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The Study of Pineapple Peel (*Ananas Comosus* L.) Waste Based-Electrolyte Medium: A Simple Experiment Design for the Students

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Abstrak

Usaha untuk meningkatan keingintahuan dan pemahaman siswa terhadap media elektrolit maka dilakukan menggunakan sel Volta sederhana. Bahan elektroda besi dan karbon masing-masing digunakan untuk anode (-) dan katoda (+). Eksperimen didesain melalui pembuatan dua rancang sistem yakni wadah tunggal (SC) dan tiga wadah yang disusun seri (3-SCs). Sifat elektrolit dapat diamati dalam medium elektrolit berbasis limbah kulit nana (*Ananas comosus* L.) selama waktu pengamatan 8 jam. Pada tegangan teramati 2.63 dan 2.60 V dari sistem 3-SCs mampu menyalakan lampu LED. Bagaimanapun dalam investigasi ini, penurunan tegangan dan arus dapat disebabkan oleh proses oksidasi dari medium berbasis kulit nanas pada udara, temperatur kamar, dan tekanan nomral selama durasi penelitian yang panjang. Penelitian ini diharapkan dapat menyediakan pengalaman dan pengetahuan yang bernilai atau sebagai sarana dalam penyaluran informasi kepada siswa dalam memahami media elektrolit dari sumber-sumber alam atau limbah.

Kata kunci: eksperimen siswa; kulit nanas; media eletrolit; sel Volta; limbah

Abstract

To promote the student curiosity and understanding in the electrolyte medium was carried out using home-made Volta cell. The electrode materials were iron and carbon for anode (-) and cathode (+), respectively. The experiment was designed by two models that were single-chamber (SC) and three series-packed chambers (3-SCs), respectively. Electrolyte properties could be investigated in pineapple peel (*Ananas comosus* L.)-based electrolyte medium during the operating time of 8 hours, respectively. The measured-voltage of 2.63 and 2.60 of the 3-SCs system could turn on the LED lamp. However, in this study, the decrease of voltage and current were due to the oxidation process of the pineapple peel-based medium under air, room temperature, and normal pressure during the long-operating time of the experiment. Finally, this research expected to provide additional valuable experience and knowledge as same as to facilitate in information delivering to the students in understanding the electrolyte medium from the waste or natural sources.

Keywords: electrolyte medium; pineapple peel; student's experiment; Volta cell; waste

Introduction

A daily learning activities of the students who are taking place on the learning interactions is usually helped by study materials or learning sources. Nowadays, the use of learning sources has an important role to help the students in understanding the delivered-lessons from a teacher (Fatkhiyani & Suhada, 2018). However, practical learning also helps to promote not only for remembering and discussing capabilities but also the student curiosity by doing a simple experiment in the class or laboratory, especially in the chemistry subject.

Chemistry has been belonging to sciences where is to be the compulsory lessons for the students. Chemistry is one of the knowledges that is close to our daily life (Mahdian et al., 2018). It does not only talk about the concepts, fact, basic principle but also a great-inventions, so it is necessary to learn and understand for the students, comprehensively. Further, it can be applied in the daily life and used as a solution to solve the problems or facing the challenges in the near future (Dewi et al., 2016; Nuzula & Azizah, 2014). There is so much study-materials in chemistry, one of that is such as electrolyte-based learning case.

Electrolyte property of medium is one of the learning cases in school not only for junior but also for senior high school in Indonesia. Electrolyte medium means that electron-transporting medium under liquid or aqueous phase, while non-electrolyte is vice versa. Prayudha et al. (2019) stated that the electrolyte is a dissolved compound into ions and then the solution becomes an electronic conductor form. Moreover, the electrolyte-based medium could be observed in water, acid, base or the other chemical compounds. In other cases, the electrolyte can be found in the gel and solid phases (Azizah et al., 2015; Mustaqim et al., 2017; Furqon & Sulistijono, 2015). In some literature (Mujadin & Rahmatia, 2017; Suciyati et al., 2018; Haq et al., 2018), the electrolyte and non-electrolyte tests could be identified by applying Volta cell experiment using easy home-made tools and ingredients.

