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Nur Ilmayasinta, Asmianto

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Agung Teguh Wibowo Almais, Ririen Kusumawati, Wahyu Hariyanto

Final Project is one of the academic stages that must be passed by students to obtain a degree. In the era of the Covid-19 pandemic, the stages to achieving this degree must be done online by students. To accommodate this, we need a system that can bridge so that the final project stages can run even...

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Utami Sri Hastuti, Vivi Novianti, Dwi Rahmawati, Ria Yustika Sari, Nadila Sekar Zahida

Jasminum Sambac L. plant, especially the flower used for ritual ceremony, i.e.: the wedding ceremony. Commonly medicinal plants have an interaction with endophytic fungi species that lived in their tissues, the interaction form is mutualism symbiotic. The research was done to: (1) identify the endophytic...

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The sustainable biomass production of fuels, chemicals, and other commercial products from lignocellulosic materials has received widespread attention. One of the potential biomass resources to be developed into biofuels is tobacco stalks. Production of tobacco plants in East Java Province was 84,100...

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Characterization, Antioxidant, and Antibacterial Activity Silver Nanoparticle of *Gelidium spinosum*

Evika Sandi Savitri, Eko Budi Minarno, Lutfiyatul Azizah

The purpose of this study was to characterize AgNP, and determine antioxidant and antibacterial activities. This research is exploratory descriptive research. The characterization method used PSA (Particle Size Analysis) and FTIR (Fourier Transform Infrared Spectroscopy). The antioxidant activity method...

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Utiya Hikmah, Alfu Nur Laila, David Lee Giant Axala, Erna Hastuti, Nur Aini, Anton Prasetyo

Nanocomposites of TiO2-reduced Graphene Oxide were synthesized with graphene oxide (GO) loadings of 4, 8, 12, and 16 mg via in situ sol-gel method. The raw material of graphene oxide was coconut shell charcoal which was processed using a modified Hummer's method by dissolving the graphite into the acid...

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Ethnobotany of Medicinal Wild Plants in the Community of Kutorejo Subvillage, Buffer Area of Alas Purwo National Park Banyuwangi Regency

Eko Budi Minarno, Akhmad Rubani, M. Rosyid Ridho

Alas Purwo National Park has a buffer area, namely Kutorejo Subvillage, Kalipahit Village, Tegaldlimo District, Banyuwangi Regency. The communities around the buffer area have local wisdom in the use of medicinal plants. Therefore it is important to carry out an ethnobotanical study in this area as a...

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Eco-friendly Synthesis of $SrBi_4Ti_{3,95}Fe_{0,05}O_{15}$ via Molten Salt Method

Rizki Fitriana Dewi, Anton Prasetyo

The molten salt synthesis has been known as an eco-friendly synthesis method because it does not produce hazardous waste and also, there is no requirement for a high calcination temperature. In this research, we synthesized SrBi4Ti3.95Fe0.05O15 photocatalytic material via the molten salt method using...

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Earthquake Microzonation Using Microtremor Analysis and Horizontal to Vertical Spectral Ratio Method Study Case at Ampelgading and Tirtoyudo Sub-district, Malang, East Java

Juan Pandu Gya Nur Rochman, Mirza Akbar Sadewa, Aditya Manafiska Putra

The earthquake that occurred on April 10, 2021, with a magnitude of 6, was felt in several areas on the island of Java and Ampelgading and Tirtoyudo sub-districts are the most affected areas. Due to the impact caused by the earthquake, a method is needed to be able to reduce the destructive effects of...

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Quantitative Structure-Activity Relationship (QSAR) of *N*-Benzoyl-*N'*-Naphtylthiourea Derivative Compounds by *in Silico* as Anticancer Through Inhibition of VEGFR2 Receptors

Dewi Sinta Megawati, Juni Ekowati, S. Siswandono

Vascular endothelial growth factor receptor (VEGFR) tyrosine kinases (TKs) are clinically validated drug targets for anticancer therapy because they play an important role in the process of angiogenesis, tumor growth, and metastasis. VEGFR2 is a member of the VEGFR-Tks. VEGFR2 is an important regulator...

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Analysis of Seismic Vulnerability Index Based on Microtremor Investigation (Case Study of Majangtengah Village, Dampit, Malang Regency)

Siti Rohmah, Adi Susilo, Didik Yudianto, Farizky Hisyam, Eko Andi Suryo, Sarjiyana

Some of the damage caused by earthquakes is not always caused by the strength of the earthquake or the distance from the epicenter of the earthquake to the affected buildings but is also influenced by local geological conditions. Majangtengah Village, Dampit District, Malang Regency is one of the areas...

