

Utilization of *aloe vera* extract as electrolyte for an accumulator

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Abstract. Aloe vera contains acid, which has the potential to generate electric current. The objective of this research is to study the potency of aloe vera extract as electrolyte for an accumulator. Experimental results showed that aloe vera extract has no a stable value of voltage and currency. The voltage and currency of aloe vera extract were reduced more than 50% for 60 minutes. Then, aloe vera extract was mixed with accu zuur to produce electrolyte solution. The mixture composition of aloe vera extract to accu zuur of 50:50 (v/v) generated stable voltage and currency. The experimental results showed the potential use of aloe vera extract to reduce the chemicals used in a conventional electrolyte solution.

1. Introduction

Aloe vera (*Aloe vera* L.) is native to Northern Africa, but it is now widely distributed throughout the world. It has thick leaves and thorns on its edges, is green colored, and is characterized by slimy leaves. It grows wild in subtropical parts of the world, and it is considered to be intolerant of low temperatures. Aloe vera has been used for thousands of years in medicine, cosmetics, and as an ornamental plant [1]. The leaf of aloe vera contains latex and gel. The juice or sap of aloe vera is the latex present beneath the epidermis layer, which occupies approximately 20–30% of the weight of the whole leaf. Meanwhile, the inner part of the leaf bears tasteless and colourless gel in the form of pulp or mucilage from the parenchyma cells [2].

Aloe vera is a well-known medicinal plant. It has many biological activities, including anti-viral, anti-bacterial, laxative, protection against radiation, anti-oxidant, anti-inflammation, anti-cancer, anti-diabetic, anti-allergic, and immuno-stimulation [3]. It also can be used as prebiotic [4].

Recently, a new form of energy source based on plants has been investigated by many researchers due to a shortage of energy sources, especially conventional fossil-based energy. Electrical phenomena in plants have attracted researchers for a long time. Some plants have been proven to have the potential to serve as a renewable energy source by embedding pairs of electrodes into them to allow the flow of ions and hence generate electricity. The cells of many biological organs can generate electric potentials that result in the flow of electric currents. Also, electrical impulses may arise as a result of stimulation. Once initiated, these impulses can propagate to adjacent excitable cells. The change in transmembrane potential creates a wave of depolarization that affects the adjoining resting membrane. Electrical signals can propagate along the plasma membrane over short distances in plasmodesmata and over long distances in conductive bundles [1]. The plant tissue of aloe vera has

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biologically closed electrical circuits and electric fields that regulate its physiology. The electric circuits spread over aloe vera tissues [5]. Meanwhile, Ningsih et al. [6] also reported the potency of biologic material as an electrolyte for an accumulator. They found that *Manihot Glaziovii* has cyanide acid that potentially reduces the usage of chemicals as electrolyte solution for an accumulator.

The purpose of this study is to evaluate the electrical potency of aloe vera extract. There is no such comprehensive study previously reported on this crop. The information gained from this study can be used to produce an electrolyte that has less chemicals (such as organic acids) compared with electrolyte solution used in conventional accumulators.

2. Materials and Methods

Materials used in this research are aloe vera plant, aquadest, sulfuric acid (H_2SO_4 97%), and accu zuur (conventional electrolyte used in accumulators). The sample used in this research is aloe vera extract from the aloe vera plant (*Aloe Vera* L.), which was obtained from a local farmer in the Aceh Besar District, Aceh, Indonesia.

Firstly, the aloe vera was washed, and then its outer leaf was peeled off. The sample was then sliced to 3 cm of length, then, placed on filter cloths and pressed to produce slime (aloe vera extract). Then, the voltage and electric current measurements were conducted to aloe vera extract. The voltage and electric current measurements of aquadest, sulfuric acid, and accu zuur were also collected for comparison. Subsequently, aloe vera extract and accu zuur were mixed with a specified composition (volume ratio of aloe vera extract to accu zuur 70:30, 60:40, and 50:50). Sample solutions were then tested on an accumulator (12 volt, 5 ampere).

The electric current and voltage of the accumulator were measured with a multimeter every 60 minutes for a total period of 300 minutes. Data were obtained by measuring the circuit with the multimeter. The obtained data contained voltage and electric current in specified time interval and different concentrations. All measurements were conducted in the laboratory at ambient temperature; the measurements were collected in duplicate, and the averaged data are reported.

