THE POTENTIAL OF BIO-BATTERY BIOMASS AS AN ALTERNATIVE ENERGY SOURCE (REVIEW ARTICLE)

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Abstract. Batteries are an alternative that is made to help the needs of electrical energy. Batteries are toxic and hazardous materials that can pollute the environment. The use of alternative renewable energy sources that are based on nature has the potential not to pollute the environment. Efforts to reduce the use of chemicals that pollute the environment require innovation to overcome these problems. One of them is by replacing the chemicals contained in the battery by utilizing biomass. The purpose of the literature study is to find out the best voltage and current produced from biomass. The biomass used in this literature study is Durian Peel, Pineapple Peel, Banana Peel, Cassava Peel, Orange Peel, and Potato Peel. The best results from literature studies on voltage and current were obtained from Orange Peel biomass.Orange peel has a pH of 3.9 where at that pH, orange peel has great potential to generate electricity in bio-batteries because it has acidic properties which can be used as an ingredient for making electrolyte in batteries.

keywords: electric current, biobattery, biomass, banana peel, orange peel, voltage

INTRODUCTION

Indonesia and even the world are very dependent on electrical energy where all life activities of almost all of them use electrical energy, the use of electrical energy has greatly increased along with the times(Results et al., 2022). It can be said that electrical energy is a basic need or an important factor for human life(Abdullah & Masthura, 2021). However, electrical energy does not include new and renewable energy where the source of electricity comes from fossils, therefore many other alternatives have been created and developed to meet this need. Such as the use of alternative energy sources available in nature or renewable and environmentally friendly(Muhlisin et al., 2015).

Batteries are an alternative that is created and developed to help meet the needs of electrical energy. Batteries are tools that can generate electricity whose use cannot be separated from household appliances(Nurannisa et al., 2021)by involving the transfer of electrons through a conductive medium from two electrodes (anode and cathode) so as to produce an electric current and a difference in potential. The main components of the battery consist of electrodes and electrolyte(Erviana et al., 2020). The battery components consist of zinc as the anode, carbon as the cathode and the electrolyte used is a paste mixed with MnO_2, carbon powder, and NH_4Cl.(Ristiono, 2021).

Where batteries include materials that contain hazardous and toxic materials such as containing inorganic materials such as nickel, cadmium, lead and mercury so that they can potentially pollute the environment(Siregar, 2017). Therefore, the use of renewable alternative energy sources based on nature has the potential not to pollute the environment(Yolanda et al., 2022). Efforts to reduce the use of chemicals that pollute the environment require innovation to overcome these problems. One of them is by replacing the chemicals contained in the battery by utilizing waste or biomass(Salafa, Hayat, & Ma'ruf, 2020).

