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Assessing The Change In Voltage In Citric Fruit Lemon Due To Ageing

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Abstract: *In this study citric fruit lemon was used for generation of electricity. The lemon fruit can be used as such or in crushed form. In order to achieve higher voltages, we connected more number of fruits in series. For higher magnitude of current we have to connect lemon in parallel and for increased voltage and current we have to connect lemon in series parallel combination. Here we used citrus fruits, wires and electrodes for performing the experiment. The out is connected to LED to check the output. Output voltage is measured in various conditions using Multimeter. The various conditions under study are raw lemon, ripe lemon, aged lemon. The assumption was due to ageing the magnitude of voltage and current decreases. It is found that raw and ripe lemon gives better output voltage compared to aged lemon. More the age of the lemon lesser is the magnitude of voltage. This method can be used not only for power generation using citric fruit lemon but also after power generation it can be used as natural manure. More over this method does not cause any pollution or global warming. As the magnitude of the current and voltage is small the output can be used for working of devices which operates in low voltage and current thereby reducing the usage of pollution causing batteries.*

Keywords: Bioelectricity, Lemon fruit, Ageing effect, Voltage magnitude.

I. INTRODUCTION

Voltage is referred as the potential difference between two points and current as the flow of electrons[5]. Electricity is produced due to electrochemical reaction. The chemicals present in citrus fruit act as electrolyte. The acid present in fruit is similar to acid in the cell. In a battery or wet cell there is negative and positive electrode with an electrolyte. The juice of citric fruit act as electrolyte as it is acidic in nature. Higher the acidity higher is the voltage. Size of fruit also affects generation of current as the citric acid inside the fruit is more for larger fruit [2].

The value of pH of different fruits are different. More the acidic lesser will be the pH Fruit which is more acidic is best suited for power generation. Lemon, orange, grapes etc. are the commonly available fruits. Lemon is having twice the citric acid compared to grapes and five times compared to orange. The pH value of citric juice in Lemon is 2 to 3, grape is 3.38 and orange is 4.35. So Lemon is best suited for the study as it is more acidic which is required for power generation to act as a cell electrolyte.

Citrus fruit lemon is the third highly grown fruit crop in India, South East Asia and China. During the early raw and overaged stage of lemon the accumulation of juice and water content will be less. Also acidity of lemon will be less during early raw stage of lemon, increases as the lemon ripe and decreases as it gets overaged [3]. For the lemon to act as a cell electrolyte the acidity should be more with sufficient juice for easy movement of ions. The used lemon or bio-waste is ecofriendly and can be converted to natural manure [6].

For current to flow we have to connect two electrodes to the fruit so that it comes in contact with the citric juice. For good electrical conductivity the juice of lemon plays a vital role. The two electrodes should be opposite to each other and should not touch each other. Using connecting wires and LED lamps we can complete the circuit and check the flow of electric current from glowing lamp. Glowing lamp indicates generation of electric current. To measure the magnitude of voltage and current connect Multimeter across the lamp [4].

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It is safer to use Copper and Zinc or Copper and galvanized iron as electrode for better power generation. Also it is readily available and cost efficient compared to other electrodes. More over in most of the experimental setup and study conducted it was found that Copper and galvanized iron or Zinc is best suitable [1].

In the study we have assumed ripe lemon gives higher voltage, as lemon gets over aged the voltage developed decreases and to get higher voltage lemon has to be connected in series. For conducting the experiment Copper and galvanized iron was used as electrode and the three stages of nearly same size lemon was used namely raw lemon, fresh ripe lemon, slightly over aged lemon, moderately over aged lemon and highly over aged lemon. The temperature and distance between the electrodes was kept constant.

II. Materials and Methods

2.1 Materials

Lemon, copper electrode, galvanized iron electrode, connecting wires, knife, Multimeter, LED bulb and alligator clips were used for conducting the experiment.

2.2 Methods

For the experimental procedure we selected three types of lemon of nearly same size. The lemon selected were raw, ripe and over aged ones. Three overaged lemon of different age was used keeping the size nearly same. The selected citric fruit lemon was cleaned and pressed slightly so that juice gets loosen for efficient ion movement. The lemon used was cut for inserting electrode. Special care was taken to keep distance between electrodes to avoid short circuit. The electrodes were kept opposite to each other and LED/ multi meter is connected using connecting wire and alligator clips. As the circuit was complete and closed one current started flowing showing voltage in the multimeter. The experiment was repeated for three stages of lemon namely unripe, ripe and over ripe. For testing current in over ripe three over ripe stages were considered namely less over ripe, moderately over ripe and highly over ripe. As the study conducted was on different stages of lemon we kept the size of fruit, electrode, temperature of experimental setup and distance between the electrodes as constant or same (Figure 1).