3. Results and Discussion

Figure 1 shows the time dependencies of voltage and current for aquadest, aloe vera, and accu zuur. Experimental results show that accu zuur has higher voltage and current and is more stable than aquadest and aloe vera. Accu zuur is a solution with H_2SO_4 concentration of 30 %-v. It shows high voltage and current of about 13.5 volts and 5.6 ampere, respectively. This result has been known previously, although accu zuur has been used as a conventional electrolyte solution in accumulators in which each of 6 cells has 2 volts. Aquadest has lower values of voltage and current. It generates no electricity in the first of 60 minutes. Meanwhile, aloe vera extract has similar results as aquadest. Aloe vera extract also has no stable value of voltage and current. The voltage and current of aloe vera extract reduced more than 50% for 60 minutes. Volkov et al. [1] previously reported a similar trend for aloe vera leaf. However, there is the possibility to make an alternative electrolyte solution by mixing of aloe vera extract and accu zuur to reduce the use of chemicals in an electrolyte solution.

An electrolyte is a compound that can conduct electric current. Electrolyte solution can produce electric current because atoms move freely in the solution. Atoms that contain an electric charge are called ions. Ions with positive charge are called cations, and ones with negative charge are called anions. Electrolytes can be acids, bases, and salt solutions. Electrolyte solution has an important role in metal corrosion because this solution can be a medium for contact between anode and cathode. Anodes can be corroded by releasing electrons from neutral metal atoms to create ions. These ions might remain in solution or react and then form dissolved corrosive ions. As observed in the experiments (data not shown), sulfuric acid with concentration of 97% has a higher electricity compared with all electrolyte solutions used. Sulfuric acid with concentration of 97% has voltage and current of approximately 14 volts and 5.8 ampere, respectively. However, it corrodes and quickly damages the electrodes in the accumulator. Thus, sulfuric acid with concentration of 97% could not be

used as an electrolyte solution in accumulator. Accordingly, a proper choice of electrolyte solution is one important aspect in order to achieve good performance of an accumulator.

