

Comparative Experimental Studies to Generate Electricity from Various Types of Plants Using Different Electrode Pairs

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ABSTRACT

Experimental studies have been carried out to make comparison of voltage generation capacity of each of the various types of plants like- Aloe vera (Aloe barbadensis miller), Akanda (Gigantea), Tulsi (Ocimum tenuiflorum), Banana (Musa acuminata) and Sugar cane (Saccharum officinarum). Studies have also been made to find the effects of pairs of electrodes to extract power from the above plants. Effects of the Intensity of solar radiation that changes with time of the day (8 a.m. to 6 p.m.) have also been studied on the generation of voltage by one of the plants, i.e., Aloe vera with the application of Carbon and Zinc pair of electrodes. Results have been tabulated, shown graphically and discussed.

Keywords: Plant electricity, Voltage generation; Electrode pair; Voltage measurement; Intensity of solar radiation.

INTRODUCTION

Trees and plants prepare their foods using minerals and water from the soil, and sunlight with the help of chlorophyll present in the leaves [1]. These foods contain electrons, ions and neutral particles [2]. They act like electrolytes and hence, are sources of small amount of electricity.

The generation of electricity from the movement of the branches and twigs during storm and high-speed wind using small generator has been reported by Jermy Cook [3]. Generation of electricity using artificial trees in the form of wind turbines has been reported by Ganzalo Mendo [4]. Production of 200 mV by connecting electrodes between the stem of the tree and the nearby soil, has been reported by Babak Parviz et al. [5]. Generation of 0.78 V from Sengon tree has been reported by A Muladi et al. [6]. Extraction of electrical energy from Aloe barbadensis Miller and Musa acuminata plants has been reported by Onyekachukwu et al. [7].

In these experimental studies, an attempt has been made to select various types of plants to find their electricity generation capabilities with different types of electrode pairs. From these experimental studies, best tree and best electrode pair have been determined. Considering best tree and best electrode pairs, experiment has also been carried out to find the change in the voltage generation with the variation of the intensity of solar radiation at different hours from 8 a.m. to 6 p.m.

Results have been tabulated, shown graphically and pictorially, and discussed. Conclusion has been drawn based on the results obtained.

MATERIALS AND METHODS

Selection of plants Following plants have been considered for the experiments.

- a) Aloe vera (Aloe barbadensis miller)
- b) Akanda (Caltropis procera/gigantea)

- c) Banana (*Musa acuminata*)
- d) Sugar cane (*Saccharum officinarum*)
- e) Tulsi (*Ocimum tenuiflorum*)

Selection of the pair of electrodes Following metals have been considered as electrode pairs.

- a) Zinc and Carbon b) Zinc and Copper c) Zinc and Aluminum d) Copper and Carbon

Methods of Voltage Measurement

Connection of electrodes between the stem of the plant and nearby ground (earth) . Figure 1 shows the schematic connection diagram for voltage measurement using carbon rod as +ve electrode and Zinc plate as -ve electrode. The Carbon electrode is put 0.25 cm inside the stem of an Akanda plant (*gigantea*) and the Zinc rod is put 1 cm in the ground about 30 cm away from the stem. The voltage is measured between the electrodes. The voltage shown by the multimeter is displayed in Photograph-I. This procedure is repeated for voltage measurement for other pairs of electrodes such as – Zn -Cu, Zn -Al and Cu -C. The same procedure is followed for each case of other plants, like- Aloe vela, Tulsi, Sugar cane and Banana. The surface area inside the stem of carbon electrode is $2 \times 10^{-4} \text{ m}^2$ and that of the Zinc electrode is 10^{-4} m^2 in side the earth.

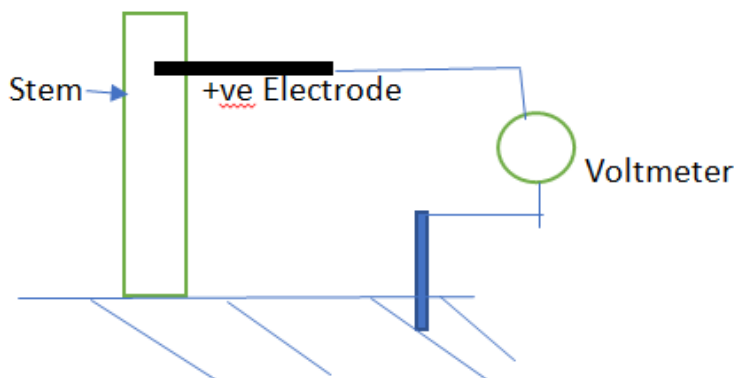


Fig.1: Schematic circuit diagram for voltage measurement between the stem of Akanda plant (*gigantea*) and earth



Photograph 1: Experiment with Akanda (*Gigantea*) plant

Connection of electrodes between the leaf of the plant and nearby ground (earth).

