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Producing energy using fiber plants as an alternative source of battery

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Abstract

The study aimed to investigate the feasibility and effectiveness of utilizing fiber plants as an alternative source of energy for electricity production. The study utilized true-experimental design highlighting pretest-posttest control group design which centered on the effectiveness of using fiber plants as an alternative source of energy. The study utilized self-structured instrument measuring the produced energy from each fiber plant and cumulative energy produce of different terminal sources from different electrodes. Fiber plants are underwent washing, chopping and blended into a fiber plant mixture. Fiber plant mixture is sun-dried, squeezed and extracted. The analysis involves both qualitative and quantitative aspects such as recording and comparing the energy produced by different plant and their efficiency in powering LED bulb. The results showed that it could light up bulb up to four (4) volts using four (4) 250 ml electrode increasing the energy produce by increasing the number of terminal sources. Fresh fiber plants can produce high energy while a decrease of energy produced was recorded as length of time increase from the fiber plants harvest. However, this shows significant relationship of the number of sources and to the amount of each fiber plants.

Keywords

Alternative energy,
alternative battery,
energy,
fiber plant
LED bulb

Introduction

In the production of electricity as an alternative energy source from fibrous plants, the properties of certain plant fibers were used to generate energy from mechanical vibrations and stresses, which could provide an ecological and sustainable energy solution. As well as the natural fibers were readily accessible materials that were environmentally friendly and offered benefits such being affordable, light, renewable, biodegradable, and having high specific characteristics. An official report by the International Energy Agency (IEA) indicated that the demand for fossil fuels to produce electricity had begun to decline since 2019, alongside an

increase in the use of renewable energy to meet global energy needed. Nowadays, more sustainable energy technologies were required to replace conventional electricity generation resources such as fossil fuel, due to the worldwide demands especially in developed and developing countries.

Growing interest in using fiber plants as an alternative source of power was a result of the rising worldwide demand for clean, renewable energy sources. Therefore the created composites had a light transmission rate of more than 90%, and their tensile performance was comparable to that of composites made from synthetic fibers Ravindran(2023). While in the article eia(2023) stated that nearly 4.24 trillion kilowatt-hours (kWh) of energy were produced by utility-scale electrical producing facilities in the US in 2022, which was 4,243 billion kWh. This power was generated using fossil fuels, such as coal, natural gas, petroleum, and other gases, to the tune of about 60%. Nuclear energy accounted for around 18% of the total, while renewable energy sources made for about 22%. However this approach held promised several significant challenges and issues needed to be addressed to ensure its viability and effectiveness. The researchers IIT(2018) stated that living plants were truly "green" energy sources: They could generate more than 150 volts from a single leaf, enough to power 100 LED bulbs simultaneously which could save people in higher cost and as well as it had a pollution free and environmental friendly. Therefore the Ormoc City government in Leyte had adopted an official policy to develop renewable energy (RE) within its jurisdiction and encouraged the entire province to implement this policy Rivera (2022). Natural fibers were renewable materials that were found in nature and had benefits including low cost, light weight, renewable qualities, biodegradability, and high specific properties. (Mater, 2019).

Meanwhile, PMC (2019) established that electrical energy could be extracted from live plants, making this a possible renewable energy source for recharging or replacing batteries in remote locations for wireless devices. The use of specific plant fibers to exploit vibration and mechanical stress to produce electricity from fiber mills offered a viable green and sustainable energy solution. Accessibility and properties The environmental friendliness of natural fibers, combined with their affordability, lightweight properties, renewable properties, biodegradability and impressive properties made them an alternative energy source promising. As the demand for fossil fuels declines and the use of renewable energy increases, it was imperative to explore sustainable energy technologies to replace conventional electricity generation methods. However, although promising, this approach faced significant challenges that required careful consideration to ensure its feasibility and effectiveness. Research had shown that living plants had the potential to serve as a "green" energy source by generating significant voltage, a potential that had sparked policy initiatives such as those in Ormoc City, Leyte. Additionally, the beneficial and renewable properties of natural fibers and their ability to derive electrical energy from living plants offered opportunities for a variety of applications, including remote charging of batteries and devices wireless.

1.1 Study objectives and hypotheses

This study aimed to investigate the feasibility and effectiveness of utilizing fiber plants as an alternative source of energy for electricity production. More so, it aims to determine the amount of energy produced by each fiber plant and record the cumulative energy produced from different terminal sources to light up LED bulb up to a significant length of time.