Rakhmawati et al. (2015) suggested that the electrolyte and non-electrolyte lessons are presumably difficult to understand because the students cannot see directly the electricity generation process. The electricity generation process somehow due to the movement of free ions that was able to produce electrical conductivity. Briefly, this explained that difficulty in information delivering to the students. However, at least it needs an illustration and practical session to overcome this drawback. Lubis et al. (2018) reported that multimedia development using scientific approach increased the student interest in the electrolyte and non-electrolyte-based lessons. The same trend is also resulted by Muhaimin (2016) using a presentation software-based media. Enawaty & Sari (2010) reported that comic-based learning media could enhance the student achievement of senior high school. Krisyanti & Sanjaya (2014) also stated that the use of interactive e-book increasing the curiosity of the students. Despite these, a simple practical experiment-based learning media is also needed to promote the understanding of the students about this study deeply except interactive or illustration-based learning media. Therefore, herein we reported a simple experiment using pineapple peel (*Ananas comosus* L.) waste-based electrolyte medium to know their voltage (V) and current (I) characteristics using Volta cell test. The system was designed by two system models that were single-chamber (SC) and three series-packed chambers (3-SCs). This research expected the electrolyte medium test using pineapple peel could give valuable knowledge and experience for the students in understanding the electrolyte properties of the medium from the waste or natural sources. Finally, all results will be discussed and explained in this research.

Method

Materials and research time

The research was done in the school's library of junior high school of Al Islamiyyah Al Irsyad Boarding School Purwokerto Central Java within 10 days, starting from 9 up to 19 January 2019. The materials were a nail, carbon rod of used battery, miniature LED, Avometer, container or chamber, cable, clamp, and pineapple peel (*Ananas comosus L.*) waste.

Research preparation

Typically, pineapple peel waste was washed using water and crushed into small properly. While the electrodes were prepared by using a nail (4 cm in length) and carbon rod of used battery for iron and carbon electrodes that assigned as the anode (-) and cathode (+) as shown in Fig. 1, respectively. The electrodes were connected to each other using a black and red clamp for iron and carbon rod electrodes, respectively.

Figure 1. Electrode preparation.

Volta cell test of pineapple peel waste-based electrolyte medium

The single-chamber (SC) system was used for the first experiment. Typically, the mashed pineapple peel was poured into a sterile-container or chamber by the height of the medium was about 6 cm. Then, the voltage (V) and current (I) of those was measured against time (h). The second experiment was carried out using the above-mentioned method with the series system of three series-packed chambers (3-SCs). The SC and 3-SCs were illustrated as shown in Fig. 2, respectively.

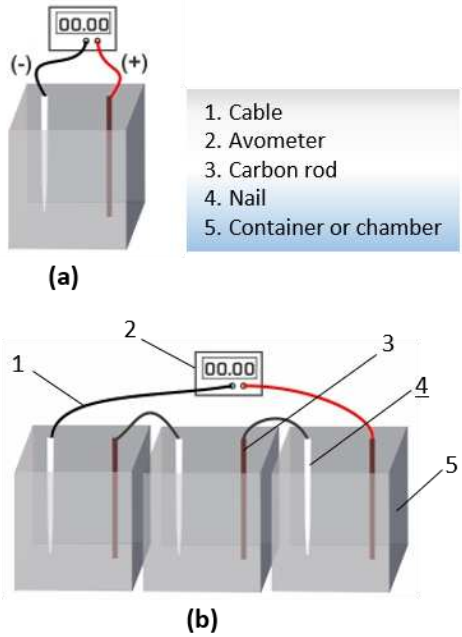

Figure 2. Illustration of SC (a) and 3-SCs (b) system, respectively.

Results and Discussion

Firstly, sample of pineapple peel was washed to remove contaminant that etched along pineapple peel waste surfaces and crushed properly so that got a homogeneous form. Subsequently, pineapple peel waste-based medium was poured into a container or chamber. The electrodes in such way were assembled into the chamber too, as shown in Fig. 3 and 5. The electrode terminal was connected to the Avometer. The Avometer was used to measure the voltage (V) and current (I) of pineapple peel waste-based electrolyte medium over the certain experiment time. Then, the voltage and current of the pineapple peel based-electrolyte medium were measured against time (hour) over the operating time of 8 hours, respectively. Noted that the test was withdrawn every 2 hours. However, the design experiments were divided into two

categories as illustrated in Figure 2 (the real-devices were shown in Fig. 3 (a) and Fig. 3 ((b) and (c)) for single-chamber (SC) and 3-series packed-chambers (3-SCs), respectively. The two-system design of SC and 3-SCs were used to know the differences of its voltage and current characteristics between them.

