Advance Sustainable Science, Engineering and Technology (ASSET) is a peer-reviewed open-access international scientific journal dedicated to the latest advancements in sciences, applied sciences and engineering, as well as relating sustainable technology. This journal aims to provide a platform for scientists and academicians all over the world to promote, share, and discuss various new issues and developments in different areas of sciences, engineering, and technology.

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Editorial Preface

Advance Sustainable Science, Engineering and Technology (ASSET)
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We are delighted to present Volume 5 Number 1 of Advance Sustainable Science, Engineering and Technology (ASSET). In this issue, we showcase a diverse collection of research articles that exemplify the remarkable contributions made by scholars in various fields. These papers shed light on important topics and provide valuable insights into the advancement of science, engineering, and technology.

Firstly, we have the article titled "Physical and Chemical Characteristics of Biscuits with Catfish Flour (Clarias batrachus) Addition" by Rini Umiyati et al. This study explores the addition of catfish flour to biscuits and investigates the resulting physical and chemical characteristics. Next, we present the research paper titled "Analysis Spatial Pattern Garbage Bank using Web Geographic Information System in Yogyakarta City" by Vidyana Arsanti et al. This study examines the spatial pattern of garbage banks in Yogyakarta City using a web geographic information system, providing valuable insights for waste management. Another significant contribution is the article titled "Power Losses Caused by Load Imbalance in the Central Building of PGRI Semarang University" by Muhammad Zaenal Arifin et al. This study focuses on identifying and addressing power losses caused by load imbalance in the central building of PGRI Semarang University, aiming to improve energy efficiency. In addition, we showcase the paper titled "My Javelin Throw: An Android-based Javelin Throw Learning Application" by Ibnu Fatkhu Royana et al. This study introduces an innovative learning application designed to enhance javelin throw skills, utilizing modern technology to improve athletic training. Furthermore, we present the research article titled "The Effect of Storage Conditions on the Absorption Profile of 2% Lydocaine Hydrochloridum Injection by UV-Vis Spectrophotometry" by Dian Marlina et al. This study investigates the impact of storage conditions on the absorption profile of a specific pharmaceutical injection, providing crucial insights into the stability and efficacy of the medication. Additionally, we feature the paper titled "Utilization of Heat from Geothermal Well Pipes as Electricity for Road Lighting Based on The Internet of Things" by Rizani Firdaus and Muhamad Ariandi. This study explores the utilization of geothermal energy from well pipes to generate electricity for road lighting, demonstrating an innovative application of the Internet of Things (IoT) technology. Moreover, we present the research on "Ergonomic Evaluation of Mechanical Workshop Activities to Reduce Musculoskeletal Disorders" by Saifun Hakim et al. This study evaluates the ergonomic aspects of mechanical workshop activities to minimize the risk of musculoskeletal disorders, aiming to create a safer and healthier work environment. Additionally, we feature the article titled "Analysis Determination of the Best Employee Using the Simple Additive Weighting Method" by Haryo Kusumo et al. This study presents an analysis method for determining the best employee using the Simple Additive Weighting (SAW) technique, providing valuable insights for human resource management. Furthermore, we highlight the research paper titled "Aspect-based Sentiment Analysis on Car Reviews Using SpaCy Dependency Parsing and VADER" by Muchamad Taufiq Anwar et al. This study applies aspect-based sentiment analysis on car reviews using SpaCy dependency parsing and VADER (Valence Aware Dictionary and sEntiment Reasoner) to extract and analyze the

sentiment expressed towards specific aspects of the reviewed cars. Moreover, we showcase the research on "Reduction of Dissolved Ammonia with the Stripper Method in pH and Temperature Variations" by Ery Fatarina et al. This study investigates the reduction of dissolved ammonia using the stripper method under varying pH and temperature conditions, contributing to the understanding of ammonia removal techniques in water treatment processes. Additionally, we present the study titled "Measuring Risk Factor Analysis Using PCA Method In Batik Business (Case Study: SMEs Batik Cirebon)" by Alya Az Zahraa et al. This research employs the Principal Component Analysis (PCA) method to measure risk factors in the batik business, specifically focusing on Small and Medium Enterprises (SMEs) in Cirebon, Indonesia. Furthermore, we feature the article titled "Glycemic Index of Diverse Rice Genotypes and Rice Products Associated with Health and Diseases" by Yheni Dwiningsih and Jawaher Alkahtani. This study examines the glycemic index of different rice genotypes and rice products, exploring their association with health and diseases. Lastly, we present the research on "The Effect of Combination of Coconut Water and Sugarcane Water on Freshness Duration and Solution Absorption in Cut Chrysanthemums" by Ipah Budi Minarti et al. This study investigates the effect of combining coconut water and sugarcane water on the freshness duration and solution absorption in cut chrysanthemums, providing insights into the post-harvest preservation of flowers.

We express our sincere gratitude to all the 57 authors who have contributed their valuable research to this issue. Their dedication and expertise have made this publication possible. We would also like to acknowledge the universities involved, including Universitas PGRISemarang, Universitas Amikom, Universitas PGRI Semarang, Universitas Setia Budi, Universitas Bina Darma, Diponegoro University, Universitas Sains dan Teknologi Komputer, Politeknik STMI Jakarta, UNTAG University, University of Arkansas (USA), and King Saud University (Saudi Arabia).

Lastly, we extend our warm congratulations to ASSET for achieving the esteemed SINTA3 accreditation status based on the Decree of the Director General of Director General of Higher Education, Research, and Technology, Ministry of Education, Culture, Research, and Technology (Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi) of Indonesia Number 225/E/KPT/2022 on 7 December 2022. This recognition reflects ASSET's commitment to maintaining high-quality standards and contributing to the advancement of science, engineering, and technology.

April 2023
Assoc. Prof. Mega Novita
Asst. Prof. Rizky Muliani Dwi Ujianti

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Physical and Chemical Characteristics of Biscuits with Catfish Flour (Clarias batrachus) Addition

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Abstract. Biscuits are a snack that is preferred by many people because they have a more dominant carbohydrate content and relatively lower protein content, so it is necessary to add flour with a high protein content, one of which is catfish flour. The purpose of this study determines the effect of different characteristics of catfish flour biscuits with the addition of each concentration treatment on the physical, chemical and organoleptic properties of catfish biscuits (0%, 5%, 10%, 15%). The research method used a Completely Randomized Design of One Component Factors with four treatments B0, B1, B2 and B3. Research analysis carried out included chemical properties (moisture content, ash content, protein content, fat content) and color test. The results of this study indicate that biscuits with the addition of catfish flour obtained a moisture content between 4.96-4.53%, ash content 2.19-4.07%, fat content 62.95-78.23%, protein content 6.74 -8.68%, Color between 10.73-7.73%, Texture between 24.01-23.18%. The color test results with the addition of catfish flour can reduce the value of the color test. This shows that the addition of catfish flour is effective in increasing the protein content of biscuits.

Keywords: biscuit, cat fish, cat fish flour

1. Introduction

Fish flour is an important source of animal protein because it contains complex amino acids such as lysine and metinine, which are found in animal and fish feeds. According [1], fish flour has not been widely developed for use as human food, currently people only use it as fish feed [1]. Catfish protein (Clarias sp.) which is a by-product of fish processing is known as catfish flour. The use of catfish flour as a source of protein in the manufacture of catfish flour biscuits offers a promising alternative for the production of biscuits and the use of fish flour as a food ingredient. Fish flour is a fish product that has been processed so that it has a longer shelf life. According to [2] good catfish flour is used, namely from the head and body of the fish which contains protein between 56-64%.

The addition of food ingredients from food ingredients is one way to improve the nutritional quality of the community, which can be done by fortifying proteins, minerals and vitamins. The addition of protein itself can be done by adding vegetable protein from soybeans which are high in protein and can also be from animal protein from fish. One of them comes from catfish, a superior fresh water product that is easy to cultivate, inexpensive, and has sufficient protein (17.7 percent) in its body. The use of catfish flour itself has benefits as a source of animal protein in addition to making biscuits which has not been done much. By making a light breakfast with a high protein content using a combination of medium protein flour and catfish flour, people can overcome the problem of malnutrition due to biscuits.

Biscuits are dry baked goods made with cake batter made from wheat flour (can be substituted). Permitted food additives may also be used. Margarine, powdered milk, powdered sugar, egg yolks, salt and baking powder can all be used to make biscuits. This product has a low moisture content, less than 5%, and is dry. All ages, both children and adults, can consume this product with various types of biscuits [3].

One food ingredient that has sufficient protein content and can be used as an additional component in biscuits is catfish. Lysine is an amino acid found in catfish in high proportion (10.5%) along with a relatively high amount of protein (17 percent). Because of catfish's high water content (76 percent), which makes it susceptible to spoilage, coating catfish flesh is the best way to work catfish when preparing biscuits. The protein content of catfish itself is quite high, namely 63.83% [4]. Improving the nutritional condition of toddlers can be influenced by consuming biscuits to replace catfish flour for 88 days, according to [5].

Based on this context, a study was conducted with the effect of adding catfish flour to the characteristics of catfish biscuits. This study aims to determine the differences in the addition of catfish flour to chemical characteristics.

2. Methods

The instruments used in chemical analysis are Knives, cutting boards, mixers, spoons, tins, biscuit molds, incubators, erlemeyers, filter paper, scales, label paper, tissue, cotton, and blenders are the tools used to make catfish flour and biscuits. Soxhlet, circular flask, china dish, oven, desiccator, analytical balance, mortar, circular flask, aluminum foil, filter paper, kjehdahl flask, pipette, Erlenmeyer and ruler. The ingredients used are fresh catfish obtained from Pasar Kobong Semarang (Fish Market), Eggs, Low Protein Wheat Flour (Blue Key Brand), Refined Sugar, Butter, Baking Soda (Kopoe-Kopoe Brand), Salt.

Three steps are involved in producing biscuits: making the dough, molding it, and baking it. The procedure for combining and mixing the ingredients is the first step in making the dough. According to [6] the creaming method and the all-in method are the two basic approaches to mixing dough. The basic elements are combined gradually when using the cream method. Fat and sugar are mixed first, then flavorings and coloring are added, then milk and aerating agents are added, as well as salt which has been dissolved in water. The final step is to add flour. According to [7] in [8] this technique produces dough that prevents excessive gluten formation, making it suitable for biscuits. The all-in approach is done by combining all the ingredients and then stirring them until they become a dough that lives up to its name.

The analysis carried out included chemical and physical analysis which included physical analysis, texture and color, chemical analysis including water content, fat content, protein content. The analysis carried out included chemical analysis, physical analysis, then statistical analysis data testing was carried out using One Away Anova to evaluate the test data. Continue with the DMRT test at the 5% level if the analysis results show a significant difference between treatments. SPSS 26.0 was used for data analysis.

3. Results and Discussion

3.1. Systematics of the Article

The water content included in food products is the water content which is usually expressed as a percentage. Water content can affect appearance, texture, and taste in food Based on the results of water content can be seen in Table 1.

Table 1. Value of Chemical Analysis of Catfish Biscuits

Sample	Chemical Analysis			
	Water Content	Ash Content	Fat	Protein
0%	4,95 ± 0,83a	2,19 ± 0,23[a]	62,95 ± 0,58[a]	6,74 ± 0,03[a]
5%	4,92 ± 0,86a	2,34 ± 0,00[a]	64,70 ± 0,59[b]	7,46 ± 0,00[b]
10%	4,60 ± 0,46a	3,76 ± 0,63[b]	67,48± 1,17[c]	8,24 ± 0,00[c]
15%	4,75 ± 0,46[a]	4,07 ± 0,92[b]	78,22 ± 0,76[d]	8,68 ± 0,02[d]

At this value it can be seen that the water content in the biscuit with the addition of catfish flour was not significantly different. Based on the value of the water content has decreased, this is due to the higher content of catfish flour, the lower the resulting water content. At a concentration of 0% biscuits without the addition of catfish flour the water content was 4.96% while at a concentration of 5% -15% it decreased significantly. In this study, there was a decrease in water content, namely the higher the addition of catfish flour [6]. This was due to the raw material used, namely the water content in wheat flour, the water content was 11.82% so the water content in 0% biscuits has a high value, this can also be caused during the baking process denaturation occurs with the addition of catfish flour, this is due to the fact that there are quite a lot of substitutions for catfish flour so that the water content obtained is low. According to [6] in this study the water content of catfish biscuits was 4.00-1.63% during roasting and the temperature used was lower so it was lower, it was feared that it would affect the protein contained in the catfish flour.

The ash content values of 2.35 percent and 4.07 percent increased from the addition of 5 percent concentration to an additional 15 percent concentration. The amount of catfish flour increased the ash content of the fortified catfish flour biscuits, therefore the higher the concentration of catfish flour added, the higher the ash content of the catfish biscuits. This is due to the high mineral content in catfish biscuits. The result of the addition of biscuit ash content is due to the addition of minerals contained in catfish flour. Based on these findings, the ash content of biscuits exceeds or does not meet the quality standards set out in SNI 01-2973-1992 by the National Standards Agency (1992), which states that the ash content of biscuits may not exceed 1.5 percent [9]. According to [10], despite the high ash concentration, the ash content of other biscuits can range from 0.5 percent to 4.3 percent.

The fat content in the table shows the fat content of the biscuits after being enriched with catfish flour. With the addition of catfish flour, the fat content in the biscuits is drastically different. Where at the biscuit concentration value of 0% the fat content was 62.95% and at a concentration of 5-10% there was an increase in the value of the fat content which was 64.7-67.49% while the fat content value of the biscuit with the addition of catfish flour increased the fat content quite high, namely 78.23% where the fat content of 15% is high. [4] stated that the addition of catfish flour can also increase the fat content of the biscuits. This is due to the high fat content of catfish flour (20.83%). This can also occur due to the addition of raw materials such as eggs and margarine which have a high fat content due to the high fat content. According to BSN (1992) the fat content has been set at a minimum of 6% so that biscuits with the addition of catfish flour meet the quality standards of biscuits. This also happened in research [11] where the value of the fat content increased in the manufacture of MPASI biscuits with the addition of catfish, which was 16.5-21.0%.

The protein content in the biscuits with the addition of catfish flour showed significantly different results from the protein content in the catfish flour biscuits. It can be seen in the diagram that the more catfish flour added, the higher the protein content in the biscuit. At a concentration value of 0% without the addition of catfish flour, the protein content value is 6.74%, while at 5-10% the protein content value

increases, namely 7.46-8.68%. This is because the protein content in catfish flour is a high quality protein source, so it can increase the protein content in these biscuits. According to[6] the protein content in catfish body is 63.83% greater than catfish head flour which is 56.04%. According to the biscuit quality requirements based on SNI 01-2973-1992 where the protein content is at least 6%. The results of research on making biscuits with the addition of catfish flour that meet SNI standards for protein content in biscuits show this. The protein content value of 0-15% has fulfilled the SNI quality standard of 6.74-8.68%. This may also be because raw materials containing protein found in eggs are used to increase the value of the quality of protein content

3.2. Color Analysis
Biscuit color testing with the addition of catfish flour was carried out using a color reader, knowing the values of L*, a* and b*. The results of the biscuit color analysis can be seen in Table 2.

Table 2. Color Analysis

Sample	Parameter		
	L*	a*	b*
0%	60,92 ± 0,75[a]	10,73± 0,04[a]	24,01± 0,77[a]
5%	55,77 ± 0,11[a]	10,26 ± 0,28[b]	23,64 ± 0,40[a]
10%	55,68 ± 0,30[a]	9,65 ± 0,11[c]	23,63 ± 0,83[a]
15%	55,63 ± 0,12[b]	7,73 ± 0,21[d]	23,18 ± 0,91[a]

The L* notation indicates how light or dark a color is. The L* notation states the brightness parameter which has a value between 0 (black) to 100 (white). The L* value of the biscuits was 55.63-60.92 which indicated that the biscuits with the addition of catfish flour were less bright or dull in color. When baking biscuits, the addition of catfish flour had a significant effect on the brightness level of the finished product compared to biscuits without the addition of catfish flour. This could be due to the inclusion of catfish flour which has a low brightness level, making the biscuits less bright than the control biscuits, or the absence of catfish flour. In addition, the Maillard reaction occurs during the baking of biscuits, turning them brown. When lysine, an amino acid with a high concentration in catfish flour, is roasted with sugars including fructose, maltose, and lactose, the Maillard reaction occurs.

With the addition of catfish flour, it can be seen in Table 2 that the value of a* shows a decreasing value. This causes the color of the biscuits with the addition of catfish flour to tend to be reddish in color. When catfish flour is added during the preparation of these biscuits, the value of a* will increase the more catfish flour is added and the less flour is added. According to [12] this occurs due to reactions between the amino groups in acids from catfish flour, wheat flour, eggs, skim milk with glycosidic hydroxyl groups in sugar which can result in the formation of polymers brown nitrogen is called the Maillard reaction. When catfish flour is added, the color is dirtier than without flour. Catfish flour which contains brown flour pigment makes the biscuits look blackish brown spots.

Based on the b* value, the color of the biscuits with the addition of catfish flour has a b* value above the biscuits with the addition of catfish flour which has a positive b* value, which means the chromatic color is yellow and shows a b* value in catfish biscuits with the addition of catfish flour which has a tend to be brown. brass. Biscuits added with catfish flour caused a decrease in b* value which was not significantly different. biscuits with the addition of catfish flour in the manufacture of these biscuits where the higher the addition of catfish flour and the lower the addition of wheat flour, the a* value increases. According to [12] this occurs due to reactions between the amino groups in acids from catfish flour, wheat flour, eggs, skim milk with glycosidic hydroxyl groups in sugar which can result in the formation of polymers brown nitrogen is called the Mailard reaction.

4. Conclusion
Based on the research results it can be concluded that the addition of wheat flour with a concentration of 0%, 5%, 10%, 15% can affect the water content, ash content, fat content, protein content, color of the

material. biscuits. The results of the best biscuit chemical analysis showed that the addition of catfish flour was able to reduce the water content and ash content. While the fat content and protein content can increase the protein and fat content in biscuits. The results of the color analysis test showed that the highest L* value was parameter 0 with the addition of catfish, while the lowest value was biscuits with the addition of 15%. The highest a* value is 0% and the lowest a* value is 15%. The highest b* value is 0% while the lowest b* value is the addition of 15% catfish flour.

References

[1]   D. P. Sari, R. Nopianti, dan A. Baehaki, "Karakteristik Sensori dan Fisiko-Kimia Crackers dengan Penambahan Tepung Ikan Sepat Siam (Trichogaster pectoralis)," *FishtecH – J. Teknol. Has. Perikan.*, vol. 6, no. 2, hal. 115–125, 2017.

[2]   Hermanto dan A. Susanty, "KARAKTERISTIK FISIKOKIMIA DAN SENSORIS BISKUIT DENGAN PENAMBAHAN TEPUNG IKAN TOMAN (Channa micropletes) PHYSICOCHEMICAL," vol. 14, no. 2, hal. 253–262, 2020.

[3]   R. Setyawati, H. Dwiyanti, dan N. Aini, "SUPLEMENTASI TEPUNG IKAN-TEMPE PADA BISKUIT UBI KAYU SEBAGAI UPAYA PENANGGULANGAN KURANG ENERGI PROTEIN PADA IBU HAMIL," in *Prosiding Seminar Nasional dan Call for Papers "Pengembangan Sumber Daya Perdesaan dan Kearifan Lokal Berkelanjutan VII"17-18 November 2017 Purwokerto*, 2017, no. November, hal. 314–323.

[4]   R. F. Widyaniputria, N. Novidahlia, D. A. Nur'utami, dan C. Nurwitri, "Penambahan Tepung Ikan Lele Dan Tepung Kedelai Pada Biskuit Modified Cassava Flour Untuk Lansia," *J. Agroindustri Halal*, vol. 6, no. 1, hal. 77–86, 2020.

[5]   W. Horwitz dan J. George W. Latimer, *Official Methods of Analysis of AOAC International*, 18 ed., no. February. MARY LAND: AOAC IN TER NA TIONAL SUITE 500 481 NORTH FRED ER ICK AV E NUE GAITHERSBURG, MARY LAND 20877-2417, USA, 2006.

[6]   N. Amir, Syahrul, N. Djamaluddin, dan I. Andriani, "THE PREFERENCY AND CHEMICAL CHARACTERISTICS OF STICK PRODUCTS FORTIFICATION OF SUCKERMOUTH CATFISH FLOUR (Pterygoplichthys pardalis)," *J. IPTEKS PSP*, vol. 9, no. October 2022, hal. 76–86, 2023, doi: 10.20956/jipsp.v9i2.23773.

[7]   K. . Buckle, R. . Edwards, G. H. Fleet, dan M. Wootton., *Ilmu Pangan (Food Science)*. Jakarta: Penerbit Universitas Indonesia (UI-Press).

[8]   I. P.A.N dan F. Ayustaningwarno, "PENGARUH SUBSTITUSI TEPUNG DAGING IKAN LELE DUMBO (CLARIAS GARIEPINUS) DAN TEPUNG UBI JALAR KUNING (IPOMOEA BATATAS L.) TERHADAP KANDUNGAN ZAT GIZI DAN PENERIMAAN BISKUIT BALITA TINGGI PROTEIN DAN B-KAROTEN," *J. Nutr. Coll.*, vol. 2, no. 1, hal. 89–97, 2013.

[9]   H. Wijaya dan N. Aprianita, "Kajian Teknis Standar Nasional Indonesia Biskuit," 2018.

[10]   R. I. Pratama, I. Rostini, dan E. Liviawaty, "Karakteristik Biskuit dengan Penambahan Tepung Tulang Ikan Jangilus (Istiophorus Sp .)," *J. Akuatika*, vol. V, no. 1, hal. 30–39, 2014.

[11]   M. B. C. Pramandani, M. Razak, dan Sulistiastutik, "PENGEMBANGAN MAKANAN PENDAMPING AIR SUSU IBU (MPASI) BERBASIS TEPUNG IKAN PATIN (Pangasius Sp .) DAN TEPUNG KECAMBAH KEDELAI PENDAHULUAN Masalah kurang energi protein merupakan salah satu masalah gizi utama di Indonesia . Berdasarkan Riskesdas tahun 20," *J. Ilm. – VIDYA*, vol. 27, no. 1, hal. 30–38, 2017.

[12]   M. Kurniadi, M. Angwar, Miftahkussolikhah, D. R. Affandi, dan N. Khusnia, "KARAKTERISTIK COOKIES DARI CAMPURAN TEPUNG UBIKAYU

TERMODIFIKASI (MOCAF), TEMPE, TELUR, KACANG HIJAU DAN IKAN LELE CHARACTERISTIC," *J. Din. Penelit. Ind.*, vol. 30, no. 3, hal. 1–9, 2019.

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Analysis Spatial Pattern Garbage Bank using Web Geographic Information System in Yogyakarta City

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Abstract. Minimizing waste with independent waste management embodies the 3-R principles, one of which is the waste bank program. There are 448 waste banks throughout Yogyakarta City, around 73% of the total RWs in Yogyakarta City. However, the location of the waste banks has yet to be discovered. Ideally, each location of the waste bank can be known with certainty, so this research produces a visual form in the form of a thematic map of the spatial distribution of waste banks in the city of Yogyakarta and the pattern of distribution of waste banks in the city of Yogyakarta. The objectives of this study are (1) to determine the visual form of the spatial distribution of waste banks in the city of Yogyakarta; (2) to analyze the distribution pattern of waste banks in the city of Yogyakarta. This quantitative research uses the Nearest Neighbor Analysis method to analyze the distribution pattern of waste banks in Yogyakarta City. The results are (1) The visual form of the spatial distribution of waste banks in the City of Yogyakarta is spread over almost all areas of the City of Yogyakarta, with an area of 32.5 km2. There are 448 waste banks whose locations have been mapped; (2) The distribution pattern of the waste banks in the City of Yogyakarta is scattered, or the distribution pattern is uniform/regular. The conclusion is that in Yogyakarta City, the distribution of waste banks is even; it is just that several waste banks need to be reactivated, which are experiencing a vacuum. With a visual form in the form of a thematic map of the spatial distribution of waste banks in the city of Yogyakarta using GIS web technology, this will have an impact, namely making it easier for the DLH (Department of the Environment) Yogyakarta City to do assistance waste banks that experience this vacuum.

Keywords: Nearest Neighbor Analysis, Spatial Spread, Waste Bank, Web Geographic Information System

1. Introduction

Waste management reduces waste products from the source, namely each household[1]. This is done to create a clean, healthy, and comfortable environment. The first stage of waste management is sorting between organic waste (easily biodegradable) and non-organic waste (not readily biodegradable). The second stage is managing the two types of waste; organic waste can be made into compost, waste briquettes, and eco enzyme[2]. Non-organic waste is also sorted according to its types, namely the type of plastic waste, the type of paper waste, the kind of glass waste, and the type of metal waste, such as electronic devices that are no longer functioning. All these types of non-organic waste can be deposited into the Waste Bank. A garbage bank is a place to collect or save non-organic kind of waste where the waste has been sorted from several households; from the waste bank, the process of selling waste to the collectors will be continued, or some waste that is fit for creation will be converted into new products[3]. Garbage banks with this banking system are like people saving money in the bank, but waste is saved here; waste savers are also referred to as customers eligible to get a waste passbook. This can provide positive value for customers because these waste savings can be disbursed in rupiah whenever they want. Besides being able to add rupiah for customers by saving this waste, it also provides a clean environment, free from rats and mosquitoes for customers' homes because items that are not used can be stored in a waste bank[4].

To minimize the amount of waste that is moved from each TPS in the city of Yogyakarta, the government of the city of Yogyakarta, especially the DLH (Environmental Service) of the city of Yogyakarta, recommends independent management in each region. This independent waste management embodies the 3-R (Reduce, Reuse, Recycle) principle, one of which is the waste bank program. Small things done by households will significantly impact the environment through the waste bank program. The volume of non-organic waste will be reduced by half with this waste bank. In addition to keeping the environment clean from items that are no longer used, it will also reduce the proliferation of diseases such as Dengue Fever from mosquitoes that like to nest in items that have never been touched and larvae that live in bottles, plastic cups, plastic buckets; besides that it can prevent one of the causes of air pollution due to burning waste; and the quality of the soil will be maintained because it is not used to bury used goods from these types of non-degradable waste[5]. So the existence of a waste bank in the community is very important to support the Yogyakarta City Environment Service in creating a healthy, clean, and comfortable environment for the City of Yogyakarta.

The waste bank's operation schedule is determined by the members of the waste bank, which includes the manager and customers of the waste bank. Waste bank managers are obliged to accept non-organic waste from waste bank customers. The received waste is weighed and counted, and the waste bank manager records the results in the customer's savings book. The price of the type of waste saved determines the amount of rupiah for customer waste savings. Waste Bank customers are residents of the local area who save waste, are registered as members of the waste bank, and have waste savings, as evidenced by a waste bank passbook.

In the future, if the waste is not managed correctly from the household scope in every RW in the city of Yogyakarta, there will be environmental problems that are not easy to overcome, considering that the city of Yogyakarta has limited land and a large population, in the future if this is not addressed squinting modifier It is undeniable that with this large population, it will contribute a large number of waste products, if not controlled there will be a waste explosion, the city environment of Yogyakarta will become dirty and slum and an unhealthy environment. You can imagine when the Piyungan TPA stops operating. Garbage will overflow everywhere in every corner of the TPS in Yogyakarta City, even up to the road, and plastics are also flying. The dangling modifier, the Yogyakarta City Environment Agency (DLH), targets that every 1 RW in each region is recommended to have 1 Waste Bank. According to data collection conducted by the Garbage Bank Association throughout Yogyakarta City, the number of waste banks is 448, about 73% of the total RW in Yogyakarta City; there are 617 RW. However, from this temporary calculation data, the visual form of the spatial distribution of waste banks in the city of Yogyakarta has yet to be discovered with certainty. Through these conditions, research to determine the pattern of distribution of waste banks in Yogyakarta City needs to be carried out so that

through this condition, a review related to this research focused on the analysis of the distribution of space (location), which is a study of geography. The research addresses two questions:

1. What is the visual form of the spatial distribution of waste banks in Yogyakarta City?
2. What is the distribution pattern of the waste bank in Yogyakarta City?

2. Methods

The method used in This research is a survey method with a quantitative approach. The geographic analysis uses a spatial approach to analyzing spatial patterns[6]. The data used by researchers are primary data and secondary data. Preliminary data is data obtained through direct measurement or plotting in the field. The data to be collected is about the distribution of waste bank locations in the Yogyakarta City area. Primary data collection will be carried out, namely the field survey method with survey tools, namely GPS and the Indonesian Topographic Map (RBI), a basic map that provides information specifically for land areas; the RBI map used is a 1:25,000 scale. Meanwhile, the secondary data used in this study are (1) Data on waste banks in the city of Yogyakarta, which are 448 waste banks, the data obtained from the Yogyakarta City Environmental Service; (2) Data on the area of Yogyakarta City obtained from the City of Yogyakarta in Figures 2022 by the Central Statistics Agency; (3) Several documents as references collected by researchers in the preparation of proposals to reports later.

The data obtained from the Yogyakarta City Environment Agency contains information, including the name of the waste bank, the name of the person in charge of the waste bank, the number of customers, and the address of the waste bank. The data does not yet have a coordinate reference, so it is not feasible to be displayed in a Web GIS as point data. Therefore, a field survey was conducted to obtain coordinated data. The field survey utilizes the "Avenza Maps" application installed on the Smartphone. The field survey was conducted to get accurate information and update existing waste bank data if it changes. The survey was also conducted online using the Google Form platform. This was done because the field survey found obstacles, namely, not finding the location of the waste bank or the person in charge of the waste bank, and saving time and transportation costs.

Analysis of the potential based on geographical data related to providing an overview or visual form of the location of the distribution of waste banks in the city of Yogyakarta. In this study, two data were processed separately. The data are photos of the waste bank and plotting data on the location of the waste bank using "Avenza Maps." The image of the waste bank is then uploaded to Google Drive so that it can be accessed online, while the plotting data from the field survey results obtained through "Avenza Maps" is exported into a file with the extension KML or KMZ. To be processed into ArcGIS Desktop 10.8 software, the file must first be converted to a file with a .shp extension. The conversion process utilizes a third-party site that can be accessed for free (https://mygeodata.cloud/). After becoming a file with the .shp extension, the file is opened with ArcGIS Desktop 10.8 software. The editing process carried out on the .shp file includes adding a column as a place to enrich waste bank information and adding a URL link for the waste bank photo obtained from Google Drive sharing. The information displayed is the waste bank's name, the person in charge, the cellphone number, the number of customers, and the address. Geographical analysis is a spatial approach with Nearest Neighbor Analysis[7]. The nearest neighbor analysis is an analysis method used to determine a pattern of distribution, whether patterned uniform, random, or cluster. Nearest neighbor analysis, in its calculations, considers distance, the number of points of distribution, and the area; the final result of this analysis is in the form of an index nearest neighbor (T) whose values range from 0 to 2.15[8].

3. Results and Discussion

3.1. *Visual Form of Spatial Distribution of Waste Banks in Yogyakarta City*

Web GIS creation is done using ArcGIS online. The .shp file processed from the editing results on ArcGIS Desktop is then uploaded to ArcGIS Online. The process carried out in ArcGIS online is divided into two, namely, map making and Web App creation. At the stage of making the process map, what is done is set the symbology in the .shp file that has been uploaded. The symbology needs to be considered

so that map users can well understand information about the waste bank. The distribution of waste banks is displayed using a dot symbol, while the administrative boundary is displayed with an area symbol. The pop-up settings and the information displayed in the pop-up are also set in the map creation process. The map will be shared as a Web App after the pop-up symbology and setup process is complete.

The Web App has several supporting widgets that can be used to integrate .shp files. Some widgets used in making this Web GIS are Layered and base maps. The following is a flow chart for creating a Web GIS (Figure 1).
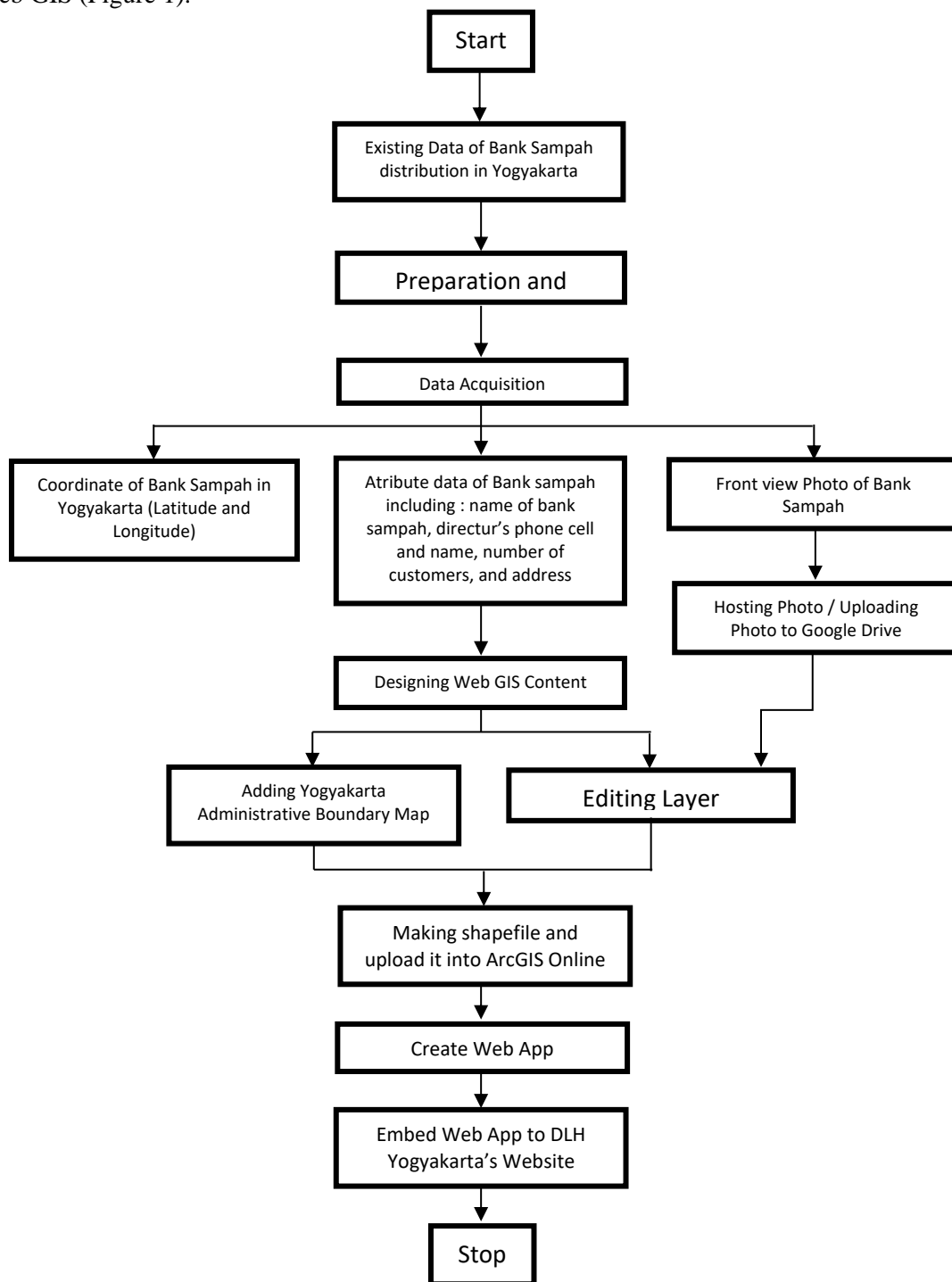
Figure 1. WebGIS creation flowchart

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The Yogyakarta City Environment Service's website already has a waste bank map menu but does not yet have map content like in figure (Figure 2). The Embed website, as a result of field processing with GIS applications, will be displayed to model the distribution of waste bank locations. Embed the website as a result of field processing with GIS applications to model the distribution of waste bank locations that can be displayed on the DLH website. Then the Yogyakarta City Environment Service website will look like in figure (Figure 3).