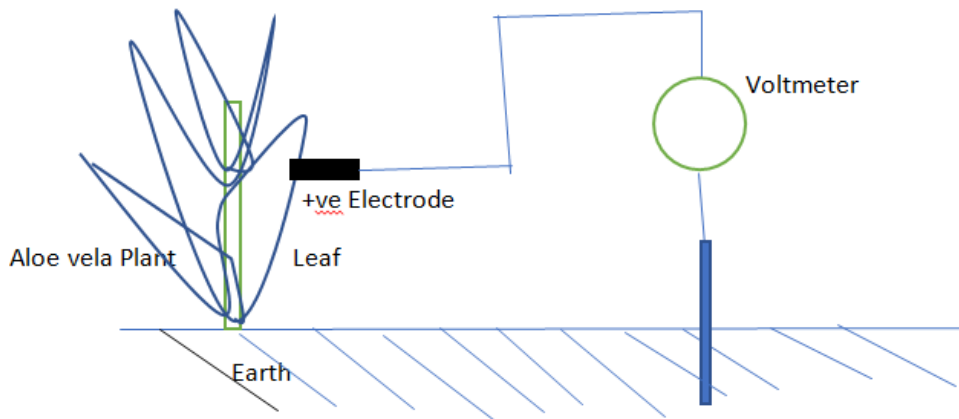


Fig. 2: Schematic circuit diagram for voltage measurement between the leaf and ground

Figure 2 depicts the schematic connection diagram for measurement of voltage for Aloe vera plant by connecting the +ve electrode inside the leaf of the Aloe vera plant and the -ve electrode inside the earth. The voltage between the leaf and the ground is measured by the multimeter. The measured voltage displayed by the multimeter is shown in Picture-II. The same procedure is followed using other types of plants with different pairs of electrodes for voltage measurement.



Photograph 2: Experiment with Aloe vera plant

RESULTS AND DISCUSSION

The data, obtained from the experiments conducted as mentioned in the previous section, have been analyzed to study the performance of each system of voltage measurement from the various plants and hence a comparison has been made to find the best plant and also the suitable pair of electrodes for highest voltage production.

Table-I Voltage generated by various types of plants with different types of electrode pairs

Sr. No.	Types of plants	Types of Electrode pair	Voltage (in volt)
1	Aloe vela	i)Carbon and Zinc ii) Carbon and Copper iii) Carbon and Aluminum iv) Copper and Zinc	i) 1.352 ii)1.04 iii) 0.7 iv) 0.4
2	Akanda	i)Carbon and Zinc ii)Carbon and Copper iii)Carbon and Aluminum	i)1.323 ii)0.9 iii)0.58

		iv) Copper and Zinc	iv) 0.2
3	Tulsi	i) Carbon and Zinc ii) Carbon and Copper iii) Carbon and Aluminum iv) Copper and Zinc	i) 1.032 ii) 0.62 iii) 0.44 iv) 0.25
4	Banana	i) Carbon and Zinc ii) Carbon and Copper iii) Carbon and Aluminum iv) Copper and Zinc	i) 1.205 ii) 0.4 iii) 0.3 iv) 0.2
5	Sugar cane	i) Carbon and Zinc ii) Carbon and Copper iii) Carbon and Aluminum iv) Copper and Zinc	i) 1.325 ii) 0.6 iii) 0.4 iv) 0.2

The Fig. 3 shows the Bar Diagrams to indicate the voltage generation capacity each of the various types of plants with respect to different pairs of electrodes. It can be seen from these Bar Diagrams that Aloe vera has the highest voltage generation capacity of 1.406 volts with Carbon and Zinc pair of electrodes among the various plants. It can also be seen that when other electrode pairs are used, Aloe vera has the best voltage generation capacity, compared to other plants.

