TUBERS: ECO-FRIENDLY BATTERY

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ABSTRACT

The research aimed to determine alternative sources of an eco-friendly battery out of tuber crops that can supply electrical energy. This was conducted as a response to the thrusts of the University on environmental stewardship and served as an initiative to help alleviate economic crises in general. More specifically, the limited importation of commercialized batteries calls for the utilization of locally available raw materials as possible substitutes. The use of the tuber crops as sources of electrolyte to power-up an eco-friendly battery is very important due to increasing demand for battery. The presence of alternatives found in natural resources is needed to reduce or eliminate the use of synthetic electrolytes found in commercialized batteries such as titanium, lithium, and nickel-cadmium. These electrolytes are considered heavy metals that are toxic and can pose environmental concerns. The tuber crops consist of cassava or kamoteng kahoy (Manihot exculenta Crantz), sweet potato or camote (Ipomoea batatas L.), taro or gabi (Colocasia esculenta), ginger or luya and potato or patatas (Solanum tuberosum L.). These tuber crops are good sources of electrolytes. However, they will produce only small amount of energy. It cannot support any electrical device that requires a high amount of electrical consumption because it only generates a small amount of voltage. Their life span also depends on their freshness or how long they have been harvested. The power efficiency output of the tuber crops could be affected by several factors like size and the form when it was tested such as its juice and in osteorized form and the electrical device rate of power consumption. Tuber crops are only designed for small energy consuming devices. Hence, this study aimed at developing alternative sources of electrolyte found in tuber crops that would aid in the generation of electrical energy to power-up an eco-friendly battery.

Keywords*: Tubers, Eco-friendly battery*

INTRODUCTION

Last school year 2012- 2013 first semester, the of Bachelor of Science in Electronics Communication and Computer Science (BSEECS) 5th-year students of St. Paul University Philippines (SPUP) Tuguegarao City, Cagayan, had their project implementation under Engr. Norman G. Tallud as their adviser. One of the projects to be implemented was the “Potato Battery in case of Calamity.” This project was conceptualized by four male students and a female student in the person of, Miss Pinky Berbano as the project leader. From the study, the group found out that potatoes can generate electricity. Thus it can run small devices powered by a commercialized battery. Considering the impact of the above-mentioned study, the researchers were inspired to enhance the “Potato Battery by considering plants within the family of Tuber crops. These tuber crops consist of Cassava or kamoteng kahoy (Manihot esculenta Crantz), Sweet potato or camote (Ipomoea batatas L.), Taro or gabi (Colocasia esculenta), Ginger or luya and Potato or patatas (Solanum tuberosum L.) as the baseline or control group/ subject of the study. Batteries have become a common power source for many types of equipment such as household, medical equipment, and industrial applications. Making electricity from chemicals is based on the same scientific principle on which all modern batteries work. They generate electricity through a chemical reaction between two different electrodes and one electrolyte. Use of Copper and Zinc electrodes and Sulfuric acid as electrolyte is a proven method for this process. This study would like to look into the above-mentioned tuber crops aside from potato as a source of electrolyte . The tuber crops which are the test subjects of this study has the same characteristics and nutritional values like the Potatoes. They contain vitamins, minerals, and phytochemicals. They are best known for their carbohydrate content. The predominant form of this carbohydrate is starch. Starch is a carbohydrate consisting of a large number of glucose units joined by glycosidic bonds. This polysaccharide is produced by all green plants as an energy store. Tuber crops battery is an electrochemical battery or an electrochemical cell. An electrochemical cell is a cell in which chemical energy is converted to electric energy. This is achieved when spontaneous electron transfer is occurring.

The common battery or the commercialized one contains synthetic electrolytes such as titanium, lithium, and nickel-cadmium. These electrolytes are considered heavy metals and known to be toxic. These commercialized batteries are one of the composition of electronic wastes or E-wastes, when discarded they pose environmental concerns. Considering the importance of environmental preservation, it is in this context that the researchers were impelled to study possible tubers as alternative sources of eco-friendly battery.

Statement of the Problem

The project aims to develop alternative sources of an eco-friendly battery out of tuber crops that can supply electrical energy.

The researchers answer the following problems:

1. What are the possible tuber crops that can be used as alternative sources of an eco-friendly battery?

2. What is the extent of efficiency of the identified tuber crops being used as possible alternative sources of electricity?

3. What is the volume of the identified tuber crops being used as an alternative source of electricity?

4. What is the possible voltage that can be derived from the identified tuber crops with regard to its volume?

5. Which among the identified tuber crops produce high voltage and amperage using the same volume?

6. Is there a significant difference of using processed with respect to solid form of the identified tubers in producing voltage and amperage?

