Research Article

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Next-generation Electricity Potential from Aqueous Extracts of Plant Resources

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ABSTRACT

Electrical energy plays a major role in our daily life and its consumption is ever-increasing. Conventional source-based electricity generation has massive environmental challenges such as pollution and global warming. To overcome this, many non-conventional energy source-based generation have been tried and tested such as solar energy, wind energy and biofuels. The present investigation deals with a new technology to produce electricity by using aqueous extracts of various plant resources. Some plants in nature have the properties congenial for the generation of electricity, which may be enhanced.

Keywords: Electricity; Plants; Non-conventional energy; Conductivity; Electrolyte.

1. INTRODUCTION

Energy is the prime requirement in all sectors including industry, transportation, agriculture and domestic (Carvalho *et al.* 2011); a lion's share of the energy comes from non-renewable sources including petroleum, coal, oil and natural gas, which are depleting at a high rate (Larhum *et al.* 2010). Fossil fuels play a significant source of global warming and pollution due to the increase in greenhouse gases, volatile matter and particles in the atmosphere (Khan *et al.* 2011). To overcome these drawbacks, eco-friendly technologies utilizing renewable energy sources is growing all around the world. The bio-voltaic cells are used for charging mobile batteries and wall clocks; studies were carried out using various plant extracts such as peeled skin of vegetables, Akashmoni leaf (*Acacia auriculiformis*), flower of Marigold (*Tagetes erecta*) and Tagar (*Tabernaemonta nasananho*) and Star fruit (*Averrhoaca rambola*) for low-cost power generation (Satarupa *et al.* 2015). Bioelectricity generation from waste citrus extract as a model of Galvanic cells using Zinc electrodes has mitigated the use of non-renewable resources and fossil fuels leading to global warming (Abdul *et al.* 2015). The aqueous extract of *Eucalyptus Sp.* obtained an emf value is 1.86 V and a current of 3.5 A, used to glow LED light, promising renewable energy towards the global community (Kulkarni *et al.* 2015). The present study has been conducted to compare the conductance and potential voltage of aqueous extracts of *Aloe vera*, Ficus, Neem and *Bauhinia tomentosa*.

2. PLANT DESCRIPTION

2.1 ALOE VERA (*Aloe barbadensis*)

Aloe Vera (Fig. 1) is a stemless or very short-stemmed succulent plant, growing to 60-100 cm (24- 39 in) tall, and it is widespread. The leaves are thick and fleshy, green to grey-green, showing white flecks on their upper and lower stem surfaces. Aloe vera gel contains 99.3% of water and the remaining 0.7% of solid constituents - polysaccharides of glucose and mannose. It produces flowers 2-3 cm long during summer, on a spike up to 90 cm tall yellow tubular corolla,

Aloe Vera forms arbuscular, mycorrhiza symbiosis which allows the plant better access to mineral nutrients in soil. It has a unique quality that can grow without water in any climatic conditions. The life span of this plant is comparatively longer when compared to other plants.

2.2 ALEO VERA GEL

Aloe gel is a thick viscid liquid found in the interior of the leaves. Leaves are commonly used in the treatment of burns and the aloin - a bitter milky, yellowish liquid, is used as a laxative. Zinc, copper and magnesium compounds are used to generate electricity. Aloe vera plays a vital role in our daily life with versatile medicinal values.

Fig. 1: Aloe vera plant

2.3 *FICUS RELIGIOSA*

Ficus religiosa or sacred fig, shown in Fig. 2, is a native of the Indian subcontinent and Indo-China belonging to the Moraceae family. The other names of fig are Bodhi tree, Pippale tree, Peepal tree, Peepal or Ashwatha tree (in India and Nepal). The genus *Ficus* belongs to large dry deciduous or semi-evergreen trees growing up to 30 m tall with a huge trunk of diameter 3 m (9.8 ft). The tree is considered sacred in Hinduism, Jainism and Buddhism. Gautama Buddha attained enlightenment (Bodhi) while meditating underneath this tree at Bodh Gaya, Bihar, India.