Figure 2. DLH Website Display (https://lingkunganhidup.jogjakota.go.id/page/index/peta-bank-sampah, 2022), Before Embed installation

Figure 3. DLH Website Display (https://lingkunganhidup.jogjakota.go.id/page/index/peta-bank-sampah, 2022), After Embed installation

After completing all the processes, you will begin to enter the final stage of making the map. A following picture is a visual form of the spatial distribution of waste banks in the city of Yogyakarta (Figure 4):
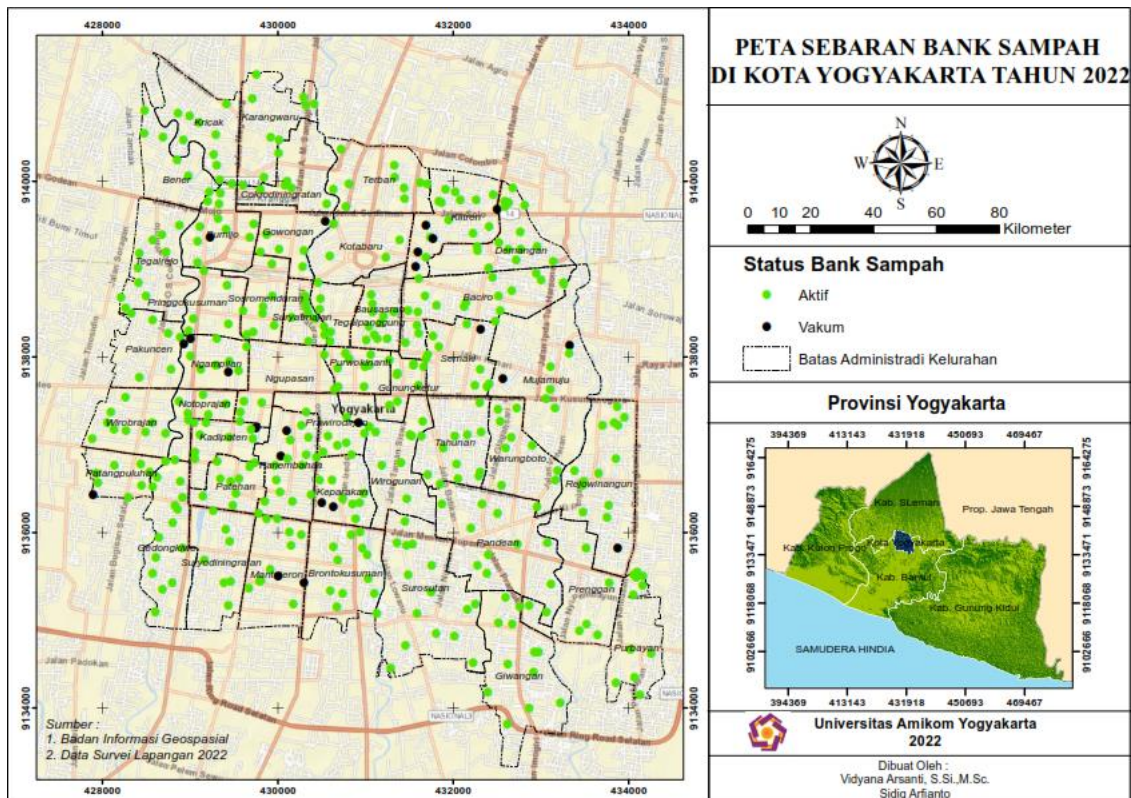
Figure 4. DLH Website Display

3.2. Garbage Bank Distribution Pattern in Yogyakarta City

To determine the distribution of waste banks in the city of Yogyakarta, researchers used the Nearest neighbor analysis method, which previously calculated the arbitrary distance between the point of the waste bank and the nearest one scattered in the city of Yogyakarta. After measuring the distance between these closest points, they are summed and divided by the total location points of the waste bank in Yogyakarta City to find the average distance of the nearest neighbors. After finding the average distance between the waste bank location points and using the area of Yogyakarta City, the final result is obtained in the form of an index calculation ranging between 0 – 2.15. The first step in determining the nearest neighbor analysis, namely the boundaries of this research location, has been determined by the Yogyakarta City administration. After that, the distribution pattern of the location of the waste bank is given in order; here, the researcher gives the serial number of the waste bank that is still in the active category. A serial number will not be given if the Yogyakarta City waste bank status is no longer active. The following figure is as follows the order of distribution of waste banks in the city of Yogyakarta (Figure 5):
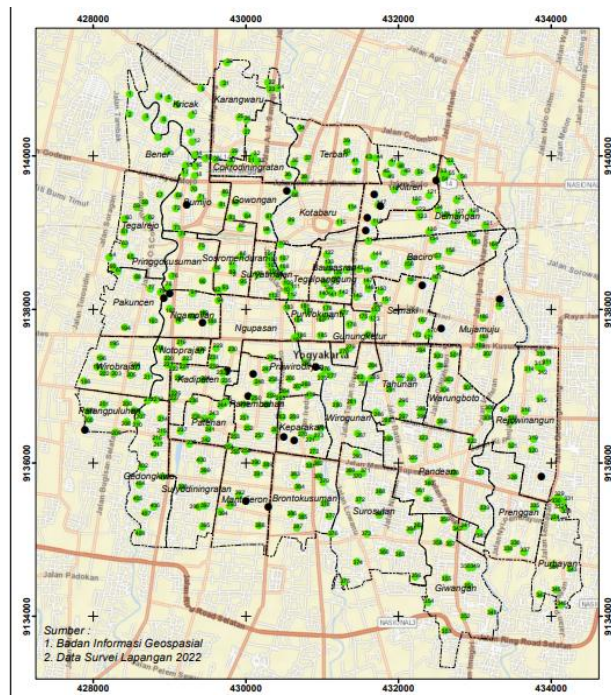
Figure 5. Waste Bank Order Map

The serial number of waste bank locations starts from 1 to 411, so from the total plotting of 448 waste bank locations, there are only 411 active waste banks. This means that there are 37 or 8.26% of waste banks with a status no longer active or vacuum. According to information from the RW head, one example of the Pakuncen area, especially RW 02, is that it is no longer active. For RW 03, according to information from residents, the waste bank there is also no longer operating. After successfully assigning a serial number at each point of the waste bank, the researcher measured the closest distance, namely the distance on a straight line between one waste bank location and the nearest other.

The calculations using the formula for determining the nearest neighbor value give the result of 5.11; it can be concluded that the distribution pattern of waste bank locations in Yogyakarta City is a Dispersed or uniform/regular distribution pattern[9]. This is because the distance between one waste bank location and another is relatively the same. The distribution pattern is uniform if the index value is more than 2.15 (two points fifteen).[10]

4. Conclusion

From the results of the research that has been done, the conclusions obtained are that the visual form of the spatial distribution of waste banks in the city of Yogyakarta is spread in almost all areas of the city of Yogyakarta, with an area of 32.5 km2. The locations of waste Banks that have been plotted are 448 waste banks; there are only 411 active waste banks; this means that there are 37 or 8.26% of waste banks with a status no longer active or vacuum. The visual form of the spatial distribution of the waste bank can be seen via the link: https://arcg.is/1unqD1. The distribution pattern of the waste bank in the city of Yogyakarta is a dispersed or uniform/regular distribution pattern. Because the distance between one waste bank location and another is relatively the same if the index value is more than 2.15 (two points fifteen), then the distribution pattern is uniform.

areas that already have or do not have a waste bank. In addition, it is also possible to find out several waste banks that have been vacuumed or are no longer active so that it can be easier to provide assistance

References

[1]   F. M. Assef, M. T. A. Steiner, and E. P. de Lima, "A review of clustering techniques for waste management," *Heliyon*, vol. 8, no. 1. Elsevier Ltd, Jan. 01, 2022. doi: 10.1016/j.heliyon.2022.e08784.

[2]   M. Paul and M. J. Bussemaker, "A web-based geographic interface system to support decision making for municipal solid waste management in England," *J Clean Prod*, vol. 263, Aug. 2020, doi: 10.1016/j.jclepro.2020.121461.

[3]   E. Utami, *Buku Panduan Sistem Bank Sampah & 10 Kisah Sukses*. Jakarta: Yayasan Unilever Indonesia, 2013.

[4]   K. Sasmita, E. Retnowati, M. K. Azizi, P. Hadiyanti, and S. Kuswantono, "Empowerment of Youth Organizations in Building Awareness of a Clean and Healthy Environment Through Waste Banks," *Journal of Nonformal Education*, vol. 8, no. 1, pp. 122–128, 2022, doi: 10.15294/jne.v8i1.34276.

[5]   M. Kiptiah, A. Kuswoyo, P. Negeri, T. Laut, and K. Selatan, "The Influence Of The Trash Banks Customers' Behavior On Waste Management In The Bakunci Landfill Tanah Laut," vol. 15, no. 3, pp. 365–373, 2019.

[6]   A. R. I. D. Shara, U. Listyaningsih, and S. R. Giyarsih, "Analisis Sebaran Spasial Pengemis Di Kawasan Sanglah Denpasar," *Media Komunikasi Geografi*, vol. 20, no. 2, p. 150, Dec. 2019, doi: 10.23887/mkg.v20i2.20971.

[7]   Menteri Negara Lingkungan Hidup, *Peraturan Pedoman Pelaksanaan Reduce, Reuse, dan Recycle Melalui Bank Sampah*. Indonesia: Menteri Negara Lingkungan Hidup, 2012.

[8]   A. R. Riadhi, M. K. Aidid, and A. S. Ahmar, "Analisis Penyebaran Hunian dengan Menggunakan Metode Nearest Neighbor Analysis," *VARIANSI: Journal of Statistics and Its application on Teaching and Research*, vol. 2, no. 1, p. 46, Mar. 2020, doi: 10.35580/variansiunm12901.

[9]   L. Muta'ali, *Teknik Analisis Regional untuk Perencanaan Wilayah, Tata Ruang dan Lingkungan*. Yogyakarta: Badan Penerbit Fakultas Geografi Universitas Gadjah Mada, 2015.

[10] W. D. Arisca and E. P. Agustini, "Pola Persebaran Sekolah Sma Dan Smk di Kabupaten Ogan Komerin Ulu, Ogan Ilir, Penukal Abab Lematang Ilir, dan Prabumulih Menggunakan Metode Avarage Nearst Neighbour," Palembang, Jul. 2020.

Power Losses Caused by Load Imbalance in the Center Building of PGRI Semarang University

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Abstract. The use of energy is basically very much needed in everyday life. Energy that is widely used is electrical energy, because electricity is one of the important factors in human life. Some electrical energy producers, in the country use fossil fuel sources such as coal and petroleum, and fossil energy is not renewable. Therefore, the government through the Regulation of the Minister of Energy and Mineral Resources number 14 of 2012 regulates energy management to control energy consumption in order to achieve effective and efficient energy utilization. PGRI Semarang University as an academic institution uses a lot of non-linear loads for administrative, teaching, laboratory and other supporting activities. Based on the analysis of data obtained at the Center Building of PGRI Semarang University experiencing an imbalance, the condition is not in accordance with the standards and risks increasing power losses. Seeing these conditions, recommendations were obtained that can be implemented at the Center Building of PGRI Semarang University, namely, balancing the load of phases R, S, T to reduce current imbalances. From the load imbalance, there were power losses on the neutral wire of 889,363 kW and power usage for one day in the R, S, T phases of 15,497,991 kW.

Keywords: Efficiency, Load Imbalance, Neutral Wire Losses

1. Introduction

The use of energies is basically very much needed in everyday human life. Energy cannot be separated in many aspects as a support for household, commercial, government agencies, industry and so on. Energy that is widely used is electrical energy, because electricity is one of the important factors in industrial operations and other agencies. Some electrical energy producers in the country use fossil fuel sources such as coal and petroleum. Fossil energy sources are non-renewable, causing energy reserves to decrease. Therefore, the government through the Regulation of the Minister of Energy and Mineral

Resources number 14 of 2012 regulates energy management to control energy consumption in order to achieve effective and efficient energy utilization.

PGRI Semarang University as an academic institution uses a lot of non-linear loads for administrative, teaching, laboratory and other supporting activities. As a result of the use of such loads there is a possibility of an impact on the quality of electrical power. This research is expected to provide information on the effect of these burdens on the amount of losses generated and can achieve effective and efficient energy utilization.

2. Research Methodology

This study was conducted to reduce losses caused by inefficient use of loads. The method used in this study is to use quantitative methods. The research procedure in this study used a Power Quality Analyzer (PQA) tool to obtain research data. The data taken are data on electrical load, voltage, frequency, current, power factor, and Total Harmonic Distortion. The design of this study was carried out based on the analysis to determine the quality of electrical power shown in Figure 1 and figure 2 showing the flowchart implementation carried out to obtain the results of the study, along with the stages. The collection of data carried out by researchers is data collection at the Center Building of PGRI Semarang University which is taken in the Main Distribution Panel panel and the floor panel. The data taken include data on electrical load, voltage, frequency, current, power factor, and voltage THD. Load measurement on the Center Building of PGRI Semarang University MDP is carried out by recording data for 24 hours. In the data process, the data taken is calculated using formulas and then graphed using Microsoft Excel software to facilitate the analysis process and compare with existing standards. The economic value in this study is to be able to find out the losses caused by poor quality of electrical power, then recommendations are made to reduce losses.
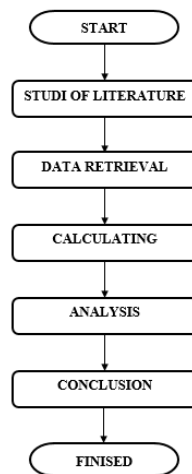
Figure 1. Research Design
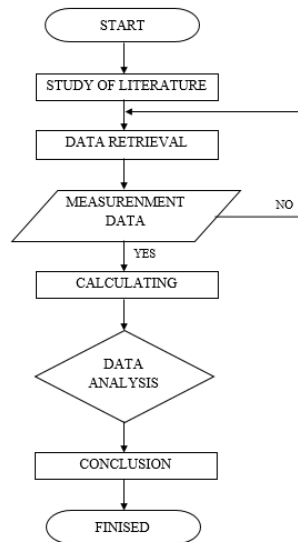
Figure 2. Research Flowchart

3. Results and Discussion

In lecture and office activities as well as laboratory activities at the Center Building of PGRI Semarang University, it is not spared from the use of electrical energy. The electric power system of the Center Building of PGRI Semarang University comes from Perusahaan Listrik Negara (PLN) sources in the 20 KV distribution network system which is lowered in voltage by the power transformer to 380/220 V and a 400 KVA capacity generator that works and is regulated by the Automatic Transfer Switch panel (Kusmantoro, Adhi 2015).

3.1. Current Imbalance

The current imbalance will be analyis using the existing formula. Dan current imbalance is taken when the Center Buildingis in high load condition. The following is a picture of the current chart on the MDP of the Center Building of PGRI Semarang University:
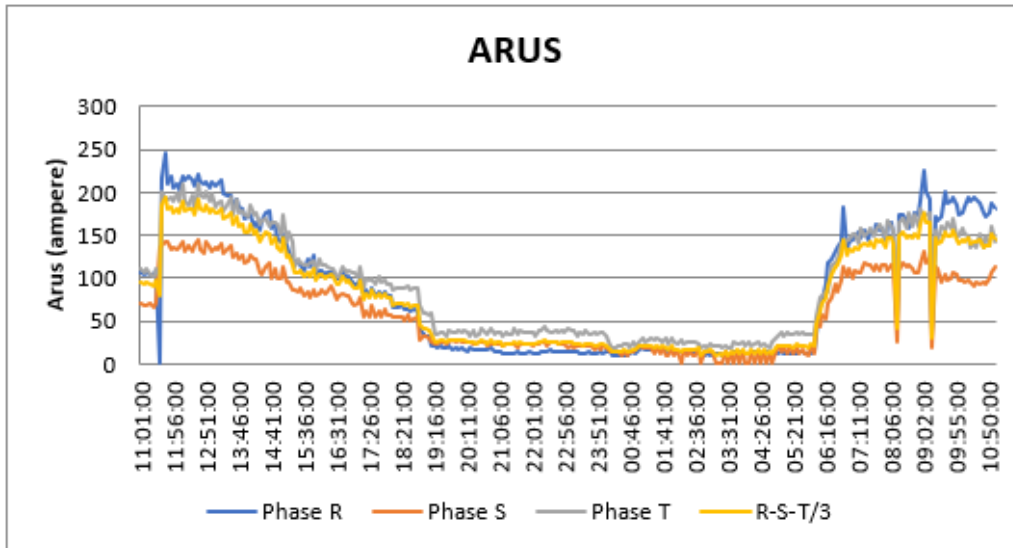
Figure 3. Graph Flows between phases

We can see in Figure 3 that there is a considerable difference in current in each phase. To find out the imbalance value, you can take an example of current data in MDP under certain conditions with the highest average value, an example of calculating the current imbalance value will be made as follows:

Table 1. Example of current data

Time	R	S	T	Current AVG
11:31:00	0	136,5	100,4	78,98
16:21:00	107	91,45	111,7	103,37

The formula for calculating the current imbalance is shown in the following equation:

$$I_{Rata-rata} = \frac{R + S + T}{3} \tag{1}$$

Where the magnitude of the phase current in the balanced state I is equal to the magnitude of the average current, then the coefficients a,b and c are obtained by :

$$a = \frac{IR}{Irata - rata} \tag{2}$$

$$b = \frac{IS}{Irata - rata} \tag{3}$$

$$c = \frac{IT}{Irata - rata} \tag{4}$$

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In the equilibrium state the coefficients a,b,c are equal to 1 then the mean load imbalance in (%) is :

$$\%ketidakseimbangan\ beban = \left(\frac{|a-1|+|b-1|+|c-1|}{3}\right)100\% \qquad (5)$$

1. Highest imbalance
Coefficients a, b, c:

$$a = \frac{IR}{Irata-rata} = \frac{0}{78,98} = 0$$

$$b = \frac{IS}{Irata-rata} = \frac{136,5}{78,98} = 1,73$$

$$c = \frac{IT}{Irata-rata} = \frac{100,4}{78,98} = 1,27$$

$$\%ketidakseimbangan = \frac{|a-1|+|b-1|+|c-1|}{3} \times 100\%$$

$$= \frac{|0-1|+|1,73-1|+|1,27-1|}{3} \times 100\%$$

$$= \frac{1+0,73+0,27}{3} \times 100\%$$

$$= 66,67\ \%$$

2. Lowest imbalance
Coefficients a, b, c:

$$a = \frac{IR}{Irata-rata} = \frac{107}{103,37} = 1,03$$

$$b = \frac{IS}{Irata-rata} = \frac{91,45}{103,37} = 0,88$$

$$c = \frac{IT}{Irata-rata} = \frac{111,7}{103,37} = 1,08$$

$$\%ketidakseimbangan = \frac{|a-1|+|b-1|+|c-1|}{3} \times 100\%$$

$$= \frac{|1,03-1|+|0,88-1|+|1,08-1|}{3} \times 100\%$$

$$= \frac{0,3+0,12+0,8}{3} \times 100\%$$

$$= 7,69\ \%$$

Based on the calculation of the lowest current imbalance value of 7.69% while the highest of 66.67%, the value is far from the IEC (International Electrotechnical Commission) standard of 5%. The value is in a bad condition, so it is necessary to equalize the load on each phase.

Table 2. IEC imbalance standards

Characteristic	Index			
	Good	Not Good Enough	Bad	Very Bad
Inter-Phase Current Imbalance	< 5	< 10	< 15	> 20

We can see from the calculation using the formula, the current imbalance value contained in the MDP of the Center Building as measured by the time span of data retrieval looks quite high. To make analysis easier, the calculated data can be changed graphically as shown in figure 4 below:
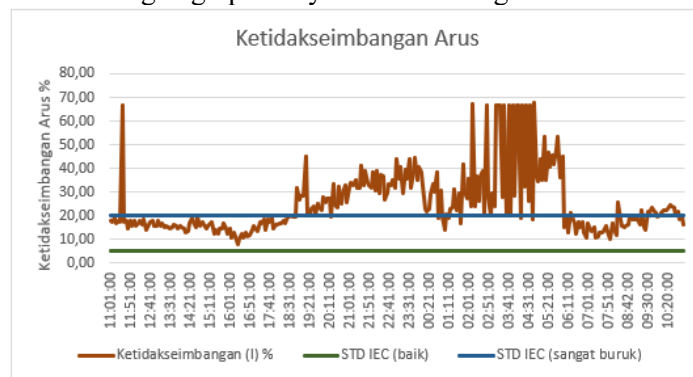
Figure 4. Current imbalance graph

When used during working hours, there are differences between phases. Therefore, there is an imbalance in current, a significant imbalance occurs at night. The use of electrical power at night is building lighting, garden lighting, radio transmitters. It is most likely that the current imbalance occurs in the phase used for motors and radio transmitters.

3.2. Neutral Wire Losses
The load imbalance in all three channel currents results in an outflow in the neutral wire. neutral wire that should be zero, due to the unbalanced current between phases, causing power losses. Resistance (R) on neutral conducting wire is assumed to be 0.00114 Ω. In order to make it easier to analyze, we can take an example of calculations with existing data, as follows:

Table 3. Examples of current and neutral current data

Time	Current (I)			
	R	S	T	N
11:31:00	0	136,51	100,44	127,69
01:01:00	17,29	20,165	25,331	9,23

1. At 11: 31 WIB

In the morning, it was seen that there was a current that multiplied on the neutral wire, which was 127.69 A.

$$P N = I N^2 x R_N$$
$$= 127.69^2 x 0.00114$$
$$= 18.59 \text{ kW}$$

2. At 01:01 WIB

In the morning, it was seen that there was a multiplied current on the neutral wire, which was 9.23 A.

$$P N = I N^2 x R_N$$
$$= 9.23^2 x 0.00114$$
$$= 0.10 \text{ kW}$$

From the example taken from the measurement data from the calculation of the equation above, we can see that the outgoing current flowing on the neutral wire causes power losses of 18.59 kW as the highest value and 0.10 kW as the lowest value. The loss for consumers is the loss on electricity bills due to losses of power flowing on the neutral wire.

(a) Sample data

To support the data, a full load of data samples was taken on the 3rd, 4th, 5th, 6th floors of the Central Building, in table 4, the current in each phase was calculated. When compared with the IEC standard, the current imbalance value in the Center Building floor data sample is not up to standard. Here is Table 4 which shows the results of calculating the current imbalance:

Table 4. Data samples taken in the central compose

Panel	Current			Unb. Current %	Information
	R	S	T		
LT 3	32,5	22,4	21,8	18,08	Not Up to Standard
LT 4	33,9	33,9	16,3	39,04	Not Up to Standard
LT 5	33,9	17,02	32,1	25,66	Not Up to Standard
LT 6	25	15,81	37,2	28,71	Not Up to Standard

By looking at table 4, it can be seen that the difference in current between phases is very high. As an example of calculations can be taken data on the 6th floor of the Central Building, here are the results of the calculations:

Coefficients a, b, c:

$$a = \frac{IR}{Irata - rata} = \frac{25}{26,003} = 0,961$$

$$b = \frac{\text{IS}}{\text{Irata} - \text{rata}} = \frac{15,81}{26,003} = 0,608$$

$$c = \frac{\text{IT}}{\text{Irata} - \text{rata}} = \frac{37,2}{26,003} = 1,43$$

$$\%ketidakseimbangan = \frac{|a-1| + |b-1| + |c-1|}{3} \times 100\%$$

$$= \frac{|0,961-1| + |0,608-1| + |1,43-1|}{3} \times 100\%$$

$$= \frac{0,039 + 0,392 + 0,43}{3} \times 100\%$$

$$= 28,7\,\%$$

Based on data on the 6th floor, the load used is air conditioning, projector and lights. The highest current of 37.2 A is located in the T phase which is indicated as an AC load, therefore it is necessary to transfer the load at the smallest current, namely in the S phase of 15.81 A. For equalization, it can be done by moving the AC load from the T phase to the S phase so that the current imbalance of 28.7% can be reduced.

(b) Equalization of Load

By looking at the calculation results in table 4, it is required to equalize the load so that the current imbalance value can be suppressed. For this reason, some recommendations so that the load imbalance value can be suppressed, namely by moving the phase from the highest to the lowest. The following table 5 is the result of the calculation after equalization of the load:

Table 5. Data after load transfer

Panel	Current			Unb. Current	Information
	R	S	T		
LT 3	25,3	26	25,4	1,13	As Standard Compliant
LT 4	21,3	21,7	21,14	1	As Standard Compliant
LT 5	28,5	27,82	26,7	2,34	As Standard Compliant
LT 6	25	26,61	26,4	2,57	As Standard Compliant

As an example of calculations can be taken data on the 6th floor of the Central Building, here are the results of the calculations:

Coefficients a, b, c:

$$a = \frac{\text{IR}}{\text{Irata} - \text{rata}} = \frac{25}{26,003} = 0,961$$

$$b = \frac{\text{IS}}{\text{Irata} - \text{rata}} = \frac{26,61}{26,003} = 0,023$$

$$c = \frac{\text{IT}}{\text{Irata} - \text{rata}} = \frac{26,4}{26,003} = 0,015$$

$$\%ketidakseimbangan = \frac{|a-1| + |b-1| + |c-1|}{3} \times 100\%$$

$$= \frac{|0,961-1| + |1,023-1| + |1,015-1|}{3} \times 100\%$$

$$= \frac{0,039 + 0,023 + 0,015}{3} \times 100\%$$

$$= 2,56 \ \%$$

Based on the data of table 5 equalization with the transfer of part of the load to the lowest phase, it is proven that it can reduce the current imbalance figure according to the standard. Therefore, this recommendation can be implemented in the Center Building of PGRI Semarang University in order to minimize load imbalances.

4. Conclusions

Based on the process that has been carried out, that the electricity in the Center Building of PGRI Semarang University is in accordance with data and calculations, it can be concluded that there is a large enough current difference in each phase, the lowest current imbalance is 7.69% while the highest is 66.67%, the value is far from the IEC (International Electrotechnical Commission) standard of 5%. These conditions are in a bad condition, so it is necessary to equalize the load on each phase.

Due to the occurrence of a current imbalance, resulting in the occurrence of current flowing in the neutral phase which results in power losses of 889,363 kW borne by the customer, the condition becomes ineffective because the customer has to pay more to replace the lost power.

To overcome the problem of current imbalance, there must be an even distribution in each phase, for example, on the 6th floor, load transfer is carried out from phase T to Phase S. Therefore, the same can be done on each floor in the Center Building of PGRI Semarang University in order to minimize losses due to load imbalance.

5. Acknowledgments

6. References

[1] Yunanto, A. T., Windarta, J., & Handoko, S. (2018). STUDY OF OPPORTUNITIES FOR EFFICIENCY OF ELECTRICAL ENERGY CONSUMPTION IN PT. SAI APPAREL SEMARANG.

[2] HARTONO, F. M. (2018). *MEASUREMENT AND ANALYSIS OF THE QUALITY OF ELECTRICAL POWER IN PT. TECHPACK ASIA* (Doctoral dissertation, University of Muhammadiyah Semarang).

[3] Priyatama, W. A. (2018). Energy Audit Analysis at Panti Rapih General Hospital Yogyakarta.

[4] Cahyo, S. D., Nisworo, S., & Pravitasari, D. (2021). Electrical Power Quality Audit of Mental Hospital Prof. Dr. Soerojo Magelang.

[5] Prasetya, I. W. Y., Setiawan, I. N., & Arjana, I. G. D. (2020). Analysis of Load Imbalances and Harmons in the MI 0096 Distribution Transformer Abianbase Feeder.

[6] Kusmantoro, A., & Nuwolo, A. (2015). Identification of Electrical Power Quality of PGRI Semarang University Building. *Proceedings of SNST Faculty of Engineering*, 1(*1*).

[7] Despa, D., Nama, G. F., Septiana, T., & Saputra, M. B. (2021). Electrical Energy Audit Based on the Results of Measuring and Monitoring the Amount of Electricity in Building A of the Faculty of Engineering Unila. *Electrician*, *15*(1), 33-38.

[8] Margono, M., Amiruddin, M., & Farikhah, I. (2021). Current and Voltage Imbalances at BPTIK PGRI Semarang University. *Advance Sustainable Science Engineering and Technology*, *3*(1), 0210104.

[9] Jamal, J., Marlina, F. D., & Dwi, D. (2019). Energy Audit and Analysis of Electrical Energy Saving Opportunities in the Production Department at PT. EPFM Makasar

"My Javelin Throw" Android-based Javelin Throw Learning Application

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Abstract. This research is motivated by the need for a new learning model with different and engaging learning media, particularly in javelin throwing education. The aim of this research is to create an Android-based learning media for javelin throw. The method in this research is Research and Development (R&D). The subjects and location of this research are 11th-grade students of SMA Negeri 1 Bantarbolang, Pemalang Regency. In the small-scale research, the sample consists of 21 11th-grade students, while in the large-scale research, the sample consists of 272 11th-grade students. The data collection technique used is a questionnaire as the instrument. The quantitative data analysis technique in this research utilizes descriptive statistical analysis. The final validation results from media experts indicate that all aspects are rated as "Good" with a score of 78%. Meanwhile, the final validation from subject matter experts indicates that all aspects are rated as "Excellent" with a score of 82%. According to the data analysis results in the small-scale trial, the percentage obtained is 86.17%.

Keywords: Learning Media, Android, Javelin Throw.

1. Introduction

Education is learning provided through formal or non-formal education which is carried out as an effort to increase one's degree of intelligence towards something. Based on Law Number 20 of 2003, the definition of education is a planned and conscious effort to create an atmosphere of learning and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and state. Education is carried out with the aim of educating the nation's life as stated in the preamble of the 1945 Constitution [1].

Learning media is a medium for delivering learning materials and information. Advances in

technology and science have a significant impact on human life. Learning media in physical learning activities are used to facilitate the delivery of knowledge to students. Learners will be assisted when receiving the knowledge conveyed. The use of media has a role when providing learning experiences for students. Learning is communication between a person and other people, media, or with the environment [2].

Audiovisual media is a media that can comprehensively express the elements of image and sound when conveying news or information. In audiovisual lessons, you can express objects and events as real situations so that students can obtain information [2].

According to Sukadiyanto (2008, p.3) PE has two meanings, namely (1) education for the body, and (2) education through physical activity. Education for the body means that education aims to improve physical quality, for example: strength, endurance, speed, agility, coordination, balance, and so on. Education through physical activity means that physical activity is used as a tool to educate, while the purpose of education is the same as the purpose of education in general, namely the development of cognitive, affective, psychomotor, and kinesthetic aspects [3].

Javelin throw is one of the throwing numbers of athletics. The javelin throwing movement is relatively the easiest compared to other throwing numbers, for example: shot put, discus throw, and hammer throw, because the movement is the most natural compared to other types of throwing [3]. In physical education athletic material teacher creativity is needed to give birth to motion ideas that are easily carried out by students, teachers can utilize simple tools and the most important of all is the excitement factor in children arising from these activities, so that children are interested and start to like athletic sports [4].

Based on observations at SMA N 1 Bantarbola during this pandemic, teachers only give assignments and provide material through google classroom so that it is still considered insufficient as a support for the online learning process. According to the PE teacher, students are less enthusiastic in learning PE, including in the javelin throwing material, this can be seen from the students' response to the material provided by the teacher, the presence of students who are often late and some are not present at all, in the collection of assignments there are still many who do not collect their assignments. With innovative learning media, it can increase students' interest in learning.

Based on the results of [5] [6] research, the development of android-based learning media is very good for increasing student interest and motivation to learn, because android is used by students in their daily lives.

Based on the background above, researchers are interested in making the development of android-based javelin throwing learning media with the name "My Javelin Throw".

2. Research Method

The definition of Development Research or Research and Development (R&D) is often defined as a process or steps to develop a new product or improve existing products [7]. This research is a development research (Research and Development) which uses the Borg and Gall model with 10 research stages, namely: information needs analysis, planning, initial product development, initial field trial, revision of trial results, main product field test, product revision, wide-scale field trial, final product revision, dissemination and implementation [8].

The sample in this study were SMA Negeri 1 Bantarbolang Class XI MIPA 1 students for small-scale product trials and all SMA Negeri 1 Bantarbolang Class XI students for large-scale product trials. The quantitative data analysis technique in this study uses descriptive statistical analysis, which is in the

form of statements that are very less, less, quite good, good and very good which are converted into quantitative data on a scale of 5, namely by scoring from numbers 1 to 5.

Data analysis using theoretical analysis based on the data obtained and then analyzed using theories that have been put forward [9]. The steps in data analysis include: collecting rough data, scoring, the scores obtained are then converted into values with a scale of 5 according to Suharyanto, 2007: 52 which is presented in the table below:

Score	Rate	Categories
X > 4,21	A	Very Good
3,40 < X ≤ 4,21	B	Good
2,60 < X ≤ 3,40	C	Good Enough
1,79 < X ≤ 2,60	D	Enough
X ≤ 1,79	E	Very Less

Table 1. scoring criteria
(Suharyanto, 2007: 52)

3. Result and Discussion

My Javelin Throw has undergone 4 stages of revision based on evaluations conducted by media experts, subject matter experts, large-group testing, and small-group testing. As a result, a developed javelin throwing learning media product based on Android was obtained, which is deemed suitable for use as a learning media for students of SMA Negeri 1 Bantarbolang.

a. Media Expert Validation Results

The results of the validation of android-based javelin throwing learning products by media experts are the average scores given to the display aspects and programming aspects of these things have been presented in the table below:

Table 1. Media Quality Results of Media Expert Validation

Assessment Aspect	Expert	Media	Average	Category
	Phase I	Phase II		
Display Aspect	80%	77,14%	78,57%	Good
Programming Aspects	80%	80%	80%	Good

b. Material Expert Validation Results

The results of the validation of android-based javelin learning products by material experts are the scores obtained in the aspects of learning quality and the quality of the content of the material the results of the assessment have been presented in the table below:

Table 2. Media Quality Results of Material Expert Validation

Assessment Aspect	Expert	Media	Average	Category
	Phase I	Phase II		
Learning Aspects	80%	80%	80%	Good
Aspects of Material Content	80%	84%	82%	Very good

c. Small Scale Trial

The assessment of learning products during the small group trial was included in the "Very Good" criteria with an assessment score of 86.03%. These have been presented in table 3 below:

Table 3. Quality of Android-Based Javelin Throwing Learning Media from Small Scale Trial Results

Assessment Aspect	Average Score	Kriteia
Display Aspect	85,24%	Very good
Learning Aspects	86,82%	Very good
Overall Average	**86,03%**	**Very good**

d. Large Scale Trial

Student assessment on the display aspect explained that the Android- based javelin learning media had a "Very Good" quality with a score of 82.91%. As well as the learning aspect obtained a quality of "Very Good" with a score of 82.19%

Table 4. Quality of Android-Based Javelin Throwing Learning Media Results of Large Scale Trial

Assessment Aspect	Average Score	Kriteia
Display Aspect	82,91%	Very good
Learning Aspects	82,19%	Very good
Overall Average	**82,55%**	**Very good**

According to the observation of small-scale trial data, a percentage of 86.03% was obtained. Based on the quality that has been determined, this android-based javelin learning media meets very good quality. Therefore, the small-scale trial application is suitable for use by SMA Negeri 1 Bantarbolang students. The thing that this media can be accepted by SMA Negeri 1 Bantarbolang students is that from all the criteria tested, students can use the application properly. This android- based javelin throwing learning media can be well received by SMA Negeri 1 Bantarbolang students, so this small-scale trial model can be used for SMA Negeri 1 Bantarbolang students.

Based on observations of large-scale trial data, a percentage of 82.55% was obtained. Based on predetermined standards, android-based javelin throwing learning media is very good, it can be concluded that the development of android- based javelin throwing learning media is suitable for SMA Negeri 1 Bantarbolang students.

Discussion

After going through 2 revisions based on evaluations conducted by media experts, material experts and trials on a small scale and large scale, it can be obtained that the product development of android-based javelin throwing learning media with the name "My Javelin Throw" is suitable for use as an interesting and innovative learning tool.

The following is the appearance of the "My Javelin Throw" application shown in the picture

Figure 1. Main Menu Display

Figure 2. Menu View *"Teknik"*

Figure 3. Menu View *"Video"*

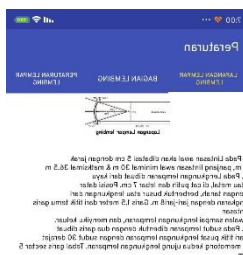Figure 4. Menu View *"Quiz"*

Figure 5. Menu View *"Peraturan"*

Figure 6. Menu View *"Petunjuk"*

The advantage of this application is that it makes it easier for students to learn with new and innovative media. In addition, the material displayed is complete starting from history, material, videos and practice questions. However, this application also has disadvantages including that it can only be used for android devices, not yet multi-platform, besides that an internet connection is needed to be able to play videos in the application.

Learning media makes it easier for students to learn. Especially if you use modern media that is currently in great demand by students, namely smartphones [10]. This research is in accordance with [11] research that the interactive media displayed in the application, makes students more interested in learning. It is also similar to [12] research that android applications that are widely used by students in their daily lives, would be very good if they are also used for learning.