1.2 Scope and delimitation

The study centered on the determining the feasibility of utilizing fiber plants as alternative energy source. The fiber plants include aloe vera, orange, lemon and banana. The primary aim of the study is to determine the cumulative energy produced of fiber plant extracts at different terminal sources. Moreover, the duration of the energy produced to a LED bulb is determined.

2. Literature Review

The fiber plants are *Aloe vera*, banana peel, lemon, orange peel, and pineapple that can produce electricity, there are literatures proved that this fiber plants can produce electricity. The contents on National Institutes of Health (2019), this experimental results show that aloe vera electrical energy can produce 3.49 V and 1.1 mA, which can be channeled to a power management circuit for 10.9 V under no load. This energy can activate a temperature and humidity sensor, proving its potential of Internet of Things (IoT) wireless sensor networks. In addition, Chong et. Al (2019) characterization of aloe barbadensis miller leaves as a potential electrical energy source with optimum experimental setup conditions revealed that aloe vera can generate 1111.55uW of electrical power with 24 electrode pairs, which can be stored in a capacitor for low-power consumption devices. Moreover, the tropical desert plant (*Aloe-vera*) is a natural bio-organic material used to convert waste mechanical energy into electrical energy. The piezoelectric force microscopy measurement of AV film confirms its ferroelectricity, with a converse piezoelectric coefficient of 6.5 pm V−1. The piezoelectric AV film-energy harvester (AV film-EH) generates a peak-to-peak output response of 1.2 V, 20 self 0 nA, and an instantaneous peak power of approximately 0.42 μW. The AV film-EH can also be used as a -powered finger monitoring sensor and powering a smartwatch (Nano Energy, 2020).Furthermore, *Aloe vera* produces voltage that can be amplified to light an LED. Aloe Vera plants can grow in deserts and withstand temperatures ranging from 104°F to freezing. They harvest energy through photosynthesis, converting it into food and oxygen. Ionic current in the plant detects small voltage, which can be amplified to light an LED or bulb (University of Delhi, 2023).

Elviliana, et.al (2018), the study investigated the potential of banana peel waste and orange peel waste as feedstocks for microbial fuel cells (MFCs). The results showed that orange peel waste contained higher organic materials and produces electricity with slightly different amounts. The study confirmed that the organic content of substrates and microbial activity influence the electricity produced from MFCs, making them a promising green technology for renewable energy sources the study investigated the potential of banana peel waste and orange peel waste as feedstocks for Microbial Fuel Cells (MFCs). The results showed that orange peel waste contains higher organic materials and produces electricity with slightly different amounts. The study confirmed that the organic content of substrates and microbial activity influence the electricity produced from MFCs, making them a promising green technology for renewable energy sources. On the other hand, bioethanol production from banana peels. The bioethanol production was found to be dependent on the pretreatment of water, acidic, and alkaline conditions, with concentrations ranging from 40 to 80 ppm (Danmaliki et al., 2016; Aziz et al., 2019).

Buddies & Buddies (2020) found out that batteries store chemical energy, which can be converted into electricity through electrochemical reactions. The battery created has copper and aluminum electrodes separated by lemon juice. The electricity flows from one electrode to the other using aluminum strips. Connecting the battery to a body part can cause a tingling sensation in sensitive areas like the fingertip or tongue. The aluminum strips' contact creates an easy path for electricity to flow, eliminating the sensation. In addition, Açıkalın, K. (2021), the study involved students creating a voltaic battery using potatoes or lemons. Both contain acids, with lemons being mostly citric and potatoes being mild phosphoric. The positive and negative terminals are created by placing two metals, zinc and copper, as electrodes. The cathode gains electrons, while the anode releases them. The study demonstrated that a potato can produce one volt and a lemon can produce 0.7 volts. Furthermore, the study involved students creating a voltaic battery using potatoes or lemons.

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The Global Energy (2021), Seville's municipal water company, Emasesa, has launched a pilot project to generate electricity from methane from abandoned oranges. The bitter oranges, previously used for livestock feed, perfume production, and cooking, are now used to produce biogas and electricity. The project powered Emasesa's water purification plant and the city's grid within two years. The project is expected to produce 1,500 kWh of power, enough to meet the needs of 150 households. Further, the study demonstrated the potential of orange peels as a renewable energy source (OSL Toding et al., 2018).