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Laplacian Spectrum of Identity Graph of Commutative Ring Z 2 p $${\mathbb{Z}}_{2{\varvec{p}}}$$

Fidyatus Safitri, Purwanto, Santi Irawati, Wahyu Henky Irawan

Research on the spectrum of a graph with an algebraic structure still attracts much attention. Let Z be a commutative ring. The I (Z) is a graph...

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Antibacterial Activity Test Turmeric(*Curcuma longa* L.) Extract Herbal Oil in Extra Virgin Olive Oil Against *Staphylococcus aureus* and *Propionibacterium acnes*

Rif'atul Mahmudah, Yuni Tria Lestari, Berliana Aulia Khabibah

Turmeric and olive oil can be combined to produce herbal oil extracts. The purpose of this study was to determine the content of active compounds and to determine the effect of variations in the concentration of extracts on antibacterial activity. Turmeric is combined with extra virgin olive oil using...

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Effect of Fermentation Time on Antibacterial Activity of Fermented Red Rice Bran by *Rhizopus oryzae* in Inhibiting *Staphylococcus aureus* and *Escherichia coli*

Akyunul Jannah, Anik Maunatin, Aisyah Ainur Rachma

Rice bran is a by-product of the rice milling process which is rich in nutrients and bioactive compounds such as flavonoids, alkaloids, triterpenoids, and so on. Pigmented rice bran such as red rice bran is richer in bioactive compounds because it contains anthocyanin compounds. The number of bioactive...

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Effect of Application of Propolis as Feed Supplement and Preservation Agent to Pathogenic Microbes Contamination of Local Chicken Meat

Ida Kinasih, Fitri Anggraeni, Yani Suryani, Ukit Ukit, Ramadhani Eka Putra

Chicken meat is one of the primary protein sources for the Indonesian market. However, due to the warm and humid climate, chicken meat is subject to microbial contamination, i.e., Escherichia coli dan Salmonella sp. The source of the contamination is the chicken gastrointestinal environment during rearing...

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Ginger (*Zingiber Officinale*): Drying to Encapsulation in Alginate-PVA Beads

Lukman Nulhakim, Reviana Inda Dwi Suyatmo, Flora Elvistia Firdaus, Rendhy Prasetia Utama, Siti Jariah, Eko Prabowo, Reyhan Syahreza Muslim

Ginger is one of the most widely produced horticultural commodities from the spice and medicinal plant group compared to other commodities. Ginger can be used in the form of dry powder or the form of ginger essential oil. Ginger essential oil has properties: it is unstable and susceptible to oxidation...

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Dynamics of HIV Transmission with Saturated Incidence and Treatment Strategy

Marsudi, Agus Widodo, Darmajid

This paper presents a mathematical model for dynamics of HIV transmission by considering a saturated incidence type interaction for the human to human sexual transmission. The equilibria of the model are discovered, and the basic reproduction number is calculated. The analysis shows that if the basic...

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Potency Complex Compound Mn(II)-TMPyP as a Dye Sensitizer on DSSC

Harsasi Setyawati, Handoko Darmokoesoemo, Irmina Kris Murwani, Evi Triana Putri

Both the increasing human population and energy consumption are the main factors which cause energy crises. In this situation, we need new alternative energy source. DSSC (Dye Sensitized Solar Cells) has great potential to develop because the dye as a light catcher can be directly applied in daily life....

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Optimization of Zeolite-X Catalysed Palm Oil Transesterification Using Response Surface Methodology

Diska Indah Alista, Kamisah Delilawati Pandiangan, Khoirin Nisa, Wasinton Simanjuntak, Erika Noviana, Selvia Anggraini Hasan

In this study, response surface methodology was applied to optimize the transesterification of palm oil using zeolite-X prepared from rice husk silica and aluminum foil as a catalyst. For this purpose, response surface methodology (RSM) with a 3-level-3 factor central composite design was applied to...

