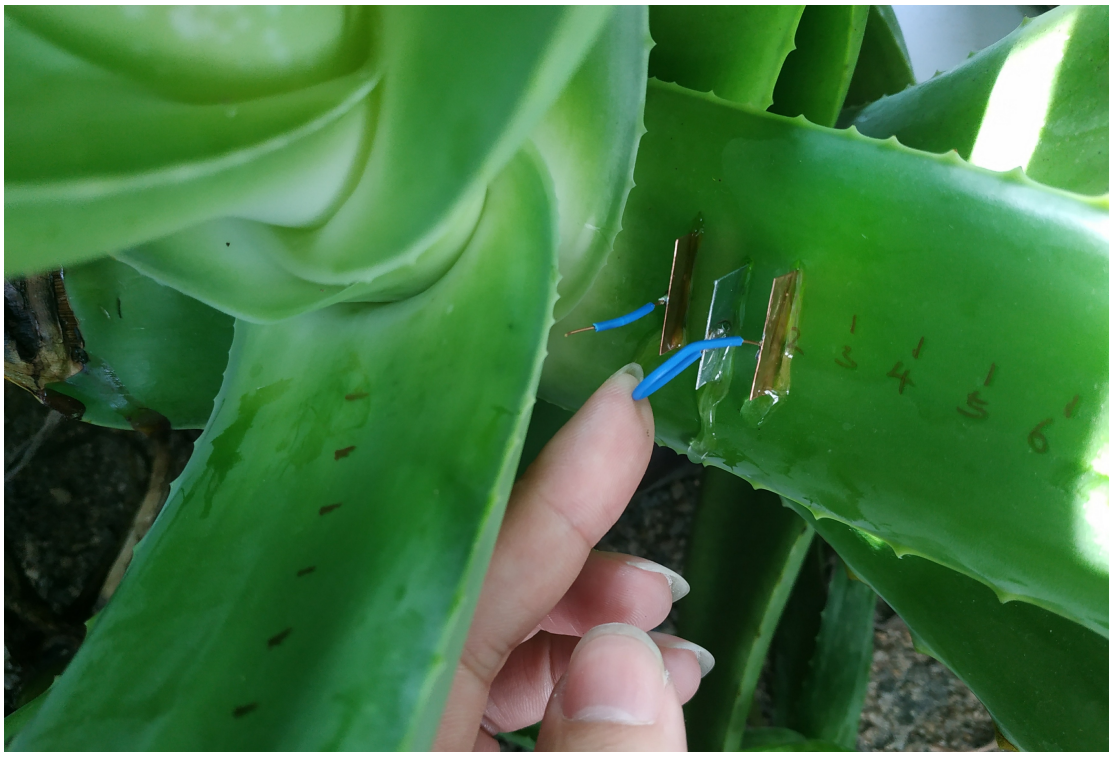

Fig 8: Inserting electrode pair into the Aloe Vera leaf.

9 Insert the desired number of electrode pairs in to the leaf. Recommended to use only 6 to 8 electrode pairs per leaf due to limitation of the size of the leaf. Standardize the number of electrode pairs used per leaf in the experiment is crucial.

Fig 9: Standardize the number of electrode-pair immersed into each leaf to be the same.

10 Measure the voltage and current generated by each leaf with a multi-meter, preferable a multimeter with datalogging and wireless interface to a computer in order to collect the data continuously. Connect the positive terminal to the copper electrode (cathode) and the negative terminal to the zinc electrode (anode).