Fig. 2: *Ficus religiosa*

2.4 *AZADIRACHTA INDICA* (Neem)

Azadirachta indica (Fig. 3) is traditionally known as Neem, Nim tree or Indian Lilac tree, belonging to the Meliaceae family. The tree is basically of Indian origin and is also found in tropical and semi-tropical regions. *Azadirachta indica* is a fast-growing tree reaching a height of 15-20 m (49-66 ft), roundish of diameter 15- 20 m (49- 66 ft) in old ages. The neem tree is noted for its drought-resistance and can tolerate high to very high temperatures but cannot tolerate temperatures below 4 ˚C (39 ˚F).

Fig. 3: *Azadirachta indica* (Neem)

2.5 *BAUHINIA TOMENTOSA*

Bauhinia tomentosa, depicted in Fig. 4, is a commonly known yellow bell orchid tree belonging to the Fabaceae family; it is a versatile and most commonly used household remedy for many manifestations. The word "tomentosa" means hairy and it refers to the velvety hair pods. It is a small tree with a maximum height of 4 cm with drooping slender branches and scrambling stems (usually multi-stemmed). Leaves are greenish, deeply divided, elliptical and entirely margined. Flowers are yellow and bell-shaped, with large petals. It prefers sunlight and needs a moderate amount of water.

Fig. 4: *Bauhinia tomentosa*

3. METHODOLOGY

3.1 AQUEOUS EXTRACT PREPARATION

Fresh leaves were collected from the farming fields of Kanchipuram district, Tamilnadu, India, and cleaned using tap water, followed by distilled water. After washing, the leaves were spread over the blotting paper to remove water droplets. Then, the leaves were sliced into small fragments and weighed (about 20 g) and crushed using sterile mortar and pestle. The extracts were filtered using Whatman filter paper and the extracts were made into the final volume by adding distilled water.

3.2 CONDUCTIVITY MEASUREMENT

The extract of each sample was subjected to conductivity measurement (Fig. 5) by using a conductivity cell. A known volume of about 40 ml was taken and conductivity was checked by dipping the conductivity cell into the extracts.

Fig. 5: Conductance measurement of plant extracts

3.3 VOLTAGE MEASUREMENT

The extract of each sample was subjected to voltage measurement by using a multimeter, as depicted in Fig. 6. A known number of samples were taken and the needles of two probes, connected to the multimeter, were dipped into the extract solution. The reading was taken for every 5-minute interval. The graph was plotted between voltage and time.

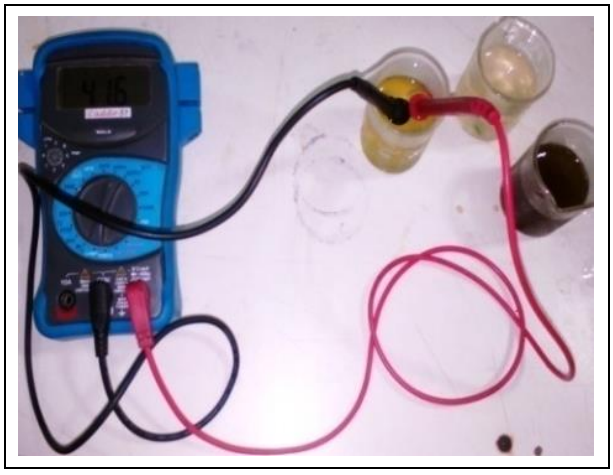

Fig. 6: Voltage measurement of plant extracts

4. RESULT AND DISCUSSION

Bioenergy as a clean and sustainable fuel captivated utilization of renewable energy sources like biomass (Kaygusuz *et al.* 2009). The novel concept of biomass energy's ability to generate electricity from certain succulent leaves like Bryophyllum was reported (Datta *et al.* 2003). For normal usage of common voltaic cell, commercially available inorganic electrolytes were used. After the expulsion of a drained battery, it causes environmental pollution (Velusamy and Visalakshi, 2007). Plant extracts can be used as electrolytes because all plant materials contain various types of inorganic and organic electrolytic substances, absorbed through their root system and metabolic pathways (Datta *et al.* 2003). In the present investigation, aqueous extracts of *Aleo vera*, *Ficus religinosa*, *Azadirachta indica* and *Bauhinia tomentosa* were used to check the electricity potential properties such as conductivity and voltage. It has been observed that *Ficus* has more conductivity compared to other leaf extracts. As presented in Table 1, Neem has more conductance (1.4 ohm^{-1}) in comparison to *Aleo Vera* (1.3 ohm^{-1}) and *Bauhinia tomentosa* (0.5 ohm^{-1}). *Aleo vera* registered higher voltage when compared to the other three plants, as shown in Fig. 6. The *Bauhinia tomentosa* extracts showed very low voltage potential. According to computational biology, understanding the concept of biomolecules and their interaction modeling behind the cellular and electronic level stimulates the diffusion of electrochemical gradient across the cell membrane based on the presence of protein, lipid and carbohydrate groups (Pengyu *et al.* 2012).