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Identification of Insects Visitors to Oil Palm Flowers in the Community Plantation of Kalicinta Village, North Kotabumi District, North Lampung Regency

Astuti Kusumorini, Novita Awalia Rahmah, Ida Kinasih

Palm oil is a plantation commodity with economic value in Indonesia. Insects are one of the crucial factors influencing oil palm fruit productivity. The study aimed to identify the insect visitors on male and female palm flowers based on border habitat types and visitation times. The research was conducted...

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Eco-Friendly Synthesis and Characterization of $SrBi_4Ti_{3.9}Fe_{0.1}O_{15}$ via Molten Salt Method

Nurul Fitriathus Sholikhah, Anton Prasetyo

One method of synthesizing metal oxide compounds is the molten salt method. This method is an environmentally friendly method because it does not produce waste from residual solvents and uses a lower temperature. In this research, the synthesis of the compound SrBi4Ti3.9Fe0.1O15 was carried out via...

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The Use of Coastal Wind for Electricity Generation Through Savonius Vertical Axis Wind Turbine at Remote Islands in East Java Offshore

Unung Lesmanah, Artono Raharjo, Margianto, Sugiono

Although Wind Turbine Generator has common use in several countries, in Indonesia, this thing is rarely used, even though Indonesia's geographic itself stored a lot of potential in developing such an energy source. Indonesia is an archipelagic nation with five main islands and thousands of small islands....

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Electronic Mathematics Student Worksheet Development Using Adobe Flash CS6

Sumardin Raupu, Maula Uswatun Hasanah, Mardi Takwim

This study discusses the development of electronic mathematics student worksheets assisted by Adobe Flash CS6 at SMAN 2 Palopo. Electronic student worksheets in mathematics were developed with the help of Adobe Flash CS6 in the form of applications that can be accessed via Android or computers. The development...

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Detergent-Tolerant Heterotrophic Bacteria Consortium Strain Decomposer to Improve Environmental Health

Lud Waluyo

The increasing population and level of life in big cities in Indonesia has resulted in higher pollution of domestic wastewater in recent years. Efforts are urgently needed to overcome them, among others, with indigenous heterotrophic bacteria in the form of a consortium. The method used in this study...

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Molecular Docking of Selected Phytosterol from *Hydrilla verticillata* on Estrogen Receptors as Candidates of Anti-breast Cancer

A. Ghanaim Fasya, Warsito, Elvina Dhiaul Iftitah, Rollando

Hydrilla verticillata is an aquatic plant that contains various secondary metabolites, such as triterpenoids and steroids. Several steroid compounds contained in Hydrilla verticillata are

β-sitosterol, stigmasterol, fucosterol, campesterol, and cholesterol. Steroid compounds have the potential as candidates...

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Implementation of Rubik's Cube Algorithm and Rivest-Shamir-Adleman (RSA) Algorithm on Iris Digital Image Security

Muhammad Khudzaifah, Siti Habibatul Ma'rifah, Hisyam Fahmi

Technological developments, especially smartphones, have led to an authentication process that must be developed. One of them is the use of the iris in the authentication process. The use of the iris can increase security in the authentication process because the structure of the iris is unique and differs...

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The Influence of Gender, Age, Personal Selling and Brand Activation on Consumer Purchase Intentions on Xiaomi

M. Husnus Syawab, Sri Harini, Cahyo Crysdian, Eva Yustina, Ihsan Bagus Fahad Arafat, Muhammad Aji Permana, Setiyaris, Lia Wahyuliningtyas, Nur Hasyim Asyari

Competition and prospecting in the business world today is getting tight. It is also felt by businesses such as Xiaomi. Many other attempts that have sprung up with the characteristics of each. That customers are satisfied and do not move to another place, then the company should know the factors that...

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Potential of Anthocyanin from Young Fruit Skin of *Elaeis Guineensis* as a pH Sensor

Dedi Futra, Lenny Anwar, Fitri Aldresti

The increased consumer demand for the freshness and safety of food products would contribute to providing new technologies, which could function intelligently and could monitor the freshness of packaged foods. Chemical indicators are often used to monitor the freshness of food, but they have toxic properties...

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Prevention of Cytoadherence and Heart Cell Hypoxia of Balb/C Mices Infected with *Plasmodium Berghei* with Therapy of Pare (*Momordica charantia L*)

Zainabur Rahmah, Ilham Muhammad Faris, Riskiyana, Nurfianti Indriana, Alvi Milliana, Munawar Kholil, Achmad Nashichuddin

Background: Malaria is a disease caused by Plasmodium parasites (P. falciparum, P. ovale, P. vivax, P. malariae, P. knowlesi) infection often caused by the bite of female Anopheles mosquitoes which have Plasmodium parasites in their salivary glands. Plasmodium develops in the human liver and then invades...