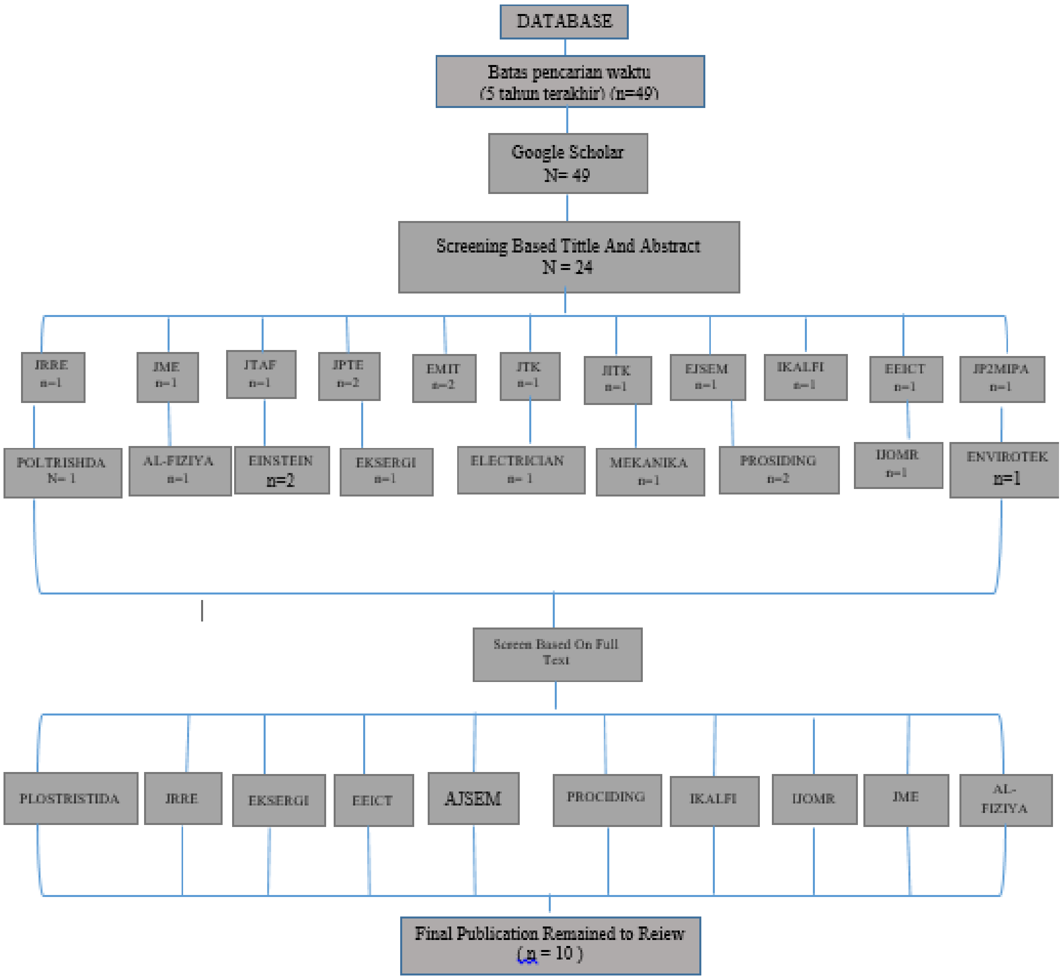
Biomass is a biological material derived from living organisms with a carbon structure which contains organic chemical elements including oxygen, nitrogen, hydrogen and several small atoms that we usually get from plant, animal and human waste.(Setyowati, 2020). This biomass waste will become a problem if it is not utilized properly, and in the end it will become waste that is not useful and has the potential to pollute the environment. This is why biomass is an alternative that can be used as an alternative source of environmentally friendly energy processing such as alternative electricity Bio-Battery.(Iskandar & Rofiatin, 2017).

That is, based on the facts above, it is necessary to solve the problem of reducing the negative effects of batteries and unused biomass waste as a solution to the problem. This is done by recycling the batteries Utilizing waste biomass from durian peels, pineapple peels, banana peels, cassava peels, orange peels and potato peels to become an alternative energy source for bio-batteries that is more ecologically friendly and easy to decompose(Ernawati et al., 2019).

RESEARCH METHOD

This type of research uses a systematic literature review method using the PRISMA model (Preferred Reporting Items for Systematic Review and Meta-analysis). To evaluate meta-analysis, this type of research uses library data collection. method in the form of magazines or articles from national and international magazines. Priority Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) is a complete and detailed step on how to conduct a literature search and consists of five steps to conduct a literature search, namely: (1) Definition of selection criteria (2) definition of data sources (3) selection literature (4) data collection and (5) selection of data elements. Of the many articles received, there are certain criteria, namely the magazine published in the last 5 years (2017-2022) with the reason that this year's publication is still very important to use as a reference. Looking for journal articles Some sources have limited keywords, namely the potential of biomass batteries as an alternative source of electrical energy.(Saputri, Adisya Gressyela & Trihantoyo, 2022).

This study uses a literature review for data collection. The articles in this literature review were re-analyzed by searching the online article database, namely Google Scholar. The keywords used in the search are batteries, biomass, and energy sources. The search results for articles searched in the database yielded 49 articles that were selected, then based on bio-battery, biomass, type of biomass, and energy sources. And then, from the 49 articles found, 24 articles were found with the keyword Biomass used in battery manufacture, then the title and abstract were selected. After analyzing the abstract and full paper, it turned out that only 10 articles were relevant to the topic of discussion. The election results can be seen in table 1.