The word "Media" comes from Latin which is the plural form of "medium", literally meaning intermediary or introduction. Association for Education and Communication Technology (AECT), defines the word media as all forms and channels used for the information process. [13].

The benefits of learning media are as follows [13]:

a. Equalizing Student Perceptions. By seeing the same object and consistently, students will have the same perception.
b. Concretize abstract concepts. For example, to explain the government system, economy, wind blowing, and so on. can use images, graphs or simple charts.
   Bring objects that are too dangerous or difficult to obtain into the learning environment. For example, the teacher explains using pictures or movies about wild animals, erupting mountains, oceans, the north cap etc.
c. Displaying objects that are too big or small. For example, the teacher will convey an overview of a ship, airplane, market, temple, and so on. Or display objects that are too small such as bacteria, viruses, ants, mosquitoes, or other small animals/objects.
d. Showing movements that are too fast or slow. By using slow motion techniques in film media, you can show the trajectory of a bullet, the flight of an arrow, or show an explosion. Likewise, movements that are too slow such as the growth of sprouts, the blooming of wijaya kusumah flowers and others.

4. Conclusion

Based on the results of research and validation of media experts and material experts, it can be concluded that android-based javelin throwing learning media with the name "My Javelin Throw" is suitable for use.

References

[1]   E. Irawati and W. Susetyo, "Implementasi Undang-Undang Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional Di Blitar," *Jurnal Supremasi*, vol. 7, no. 1, p. 3, Mar. 2017, doi: 10.35457/supremasi.v7i1.374.

[2]   T. T. Cahyono, C. Resita, and A. S. Hidayat, "Penggunaan Media Pembelajaran dalam Pembelajaran Pendidikan Jasmani Olahraga dan Kesehatan di Masa Pandemi Covid-19," *Jurnal Patriot*, vol. 3, no. 3, pp. 314–328, Sep. 2021, doi: 10.24036/patriot.v3i3.806.

[3]   A. W. Munendra and R. Lumintuarso, "Pengembangan Model Pembelajaran Lempar Lembing Untuk Siswa Sekolah Menengah Pertama (Smp)," *Jurnal Keolahragaan*, vol. 3, no. 2, p. 127, 2015, [Online]. Available: http://journal.uny.ac.id/index.php/jolahraga

[4]   E. C. Gupita and A. T. Wibowo, "Upaya Meningkatkan Motivasi Siswa Belajar Olahraga Lempar Lembing Dengan Media Lempar Rocket di Sekolah Dasar Negeri 01 Buay Runjung," *Jurnal Olympia*, vol. 3, no. 1, pp. 9–17, Jul. 2021, doi: 10.33557/jurnalolympia.v3i1.1400.

[5] K. S. Kartini, N. Tri, and A. Putra, "Respon Siswa Terhadap Pengembangan Media Pembelajaran Interaktif Berbasis Android," *Jurnal Pendidikan Kimia Indonesia*, vol. 4, pp. 12–19, 2020, [Online]. Available: https://ejournal.undiksha.ac.id/index.php/JPK/index

[6] A. Marhamah Hasibuan, "Pengembangan Media Pembelajaran Berbasis Aplikasi Android Untuk Meningkatkan Hasil Belajar Ips Siswa," 2021.

[7] S. Wanto, A. Okilanda, M. El Cintami Lanos, D. Dwiansyah Putra, H. Lestari, and M. Awali, "Kupas Tuntas Penelitian Pengembangan Model Borg & Gall," *Wahana Dedikasi Copyright@Dede Dwianysah Putra*, vol. 46, 2020, doi: 10.31851/dedikasi.v3i1.3023.

[8] A. Hidayat, A. Mujib, E. Muslihah, and U. Sultan Maulana Hasanuddin Banten, "Pengembangan Media Pembelajaran Interaktif Berbasis Powerpoint Untuk Keterampilan Membaca Intensif Melalui Model Pengembangan Borg Dan Gall."

[9] Muh. I. N. Wibisana, "Analisis Indeks Kelelahan dan Daya Tahan Anaerobic Atlet Futsal SMA Institut Indonesia Semarang," *Jurnal Terapan Ilmu Keolahragaan*, vol. 5, no. 2, Oct. 2020, doi: 10.17509/jtikor.v5i2.26956.

[10] D. A. Setyawan, P. Kresnapati, B. Kusumawardhana, and T. Herlambang, "Pengembangan Aplikasi Tes Kondisi Fisik Olahraga Futsal Berbasis Android," 2022. Accessed: Jul. 06, 2023. [Online]. Available: https://journal.unnes.ac.id/sju/index.php/jscpe/article/view/58634/24147

[11] I. F. Royana, U. H. Zhannisa, and T. Herlambang, "Roll spin: forehand spin training media in table tennis," *Jurnal SPORTIF : Jurnal Penelitian Pembelajaran*, vol. 5, no. 1, p. 113, May 2019, doi: 10.29407/js_unpgri.v5i1.12850.

[12] I. D. Pratama, T. Herlambang, B. Kusumawardhana, and I. F. Royana, "Go Pong: Media Pembelajaran Teknik Dasar Tenis Meja Berbasis Android," *Jendela Olahraga*, vol. 05, no. 1, pp. 86–90, 2020.

[13] T. Nurseto, "Membuat Media Pembelajaran yang Menarik," *Jurnal Ekonomi dan Pendidikan*, vol. 8, no. 1, pp. 19–35, Apr. 2012, doi: 10.21831/jep.v8i1.706.

The Effect of Storage Conditions on the Absorption Profile of 2% Lydocaine Hydrochloridum Injection by UV-Vis Spectrophotometry

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Abstract. Lidocaine HCl injection is a sterile product that is easily contaminated when opened. The temperature and humidity in the injection storage conditions also affect the quality of the drug that could be described from the UV-Vis spectrophotometric absorption profile. The aimed of this study is to find out how the effect of storage conditions on the absorption profile of 2% lydocaine HCl injection by UV-Vis spectrophotometry. The impact on the UV-Vis absorption spectral changed can described how molecular structure damage occur on the inappropriate storage condition of the drug. The study used 27 ampoules of 2% lidocaine HCl injection and was qualitatively analyzed using UV-Vis spectrophotometry. The study lasted for 14 days by first storing the injections in storage conditions at room temperature (25-27ºC), cold temperatures (5-10ºC), and exposed to Ultraviolet light (380 nm). Based on the results of laboratory tests, the most suitable storage condition used for storing lidocaine HCl injection was cold storage (5-10ºC) because there was no shift in the maximum wavelength as occurred during the 14th day of UV exposure storage.

Keywords: Absorption Profile, Lydocaine HCl, Storage, UV-Vis Spectrophotometry

1. Introduction

The problem of pain is a problem that is very often found in the medical world. Pain can be said as a symptom that arises due to inflammation that occurs in the body. Pain stimuli send pain impulses into the spinal cord through the body's nerve cells (1). The international association for the study of pain (IASP) states that pain is a feeling of discomfort caused by a person's sensory and emotional connection or because of tissue damage. Pain can occur for several reasons including trauma, surgery, cancer, dysmenorrhea, arthritis, dental disease, etc. (2). After the operation, the patient will certainly have pain that starts to bother, so the medical staff will give anesthesia. Anesthesia is composed of Greek, namely an which means not, and ais thesis which

means feeling so that it can be said that anesthesia is a state of loss of sensation or feeling (1). Anesthesia is divided into two, namely local and systemic. Local anesthetics play a role in inhibiting sensory nerve conduction when used in certain places with the appropriate dose. Local anesthetics have a mechanism of action by blocking pain impulses to the central nervous system (CNS) so that pain, itching, heat or cold can be reduced (3).

Lydocaine injection is an example of an amide class of local anesthetic that has a fast onset of action with high potency and is frequently used. One of the studies conducted at the Temanggung District Hospital for the period January-June 2017 stated that the most widely used drug combination for the treatment of osteomyelitis pain was lidocaine injection combined with meloxicam, flamicort, ranitidine at 8.6% (4). Apart from being in the form of injection, lidocaine is also found in other topical dosage forms such as aerosols, ointments, and topical solutions (3). Lidocaine has a much better safety profile than other local anesthetics and has a low level of tissue toxicity, therefore it is preferred by practitioners as a local anesthetic (1). Research conducted by Mohammadi et al., 2016 showed results that patients induced by propofol with lidocaine premedication had a prevalence of no pain of 95% and mild pain of 4% (5). Lidocaine HCl injection is also widely used by dentists with a usage rate of 41.93% as a local anesthetic in tooth extraction because lidocaine HCl is able to anesthetize the mucosa when administered locally. In dentistry practice, adrenaline is often added as a vasoconstrictor from lidocaine HCl so that the anesthetic effect appears more quickly and lasts longer (1).

Maria Martina in her research in August 2013 revealed that there was an incidence of anaphylactic shock due to the use of local anesthetics, namely lidocaine, of less than 1%. However, even though the percentage rate is not high, preparatory measures for the possibility of an allergic reaction or anaphylactic shock in each patient must still be carried out. Allergic reactions that occur due to the use of local anesthetics such as lidocaine are rare cases, but do not rule out allergies to preservative substances (6).

Inappropriate drug storage is also a factor in decreasing the quality of drugs and causing losses to hospitals and patients. Improper storage can make the drug spoil more quickly before entering its expiration date so that the drug cannot be used (7). According to Akbar et al., in 2016, inappropriate drug storage will lead to the drug not being maintained, which will lead to irresponsible drug abuse, drug availability is not maintained, and it is difficult to monitor drug quality. Errors in storing drugs at the health centre can cause the drug to be damaged resulting in a decrease in drug levels/potency so that when consumed by patients it becomes ineffective in therapy (8).

Qualitative analysis of lidocaine HCl injection can be carried out using high performance liquid chromatography (HPLC) and visible spectrophotometry (3). Derivative spectrophotometry methods can be used for quantitative analysis of substances in mixtures where the spectra may be hidden in a form of large overlapping spectra regardless of the process of separating the substances first. The concept of the derivative was first introduced in 1950, where it was seen to provide many advantages. The main application of visible light ultraviolet derivative spectroscopy is for the qualitative identification and analysis of samples. Derivative spectroscopy methods are very suitable for the analysis of absorption bands that overlap or are too sloping (9). Evaluation of UV-Vis spectrophotometric absorption profile based on storage conditions has never been done. Therefore, researchers wanted to apply UV-Vis spectrophotometry to compare the absorption profile of lidocaine HCl in 2% lidocaine HCl injection (20 mg/mL) based on storage conditions.

2. Materials and Method

2.1. Materials

The materials used were 2% lidocaine HCl injection with a generic lidocaine HCl concentration of 20 mg/ml (@2mL) in 27 ampoules and Water For Injection. While the tools used were glassware in the form of a 25 mL measuring flask, 1000 IU micropipette, refrigerator, Grow Light LED 50w 220v, hygrometer, cold thermometer, UV-Vis Shimadzu UV-1800 spectrophotometer, and spina software version 3.0.

2.2. Method

This study used 27 ampoules of 2% lidocaine HCl injection obtained from PT. "X" with the same batch number. The study was started by treating three storage conditions to samples of 2% lidocaine HCl injection for 14 days of storage. Samples were prepared at a concentration of 300 ppm and analyzed qualitatively using UV-Vis spectrophotometry on days zero (0 hour), first (24 hour), second (48 hour), third (72 hour), fifth (120 hour), seventh (168 hour), ninth (216 hour), eleventh (264 hour), and fourteenth (336 hour), adjusting laboratory operating hours. Qualitative analysis was carried out with Spina software version 3.0 using absorbance values at a wavelength of 200 to 300 nanometers obtained by UV-Vis spectrophotometry. Evaluation of the absorption profile of 2% lidocaine HCl injection was carried out at the maximum UV-Vis wavelength profile obtained from conventional spectral data according to the time span of each absorption. The evaluation includes the number of spectral peaks shown, the differences in the resulting spectral patterns, the shift in the wavelength that appears in each sample using the 2nd derivative on Spina software version 3.0. Figure 1 describes schematic research method.
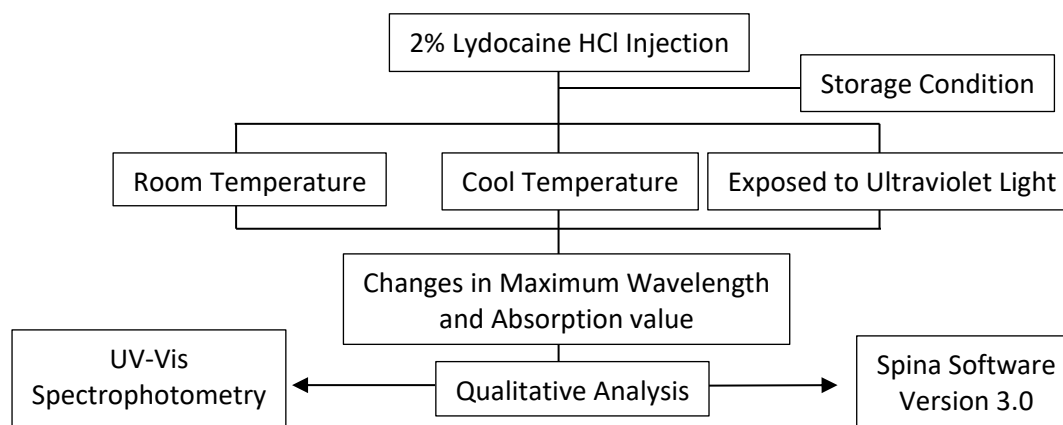
Figure 1. Research Method

3. Results and Discussion

Evaluation of the UV-Vis spectrophotometric maximum wavelength profile was carried out using the help of Spina software version 3.0 which was operated via a laptop. The maximum wavelength profile used in this evaluation is the wavelength profile when measuring absorbance values for assays starting from day 0 to day 14 with conventional spectral absorbance data at a wavelength of 200-300 nm. O'Haver (1979) stated that derivative spectroscopy is a spectrum measurement derived from the average change in absorbance with wavelength (9). Data on the absorbance values of replicates 1, 2, and 3 which are located at 200-300 nm in each storage condition and storage time are then averaged. After the data is averaged, it is then processed using Spina software version 3.0 by first changing the xlxs format be csv. Conventional Spectra data that already has a csv file format are then processed with spina 3.0 software and the 2nd derivative is determined.

The second derivative or often called the 2nd derivative is one of the second derivative analysis methods from the maximum wavelength of conventional spectra. Conventional spectral data is shown with red spectra lines, while the 2nd derivative is shown with green spectra lines. Display of Conventional Spectra data and 2nd derivative can be seen in Figure 2.
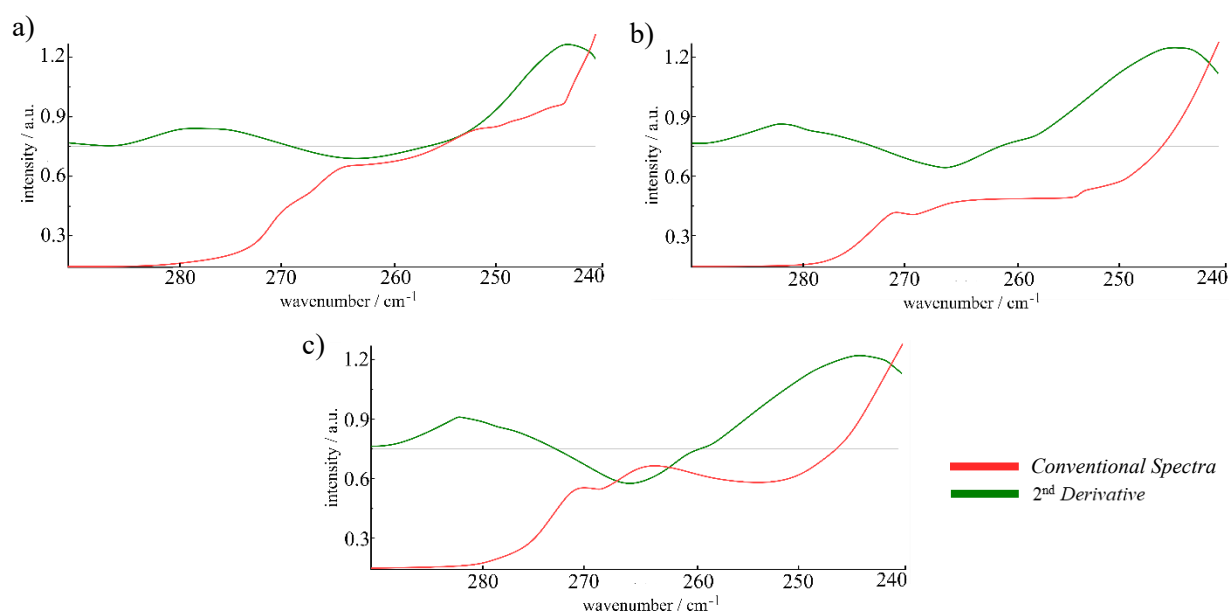
Figure 2. Conventional VS 2nd Derivative Spectra at storage conditions a) Room Temperature (25 – 27°C), b) Cold Temperature (5,5 – 9,5°C), c) UV Exposure (380 nm)

Figure 2a shows the spectra between the conventional spectra and the 2nd derivative at room temperature (AC) storage conditions. Figure 2b shows the spectra between the conventional spectra and the 2nd derivative under cold storage conditions. Figure 2c shows the spectra between the conventional spectra and the 2nd derivative under UV exposure. From the three spectral images it can be seen that the UV exposure storage conditions have a very strong peak 2nd derivative when compared to the cold temperature and room temperature (AC) storage conditions.

After obtaining the spectral profile of the second derivative, characterization is then carried out to determine the maximum wavelength in the second derivative spectra. Dismoothing data using the principle of the Zalvitzki Golay equation to remove background noise which often appears as false peaks and interferes when reading the spectral profile. Sometimes the peak position of the second derivative spectra will shift slightly due to the influence of the smoothing process being carried out. Then an analysis is carried out using the second derivative method where this method helps to ensure that the peaks produced are the true peaks. Sometimes there is only one visible peak in the conventional spectra but it can be seen that there are two overlapping peaks in the second derivative spectra as seen in the maximum wavelength table of the compound lidocaine HCl (9). Meanwhile, the maximum wavelength data in the conventional spectra can be seen in Table 1.

Table 1. Maximum Wavelength Data on Conventional UV-Vis Spectrophotometry Spectra

Storage Time (Days)	Maximum Wavelength (nm)		
	Room Temperature (25-27°C)	Cool Temperature (5,5-9,5°C)	Exposed UV Light (380 nm)
0	262	262	262
1	262	262	262
2	263	263	262

3	262	263	262
5	263	262	262
7	262	262	262
9	262	262	262
11	262	262	262
14	262	262	262

In the conventional spectra table, the maximum wavelength value at one peak is between 262 nm and 263 nm. This is due to broadening and overlapping of spectral patterns or peaks which causes a shift in the maximum wavelength as a result of temperature changes in storage conditions. Changes in spectral patterns occur at each storage condition accompanied by changes in absorption values in the spectra. Whereas in the 2nd derivative two peaks were found with a maximum change in wavelength from 262 nm to 266 nm and 263 nm on storage conditions on the 14th day of first peak UV exposure. The change in the maximum wavelength of the second derivative only occurs on the last day of UV exposure. This shows that the injection of 2% lidocaine HCl was not able to survive under UV light exposure until the 14th day. The change on the spectral behaviour reflects in the level of molecular change (10). Meanwhile, the maximum wavelength data in the 2nd derivative can be seen in Table 2.

Table 2. Maximum Wavelength Data on 2nd Derivative Software Spina

Storage Time (Days)	Maximum Wavelength (nm)					
	Room Temperature (25-27°C)		Cool Temperature (5,5-9,5°C)		Exposed UV Light (380 nm)	
	Peak		Peak		Peak	
	1	2	1	2	1	2
0	266	262	266	262	266	262
1	266	262	266	262	266	262
2	266	262	266	262	266	262
3	266	262	266	262	266	262
5	266	262	266	262	266	262
7	266	262	266	262	266	262
9	266	262	266	262	266	262
11	266	262	266	262	266	262
14	266	262	266	262	263	262

This is in accordance with the research by Putri et al (2014) that sometimes two peaks are found in the second derivative spectra even though in conventional spectra there is only one peak. In the 2nd derivative spectra, the maximum wavelength is produced at 266 nm because at that wavelength it gives a high peak intensity with a peak that is very clearly visible and always appears in every storage condition. The spectral profile of the conventional spectra and the second derivative can be seen in Figures 3 and 4.
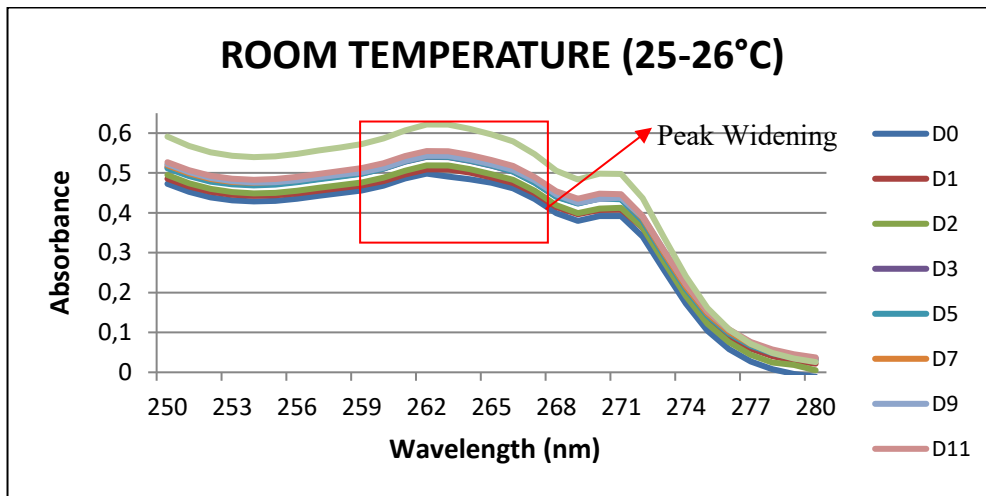
Figure 3. Wavelength profile of Room Temperature Conventional Spectra (D=Day)
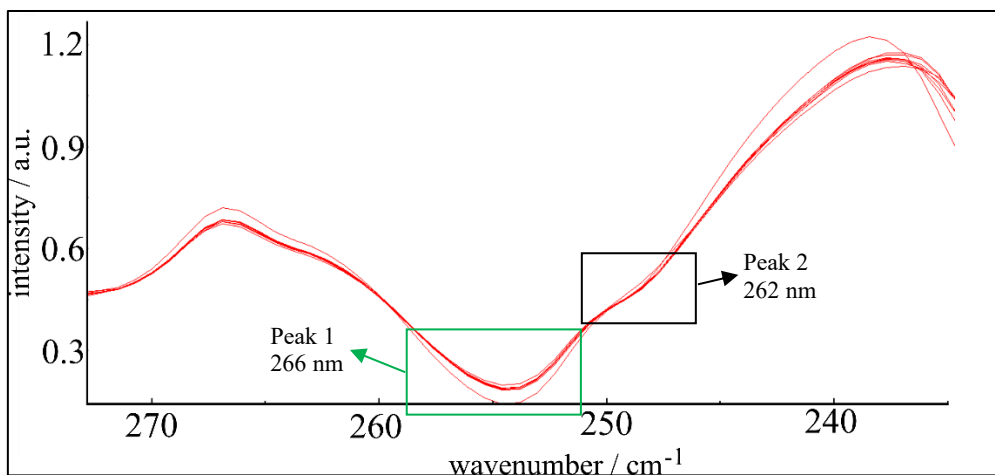
Figure 4. Wavelength profile of 2nd Room Temperature Derivative

In the 2nd derivative image, there is no shoulder peak at 272 nm which appears when an absorption scan is performed. But actually there are 2 peaks, namely 262 nm and 272 nm. At a maximum wavelength of 272 nm it has a weak peak intensity. This is proven in the 2nd derivative where the spectral pattern does not show any shoulder peaks and there are only 2 peaks with high intensity, namely at 266 nm and 262 nm, so that it can be said that the maximum wavelength of 272 nm is too weak to be used as a peak. A single peak at a wavelength of 262 nm when analyzed with the 2nd derivative will produce 2 peaks at a wavelength of 266 nm and 262 nm. A comparison graph of the maximum wavelength of the conventional spectra with the second derivative spectra at room temperature storage conditions can be seen in Figure 5.
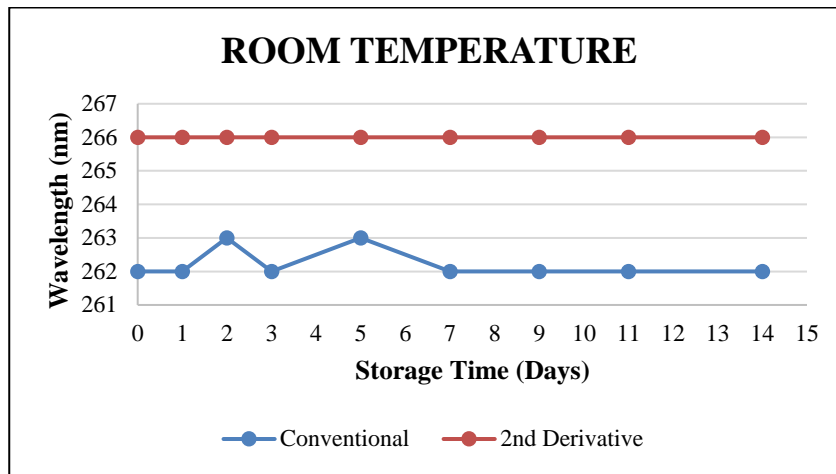
Figure 5. Graph of Maximum Lamda Comparison of Conventional Spectra VS 2nd Derivative Room Temperature Storage Conditions

From Figure 5, it can be seen that in the Conventional Spectra temperature storage conditions experienced a maximum wavelength shift from 262 nm to 263 nm on the 2nd and 5th day then shifted back to 262 nm. Meanwhile, the 2nd derivative does not experience a single wavelength shift so it can be said to be constant. The conventional and second-derivative spectral profiles and graphs for cold storage can be seen in Figures 6, 7 and 8.
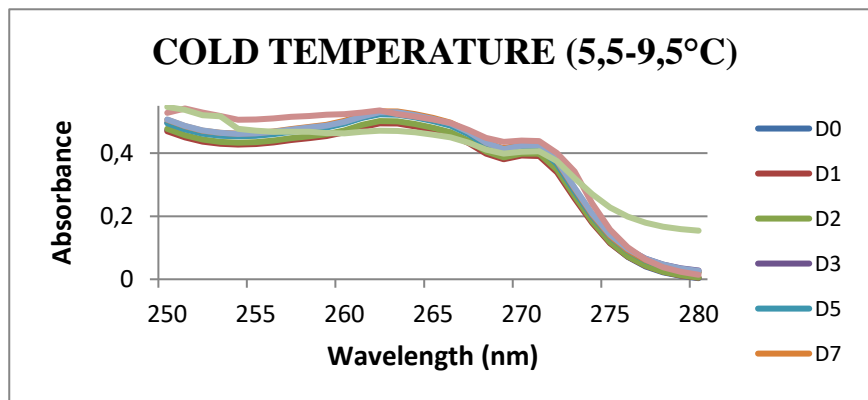
Figure 6. Wavelength profile Cold Temperature Conventional Spectra (D=Day)
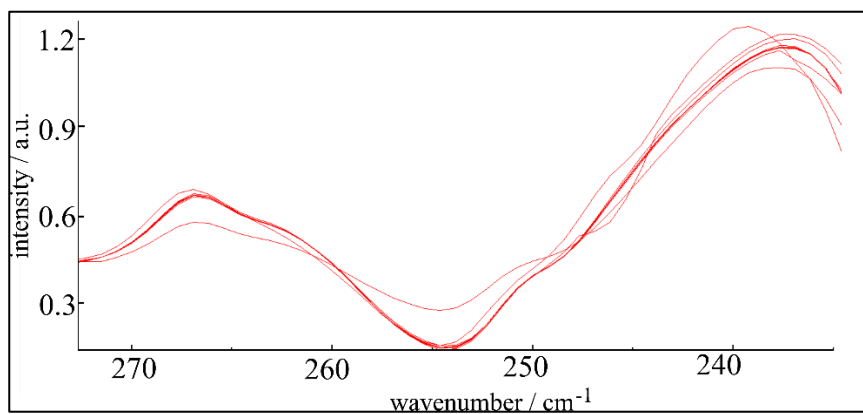
Figure 7. Wavelength profile of 2nd Cold Temperature Derivative
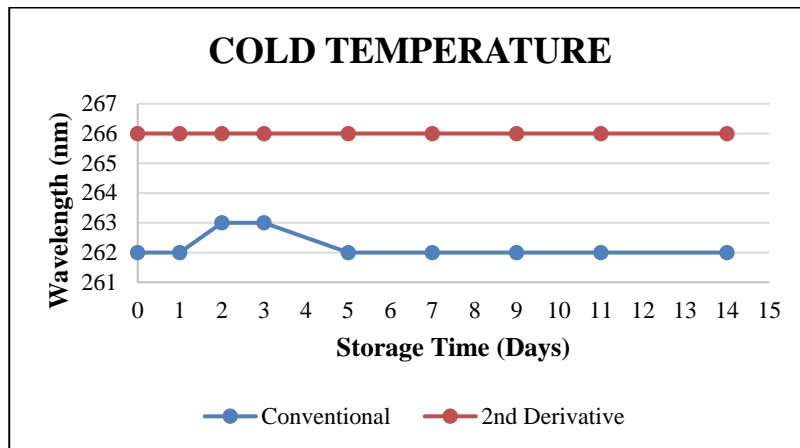
Figure 8. Graph of Maximum Lamda Comparison of Conventional Spectra VS 2nd Derivative Cold Storage Conditions

From Figure 8, it can be seen that in the Conventional Spectra under cold storage conditions, the maximum wavelength shifted from 262 nm to 263 nm on the 2nd and 3rd day and then shifted back to 262 nm. The graph shown is almost similar to the room temperature (AC) graph. Meanwhile, the 2nd derivative also does not experience a shift in either the first or second peak, which means even one wavelength, so it can be said to be constant at 266 nm as shown by a linear line on the graph of the 2nd derivative of cold temperatures. The spectral profiles of conventional spectra and second derivatives as well as graphs on UV exposure storage can be seen in Figures 9, 10 and 11.
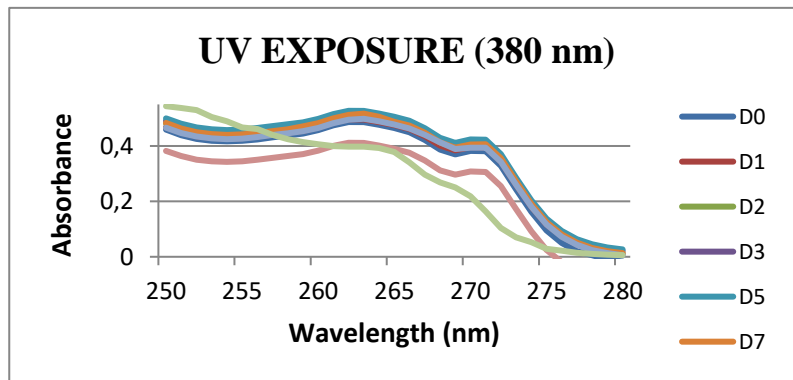
Figure 9. Wavelength profile Conventional UV Exposure Spectra (D=Day)
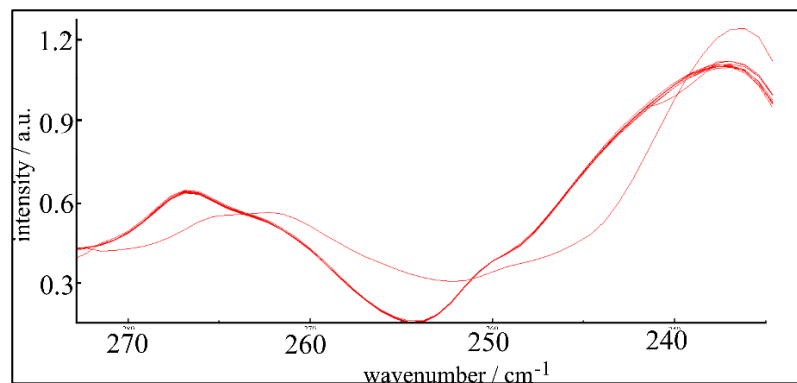
Figure 10. Wavelength profile 2nd Derivative UV Exposure Temperature

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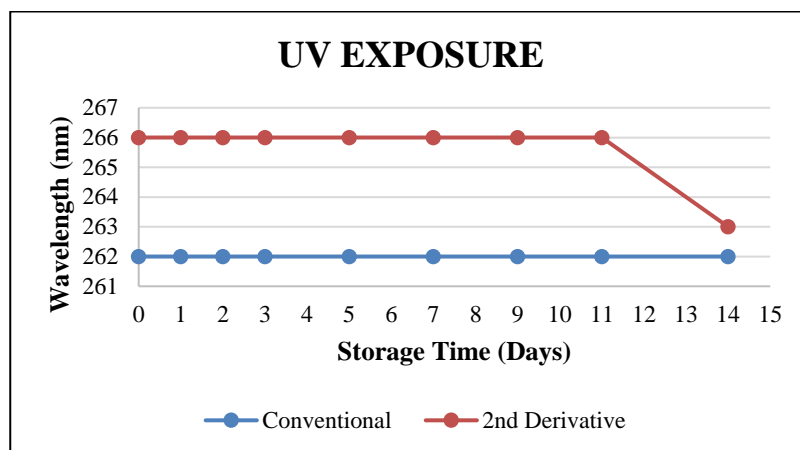
Figure 11. Graph of Maximum Lamda Comparison of Conventional Spectra VS 2nd Derivative UV Exposure Storage Conditions

In contrast to the previous conditions of room temperature (AC) and cold temperatures, the maximum wavelength profile in UV storage conditions experienced a 2nd derivative shift at the first peak. However, the Conventional Spectra does not experience the shift that occurs as in room temperature (AC) storage conditions and cold temperatures. The shift occurred on the 14th day, when the maximum wavelength of the 2nd derivative was shown at 266 nm and then shifted to 263 nm. With a shift in the maximum wavelength, it indicates a change in the spectral pattern, namely in the storage conditions of UV exposure.

4. Conclusion

Based on the laboratory research that has been done, it can be concluded that the UV-Vis spectrophotometric second derivative method can be used to analyze the compound lidocaine HCl in 2% lidocaine HCl injection preparations. Then there is a difference in the maximum wavelength profile in each storage condition indicated by a shift in the maximum wavelength in the Conventional Spectra from 262 nm to 266 nm in condition of storage at room temperature with air conditioning and cold temperature. The shift occurred again at 266 nm to 263 nm on UV exposure storage shown by the 2nd derivative. So that the most suitable storage conditions for storing 2% lidocaine HCl injection preparations are cold and room temperature storage conditions with temperatures of (5,5-9,5 ℃). and (25-27 ℃) respectively.

References

[1]   Mattalitti, S. F., Lestar, N., Wijaya, M. F., Jayakusuma, A., Lauddin, T., and Azi, D. S. 2019. Uji Perbandingan Efektivitas Kerja Anestetikum Lidokain dan Lidokain + Epinefrin Terhadap Rasa Nyeri. *Sinnun maxillofacial journal* 48-57.

[2]   Prayoga, I. K., and Dr.dr.I Wayan Suranadi, S. K. 2017. Mekanisme Nyeri Akut. 4. *https://simdos.unud.ac.id/uploads/file_penelitian_1_dir/2d20de86c1b7b d4ed16cdb23abed7b37.pdf*. 22 Juni 2022.

[3]   Yarti, R. A. 2010. Penetapan Kadar Lidokain HCl Dalam Sediaan Injeksi Secara Spektrofotometri Visibel Menggunakan Agen Pengkompleks Tetrathiocyanatocobaltate. *Thesis.* Universitas Sanata Dharma. Yogyakarta.

[4]   Hidayat, Y. 2018. Gambaran Penggunaan Obat Pada Pasien Osteoarthritis di Poli Saraf RSUD Kabupaten Temanggung Periode Januari-Juni 2017. *Thesis.* Universitas Muhammadiyah Magelang. Magelang.

[5]   Pratiwi, M. S., Suranadi, I. W., Sinardja, I. K., and Kurniyanta, I. P. 2022. Kualitas dan Derajat Nyeri Pada Injeksi Propofol Intravena Dengan Pemberian Lidokain Intravena di RSUP Sanglah Denpasar. *Jurnal Medika Udayana 11*:2. doi:10.24843.MU.2022.V11.i3.P01.