University of Colombia (2020)have discovered that the pineapple skin may be utilized as a source of electric, thermal, and bio-combustible energy. Because it includes acetic acid, ascorbic acid, citric acid, and glucose to produce energy, discarded pineapple peel is also acidic. Furthermore, the pineapple may generate an electric current, which is demonstrated by the existence of a voltage when detected by a voltmeter(Syahirah, 2021).

Related Studies

Azmi, et al. (2018) study the utilization of aloe vera extract as electrolyte , the study indicates the ability of aloe vera extract to function as an electrolyte for an accumulator the researcher found that aloe vera contains an acid that can generate electrical current. Furthermore, the experimental findings showed that aloe vera extract lacks a steady voltage and current value, suggesting that it could be used to reduce the amount of chemicals used in a typical electrolyte solution. Additionally, Sounder et al. (2022) studied the green electricity plant Aloe Vera, electricity from the plant is an eco-friendly electrical technology to create a new type of electrical battery using aloe vera gel. The researchers state that aloe vera is a very useful technology in the electrical field. It also comes from a new revelation in the field of electronics, on the other hand, it can create a battery with environmentally friendly products, a safe product that brings new exposure to electrical and electronic fields.

Segundo, et al(2020) stated that banana waste was used as the source of bioelectricity. The main goal of this study was to create bioelectricity from banana waste using a low-cost, lab-scale technique that produces the maximum current and voltage. The researcher gave thefruit a second use, which is advantageous for farmers and businesses involved in exporting and importing which can cut costs by using their own waste. More so, Arizona at Universities Islam Riau (2021) yielded the following outcomes: banana peel wastepaste demonstrated electrical conductivity, generating a voltage of 1.24 volts, and the bio battery crafted from banana peel exhibited a runtime of 16 hours; lemon has a voltaic cell that converts chemical energy into electrical energy as demonstrated by Mazumder et al. (2018). The lemon is an electrolyte or a substance that conducts an electric current which also notes that the lemon provides citric acid, and acids contain ions that transmit electricity (Gorski, 2023).

Victoria et al. (2020) using the qualities of oranges as a good power source of electricity, this study attempted to develop an alternative energy source. The fruit was pierced with nails to obtain juice from oranges. The cables for the LED bulbs were stripped of their insulation and the exposed wires were wrapped around the nails. An identical process was performed thrice with three different oranges. Nails composed of copper and zinc was used as electrodes in the battery. The copper and zinc nails acted as the anode and cathode, respectively, and the orange juice functioned as the electrolyte. The battery provided an adequate voltage after joining the individual orange batteries with a wire from the light bulb. This

voltage was sufficient to power the LED. Furthermore,, the results revealed that the orange peel had a pH of 3.8 and acidic qualities, allowing it to be employed as an electrolyte on batteries, with a resistor load mounting of 4.7 K, the electrolyte created by the orange peel generates a voltage of 0.81 volts and a high current of 0.049 mA (FahmiSalafa et al. 2020).

In study conducted by Putriirani, et al. (2018) revealed that the peel from a discarded pineapple may be used as a battery to light up the communities that were formerly dark. The leftover pineapple peel may then be utilized as a vehicle battery. Therefore, wasted pineapple peel may be converted into renewable energy and utilized as a source of electricity. However, Omar et al. (2023) proved that pineapple waste can replace fossil fuel electricity generation. Research showed that pineapple LCA produces fewer emissions for environment compared to conventional electricity production. However, fiberplants have the potential to be reliable substitutes for fossil fuels as sustainable and renewable sources of electricity. The growth and usage of fiber plants for the generation of electricity has the potential to offer a sustainable and eco-friendly alternative energy source with the ability to produce a sizable amount of electrical power while reducing greenhouse gas emissions.

The electrical qualities of fruit and vegetable waste, which include many electrolytes, can be exploited as a sustainable alternative energy source in the form of bio-batteries as a replacement for conventional batteries (Fauzia & Ashiddiqi, 2019).

2.1 Theoretical Background

The study was hinged on the position of Production, Alternative, and Energy Theory. Production theory provided a framework for examining the input-output connection in any manufacturing process, as stated by Charnes, Cooper, and Rhodes (1978).