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The Dynamic Analysis of the COVID-19 Spread Model in the SIHCR Population with Time Delay

Ifa Sarifatus Hidayati, Ari Kusumastuti, Heni Widayani

This study discusses the dynamic analysis of the COVID-19 spread model in the SIHCR population with time delay to represent the behavior of the spread of COVID-19 with time delay. The SIHCR model divides the human population into five subpopulations, namely Susceptible ...

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Optimization of Drug Design Composition by Hybrid Islamic and Evolutionary Medicine for Covid-19 and Its New Variants Using Geometric Time Variants Extreme Genetic Algorithm

Imam Cholissodin, Lailil Muflikhah, Sutrisno, Arief Andy Soebroto, Aurick Yudha Nagara, Renny Nova, Tamara Gusti Ebtavanny, Zanna Annisa Nur Azizah Fareza

There is a difficulty in building the implementation of a computational model to build a complex Covid-19 drug design involving a smart ecosystem. Covid-19 and the drug design of its new variants are formed by combining the appropriate compound and dose as an antiviral. Drug designs as the candidates...

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Linear Discriminant Analysis (LDA) and Partial Least Square (PLS) of Chemometric in Mixture of Lard and Palm Oil-Based on Ftir-Spectroscopy Data

Imam Tazi

Oil as a basic food requirement is often misused by irresponsible individuals, such as lard mixed in palm oil. This is certainly detrimental to society. Indonesia which has a majority Muslim population will have a big influence on the authenticity of oil. FTIR can be an alternative way to distinguish...

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Synthesis of Schiff Base Compounds from 4-Formilpyridine and *P*-Anisidina Using Sonication Method as Antibacterial

Ahmad Hanapi, Lutfiyatul Hasanah, Rachmawati Ningsih, Himmatul Barroroh

Schiff base compounds are reported to have various biological activities, one of which is antibacterial. This study aims to determine the characterization of the Schiff base product with the sonication method and to determine its antibacterial activity. Schiff base products from 4formylpyridine and panisidine...

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Clustering of COVID-19 Provinces in Indonesia Using Fuzzy Means Cluster Methods

Ria Dhea L. N. Karisma, Tiara Setyo Arinda, Heni Widayani, Ari Kusumastuti

COVID-19 is a contagious virus that has global pandemic. Indonesia has the highest infected cases of COVID-19 in South-East Asia. The aim of the research is classified provinces in Indonesia using Fuzzy Mean Cluster (FCM) based on positive cases, recovery cases, and death cases of COVID-19. The result...

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Test of Active Carbon Adsorption from Cassava (*Manihot Utilissima*) Peels Against Dyes

Wiwis Sasmitaninghidayah, Retno Indarti, Dewi Anggraeni

Cassava peel is the leading waste generated by the cassava processing industry. One of the regulatory efforts is to use it as a raw material for activated Carbon to adsorb dyes. This study aims to determine the adsorption capacity of activated Carbon from cassava peel waste on yellow dye. Activated Carbon...

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Gen AdipoQ Polymorphism on Type 2 Diabetes Mellitus Patients

Tyas Nyonita Punjungsari

DNA polymorphisms is variation on DNA sequence that change amino acid and gene function through changes in splicing, one of this polymorphism was SNP which only one nucleotide that change on target sequence. A survey that comprised 44 single nucleotide polymorphism (SNP)s of 31 candidate genes related...

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Decomposition Hamilton in Cayley Graphs with Certain Invers Generator of Dihedral- 2 n $$2n$$ Group

Astri Kumala, Hery Susanto, Desi Rahmadani, Wahyu Henky Irawan

The Hamilton decomposition of graph G is a partition of the edge set into a Hamilton cycle and 1-factor if the vertex degree is odd or a partition into a Hamilton cycle if the degree of the vertex is even. In 2020, the focus was on determining the Hamilton decomposition...

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Human Voice Recognition System with Backpropagation Neural Network Method

Mohammad Bagus Dimas Prayugo, Nanda Azzahrotun Nafisa, Azis Yulianas, Hisyam Fahmi

The system on the computer can make everything run quickly and efficiently, so that it becomes a tool in information processing. One of the computer systems is an Artificial Neural Network (ANN). Along with technological advances, events that require computational models to perform speech recognition...