JRRE	: Journal of Electrical Engineering Research
JME	: Journal of Electrical Media
JTAF	: Journal of Theory and Application of Physics
JPM	: Journal of Community Service
BRAKE	: Journal of Renewable Energy & Mechanics
JTK	: Chemical engineering journal
JNIP	: Journal of Education Management Inspiration
JPCS	:Journal Of Physics
RBAET	: Journal of Engineering Materials and Sustainable Energy
AJSEM	: Asean Journal For Science And Engineering In Materials
JPTE	: Scientific Journal of Electrical Education
IJOMR	: Indonesian Journal Of Multidisciplinary Research
JOTP	: Journal Of Technomaterials Phyrics
EMIT	: Journal Of Energy, Materials, And Instrumentation Technology
HSJ	: Hasanuddin Student Journal
SCENARIOS	: Seminar Of Social Sciences Engineering & Humanion
EECT	: EEICT Journal
EINSTEIN JOURNAL	
AL-FIZIYA	
IK-KALFI	: Journal of the UNIMED Physics Alumni Association
THESIS	
JIMTEK	: Scientific Journal of the Faculty of Engineering

EXERGY : Journal of Energy Engineering
PROCEDURE
IJCST : Indonesian Journal Of Chemical Sciences And Technology
POLTRISTIDE
TECHNICAL : Journal of the Faculty of Engineering

Table 1. Screening results of articles to be reviewed

No.	Article Title	Indexed	Journal Type
1.	THE POTENTIAL OF BANANA SKIN AS A SUBSTITUTE FOR BATTERY CONTENT ELECTROLYTE PASTE IN LINE FOLLOWER ROBOT	Google Scholar	POLTRISHDA
2.	Analysis of Citrus (Citrus Sinensis) Peels as Electrolyte Making Materials in Bio-Batteries	Google Scholar	JRRE
3.	ANALYSIS OF THE UTILIZATION OF BANANA PEEL WASTE AS AN ALTERNATIVE ENERGY IN BATTERIES	Q5	EXERGY
4.	Effect of Variations in Temperature and Drying Time of “Manurun” Kepok Banana Peel Battery Paste Samples on Battery Voltage and Current	Google Scholar	EECT
5.	Teaching concept of bio-battery material: Use of Sweet Potato Peels and Lime Juice Solution	Google Scholar	EJSEM
6.	ELECTRICAL ANALYSIS OF DURIAN (DURIO ZIBETHINUS) WASTE ELECTROLYTE PASTE AS A BIO BATTERY	Google Scholar	PROCIDING
7.	EFFECT OF VOLUME VARIATION OF PINEAPPLE SKIN SOLUTION ON THE ELECTRICAL PROPERTIES OF BIO-BATTERIES	Google Scholar	IKALFI
8.	Analysis of Cassava Peel and Pineapple Peel as Electrolytes in Bio Battery	Google Scholar	IJOMR
9.	UTILIZATION OF BANANA SKIN WASTE AS AN ALTERNATIVE DIRECTIONAL CURRENT SOURCE IN REPLACEMENT OF BATTERY PASTE	Google Scholar	JME

10	Processing Durian Peel Waste and Used Batteries to Become a Source of Environmentally Friendly Electrical Energy	Google Scholar	AL-FIZIYA

RESULT AND ANALYSIS

Biobattery is a tool that generates electrical energy from living things.(Suciyati et al., 2019)The use of disposable batteries generates waste containing B3 types of inorganic waste (hazardous and toxic materials). It is clear from that statement that the commercially available batteries that we use today contain heavy metals such as mercury, lead, cadmium and nickel. Until now, battery processing has not been carried out specifically by related parties or other parties such as the Government. Even though batteries are disposed of carelessly without being treated first, they definitely have a negative impact on the environment because of their heavy metal content.(Ristiono, 2021).