Table 1. Conductivity potential of plant resources

Plant name	Part	Conductance
Aloe vera	Leaf – small	0.9
	Leaf – large	1.3
Ficus	Leaf	1.1
Neem	Leaf	1.4
Bauhinia	Leaf	0.4
	Flower	0.5

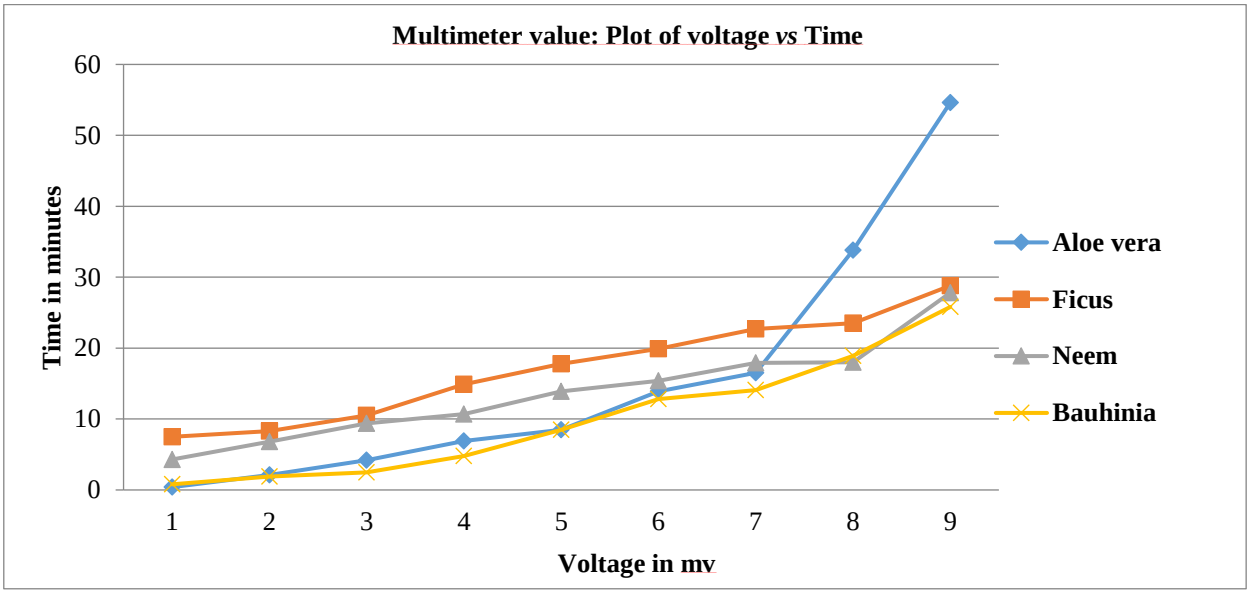

Fig. 6: Voltage *vs* Time plot

5. CONCLUSION

The shortcomings of the non-renewable and conventional energy sources like fossil fuels which are, being depleted, posing major threats of global warming and pollution, inspired the authors to conduct this research on generating electricity from aqueous extracts of different plant resource; some basic parameters such as conductance and voltage were investigated for various plant resources. It has been proved the plant extract has a marked potential to generate electricity due to the presence of biomolecules and metabolites such lipids, proteins, carbohydrates, phenolic compounds, which are responsible for acting as electrolytes for the development of voltaic cell system. Further research in this direction will yield efficacious ways for renewable and eco-friendly energy generation.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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