[6]   Nahak, M. M. 2013. Shock Anafilaksis Akibat Anestesi Lokal Menggunakan Lidocaine. *Jurnal Kesehatan Gigi 1*(2): 106-114. doi:ISSN : 2337-4187.

 [7]   Qiyaam, N., Furqoni, N., dan Hariati, H. 2016. Evaluasi Manajemen Penyimpanan Obat Di Gudang Obat Instalasi Farmasi Rumah Sakit Umum Daerah Dr. R. Soedjono Selong Lombok Timur. *Jurnal Ilmiah Ibnu Sina 1*(1): 61 - 70. https://doi.org/10.36387/jiis.v1i1.30.

[8]   Satibi. 2014. *Manajemen Obat di Rumah Sakit. Gadjah Mada University Press*. Yogyakarta.

[9]   Putri, S., Yola, F., Farmawati, D., Dolu, M. N. 2014. Penetapan Kadar Sulfametoksazol dan Trimetoprim Dalam Suspensi Cotrimoksazol Dengan Spektrofotometri Metode Kurva Turunan Pertama (Derivatif).*Proceeding*. Universitas Katolik Widya Mandala.

[10]   Marlina, D. 2019. Hydrogen bonding investigation of poly(3-hydroxybutyrate)/glycol chitosan blends studied by infrared dan terahertz spectroscopies

Utilization of Heat from Geothermal Well Pipes as Electricity for Road Lighting Based on The Internet of Things

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Abstract. PT. Pertamina Geothermal Energy Area Lumut Balai has a very extreme work location with various contours, safety factors and lack of access to electricity for street lighting are things that need attention given the importance of street lighting in the company's operations. Street lighting is an important element that supports the comfort and safety of road users in their activities at night. The research objective is to design an IoT (Internet Of Things) system that can monitor the utilization of pipe heat into electrical energy for street lighting and provide street lighting needs around geothermal well pipes. In this study used thermoelectric as a tool to generate electrical energy from available heat. The IoT system is used to read data parameters as a tool to display temperature, voltage and current values on the LCD (Liquid Crystal Display) and the Thingspeak website. The temperature value is read by the MAX6675 thermocouple sensor while the INA219 sensor is used to read the voltage and current values. The focus of this research is to heat the thermoelectric so that it can produce electrical energy to turn on the lights as lighting and can monitor parameter data directly. The highest thermoelectric electrical energy output is at a temperature of 75.1˚C. Where at this temperature a voltage of 2.32 V is generated and a current of 0.03 A. The lamp will turn on if the thermoelectric heat is fulfilled. The light turns on when the environment is dark and the light turns off when the environment is bright.

Keywords: Street Lighting, Internet of things, Thermoelectric, MAX6675, INA219, Lights

1. Introduction

Street lighting is an important element that supports the comfort and safety of road users in their activities at night [1]. Street lighting can provide lighting that resembles conditions during the day so that activities at night can be more effective [2]. Street lighting is a facility that must exist in the business activities of a company [3]. Regional owned enterprises (BUMD) and State-owned enterprises (BUMN) are business entities that need street lighting for each of their activities, especially at night [4]. One of the BUMN that requires street lighting for its activities is PT. Pertamina Geothermal Energy [5].

PT. Pertamina Geothermal Energy is a company that produces electricity from geothermal energy. One of the working areas of PT. Pertamina Geothermal Energy is located in the Lumut Balai Area which

has been operating to generate electricity commercially since 2020 [6]. In the operation of a geothermal plant, the fluid used to generate electrical energy is in the form of steam (steam) or water (brine) which will be flowed through a pipeline network along the 9 km which are interconnected between production wells, reinjection wells, and generators [7]. The fluid flowing through the pipes has wasted heat that is not utilized. The pipes used are relatively long and laid along the road between the wells [8]. PT. Pertamina Geothermal Energy Area Lumut Balai has a very extreme work location with various contours [9]. Safety factors and the lack of access to electricity for street lighting are things that need attention given the importance of street lighting in the company's operations [10].

Based on research previously conducted by Dodit Arditama, et al (2021) with the title "Utilization of Thermal Energy from Smokeless Burning of Garbage as an Alternative to Small-Scale Power Generation Using Thermoelectrics". The result of this research is that the heat from combustion can generate an electric voltage so that it can light up a light bulb [11]. In a journal entitled "Utilization of Rice Husk Briquettes as a Heat Producer in a Thermoelectric Generator Stove for Street Lighting" research results by Suliono, et al (2019). The results of research in this journal can be concluded that electrical energy with the highest output is generated by using 6 thermoelectric pieces arranged in series which are capable of turning on 1 lighting lamp and 1 fan for cooling [12].

The purpose of this research is to use geothermal well pipe heat to design an Internet of Things system that can monitor the utilization of pipe heat into electrical energy for street lighting and provide street lighting needs around geothermal well pipes. This is very useful where apart from safety and comfort factors, street lighting can also streamline the process of monitoring pipes along the PLTP.

2. Methods

The preparation of this scientific work is based on several studies related to the utilization of heat in electrical energy. These studies inspired the authors to utilize heat from geothermal good pipes to turn into electrical energy for street lighting.

2.1 Tool Planning

Planning is the initial stage in designing a tool [13]. Planning is a stage that has an important role in completing the manufacture of a tool. In the planning process, there is a design and manufacture that will be taken in several steps, including the selection of a component that adapts to the needs of a tool. The process carried out in planning this tool has all stages that are interconnected with a series, namely Hardware planning and Software planning (programming language).

2.2 Tool Design

This tool, which is made for the utilization of pipe heat into electrical energy, has three stages, namely input, then process, and finally output. These stages have an important role in each other. The stages are described in the block diagram as follows:
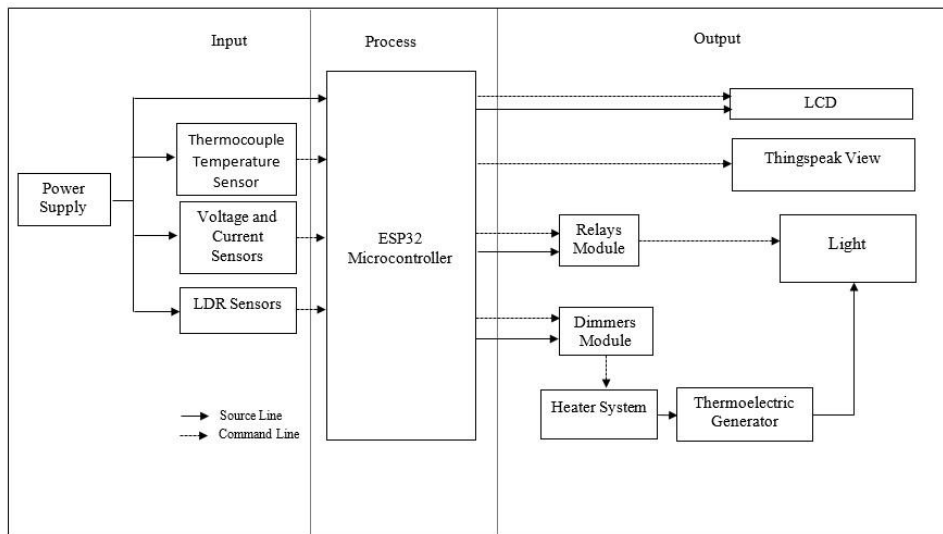
Figure 1. System Block Diagram

2.2.1 Tools Testing

Tool testing is done by collecting data directly on the components that have been installed. Testing is done by measuring components such as power supplies, microcontrollers and sensors. Schematic of a series of pipe heat utilization into electrical energy can be seen in the following figure:
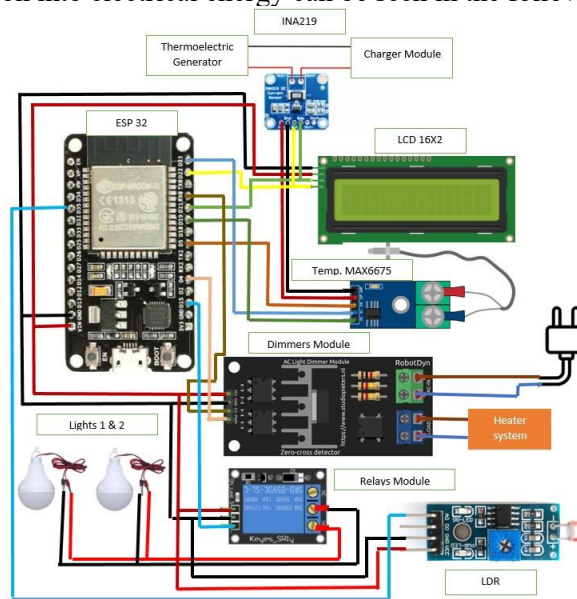
Figure 2. Tool Schematic Diagram

2.2.2 Tools Schematic

When designing what we have to pay attention to is the working principle of the circuit, the specifications of the components to be installed in the circuit so that during the design there will be no damage when we install the components. The flowchart of the tools made can be described as follows:
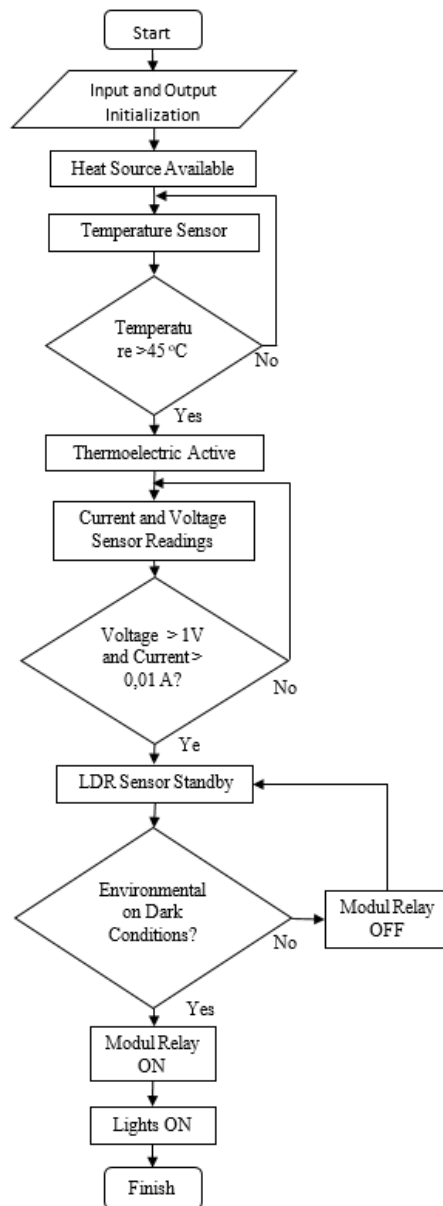
Figure 3. Flowchart system

2.3 How the Tool Works

The working system of the tool that is made is thermoelectric to convert pipe heat into electrical energy. In this tool, the pipe heat energy is replaced by using a heater or heater. The output heat of the heater can be adjusted using the dimmer module [14]. The value of the temperature generated by the heater can be determined using the MAX6675 thermocouple temperature sensor, besides that the current and voltage will also be read by the INA219 sensor. The sensor used requires a 5V power supply so that it can be used to read the actual value generated by the tool. These sensors will be integrated with the ESP32 microcontroller which has a wifi module. This microcontroller will send the readings of the sensors to the internet of things, in this case using Thingspeak View. In Thingspeak View, we can read the resulting temperature, current, and voltage values so that they can be monitored remotely using electronic equipment such as laptops or cell phones. In addition to Thingspeak, the value sent by the sensor will also be read on the 16x2 LCD. Then according to its purpose, the electrical energy that has been produced by the thermoelectric will be used to turn on the lamp for lighting.

2.4 Tool Assembly

Figure 4. Assembly of All Components

In Figure 4, all the components that have been assembled are installed. All components are connected and placed on the table that has been created. Installation of power supply components such as transformers, diodes, capacitors, and IC regulators which are useful as a source of electricity

3   Results and Discussion

3.1 Tool Testing

Tool testing is done by collecting data directly on the components that have been installed. Testing is done by measuring components such as power supplies, microcontrollers, and sensors. The image of the measurement points carried out for testing the tool can be seen in Figure 5 as follows.
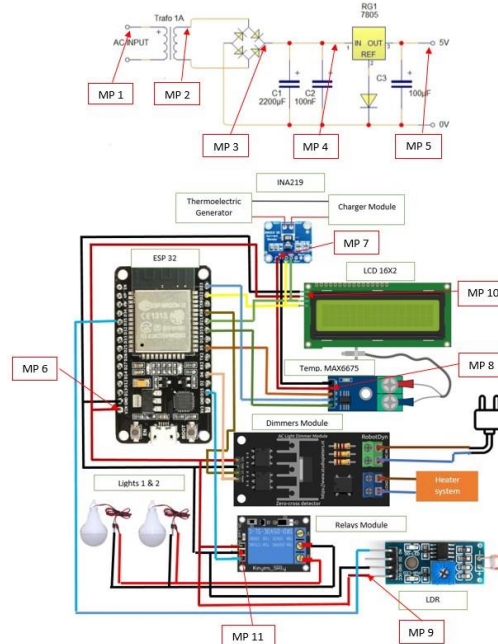
Figure 5. Tool Measurement Point

To get a good measurement value, measurements were carried out 5 times for each component. So the measurement results require an average value to get the measurement value. The formula for calculating the average of the measurement values is.

$$\overline{X} = \frac{X_1 + X_2 + X_3 + X_4 + X_5}{n} = \frac{\sum X_i}{n}$$

Ex :
$\overline{X}$ = average measurement value
$\sum X_i$ = total number of samples
n   = number of measurements

The tool testing process includes measuring height with a tool that has been designed and will be compared with manual height measurement and testing of sound output. Tool testing data from measurements and calculations can be seen in Table 1.

Table 1. Testing Tool Voltage

Measurement Point	Measurement Voltage (V)					
	V_1	V_2	V_3	V_4	V_5	$V_{average}$
Power Supply (MP1) - Vac	219,0	219,2	220,2	218,9	220,7	219,6
Trafo (MP2) - Vac	12,07	12,09	12,08	12,07	12,10	12,08
Diode (MP3) - Vdc	12,63	12,63	12,66	12,64	12,65	12,64
Capacitor (MP4) - Vdc	12,71	12,69	12,68	12,70	12,68	12,69
IC 7805 (MP5) - Vdc	4,98	4,97	4,98	4,96	4,98	4,97
ESP 32 (MP6) - Vdc	4,96	4,94	4,96	4,95	4,97	4,95
INA219 Sensor (MP7) - Vdc	4,97	4,96	4,96	4,95	4,94	4,95
Thermoucouple Sensor (MP8) - Vdc	4,93	4,95	4,95	4,94	4,93	4,94
LDR Sensor (MP9) - Vdc	4,95	4,94	4,94	4,93	4,92	4,93
LCD 16x2 (MP10) - Vdc	4,94	4,97	4,95	4,94	4,96	4,95
Relay (MP11) - Vdc	3,04	3,03	3,04	3,05	3,04	3,04

The form of application of diodes as a rectifier for alternating current to direct current, usually this rectifier circuit uses four diodes arranged in a rectangular shape with a diode on each side. To find out the bridge diode voltage before it is filtered by the capacitor, it can be calculated using the formula below. To find out the bridge diode voltage before it is filtered by the capacitor, it can be calculated by the formula below.

$V_m = V_{rms}.\sqrt{2}$

Ex:

$V_m = V_{max}$

V_{rms} = Secondary transformer voltage

The percentage error is the difference between the estimated value and the exact value and the percentage of the exact value. To find out the percentage of errors from the tool, it is necessary to compare the test data with the specifications of the tool. The formula for calculating the percentage of errors is.

$$\% \text{ Error} = \frac{|\text{Measurement Value} - \text{Specification Value}|}{\text{Specification Value}} \times 100$$

A measuring tool is used to determine the quality and value of the component to be measured. Data comparison of measurement values and tool specification values can be seen in Table 2.

Table 2. Error Percentage

Measurement Point	$V_{Average}$	$V_{Spefication}$	$V_{Calculation}$	% Error
Power Supply (MP1) - Vac	219,6	220	-	0,001
Trafo (MP2) - Vac	12,08	12	11,98	0,006
Diode (MP3) - Vdc	12,64	-	9,97	0,267
Capacitor (MP4) - Vdc	12,69	-	16,78	0,243
IC 7805 (MP5) - Vdc	4,97	5	-	0,006
ESP 32 (MP6) - Vdc	4,95	3,3 - 5	-	In Range
INA219 Sensor (MP7) - Vdc	4,95	5	-	0,012
Thermoucouple Sensor (MP8) - Vdc	4,94	5	-	0,012
LDR Sensor (MP9) - Vdc	4,93	5	-	0,014

LCD 16x2 (MP10) - Vdc	4,95	5	-	0,010
Relay (MP11) - Vdc	3,04	3 - 5	-	In Range

3.2 Tool Experiment Results

The experiment was carried out by taking data measured by the sensors that have been installed on the device. The measurement results are in the form of sensor readings displayed on the LCD and the Thingspeak website. The units for the voltage and current values read by the INA219 sensor are Volts (V) and Amperes (A). Meanwhile, the unit for the temperature value read by the MAX6675 Type K sensor is degrees Celsius (ºC). Measurements are carried out indoors with the aim of knowing the characteristics of the Light-dependent resistor (LDR) by turning the room lights off or on. If the room light is on, it means you are in the daytime, while the room light is off, it means you are at night. Measurement data is displayed on the LCD as shown in Figure 6 and displayed on the Thingspeak website as shown in Figure 7.

Figure 6. Display on LCD
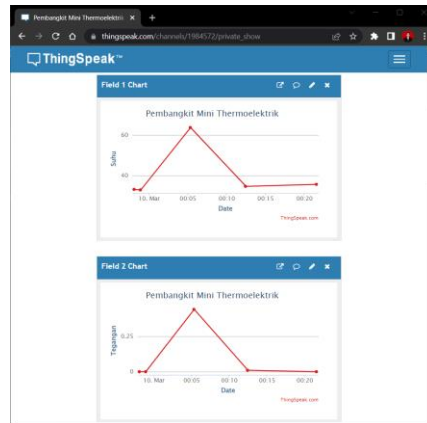
Figure 7. Display on the thingspeak website

Measurement or observation data expressed in the form of numbers requires a basis for managing measurement results data so that it is easier to process data. The results of measurement data can be seen in Table 3.

Table 3. The measurement results of the sensors

Measurement Time	Temperature (ºC)	Voltage (V)	Current (A)	Power V x I (W)	Energy P x t (Joule)	Information
0th minute	30,25	0,00	0,00	0,00	0,00	Lamps Off
1st minute	36,00	0,42	0,00	0,00	0,00	Lamps Off
2nd minute	39,75	0,61	0,00	0,00	0,00	Lamps Off
3rd minute	47,23	1,01	0,01	0,0101	1,818	Lamps On
4th minute	51,12	1,13	0,01	0,0113	2,712	Lamps On
5th minute	55,74	1,27	0,01	0,0127	3,810	Lamps On
6th minute	58,53	1,62	0,02	0,0324	11,664	Lamps On

7th minute	61,77	1,87	0,02	0,0374	15,708	Lamps On
8th minute	66,34	2,06	0,03	0,0618	29,664	Lamps On
9th minute	71,00	2,30	0,03	0,0609	32,886	Lamps On
10th minute	75,01	2,32	0,03	0,0696	41,76	Lamps On

From the data shown in Table 3 it can be seen that the first time the device was turned on the voltage and current had not been read because the thermoelectric was not active. When the heater turns on and distributes heat to the thermoelectric, there will be voltage and current values. It can be seen in the third measurement that the lighting lights are on.

3.3 Overall Tool Work Process Testing

One of the signs of damage to watch out for is when the motor indicator light is on or flashing continuously. When it is first turned on, the power supply indicator light will light up with the LCD flashing as shown in the picture in Figure 8.

Figure 8. The Power Supply and LCD Displays Light Up

This indicates that the DC voltage source for the microcontroller and sensor is properly available. In Figure 8 measurements are taken to test whether the tool is working at a good working voltage or not. It can be seen that the percentage error between the measurement value and component specifications is relatively small so that the tool works in optimal conditions. During the day the LDR will give a signal that the lights must be turned off as shown in Figure 9 below.

Figure 9. Lights Off When Bright Conditions

The lights turn on according to the conditions in the field supported by LDR. The LDR here is used as a light sensor to detect the light from the lamp. At night the LDR will give a signal that the lights must be on as shown in Figure 10 below.

Figure 10. Lights On When Dark Conditions

In 3 it can be seen that the higher the temperature value, the higher the resulting voltage will be, but the thermoelectric has a work limit on temperature with a working limit of -55 ℃ to 83 ℃ so that the heat output from the heater must be maintained so that it does not exceed the specified limit. but by setting using the dimmer module. The dimmer module receives commands from the ESP32 microcontroller according to the values written in the program.

4 Conclusion

Based on the results of the study it can be concluded that the Internet of Things System is capable of monitoring Temperature, Voltage and Current values which can be displayed via the LCD and the Thingspeak website. The lamp can turn on when the thermoelectric heat is fulfilled so that it can be used as street lighting. The light will turn on when the environment is dark and the light will turn off when the environment is bright. The highest thermoelectric power output is at a temperature of 75.1 $^{\circ}$C. Where at this temperature a voltage of 2.32 V is generated and a current of 0.03 A is generated.

References

[1] Desmira D. Aplikasi Sensor LDR (Light Dependent Resistor) Untuk Efisiensi Energi pada Lampu Penerangan Jalan Umum. PROSISKO J Pengemb Ris Dan Obs Sist Komput. 2022 May 19;9(1):21–9.

[2] Toh-arlim M, Ma'arif A, Anggari Nuryono A. Desain Sistem Pengukuran Parameter dan Keamanan Penerangan Jalan Umum Tenaga Surya Berbasis Internet of Thing (IoT). Maj Ilm Teknol Elektro. 2021 Dec 25;20(2):333.

[3] Zarkasi A. Implementasi Monitoring Real Time Suhu Dan Kelembaban Jarak Jauh Berbasis IOT. Prosiding Annual Research Seminar 2019. 2019;5(1).

[4] Djafar Z, Putra N, Koestoer RA. Kajian Eksperimental Pengembangan Generator Termoelektrik Sebagai Sumber Listrik. Seminar Nasional Tahunan Teknik Mesin (SNTTM) ke-9. 2010;

[5] Hidayat D, Sari I. Monitoring Suhu dan Kelembaban Berbasis Internet of Things (IoT). Jurnal Penelitian Teknik Informatika. 2021;4(1).

[6] Abrar, Fauzi MR, Istana B. Optimasi Pemanfaatan Panas Buang pada Tungku Gasifikasi Biomasa Sebagai Penghasil Listrik. Simposium Nasional Teknologi Terapan (SNTT)2. 2014;

[7] Suliono S, Haris E, Rachmatullah R, Al Gifari AR. Pemanfaatan Briket Sekam Padi Sebagai Penghasil Panas Pada Kompor Generator Termoelektrik Untuk Penerangan Pedagang Kaki Lima. Pros Konf Nas Pengabdi Kpd Masy Dan Corp Soc Responsib PKM-CSR. 2019 Dec 15;2:318–23.

[8] Ardiatma D, Sari PA, Sumarna A. Pemanfaatan Energi Panas Hasil Pembakaran Sampah Tanpa Asap Sebagai Pembangkit Listrik Alternatif Berskala Kecil Menggunakan Termoelektrik. Jurnal Pelita Teknologi. 2021;16(1).

[9] Adam A, Muharnis M, Ariadi A, Lianda J. Penerapan IoT Untuk Monitoring Lampu Penerangan Jalan Umum. Elinvo Electron Inform Vocat Educ [Internet]. 2020 Sep 23 [cited 2023 Mar 16];5(1). Available from: https://journal.uny.ac.id/index.php/elinvo/article/view/31249

[10] Zuhri S, Eko Prasetiyo E, Irmawan E. Pengujian Temperatur ESC Menggunakan Pendingin PELTIER TECI-12706 dengan Metode Eksperimen. Tek STTKD J Tek Elektron Engine. 2022 Jul 30;8(1):146–51.

[11] Wijayanto D, Haryudo SI, Wrahatnolo T. Rancang Bangun Monitoring Arus dan Tegangan Pada PLTS Sistem On Grid Berbasis Internet of Things (IoT) Menggunakan Aplikasi Telegram. Jurnal Teknik Elektro. 2022;11(3).

[12] Markapolo T, Ayu Manik Dirgayusari, I Gede Adnyana, I wayan Sudiarsa, I Dewa Putu Gede Wiyata Puta. Rancang Bangun Alat Detektor Kebocoran Gas PLTDG 200 MW Berbasis IOT Notifikasi Telegram. J Rekayasa Teknol Nusa Putra. 2022 Aug 31;8(2):90–100.

[13] Imam R, W IGPWW, Bimantoro F. Rancang Bangun Sistem Monitoring dan Controlling Penerangan Jalan Umum Berbasis IoT dan Android. J Teknol Inf Komput Dan Apl JTIKA. 2020 Mar 31;2(1):101–12.

[14] Hudan IS. Rancang Bangun Sistem Monitoring Daya Listrik pada Kamar Kos Berbasis Internet Of Things (IOT). Jurnal Teknik Elektro Unesa. 2019;8(1).

Ergonomic evaluation of mechanical workshop activities to reduce musculoskeletal disorders

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Abstract. There are many brands of two-wheeled vehicles, one of which is Honda. Entering 1982 to 1984 Honda released the CB 100 and CB 125 with a more attractive appearance. In the type of CB in 1978 to Tiger Revo 2012 has a change in shape that shows the development of innovation. To fulfil the demands of work in the workshop, mechanics experience various types of movements such as moving, bending, turning, holding machines and installing manually without the help of ergonomic aids. This study was conducted on 5 workshop mechanics located in 33 districts/cities in Central Java province. The research results from 5 mechanics resulted in a high risk level using the NERPA, WERA and KIM methods. Then the improvement proposal is made with the design of a tool design in the form of a mechanical work table so that it can reduce the occurrence of Musculoskeletal Disorders. in calculation with tools to disassembling the machine obtained results in the NERPA method of 4 which means the activity has a medium risk. In the WERA method assessment, the final risk value is 33 with a medium risk value. The third calculation using KIM obtained a final risk value of 40 at level 2, meaning that the intensity increased slightly. The calculation of raising the machine obtained a NERPA value of 4 with a medium risk. The WERA method obtained a value of 38 with medium risk. The third calculation using KIM obtained a value of 35 with a level 2 value.

1. Introduction

Traffic jams are a long-standing problem in major cities in Indonesia. The worsening congestion is caused by the increasing volume of private vehicles and inadequate public transport. The large number of vehicles is directly proportional to using vehicle maintenance earlier so that the vehicle is in good

performance. Two-wheeled vehicle components will sooner or later experience damage or a decrease in ability, especially if maintenance is not carried out with a routine.

Indonesia's regulations on the length of use of two-wheeled vehicles are not implemented like neighbouring countries such as Singapore and Malaysia. So there are still many circulating two-wheeled vehicles that are old and can still be used. The absence of rejuvenation regulations makes vehicles still used starting from engine power, two-wheeled vehicle frames and vehicle shapes. There are many brands of two-wheeled vehicles, one of which is Honda. Honda was present in Indonesia on 11 June 1971 through PT Federal Motor which is currently known as PT Astra Honda Motor (AHM). Entering 1982 to 1984 Honda released the CB 100 and CB 125 with a more attractive appearance. The round frame shape and engine have increased performance which makes these two motorbikes a favourite of motorcycle users in Indonesia.

Every vehicle must have maintenance undertaken. In the maintenance of two-wheeled vehicles, there are sources of physical hazards that are most common and will appear in most workplaces at any given time. The workshop is a two-wheeler maintenance place that has the task of repairing vehicles. Workshop activities support the marketing of the product being sold (which in this case means two-wheelers). To fulfil the demands of work in the workshop, mechanics experience various types of movements such as moving, bending, turning and holding in a standing position. This is based on the fact that manual handling also has the advantage of being flexible in movement so as to facilitate the transfer of loads in limited spaces and irregular work (Nugroho et al., 2013).

Figure 1. Mechanical body posture

Moving goods with MMH can result in musculoskeletal (MSD) risks. MSD disorders are complaints that are in the skeletal muscles or skeletal muscles that are responded to by workers ranging from mild to severe complaints. Typical signs include chronic pain, discomfort during activity or static postures that lose mobility (Cooper 2015). If the muscles receive static loads repeatedly and for a long period of time, it will produce complaints in the form of damage to the joints. It can be seen in **Figure 1.** that mechanics perform activities by bending and without tools so that they can produce complaints of injury. In order to minimise the injuries that occur, a study was conducted to analyse work postures using the Workplace Ergonomic Risk Assessment (WERA) method to be a tool to analyse six physical risk factors in the workplace. WERA was developed by Rahman in 2009 and has physical movement identification factors that cause Musculoskeletal Disorders, namely posture, repetition, force, vibration, stress relationships and duration. The second method Novel Ergonomic Postural Assesment (NERPA) modifies some of the body part assessments observed from the RULA method. Therefore, this method is able to detect postures with ergonomic risks that are more sensitive to ergonomic improvement

detection than the RULA method. And finally, the Key Indicator Method (KIM) is used to assess a manual load handling risk in two stages. The first stage is an ordinal scaled description of the temporary work load section, the second stage is to evaluate the array of possible physical overloads. These three methods were chosen to identify all activities.

2. Methods
This research was conducted by direct observation of manual object workers in a work cycle, to determine the risk composition of lifting, lowering, carrying or grasping activities using the WERA, NERPA, and KIM MHO methods by direct observation related to the work process. Research related to the analysis of manual material handling was conducted on the activities of non-official workshop mechanics located in 33 districts/cities in Central Java province. This research was conducted on 5 workshop mechanics.

Musculoskeletal complaints felt by workshop mechanics during activities can be known through the Nordic Body Map (NBM) questionnaire. NBM complaint data was obtained from the results of asking directly to workshop mechanics. Workshop mechanics who filled out the questionnaire were asked to mark the presence or absence of disturbances in the body area. Workshop mechanics who were used as the object of research totalled 43 people.

The first processing uses the NERPA method by grouping the scores of body parts, load weight and muscle use in work activities, by selecting a score for each part of group A and group B. Then the score is entered in table A to obtain score A and table B to obtain score B. Then, scores A and B are allocated in table C to obtain the final score.

In the WERA method the risk assessment tool is measured by a combination of two items, e.g. a combination of postures with repetitions for the shoulder, wrist and back body regions and postures combined with task durations for the neck and foot body regions. A combination of force and wrist posture is also included in this assessment. To provide a high array sensitivity to vibration, a combination of force and wrist posture was performed. As in the case of vibration sensitivity, contact stress was also combined with wrist posture. Finally, a total score is calculated based on the sum of the nine risk factors that are combined with each other to obtain a final score and action risk array.

The use of the KIM method has three steps that are carried out, the first is determining the rating value of working time, in determining the rating value into other indicators where the indicator serves as a variable in the assessment such as activity indicators at work every day. The second step includes indicators of power transfer, indicators of hand movement position, indicators of working conditions, indicators of posture position, indicators of work organisation. The last step is assessment and evaluation, namely by adding or summing up the six variables and obtaining the final result and then analysing it according to the parameters.

3. Results and Discussion
This chapter lays out specific instructions for writing the full text, including the article section, the systematic chapter and its contents. These specific instructions will guide the entire editorial process of the article as shown in Figure 2.

3.1 NBM *Assesment*
Musculoskeletal complaints felt by workshop mechanics during activities can be known through the Nordic Body Map (NBM) questionnaire. NBM complaint data is obtained from the results of asking directly to workshop mechanics, this study explains the questions based on complaints felt at work and based on the contents of the NBM questionnaire.
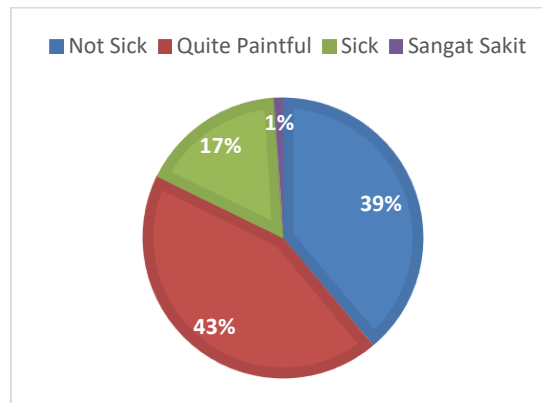
Figure 2. NBM Assesment

The results of the calculations in **Figure 2.** obtained Moderately Sick complaints with a value of 43% totalling 522 in each type of complaint investigated, for the assessment of complaints Not sick get a value of 39% totalling 468 in each type of complaint, on complaints Sick get a value of 17% totalling 202 in each type of complaint, and for complaints Very Sick get a value of 1% with a total of 12 in each type of complaint.

Whereas in the upper body there are complaints of no pain of 32% with a total of 252, for complaints Sick enough to get a value of 47% with a total of 357, complaints Sick get 20% with a total of 157, and Complaints Very Sick get a presentation of 1% with a total of 8. For the lower body part resulting from complaints Not Sick of 50% with a total of 430, for complaints Sick enough to get a value of 39% with a total of 216, while for complaints Sick get a value of 10% with a total of 157, and the type of complaint Very Sick Get Value 1% with a total of 4.

3.2 Assesment Methods
After calculating the NBM, it was found that there were musculoskeletal complaints experienced by mechanics in the mechanic workshop so that further assessment was carried out to assess the risks. Furthermore, calculations are carried out to assess how severe or high the activities carried out by workshop mechanics.

Table 1. Assessment of ergonomic risk levels

No	Activities	Value of Each Method		
		NERPA	WERA	KIM-MHO
1	Disassembling the Machine	7	47	58
	Raising the Engine	7	45	93
2	Disassembling the Machine	7	48	72
	Raising the Engine	6	52	105
3	Disassembling the Machine	7	47	74
	Raising the Engine	7	49	187
4	Disassembling the Machine	7	53	111
	Raising the Engine	7	47	62
5	Disassembling the Machine	7	53	62
	Raising the Engine	6	51	62

Mechanic 1 Activity of Disassembling the Machine obtained the results of calculating the risk level using the NERPA method on the activity of lowering the machine after the calculation obtained a final value of 7 which work requires further research and changes as soon as possible. The results obtained in the WERA method obtained a final value of 47 which can indicate that the activity is at a high level.

From the KIM-MHO method, the results obtained a total value for Disassembling the Machine of 58, which is a much-increased intensity. For Mechanic 1 in the activity of Raising the Machine, the risk level is obtained using the NERPA method in the activity of Disassembling the Machine after the calculation obtained a final value of 7, which requires further research and immediate changes. The results obtained in the WERA method obtained a final value of 45 which can indicate that the activity is at a high level. From the results obtained, the total value for Disassembling the Machine is 114, which is high intensity.

Mechanical Assessment 2 Activity Disassembling the Machine obtained a risk level calculation using the NERPA method on the activity of Disassembling the Machine after the calculation obtained a final value of 7 which work requires further research and immediate changes. The results obtained in the WERA method obtained a final value of 48 which can indicate that the activity is at a high level. From the results of the KIM-MHO method, the total value obtained for lowering the machine is 72, which is a much-increased intensity. In the activity of Raising the Machine, the resulting risk level calculation using the NERPA method on the activity of Disassembling the Machine after the calculation obtained a final value of 6 which means the work requires further research and immediate changes to the activity. The results obtained in the WERA method obtained a final value of 52 which can indicate that the activity is at a high level. From the results of the KIM-MHO method, the total value for lowering the machine is 105, which is at a high intensity.

Mechanical Assessment 3 on the activity of Disassembling the Machine gets the NERPA method calculation on the activity of Disassembling the Machine after the calculation obtained a final value of 7 which work requires further research and changes as soon as possible. The results obtained in the WERA method obtained a final value of 47 which can indicate that the activity is at a high level. From the results of the KIM-MHO method, the total value obtained for Disassembling the Machine is 74, which is a much-increased intensity. The NERPA method on the activity of lowering the machine after calculation obtained a final value of 7 which requires further research and immediate changes. In the results obtained in the WERA method, the final value is 49 which can indicate that the activity is at a high level. From the results obtained, the total value for lowering the machine is 87, which is an intensity that has increased a lot.

Mechanical Assessment 4 Activity of Disassembling the Machine NERPA method on the activity of Disassembling the Machine after calculation obtained a final value of 7 which work requires further research and immediate changes. In the results obtained in the WERA method, the final value is 53 which can indicate that the activity is at a high level. From the results obtained the total value for Disassembling the Machine as much as 111 is high intensity. While the Activity of Raising the Machine NERPA method on the activity of lowering the machine after calculation obtained a final value of 7 which work requires further research and changes as soon as possible. In the results obtained in the WERA method, the final value is 47 which can indicate that the activity is at a high level. From the results obtained, the total value for lowering the machine is 62, which is an intensity that has increased a lot.