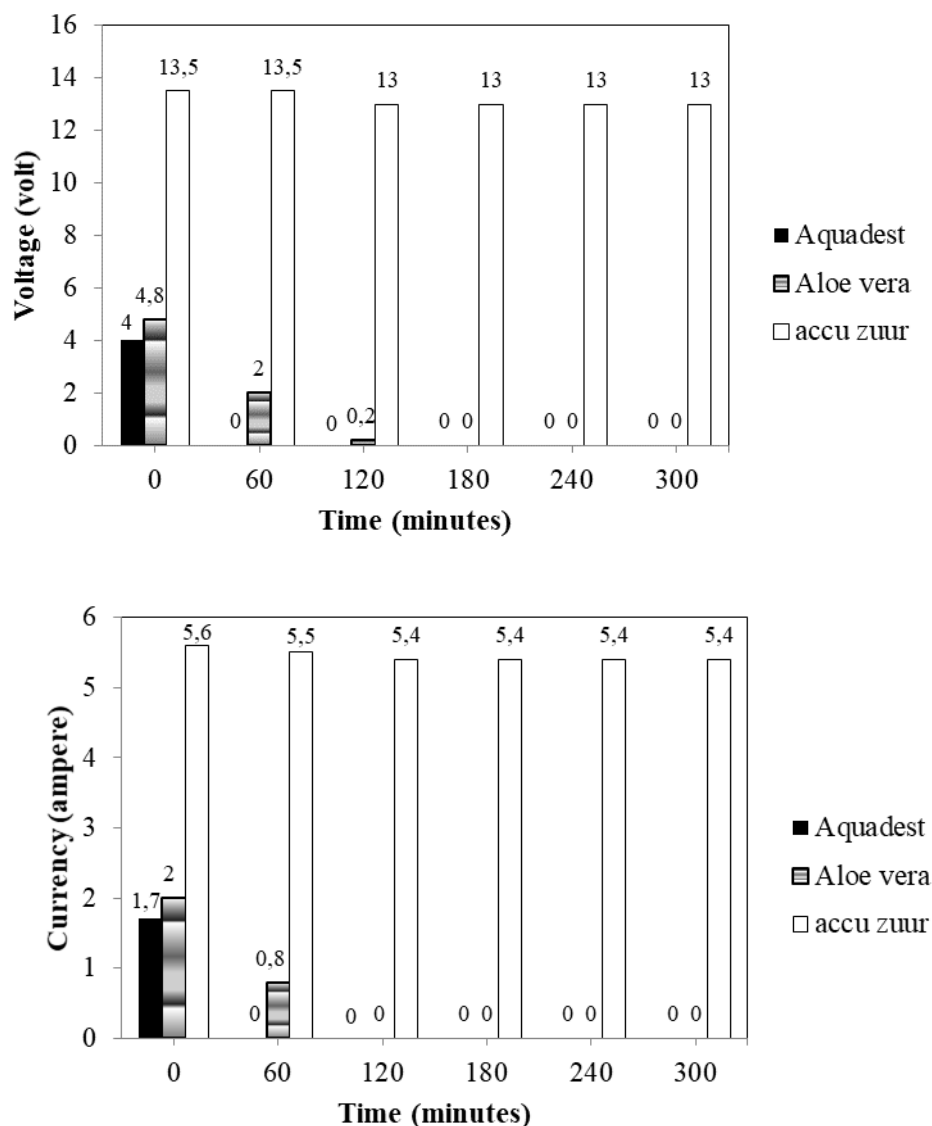


Figure 1. Voltage (V) and current (I) measurements for aquadest, aloe vera and accu zuur.

Figure 2 shows the time dependencies of voltage and current for mixtures of aloe vera and accu zuur. The experimental results showed the mixture composition of aloe vera extract to accu zuur of 50:50 as the best composition for reducing the usage of chemicals in the accumulator. This mixture produces voltage that has the same stability as a conventional electrolyte. It also lights the lamp on a simple electrical circuit. The mixture composition of aloe vera extract to accu zuur of 50:50 generates voltage and current of approximately 12.5 volts and 5.2 ampere, respectively. These values were constant over the entire period of 300 minutes. Ningsih [6] previously reported that another biological material of *Manihot glaziovii* was mixed well with accu zuur (60:40 mixture composition), but only produced 4.8 volts and 1 ampere. It can be concluded that aloe vera has some effects to support the role of accu zuur as an electrolyte solution for accumulators. It was also observed that the mixture of aloe vera and sulfuric acid with concentration of 97% could not be used as an electrolyte on the accumulator, as it will corrode and quickly damage the electrodes in the accumulator.

