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Utilization of Sunti Acid Extract as Electrolyte Gel for Used Batteries Recharge

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Abstract. Carambola wuluh is one of Indonesia's natural resources that is still less optimized in its utilization. Generally, people use Carambola wuluh only to be processed into sunti acid which is then used as a flavor enhancer in cooking. The content of oxalic acid in sunti acid can be utilized as a raw material for the gel electrolyte which will be used to recharge used batteries. This study aims to determine the potential of sunti acid extract for the recharging process of used batteries. The voltage obtained from the electrolyte gel of the sunti extract is greater when compared to the accuser voltage. The results showed that the best compositions for obtaining the optimum voltage and current strength was 7% (w / v), NaCl 1.25% (w / v) and Glycerol 40% (v / v) for the electrolyte gel and addition of 10% NaOH 1M and 0.01% $KMnO_4$, based on the volume of the electrolyte gel, to increase the voltage and the strength of the resulting current. The results obtained are expected not only to turn on the LED lights and the motor drive (dynamo), but also be an alternative material for recharging used batteries.

1. Introduction

Carambola wuluh (Averrhoa bilimbi L.) is a tropical plant originating from the Southeast Asia region. Carambola Wuluh is included in one of Indonesia's natural resources which is still underutilized. In Indonesia, especially in the Aceh region, people only use carambola wuluh to be processed into sunti acids which are used to add flavor to the cuisine [1]. Carambola wuluh is a tree-type plant that generally lives at an altitude of 5 - 500 meters above sea level. The use of carambola wuluh as a flavor-enhancing ingredient in cuisine because carambola wuluh has a distinctive taste that is not possessed by other fruits [2].

Carambola wuluh is processed into sunti acids through a fermentation process with a dry salting method to obtain the results of sunti acids which have a chewy texture and brownish color. In addition, sunti acids themselves can provide a specific and distinctive aroma in food [3]. Due to the lack of socialization and the introduction of other benefits from sunti acids, the community only uses sunti acids as a cooking ingredient, whereas high oxalic acid content in sunti acids can be used as the main raw material for the manufacture of electrolyte gels to reduce the use of chemicals in the recharge of used batteries [1].

Today, the used battery waste in Indonesia has increased considerably. This is due to the increasing number of motorized vehicles that make the number of used batteries become waste. The average age of battery usage is 2 years. After that age, the battery can no longer be used. Indonesian people generally prefer to replace their motorized vehicle battery compared to having to recharge because the process is fairly complicated and requires relatively high costs. Along with the advancement and development of science and technology in Indonesia, more and more the researchers are also conducting research in the field of renewable energy. Until now, research has been conducted on the utilization of typical Indonesian plants as raw materials in the process of used batteries recharge. Among them is the utilization of aloe vera extract which is converted into electrolyte gel which is then mixed with batteries liquid as a raw material for used batteries recharge.

The purpose of this study was to make sunti acids from carambola wuluh conventionally. Get the extract of sunti acids as the main raw material for making electrolyte gel and determine the level of oxalic acid in the sunti acids. Determine the variation in the concentration of the gel-making material that is suitable to get the optimum voltage, and find out the right gel electrolyte levels to recharge used batteries. The information obtained from this study is expected to be used in the production of electrolyte gel as an alternative material for recharge used batteries.

2. Materials and Method

The material used in this study was carambola wuluh from the residents' gardens around Banda Aceh and Aceh Besar, aquadest, agar (swallow), NaCl (wallet), Glycerol 85% (Merck), NaOH (Merck), phenolptalein indicator (Merck), and $KMnO_4$ (Merck).