Table 1. The estimated prices of the experiment system in SC and 3-SCs

No	Materials list	Quantity	Price (Rp)
1.	Miniature LED lamp	2	4.000
2.	Clamp	12	24.000
3.	Container or chamber	4	20.000
4.	Cable	2 meters	5.000
5.	Pineapple peel	-	free
6.	Nail	4	4.000
7.	Carbon rod (battery)	4	12.000
8.	Avometer	1	90.000
	Total price		**159.000**

For class or school laboratory scale, the suitable experimental design and the materials needed are an important thing. In this research, the total price that used to prepare the SC and 3-SCs were also estimated in Table 1. In addition, previous research has rarely reported the price what they have done such similar research by Suciati et al. (2019), Atina (2015), and so on. Further, in our case for the experiment charges, the research only spent around Rp. 159.000 (purchase in 2019) to organize the experiment system of SC and 3-SCs. We assumed that this experiment charges are still cheap, affordable, and could be applied in class or school's laboratory scale. The price lists were summarized in Table 1.

The observation conditions of the experiment are shown in Fig. 2 and Fig. 4. Fig. 3 and Fig. 4 were the voltage and current measurements of pineapple peel-based electrolyte medium and LED test by using the measured-voltage of 3-SCs, respectively. However, the results showed that the differences between SC and 3-SCs. The system of 3-SCs has higher voltage and current than in SC system. It was assumed that the higher quantity of pineapple peel medium can increase their voltage and current. The voltage and current of SC and 3-SCs were collected in Table 2-3 and Fig. 4.

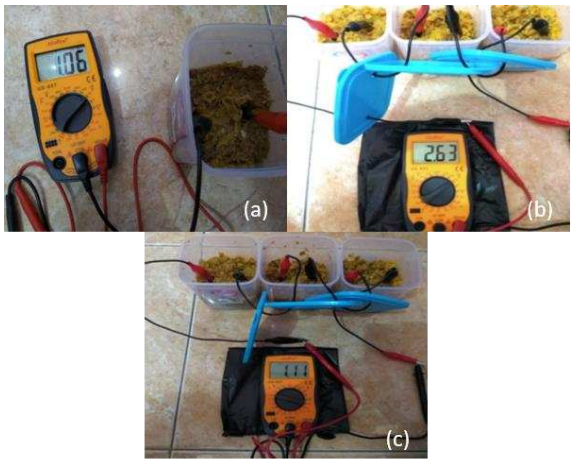

Figure 3. the voltage measurement (a) of SC and the voltage (b) and current (c) measurements in 3-SCs system, respectively.

In other case, the higher voltage could turn on the miniature LED lamp than the lower voltage as shown in Table 4 (and Fig. 5 for the real condition of the LED test). The light of the miniature LED lamp could be observed in the measured-voltage of 2.63 and 2.60 V than in 2.07 and 2.06 V of 3-SCs system. Experimentally, the higher voltage might be able to turn on the miniature LED lamp than in the lower voltage.

Table 2. Data collection of V vs time characteristics in SC and 3-SCs system

Chamber system	time (h) against voltage (V)			
	2	4	6	8
SC	1.06	1.00	1.00	0.99
3-SCs	2.63	2.60	2.07	2.06

Table 3. Data collection of I vs time characteristics in SC and 3-SCs system

Chamber system	time (h) against current (A)			
	2	4	6	8
SC	0.08	0.07	0.05	0.01
3-SCs	1.11	1.10	0.71	0.63

As shown in Fig. 4 and Table 2-3, the pineapple peel-based electrolyte medium showed differences voltage and current characteristics in the various time measurements. However, an excess time measurement slightly decreased their voltage and current values over the operating time of 8 hours. Moreover, the decrease in voltage values was proportional to the decrease in current values. It can be proved by Ohm's rule as follows (Cahyono & Rasi, 2019): $V=I.R$ where V, I, and R were a voltage (Volt), current (Ampere) and resistant (ohm), respectively. In point of the equation above, the high value of current could increase the voltage of the system at fixed resistant and vice versa.

The decrease of voltage and current of SC and 3-SCs were assumed that organic samples like pineapple peel is easily oxidizing under air, room temperature, and normal pressure conditions. Moreover, the oxidation process can also be affected by the heat from the sunlight while the experiment used transparent-chamber (Farikha et al., 2013). The oxidizing agent such as oxygen destroying the chemical and structural of samples thus changing their physical and chemical characteristics. Even though in this research was not apparantly found the physical transformation of pineapple peel over 8 hours the experiment taking place. But it can be identified by the decrease of its voltage and current values. However, this result slightly showed a high voltage and current values than similar previous report (Fadli et al., 2012).