Roger's Theory of alternatives, sustainable and unusual ways of producing power from fiber plants might eventually lead to more environmentally friendly as well as efficient energy solutions. On the other hand Joule's theory of energy, energy was only transferable from one state to another and couldn't be produced or destroyed. Production theory could be employed to gain insight into and facilitate the production of electricity through the use of fiber plants such as lemon, aloe vera, banana, orange, pineapple as a substitute energy source.

It could be used to evaluate the effectiveness and performance of a system. An alternative theory might be to use fast-growing fibers like aloe vera , banana, lemon, orange, and pineapple instead of traditional sources of energy, which could help reduce CO2 emissions and make energy production more eco-friendly. Additionally Alternative theory could be use to modern energy conversion technologies like microbial cells, which could use fiber plant waste to generate energy.

This theory looked at cutting-edge technologies that could makeVb energy production more efficient. Energy theory provided a scientific basis for understanding and optimizing the conversion of different types of energy. Energy theory could help guide us in the efficient use of energy stored in fiber plants and the conversion of this energy into electricity. Energy theory could provide a scientific basis for evaluating the feasibility and sustainability of an alternative energy source.

In order to evaluate the possibilities of employing fiber plants like lemon, aloe vera, banana, orange, and pineapple as an alternative energy source, this study drew on the production, alternative, and energy theories. Production theory provided a framework for assessing the efficiency and performance of systems and shed light on the input-output connection in energy production processes. According to the idea of Alternative, utilizing quickly expanding fibers and cutting-edge technology might result in more eco-friendly

and effective energy solutions, potentially lowering CO_2 emissions. The scientific basis for maximizing the conversion of energy stored in fiber plants into electricity was provided by energy theory, which also aided in determining the viability and sustainability of this alternative energy source. This work laid the door for a more ecologically friendly future by merging these notions.

2.2 Conceptual Framework

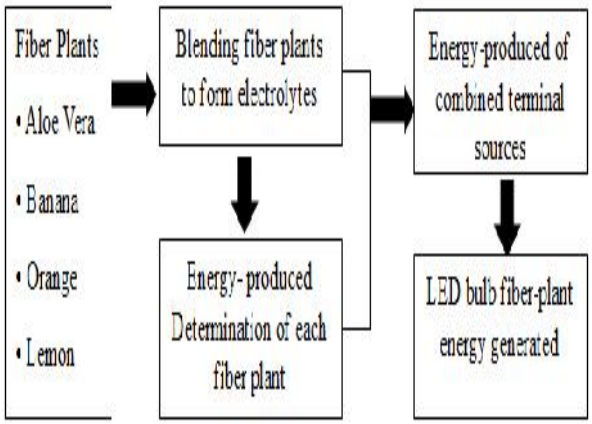

Figure 1. Schematic Diagram on the Framework of the Study

The conceptual framework of this study involved a series of steps. The experimental procedure involved determining the various fiber plants available in the locality as alternative sources of energy. They were examined on the energy produced by each fiber plant. Washing all fiber plants, then test each voltage then cut each fiber plants into pieces, then blending all fiber plants, after blending was sun drying after three (3) days of sun drying, squeeze the sun dried fiber plants and then its extract was place in a container with 500ml of fiber plant extract, after placing the extract of fiber plants was testing the amount produce of each container and in one container there were 1 volts. The cumulative energy-produced is determined to light up a LED bulb.

This study aimed to assess the efficiency of energy production using fiber plants as an alternative energy source. This comprehensive approach allowed for a systematic evaluation of alternative energy sources compared to current energy sources.

3. Methodology

3.1 Research Design

The study utilized true-experimental design highlighting pretest-posttest control group design which centered on the effectiveness of using fiber plants as an alternative source of energy. Primarily, the study aimed to evaluate the feasibility of producing electricity using fiber plants as an alternative and sustainable source of energy. Furthermore it involved two groups, the experimental group and a control group and both were tested before and after the introduction of the experimental treatment. This design allowed for a reliable comparison of the impact of the treatment on electricity production

3.2 Research Locale

The study was conducted in the Barangay New Pilar, Abuyog, Leyte, Philippines. New Pilar was relocated and was in closed proximity to Barangay Tinalian, Abuyog, Leyte. It was approximately 15 kilometers away from the heart of the municipality where abundance of fibrous plants was highly observed. Moreover, a significant proportion of 0.07% of the household of the locality had limited access to electricity. Significantly, the residents of the said locality were survivors of catastrophic event. Hence, a gradual decrease of electricity bill statistically significant when viability of alternative energy source was feasible.