The carambola wuluh that has been collected is cleaned first with clean water, followed by making sunti acid by drying the carambola wuluh for ± 5 days in direct sunlight and adding salt during the drying process [4]. Salt functions as a preservative and mineral binder in carambola wuluh [3]. After obtaining the sunti acid with a chewy texture, brown and oval shaped, then the sunti acid is cut into a smaller size and do lubrication then filtered to get the extract. Subsequently, the acid-base titration is carried out with 1 M NaOH titers to determine the levels of the acids contained in the extract of sunti acid. Electrolyte gel was prepared using agar, Glycerol, and NaCl, with the variation of agar of 1.25%; 2%; and 7% (weight%), Glycerol of 10%; 20%; 30% and 40% (volume%) and NaCl of 1.25 (weight%). Furthermore, an electrochemical cell circuit is made for the electrolyte gel that has been formed which is injected into the used battery and measured the voltage and current strength.

3. Results and Discussion

3.1. Extraction of Sunti Acid

Sunti acid is made conventionally for 5 days. Raw materials and sunti acid products can be seen in Figure 1.

Figure 1. Raw materials and sunti acid products

After making sunti acids, the next step is taking the extract of sunti acids and testing the acid content of the sunti acids using the alkali metric (acid-base) titration method. Extraction process uses

H_2O solvents which aim to obtain high acid content and the use of H_2O solvents does not affect the performance of electrolyte gel.

The acid content in the sunti acid was analyzed by varying the weight of the sunti acid with H_2O volume of 1:1, 1:2, 1:3, and 1:4 and then titrated using NaOH solution. Effect of the ratio of sunti acid: H_2O on acid content is shown in Figure 2.

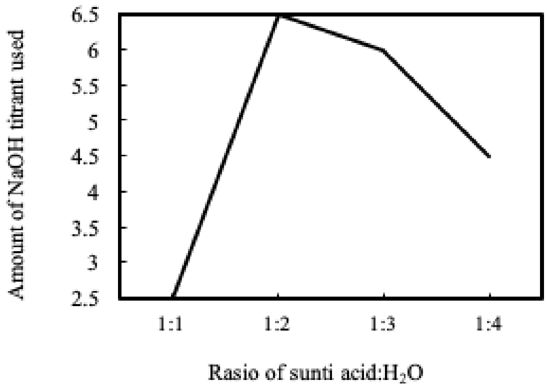

Figure 2. Effect of ratio of Sunti Acid: H2O to a volume of NaOH

Figure 2 shows that the highest NaOH used is at the ratio of sunti acid and H_2O of 1:2. The more NaOH titrant is used, the more acid is contained in the sunti acid extract. At the ratio of 1:1, sunti acid is not completely crushed, which causes the extract obtained is very small. For the ratio of 1:2, the sunti acid is perfectly crushed that makes the broad surface of the contact is getting bigger. Whereas for the ratio of 1:3 and 1:4, there is too much water. Then the 1:2 ratio of sunti acid: H_2O is chosen to be the appropriate condition to be used in a further process.

3.2. Electrolyte Gel

Glycerol and agar composition influence the voltage and currency strength of the electrolyte gel as illustrated in Figure 3 and Figure 4.

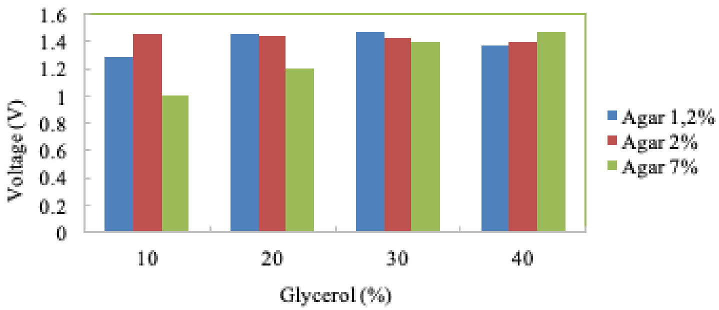

Figure 3. Effect of glycerol and agar composition on voltage

It can be seen from the figure that the voltage change in the electrolyte gel is not significant. The resulting voltage ranges from 1-1.47 Volts. The highest voltage is obtained from the condition of 40% Glycerol and 7% agar.

