BIOELECTRIC POTENTIAL OF PHALERIA MACROCARPA (MAHKOTA DEWA) FRUIT
Voltage Measurement and Application as an Alternative Power Source

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ABSTRACT

The use of electrical energy from year to year is increasing, but the source of electrical energy has limitations. This electrical energy crisis must be addressed immediately, one of which is using environmentally friendly and renewable fuels. One of the environmentally friendly sources of electricity is the fruit of the mahkota dewa (Phaleria macrocarpa). The purpose of writing this paper is to investigate the benefits of the crown of the gods as an alternative source of electrical energy. The subject of this research is the crown of the god fruit with the criteria that the fruit is ripe which is marked with a red color which will be used as an alternative source of electrical energy to replace batteries. In addition to its medicinal properties, the results of this study indicate that the crown of the god fruit contains alkaloid compounds (bases) that can generate electricity. The electric voltage generated from the four pieces of the crown of the god can reach a voltage of 1.8 V. Meanwhile, the current generated from one crown of the god is very small and only produces a voltage of 0.9 V. The use of the crown of the gods as a source of electrical energy has a number of advantages in addition to some of the disadvantages it has. Based on the results of research on the power source from the crown of the god, it can be concluded that the hypothesis that there are benefits of the crown of the god as an alternative source of electrical energy is acceptable.

Keyword: *Bioelectric, Phaleria macrocarpa, Alternative Electricity.*

INTRODUCTION

Recently, humans make electrical energy as a basic need after food, clothing and shelter. That's because the role of electricity is very important in supporting all aspects of life. But not everyone can fully enjoy electricity, although basically electricity is an energy that can neither be destroyed nor destroyed (Hobbis, 2021). In indonesian law that is UU No. 30 of 2009 concerning electricity which reads "Electricity development aims to ensure the availability of electricity in sufficient quantities, of good quality, and at reasonable prices in order to improve the welfare and prosperity of the people in a fair and equitable manner and to realize sustainable development" (RI, 2009).

Various efforts have been made by the government to provide electrical energy to meet needs, including: building power plants, distributing electricity to the regions and seeking the creation of alternative sources of electrical energy. The government through PT. PLN (Persero) has sought the above matters for the realization of the electricity development goals regulated by law. The fact is that the use of electrical energy in Indonesia is increasing from year to year (Arifin, 2020; Moey et al., 2020). Meanwhile, the supply of electrical energy sourced from oil, natural gas, and coal has limitations. This is because these materials are non-renewable. Although on the other hand there are many sources of electrical energy such as

solar power, wind, water flow and others. However, all of this has not been used optimally. Until now, the source of energy for power generation in Indonesia is largely dependent on oil, natural gas, and coal, which are non-renewable because the formation process takes millions of years. This electrical energy crisis must be addressed immediately, one of which is using environmentally friendly and renewable fuels (Gicquel & Gicquel, 2013; Langer et al., 2021).

On a smaller scale, Hazardous and Toxic Materials (B3) sourced from household waste containing metals have the potential to threaten human health and the environment, one of which is battery waste which is the biggest contributor. Battery waste containing mercury, chromium, zinc, lead, cadmium, and nickel can enter the human body directly or through the food chain. This metal has been shown to cause damage to DNA and cell cycles, thereby triggering apoptosis, carcinogenesis, and oxidative stress, which can lead to serious health problems later in life. Energy sources are needed from materials that are safe for the environment and health, especially in reducing harmful metal materials in batteries (Ijadi Bajestani et al., 2014; Kang et al., 2013).

There are many renewable and environmentally friendly sources of electricity, one of which is the fruit of the crown of the gods. Mahkota Dewa *(Phaleria macrocarpa)* is a plant originating from Papua and can be found in a number of countries. However, some people do not know the benefits and do not even know this fruit. In the world of health, the fruit of the crown of the gods has been widely used for herbal medicine that can treat various deadly diseases (Alara et al., 2016). In addition, this fruit actually contains many other benefits, one of which is that it can generate electricity because like research on other fruits, Mahkota Dewa is thought to have various bioactive compounds that can be useful for generating electricity even on a small scale (Arizona, 2021). To prove that, a study will be conducted to confirm other benefits of this plant besides being a medicinal ingredient, namely as a producer of bioelectricity.

CONCEPTUAL FRAMEWORK

This study is grounded in the concept that certain fruits contain electrolytes capable of generating electrical energy when combined with two dissimilar electrodes. In the case of *Phaleria macrocarpa*, copper coins (positive electrode) and tacks (negative electrode) were used to form a simple galvanic cell.

The framework consists of the following elements:

1. **Input**: Mahkota dewa fruit combined with copper and tack electrodes.
2. **Process**: Experimental setup with one fruit (single cell) and four fruits connected in series.
3. **Output**: Direct measurement of voltage using a voltmeter.
4. **Analysis**: Descriptive presentation of voltage values (single vs. series).
5. **Interpretation**: Evaluation of whether connecting fruits in series increases the total voltage, consistent with the theoretical principle of galvanic cells.

Conceptual framework shows on Figure 1.

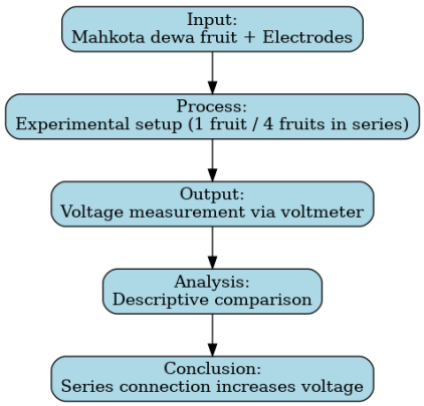

Figure 1. Conceptual framework of research.