Table 4. LED test in series system using the measured-voltage

Characteristic of	three series-packed chambers (3-SCs)			
Measured voltage (V)	2.63	2.60	2.07	2.06
LED lamp	on (+)	on (+)	off	off

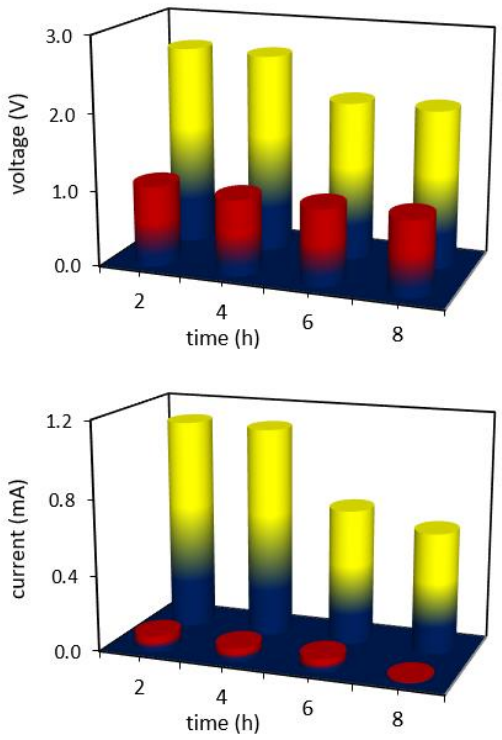

Figure 4. Time against voltage (above) and current (below). Red and yellow cylinders were assigned as voltage and current in SC and 3-SCs, respectively.

Atina (2015) reported that the pineapple is acid with a pH of 4. Although in this research we used a pineapple peel, at least the pH of the medium is still in the lower scale or acid condition. The lower pH caused by the fruit flesh that attached along with the pineapple peel waste. The high acid properties of the medium could increase the ion quantity as same as enhancing their electrical conductivity. Briefly, electricity is defined by electron currents on the conductor at a certain time. On the electrolyte conductor, the electron currents

were carried using an ion carrier. Therefore, the more acidic a solution thus the more ions will be produced as same as the more electrolytes a solution.

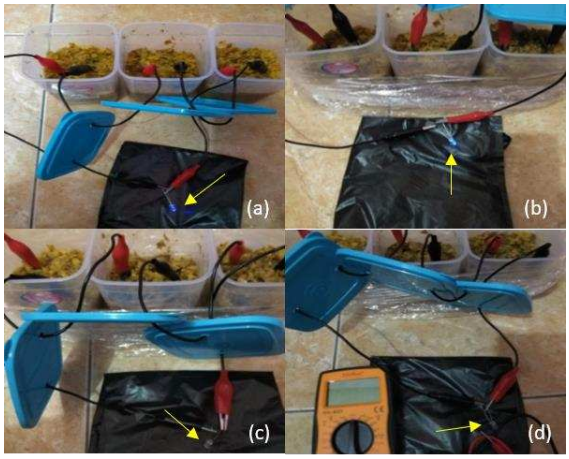

Figure 5. LED test in the measured-voltage of 2.63 V (a), 2.60 V (b), 2.07 V (c), and 2.06 V (d) in 3-SCs, respectively. Yellow arrow showed the LED lamp condition attributed to the condition of light on or off.

However, the long-operating time of experiment decreasing their voltage and current values caused by the oxidation process as shown in Fig. 4 and Table 4. The oxidation process subsequently might cause hydrogen ion (H^+) deficiency. Based on the acid and base theory of Arrhenius suggested that the hydrogen ion is a carrier of acidity property so that the loos of this carrier would decrease their acidity property as well. In addition, it was also due to the presence of oxygen in electrolyte medium can decrease the ion density along with the increase in oxygen dose or the oxidation process (Suciyati et al., 2019).

Finally, this simple research has been explained and discussed by all above-mentioned. The research was built in cheap and affordable by two model categories that are single-chamber and three series-packed chambers where assigned as SC and 3-SCs, respectively. From here, the students expected can take some information that were (1) the large quantity of pineapple peel-based electrolyte medium of 3-SCs could enhance the voltage and current values due to the high ion carrier as same as the electrical conductivity of medium, (2) the voltage and current characteristics would decrease caused by the oxidation process under air, room temperature, and normal pressure conditions over the long-operating time, and (3) the waste or natural sources potentially can be used as electrolyte medium.

Conclusion

The simple experiment of pineapple peel waste-based electrolyte medium was carried out using two systems that were single-chamber (SC) and three series-packed chambers (3-SCs). The 3-SCs showed higher voltage and current than SC. Moreover, the light of the miniature LED lamp could be observed in the measured-voltage of 2.63 and 2.60 V than in 2.07 and 2.06 V of 3-SCs. The decrease of the voltage and current were due to the oxidation process of pineapple peel waste-based electrolyte medium under air, room temperature, and normal pressure during the long-operating time of the experiment. However, this experiment expected to provide additional valuable experience and knowledge as same as to facilitate in information delivering to the students in understanding the electrolyte medium from waste or natural sources such as pineapple peel waste.

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