Table 2. Data from Literature Studies with the Best Voltage and Current

No.	Basic material	Variable	Current	Voltage
1.	Ambon Banana Skin	drying time		2 hours → 0.7 volts 4 hours → 0.75 volts 6 hours → 0.8 volts 8 hours → 0.85volts 10 hours → 1.0 volts.
2.	Orange Peel	drying time	1 minute→0.15mA 5 minutes→0.15mA 10 minutes→0.13mA 15 minutes→0.07mA 20 minutes→0.00mA 25 minutes→0.00mA	1 minute→0.92 Volts 5 minutes→0.91 Volts 10 minutes→0.64 Volts 15 minutes→0.43 Volts

				20 minutes→0.15 Volts 25 minutes→0.03 Volts
3.	Durian skin	Measurements with variations in the type of electrode used		if the voltage increases, the current also increases. The ratio of voltage and current, where the current and voltage are directly proportional, is shown by a graph consisting of straight lines that coincide.
4.	Pineapple Skin	Measurement with Cu and Zn electrodes	Volume 50 ml→0.72mA Volume 100 ml→15.6 mA Volume 150 ml→18.0 mA Volume 200 ml→31.5 mA Volume 250 ml→36.0 mA	Volume 50 ml→1.53 Volts Volume 100 ml→1.60 Volts Volume 150 ml→1.92 Volts Volume 200 ml→2.92 Volts Volume 250 ml→3.50 Volts
5.	Cassava Skin and Pineapple Skin	Measurement with electrolyte variations	Electrolyte Variation 100 : 0→0.79mA Electrolyte Variation 75 : 25→0.79mA Electrolyte Variation 50 : 50→0.74mA Electrolyte Variation 25 : 75→0.54mA Electrolyte Variation 0 : 100→0.64mA	Electrolyte Variation 100 : 0→0.83 Volts Electrolyte Variation 75 : 25→0.79 Volts Electrolyte Variation 50 : 50→0.75 Volts Electrolyte Variation 25 : 75→0.73 Volts

				Electrolyte Variation 0 : 100→0.73 Volts
6.	Ambon Banana Skin	Measurement using a multimeter	At 3 grams of banana peel mass and 20 grams of electrolyte mass→0.22 A At 5 grams of banana peel mass and 15 grams of electrolyte mass→0.26 A At 15 grams of banana peel mass and 10 grams of electrolyte mass→0.27 A At 15 grams of banana peel mass and 15 grams of electrolyte mass→0.28 A At 20 grams of banana peel mass and 5 grams of electrolyte mass→0.20 A At - gram mass of banana peel and full gram mass of electrolyte→0.32 A	At 3 grams of banana peel mass and 20 grams of electrolyte mass→2.43 Volts At 5 grams of banana peel mass and 15 grams of electrolyte mass→2.71 Volts At 15 grams of banana peel mass and 10 grams of electrolyte mass→2.88 Volts At 15 grams of banana peel mass and 15 grams of electrolyte mass→2.90 Volts At 20 grams of banana peel mass and 5 grams of electrolyte mass→2.40 Volts At - gram mass of banana peel and full gram mass of electrolyte→3.2 3 Volts
7.	King Jackfruit Banana Skin	Immersion	The current in the Jackfruit King Banana Skin is 0.75 Volts	
8.	Banana peel kepok	No drying, and at drying temperature	At 20 minutes → 0.027 A at drying temperature 100℃, 0.041 A at	At 20 → 1.262 volts at 100℃ drying temperature,

			decomposition temperature 150 ℃ and does not generate current without drying At 40 minutes → 0.028 A at 100℃ drying temperature, 0.076 A at 150℃ decomposition temperature and 0.005 A without drying At 60 minutes → 0.134 A at drying temperature 100℃, 0.005 A at decomposition temperature 150 ℃ and does not generate current without drying	1.368 volts at 150℃ decomposition temperature and no voltage output without drying At 40 → 1.139 volts at 100℃ drying temperature, 1.328 volts at 150℃ decomposition temperature and 1.110 volts without drying At 60 → 1.476 volts at 100℃ drying temperature, 1.099 volts at 150℃ decomposition temperature and no voltage output without drying
9.	Potato Peel	Bio-battery voltage measurement with the bio-battery used		In the sweet potato skin battery variation → 1.454 Volts. In the sweet potato skin battery variation → 1.475Volt. In the sweet potato skin battery variation → 1.035
10.	Durian skin	Measurement using a digital multinmeter	On the durian skin which has a mass of 10 grams and a small battery mass of 15 grams → 0.08 A	The durian skin has a mass of 10 grams and a small battery mass of 15 grams → 1.4 Volts

Bio-battery made using Ambon banana peel biomass by(Singgih & Magelang, 2020)by utilizing banana peel biomass in the form of paste with the variable used is drying time. The accompaniment process is a way in which a sample is made by drying in stages rather than being carried out all at once. The drying process requires water. In this process, water plays an important role, even though the banana peel is dried, the water is still stored in the banana peel. The level of drying of banana peels can affect the voltage that will be generated. Where when the longer drying is done, the resulting voltage will also be greater. In the research conducted by singgih, a voltage of 1.0 volts was generated for 10 hours of drying time.