Figure 4 illustrates that the best composition that obtains the highest current is at the composition of 20% Glycerol and 2% agar. However, the determination of the composition to be used must be based on the voltage and currency which are equally large in order to acquire a large wattage. In addition, the gel texture produced is also a benchmark in the selection of the appropriate variations of Glycerol and agar. For this reason, a composition of 40% Glycerol and 7% agar which produce voltage and currency of 1.47 V and 3 mA, respectively and a gel texture that can be injected into a used battery.

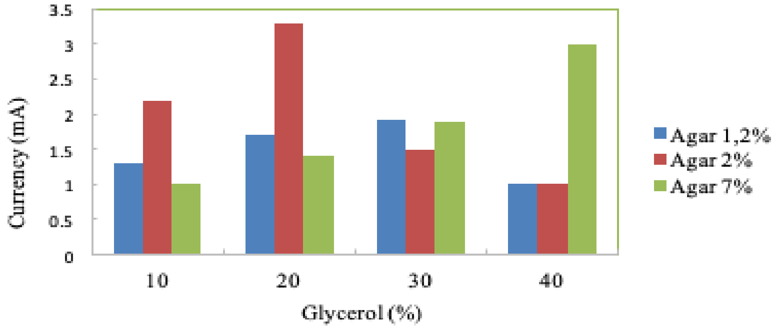

Figure 4. Effect of glycerol and agar composition on currency

3.3. Testing on LED lights and drive motors (dynamo)

After obtaining the best composition for the manufacture of electrolyte gel, the strength of the gel was tested to turn on the LED lights. These electrolyte gels are put into used batteries that are replaced by electrodes with Aluminum (Al) and Copper (Cu) plates with series and parallel circuits. Electrolyte gel resulted from a composition of 7% agar and 40% Glycerol can turn on the LED lights, as presented in Figure 5.

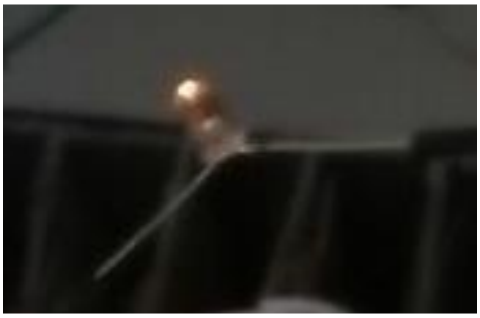

Figure 5. Flame LED Lights using Sunti Acid Electrolyte Gel

It can be seen from the figure that the light produced is still dim. Therefore, it was tested by adding 10% NaOH and 0.01% $KMnO_4$ (based on a volume of sunti acid electrolyte gel). The results obtained are 1 Volt / cell of voltage and 0.01 A / cell currency which is arranged in series and parallel. A significant increase occurred in the electrolyte gel currency, from 3.3 mA to 0.01 A. This is due to the use of $KMnO_4$ which is a strong oxidizing agent that can help increase the potential energy contained in the electrolyte gel. With this composition, the lights can light up for 5 hours, as shown in Figure 6.

Figure 6. Flame LED lights for sunti acid electrolyte gel after the addition of NaOH and $KMnO_4$

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The overall voltage of the circuit is 5.09 V with a currency of 0.06 A. Further testing of the drive motor (dynamo) is carried out. Dimano can rotate for 1 hour with a stable voltage and currency. After it was tested on the dynamo that was placed on the prototype car, the car could run for 20 seconds.

4. Conclusion

Sunti acids are made conventionally for 5 days with salting and drying methods. The best ratio for extracting sunti acid is the ratio of sunti acid and H_2O of 1: 2. The best composition in making sunti acid electrolyte gel was 40% Glycerol, 7% agar, based on the volume of the extract of the sunti acid, with the addition of 0.01% $KMnO_4$ and 10% NaOH 1 M. The resulting voltage was 1 Volt with 0.01 A currency, which when assembled in series and parallel in 6 cells can turn on LED and dynamo lights.

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