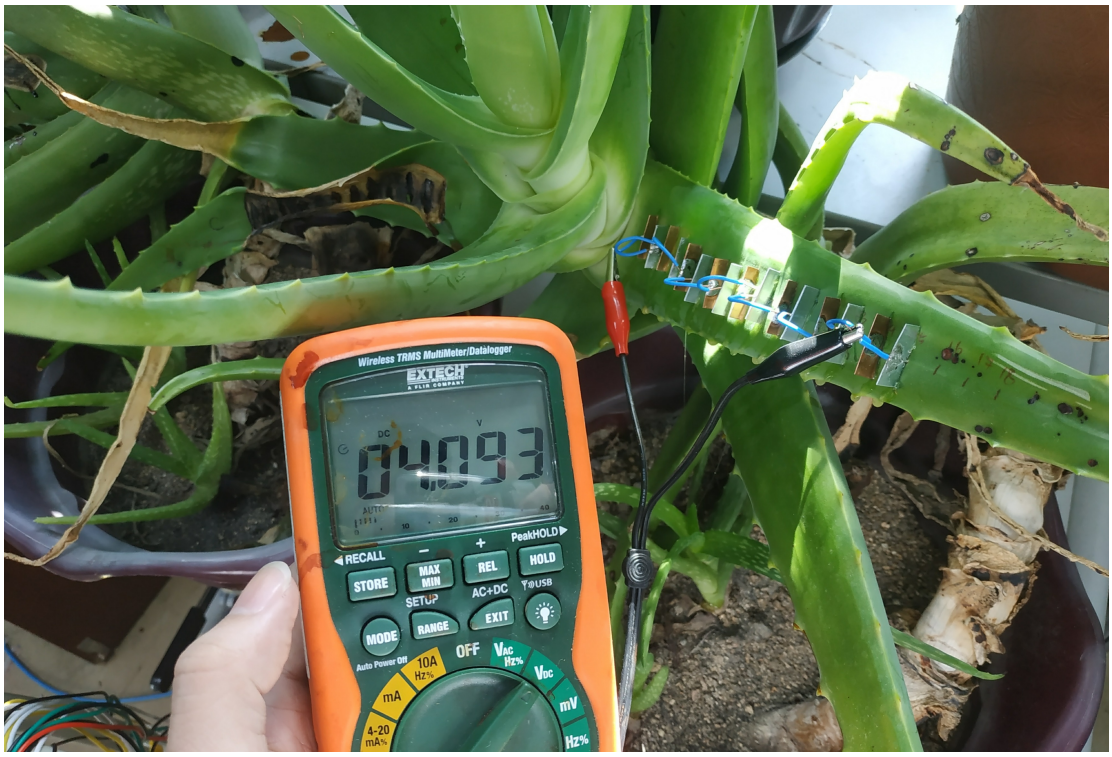

Fig 10(a): Measurement of voltage generated by the Aloe Vera leaf, which is inserted with electrode pairs.

Fig 10(b): Measurement of current generated by the Aloe Vera leaf, which is inserted with electrode pairs.

11 Multiple leaves inserted with the electrode pairs can be connected together in series or in parallel to increase the voltage or the current to a desired value. Use crocodile jumper wire or normal wire to connect the first and last electrodes inserted into the leaf to the electrodes of another leaf. The output voltage and current generated by the connected leaves can be measured by using a multi-meter. It is able to be connected with a capacitor to store the energy (preferable a 16V, 1000uF capacitor).

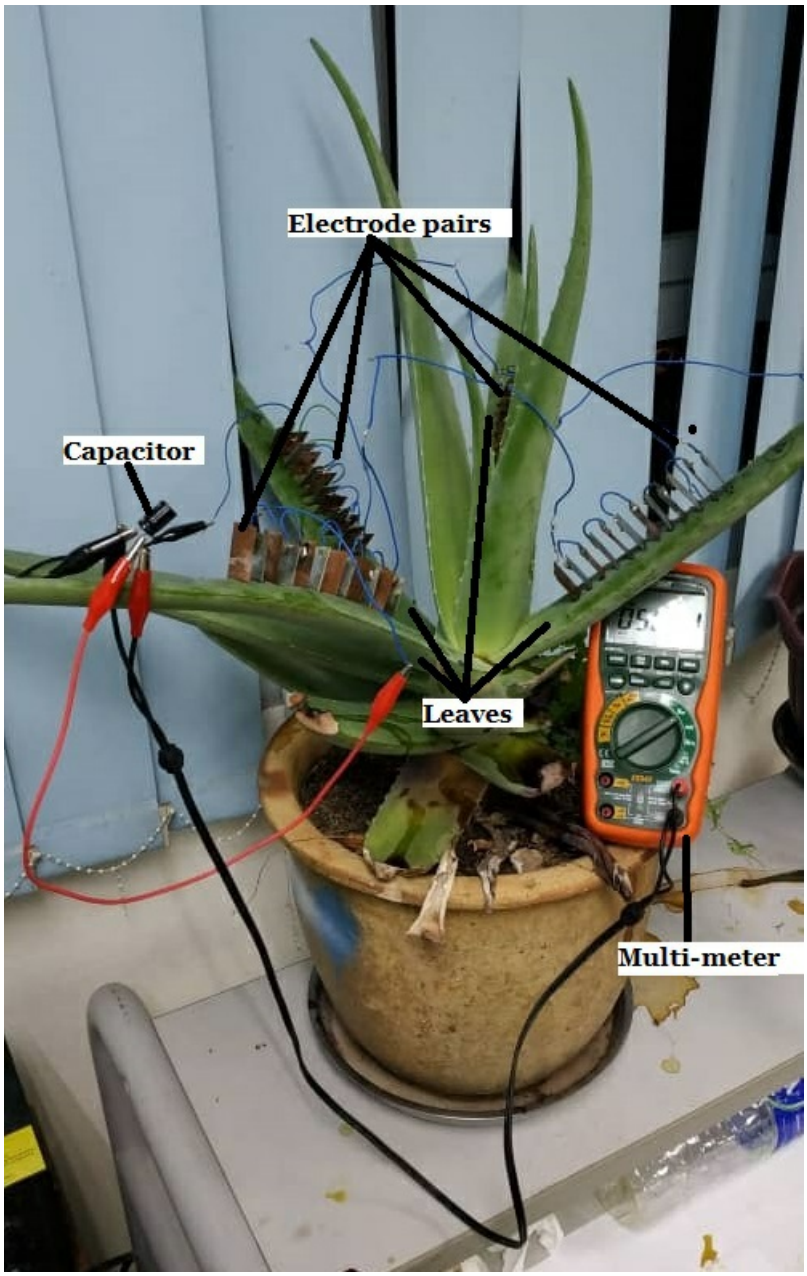

Fig11: Connecting the Aloe Vera leaves in series or parallel and storing the energy geerated in a capacitor.