Mechanical Assessment 5 on the activity of disassembling the machine NERPA method on the activity of lowering the machine after calculation obtained a final value of 7 which work requires further research and changes as soon as possible. In the results obtained in the WERA method, the final value is 53 which can indicate that the activity is at a high level. From the results obtained the total value for disassembling the machine as much as 62 is an intensity much increased. While the Activity of raising the machine NERPA method on the activity of raising the machine after calculation obtained a final value of 6 which work requires further research and immediate changes. In the results obtained in the WERA method, the final value is 62 which can indicate that the activity is at a high level. From the results obtained the total value for raising the machine as much as 51 is in the intensity of much increased.

3.3 Desain Concept

The description of needs is made to clarify the objectives in making design concepts and facilitate the stages of completion that must be carried out. Needs are obtained directly from interviews with mechanics directly or with workshop owners. There are several mechanical desires such as ease of operation, the absence of a work table in disassembling the machine, being able to move the machine to the workplace, the ease of starting the engine, and not taking up much space.
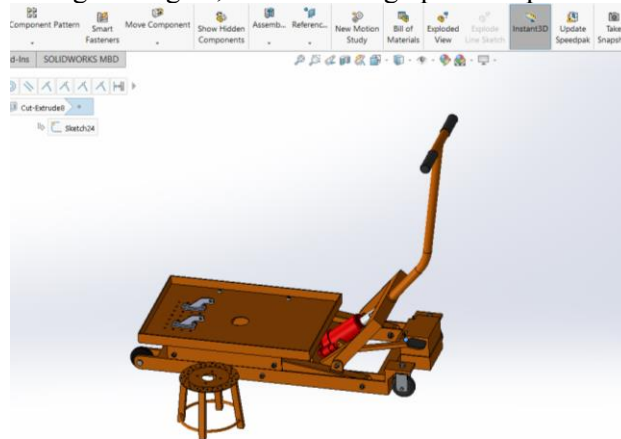
Figure 3. Design result

Figure 3. obtained the design of the mechanical input so as to simplify the operation. Dimension calculations are carried out to determine the dimensions and combined with the design data that has been prepared with the aim that the proposed improvements to the design of the tool design are made according to the objectives that have been made. Workplace height size. This calculation is adjusted to the height dimension between the ground and the machine while still on the motor. Made with additional hydraulics that can be adjusted from 0cm to a maximum of 35 cm. Anthropometric data needed to determine the diameter of the handle is the size of the diameter of the middle handle with the 50th percentile. The use of the 50th percentile is intended for the size of mechanical handles that have small palms and larger palms can use a diameter value of 5 cm. The size of the handle width is used Anthropometric data needed to determine the width of the handle is the width of the 50th percentile handle. The use of the 50th percentile is intended so that the width of the handle of the tool has a common size. So that mechanics with larger and smaller shoulder widths can hold the handle comfortably with a value of 36 cm. Width of the workbench board The calculation is adjusted to the dimensions of the width of the machine that will be transported by the mechanic when carrying out activities. Can also be used on other machines that have less width will also be used so that the size of 40 cm is made. The length of the machine table board used is adjusted to the dimensions of the distance between the front tyre of the vehicle to the middle standard point of the vehicle when carrying out mechanical activities with a length of 60 cm.

3.4 Calculations Using Design

After the design, the posture calculation is carried out using angles. Simulate this movement posture using CATIA software. From this software is used to reassess the results of the risk in the design of aids with the calculation of 3 methods can be seen in the following figure.
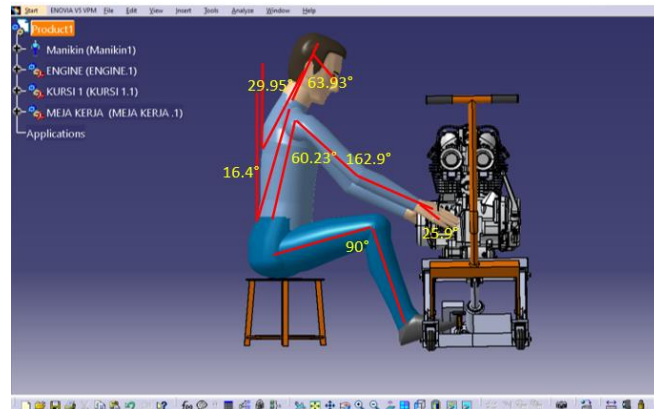
Figure 4. Posture assessment with tools

In calculations with tools such as **Figure 4** so that the calculation to disassembling the machine obtained results in the NERPA method of 4 which means the activity has a medium risk. In the WERA method assessment, the final risk value is 33 with a medium risk value. The third calculation using KIM obtained a final risk value of 40 at level 2, meaning that the intensity increased slightly. The calculation of raising the machine obtained a NERPA value of 4 with a medium risk. The WERA method obtained a value of 38 with medium risk. The third calculation using KIM obtained a value of 35 with a level 2 value.

4. Conclusion

It was found that musculoskeletal complaints in the moderately painful category were the highest at 43%, totalling 522 in each type of complaint investigated, for the assessment of complaints It doesn't hurt to get 39%, totalling 468 in each type of complaint, for complaints It hurts to get a value of 17%, totalling 202 in each type of complaint, and for complaints It hurts to get a value of 1% with a total of 12 in each type of complaint.

The results of the assessment of the level of risk of injury using the NERPA method can be seen from the 5 mechanics studied all activities have a medium to high risk so that activities need to be investigated further. While the results of research on the level of risk of injury using the WERA method can be seen that 5 work mechanics observed there are 10 activities that have a high level of risk of injury (high) which can indicate that the activity is at a high level which means that the work of mechanical activities needs further investigation and immediate changes to the activity. In the final assessment of the results of the risk of injury activity assessment using the KIM method, it can be seen that of the 8 activities carried out by 5 mechanics, the intensity has increased a lot, which means that redesign and maintenance measures should be taken with risks that fall into the level 3 category, while 2 activities are at High intensity, which means that redesign and maintenance measures should be taken with risks that fall into the level 4 category.

The improvement made is to add a work table by producing a risk reduction using the three methods with the results of the calculation to disassembling the machine obtained results in the NERPA method of 4 which means the activity has a medium risk. In the WERA method assessment, the final risk value is 33 with a medium risk value. The third calculation using KIM obtained a final risk value of 40 at level 2 with the meaning of slightly increased intensity. The calculation of raising the machine obtained a NERPA value of 4 with a medium risk. In the WERA method, a value of 38 was obtained with a medium risk. The third calculation using KIM obtained a value of 35 with a level 2 value.

References

[1]   R.S, Bridger, *Intridusction to Ergonomics*, McGraw-Hill International Edition, Singapore, 2003.

[2]   G. Cooper, "Lower Back Pain : An Overview of the Most Common Causes, In Non- Operative Treatment of the Lumbar Spine (pp.11-13), Springe International Publiushing, 2005.

[3]   A. Klussmann, F. Liebers, H. Gebhardt, M.A. Rieger, U. Latza, & U. Steinberg, Risk assessment of manual handling operations at work with the key indicator method (KIM-MHO) — determination of criterion validity regarding the prevalence of musculoskeletal symptoms and clinical conditions within a cross-sectional study, 1–13, https://doi.org/10.1186/s12891-017-1542-0, 2017.

[4]   K.H.E. Kroemer, H.B. Kroemer, K.E Kroemer-Elbert, *Ergonomica How to Design for Ease and Efficiency*, New Jersey: Prentice Hall, 2001.

[5]   W.S. Marras, Occupational low back disorder causation and control, *Ergonomics*, 43(7), 880-902, 2000.

[6]   W.S. Marras, S.A. Lavender, R.E. Splittstoesser, and G.Yang, " National occupational research agenda (NORA) future directions in occupational musculoskeletal disorder health research, *Applied Ergonomics*, 2009.

[7]   B.P.T. Nugroho, T. Rocman, I. Iftadi, Proposal of Trolley Design to be an Assistive Tool for Transporting Grain Sacks in order to Improve Work Posture in Rice Mill (Case Study: Rice Mill in Sragen), Performa, 12(1), 2013.

Analysis Determination of the Best Employee with Simple Additive Weighting Method

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Abstract. In a company, quality human resources are very important to carry out business processes in accordance with the vision and mission that has been set. CV. Jaya Abadi is a company engaged in the procurement and repair services of various electronic devices and was founded in 2015. The purpose of this research is to encourage the creation of continuously increasing performance productivity by selecting the best employees at CV. Jaya Abadi. One of the methods used is the Simple Additive Weighting (SAW) method. In the SAW method, there is a process of normalizing the decision matrix (x) on a certain scale that can be compared with all existing ratings. In this study, the data used consisted of internal data and external data. There are several criteria that are taken into consideration in selecting the best employees, namely discipline, quality of work, cooperation, and behavior. Based on the calculation of all existing criteria and alternatives, this study resulted in Abiyasa Alfarizi being the best employee with a total preference score of 1.33. The SAW method is proven to be effective and practical in calculating to determine the best employee recommendations at CV. Jaya Abadi. Thus, decision makers can consider these recommendations according to the priorities set.

1. Introduction

CV. Jaya Abadi is a private company that was established in 2015 and focuses on procurement and repair services for various electronic devices. CV. Jaya Abadi is a company that is growing and prioritizes quality in the procurement of electronic equipment and repair services. Quality human resources is one of the important factors in running a company or business well [1]. Human resources have a very important role in the field of production, development and progress of a company. If the human resources are of poor quality, it will be difficult for the company to achieve the vision, mission, goals and objectives that have been set [2]. Therefore, human resources must have a variety of competencies that can support and encourage an increase in employee productivity and performance. In addition, it is necessary to provide rewards or awards to employees as motivation to be more positive

and work better [3]. In order to realize this, CV. Jaya Abadi requires an information system that can assist companies in selecting and deciding the best employees effectively according to certain criteria.

One of the previous studies related to the research to be carried out is "Decision Support System for Selection of the Best Employees Using the Analytical Hierarchy Process Method (Case Study at PT. Bando Indonesia)". This study uses the AHP method, in which each criterion and decision alternative is compared to one another to provide a priority intensity value that assesses the performance of outstanding employees.[4]. In addition, researchers also reviewed previous research entitled "The Best Employee Selection Recommendation System with the TOPSIS Method on Bussan Auto Finance". This study used the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, which is one of the methods used in making decisions with multi-criteria. The aim is to determine the relative proximity of an alternative that has an optimal solution by selecting the alternative that has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution from a geometric point of view.[5].

Through the SAW (Simple Additive Weighting) method, this study aims to simplify CV. Jaya Abadi in selecting the best employees according to the company's criteria[6]. By taking into account preference weights and match ratings, problems in selecting the best employees can be resolved and all alternative ratings can be compared objectively to achieve results that are in line with expectations.[7].

2. Methods
The data used in this study came from external data and internal data collected in several ways, such as searching for data directly in the field, conducting interviews with employees and management of CV. Jaya Abadi, as well as conducting literature studies. The criteria to be used are the alternatives to be compared[8]. There are six alternatives and four criteria that will be analyzed through fuzzy weighting. Furthermore, the data will be processed so that it has a quantitative nature[9]. This study aims to make it easier for companies to choose the best employees according to company criteria using the SAW (Simple Additive Weighting) method and provide objective results and in accordance with expectations[10].

The methods that can be used in decision support systems are quite diverse. One of them is the SAW method, which is a weighted sum method. In the SAW method, there is a process of normalizing the decision matrix (x) on a certain scale that can be compared with all existing ratings[11], as seen in the equation below.

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max\ x_{ij}} \\ \dfrac{Min\ x_{ij}}{x_{ij}} \end{cases}$$

Information:
r_{ij} = normalized performance rating value
x_{ij} = attribute value owned by each criterion
$Max\ x_{ij}$ = the largest value owned by each criterion
$Min\ x_{ij}$ = the smallest value that is owned by each criterion
Where r_{ij} is the normalized performance rating of the Ai alternative on the C_j attribute; i = 1,2,3…,m and j = 1,2,3,…,n. In determining the preference value in each alternative (V_j) the following equation is used:

$$V_{i} = \sum_{j=1}^{n} w_j\, r_j$$

Information:

V_i = rating for each alternative
W_j = weight value for each alternative
r_{ij} = normalized performance rating value

If Vi has the greatest value, this means that alternative Ai is the best alternative. Figure 1 is a flowchart of the SAW method.
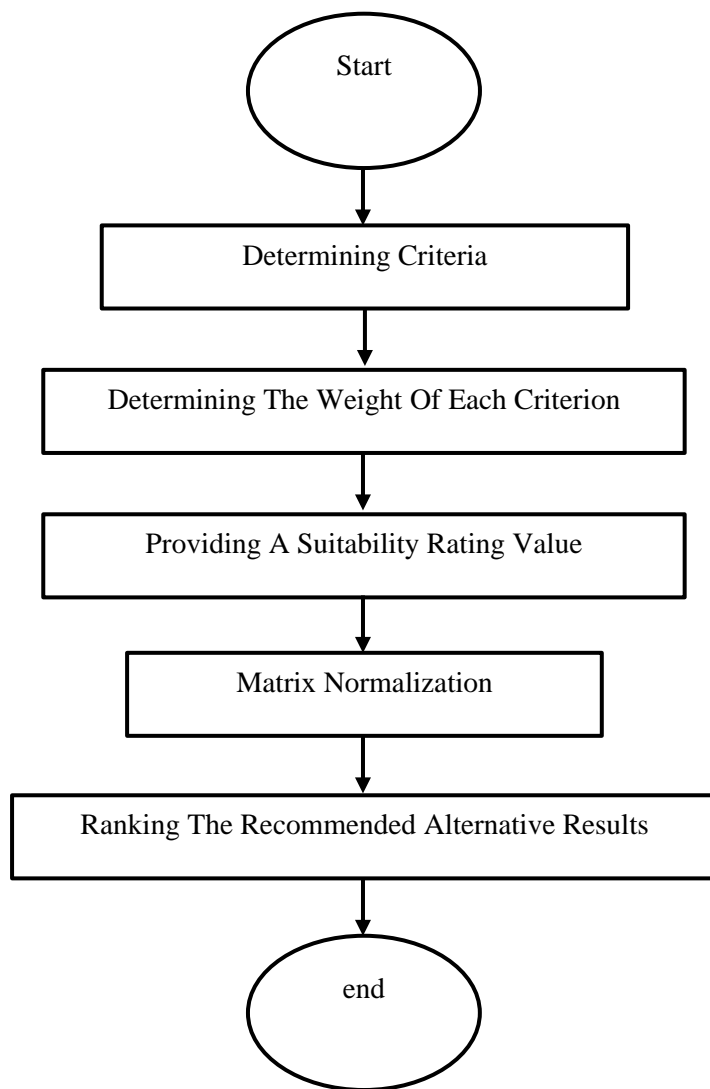
Figure 1.SAW Method Flowchart

Figure 1 is the completion steps using the SAW (Simple Additive Weighting) method based on the SAW method flowchart.

1. A value is given to each alternative (A_i) on each predetermined criterion (C_j), where the value $i = 1,2,3,...,m$ and $j = 1,2,3,...,n$.

2. The decision maker assigns a weight value (*W*) to each criterion.
3. Calculation of the normalized performance rating value for attribute C of each alternative Ai is performed to normalize the matrix.
4. The ranking process is carried out by multiplying the preference weight value with the normalized matrix.
5. The preference value is determined by the sum of the multiplication results between the preference weights and the normalized matrix.

In this study, a multi-attribute decision making (MADM) approach was applied to find alternatives that meet certain criteria and are optimal. The MADM approach is carried out in two steps[12]:

1. Aggregating decision alternatives for each objective in each alternative.
2. Ranking the alternatives based on decision aggregation.

The results of this study will provide recommendations for the best employees based on four criteria, namely cooperation, quality of work, discipline, and behavior. This recommendation information will be given to the management of CV. Jaya Abadi to be taken into consideration in selecting the best employees[13]. This process is carried out using the SAW method which processes input from users to produce a list of the best employee recommendations[14].

3. Results and Discussion

3.1. Determination of Criteria
In determining the best employee using the SAW method, the first step is to determine the criteria and weights[15]. These criteria are obtained from the results of observations at CV. Jaya Abadi. In Table 1 and Table 2 are the criteria and alternatives that have been obtained in determining the best employees:

Table1. Criteria

No		Criteria
1	C1	Discipline
2	C2	Quality of Work
3	C3	Cooperation
4	C4	Behavior

Table2. Alternatives

No		Alternatives
1	A1	Wahyu Ardito
2	A2	Jamaluddin
3	A3	Nana Triahapsari
4	A4	Rani Febriyana
5	A5	Abiyasa Alfarizi
6	A6	Ahmad Chaerudin

In table 3 there are 5 (five) Fuzzy numbers for criterion weights, namely:

Table3. Fuzzy Numbers

No	Weight	Information	linguistics
1	1	Very Low	VL
2	2	Low	L
3	3	Moderate	M
4	4	high	H
5	5	Very High	VH

3.2. Determination of Weigh of Each Criterion

Before determining the best employees using the SAW method, it is necessary to determine the criteria and weights first. These criteria were obtained through observations at CV. Jaya Abadi. The following are the criteria and alternatives that have been obtained to determine the best employees. There are 2 weightings used in this system, namely the importance level weighting and the suitability level weighting contained in each alternative. Match level weighting aims to simplify data processing and then convert it into a fuzzy form. The following is the weighting for each criterion.

Table 4 is a nursery with criteria C1, C2, C3, C4, – Discipline, Quality of Work, Cooperation, Behavior

Table4. Weighting Value

No	Mark	Information
1	0.35	Discipline
2	0.35	Quality of Work
3	0.20	Cooperation
4	0.20	Behavior

3.3. Assign a Match Rating

After setting all the criteria, the next step is to match the values of each alternative based on the criteria. From these employees the best employee will be selected, alternative data can be seen in table 5 below:

Table 5. Match Rating Value

Alternative	Criteria			
	C1	C2	C3	C4
A1	high	high	high	Very High
A2	Very High	high	high	Very High
A3	high	Very High	Very High	high
A4	Very High	high	high	high
A5	Very High	Very High	high	Very High
A6	Very High	high	Very High	high

The decision matrix x is formed from the table above and then converted into fuzzy numbers in Table 6 below.

Table6. Alternative Match Rating on Criteria

Alternative	Criteria			
	C1	C2	C3	C4
A1	4	4	4	5
A2	5	4	4	5
A3	4	5	5	4
A4	5	4	4	4
A5	5	5	4	5
A6	5	4	5	4

3.4. Matrix Normalization

The purpose of using the data in table 6 in the matrix normalization process is to obtain calculation results for each criterion. Meanwhile, Table 7 below shows the results of calculations for each criterion.

Table7. Normalized Matrix

Alternative	Criteria			
	C1	C2	C3	C4
A1	0.80	0.80	0.80	1.0
A2	1.0	0.80	0.80	1.0
A3	0.80	1.0	1.0	0.80
A4	1.0	0.80	0.80	0.80
A5	1.0	1.0	0.80	1.0
A6	1.0	0.80	1.0	0.80

3.5. Ranking of Alternative Recommendation Result

After normalizing the matrix, the next step is to multiply each normalized value with the appropriate criterion weight. Then, the results are summed and ranked. The alternative with the highest value is considered the best recommendation in decision making. The importance level of each criterion is used as the basis for giving weight by management.

$$W = 0.35; 0.25; 0.20; 0.20$$

Next, calculations are carried out using Equation 2 and adding up the multiplication results to get the best alternative recommendation.

$V1 = (0.35\ x\ 0.80) + (0.35\ x\ 0.80) + (0.35\ x\ 0.80) + (0.35\ x\ 1.0) = 1.19$
$V2 = (0.35\ x\ 1.0) + (0.35\ x\ 0.80) + (0.35\ x\ 0.80) + (0.35\ x\ 1.0) = 1.26$
$V3 = (0.35\ x\ 0.80) + (0.35\ x\ 1.0) + (0.35\ x\ 1.0) + (0.35\ x\ 0.80) = 1.26$
$V4 = (0.35\ x\ 1.0) + (0.35\ x\ 0.80) + (0.35\ x\ 0.80) + (0.35\ x\ 0.80) = 1.19$
$V5 = (0.35\ x\ 1.0) + (0.35\ x\ 1.0) + (0.35\ x\ 0.80) + (0.35\ x\ 1.0) = 1.33$
$V6 = (0.35\ x\ 1.0) + (3.5\ x\ 0.80) + (0.35\ x\ 0.80) + (0.35x\ 1.0) = 1.26$

Below is table 8 which displays the ranking calculation results of the alternatives that have been calculated previously. The alternative with the biggest V5 value is alternative A5, which can be considered as the best alternative. Based on the data in table 8, Abiyasa Alfarizi has the highest V5 score, so he can be recommended as the best employee at CV. Jaya Abadi.

Table8. Total Preference Value

Alternative	Criteria				The final result
	C1	C2	C3	C4	
A1	0.28	0.28	0.28	0.35	1.19
A2	0.35	0.28	0.28	0.35	1.26
A3	0.28	0.35	0.35	0.28	1.26
A4	0.35	0.28	0.28	0.28	1.19
A5	0.35	0.35	0.28	0.35	1.33
A6	0.35	0.28	0.28	0.28	1.26

4. Conclusion

The SAW method can be used in a decision support system to select the best employees at CV. Jaya Abadi. Criteria and sub-criteria data in this study are dynamic and can be changed according to the needs of decision makers. Service orientation criteria have the biggest contribution in determining the best employee. Abiyasa Alfarizi was chosen as the best employee with a total score of 1.33. The SAW method is effective and practical in determining the best employee recommendations so that decision makers can consider these recommendations with a predetermined priority.

References

[1] O. Rizan, C. Kirana, Hamidah, Hengki, H. A. Pradana, and A. Pangestu, "Determination of the Best Employees to Improve Service Quality using the SAW Algorithm," 2021, doi: 10.1109/ICORIS52787.2021.9649524.

[2] L. Karlitasari, D. Suhartini, and Benny, "Comparison of simple additive weighting (SAW) and composite performance index (CPI) methods in employee remuneration determination," in *IOP Conference Series: Materials Science and Engineering*, 2017, vol. 166, no. 1, doi: 10.1088/1757-899X/166/1/012020.

[3] E. Simanjuntak and B. Sinaga, "Decision Support System for Determining the Best Hospital Nurses Grandmed Method Using Simple Additive Weighting (SAW)," *J. Comput. Networks, Archit. High Perform. Comput.*, vol. 2, no. 1, 2020, doi: 10.47709/cnapc.v2i1.357.

[4] M. Hasanudin, Y. Marli, and B. Hendriawan, "Sistem Pendukung Keputusan Pemilihan Karyawan Terbaik Menggunakan Metode Analytical Hierarchy Process (Studi Kasus Pada Pt . Bando Indonesia)," *Semin. Nas. Teknol. Inf. dan Multimed. 2018*, vol. 6, no. 3, 2018.

[5] B. Setiadji and S. Sofiana, "Sistem Rekomendasi Pemilihan Karyawan Terbaik Dengan Metode TOPSIS Pada Bussan Auto Finance," *J. Inform. Univ. Pamulang*, vol. 1, no. 1, 2016.

[6] M. A. Budhi and R. Wardoyo, "Group Decision Support System Determination Of Best Employee Using Topsis And Borda," *IJCCS (Indonesian J. Comput. Cybern. Syst.*, vol. 11, no. 2, 2017, doi: 10.22146/ijccs.22773.

[7] Painem and H. Soetanto, "Decision support system with simple additive weighting for recommending best employee," 2019, doi: 10.23919/EECSI48112.2019.8977031.

[8] C. Kustandi, A. Reni, Hariyadi, T. Suharto, and N. Lestari, "Providing best employee rewards using decision support system method," *Int. J. Adv. Sci. Technol.*, vol. 29, no. 3, 2020.

[9]   Z. Jabrayilova, "The principles of developing a management decision support system for scientific employees," *EUREKA, Phys. Eng.*, vol. 2019, no. 4, 2019, doi: 10.21303/2461-4262.2019.00951.

[10]   D. Kurniawati, D. Kusumawati, and M. Arifah, "Developing a Decision Support System with Dynamic Criteria for The Best Employee Assessment," *J. Int. Conf. Proc.*, vol. 2, no. 2, 2019, doi: 10.32535/jicp.v2i2.603.

[11]   H. Kusumo, "SISTEM PENDUKUNG KEPUTUSAN PEMILIHAN SISWA BERPRESTASI SEBAGAI PESERTA OLIMPIADE SAINS MENGGUNAKAN METODE SIMPLE ADDITIVE WEIGHTING (SAW)," *J. Teknol. Inf. DAN Komun.*, vol. 9, no. 2, 2020, doi: 10.51903/jtikp.v9i2.157.

[12]   B. Efiriyanto, "Sistem Pendukung Keputusan Menggunakan Metode Simple Additive Weighting (SAW) Untuk Menentukan Karyawan Terbaik Pada Dealer Motor Berbasis Web," *Skripsi Fak. Komun. dan Inform. UMS*, 2016.

[13]   M. Marbun, M. Zarlis, and Z. Nasution, "Analysis of Application of the SAW, WP and TOPSIS Methods in Decision Support System Determining Scholarship Recipients at University," in *Journal of Physics: Conference Series*, 2021, vol. 1830, no. 1, doi: 10.1088/1742-6596/1830/1/012018.

[14]   R. Taufiq, R. S. Septarini, A. Hambali, and Y. Yulianti, "Analysis and Design of Decision Support System for Employee Performance Appraisal with Simple Additive Weighting (SAW) Method," *J. Inform. Univ. Pamulang*, vol. 5, no. 3, 2020, doi: 10.32493/informatika.v5i3.6777.

[15]   E. Putra, "Decision support system election of the best employees AT PT. Sukma Jaya Mandiri with Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) method," *J. Adv. Res. Dyn. Control Syst.*, vol. 9, no. 16, 2017.

Aspect-based Sentiment Analysis on Car Reviews Using SpaCy Dependency Parsing and VADER

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Abstract. All businesses, including car manufacturers, need to understand what aspects of their products are perceived as positive and negative based on user reviews so that they can make improvements for the negative aspects and maintain the already positive aspects of their products. One of the available tools for this task is Sentiment Analysis. The traditional document-level and sentence-level sentiment analysis will only classify each document / sentence into a class. This approach is incapable of finding the more fine-grained sentiment for a specific aspect of interest, for example, comfort, price, engine, paint, etc. Therefore, in this case, Aspect-based Sentiment Analysis is used. A total of 22.702 rows of car review data are scraped from the Edmunds website (www.edmunds.com) for a specific car manufacturer. Dependency Parsing and noun phrase extraction were carried out using the SpaCy module in Python, and VADER sentiment analysis was used to determine the polarity of the sentiment for each noun phrase. Results showed that the vast majority of the sentiments are on the positive aspects: comfortable to drive, good fuel economy / mileage, reliability, spaciousness, value for money, helpful rear camera, quiet ride, good acceleration, well-designed, good sound system, and solid build. The results for the negative aspects have some similar aspects with those in the positive class but has a very low frequency. This finding means that the vast majority of the users are satisfied with multiple aspects of the produced cars. The limitation of this research and future research direction are discussed.

Keywords: aspect-based sentiment analysis, car reviews, SpaCy Dependency Parsing, VADER

1. Introduction
All businesses, including car manufacturers, need to understand what aspects of their products are perceived

as good and bad based on user feedback so that they can improve the negative aspects and maintain the already positive aspects of their products [1]. This is part of the *kaizen* principle which in this case is related to continuous improvements of the products [2]. Sentiment Analysis (SA) is a part of the Natural Language Processing (NLP) task of extracting and analyzing people's opinions / perceptions toward certain entities such as products and services [3]–[5]. SA can be used to analyze the users' sentiment polarization (positive or negative) toward a product or service. SA can be divided into three levels: document-level SA, sentence-level SA, and aspect-based SA (ABSA) [6]. The traditional document-level and sentence-level sentiment analysis will only classify each document / sentence into a class. This approach is incapable of finding the more fine-grained sentiment for a specific aspect of interest, for example, the comfort, price, engine, paint, etc of a car. This is particularly trickier if the document / sentence contains mixed positive and negative sentiments such as "*The price is good but it's not comfortable to drive*". The traditional document-level sentiment analysis will miss such details and have difficulties in classifying the document into positive or negative sentiments. In this case, ABSA can identify the aspects of the product that are perceived as positive or negative by the users / customers. However ABSA is more difficult to perform since it has to identify a more fine-grained investigation [7]. ABSA had been used in Scientific Reviews [8], smart government app reviews [9], and tweets [10]. One of the data sources that can be used for SA / ABSA is based on review data that is available online [11], [12]. In this research, ABSA is applied to car review data to extract information on the positive and negative aspects of the cars produced by a certain car manufacturer.

The approaches used in ABSA are unsupervised methods [13]–[15], lexicon-based methods [16], [17], transfer learning [1], [18], [19], and deep-learning-based methods [20]–[22]. From those approaches, the three mainstream methods are lexicon-based, traditional machine learning, and deep learning methods [6]. This research will belong to the lexicon-based ABSA. The ABSA in this research will be facilitated by using a word dependency parser to identify phrase nouns and combined with a lexicon-based sentiment classifier called VADER (Valence Aware Dictionary and sEntiment Reasoner). The dependency parser is part of the SpaCy English pipeline which is a Python submodule for NLP. The SpaCy pipeline consists of multiple components such as Tokenizer, Part-Of-Speech (POS) tagger, Dependency Parser, Named-Entity Recognition, and Lemmatizer [23]. SpaCy is proven to be the fastest NLP parser available while also providing the best state-of-the-art accuracy [24]–[26]. In this research, the POS tagger and Dependency Parser components are mainly used to identify the phrase nouns that reflect the aspects of interest. The second part of the analysis, VADER, is a lexicon-based sentiment analysis tool that bases the sentiment classification on positive or negative keywords such as "great", "good", "worst", and "poor" [27]. Both SpaCy and VADER are available as Python modules/submodules.

2. Methods

The research methods are shown in Figure 1. The car review data are scraped from Edmunds website (https://www.edmunds.com) for one specific car manufacturer. The car review data consists of the review title and the content which are first concatenated before undergoing further analysis. These strings will then undergo dependency parsing and noun phrase extraction using the Language Processing Pipelines in the SpaCy [23] module in Python. The parser is a transition-based dependency parser. The pipeline used is the large English pipeline named "en_core_web_lg". This pipeline is trained using three datasets: OntoNotes Release 5.0 (University of Pennsylvania), ClearNLP (Emory University), and WordNet 3.0 (Princeton University) [23]. The accuracy for the Part-of-speech tagger component is 0.97, 0.92 for Sentence segmentation precision, and 0.90 for Labeled dependencies [23]. The extracted phrase nouns then will be classified into positive or negative sentiments using VADER SentimentIntensityAnalyzer [27] submodule in the nltk [28] module in Python. Lastly, frequency analysis is applied to the phrase nouns for each sentiment class to extract the aspect-based sentiment and the result is interpreted. All of the analyses were done using Python 3.7 and Jupyter Notebook [29].
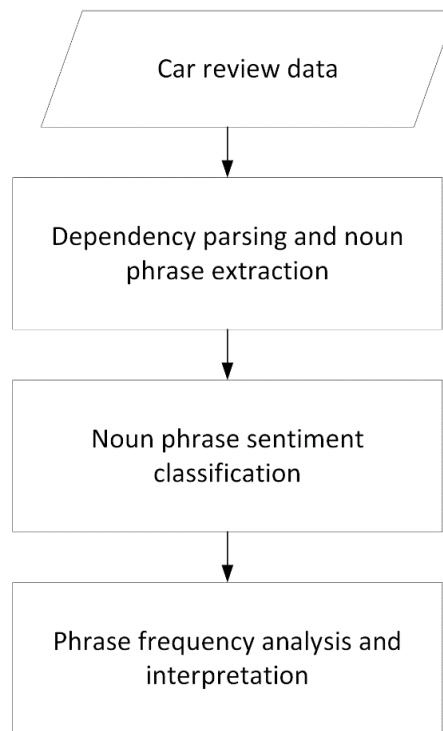
Figure 1. Research Methodology

3. Results and Discussion

A total of 22.702 rows of car review data are scraped from Edmunds website. Each review consists of a review title and review content. The length of the reviews is up to 5000 characters with an average of 412 characters which translates to up to 969 words with an average of 92 words. An example of dependency parsing and noun phrase extraction is shown in Table 1. The visualization is facilitated by using SpaCy visualization tools called displaCy.

A total of 123,372 noun phrases were extracted, which 112,620 of them (91.3%) were classified into positive sentiment. There are 52,956 unique phrases in the positive sentiment class and 6,443 unique phrases in the negative sentiment class. The frequency for each phrase was counted, and only phrases having a minimum of 20 counts in the positive sentiment class and 14 in the negative class are used in the next analysis. The threshold is set lower for the negative class to accommodate the inclusion of more phrases in the negative class because they have a far lower frequency than the positive class. The frequency of each phrase was then processed in the following manners:

- general or non-informative phrases such as "great car" are excluded;
- similar phrases, such as "reliable car" and "reliable vehicle", are merged; and
- neutral sentiment or invalid phrases such as "front brake pads" are excluded.

The results for positive and negative aspects are shown in Table 2 and Table 3 respectively. Table 2 showed that the vast majority of the findings are on the positive side: comfortable to drive, good fuel economy / mileage, reliability, spaciousness, value for money, rear camera, quiet ride, good acceleration, well-designed, good sound system, and solid built. The top four positive sentiments which have significantly higher frequency highlight the aspects that many people perceived as positive and can be seen as the brand's advantages compared to other brands i.e: comfortable to drive, good fuel economy / mileage, reliability, and spaciousness. On the other hand, Table 3 showed the results for the negative aspects such as low mileage, poor quality, poor design, hard to drive, and hard acceleration. However,

this result in the negative aspects is contradicting some of the results in the positive aspect and only has a very low frequency. This contradictory result might arise due to different perspective and experience the users have or that they may compare the car they reviewed to other cars they had previously driven (whether from the same manufacturer or not). Overall, this finding means that the vast majority of the users are satisfied with multiple aspects of the produced cars.

The phrase frequency of the result might seem low compared to the number of the dataset because not all users will use phrase nouns in their reviews. Users may also use various wordings when expressing the same ideas, for example, users may write "roomy car" or "more leg room" to express the spaciousness of the car. These variations will cause the phrases to have low frequency and therefore get excluded from the analysis based on the aforementioned threshold.

The limitation of this study is that the pipeline is unable to extract sentiment information when no clear noun phrases are present, such as in the following sentences: "*Gas mileage exceptional. The back seat had a limousine feel to it. Never had a problem with it. Because of the safety issue with the accelerator we sold it.*". Future research may enhance the phrase noun / aspect sentiment extraction by using a sentence-level or clause-level context understanding to extract richer informative aspects from the review data. Future research may also combine ABSA with Latent Dirichlet Allocation (LDA) to automatically identify the clusters of aspects [30], [31].

Table 1. Example of dependency parsing and noun phrase extraction

Phase	Example
Review text	Bought this car because of its reasonable price. It has been a pretty good car.
Dependency parsing	
Extracted noun phrases	'reasonable price', 'pretty good car'

Table 2. The list of positive aspects and their frequency

Positive aspects	Frequency
Comfortable to drive	1248
Good fuel economy / mileage	721
Reliability	610
Spaciousness	498
Value for money	191
Rear camera	165
Quiet ride	128
Good acceleration	80
Well designed	73
Sound system	41
Solid build	23

Table 3. The list of negative aspects and their frequency

Negative aspects	Frequency
Low mileage	37
Poor quality	33
Poor design	27
Hard to drive	26
Hard acceleration	18

4. Conclusion

This research aims to perform aspect-based sentiment analysis on car review data to extract positive and negative aspects of car products from a specific car manufacturer. Results showed that the vast majority of the findings are on the positive aspects: comfortable to drive, good fuel economy / mileage, reliability, spaciousness, value for money, helpful rear camera, quiet ride, good acceleration, well-designed, good sound system, and solid build. The results for the negative aspects are low mileage, poor quality, poor design, hard to drive, and hard acceleration. However, the result in the negative aspects is contradicting the results in the positive aspect and only has a very low frequency. This finding means that the vast majority of the users are satisfied with multiple aspects of the produced cars. Future research can improve the identification of aspect-related sentiment when no explicit noun phrase is present in the reviews. Future research may also combine ABSA with LDA to automatically identify the clusters of aspects.