3.3 Subject of the Study

The subject of this study was the LED light bulb. Subjects were purposively chosen relative to the energy produced by fiber plants mixture. Moreover, energy consumption of each LED bulb was pre-determined. Consequently, a combined voltage of energy produced by fiber plants' mixture was determined to compliment the needed energy source to function the subjects.

3.4 Research Instrument

The study utilized two sets of research instrument, the first instrument was a self- structured instrument aimed of measuring the produced energy from Fiberplants. It was a quantitative matrix tool which compared energy produce from each fiberplants. The second set of instrument was also a self-structured tool to measures the complimented energy produce needed to function light LED bulb.

3.5 Data Gathering

The researcher furnished a letter request to the Captain of Brgy. New PilarAbuyog, Leyte,Philippines to conduct the experiment. Upon approval, the researchers started to prepare needed materials for the experimentation. Research experiments were administered personally by the researchers. Fiber plants were pre-determined as variables of the study. Collection of materials needed followed upon identifying fiber plants. Fiber plants were washed andtested its energy content after cutting them into pieces. Crashed fiber plants are then blended and sun dried for Fiber plants extract was then placed in a four (4) 500 ml which recorded the energy produced from each terminal sources.

Researchers examined on the energy produced by each fiber plant. Energy produced was recorded on the first self-structured instrument utilized. Moreover, fiber plants were being blended and mixed with the other potential energy producing plants. Energy produced from the mixture was then recorded. A comparative analysis from the data gathered on the prime step was conducted.

To determine the efficiency of the energy produced, the researcher investigated the length of time and the kind of the appliances were able to function using the alternative energy. This approach allowed a systematic evaluation of alternative energy sources comparable to the usual energy source used by the household.

3.5 Data Analysis

The data analysis described in the text appeared to be a combination of both qualitative and quantitative analyses. Researchers had conducted experiments to evaluate alternative energy sources, particularly the energy produced by various fiber plants, and compared them to the energy from conventional sources. This analysis involved both qualitative aspects, such as the identification and collection of materials, and quantitative aspects, such as recording and comparing the energy produced by different plants and their efficiency in powering appliances. It could be characterized as a mixed-methods data analysis approach that incorporated both descriptive and numerical data to assess the viability of alternative energy sources.

4. Results and Discussion

4.1 Amount of Energy Produced by each Fiber Plants

The amount of energy produced by each fiber plant is measured after rigorous experimental process. Washed fiber plants were tested its energy content after cutting them into pieces. Crashed fiber plants are then blended and sun dried for two (2) days. Fiber plants extract was then placed in a four (4) 500 ml which recorded one (1) volt from each container.

Table 1. Amount of Energy Produced

Fiber Plants	Amount of Energy Produced (*in Volts*)
Lemon	0.966
Aloe vera	0.950
Orange	0.950
Banana	0.894

The table depicts that lemon extract has 0.966 volts which is the highest energy producing fiber plant among others. Mazumder et al. (2018) lemon has a voltaic cell that converts chemical energy into electrical energy. In contrary, Açıkalın (2021) demonstrated that lemon can produce 0.7 volts. Lemon has a higher amount of energy

produced due to acid content, and mostly citric produce a higher amount of electrodes. On the other hand, banana has the least energy produced. Segundo et al. (2020) concluded that bioelectricity from banana waste using a low-cost, lab-scale technique produced the maximum current and voltage. More so, the study of Arizona at Universities Islam Riau (2021) yielded the following outcomes: banana peel waste paste demonstrated electrical conductivity, generating a voltage of 1.24 volts, and the bio battery crafted from banana peel exhibited a runtime of 16 hours.

4.2 Comparative Amount of Energy Produced from Terminal Sources

LED bulb is the best option for lighting fiber plants. LED bulb is the recommended option because of their energy efficiency, low heat emission, and capacity to tailor the light spectrum to the particular requirements of plants. They are also well-suited to the particular requirements of fiber plant cultivation. Furthermore, LED lamps performed better than incandescent lamps. The efficiency of LED technology, which is characterized by reduced energy usage and low heat output, is in perfect agreement with the requirements of fiber plants. The adaptability of LED bulbs enables them to produce light spectra that can be customized, increases their appropriateness, and offers a customized lighting solution that promotes the best possible growth and development.