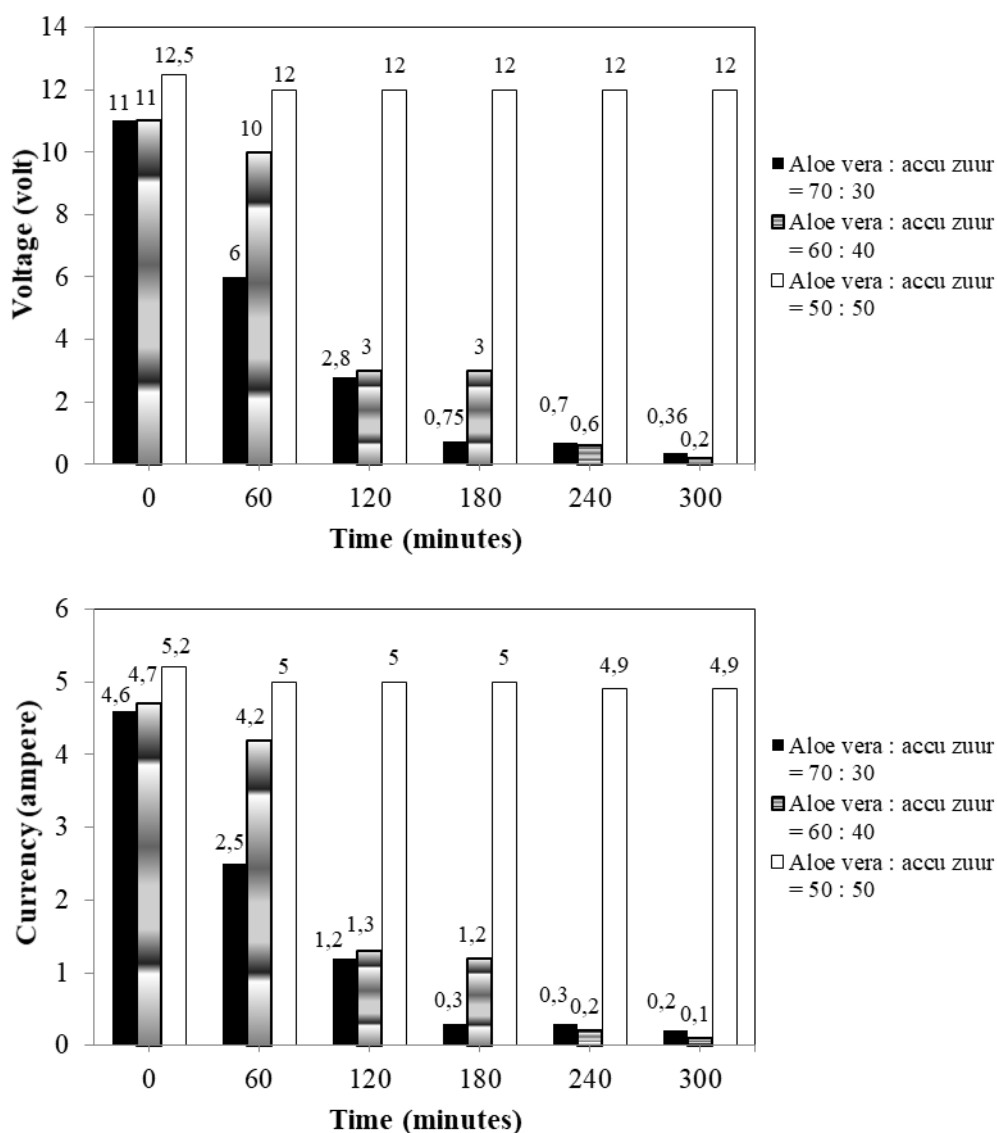


Figure 2. Voltage (V) and currenncy (I) measurements for mixture of aloe vera and accu zuur.

4. Conclusion

Investigations were carried out to study the electrical behavior of aloe vera extract. Accu zuur is demonstrated as an electrolyte that can be used in many batteries for vehicles through the data that shows high and stable electricity. In order to reduce the use of chemical or organic acid, aloe vera extract can be used as an electrolyte. The mixture composition of aloe vera extract to accu zuur of 50:50 (v/v) generates stable voltage and current.

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References

- [1] Volkov, AG., Foster, JC., Jovanov, E., Markin, VS. 2011. Anisotropy and nonlinear properties of electrochemical circuits in leaves of *Aloe vera* L., *Bioelectrochemistry*, **81** 4-9
- [2] Baruah, A., Bordoloi, M., Baruah, HPD. 2016, *Aloe vera*: A multipurpose industrial crop, *Industrial Crops and Products*, **94** 951-963
- [3] Ray A, Ghosh S., Ray A., Aswatha SM. 2015. An Analysis of The Influence of Growth Periods on Potential Functional and Biochemical Properties and Thermal Analysis of Freeze-dried *Aloe vera* L. Gel. *Industrial Crops and Products* **76** 298-305.
- [4] Hussain SA., Patil GR., Yadav V., Singh RRB., Singh AK. 2015, Ingredient Formulation Effects on Physico-chemical, Sensory, Textural Properties and Probiotic Count of Aloe Vera Probiotic Dahi. *LWT – J. Food Science and Technology* **65** 371-380
- [5] Volkov AG., Nyasani EK., Tuckett C., Scott JM., Jackson MMZ., Greeman EA., Greenidge AS., Cohen DO., Volkova MI., dan Shtessel YB. 2017. Electronic Potentials in *Aloe vera* L.: Effects of Intercellular and External Electrodes Arrangement. *Bioelectrochemistry* **113** 60-68
- [6] Ningsih YS., Gusnedi, dan Darvina Y. 2014. Effect of aquadest and accu zuur addition of to electric current and voltage of accumulator using Air Singkong Karet (*Manihot Glaziovii* M.A) (in Indonesian). *J. Pillar Physics* **1** 105-112.