References
[1]   C. Sun, L. Huang, and X. Qiu, "Utilizing BERT for aspect-based sentiment analysis via constructing auxiliary sentence," *arXiv Prepr. arXiv1903.09588*, 2019.
[2]   R. Kumar, "Kaizen a tool for continuous quality improvement in Indian manufacturing organization," *Int. J. Math. Eng. Manag. Sci.*, vol. 4, no. 2, p. 452, 2019.
[3]   M. Birjali, M. Kasri, and A. Beni-Hssane, "A comprehensive survey on sentiment analysis: Approaches, challenges and trends," *Knowledge-Based Syst.*, vol. 226, p. 107134, 2021.
[4]   I. Chaturvedi, E. Cambria, R. E. Welsch, and F. Herrera, "Distinguishing between facts and opinions for sentiment analysis: Survey and challenges," *Inf. Fusion*, vol. 44, pp. 65–77, 2018.
[5]   M. T. Anwar, L. Ambarwati, D. Agustin, and others, "Analyzing Public Opinion Based on Emotion Labeling Using Transformers," in *2021 2nd International Conference on Innovative*

and Creative Information Technology (ICITech), 2021, pp. 74–78.

[6] H. Liu, I. Chatterjee, M. Zhou, X. S. Lu, and A. Abusorrah, "Aspect-based sentiment analysis: A survey of deep learning methods," *IEEE Trans. Comput. Soc. Syst.*, vol. 7, no. 6, pp. 1358–1375, 2020.

[7] E. Cambria, D. Das, S. Bandyopadhyay, A. Feraco, and others, "A practical guide to sentiment analysis," 2017.

[8] S. Chakraborty, P. Goyal, and A. Mukherjee, "Aspect-based sentiment analysis of scientific reviews," in *Proceedings of the ACM/IEEE Joint Conference on Digital Libraries in 2020*, 2020, pp. 207–216.

[9] O. Alqaryouti, N. Siyam, A. A. Monem, and K. Shaalan, "Aspect-based sentiment analysis using smart government review data," *Appl. Comput. Informatics*, 2020.

[10] H. Jang, E. Rempel, D. Roth, G. Carenini, N. Z. Janjua, and others, "Tracking COVID-19 discourse on twitter in North America: Infodemiology study using topic modeling and aspect-based sentiment analysis," *J. Med. Internet Res.*, vol. 23, no. 2, p. e25431, 2021.

[11] Y. Yiran and S. Srivastava, "Aspect-based Sentiment Analysis on mobile phone reviews with LDA," in *Proceedings of the 2019 4th International Conference on Machine Learning Technologies*, 2019, pp. 101–105.

[12] Y. Zhang, J. Du, X. Ma, H. Wen, and G. Fortino, "Aspect-based sentiment analysis for user reviews," *Cognit. Comput.*, vol. 13, no. 5, pp. 1114–1127, 2021.

[13] S. Consoli, L. Barbaglia, and S. Manzan, "Fine-grained, aspect-based sentiment analysis on economic and financial lexicon," *Knowledge-Based Syst.*, vol. 247, p. 108781, 2022.

[14] S. M. Al-Ghuribi, S. A. M. Noah, and S. Tiun, "Unsupervised semantic approach of aspect-based sentiment analysis for large-scale user reviews," *IEEE Access*, vol. 8, pp. 218592–218613, 2020.

[15] S. M. Tedjojuwono and C. Neonardi, "Aspect Based Sentiment Analysis: Restaurant Online Review Platform in Indonesia with Unsupervised Scraped Corpus in Indonesian Language," in *2021 1st International Conference on Computer Science and Artificial Intelligence (ICCSAI)*, 2021, vol. 1, pp. 213–218.

[16] G. S. Chauhan, P. Agrawal, and Y. K. Meena, "Aspect-based sentiment analysis of students' feedback to improve teaching--learning process," in *Information and communication technology for intelligent systems*, Springer, 2019, pp. 259–266.

[17] M. E. Mowlaei, M. S. Abadeh, and H. Keshavarz, "Aspect-based sentiment analysis using adaptive aspect-based lexicons," *Expert Syst. Appl.*, vol. 148, p. 113234, 2020.

[18] X. Fang and J. Tao, "A transfer learning based approach for aspect based sentiment analysis," in *2019 sixth international conference on Social Networks Analysis, Management and Security (SNAMS)*, 2019, pp. 478–483.

[19] R. Bensoltane and T. Zaki, "Towards Arabic aspect-based sentiment analysis: a transfer learning-based approach," *Soc. Netw. Anal. Min.*, vol. 12, no. 1, pp. 1–16, 2022.

[20] Z. Kastrati, A. S. Imran, and A. Kurti, "Weakly supervised framework for aspect-based sentiment analysis on students' reviews of MOOCs," *IEEE Access*, vol. 8, pp. 106799–106810, 2020.

[21] G. Alexandridis, J. Aliprantis, K. Michalakis, K. Korovesis, P. Tsantilas, and G. Caridakis, "A knowledge-based deep learning architecture for aspect-based sentiment analysis," *Int. J. Neural Syst.*, vol. 31, no. 10, p. 2150046, 2021.

[22] S. Rida-E-Fatima *et al.*, "A multi-layer dual attention deep learning model with refined word embeddings for aspect-based sentiment analysis," *IEEE Access*, vol. 7, pp. 114795–114807, 2019.

[23] H. Matthew, I. Montani, S. Van Landeghem, and A. Boyd, "spaCy: Industrial-strength Natural Language Processing in Python," 2020, doi: 10.5281/zenodo.1212303.

[24] N. Colic, "Dependency parsing for relation extraction in biomedical literature," *Master's thesis, Univ. Zurich, Switz.*, 2016.

[25] N. Colic and F. Rinaldi, "Improving spaCy dependency annotation and PoS tagging web service using independent NER services," *Genomics \& informatics*, vol. 17, no. 2, 2019.

[26]   M. Honnibal and M. Johnson, "An improved non-monotonic transition system for dependency parsing," in *Proceedings of the 2015 conference on empirical methods in natural language processing*, 2015, pp. 1373–1378.

[27]   C. Hutto and E. Gilbert, "Vader: A parsimonious rule-based model for sentiment analysis of social media text," in *Proceedings of the international AAAI conference on web and social media*, 2014, vol. 8, no. 1, pp. 216–225.

[28]   S. Bird, E. Klein, and E. Loper, *Natural language processing with Python: analyzing text with the natural language toolkit*. " O'Reilly Media, Inc.," 2009.

[29]   T. Kluyver *et al.*, "Jupyter Notebooks -- a publishing format for reproducible computational workflows," in *Positioning and Power in Academic Publishing: Players, Agents and Agendas*, 2016, pp. 87–90.

[30]   T. Ali, B. Marc, B. Omar, K. Soulaimane, and S. Larbi, "Exploring destination's negative e-reputation using aspect based sentiment analysis approach: Case of Marrakech destination on TripAdvisor," *Tour. Manag. Perspect.*, vol. 40, p. 100892, 2021.

[31]   M. T. Anwar, M. P. Utami, L. Ambarwati, and A. W. Arohman, "Identifying Social Media Conversation Topics Regarding Electric Vehicles in Indonesia Using Latent Dirichlet Allocation," in *2022 IEEE International Conference on Cybernetics and Computational Intelligence (CyberneticsCom)*, 2022, pp. 102–106.

Reduction Of Dissolved Ammonia with the Stripper Method in pH and Temperature Variations

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Abstract. Condensate Polishing System (CPS) regeneration waste from PT. Bhimasena Power Indonesia has an ammonia level of 932 mg N/L. Therefore, research on reducing dissolved ammonia waste is very important. Research gaps in reducing dissolved ammonia waste include the effects of time variations and dissolved ammonia concentrations, the effect of water quality, and the impact of using methods on the environment. The purpose of this study was to determine the effect of variations in pH and temperature on the effectiveness of separating ammonia waste and to obtain optimum pH and temperature values for the separation of dissolved ammonia waste. The method used in this experiment is the stripper method. The results showed that the process of reducing dissolved ammonia using the stripper method reached an optimum value at a temperature of 45 °C and pH 12. Under these conditions, a reduction value of 0.75 mg N/L was obtained. So it can be concluded that the stripper method can reduce dissolved ammonia waste properly. The impact of this research can develop a more effective and environmentally friendly waste treatment method.

Keywords. Liquid Waste, Ammonia, Stripper, pH, Temperature

1. Introduction

PT. Bhimasena Power Indonesia as a steam power producer, in its activities, uses ammonia to protect the surface of the boiler pipes from corrosion by forming a protective layer. Corrosion on the surface of the pipe wall can be caused by a reaction between water and the metal used in the boiler pipe. The process of using ammonia produces complex metal ammonia compounds which function to protect metal surfaces from direct contact with water.

The use of ammonia in an aqueous environment can produce an effective protective layer to prevent corrosion on the surface of the pipe wall [1]. Mixing of ammonia and pressurized steam during the process is used to turn turbines, this steam is then condensed and may contain contaminants that affect the quality of boiler water [2]. Processing is carried out to remove unwanted substances from condensate water using the Condensate Polishing System (CPS), which aims to reduce impurities through ion exchange using resins. Waste from CPS regeneration contains high concentrations of ammonia and can

pollute the environment if disposed of without treatment. Therefore, treatment must be carried out before waste from regeneration is discharged into the environment [3].

The threshold for the concentration of ammonia in wastewater in Indonesia is stipulated by the Ministry of Environment and Forestry through the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 3 of 2010. According to this regulation, the threshold for the concentration of ammonia in wastewater for industrial areas is 50 mg/L, while for residential areas, trade, and services it is 10 mg/L (Ministry of Environment, 2010). If the concentration of ammonia on the surface of the water increases, it can cause fish in the water to die. Ammonia levels in water are affected by the pH value, which can determine whether ammonia is toxic or not. If the pH is low and the concentration of ammonia is high, the surface water becomes toxic to fish. Conversely, if the pH is high and the concentration of ammonia is low, the water on the surface is also toxic to fish in the waters [4].

the use of a combination of aeration and biofilter processes can reduce ammonia concentrations by up to 80% in fish processing industrial wastewater [5]. In addition, the use of zeolite-based adsorbents can reduce ammonia concentrations by up to 97% in textile industry wastewater. The study used the stripper method to reduce the ammonia content in liquid waste by using air or inert gas as a stripping agent [6].

The study used the stripper method to reduce the ammonia content in liquid waste by using air or inert gas as a stripping agent. In this process, liquid waste is run at high temperatures and pressure so that ammonia can be separated from the waste and collected in gaseous form [7]. The advantage of the stripping method is that it can be used to reduce the ammonia content in large amounts of liquid waste in a short time [8]. The purpose of this study was to determine the effect of variations in pH and temperature on the effectiveness of separating ammonia waste using the stripper method and to obtain optimum pH and temperature values in an effort to separate dissolved ammonia waste using the stripper method.

2. Methods

Take 1000 mL of boiler waste water, then fill it into the beaker glass. Turn on the stirrer stove, and set it to 60 rpm. Adjust the pH of the wastewater according to experiments (10, 11, and 12). Heat to the experimental temperature (35ºC, 40ºC, and 45ºC). Turn on the pump, and flow the water to the stripper column. Also, turn on the blower to make contact with wastewater so that the ammonia reduction process occurs. Maintain operating conditions for 15 minutes, then take samples.

2.1 Ammonia Test

Testing the levels of ammonia using two methods, namely ammonia High Range and Low Range. Prior to analysis using the ammonia Hight Range, the pH was set to 7 using 30% HCl. Next, start the 342 N and Ammonia HR TNT program on the DR 3900 Portable Hach spectrophotometer. Next, a blank was prepared by adding 0.1 mL of distilled water into the first tube, while the test sample was prepared by adding 0.1 mL of ammonia sample into the second tube. In each tube, reagent 1 (Ammonia Salicylate Reagent Powder) and reagent 2 (Ammonia Cyanurate Reagent Powder) were added, then closed and homogenized and allowed to stand for 20 minutes. After that, the first tube (blank) is inserted into the cuvette and zero is pressed to calibrate. The second tube (sample) was then inserted into the cuvette and analyzed for the concentration of ammonia at a wavelength of 655 nm.

Low Range ammonia testing before analysis, adjust the pH to 7 using 30% HCl. Start the 342 N, Ammonia LR TNT program on the DR 3900 Portable Hach spectrophotometer, then prepare a blank by adding 2 mL of distilled water to the first tube and prepare a test sample by adding 2 mL of ammonia sample to the second tube. In each tube, reagent 1 (Ammonia Salicylate Reagent Powder) and reagent 2 (Ammonia Cyanurate Reagent Powder) are added. Then close the tube and homogenize it, let stand for 20 minutes. After 20 minutes, insert the first tube (blank) into the cuvette, and press zero to calibrate. Next, insert the second tube (sample) into the cuvette, and press read to get the results of the concentration of ammonia in the sample at a wavelength of 655 nm.

Calculation:

$$\text{Ammonia levels (mg N/L)} = C \times fp \tag{1}$$

with the understanding:
C = Levels obtained from measurement results (mg/L).
fp = Dilution factor.
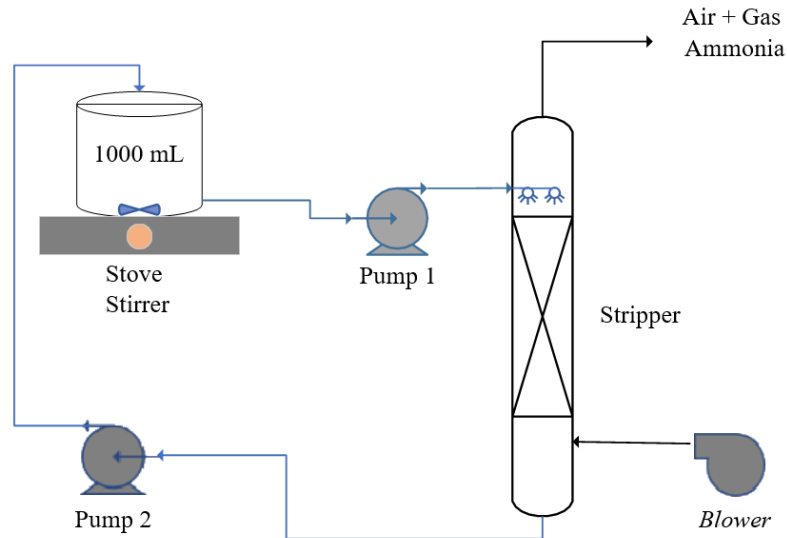
Figure 1. Design of Ammonia Separation Equipment

3. Results and Discussion

3.1 The effect of variations in pH and temperature on the effectiveness of separating dissolved ammonia waste

Reducing dissolved ammonia waste by varying pH and temperature using the stripper method can affect the process of reducing dissolved ammonia in it. This study used a variation of pH 10, 11, and 12 with a temperature variation of 35ºC, 40ºC, and 45ºC and an initial ammonia content of 932 mg N/L. After conducting experiments on reducing dissolved ammonia waste, the reduction effectiveness value (mg N/L) was obtained as follows:

Table 1. Results of Dissolved Ammonia Research

pH/Temperature	10	11	12
35 °C	**78,7**	70,8	65,6
40 °C	2,97	1,93	1,6
45 °C	1,55	1,13	**0,75**

From Table 1 it can be seen that the largest reduction in ammonia was obtained from experiments at pH 12 and a temperature of 45°C. The reduction result is 0.75 mg N/L with a reduction percentage of 99.91%. While the smallest value was obtained from experiments at pH 10 and temperature of 35 °C. The reduction result is 78.7 mg N/L with a reduction percentage of 91.55%.

The results showed that the efficiency of ammonia removal depends on the temperature and pH used. Higher temperature and pH lead to better ammonia removal efficiency [9]. If the temperature is too low, the efficiency of reducing ammonia will decrease, because it is more difficult for ammonia to escape from the solution at lower temperatures [10]. If the temperature is too high the solution can become too viscous and the reduction process becomes ineffective. The effective temperature range for the stripper method is 50 -70ºC and the optimal pH is in alkaline conditions [11].

3.2 Optimization of pH and temperature in the separation of dissolved ammonia waste with the stripper method

Determination of the optimum value of pH and temperature from the research results in Table 1. can be done through the graph as follows:
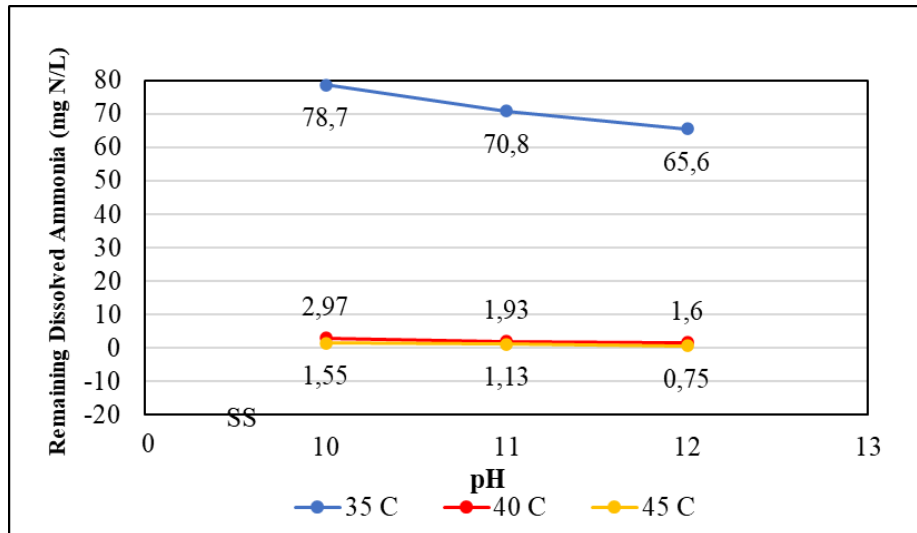
Figure 1. Graph of the Relationship Between pH vs. Remaining Dissolved Ammonia

Figure 1 shows that the variation in pH in this study affected the process of separating dissolved ammonia using the stripper method. This proves that increasing the pH above 9.25 will increase volatility due to the increasing concentration of hydroxide ions (OH$^-$) in the solution so that some of the ammonia dissolved in the solution will react with hydroxide ions and form ammonia, which is more volatile [11]. The lowest reduction value was obtained in experiments with pH 10 with a reduction percentage of 91.55% and the highest value was obtained at pH 12 with a reduction percentage of 99.91%.
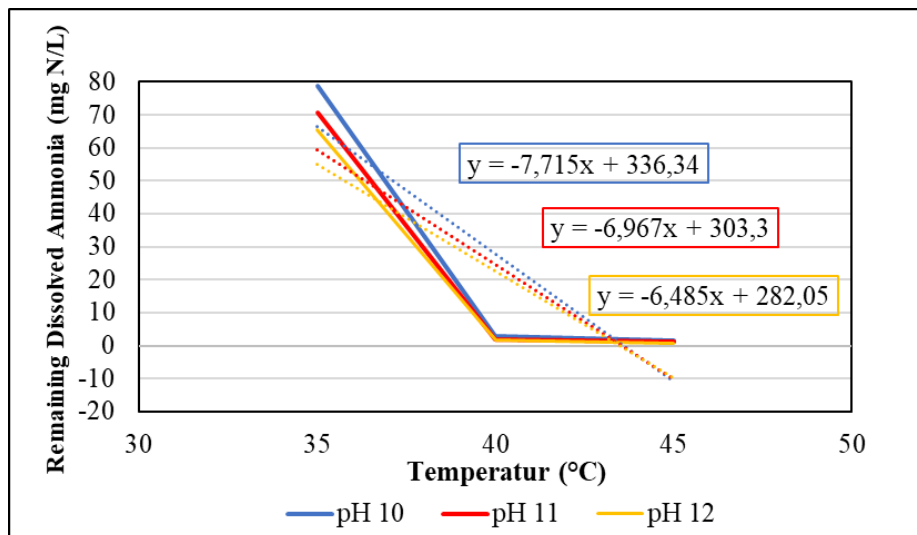
Figure 2. Graph of Relationship Between Temperature and Remaining Dissolved Ammonia

Figure 2 shows that the process of reducing dissolved ammonia by the stripper method takes place significantly at a temperature of 40 °C. At 45 °C the ammonia reduction process still occurs and reaches the optimal point. In simple chemistry, increasing the temperature will accelerate the evaporation of

dissolved ammonia.The reduction of dissolved ammonia by the stripper method reached an optimum value at a temperature of 45 °C and pH 12. It can be seen that under these conditions a reduction value of 0.75 mg N/L was obtained with a reduction percentage of 99.91%.

Based on the water pollution control policy in Permen LH Number 05 of 2014 wastewater quality standards, the allowable ammonia level is 1-10 mg/L and based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No: P.68/Menlhk/Setjen/Kum.1/8/2016 Domestic Wastewater Quality Standards, the allowable ammonia level is 1-10 mg/L [12].

From the existing policy, it can be seen that at a temperature of 40 °C and pH 10, a reduction value of 2.97 mg N/L is obtained with a reduction percentage of 99.68%. This is evidence that the pH and temperature in this study have met the government's quality standards. So when applied in industry, there is no need to raise the pH to 12 and the temperature to 45 °C because it will increase the production cost of the treatment.

4. Conclusions

From the research results it is proven that variations in pH and temperature can affect the effectiveness of reducing dissolved ammonia by the stripper method. Reduction of dissolved ammonia by the stripper method reaches an optimum value at a temperature of 45 °C and pH 12. In this condition, there is an increase in the concentration of ammonia in the form of NH3 and dissolved ammonia molecules come out of the solution more easily, achieving a reduction effectiveness of 99.91% with a reduction value of 0.75 mg N/L. This may assist in the development of more effective methods of reducing dissolved ammonia in the future.

References

[1] F. M. Alptekin and M. S. Celiktas, "Review on Catalytic Biomass Gasification for Hydrogen Production as a Sustainable Energy Form and Social, Technological, Economic, Environmental, and Political Analysis of Catalysts," *ACS Omega*, vol. 7, no. 29, hal. 24918–24941, 2022, doi: 10.1021/acsomega.2c01538.

[2] T. Cheng, X. Zhou, L. Yang, H. Wu, and H. Fan, "Transformation and removal of ammonium sulfate aerosols and ammonia slip from selective catalytic reduction in wet flue gas desulfurization system," *J. Environ. Sci. (China)*, vol. 88, no. x, hal. 72–80, 2020, doi: 10.1016/j.jes.2019.08.002.

[3] N. Imchuen, Y. Lubphoo, J. M. Chyan, S. Padungthon, and C. H. Liao, "Using cation exchange resin for ammonium removal as part of sequential process for nitrate reduction by nanoiron," *Sustain. Environ. Res.*, vol. 26, no. 4, hal. 156–160, 2016, doi: 10.1016/j.serj.2016.01.002.

[4] M. A. W. Nurul Hikmah, Tuty Alawiyah, "View of Analisis Kadar Ammonia (Nh3) Di Perairan Sekitar Pabrik Karet Daerah Banjarmasin Menggunakan Spektrofotometri Visible," *J. Pharm. Care Anwar Med.*, vol. 4, no. 2654–8364, hal. 20–30, 2021, [Daring]. Tersedia pada: http://jurnal.stikesrsanwarmedika.ac.id/index.php/jpcam/article/view/38/51

[5] P. A. Suriasni, F. Faizal, C. Panatarani, W. Hermawan, and I. M. Joni, "A Review of Bubble Aeration in Biofilter to Reduce Total Ammonia Nitrogen of Recirculating Aquaculture System," hal. 1–19, 2023.

[6] Y. Lv and M. Liu, "Corrosion and fouling behaviours of copper-based superhydrophobic coating," *Surf. Eng.*, vol. 35, no. 6, hal. 542–549, 2019, doi: 10.1080/02670844.2018.1433774.

[7] F. M. Ferraz, J. Povinelli, dan E. M. Vieira, "Ammonia removal from landfill leachate by air stripping and absorption," *Environ. Technol. (United Kingdom)*, vol. 34, no. 15, hal. 2317–2326, 2013, doi: 10.1080/09593330.2013.767283.

[8] H. Haslina *et al.*, "Landfill Leachate Treatment Methods and Its Potential for Ammonia Removal and Recovery - A Review," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 1051, no. 1, hal. 012064, 2021, doi: 10.1088/1757-899x/1051/1/012064.

[9] M. Zhang, M. Yu, Y. Wang, C. He, J. Pang, and J. Wu, "Operational optimization of a three-stage nitrification moving bed biofilm reactor (NMBBR) by obtaining enriched nitrifying

bacteria: Nitrifying performance, microbial community, and kinetic parameters," *Sci. Total Environ.*, vol. 697, hal. 134101, 2019, doi: 10.1016/j.scitotenv.2019.134101.

[10] L. Cao *et al.*, "Evaluation of ammonia recovery from swine wastewater via a innovative spraying technology," *Bioresour. Technol.*, vol. 272, no. October 2018, hal. 235–240, 2019, doi: 10.1016/j.biortech.2018.10.021.

[11] A. Zangeneh, S. Sabzalipour, A. Takdatsan, R. J. Yengejeh, and M. A. Khafaie, "Ammonia removal form municipal wastewater by air stripping process: An experimental study," *South African J. Chem. Eng.*, vol. 36, no. March, hal. 134–141, 2021, doi: 10.1016/j.sajce.2021.03.001.

[12] Menteri Lingkungan Hidup dan Kehutanan, "Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor R: P.68/Menlhk-Setjen/2016 Tentang Baku Mutu Air Limbah Domestik," *Peratur. Menteri Lingkung. Hidup dan Kehutan. Republik Indones.*, hal. 1–13, 2016.

Measuring Risk Factor Analysis Using PCA Method In Batik Businiess (Case Study: SMEs Batik Cirebon)

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Abstract. The number of business units that sell Batik creates a very high level of competition so that they are required to find alternatives or solutions to be superior to competitors. In addition, it is also necessary to manage business risks and pay attention to factors that support the risk of the Batik fashion business they are running. The purpose of this study was to determine and categorize the main factors supporting the risk of fashion Batik business in Cirebon. This study uses 15 initial variables of Batik fashion business risk which will be tested by means of factor analysis. The method used is Principal Component Analysis (PCA) with SPSS software. Data collection techniques using questionnaires and interviews. The sample used was 50 random respondents in the Batik fashion business unit in Cirebon. Four main factors were obtained from the variables that have been identified in the risk of Cirebon Batik fashion business. Factor 1 is called operational factors, factor 2 is called financial factors, factor 3 is called strategic factors, and factor 4 is called external factors.

Keywords: Business Risk, Fashion Batik, PCA

1. Introduction

There are 16 sub-sectors of the creative industry according to BEKRAF including game application and development, architecture, product design, fashion, interior design, visual communication design, performing arts, film, animation, and video, photography, craft, culinary, music, advertising, publishing, fine arts, television and radio. The Head of the Creative Economy Agency (BEKRAF) said, by looking at the facts and data there are at least three sectors that are very influential in this growing creative industry. The three sectors include fashion, culinary, and craft [1]. Based on survey results from BEKRAF and BPS, it shows that the fashion industry has an influence on the creative economy of 18.15%, which is the second highest of any sector [1].

Fashion is a "cross-cutting concept" that includes several industries, such as apparel, footwear, leather, jewelry, perfume and cosmetics [2]. Setting up a fashion business is not easy, there are several considerations and things that need to be prepared. Fashion business owners must be prepared to face all the events that exist. Business risk in the company is an uncertainty that can cause losses to the company [3] so that research needs to be done to find out and categorize the main factors that support the success of a business [4]. But in reality, fashion business owners pay less attention and readiness in facing events or risks that can come at any time. Inevitably, the business they run goes out of business. This is because fashion is included in the fast moving industry where the product life cycle is short, market demand is changing, difficult to predict, and the level of competition is high [5], even though the fashion business in Indonesia can affect the level of Gross Domestic Product (GDP).

The Cirebon batik small and medium industry (IKM) has grown rapidly in the last 10 years or so, this can be seen from the increasing number of batik businesses in Cirebon Regency. Based on data from the Cirebon Regency Disperindag, in 2014 alone there were 530 business units with a total workforce of 4,410 people. Currently, Cirebon batik is not only marketed to the domestic market but also to the international market. The ease of exporting goods and services allows products from abroad to easily enter Indonesia. If this is not properly anticipated, it will pose a threat to the sale of batik products. That way it is required to find alternatives or solutions to be superior to competitors. In addition, batik entrepreneurs also need business risk management or risk management and pay attention to the factors that support the risk of the batik fashion business they are running.

The first stage in the risk management process is the risk identification stage [6]. Risk identification is a process that is systematically and continuously carried out to identify possible risks or losses to the company's wealth, debt, and personnel. The second stage is risk analysis and evaluation and the third stage is a response or reaction to overcome the risk [7]. Basically, risk management is concerned with the means used by a company to prevent or overcome a risk faced [8].

Seeing the brief discussion above, a study was conducted on the factor analysis of Batik business in Cirebon with the aim of knowing and grouping the main factors supporting the risk of Batik fashion business in Cirebon using the factor analysis method.

2. Methods

This research was conducted at Central Batik Trusmi Cirebon in October 2020. By using 50 random samples to the perpetrators of the Cirebon Batik Trusmi business unit through interview techniques and distributing questionnaires to experts or business unit actors.

Interviews conducted with experts regarding factors that support business risk, especially in fashion batik. Table 1 shows the variables that support the business risk of fashion batik:

Table 1. Business Risk Support Variables

The variables that make up factors
Suppliers
Difficult to predict demand
Quality and production standards
Not innovative
Loss of income
Late paying rent
Difficult to determine market prices
Rising raw material prices
The level of customer satisfaction decreases
Consumer model interest changes
Competitors issue a lot of new products
High competitors
Competitors follow the output model
Loss of the market
Less market widespread

The data analysis method used in this research is the factor analysis technique. Factor analysis is a data reduction technique, which reduces the excess of variables and groups a large number of variables into a small number of homogeneous sets and creates a new variable that represents each set into a smaller or simpler part. Observed variables are called manifest variables, while shared factors are referred to as latent variables [9].

The procedures for conducting factor analysis include:
1. Conduct data standardization, validity, and reliability
2. Finding the eigenvalue of the correlation matrix (R)
3. Determine the main component of the eigenvalue.

Factor analysis has 2 types of methods that can be used, namely principal component and principal axis [10]. In principal component the amount of variation in the data contained in all indicators is considered. Principal component aims to determine the least number of factor extractions but absorbs as much information as possible contained in all indicators or accounts for most of the variance of all indicators. While the principal axis is appropriate if the main purpose of factor analysis is to identify the underlying dimensions using the variance matrix between factors. Factor analysis also has two types of analysis that can be used to determine the factor extraction of the indicators tested, namely confirmatory and exploratory [11]. In confirmatory factors that will be generated are predetermined. As well as by considering the number and which indicators are related to the factor. While exploratory the number of factors produced is not determined at the beginning of testing, so that indicators related to factors can be known after testing is carried out.

There have been many previous studies on factor analysis, especially on principal components. In the banking world in China, the principal component was conducted to examine the comparison of five popular systemic risk ratings where the results of the principal component provided a stable systemic risk rating [12]. Principal components can also be demonstrated using the partial least squares (PLS) method to examine the statistical effects of the intrinsic characteristics of perovskite and inverse perovskite on their stability [13].

3. Results and Discussion

3.1 Quistionnaire Testing

3.1.1 Validity Test

The validity test is used to measure whether a questionnaire is valid or not [14]. The validity test shows the extent to which a measuring instrument is valid in measuring the variable being measured. The results of the validity of the questionnaire with Pearson's product moment correlation with a significance level of 5% show that all $r_{count} > r_{table}$ values are 0.2787. So that a positive correlation is obtained between each questionnaire item score and the total score of all questions in the questionnaire and it can be concluded that the instrument used is valid.

3.1.2 Reliability Test

Reliability test is a test of the reliability of measuring instruments to determine the extent to which a measurement can provide the same results when measured again on the same subject, as long as the aspects measured in the respondent do not change. The reliability testing technique used is Cronbach's Alpha, which is a coefficient that describes how well the items in a set correlate positively with each other [15]. The results of the reliability test with the Cronbach's Alpha coefficient obtained an α value of 0.618, which means it is greater than the r_{tabel}, which is 0.6. These results indicate that the questionnaire used is a consistent and reliable measuring tool.

3.2 Data Analysis
3.2.1 Bartleet's and KMO's Test

A small KMO value indicates that factor analysis is not the right choice. To be able to do factor analysis, the KMO value is considered sufficient if it is greater than or equal to 0.5. The figure below shows that sig < than α where the sig value in the table is 0.000 < 0.05. So that the variables are correlated and can be processed further.

Table 2. KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,516
Bartlett's Test of Sphericity	Approx. Chi-Square	191,723
	df	105
	Sig.	,000

3.2.2 Measure of Sampling Adequency (MSA) Test

Each variable that has an MSA value below 0.5 must be removed and the MSA test is repeated without following the variable that is less than 0.5. After the variables that do not meet the MSA requirements are removed one by one, a variable is formed that has a loading value> 0.5.

Table 3. Anti Image Correlation

Variable	MSA Value	Minimum Standard Value
Supplier inaccurate (X_1)	0,709	0,5
Difficult to predict Demand (X_2)	0,700	0,5
Not innovative (X_4)	0,543	0,5
Loss of income (X_5)	0,663	0,5
Late paying rent (X_6)	0,543	0,5
Difficult to determine market prices (X_7)	0,709	0,5
Increasing Raw Material Prices (X_8)	0,680	0,5
Competitors released many new products (X_{11})	0,711	0,5
High competitors (X_{12})	0,705	0,5

Competitors follow the output model (X_{13})	0,619	0,5
Less market widespread (X_{15})	0,628	0,5

3.3 Principal Component Analysis Method (PCA)

The eigenvalue is the sum of the variances of the factor values. It can be seen in the figure below that there are 4 factors formed. In determining a group of variables that deserve to be formed as a factor, the criterion is based on the eigenvalue > 1. The four factors contribute a cumulative percentage of 58.109%, which means that the four factors can explain the variables that play a role in the risk of Cirebon Batik fashion business.

Tabel 4. Eigenvalue, % Variance, Cumulative %
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,758	18,385	18,385	2,758	18,385	18,385	2,110	14,064	14,064
2	1,962	13,078	31,463	1,962	13,078	31,463	2,003	13,356	27,421
3	1,652	11,013	42,475	1,652	11,013	42,475	1,613	10,751	38,172
4	1,358	9,054	51,530	1,358	9,054	51,530	1,600	10,667	48,839
5	1,316	8,776	60,306	1,316	8,776	60,306	1,531	10,204	59,043
6	1,117	7,448	67,754	1,117	7,448	67,754	1,307	8,710	67,754
7	,935	6,235	73,989						
8	,823	5,487	79,476						
9	,717	4,782	84,257						
10	,648	4,320	88,577						
11	,556	3,704	92,281						
12	,448	2,990	95,271						
13	,365	2,431	97,702						
14	,269	1,795	99,497						
15	,075	,503	100,000						

Extraction Method: Principal Component Analysis.

The amount of contribution of each factor to the risk of Cirebon Batik fashion business can be seen from the variance value of each factor. The factor that has the highest variance value is the factor that has the highest role in the risk of Cirebon Batik fashion business. In this study, the first factor is a factor that has the highest role in the risk of Cirebon Batik fashion business with a variance value of 24.288%.

There is a graph that explains the results of determining the number of factors, the graph can be seen in the **figure 1**. scree plot image. In **figure 1**. scree plot, it can be seen that point 1 to point 2 has a sharp difference in distance. This means that the correlation between factor 1 and factor 2 is much different, for point 2 to point 3 and point 4 there is a difference in distance that is not much different. So these 4 factors can explain 11 variables.
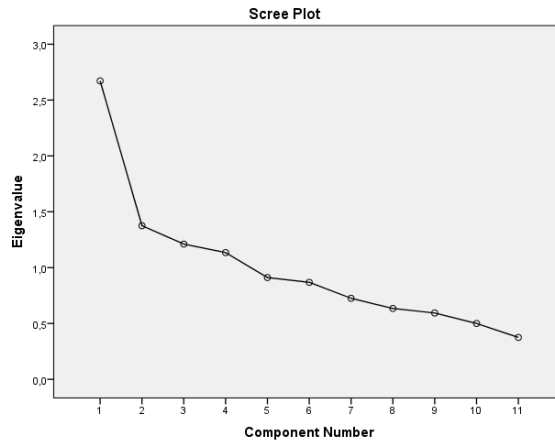
Figure 1. Scree Plot

3.4 Factor Rotation

Factor rotation aims to get factors with loadings that are clear enough for interpretation. Because in these factors many variables are correlated so it is difficult to interpret. In this study using varimax rotation. Varimax rotation aims to minimize variables by looking at factor loading. The higher the loading value means the closer the variable relationship to the factor. In this study, variables that have factor loading above 0.30 are included in one factor. **Table 5**. is a factor grouping of rotation results.