METHODOLOGY

The method used in this study is the experimental method of research. It has been used to observe the efficiency of the tuber crops, and to be able to identify the factors that can hamper the production of electrolyte from the tuber crops which will hinder the electrical flow. The sources of energy are not only from fossil fuel, coal and renewable sources or energy such as solar, wind, and wave. In this experiment, the researchers created a chemical r eaction between the phosphoric acid content of the tuber crops as an electrolyte and the two metals zinc and copper as the electrode to create electrical energy - enough to power a small light and other small battery operated devices.

In addition, one of the great advantages of the tuber crops, they are abundant in all tropic countries just like the Philippines. The by-product of the Tuber crop battery is environment friendly. Likewise, tuber crops if given opportunities will be considered as high-value crop that will help alleviate poverty.

Experimental Design

The Tuber crops are expected to supply electrolyte that will aid in the production of electricity into a device using Tuber crop eco-friendly battery. The maximum voltage is rated in 1.5V in every one piece of Tuber crop . The zinc-coated nail and the copper wire are inserted into the Tuber crop which is connected in series to generate the desired voltage that will be used to power-up, act as battery to the devices which will be tested .

Materials

Name	Complete Description	Unit	Quantity
(Tuber crops) *Cassava, Sweet Potatoes, Ginger and Taro(gabi)*	Medium sized; Clean, Fresh, whole/slice, ground/juice	pc	1 each
Weighing scale	Digital	pc	1
Blender		pc	1
Connecting wire	With alligator clips	pc	5
Nail	Zinc coated	pc	4
Copper	Wire, 3 inches long	pc	4
Multimeter/Voltmeter	Milliampere	pc	1
Spatula	Metal	pc	1
Knife	Sharp	pc	1
Containers	Test tubes/beaker or equivalent	pc	8

Circuit diagram

Figure 1: Series connection in lighting the LED

Figure 1 illustrates the main structure of the connection of the devices or materials used in the project. It shows the flow on how the Tuber crop generates current in the circuit connection. The tuber and the electrodes generate a chemical reaction that causes current to flow. The tubers like the potatoes are connected in series to produce much voltage that would light the device work.

Figure 2: Diagram showing the Measurement of the Voltage Generated

The measuring of the produced voltage is discussed in this section, and to be able to understand more on how to do it, a schematic diagram is shown in figure 2. It explains how to measure the voltage produced by the tuber battery.

The copper wire represents the positive terminal of the device, and the galvanized iron nail represents the negative terminal of the device. The polarity is important because this determines the Direct Current (DC). Afterward, the negative terminal of the probe is connected to the galvanized iron nail and the positive terminal probe to the copper wire. One has to make sure that the multimeter is in DC voltage setting. The more tuber battery connected in series, the more voltage the tuber battery will produce.

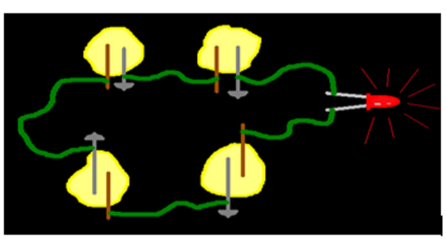


Figure 3: Schematic Diagram of the Connections of the Potato Battery

Figure 3 shows the schematic diagram of the connection of the tuber Battery as it produces current. Construction and Development.

This section discusses the procedure of the experiment. The things the researchers did were the following:

All the materials needed for the project were bought and gathered together. Galvanized iron nail and the copper wire were used as battery terminals. The galvanized iron nail and the copper wire were inserted in such a way that they become very close together but without touching each other. Using the connecting wires, the galvanized iron nail was connected to the copper wire in another tuber crop like the cassava, and it created a series (See figure 3). The two ends of the copper wires were connected to the Multimeter/voltmeter that is set in DC volt setting. The voltage of each variety of tuber crops at an average of 1.6 volts per variety of the same size. Finally, a low voltage analog clock was connected to the positive and negative terminal of the series connected tuber crops.

TESTING, OBSERVATION AND RESULTS

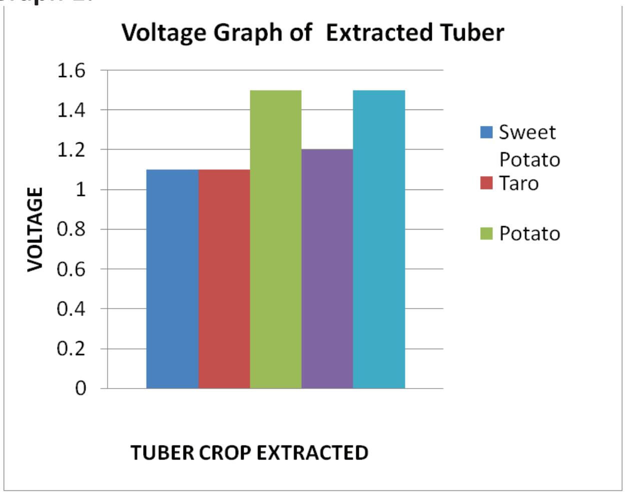
During the experimental period of the study, several test and observation were made to determine the performance of the project. The results were recorded and analyzed for the improvement of the project.