Citrus peel is a biomass that has the potential to produce electricity by making it with the help of bio-battery media. As research conducted by(Salafa, Hayat, & Ma, 2020)which seeks to reduce the use of chemicals that can pollute the environment, by utilizing orange peel waste as a battery charge in the form of a solution of orange peel extract. Orange peel has a pH of 3.9 where at that pH, orange peel has the potential to generate electricity in bio-batteries because it has acidic properties which can be used as a material for making electrolyte in batteries.

Durian shell waste is underutilized among the community, where when it is consumed, the waste is disposed of without being utilized. In fact, durian skin contains substances that can generate electricity, which can be used as alternative energy. In research conducted by(Khairiah & Destini, 2017)that durian peel waste has good potential to be used as an environmentally friendly bio-battery in the form of a paste. Where if the electric voltage rises, then the electric current generated also increases.

Volume variations affect the electricity generated in the bio-battery. As in the research conducted by(Masthura & Jumiati, 2021)that pineapple is a fruit that has a fairly high acid content and has the potential to produce electrical energy. The resulting electric current and voltage indicate that the more volume of solution used, the greater the voltage and electric current generated in the bio-battery.

Research conducted by(Sitanggang et al., 2021)by utilizing the biomass of cassava skin and pineapple skin, the greatest and best stress is produced at a 100:0 electrolyte variation. The best voltage and current is produced from a mixture of cassava skin paste and pineapple skin. Where the ratio of 100: 0 is the best ratio of voltage and curent that comes from a mixture of cassava skin and pineapple skin.

Banana is a type of biomass that has many benefits, but is underutilized by the community. Bananas are widely cultivated by the community, due to the increasing cultivation of banana plants, this has an impact on more and more banana peels being wasted without being used or recycled. In fact, banana peels have the potential to generate electricity.(Ashari et al., 2022)conducted research using banana peel waste to test the current and voltage in banana peels by utilizing bio-batteries.

Battery waste is dangerous if there is continuous no action taken to fix it, the environment will be increasingly polluted.(Purwati et al., 2017)conducted research by utilizing biomass from jackfruit plantain peels used as a substitute for carbon in batteries in the form of paste. Jackfruit plantains have the potential to produce electrical energy, because they have a higher level of acidity compared to other types of bananas, this is because jackfruit plantains contain high electrolytes.

Researchers are looking for solutions to problems that often occur among the community, namely problems related to the lack of alternative energy, where alternative energy can be renewed and can be used by people in need. Fruit waste is biomass that can be used to create alternative energy in the form of electrical energy. As research conducted by(Karim, 2018)who utilize kepok banana peel waste to create alternative energy in the form of a paste because it has good potential. Where in the experiment conducted by Karim, the greatest current and voltage results were produced when the drying temperature was 100 ℃ for 60 minutes with a current value of 0.134 A and a voltage of 1.476 Volts. The temperature and drying time contained in the banana peel paste affect the voltage value in the battery. Drying the banana peel paste sample affects the electric current generated by the battery. In the drying process, the water content in the battery paste affects the current and voltage it produces.

Potato skin biomass is used to generate electricity based on research conducted by(Maulida et al., 2022)that the biobattery paste made from sweet potato peels with 5 and 10% lime juice had the highest voltage among other varieties, namely 1.454 and 1.475 volts. Although the bio-battery voltage is lower than the standard 1.5V dry battery, the use of bio-battery can still be considered.