Table 5. Group of Rotation Factors

Variable	Factor Group			
	1	2	3	4
X_1	**0,603**			
X_2	**0,648**			
X_4				**0,835**
X_5		**0,683**		
X_6			**0,778**	
X_7			**0,744**	
X_8	**0,617**			
X_{11}	**0,671**			
X_{12}	**0,622**			
X_{13}		**0,664**		
X_{15}		**0,547**		

3.5 Factor Matrix Interpretation

After the formation of factors, each of which consists of the variables under study. These variables are grouped and named, where the name of the factor depends on the variables that make it up. So that this naming is subjective and there are no definite provisions regarding the naming. Factor naming is explained as follows:

a. Factor 1 is Operational

Factor 1 is named operational because the variables that represent it consist of X_1 = supplier uncertainty, X_2 = difficult to predict demand, X_8 = rising raw material prices, X_{11} = competitors issue many new products, X_{12} = high competitors. Factor 1 has a variance value of 24.288%. Factor 1 is named operational because it looks at the variables formed by factor 1 itself, besides that operational risk is included in the risk of production processes, products, human resources, and technology [16].

b. Factor 2 is Finace

Factor 2 is named finace because the variables that represent it consist of X_5 = loss of income, X_{13} = competitors follow the output model, X_{15} = less widespread market. Factor 2 has a variance value of 12.502%. Factor 2 is named finance because it looks at the variables formed by factor 2 itself, besides that, the risk of finance is about financing both at market prices and in terms of company operations [16].

c. Factor 3 is Strategy

Factor 3 is named strategy because the variables that represent it consist of X_6 = late payment of rent, X_7 = difficulty determining market prices. Factor 3 has a variance value of 11.006%. Factor 3 is named strategy because it looks at the variables formed by factor 3 itself, besides that the strategic risk is included in the company's business strategy [16].

d. Factor 4 is External

Factor 4 is named external because the variables that represent it consist of X_4 = Not innovative. Factor 4 has a variance value of 10.313%. Factor 4 is named external because it looks at the variables formed by factor 4 itself, besides that, external risks include reputation, environment, and competitors [16].

4. Conclusion

This study aims to determine and categorize the main factors supporting the risk of Batik fashion business in Cirebon. Based on the results and discussion that has been done, there are 15 risks identified in the Batik fashion industry business in Cirebon. Through the principal component method based on eigenvalue, the risk variables of Cirebon Batik fashion business were extracted into risk factors of Cirebon Batik fashion business. The formation of factors must fulfill the factor analysis procedure, the first is the selection of variables using KMO and Bartlett's test, MSA. For the formation of the factor itself includes cumulative determination and determination of the number of factors. The criteria for determining the cumulative by looking at the cummunality value where all the initial tables are worth 1, this means that before extraction, the variable 100% forms the factor itself. While the criteria for determining the number of factors uses an approach based on eigenvalue, extraction value, and scree plot. After that, rotate the factors where the factors formed have an eigen value greater than one. Determination of variables on factors is indicated by a large pattern loading greater than 0.30 which is then entered into one factor. Finally, interpret the results of factor analysis based on the significance of factor loading and factor naming. From the research that has been done, 11 variables are formed with 4 factors that have an eigen value greater than one.

References

[1] T. Munaf, Statistical Data and Results of the Creative Economy Survey, Jakarta: BEKRAF, 2017.

[2] A. Brun, F. Caniato, M. Caridi, G. Castelli, S. Ronchi, A. Sianesi and G. Spina, "Logistics and supply chain management in the luxury fashion retail: empirical investigation of italian firm," *Int, J. Oper. Prod. Econ,* pp. 114 (2), 554-570, 2008.

[3] B. Djohanputro, Corporate Risk Management, Jakarta: PPM, 2008.

[4] A. Purwanto, Analysis of factors supporting the success of electronic businesses in Semarang City, Fokus Ekonomi, Vol. 2, 107-119, 2007.

[5] M. Mehrjoo and Z. Pasek, "Impact of Product Varicity on Supply Chain in Fast Fashion apparel Industry," *Proceedings of The 47th CIRP Conference on Manufacturing Systems ,* pp. 17, 296-301, 2014.

[6]   H. Darmawi, Risk Management, Jakarta: Bumi Aksara, 2008.

[7]   I. Soeharto, Project Management, Jakarta: Grasindo, 2000.

[8]   H. Kerzner, Project Management : A system approach to planning, scheduling, and controlling, New Jersey, 2006.

[9]   H. Joseph F, A. J.R Ralph E, T. Ronald L and B. William C, Multivariate Data Analysis, Fourth Edition, New Jersey: Prentice Hall, 1995.

[10] S. Sharma, Applied Multivariate Techniques, Canada: John Wiley & Sons, Inc , 1996.

[11] J. Supranto, Multivariate Analysis Meaning and Implementation, Jakarta: Rineka Cipta, 2004.

[12] L. Fang, B. Xiao, H. Yu and Q. You, "A stable systemic risk ranking in China's banking sector: Based on Principal component analysis," *Physica A 492,* pp. 1997-2009, 2017.

[13] M. Boubchir and H. Auorag, "Materials genome project: The application of principal component analysis to the formability of perovskites and invers perovskites," *Computational Condensed Matter ,* p. 24, 2020.

[14] I. Ghozali, Application of Multivariate Analysis with the SPSS Program, Four Edition, Semarang: Badan Penerbit Universitas Diponegoro, 2006.

[15] M. Singarimbun and E. Sofian, Survey Research Methods, Jakarta: LP 3 ES, 1995.

[16] R. Rismy, Manual Risk Management, Jakarta: Gapura Airport Service, 2017.

Glycemic Index of Diverse Rice Genotypes and Rice Products Associated with Health and Diseases

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Abstract. Rice (*Oryza sativa* L.) is the primary source of carbohydrate for more than half of global population. The highest rice consumption is in Asia which more than 100 kg per capita. It has been reported that rice elicits a high glycemic index (GI) ranged from 54 to 121 which considers to the higher GI compared to other starchy foods. Rice consumption showed a positive correlation with diabetes incidences. Regular consumption of high-GI rice has been accelerating the development of type-II diabetes problem due to high blood glucose excursions and related to insulin resistance. The objective of this review is to identify rice genotypes and also the rice products for low GI which potentially provide information associated with good eating habits and prevent type-II diabetes and others related diseases. Information regarding GI value of rice and other rice products might help rice consumers to choose the right food to reduce the risk of health problems. Nowadays, it is difficult to find food products with nutritional label of GI value. Most of the food products, the GI value has not been defined yet. Determination of GI in food products will significantly support healthy eating habits.

Keywords: rice genotypes, rice products, glycemic index, diabetes, amylose

1. Introduction

Rice (*Oryza sativa* L.) is daily diets as main source of carbohydrates and nutrients for more than half of world-wide population with global consumption reaching 456 million tons [1,2]. The highest rice consumption is in Asia which more than 100 kg per capita [1]. It has been reported that rice elicits a high glycemic index (GI) ranged from 54 to 121 which considers to the higher GI compared to other starchy foods [3,4,5,6,7,8,9]. GI of a food is determined as the raise in the blood sugar level after the food consumption compared with a standard food, usually white bread [10,11,12,13]. Polished white rice is more consume by the rice consumers compared to un-milled brown rice. These polished white

rice contribute to higher GI than brown rice which associated with a quick spike in blood sugar of the rice consumers [14,15,16,17]. Among rice consumers, brown rice is not popular because of rancidity, poor palatability, and short of self-life [18,19]. Thus, overeating rice contributes to improve GI and potentially to have type-II diabetes.

Rice is classified as a high GI food that influenced by rice varieties, environmental factors, post-harvesting processing, and cooking procedures. Nutrient composition of rice consist of carbohydrates (80%), protein (8%), fiber (3%), and fat (3%). Starch composition, including amylose and amylopectin with linear and branched chain structure, respectively. These starch composition significantly influence the GI of rice [20,21]. High-amylose rice showed lower GI level than low-amylose rice varieties [5,22,23,24,25]. Amylose has more compact structure, leading to have more resistant from enzyme activity. Therefore, high amylose content showed a positive correlation with higher percentage of resistant starch, consequently result in a lower GI [12,26]. Prevention of type-II diabetes can be managed by consuming low GI rice [27]. However, very few countries which consume low GI rice with hard textured and high-amylose content, such as Indonesia, Sri Lanka, Myanmar, and India. The intermediate-amylose rice varieties are consumed in Latin America, Northern America, Middle East, and South Asia. Meanwhile, low-amylose rice with sticky and waxy texture is popular in China, Vietnam, Taiwan, Japan, Thailand, Cambodia, Australia, and Lao PDR. Most of the rice varieties belong to high GI [18,28]. Decreasing the GI of rice by using various approaches such as classical breeding, mutation and genetic engineering will significantly prevent type-II diabetes and related diseases.

During the digestion process, starch from the rice hydrolyze in the mouth by a-amylase enzyme and continues in the small intestine with involvement of other digestive enzymes, and converted into glucose. This glucose become the primary energy source in metabolic mechanisms. The extra calories from the starch are stored as fats or glycogen [18,29]. Therefore, excess rice consumption combine with sedentary lifestyle leads to serious health problems, including type-II diabetes, obesity, and cardiovascular [30,31,32,33]. Information regarding GI value of rice and other rice products might help rice consumers to choose the right food to reduce the risk of health problems. According to Brand-Miller et al. [34], there are three levels of GI for foods, including low GI foods (55 or less), medium GI foods (56 - 69), and high GI foods (70 or more).

Rice exhibited a wide variety of glycemic index (GI) which has been influenced by amylose content, physical size of rice grains, dietary fiber content, cooking methods, and post-harvest treatments [35,36]. The GI of freshly cooked rice is 64 to 93 [37,38]. A high amylose content in rice involves in less increased blood glucose compared to the higher amylopectin content. Whole grain rice significantly showed less GI than ground rice. A high dietary fiber in rice produces less blood glucose compared to the rice with low dietary fiber. Cooking process in rice resulting a high GI due to the gelatinization process. Additionally, milling process of rice also increase GI. Meanwhile, brown rice without milling process showed lower GI.

Nowadays, it is difficult to find food products with nutritional label of GI value. Most of the food products, the GI value has not been defined yet. Determination of GI in food products will significantly support healthy eating habits. The objective of this review is to identify rice genotypes and also the rice products for low GI which potentially provide information associated with good eating habits and prevent type-II diabetes and others related diseases.

2. Methods
2.1. Data Collection
Important information and data related to glycemic index of diverse rice genotypes and rice production associated with health and diseases were collected from published articles from 1987 until 2023 on Google Scholar and PubMed data bases.

2.2. Data Analysis

All descriptive statistics and analysis of variance (ANOVA) calculations from the collected data were analyzed by using JMP Genomics®7 (SAS Institute, Inc.).

3. Results and Discussion

3.1. Rice Glycemic Index in Health and Disease

Since 1980, global type-II diabetes population has been increasing from 108 million in 1980 become 463 million in 2020, and has predicted it will be increased reaching 700 million in 2050 [39]. Type-II diabetes has become a major global health problem [27,40]. Rice consumption showed a positive correlation with diabetes incidences. China, India, Pakistan, Brazil, Indonesia, Japan, and Bangladesh which consume rice as a staple food have high diabetes incidences. Regular consumption of high-GI rice has been accelerating the development of type-II diabetes problem due to high blood glucose excursions and related to insulin resistance [16,41,42]. Thus, low-GI rice potentially decrease the incidence of type-II diabetes and other health problems, including cardiovascular, obesity, and hyperlipidemia [43,44]. Meta-analysis identified that white rice significantly increase the risk of type-II diabetes [45,46]. Diverse rice genotypes showed high variability for GI. However, specific rice varieties with low-GI have been consuming by type-II diabetes patients [27,47]. Low-GI brown rice has been suggested to substitute the white rice in order to prevent and decrease the developing type-II diabetes [15,48]. Consumption of brown rice is relative low compared to the white rice. Acceptability of brown rice for rice consumers is lower than white rice due to the texture, aroma, taste, longer cooking time, and shorter self-life [16,49].

3.2. Glycemic Index Determination in Rice

The GI of rice can be measured by using in vivo and in vitro methods. In vivo testing for GI of rice, blood glucose of rice consumers were measured with glucose drink as the reference food. Glucose drink has a GI of 100 [27,50]. The disadvantages of in vivo method are associated with management of human volunteers and low reproducibility of the results. Hence, the simple method to determine GI of food need to be developed. Recently, in vitro method which could mimic the in vivo conditions was in progress. This in vitro method is rapid, simple, reliable, and inexpensive [30,51,52]. During in vitro testing for GI of rice, the cooked rice was mixed with artificial saliva at pH 7.0 that contains α-amylase, after 20 second the pepsin enzyme was added to acidify the sample become pH 6.0, and then incubated for 30 minutes at 37°C in a shaking water bath. Pancreatin and amyloglucosidase were added to the rice sample and incubate for 5 hours. Glucose concentration of the rice was determined by using automated electrochemical technique (YSI 2700 Select Bioanalyser, Yellow Springs, OH). GI of the rice was calculated based on the percentage of CHO which converted to glucose during incubation time [27,53]. In 2020, Fernandes et al. [12] proposed the new method for in vitro GI determination, called INFOGEST. Protocols in INFOGEST, including starch hydrolysis evaluation, determination of GI, and morphology study of starch granules. Based on the INFOGEST results, rate of the starch hydrolysis in rice was influenced by amylose/amylopectin content, and rice grain characteristics, such as particle size, cell wall intactness, and protein content.

3.3. Correlation of Rice Glycemic Index and Cooking Process

GI of rice showed significant correlation with the cooking conditions, such as cooking time, cooking method, and cooking liquid volume [16,53]. Cooking conditions which potentially lower the GI of rice are less time for boiling and steaming, parboiling process, cooling technique, and pregerminated rice. Meanwhile, cooking conditions that significantly increase the GI of rice including explosion puffing of rice, soaking process, milling rice, and grinding process. Steamed rice products have a high GI. However steaming process in rice produce the lowest GI compared to various cooking methods, such as microwaving, electric cooking, and conventional boiling. Puffing process increases the GI of rice because porous structure and gelatinization. Puffed white rice showed a GI of 74, and puffed rice cake

generated a high GI of 128. Soaking process of rice in warm water prior to cooking in order to soften the grain texture and to elongate the rice grains allow to get better gelatinization and the starch granule expansion leading to a higher GI [54]. Rice flour, porridge, and broken rice showed high GI because of the increased gelatinization and digestibility. In contrast, parboiling process of rice might reduce the GI due to the formation of resistant starch. Storing the cooked rice at refrigerator temperature 4°C led to a reduction in GI because of the crystallization process which increase the resistant starch. Pregerminated brown rice following soaking in warm water potentially reduce the GI of rice because of the production acylated steryl glucoside dysfunctional enzymes. Un-milled rice called brown rice contains high resistant starch and fiber which significantly reduce the GI. Therefore, it is important to standardize the cooking methods of rice to control the GI.

3.4. Impact of Environmental Conditions on Rice Glycemic Index

Environmental conditions, including light, air temperature, soil nutrients, water, and atmospheric carbon dioxide also influence the GI of rice which mainly mediated by the starch contents such as amylose and amylopectin [56,57]. Under the low intensity light (shading) environment, the starch content, starch synthase (SS), and granule-bound starch synthase (GBSS) enzyme activity reduced. In the low temperature (cold) condition, ratio of amylose and amylopectin significantly increase. Whereas, heat temperature conditions decreased short chain of amylopectin and increased long chain of amylopectin. Amylose content of rice tend to be increased in the soil with excess nutrients of zinc and potassium. However, in salinity condition, the amylose content significantly decreased. Flooding condition increased the amylose contents. Excess carbon dioxide up to 700 ppm also increased amylose contents. Managing the rice cultivation in the proper environmental conditions is needed to produce high-quality rice grains with low GI value.

3.5. Glycemic Index in Diverse Rice Genotypes

Diverse rice genotypes with more than 2,500 rice varieties displayed high variability in GI which have a range from 48−160. Most of the rice varieties have a high GI (Table 1). In the market only can find few rice varieties with low GI and higher price. The GI level of rice is depend on the variety and influenced by amylose and amylopectin content. Three levels of GI for foods, including low GI foods (55 or less), medium GI foods (56 - 69), and high GI foods (70 or more). The primary grain component that affects GI is amylose content. Based on the ratio of amylose and amylopectin content, rice can be classified as high amylose (25−33%), medium amylose (20−25%), low amylose (12−20%), very low amylose (5−12%), and waxy (0−2%) rice [58,59,60,61]. Amylose content also influences the texture of cooked rice and showed positive correlation with water absorption during cooking [16,62]. A high GI rice tends to have soft-tender texture compared to hard-cooked rice. GI level of three varieties of rice, including japonica, javanica, and indica also showed differences. Indica rice showed low GI and high amylose (23−31%) with short and slender grains which commonly consumed in India and southern China. Meanwhile, japonica and javanica have high GI with low amylose content 0−25%. Japonica grains have short and round shape that is preferred in northern China, while javanica grains are long and thick (Kaur et al., 2016; Jukanti et al., 2020). Therefore, it allows rice consumers to choose specific rice varieties based on GI and amylose content.

Table 1. Glycemic index in cooked diverse rice genotypes

Rice Varieties	Estimated GI	References
Karaya	109.2	[63]
Thai Jasmine	100.0	[63]
Kinaures	96.9	[63]
Bagoean	92.3	[63]

Koshihikari	80.0	[16]
Manumbaeay	87.3	[63]
Njavara	74.8	[64]
IR 64	73.2	[64]
Jyothi	73.1	[64]
Abhishek	70.4	[30]
Luna Barial	70.2	[63]
Heera	69.3	[30]
Kutsiyam	68.5	[63]
Milagrosa	68.0	[30]
Maudamani	67.9	[30]
NE-1	67.9	[30]
CR Dhan 201	67.7	[30]
Pooja	67.6	[30]
Nalbora	67.4	[30]
CR Dhan 310	66.9	[30]
Naveen	66.4	[30]
Nua Kalajeera	66.3	[30]
Kalobhat	65.5	[30]
Luna Sankhi	65.2	[30]
Sarala	63.9	[30]
Pyari	63.5	[30]
Ajay	63.5	[30]
Vandana	63.2	[30]
Tapaswini	62.4	[30]
Rajlaxmi	62.2	[30]
Riceberry	62.0	[65]
CR Dhan 907	61.4	[30]
Swarna	60.8	[30]
Mahsuri	60.1	[30]
Sinlek	58.0	[65]
Frontière	<55.0	[66]
Doongara	<55.0	[65]

Intensive selection in rice breeding program to develop low GI and high amylose by introduction suitable alleles regulating the low GI is important to prevent and reduce type-II diabetes cases. Waxy (gbssI) gene and starch synthase (SSIIIa) gene are the primary genes which related to GI in rice [27,67,68,69]. A recombinant inbred line (RIL) rice population was developed by crossing two rice varieties with high amylose content, IR5 and IR8 in order to identify the genes which associated to GI. Identification of the genetic basis of GI significantly improve the development of low GI rice. In 2017, LSU AgCenter has developed rice cultivar 'Frontiere' with low GI (<55), high protein (10.6%), long grain, semi-dwarf (36 inches), and Cypress genetic background by a mutagenesis approach [66]. Low GI PinK+4 rice was developed in Thailand with GI 48−79 combined with multiple tolerance to heat, submerge, and drought stress, and also resistance to several diseases, including brown planthopper, leaf blast, and bacterial leaf blight [65].

3.6. Glycemic Index of Rice Products
GI of rice products showed high variation influenced by the condiments, accompaniments, and also processing methods (Table 2). Acidic condiments, vegetables, dairy products (yogurt, cheese, and

milk), pulses, emulsifiers, and viscous fiber eaten with rice impacts on GI reduction due to the macronutrient affect starch digestion [16,70,71]. Addition of other starches, such as potato, tapioca, and corn to the rice starch also decrease the GI of rice. Mixing rice with bean products, including fermented soybean, bean paste soup, grounded, and roasted soybean also reduce the GI of rice. Cooking methods that promote gelatinization and disrupt starch structure tend to increase the GI. Meanwhile, parboiling technique decrease the GI of rice. Recently, food industries has been developing low GI rice noodles, pastries, snacks, etc.

Table 2. Glycemic index in rice products

Rice Products	Estimated GI	References
Boiled White Rice		
BR 16	55	[72]
Long grain rice (Oxford, UK)	47	[73]
Gem long grain (Dainty Food Inc., Toronto, Canada)	86	[74]
Long grain, boiled 25 minutes	56	[75]
Long grain boiled 15 minutes	83	[76]
Long grain boiled 5 minutes	58	[76]
Italian rice	102	[77]
Pakistani rice	98	[78]
Canadian rice	80	[79]
Indian rice	68	[80]
ZF201, indica milled rice	63	[72]
Jiayu293, indica milled rice	79	[72]
Zhefu504, indica milled rice	99	[72]
Yunuo No. 1, indica milled rice	106	[72]
JIN3, japonica milled rice	78	[72]
Xiushui 11, japonica milled rice, low amylose	69	[72]
Shaonuo, indica milled rice, waxy	102	[72]
Hyou3027, hybrid milled rice	78	[72]
Zanuo, hybrid milled rice, waxy	100	[72]
Fenyouiangzan, hybrid milled rice	92	[72]
Xieyou46, hybrid milled rice	63	[72]
Iranian rice, boiled 10 minutes	55	[81]
Thai long grain, indica	60	[82]
Thai red rice	76	[73]
Koshihikari, japonica	80	[3]
Surti Kolam, India	77	[3]
Ponni rice, India	70	[3]
Sona Masuri rice, India	72	[3]
Bg 406 unparboiled rice	7	[83]
Bg 358 unparboiled rice	67	[83]
Bg 352 unparboiled rice	67	[83]
Bg 300 unparboiled rice	61	[83]
Rathkaral unparboiled	60	[83]
LD 356 unparboiled rice	70	[83]
Heendikwel unparboiled	62	[83]
Wedaheenati unparboiled	57	[83]
Red rice, Sri Lanka	99	[84]
Boiled Brown Rice		
Tai Ken (Union Rice Company, Taipei, Taiwan)	82	[85]
Sunbrown Quick (Rice Growers Co-op, Australia)	114	[37]

Pelde brown (Rice Growers Co-op, Australia)	109	[37]
Doongara brown (Rice Growers Co-op, Australia)	94	[37]
Calrose brown (Rice Growers Co-op, Australia)	124	[37]
Brown rice, South India	50	[86]
Brown rice, USA	50	[87]
Brown rice, Canada	66	[79]
Boiled Basmati Rice		
Basmati with wild rice, North America	63	[73]
White and brown basmati rice	59	[73]
Brown basmati rice	75	[73]
White basmati (Mahatma brand, Sydney, Australia)	83	[88]
Parboiled Rice		
Bg 356 parboiled rice, Sri Lanka	64	[83]
Bg 358 parboiled rice, Sri Lanka	62	[83]
Bg 352 parboiled rice, Sri Lanka	60	[83]
Bg 406 parboiled rice, Sri Lanka	71	[83]
Hassawi rice, Al-Hassa, Saudi Arabia	59	[89]
Long-grain white parboiled (Uncle Ben's; Belgium)	54	[89]
Long grain, boiled 15 minutes, Canada	67	[76]
Long grain, boiled 5 minutes, Canada	54	[76]
Long grain, boiled 12 minutes, Denmark	60	[90]
Long grain, boiled 10 minutes, USA	61	[91]
Glutinous Rice		
Glutinous rice, Japan	105	[14]
Glutinous rice, Thailand	92	[73]
Glutinous rice, Thailand	94	[92]
Rice Noodles		
Pho (made from Thai long grain rice & tapioca starch)	62	[82]
Kway teow (made from Thai long rice & potato starch)	60	[82]
Instant rice vermicelli (Thai long grain rice, tapioca & potato starch)	59	[82]
Rice noodles, boiled, Australia	40	[92]
Rice noodles, dried, boiled (Thai World, Bangkok, Thailand)	61	[92]
Jiangxi rice vermicelli, cooked 8 minutes (Oxford, UK)	40	[73]
Guilin rice vermicelli, cooked 8 minutes (Oxford, UK)	37	[73]
Bihon, Philippines	49	[93]
Vermicelli, 99% long grain rice + 1% calcium	50	[82]
Vermicelli, 100% long grain rice	55	[82]
Taiwan vermicelli (rice, maize starch), Hongkong	68	[94]
Jianxi rice vermicelli (rice, water), Hongkong	55	[94]
Rice vermicelli, Kongmoon, China	83	[8]
Specialty Rice		
Instant Doongara, cooked 5 minutes (Rice Growers Co-op, Australia)	132	[88]
Instant rice, cooked 6 minutes (Rice Brand, Australia)	87	[6]
Instant rice, boiled 1 minutes (Canada)	65	[76]
Broken rice	86	[92]
Easy-cook long grain rice	47	[73]
Easy-cook basmati rice	80	[73]
Saskatchewan wild rice, Canada	57	[8]
Mexican Fast and Fancy (Uncle Ben's; Effem Foods Ltd, Canada)	58	[8]
Long grain and Wild (Uncle Ben's; Effem Foods Ltd, Canada)	54	[8]
Garden Style (Uncle Ben's; Effem Foods Ltd, Canada)	55	[8]
Cajun Style (Uncle Ben's; Effem Foods Ltd, Canada)	51	[8]
Other Rice Products		
Puffed rice cakes, Doongara rice (Rice Growers Co-op, Australia)	85	[88]

Puffed rice cakes, Calrose rice (Rice Growers Co-op, Australia)	128	[88]
Puffed rice cakes, white (Rice Growers Co-op, Australia)	117	[88]
Rice bubbles (Puffed rice) (Kellogg's Australia)	95	[6]
Chinese Rice Food		
Rice with stir-fried vegetables and chicken	73	[16]
Plain steamed vermicelli roll	90	[16]
Steamed glutinous rice roll	89	[16]
Sticky rice wrapped in lotus leaf	83	[16]
Fried rice in Yangzhou-style	80	[16]
Salted meat rice dumpling	69	[16]
Glutinous rice ball	61	[16]
Fried rice noodles with sliced beef	66	[16]
Fried rice vermicelli in Singapore-style	54	[16]
Japanese Rice Food		
Glutinous rice cake (mochi)	101	[16]
Rice with soybean paste soup (miso shiru)	74	[16]
White rice and fermented soybean (natto)	68	[16]
White rice and roasted, ground soybean (beihan, kinako)	68	[16]
White rice low-amylose content and pickled food	75	[16]
White rice low-amylose content with raw egg, soy sauce	114	[16]
White rice low-amylose content rolled in toasted algae	94	[16]
White rice low-amylose content and dried fish strip	115	[16]
White rice low-amylose content and salted plum (umeboshi)	98	[16]
White rice low-amylose content with curry and cheese	67	[16]
Curry rice low-amylose content	82	[16]
Butter rice low-amylose content	96	[16]
White rice low-amylose content with milk	59	[16]
Sushi, rice low-amylose content, roasted sea algae	55	[16]
Indian and Sri Lankan Rice Food		
Red rice with lentil curry	60	[16]
Red rice with lentil curry, boiled egg, salad, coconut gravy	61	[16]
Parboiled rice with green leaf curry and gravy	55	[16]
Parboiled rice with soya meat gravy	56	[16]
Parboiled rice with green leaf curry (*Amaranthus*)	48	[16]
Rice, boiled with bottle gourd and tomato curry	69	[16]
Rice with lentil and cauliflower curry	60	[16]
Malaysian Rice Food		
Fried beehoon	99	[16]
Nasi lemak	66	[16]
Fried rice	59	[16]
Chilean Rice Food		
Lentil-rice meal	49	[16]

4. Conclusion

Identification and development of rice genotypes with low GI is important to prevent and reduce type-II diabetes cases. Rice grains with high- amylose content are potentially useful for low-GI diets. High-throughput phenotyping and cost-effective technique to select molecular markers associated with low-GI in diverse rice genotypes can accelerate identification and development low-GI rice. External process, such as cooking and other processing methods which can manipulate the properties of rice also significantly reduce the GI. It is important to standardize the cooking methods of rice to control the GI. The information presented in this review paper may be useful for selecting low-GI foods.

References

[1] IRRI. Rice basics. 2010. Available from http://irri.org/about-rice/rice-facts/ rice-basics. Accessed 12 April, 2023.

[2] Meng F., Wei Y., et al. Iron content and bioavailability in rice. *J. Trace Elem. Med. Bio.*, 2005;18(4):333–338.

[3] Shobana S., Kokila A., Lakshmipriya N., Subhashini S. et al. Glycaemic index of three Indian rice varieties. *International Journal of Food Sciences and Nutrition*, 2012;63(2):178–183.

[4] Jaisut D., Prachayawarakorn S., Varanyanond W., Tungtrakul P., Soponronnarit S. Accelerated aging of jasmine brown rice by hightemperature fluidization technique. *Food Research International*, 2009;42:674–681.

[5] Hu P., Zhao H., Duan Z., Linlin Z., Wu, D. Starch digestibility and the estimated glycemic score of different types of rice differing in amylose contents. *Journal of Cereal Science*, 2004;40:231–237.

[6] Brand J. C., Nicholson P. L., et al. Food processing and the glycemic index. *Am. J. Clin. Nutr.*, 1985;42(6):1192–1196.

[7] Jenkins D. J. A., Wolever T. M. S., Jenkins A. L., Josse R. G., Wong, G. S. The glycemic response to carbohydrate foods. *Lancet*, 1984;18:388–391.

[8] Jenkins D. J., Wolever T. M., Taylor R. H., Barker H. et al. Glycemic index of foods: a physiological basis for carbohydrate exchange. *The American Journal of Clinical Nutrition*, 1981;34(3):362–366.

[9] Dwiningsih Y. Molecular Genetic Analysis of Drought Resistance and Productivity Traits of Rice Genotypes; University of Arkansas: Fayetteville, AR, USA. 2020.

[10] Jenkins D.J.A., Kendall C.W.C., Augustin L.S.A., Franceschi S., Hamidi M., Marchie A., Jenkins A.L., Axelsen M. Glycemic index: overview of implications in health and disease. *Am J Clin Nutr*., 2002;76(1):266S–273S. Doi:10.1093/ajcn/76/1.266S

[11] Ludwig D.S. The glycemic index. *JAMA*, 2002;287(18):2414. Doi:10.1001/jama.287.18.2414

[12] Fernandes J., Madalena D., Pinheiro A., Vicente A. Rice in vitro digestion: application of INFOGEST harmonized protocol for glycemic index determination and starch morphological study. *J Food Sci Technol*., 2020;57(4):1393–1404. Doi:10.1007/s13197-019-04174-x

[13] Dwiningsih Y. Alkahtani J. Genetics, Biochemistry and Biophysical Analysis of Anthocyanin in Rice (Oryza sativa L.). *Advance Sustainable Science, Engineering and Technology (ASSET)*, 2022;4(1). Doi:10.26877/asset.v4i1.11659

[14] Sugiyama M., Tang A.C., Wakaki Y., Koyama W. Glycemic index of single and mixed meal foods among common Japanese foods with white rice as a reference food. *European Journal of Clinical Nutrition*, 2003;57:743–752

[15] Sun Q., Spiegelman D., et al. White rice, brown rice, and risk of type 2 diabetes in US men and women. *Arch. Intern. Med.*, 2010;170(11):961–969.

[16] Kaur B., Viren R., Jeyakumar H. The Glycemic Index of Rice and Rice Products: A Review, and Table of GI Values, *Critical Reviews in Food Science and Nutrition*, 2016;56:2, 215-236. Doi: 10.1080/10408398.2012.717976

[17] Dwiningsih Y., Kumar A., Thomas J., Ruiz C., Alkahtani J., Al-hashimi A., Pereira A. Identification of Genomic Regions Controlling Chalkiness and Grain Characteristics in a Recombinant Inbred Line Rice Population Based on High-Throughput SNP Markers. *Genes*, 2021;12(1690). Doi:10.3390/genes12111690

[18] Jukanti A., Pautong P., Liu Q., Sreenivasulu N. Low glycemic index rice-a desired trait in starchy staples. *Trends in Food Science & Technology*, 2020:132–149. Doi:10.1016/j.tifs.2020.10.006

[19] Dwiningsih Y., Kumar A., Thomas J., Gupta C., Ruiz, C., Baisakh N., Pereira A. QTLs analysis and identification of candidate genes for flag leaf characteristics related to grain yield in US RIL rice population under drought conditions. American Society of Agronomy (ASA), Crop Science Society of America (CSSA), Soil Science Society of America (SSSA) International Annual Meeting, Salt Lake City, UT. 2021.

[20] Sivakamasundari S.K., S. Priyanga, J. A. Moses, C. Anandharamakrishnan. Impact of processing techniques on the glycemic index of rice. *Critical Reviews in Food Science and Nutrition*, 2022;62(12): 3323-3344. Doi: 10.1080/10408398.2020.1865259

[21] Dwiningsih Y., Rahmaningsih M., Alkahtani J. Development of single nucleotide polymorphism (SNP) markers in tropical crops. *Advance Sustainable Science, Engineering and Technology (ASSET)*, 2020;2(2).

[22] Srikaeo K. Sangkhiaw J. Effect of amylose and resistant starch on glycemic index of rice noodles. *Food Science and Technology*, 2014;59:1129–1135. Doi:10.1016/j.lwt.2014.06.012

[23] Denardin C.C., Boufleur N., Reckziegel P., da Silva L.P., Walter, M. Amylose content in rice (*Oryza sativa*) affects performance, glycemic and lipid metabolism in rats. *Ciencia Rural*, 2012;42:381–387.

[24] Denardin C.C., Walter M., da Silva L.P., Souto G.D., Fagundes C.A.A. Effect of amylose content of rice varieties on glycemic metabolism and biological responses in rats. *Food Chemistry*, 2007;105:1474–1479.

[25] Dwiningsih Y., Kumar A., Thomas J., Yingling S., Pereira A. Molecular genetic analysis of drought resistance and productivity in US rice cultivars. Plant and Animal Genome XXVII Conference (January 12-16, 2019). 2019.

[26] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Ruiz C., Yingling S., Crowley E., Pereira, A. Molecular genetic analysis of drought resistance and productivity mechanisms in rice. Plant and Animal Genome XXVIII Conference, January 11-15, 2020.

[27] Fitzgerald M.A., Rahman S., Resurreccion A.P., Concepcion J., Daygon V.D., Dipti S.S., Kabir K.S., Klingner B., Morell M.K., Bird A.R. Identification of a major genetic determinant of glycaemic index in rice. *Rice*, 2011;4:66–74. Doi: 10.1007/s12284-011-9073-z

[28] Dwiningsih Y., Kumar A., Thomas J., Ruiz C., Alkahtani J., Baisakh N., Pereira A. Quantitative trait loci and candidate gene identification for chlorophyll content in RIL rice population under drought conditions. *Indonesian Journal of Natural Pigments*, 2021;3(2):54–64. Doi:10.33479/ijnp.2021.03.2.54

[29] Ge X., Khan Z.I., Chen F., Akhtar M., Ahmad K., Ejaz A., Ashraf M.A., Nadeem M., Akhtar S., Alkahtani J., Dwiningsih Y., Elshikh, M.S. A study on the contamination assessment, health risk and mobility of two heavy metals in the soil-plants-ruminants system of a typical agricultural region in the semi-arid environment. *Environmental Science and Pollution Research*, 2022;29,14584–14594. Doi:10.1007/s11356-021-16756-4

[30] Kumar A., Sahoo U., Baisakha B., Okpani O., Ngangkham U., Parameswaran C., Basak N., Kumar G., Sharma S.G. Resistant starch could be dicisive in determining the glycemic index of rice cultivars. *Journal of Cereal Science*, 2018;79:348–353. Doi: 10.1016/j.jcs.2017.11.013

[31] Choi Y., Giovannucci E., Lee J.E. Glycaemic index and glycaemic load in relation to risk of diabetes-related cancers: a metaanalysis. *Br. J. Nutr.*, 2012;108(11):1934–1947.

[32] Hu J., La Vecchia C., Augustin L.S., Negri E., de Groh M., Morrison H. Glycemic index, glycemic load and cancer risk. *Ann. Oncol.*, 2013;24:245–251.