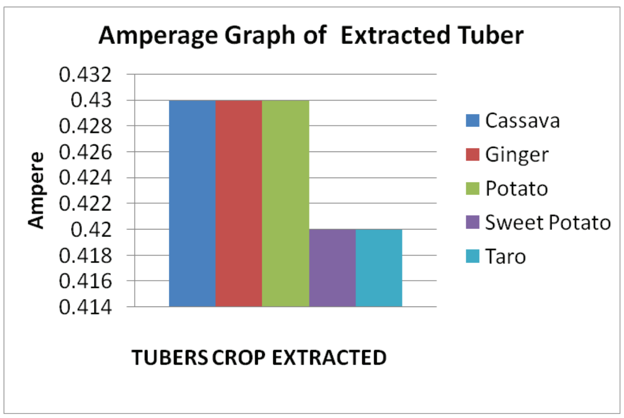
TEST 1: The researchers had their first testing on June 29, 2013, the ability of the following using extracted tuber crops with volume equal to 50 ml; Cassava, Sweet Potatoes, Ginger, and Taro, were compared to the ability of the potatoes being the control tuber, were tested and they all generated electricity. The circuit was made to see if all the tuber crops identified produced electricity. The researchers used digital analog clock as their testing device.

Observation: The LED bulb worked properly with four whole potatoes but did not work when the potato was less than four. However, the light in the Lamp Shade was fluctuating with seven potatoes.

Results: The amount of the voltage generated by the potato battery must be equal to the amount of voltage required by the device to work well.

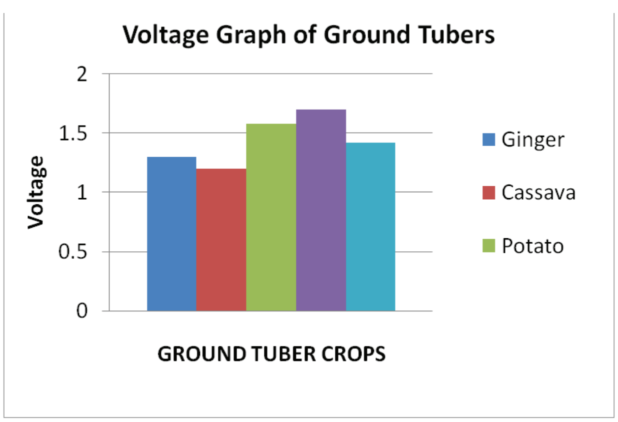
Graph 1:

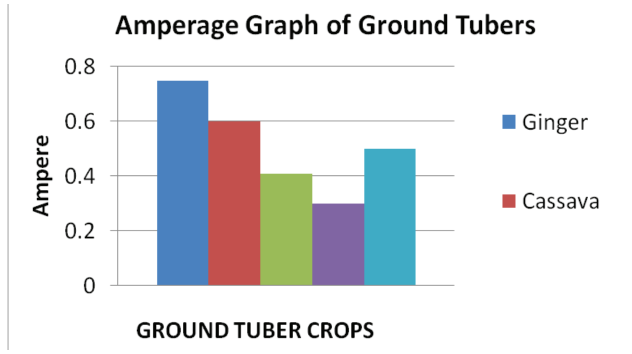




TEST 2: The researchers tested the device again after a week by using ground tuber crops with different weights to see if the analog clock worked properly this time.

Weights of Ground Tubers
Ginger= 123.15 grams, Potato = 325.10 grams
Cassava= 231.50 grams, Taro = 231.50 grams,
Sweet potato = 412.25 grams





TEST 3: Last October 2013, the project was tested in its duration of powering the digital clock. In the next page, Table 3 shows the duration when the battery worked.

Observation: The digital clock worked with extracted and grounded tuber crops with a fluctuating voltage averaging to 2.1 volts.

CONCLUSIONS

The voltage appearing on the tuber crops depends on the given tuber protein and the kind of terminals used like galvanized iron nail and copper electrode. The tubers contain phosphoric acids which cause a chemical reaction between the two terminals. This causes an excess electron to flow from the galvanized iron nail, and when a wire is connected to it, then electrons will flow.

This flow of the electrons is the electrical current that makes the digital clock function. The theory is that the phosphoric acid in the tubers would react with the zinc on the galvanized nail and react with the copper on the copper electrode to produce enough electricity to make the digital clock work. The tuber battery would produce 1.65 volts, which is almost the same as any AA sized battery and able to produce enough electricity to make the clock work.

RECOMMENDATIONS

This project was effectively and efficiently made and designed that the designer would like to recommend the following:

1. Further screening of the extract should be done to determine the bioactive compounds present in the identified tubers.

2. Further studies to enhance the project.

3. Further studies using other tubers.

References