Gifron conducted research by utilizing the biomass from durian skin, that durian skin which was done by drying using an oven for 2 hours, was better and had a longer shelf life. In addition to its longer durability, the experiment was carried out with a shorter 2 hour time compared to that carried out by drying it in direct sunlight. From these experiments, with a short time, it was able to produce an environmentally friendly battery in just 2 hours.(Gifron et al., 2018)

CONCLUSION

Batteries are an alternative energy that is made and developed to meet the needs of electrical energy. Batteries are materials that are toxic and dangerous which can pollute the environment. The efforts that can be made toTo reduce the use of chemicals that pollute the environment, innovation is needed to overcome this problem. One of them is by replacing the chemicals contained in the battery by utilizing waste or biomass. Based on the articles that have been reviewed, it is concluded thatBased on research conducted by Salafa thatOrange peel has a pH of 3.9 where at that pH, orange peel has great potential to generate electricity in bio-batteries because it has acidic properties which can be used as an ingredient for making electrolyte in batteries.

References

Abdullah, A., & Masthura, M. (2021). Pemanfaatan Sari Nenas Sebagai Sumber Energi Alternatif Pembuatan Bio-Baterai. *CIRCUIT: Jurnal Ilmiah Pendidikan Teknik Elektro*, *5*(1), 51. https://doi.org/10.22373/crc.v5i1.8494

Ashari, H., Vitalocca, D., Ilmia, N., Elektro, P. T., Makassar, U. N., Makassar, U. N., Elektro, P. T., & Makassar, U. N. (2022). *Pemanfaatan Sampah Kulit Pisang Sebagai Alternatif Sumber Untilization Of Banana Peel Waste As An Alternative Source Of Direct Current Instead Of Battery Stone Paste*. *19*(3), 144–148.

Ernawati, D., Arifudin, M., & Husodo, S. B. (2019). Baterai Ramah Lingkungan dari Limbah Serbuk Kayu Merbau (Intsia bijuga) dan Matoa (Pometia sp .) (Eco-friendly battery from Merbau (Intsia bijuga) and Matoa (Pometia sp .) sawdust). *Ilmu Teknl. Kayu Tropis*, *17*(1), 83–89.

Erviana, Y., Supriyanto, A., Suciyati, S. W., & Pauzi, G. A. (2020). Analisis Karakteristik Elektrik Onggok Singkong Fermentasi yang Diawetkan sebagai Pasta Bio-Baterai. *Journal of Energy, Material, and Instrumentation Technology*, *1*(1), 27–32. https://doi.org/10.23960/jemit.v1i1.10

Gifron, M., Agustina, N., & Wela, D. (2018). Pengolahan Limbah Kulit Durian dan Baterai Bekas Menjadi Salah Satu Sumber Energi Listrik yang Ramah Lingkungan. *Al-Fiziya: Journal of Materials Science, Geophysics, Instrumentation and Theoretical Physics*, *1*(1). https://doi.org/10.15408/fiziya.v1i1.8997

Hasil, J., Bidang, P., Bio-baterai, P., Sirait, R., & Putri, I. (2022). *EINSTEIN (e-Journal)*.

Iskandar, T., & Rofiatin, U. (2017). Karakteristik Biochar Berdasarkan Jenis Biomassa Dan Parameter Proses Pyrolisis Biochar Characteristics Based on Biomass Types and Pyrolysis Process Parameters. *Teknik Kimia*, *12*, 28–34.

Karim, S. (2018). Jurnal EEICT https://ojs.uniska-bjm.ac.id/index.php/eeict. *Jurnal Ilmiah Teknik Elektro*, *1*(2), 41–52.

Khairiah, & Destini, R. (2017). Analisis Kelistrikan Pasta Elektrolit Limbah Kulit Durian (Durio Zibethinus) Sebagai Bio Baterai. *Prosiding Seminar Nasional Pendidikan FKIP UNTIRTA 2017*, *1*, 41–44.

Masthura, & Jumiati, E. (2021). Pengaruh Variasi Volume Larutan Kulit Nenas Terhadap Sifat Kelistrikan Bio-Baterai. *Jurnal Ikatan Alumni Fisika Universitas Negeri Medan*, *7*(3), 1–6.

Maulida, R., Daffa, M. N., Nadhira, S. F., Hotimah, A. P., & Anggraeni, S. (2022). *ASEAN Journal for Science and Engineering in Materials Teaching concept of bio-battery material : Use of Sweet Potato Peels and Lime Juice Solution*. *1*(2), 55–58.

Muhlisin, M., Soedjarwanto, N., & Komarudin, M. (2015). Pemanfaatan Sampah Kulit Pisang dan Kulit Durian Sebagai Bahan Alternatif Pengganti Pasta Batu Baterai. *Jurnal Rekayasa Dan Teknologi Elektro*, *9*(3), 137–147.