[33] Maqsood A., Khan Z.I., Ahmad K., Akhtar S., Ashfaq A., Malik I.S., Sultana R., Nadeem M., Alkahtani J., Dwiningsih Y., Elshikh, M. Quantitative evaluation of zinc metal in meadows and ruminants for health assessment: implications for humans. *Environmental Science and Pollution Research*, 2022; 29(15)21634–21641. Doi:10.1007/s11356-021-17264-1

[34] Brand-Miller J., Hayne S., Petocz P., Colagiuri S. Low-glycemic index diets in the management of diabetes: a meta-analysis of randomized controlled trials. *Diabetes Care*, 2003;26:2261–2267.

[35] Chang U., Hong Y., Jung E., Suh H. Rice and the Glycemic Index. Academic Press., 2014;ISBN 9780124017160. 357–363. Doi:10.1016/B978-0-12-401716-0.00027-1.

[36] Sitrarasi R., Nallal U.M., Razia M., Chung W.J., Shim J., Chandrasekaran M., Dwiningsih Y., Rasheed R.A., Alkahtani J., Elshikh M.S., Debnath O., Ravindran B. Inhibition of multi-drug resistant microbial pathogens using an ecofriendly root extract of Furcraea foetida silver nanoparticles. *Journal of King Saud University-Science*, 2022;34(2)101794. Doi:10.1016/j.jksus.2021.101794

[37] Miller J. B., Pang E., et al. Rice: A high or low glycemic index food? Am. J. Clin. Nutr., 1992;56(6):1034–1036.

[38] Bashir S., Gulshan A.B., Iqbal J., Husain A., Alwahibi M.S., Alkahtani J., Dwiningsih Y., Bakhsh A., Ahmed N., Khan M.J., Ibrahim M., Diao Z-H. Comparative role of animal manure and vegetable waste induced compost for polluted soil restoration and maize growth. *Saudi Journal of Biological Sciences*, 2021;28(4)2534–2539. Doi:10.1016/j.sjbs.2021.01.057

[39] International Diabetes Federation. IDF Diabetes Atlas Ninth edition 2019. 2019;ISBN: 978-2-930229-87-4

[40] Ali M.H., Khan M.I., Bashir S., Azam M., Naveed M., Qadri R., Bashir S., Mehmood F., Shoukat M.A., Li Y., Alkahtani J., Elshikh M.S., Dwiningsih, Y. Biochar and Bacillus sp. MN54 Assisted Phytoremediation of Diesel and Plant Growth Promotion of Maize in Hydrocarbons Contaminated Soil. *Agronomy*, 2021;11, 9, 1795. Doi:10.3390/agronomy11091795

[41] Salmeron J., Manson J. E. et al. Dietary fiber, glycemic load, and risk of noninsulin-dependent diabetes mellitus in women. *JAMA-J. Am. Med. Assoc.* 1997;277(6):472–477.

[42] Adil M., Bashir S., Bashir S., Aslam Z., Ahmad N., Younas T., Asghar R.M.A., Alkahtani J., Dwiningsih Y., Elshikh M.S. Zinc oxide nanoparticles improved chlorophyll contents, physical parameters, and wheat yield under salt stress. *Front. Plant Sci*. 2022;13,932861. Doi:10.3389/fpls.2022.932861

[43] Augusteschi L.S., Franceschi S., Jenkins D.J.A., Kendall C.W.C., Vecchia, C.L. Glycaemic index in chronic disease: A review. *Eur. J. Clin. Nutr*., 2002;56:1049–1071.

[44] Alkahtani J., Elshikh M.S., Dwiningsih Y., Rathi M.A., Sathya R., Vijayaraghavan P. In-vitro antidepressant property of methanol extract of Bacopa monnieri. *Journal of King Saud University – Science*, 2022;34,102299. Doi:10.1016/j.jksus.2022.102299

[45] Hu E.A., Oand P.A., Malik V., Sun Q. White rice consumption and risk of type 2 diabetes: meta-analysis and systematic review. *BMJ*, 2012;344:1–9.

[46] Alshiekheid M.A., Dwiningsih Y., Sabour A.A., Alkahtani J. Phytochemical Composition and Antibacterial Activity of Zingiber cassumunar Roxb. against Agricultural and Foodborne Pathogens. *Preprint,* 2022. Doi:10.20944/preprints202208.0511.v1

[47] Dwiningsih Y., Alkahtani J. Phenotypic Variations, Environmental Effects and Genetic Basis Analysis of Grain Elemental Concentrations in Rice (Oryza sativa L.) for Improving Human Nutrition. *Preprints*, 2022; 2022090263. Doi:10.20944/preprints202209.0263.v1

[48] Dwiningsih Y., Alkahtani J. Rojolele: a Premium Aromatic Rice Variety in Indonesia. *Preprints*, 2022; 2022100373. Doi:10.20944/preprints202210.0373.v1

[49] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Gill N., Ruiz C., Alkahtani J., Baisakh N., Pereira A. Identification of QTLs and Candidate Loci Associated with Drought-Related Traits of the K/Z RIL Rice Population. *Research Square*, 2022. Doi:10.21203/rs.3.rs-1609741/v1

[50] Dwiningsih Y., Al-Kahtani, J. Genome-Wide Association Study of Complex Traits in Maize Detects Genomic Regions and Genes for Increasing Grain Yield and Grain Quality. *Advance Sustainable Science Engineering and Technology*, 2022;4(2), 0220209. Doi:10.26877/asset.v4i2.12678

[51] Lone J., Shikari A., Sofi N., Ganie S., Sharma M., Sharma M., Kumar M., Saleem M.H., Almaary K.S., Elshikh M.S., Dwiningsih, Y. Screening technique based on seed and early seedling parameters for cold tolerance of selected F2-derived F3 rice genotypes under controlled conditions. *Sustainability*, 2022;14(14):8447. Doi:10.3390/su14148447

[52] Dwiningsih Y., Kumar A., Thomas J., Gupta C., Ruiz C., Alkahtani J., Baisakh N., Pereira, A. Identification and expression of abscisic acid-regulated genes in US RIL rice population under drought conditions. In *82nd Meeting of Southern Section of the American Society of Plant Biologists*. 2021.

[53] Dwiningsih Y., Kumar A., Thomas J., Yingling S., Pereira, A. Identification of QTLs associated with drought resistance traits at reproductive stage in K/Z RILs rice population. In *5th Annual Meeting of the Arkansas Bioinformatics Consortium AR-BIC*. 2020.

[54] Dwiningsih Y., Kumar A., Thomas J., Yingling S., Pereira, A. Molecular genetic analysis of drought resistance and productivity in K/Z RIL rice population. *Arkansas Bioinformatics Consortium*. 2019.

[55] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Crowley E., Ruiz C., Pereira, A. Drought stress response in US recombinant inbred line of rice population. In *National Science Foundation (NSF) 26th National Conference*. 2019;26(76)127.

[56] Patindol J.A., Siebenmorgen T.J., Wang, Y. Impact of environmental factors on rice starch structure: A review. *Starch/Sarke*, 2015; 67:2–54. Doi: 10.1002/star.201400174

[57] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Yingling S., Basu S., Pereira, A. Circadian expression patterns of the HYR gene. *Arkansas Bioinformatics Consortium*, *7*(11), 2018;34.

[58] Juliano B. O. Rice in human nutrition. *Food and Agriculture Organization of the United Nations, International Rice Research Institute*, *Rome*. 1993.

[59] Dwiningsih Y., Kumar A., Thomas J., Pereira, A. Identification drought-tolerance rice variety for reducing climatic impacts on rice production. In *Fulbright Enrichment Seminar Climate Change, Estes Park, Colorado, USA*. 2017.

[60] Rock, W. R. L. Artificial Intelligence (AI) in Arkansas (AR). 2020.

[61] Ismanto A., Hadibarata T., Widada S., Indrayanti E., Ismunarti D., Safinatunnajah N., Kusumastuti W., Dwiningsih Y., Alkahtani J. Groundwater contamination status in Malaysia: level of heavy metal, source, health impact, and remediation technologies. *Bioprocess and Biosystems Engineering*. 2022. Doi:10.1007/s00449-022-02826-5

[62] Dwiningsih Y., Alkahtani, J. Agronomics, Genomics, Breeding and Intensive Cultivation of Ciherang Rice Variety. *Preprints*, 2022. 2022110489. Doi: 10.20944/preprints202211.0489.v1

[63] Frei M., Siddhuraju P., Becker K. Studies on the in vitro starch digestibility and the glycemic index of six different indigenous rice cultivars from the Philippines. *Food Chemistry*, 2003;83:395–402. Doi:10.1016/S0308-8146(03)00101-8

[64] Deepa G., Singh V., Naidu K. A comparative study on starch digestibility, glycemic index and resistant starch of pigmented ('Njavara' and 'Jyothi') and a non-pigmented ('IR 64') rice varieties. *J Food Sci Technol.*, 2010; (Nov–Dec 2010) 47(6):644–649. Doi:10.1007/s13197-010-0106-1

[65] Vanavichit, A. The hard solution to develop low glycemic rice for diabetes. Open Access Government. www.openaccessgoverment.org. 2021.

[66] Wenefrida I., Utomo, H. LSU-bred higher-protein, low-glycemic rice variety gains traction. Rice Research Station, Crowley. Louisiana Agriculture. 2021.

[67] Dwiningsih Y., Alkahtani J. Potential of Pigmented Rice Variety Cempo Ireng in Rice Breeding Program for Improving Food Sustainability. *Preprints;* 2023, 2023020039. Doi: 10.20944/preprints202302.0039.v1

[68] Alshiekheid M.A., Dwiningsih Y., Alkahtani, J. Analysis of Morphological, Physiological, and Biochemical Traits of Salt Stress Tolerance in Asian Rice Cultivars at Different Stages. *Preprints*, 2023;2023030251. Doi:10.20944/preprints202303.0251.v1.

[69] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Gill N., Ruiz C., Alkahtani J., Baisakh N., Pereira A. Morphological, Physiological, and Genomics Responses of Recombinant Inbred Lines Rice Population under Drought Stress Condition. 2023 Meeting of Southern Section of the American Society of Plant Biologists. Fayetteville, Arkansas. United States of America. https://southern.aspb.org/2023-annual-meeting-2/

[70] Dwiningsih Y., Thomas J., Kumar A., Gupta C., Alkahtani J., Pereira, A. Overexpression of the Transcription Factor *HYR* in Rice Improves Grain Yield and Grain Quality under Drought and High Temperature Stress Conditions. 2023 Meeting of Southern Section of the American Society of Plant Biologists. Fayetteville, Arkansas. United States of America. https://southern.aspb.org/2023-annual-meeting-2/

[71] Alkahtani J., Ruiz C., Thomas J., Dwiningsih Y., Kumar A., Pereira A. Characterization of Arabidopsis Activation Tagged Genes maintaining Photosynthesis in Response to Salinity and Fluctuating Light conditions. 2023 Meeting of Southern Section of the American Society of Plant

Biologists. Fayetteville, Arkansas. United States of America. https://southern.aspb.org/2023-annual-meeting-2/

[72] Larsen H.N., Rasmussen O.W., Rasmussen P.H., Alstrup K.K., Biswas S.K., Tetens I., Thilsted S.H., Hermansen, K. Glycaemic index of parboiled rice depends on the severity of processing: Study in type 2 diabetic subjects. *Eur. J. Clin. Nutr*., 2000;54:380–385.

[73] Ranawana D.V., Henry C.J.K., et al. Glycaemic index of some commercially available rice and rice products in Great Britain. *Int. J. Food Sci. Nutr*., 2009;60(s4):99–110.

[74] Wolever T.M., Jenkins D.J., Josse R.G., et al. The glycemic index: similarity of values derived in insulin-dependent and non-insulin-dependent diabetic patients. *Journal of the American College of Nutrition*, 1987;6(4):295– 305.

[75] Liu S., Willett W.C., et al. A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. *Am. J. Clin. Nutr*., 2000; 71(6):1455–1461.

[76] Wolever T.M.S., Jenkins D.J.A. Effect of fiber and foods on carbohydrate metabolism. In: Handbook of Dietary Fiber in Human Nutrition. Spiller, G., Ed., CRC Press Inc., Boca Raton. 1986.

[77] Gatti E., Testolin G., Noe D., Brighenti F., Buzzetti G.P., Porrino M., Sirtori, C.R. Plasma glucose and insulin responses to carbohydrate food (rice) with different thermal processing. *Annals of Nutrition and Metabolism*. 1987;31(5):296–303.

[78] Rahman M., Malik M.A., et al. Glycaemic index of Pakistani staple foods in mixed meals for diabetics. *J. Pak Med. Assoc.*, 1992;42(3):60–62.

[79] Jenkins D.J.A., Wolever T.M.S., Jenkins A.L., Lee R., et al. The glycaemic index of foods tested in diabetic patients: a new basis for carbohydrate exchange favouring the use of legumes. *Diabetologia*. 1983;24(4):257– 264.

[80] Dilawari J.B., Kamath P.S., et al. Reduction of postprandial plasma glucose by Bengal gram dal (Cicer arietinum) and rajmah (Phaseolus vulgaris). *Am. J. Clin. Nutr*., 1981;34(11):2450–2453.

[81] Parastouei K., Shahaboddin M.E., Motalebi M., Mirhashemi S.M., Faraji A.M., Seyyedi F. Glycemic index of Iranian rice. *Scientific Research and Essays*, 2011;6:5302–5307.

[82] Sato S., Fukumura K., et al. Glycemic index and glucose utilization of rice vermicelli in healthy subjects. *Biol. Pharm. Bull*., 2010;33(8):1385–1393.

[83] Pathiraje P., Madhujith W.M.T., et al. The effect of rice variety and parboiling on in vivo glycemic response. 2010.

[84] Hettiaratchi U.P.K., Ekanayake S., Welihinda J. Do different fractions of digestible carbohydrates in foods influence the glycaemic responses? *Journal of Food and Agriculture*, 2009;2(2):28–35.

[85] Lin M., Wu M.C., Lu S., Lin, J. Glycemic index, glycemic load and insulinemic index of Chinese starchy foods. World J. *Gastroentero*, 2010;39:4973–4979.

[86] Kurup P.G., Krishnamurthy S. Glycemic index of selected foodstuffs commonly used in south India. International journal for Vitamin and Nutrition Research. Internationale Zeitschrift fur Vitamin-und Ernahrungsforschung. *Journal International de Vitaminologie et de Nutrition*, 1991;62 (3):266–268.

[87] Potter J.G., Coffman K.P., Reid R.L., Krall J.M., Albrink, M.J. Effect of test meals of varying dietary fiber content on plasma insulin and glucose response. *The American Journal of Clinical Nutrition*, 1981;34(3):328–334.

[88] Holt S.H.A.; Brand-Miller J. Increased insulin responses to ingested foods are associated with lessened satiety. *Appetite*, 1995;24(1):43–54.

[89] Al-Mssallem M.Q., Hampton S.M., et al. A study of Hassawi rice (Oryza sativa L.) in terms of its carbohydrate hydrolysis (in vitro) and glycaemic and insulinaemic indices (in vivo). *Eur. J. Clin. Nutr*., 2011;65(5):627– 634.

[90] Rasmussen O., Gregersen S., Hermansen K. Influence of the amount of starch on the glycaemic index to rice in non-insulin-dependent diabetic subjects. *British Journal of Nutrition*, 1992;67(03):371–377.

[91] Krezowski P.A., Nuttall F.Q., Gannon M.C., Billington C.J., Parker S. Insulin and glucose responses to various starch-containing foods in type II diabetic subjects. *Diabetes Care*, 1987;10(2):205–212.

[92] Chan H.M.S., Brand-Miller J.C., Holt S.H.A., Wilson D., Rozman M., Petocz P. Original communication: The glycaemic index values of vietnamese foods. *Eur. J. Clin. Nutr*., 2001;55:1076–1083.

[93] Trinidad T.P., Mallillin A.C., et al. Glycemic index of commonly consumed carbohydrate foods in the Philippines. *J. Funct. Foods*, 2010;2(4):271– 274.

[94] Lok K.Y., Chan R., Chan D., Li L., Leung G., Woo J., Lightowler H.J., Henry C.J.K. Glycaemic index and glycaemic load values of a selection of popular foods consumed in Hong Kong. *Brit. J. Nutr.*, 2010;103 (04):556–560

The Effect of Combination of Coconut Water and Sugarcane Water on Freshness Duration and Solution Absorption In Cut Chrysanthemums

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Abstract. Indonesia has fertile natural conditions, providing great potential for developing horticultural commodities, one of which is ornamental plants. Chrysanthemum is an ornamental plant that has high economic value and is in high demand, so it must be balanced with the quality and quantity of the flower itself. Chrysanthemum flowers are very susceptible to physical damage after harvesting. The purpose of this study was to see the effect of giving a combination of coconut air and sugarcane air on freshness and absorption of cut chrysanthemum solution. This study used a completely randomized design (CRD) using 1 factor with 4 treatments with 3 replications.P0: 1 liter water (control), P1: 200 ml / l coconut water + 25 ml / l sugarcane juice + 775 ml air, P2: 400 ml / l coconut water + 35 ml / l sugarcane juice + 565 ml air P3: Coconut water 600 ml / l + 45 ml / l sugarcane juice + 355 ml air. Research data on the shelf life of hedge flowers were good and the solution was most absorbed in the P1 treatment with a combination of 200 mL / L coconut water and 25 mL / L sugarcane water with flower freshness reaching 13.3 days. and the absorbed solution was 66.67. Based on the research, it can be denied that there is an effect and interaction of coconut water and sugarcane juice on the freshness and absorption time of the cut chrysanthemum solution.

Keywords: *coconut water, sugarcane water, cut chrysanthemums, freshness duration and solution absorption*

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1. Introduction

The fertile natural conditions in Indonesia can provide great potential for developing horticultural commodities, one of which is ornamental plants. Ornamental plants have their own beauty and charm. In addition to the beauty and attractiveness of ornamental plants, they also have high economic value. Cut chrysanthemum flower is an ornamental plant that has high economic value and is in great demand. Based on the 2016 Horticultural Production Statistics, 2016 chrysanthemum production was 433,100,145 stalks with a harvested area of 10,914,154 m2.

The determining factor for the quality of cut flowers is postharvest handling of cut flowers. The quality of the cut flower itself is determined by the length of the stalk, the bloom of the flower, the durability of the flower during storage and display where a good flower appearance with a long shelf life is the hope

of both traders and consumers but, in reality the freshness of cut chrysanthemum flowers can only last for 2-4 days on display at room temperature depending on variety and quality (Sutater & Darliah 1994).

The problem that is often experienced by producers and consumers is in maintaining the freshness of cut flowers. Freshness is determined by the number of nutrients contained in the storage media for cut flowers (Evan, 2010). For traders, the short shelf life of interest is a big obstacle because it will result in a short marketing time. If cut flowers don't sell fast, the freshness of the flowers that decreases will cause a decrease in prices and even the flowers won't sell well. This of course will be detrimental to the cut chrysanthemum flower traders themselves.

The decline in the quality of cut flowers after postharvest is caused by respiration, evaporation, microorganisms and lack of nutrients (Sukartawi, 1996). In order for the quality of the flowers to be maintained in the hands of consumers, cut flowers need to be given post-harvest handling so that the quality of the cut flowers remains good. The basic ingredients of preservative solutions for cut flowers generally consist of several components such as sugar, bactericidal or germicidal, salt, metal, respiration inhibiting compounds and acidic compounds to lower the pH of the water (Sarwono, 2002).

At present there have been many studies examining post-harvest handling to extend the freshness of flowers, one of which is research conducted by Cintya (2016). According to the results of research data (Cintya, U.D.2016) explained that the freshness level of cut chrysanthemum flowers was highest in immersion with a concentration of 40% coconut water and starfruit extract at a concentration of 25%, which was an average of 13.66 days, while the freshness level was the lowest in the control (100% distilled water), that is, an average of 8.33 days. In the parameter of the absorbed solution, the highest amount of absorbed solution was in the K2F3 treatment, namely the concentration of 40% coconut water solution and 25% star fruit extract, which was 24.66 ml, while the least absorbed solution was in the control treatment (100% distilled water), namely 14.66 ml.

In contrast to research conducted by Cintya, in research conducted by Wiraatmaja and Astawa (2007) that the use of a preservative solution with a composition of 2.7% sucrose and 400 ppm citric acid can cause the freshness of cut chrysanthemum flowers for 13.02 days. Sucrose in solution acts as a source of nutrition for cut flowers, giving sucrose can cause bacteria to arise, to inhibit bacterial growth by adding citric acid.

Proper postharvest handling in maintaining the freshness of cut chrysanthemum flowers for a short time during demonstration will reduce the risk of higher losses. There is a need for an alternative in the postharvest handling of cut chrysanthemums during demonstration that is able to maintain the freshness of the cut chrysanthemums, has a cheap price and is easy to find, so as to provide a solution to the relatively short shelf life problem during demonstration. This research will use coconut water pulshing materials with the addition of sugarcane juice and antibacterial as a soaking solution.

Coconut water, sugar cane water is used as a soaking solution because coconut water can lower the pH of the solution, where a low pH solution can help absorption by cut flowers. According to Shanan (2017) a low pH can increase nutrient absorption. Sugarcane juice is used as a soaking solution as the main source of nutrition and energy for cut flowers for the continuity of metabolic processes because it contains sucrose. According to Wiraatmaja, et al (2007) the high sucrose content in the soaking solution allows for the availability of sufficient carbohydrates for the respiration activity of cut flowers, while antibacterials are used to control mussels or microorganisms. From various studies that have been carried out using sucrose as a soaking solution, it allows the availability of sufficient carbohydrates for the respiration activity of cut flowers. In this study the material used as an alternative to sugar as an energy source is by using sugarcane juice which is relatively cheap and easy to obtain. Sugarcane stalks consist of several components such as 0.5-1.5% monosaccharides, 11-19% sucrose, 0.15% organic matter, 65-75% water, and 12% other ingredients (Primahandana and Hendroko, 2008).

This study used coconut water and sugarcane juice as a medium for cut flowers. The use of materials that are easy to find and relatively cheap from an economical point of view is an added value

so that traders only need to pay a little extra. Based on this problem, this study intends to extend the life of cut flower freshness by using cheap and easy-to-obtain ingredients so as to minimize losses for cut flower traders.

2. Methods

This study used chrysanthemum plants taken from the chrysanthemum garden in Wisata Kampung Krisan Clapar on Jl. Kendalisodo, Candi, Kec. Bandungan Semarang, Semarang, Central Java. The research was conducted at the Laboratory of SMP N 1 Sukolilo. The subjects of this study were 12 stalks of cut chrysanthemums taken from the chrysanthemum garden in Kampung Krisan Clapar Tourism, Bandungan with the criteria that the chrysanthemum flowers used in the study had a stalk length of 60 cm with the provision that the flower harvest had 2-3 flower petals in bloom or the inside of the flower had stretched (half bloom).

This study was an experimental study using a Completely Randomized Design (CRD) with the experiment consisting of a combination of coconut water and sugar cane preservative solutions at 4 treatment levels with 3 replications. Thus producing 12 experimental units. In the treatment of preservative solution composition includes T0: 1 liter of water (control); T1: 200 ml/l coconut water + 225 ml/l sugarcane juice + 775 ml water, T2: 400 ml/l coconut water + 35 ml/l sugarcane juice + 565 ml water, T3: 600 ml/l coconut water + water sugar cane 45 ml/l + water 355 ml/l. Research design as follows:

Repetition (R)	Treatment (T)			
	T1R1	T3R1	T0R2	T2R2
	T1R3	T0R3	T3R2	T1R1
	T2R1	T2R3	T0R1	T3R3

Information :
T0 : Water 1 Liter (control)
T1 : Coconut water 200 ml/l + sugarcane juice 25 ml/l + water 775 ml
T2 : 400 ml/l coconut water + 35 ml/l sugarcane juice + 565 ml water
T3 : Coconut water 600 ml/l + sugarcane juice 45 ml/l + water 355 ml

The procedure in this research is as follows:
1) Prepare cut chrysanthemums and uniform the diameter of the cut chrysanthemums to 40-45 mm with 2/3 petals in bloom or half-opened flowers.
2) Cut each Chrysanthemum flower with a length of 60 cm from the tip of the stem to the top
3) Measure the volume of the solution before soaking the chrysanthemum flowers
4) Put the cut chrysanthemum flowers into the combined preservative solution as much as 1 liter/bottle and measure the pH of the preservative solution for each bottle.
5) Soak the cut chrysanthemums in a preservative solution with a different combination of coconut water and sugarcane juice for each bottle.
6) Check the sample and fill each bottle with 1 flower stalk.
7) Store at room temperature 27°C-30°C.
8) Make observations every day on the length of freshness of flowers during storage, counting when the flowers are fresh until they show symptoms of wilting and measure the amount of solution absorbed by measuring it at the end of the demonstration by calculating the difference in the initial volume and the final volume.

3. Results and Discussion
Result
Research data regarding the effect of giving a combination of coconut water and sugarcane juice on the freshness of the cut chrysanthemum flowers on the shelf life of the cut chrysanthemums and the absorption of the cut chrysanthemum solution with the following data:

Table 1. Storage period data for cut chrysanthemum flowers at an average storage temperature of 28°C.

Treatment		

Repeat Number	T0	T1	T2	T3	Sum
R1	12	13	8	10	43
R2	12	13	8	11	44
R3	13	14	8	10	45
Number of Treatment	37	40	24	31	132
Treatment Average	12,3	13,3	8	10,3	43,9

Based on Table 4.1, it can be seen that the effect of giving a combination of coconut water and water as a soaking solution as a preservative on the storage period (Vase life) of cut chrysanthemum flowers during the demonstration period at room temperature expressed in days gave the longest flower storage period results in the combination treatment P1 with combination treatment of 200 mL of coconut water and 25 mL of sugarcane juice with an average flower storage period of 13.3 days. The shortest flower storage period was in treatment P2 with a combination of 400 mL of coconut water and 35 mL of sugarcane juice with an average storage period of only 8 days.

Table 2. Data on the effect of coconut water and sugar cane water on the absorption of the solution

Repeat Number	Treatment				Sum
	T0	T1	T2	T3	
R1	54	59	32	45	190
R2	54	63	32	49	198
R3	57	60	37	44	198
Number of Treatment	165	182	101	138	586
Treatment Average	55	60,67	33,67	46	48,84

Based on table 4.6 it can be seen that giving a combination of coconut water and sugarcane water as a soaking solution for preservatives for the absorption of the solution, gave the most absorption results in treatment T1 with a combination of 200 mL/L coconut water and 25mL/L sugarcane water treatment which had an average absorption of the solution as much as 60.67 mL and the lowest average absorption of solution was in treatment P2 with 400 mL of coconut water and 25 mL of sugarcane juice.

Discussion

In this study the most effective combination of coconut water and sugarcane juice in maintaining the freshness of cut chrysanthemums was treatment P1, namely coconut water 200 mL/L + sugarcane juice 25 mL with an average storage of 13.3 days, which was significantly different from treatment T2, namely 400 mL/L coconut water + 35 mL sugarcane juice with an average storage of 8 days and T3 treatment, namely 600 mL/L coconut water + 45 mL of sugarcane juice with an average storage of 10.3 days. In treatment T1, a concentration of 200 mL of coconut water and 25 mL of sugarcane juice was the most optimal for soaking cut chrysanthemum flowers because giving too much coconut water would

accelerate the damage of cut flowers because the high concentration of coconut water causes more sugar content. This facilitates the proliferation of bacteria on the chrysanthemum flower stalks. Factors that cause wilting of cut flowers can occur due to a water supply that is not smooth due to the covering of the tissue on the flower stalks by microorganisms, for example: bacteria or fungi such as bacteria which are yellowish white and round in shape. This statement is supported by Durkin (1979 in Suciati, 2002) which states that the inhibition of absorption of the solution causes it to wilt quickly, due to lack of water. So it is also necessary to add enough citric acid to prevent the presence of bacteria. Citric acid can be found in coconut water. Microorganisms can cause injuries which trigger the release of ethylene gas which can accelerate the process of withering flowers and yellowing of leaves, causing the shelf life and freshness of cut flowers to decrease (Andayani, 2011). This is also in accordance with research conducted by Yulianti (2019) where 4% coconut water and 400 ppm citric acid is the best treatment that can maintain the freshness of cut chrysanthemum flowers for 11 days.

Treatment T1 had the longest flower storage period because treatment T1 with 200 mL/L coconut water + 25 mL teb water was the longest dose in maintaining the storage period of cut chrysanthemum flowers. According to Halevy and Mayak in Triyanto (2000) the use of sucrose as a holding (between 0.5% and 2%, while according to Sabari, et al (1997) and Tirtosoekotjo (1996) the best use of sugar concentration as a holding solution is a refresher given to flowers continuously for a long time, for example during display for cut roses is 3 percent.

Treatment T1 with 200 mL/L coconut water + 25 mL of sugarcane juice showed that the concentration of the solution outside the cell was lower than the concentration of the solution inside the cell so that water from outside the cell would enter the cell. The entry of water into the cell can cause the cell to be tugid (rigid) which in this condition is the best condition for plant cells (Cambell, 2008). The nature of this rigid cell allows the flower stalks to remain rigid so that the shelf life of the flowers will be longer, apart from the fact that the composition of the solution is suitable for the length of the storage period in the T1 treatment, it is also influenced by the availability of sufficient nutrients for metabolic processes during the flower display period. In addition, the use of sugarcane juice as a source of nutrition for kruang flowers is effective because it will cause a lot of mucus which will inhibit the passage of water to enter the stem, so it is more effective to use sugarcane juice with a low concentration.

Treatment of T2 with 35 mL of sugarcane juice and treatment of T3 with 45 mL of sugarcane juice even though there are nutrients as metabolic materials but has a short storage period, this is possible because the sucrose content in the sugarcane water given to the soaking solution is too high so it will cause the soaking solution to become concentrated. According to Ichimbra and Pun (2003) the higher the soaking composition will inhibit the absorption of the flowers because the higher the composition of the solution, the more concentrated the solution will be so it will be more difficult to absorb. effective in maintaining the freshness of cut chrysanthemum flowers because the more sugarcane juice is given, the more mucus will be produced on the flower stalks which can block the passage of water into the chrysanthemum stems.

The best solution absorption treatment was treatment T1 with an average absorption of 60.67 mL, this was not significantly different from treatment T2 with an average treatment of 33.67 mL. There is a significant difference between the T1 and T2 treatments because the two treatments have solutions with different pH. The T1 treatment had a pH of 4.3 while the T2 treatment had a pH of 5. According to Shanan (2017) a low pH (3.0-4) can increase nutrient absorption. the stem will increase, reducing embolization and inhibiting the growth of microorganisms. An increase in pH provides a low absorption rate so that in this study the most absorption was in the T1 treatment due to the ability to have a low pH. Whereas in treatments P2 and P3 the concentration of coconut water and sugarcane juice was higher, even though these treatments contained a source of nutrients in the form of coconut water, but if the use of coconut water solution was too high, the solution would be hypertonic in cut flowers (Farah, 2012). The solution is hypertonic because the concentration of liquid in the immersion solution is higher than

the concentration of the solution inside, which will trigger osmosis. Water molecules are sucked out due to differences in osmotic pressure. This will cause the stalk to lose fluid. In addition, the use of sugarcane juice that is too high can also cause mucus on the flower stalks, thus blocking the entry of nutrients into the cut chrysanthemums. In the control treatment using 1000 mL distilled water, water moves from high potential to low potential so that there will be a balance between the two but there are not enough nutrients to carry out metabolism.

4. Conclusion

From this study, we conclude that:

a. The combination of coconut water and sugarcane juice given as a soaking solution has a significantly different effect on maintaining the freshness of cut chrysanthemum flowers with the most optimal concentration in treatment T1 (200 mL/L coconut water + 25 mL/L sugarcane juice + 775 distilled water) mL) which is able to maintain freshness for 13.3 days.

b. Giving a combination of coconut water and sugarcane juice which is given as a soaking solution has a significantly different effect on the absorption of the solution on cut chrysanthemum flowers with the most optimal concentration, namely in treatment T1 (coconut water 200 mL/L + sugarcane juice 25 mL/L + distilled water 775 mL) with a solution absorption of 60.67 mL.

c. It is necessary to sterilize coconut water used in making preservative solutions by heating it to remove microorganisms present in coconut water.

References

[1]   Amiarsi, D. and Sunarmani. 2011. The use of pulsing soaking solution to maintain the freshness of tuberose flowers at room temperature. Proceedings of the Bogor Floriculture National Seminar.

[2]   Amiarsi, D., and Tejasarwana. 2011. Preservatives to Maintain the Quality of Rose Cut Flowers During Storage. J. Hort.

[3]   Astutik, "The Use of Coconut Water in Banana Tissue Culture Media". Science World. Vol. 8. No. 1. Th. 2008.

[4]   Campbell. 2003. Biology Volume 1 Fifth Edition. Jakarta: Erlangga.

[5]   Chen, James. C. P. And Chou, 1993, Cane Sugar Hand Book, 12th edition, Jhon Willey and sons: New York.

[6]   Directorate of Floriculture Cultivation and Postharvest. 2011. Guidelines for Postharvest Handling of Chrysanthemum Cut Flowers. Ministry of Agriculture.

[7]   Evan. 2010. "Post Harvest Cut Flowers". http://z47d.wordpress.com/. accessed on 1 February 2020.

[8]   Farah Meita Pratiwi, and Pande Ketut Sutara. "Ethnobotany of Coconut (Cocos Nucifera L.) in the Denpasar and Bandung regions." Journal of Symbiosis 1, no. 2 (2013): 102–11.

[9]   Gomez, K.A. and Gomez A.A. (1995). Statistical Procedures for Agricultural Research. Second Edition. Jakarta : UI – Press.

[10]   Hashemabadi, D. 2013. "Effect Of Silver Nanoparticles On The Vase Life And Quality Of Cut Chrysanthemum (Chrysanthemum morifolium L.) Flower" in European. Journal of Experimental Biology

[11]   Iriani, F. 2009. Formulation of a preservative solution for cut flowers of chrysanthemums, carnations and gerbera. J. Agriculture.

[12]   Lakitan, B. 2011. Fundamentals of Plant Physiology. Jakarta: Raja GrafindoPersada.

[13]   Mattjik, N.A. 2010. Cultivation of Cut Flowers and Ornamental Plants. Bandung: IPB Press.

[14] Nento, R., Tiwow, D. S., and Demmassabu, S. L. 2017. Application of a Preservative Solution on the Quality of Cut Flowers of Krisam (Chrysantemum sp). Journal. Manado: Sam Ratulangi University.

[15] Nofriati, D. 2005. Study of the packaging system of cut roses (Rosa hybrida) during storage to extend the shelf life. Graduate School. Bogor Agricultural Institute.

[16] Nuryanto, H. 2007. Cultivation of Chrysanthemum Plants. Bekasi: Geneca.

[17] Permana, S.B. 2010. The Effectiveness of Concentration and Frequency of Giving Compost Tea from Coffee Peel Waste and Coconut Water in Increasing the Success of Cocoa Flowers to Fruit. Jember. Jember University Faculty of Agriculture.

[18] Plantus. 2006. Coconut Water Promotes Orchid Growth and Flowering. Http://anekaplanta.wordpress.com/2010/01/19/air-kelapa-pemacumbuh-dan-pembungaananggrek/, accessed on 20 October 2019.

[19] Purwanto, A. W. and Martini, T., 2009. Chrysanthemum Flower of a Thousand Colors. Canisius. Yogyakarta.

[20] Rahardi, Wahyuni and Nur cahyo, Ornamental Plant Agribusiness, (Jakarta: Independent Spreader, 2001).

[21] Rismunandar. 1995.Cultivation of Cut Flowers. Jakarta: Independent Spreader.

[22] Rukmana, H.R. 2003. Various Processed Coconut. Yogyakarta: Kanisius.

[23] Sarwono, B. 2002. Producing Prime Quality Cut Orchids. Jakarta: Agromedia Pustaka.

[24] Soekarwati, 1996. Cut Flower Agribusiness Management. press UI. Jakarta.

[25] Sugiyono. 2015. Educational Research Methods. Bandung: Alphabet.

[26] Warisno. 2004. Easy and Practical to Make Nata de Coco. Jakarta: Argomedia Pustaka.

[27] Wiraatmaja, I.W., I.N.G. Astawa., and N.N.Deviantri. 2007. Extending the Freshness of Chrysanthemum Flowers (Dendranthema grandiflora Tzvelev.) With Sucrose and Citric Acid Soaking Solutions. Agritop 26 (3):129 – 135. Faculty of Agriculture Udayana Denpasar, Bali.