RESEARCH METHODOLOGY

This research employed a pure experimental design using *Phaleria macrocarpa* (also known as mahkota dewa) fruit as the primary material. The study was conducted in the Physics Laboratory of SMP Negeri 1 Batang Kapas over two weeks, covering preparation, experimentation, and data recording.

The experimental materials consisted of four mahkota dewa fruits, copper coins as positive electrodes, tacks as negative electrodes,

alligator clips, connecting wires, and a voltmeter. The procedure was carried out in two variations: (1) a single fruit functioning as one galvanic cell, and (2) four fruits arranged in series. In each variation, the copper coin and tack were inserted into the fruit at a fixed distance, then connected to a voltmeter using clips and wires. For the series arrangement, the positive electrode of one fruit was connected to the negative electrode of the next, with the first positive electrode linked to the voltmeter's positive terminal and the last negative electrode linked to the voltmeter's negative terminal.

The generated electrical potential (voltage) was measured directly using a voltmeter. The results were then analyzed descriptively by presenting the measured values in tables and comparing the voltage produced by one fruit and by four fruits connected in series.

RESULT AND DISCUSSION

This study aimed to investigate the potential of *Phaleria macrocarpa* (mahkota dewa) fruit as a source of electrical energy. Ripe fruits, characterized by their dark red color, were selected as the experimental material. The rationale for using this fruit is based on its bitter taste, which indicates alkaline properties.

According to electrochemical theory, acidic and alkaline substances can serve as electrolytes capable of conducting electricity. The experimental findings are summarized in the Table 1.

Table 1. The Results of Measuring the Electrical Content of the Crown of the Gods Using a Voltmeter.

Experiment	The amount of *Phaleria macrocarpa* fruits	Voltage(s)
1	1 piece	0,9 Volt
2	2 pieces	1,3 Volt
3	3 pieces	1,65 Volt
4	4 pieces	1,8 Volt

As shown in Table 1, the first experiment using a single *Phaleria macrocarpa* (mahkota dewa) fruit produced a voltage of 0.9 V when measured with a voltmeter set at a 10 V range. In the second experiment, two fruits connected in series generated 1.3 V under the same measurement conditions. The third experiment, using three fruits, yielded a voltage of 1.65 V, while the fourth experiment with four fruits produced 1.8 V. To verify the practical application, the circuit was connected to a 1.5 V LED lamp, which successfully lit up, demonstrating the potential of mahkota dewa fruit as an alternative energy source. The experimental results are presented in Figures 1 and 2.

Figure 2. Experiment Using LED Lights with the Mahkota Dewa *(Phaleria macrocarpa)* Fruits.

Figure 3. Electrical Circuit of Mahkota Dewa *(Phaleria macrocarpa)* Fruits.

The series arrangement of four *Phaleria macrocarpa* (mahkota dewa) fruits generated an electrical potential of 1.8 V. This bioelectric source demonstrated its ability to conduct

current, as evidenced by the illumination of an LED lamp. Statistical analysis revealed significant results ($p = 0.018$) with a very strong correlation between the tested variables ($r = 0.982$). These findings indicate that mahkota dewa fruits are capable of generating and conducting electricity, as shown by both the voltmeter readings and the lighting of the LED. The electrical activity is likely attributed to the alkaline properties of the fruit, particularly the presence of alkaloid compounds in the skin and flesh, which function as electrolytes (Anggraini & Lewandowsky, 2015).

Similar to a conventional battery, *Phaleria macrocarpa* (mahkota dewa) fruit can generate electricity when combined with metal electrodes, although the voltage produced by a single fruit is relatively weak. When several fruits are connected in series, the total voltage increases because the electrical energy from each fruit is accumulated within the circuit and subsequently detected by a voltmeter. This principle follows the basic electrochemical concept in which the potential difference of multiple cells arranged in series is additive.

The ability of mahkota dewa fruit to generate electricity is attributed to the presence of alkaloid compounds in the skin and flesh of the fruit. These compounds, which possess alkaline properties, interact chemically with the inserted metals, functioning similarly to electrolytes in an accumulator (battery). Through this electrochemical interaction, ions in the fruit facilitate the movement of charge between electrodes, thereby producing an electric current. Although the generated energy is modest, the findings suggest that mahkota dewa fruit has potential as a bio-based source of electrical energy and can be utilized as a contextual learning medium to demonstrate basic principles of electricity and electrochemistry (Arizona, 2021).

On a larger scale, the bioelectric potential of *Phaleria macrocarpa* (mahkota dewa) fruit could be further explored as a complementary alternative energy source. Although the voltage produced by the fruit is relatively low compared to conventional power sources, its utilization demonstrates the possibility of developing environmentally friendly bio-based energy. Unlike batteries, accumulators, or diesel generators which often involve toxic chemicals, heavy metals, and carbon emissions, energy derived from natural fruit-based electrolytes is renewable, biodegradable, and non-toxic (Gaines, 2014).

While practical application on an industrial scale would require further research, innovation, and optimization, this study provides an initial indication that mahkota dewa fruit may contribute to sustainable and green energy alternatives in the future.

CONCLUSION

The findings of this study support the hypothesis that *Phaleria macrocarpa* (mahkota dewa) fruit can serve as an alternative source of electrical energy. The generated voltage, detected through voltmeter measurements, was sufficient to illuminate an LED lamp, demonstrating the fruit's ability to conduct electricity. Statistical analysis also indicated a significant correlation between the variables measured.

For future research, it is recommended to conduct experiments on a larger scale with improved tools and more robust circuit designs in order to increase the amount and stability of the electrical energy produced.

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