Table 2. Comparative Amount of Energy Produced from Terminal sources

Fiber Extract	Amount of Energy Produced (*in Volts*)
250 ml electrodes (Single Source)	1.5
500 ml electrodes (Single Source)	1.2
500 ml electrodes (4 termianl Source)	7.2

In this table, energy produced in any terminal sources it is not the amount of fiber plants produce but the number of terminal sources. In contrary, Ravindran (2023) created composites of light transmission rate of more than 90%, and their tensile performance was comparable from synthetic fibers. In addition, living plants were truly "green" energy sources; they could generate more than 150 volts from a single leaf, enough to power 100 LED bulbs simultaneously which could save people in higher cost and as well as it had a pollution free and environmental friendly.

The significance of the study lies in exploring the electricity-generating potential of various fiber plants, including lemon with a voltage of 0.966 volts, Aloe Vera with 0.950 volts, Orange with 0.956 volts, and Banana with 0.894 volts. By understanding the voltage output of each plant and combining them, researchers can assess their collective contribution to generating 5 volts of electricity. This information could have implications for sustainable energy sources and alternative power generation methods.

4.3 Duration of Consumed Energy in LED Bulb

The result shows that the alternative source of electricity from mixed fiber plants, including *Aloe vera*, banana, lemon, and orange, can last approximately 40 minutes using LED bulbs and produce an output ranging from 3 to 5 volts.

5. Summary of Findings, Conclusion and Recommendations

5.1 Amount of Energy Produce by each Fiber Plants

The findings on energy produced by each fiber plants showed that banana has a 0.894 volts indicating that it has a “moderate” capacity for energy generation. In contrary, *Aloe vera* showed a slightly higher voltage of 0.950 volts, indicating a potential for improved energy yield per fiber compared to banana. Lemon and orange plants displayed even higher voltage results, with 0.966 volts and 0.956 volts, respectively, suggesting that these citrus fruits may have a more substantial capacity for energy production per fiber compared to banana and *Aloe vera.*

5.2 LED Bulb (3 volts) Light Characteristics and Duration of Energy Produced

To test the efficiency of energy produced by each fiber plants in using LED bulb, showcasing the ability to light using the energy produced by a fiber plants. In the study using the energy produced by a fiber plants into a LED bulb, it has the efficiency to light the bulb averaging of 3 volts. Additionally, the study showed that the light of the LED bulb has the same light to the normal bulb. In 40 minutes, the light of the bulb has turned deem until it turns off.

5.3 Cumulative Energy Produced from Fiber Plant Extract

The significance of the study lies in exploring the electricity-generating potential of various fiber plants, including lemon with a voltage of 0.966 volts, Aloe Vera with 0.950 volts, Orange with 0.956 volts, and Banana with 0.894 volts. By understanding the voltage output of each plant and combining them, it could be assessed that the collective energy generated ranges 7.2 volts. This information could have implications for sustainable energy sources and alternative power generation methods.

5.4 Conclusion

Fiber plants are potential energy producers. In the study, it showed that it could light up a 3 – volts LED bulb using four 250ml electrodes. The duration of fiber plant extracts decreases the amount of energy produced. Moreover, increasing the volume of the electrodes decreases the amount of energy produced. More so, fresh fiber plants produced high energy. However, the number of terminal sources of different volume increases the amount of energy produced. Thus, terminal sources equate higher energy generated.

5.5 Recommendations

In view of the findings, the following recommendations are put forward:

1. Consider using small containers for fiber extract mixtures. Having multiple terminal sources increases energy generation. This diversification enhances reliability and resilience in your energy supply;
2. Use LED bulbs suitable for the intended purpose. Additionally, consider testing with higher voltage bulbs cautiously to assess the capability of the fiber plant extracts in carrying higher voltage while ensuring safety measures are in place;
3. Consider other fiber plants such as pineapple, jackfruit, and grapes any other fruit that rich in fiber and add some vegetable peel;
4. Ensure that safety protocols are followed throughout the experimental procedure, especially when dealing with potentially hazardous materials or equipments. Incorporating these suggestions can strengthen the study and provide a more robust assessment of the efficiency of using fiber plants as an alternative energy source; and
5. Use Maxxeland Everyday battery, used the copper and black stick, it is useful for connecting the electrodes made and it can help to measure the amount of the fiberplant extracts.

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