Nurannisa, A., Muhammad, A., Taufan, I., Muhamad, A., & Akbar, I. (2021). Diseminasi Olah Praktis pada Ibu PKK Dusun Kallimpo dalam Pengolahan Limbah Kulit Pisang menjadi Bio-Baterai. *Prosiding Seminar Nasional Pengabdian Kepada Masyarakat*, *3*(Peran Akademisi dalam Pemberdayaan Masyarakat di masa Pandemi), 103–110.

Purwati, W., Eng, M., Teguh,), Drs, H. M., Program,), Teknik, S., Energi, K., Teknik, J., Politeknik, M., Semarang, N., & Sudarto, J. H. (2017). Analisis Pemanfaatan Limbah Kulit Pisang Sebagai Energi Alternatif Pada Batterai. *EKSERGI Jurnal Teknik Energi*, *13*(2), 61–67.

Ristiono, A. (2021). Analisis Pemanfaatan Limbah Kulit Pisang Sebagai Komponen Baterai Ramah Lingkungan. *Mekanika*, *2*(2), 47–53.

Salafa, F., Hayat, L., & Ma'ruf, A. (2020). An Analysis of Orange Peel (Citrus Sinensis) as the Material for Electrolystes in Bio-Batteries. *Jurnal Riset Rekayasa Elektro*, *2*(1). https://doi.org/10.30595/jrre.v2i1.6443

Salafa, F., Hayat, L., & Ma, A. (2020). Analisis Kulit Buah Jeruk (Citrus Sinensis) Sebagai Bahan Pembuatan. *Jurnal Riset Rekayasa Elektro*, *2*(1), 1–9.

Saputri, Adisya Gressyela, & S., & Trihantoyo. (2022). Penerapan Model Pembelajaran Problem Solving Dalam Perspektif Merdeka Belajar Di Masa Pandemi Covid-19. *Jurnal Inspirasi Manajemen Pendidika*, *10*(2), 352–363. https://ejournal.unesa.ac.id/index.php/inspirasi-manajemen-pendidikan/article/view/47242%0Ahttps://ejournal.unesa.ac.id/index.php/inspirasi-manajemen-pendidikan/article/view/47242/40533

Setyowati, N. (2020). Analisis Kelistrikan Limbah Biomassa Sebagai Gel Elektrolit Baterai. *Jurnal Ilmiah Teknik Lingkungan*, *1*(2), 7–11.

Singgih, S., & Magelang, U. T. (2020). Potensi Kulit Pisang Sebagai Pengganti Pasta Elektrolit Isi Baterai. *Jurnal Poltrisdha*, *1*(1 November 2018), 112–115.

Siregar, S. M. (2017). Pengaruh Bahan Elektroda Terhadap Kelistrikan Belimbing Wuluh (Averrhoa Bilimbi) sebagai Solusi Energi Alternatif Ramah Lingkungan. *Jurnal Penelitian Pendidikan MIPA*, *2*(1), 166–173. https://jurnal-lp2m.umnaw.ac.id/index.php/JP2MIPA/article/download/143/136

Sitanggang, J. E., Latifah, N. Z., Sopian, O., Saputra, Z., Nandiyanto, A. B. D., Anggraeni, S., & Rahmat, A. (2021). Analysis of Cassava Peel and Pineapple Peel as Electrolytes in Bio Battery. *Indonesian Journal of Multidiciplinary Research*, *1*(1), 59–62. https://doi.org/10.17509/ijomr.v1i1.33774

Suciyati, S. W., Asmarani, S., & Supriyanto, A. (2019). Analisis Jeruk Dan Kulit Jeruk Sebagai Larutan Elektrolit Terhadap Kelistrikan Sel Volta. *Jurnal Teori Dan Aplikasi Fisika*, *7*(1), 7–16.

Yolanda, N., Masthura, & Daulay, A. (2022). Pengaruh Variasi Waktu Fermentasi Terhadap Kelistrikan Sel Volta dengan Menggunakan Larutan Buah Tomat. *Jurnal EINSTEIN*, *10*(2), 61–66. http://jurnal.unimed.ac.id/2012/index.php/einsten