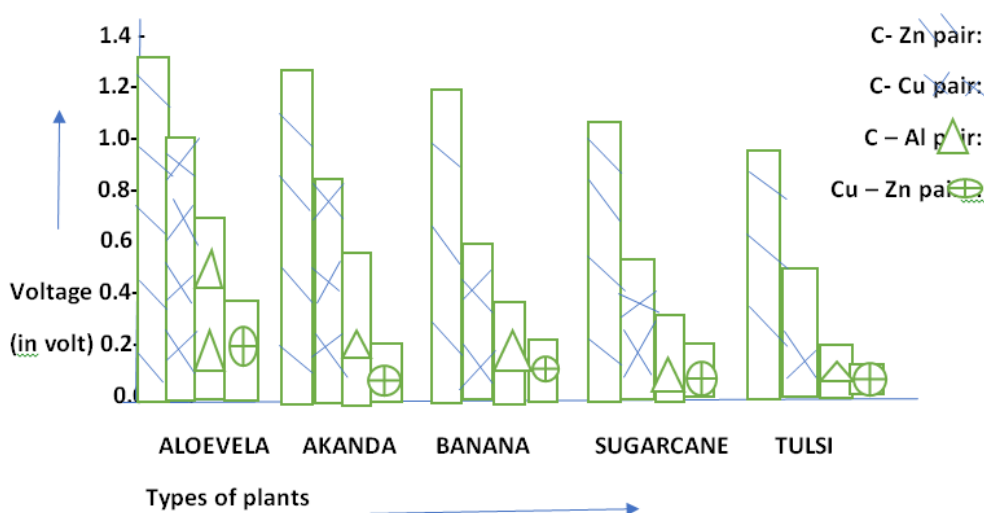


Fig. 3: Bar diagram to show the generation capacity of voltage of different plants with various types of electrodes

Table-II Variation of voltage generation by Aloe vera plant with time (in hour) and Intensity of Solar radiation (in watt/m²)

Time (in hour)	Intensity of solar radiation (in watt/m ²)	Voltage (in volt)
8	150	0.25
9	200	0.38
10	220	0.49
11	510	1.0
12	800	1.352
13	610	1.34
14	550	1.30
15	450	1.22
16	300	1.0
17	100	0.6
18	0	0

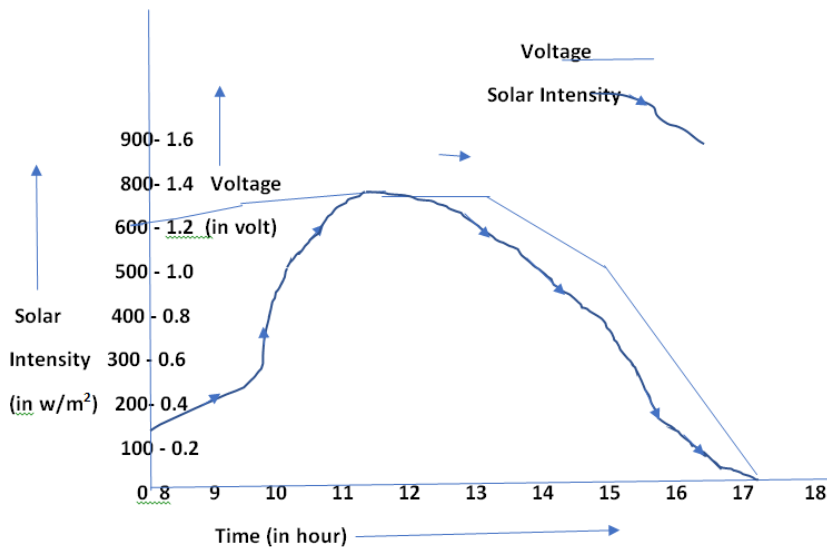


Fig 4: Variation of voltage generation of Aloe vela plant with the Intensity of solar radiation during day time

Figure 4 shows the variation of generation voltage by Aloe vela plant with carbon-zinc electrode pair with time from 8 A.M to 6 P.M. (10 hours) and also with the intensity of solar radiation. It can be seen that at initial stage the voltage generation is less due to low intensity of solar radiation. As the intensity of solar radiation starts increasing the voltage generation also increases because the plant produces more food material with the help of air, water solution, sunlight with help of its chlorophyll present in plant leave. Voltage is maximum of 1.352 volts between 12 noon to 13- hour as shown in the graph. This is due to the fact that during this period intensity of solar radiation is maximum, i.e., 800 W/m² at peak period of the day and also food produced by the plant is height and hence voltage generation capacity of the plant is maximum.

CONCLUSION

This investigation has been done on a specific group of plants. But there can be other types of plants which may show better results for same situation and condition. Moreover, other parameters- like, speed of wind, humidity, dark and cloudy conditions and earth magnetic field, etc. will also have effect on the performance of each plant system. There will be also the effects on the variation of the depth of insertion of electrode length and hence the surface area of the electrodes on the generation of voltage by each of the plants under study.

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