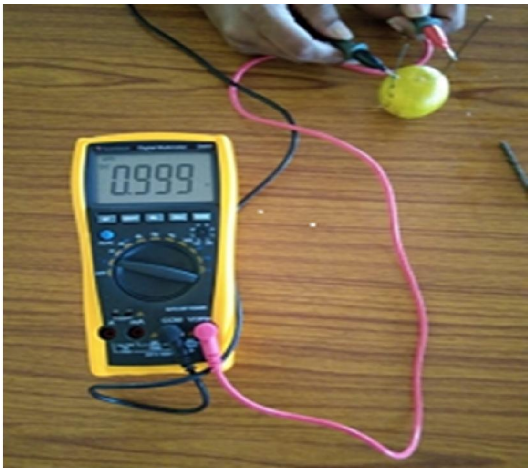

Figure 1: Experimental setup and measurement of voltage

III. Result and Discussions

The experiment setup and measurement is shown in figure 1.In the figure the value of voltage obtained for ripe lemon measured using multi meter was shown. The same procedure was used for measuring voltage of all stages of lemon. Voltages for various stages of lemon was measured using the experiment setup and the result is shown in table 1.

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Table 1: Experimental result

Case	Number of Lemon	Stages of Lemon	Average voltage developed (Volt)
1	1	Raw	0.973
2	1	Ripe	0.999
3	1	Slightly overaged	0.724
4	1	Moderately overaged	0.644
5	1	Highly overaged	0.599
6	2	Raw lemon in series	1.65
7	2	Ripe lemon in series	1.67

For all cases the electrode, size of the lemon and distance between the electrodes was kept as constant. In order to understand the effect of life of lemon on voltage developed the percentage change in voltage developed for all the cases considering ripe lemon as standard as it gave maximum voltage when connected alone.

The voltage developed and percentage change in voltage with respect to single ripe lemon is shown in figure 2. In figure 2, series 1 and 2 represents percentage change in voltage w.r.t voltage developed in ripe lemon. The histogram 1 to 6 represents values of voltage and percentage voltage change due to raw lemon, slightly overaged, moderately overaged, highly overaged, two raw lemons in series and two ripe lemons in series respectively.

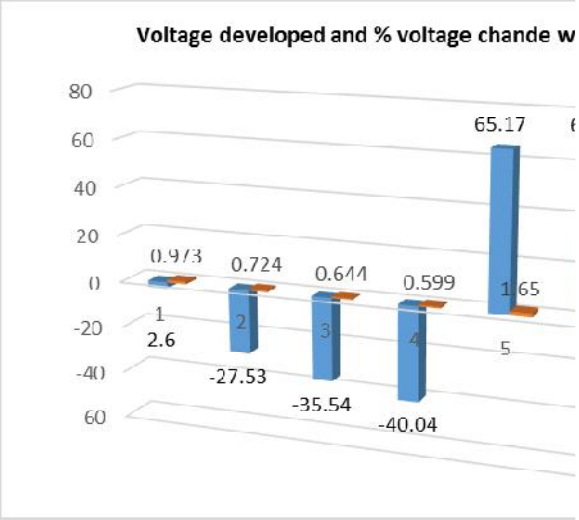

Figure 2: Graphical representation of voltage developed and percentage change in voltage.

It is clearly seen that more voltage is obtained if we connect lemon in series and its magnitude is 1.67V which is more than single ripe lemon and percentage increase is 67.17%. When two raw lemons were connected in series the voltage obtained was 1.65Vwhich is more than single ripe lemon and percentage increase in voltage is 65.17%. For single raw lemon the voltage is 0.973V which is less than single ripe lemon and the percentage change is -2.6%. Slightly overaged, moderately overaged and highly overaged lemon gave 0.724V, 0.644V and 0.599V respectively which is less than single raw and ripe lemon. The percentage change in voltage of slightly overaged, moderately overaged and highly overaged lemon are -27.53, -35.54 and -40.04%. As age of lemon increased the developed voltage decreased.

IV. Conclusion

Lemon was selected for the study as it was more acidic citric fruit compared to other readily available citric fruits. Throughout the study the parameters kept constant were size of the lemon, electrode, distance between electrode and temperature of experimental setup. It was found that fresh ripe lemon gives higher voltage compared to raw and overaged lemon. The voltage developed in raw lemon was more compared with overaged lemon. From the analysis of

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voltage developed in slightly overaged, moderately overaged and highly overaged lemon it was found that as age increases the voltage developed decreases. So we can conclude that during early raw stage of lemon and overaged stage the accumulation of juice and acidity of lemon is less. This decrease adversely affects in flow of current and value of voltage when lemon act as cell electrolyte. For better current and hence voltage lemon should be more acidic and it was more acidic in fresh ripe stage. In order to get higher voltages, we connected more number of lemon in series. Maximum voltage was obtained when fresh ripe lemon was connected compared to other stages of lemon. The main advantage of lemon as a cell compared to low voltage battery, it was environmental friendly and does not produce greenhouse gas or causes pollution. The used lemon was a good source for bio-waste.

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