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Optimization of *Centella asiatica* (L.) Urban Dosage in Improving Memory of Mice with Brain Necrosis Model

Bayyinatul Muchtaromah, Ely Nuril Fajriyah, Wahyuni Risalatul Azmah, Maharani Retna Duhita, Arif Nur Muhammad Ansori, Tanjina Sharmin

Brain necrosis in mice can be triggered by injection of streptozotocin (STZ), causing nerve cell injury that can trigger neurodegenerative diseases. Centella asiatica (L.) Urban is one of the herbs whose triterpenoid compounds have neuroregenerative activity, so it is widely used as Centella asiatica...

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Antiaging Potency of *Centella Asiatica* Extract on Fibroblast Cells of *Rattus Norvegicus* Fetus by in Vitro and in Silico Approach

Zuliati Ningsih, Bayyinatul Muchtaromah, Maharani Retna Duhita, Robiatul Adawiyah, Farah Fauzia Maulahibati, Alfiah Hayati, Tanjina Sharmin

Aging is a physiological process that cannot be avoided, but can be prevented by giving antioxidants. Antioxidants can be obtained from Centella asiatica extract (EkCa). EkCa has secondary metabolites that have biological effects related to inflammation and prevent aging. The purpose of this study was...

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Agglomerative Hierarchical Clustering Analysis Based on Partially-Ordered Hasse Graph of Poverty Indicators in East Java

Ina Maya Sabara, Fachrur Rozi, Mohammad Nafie Jauhari

Poverty is a central issue in many countries, so one of the main goals of a country is to eradicate poverty. One of the efforts is to identify indicators that affect poverty using cluster analysis. In this research, we discuss cluster analysis using the agglomerative hierarchical clustering method based...

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Alkaline Pretreatment Optimization of Tobacco Stalks for Bioethanol Production

Bekti Palupi[1,2(✉)], Diana Fitriati[1], Devadha Halida Vinkarisma[1], Boy Arief Fachri[1,2], Istiqomah Rahmawati[1,2], Meta Fitri Rizkiana[1,2], and Helda Wika Amini[1,2]

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[2] Resesarch Center for Biobased Chemical Product, Universitas Jember, Jember, Indonesia

Abstract. The sustainable biomass production of fuels, chemicals, and other commercial products from lignocellulosic materials has received widespread attention. One of the potential biomass resources to be developed into biofuels is tobacco stalks. Production of tobacco plants in East Java Province was 84,100 t, with the highest production from Pamekasan Regency at 13,520 t, followed by Jember Regency at 13,110 t. This shows that Jember Regency has the potential to develop tobacco stalks to produce biofuels because their availability is relatively abundant. One of the biofuels that can be produced from tobacco stalks is bioethanol. Bioethanol production has increased every year along with the increasing demand for bioethanol, so the bioethanol market opportunity is wide open and can strengthen the nation's economy. Besides being used as a source of energy fulfilment, bioethanol is also needed as a raw material for production in the fields of cosmetics and pharmaceuticals. The increasing need for hand sanitizers during the Covid-19 pandemic has caused the need for bioethanol to increase. Pretreatment in this study was carried out using alkaline, namely NaOH, by varying the temperature and concentration. The purpose of this study was to find the optimum conditions for the pretreatment processes during the production of bioethanol. The optimum conditions in this study were a NaOH concentration of 6%, a temperature of 140 °C, and a rotational speed of 150 rpm with the yield of lignin 12.463%, cellulose 31.194%, and hemicellulose 3.172%.

Keywords: Alkaline pretreatment · Bioethanol · Tobacco stalks

1 Introduction

Sustainable biomass production for chemicals, fuels, and other commercial products from lignocellulosic materials gets attention from various parties [1]. One of the potential biological resources to be developed into biofuels is tobacco stalks. Based on Ferdiyansyah and Rachmawati [2], the production of tobacco plants in East Java Province was 84,100 t, with the highest production from Pamekasan Regency at 13,520 t, followed by Jember Regency at 13,110 t. This shows that Jember Regency has the potential to develop tobacco stalks to produce biofuels because their availability is quite abundant. In general, the part of the tobacco plant that is used is the leaf. Tobacco leaves are used

E. Susanti et al. (Eds.): ICGT 2022, AER 221, pp. 34–44, 2023.
https://doi.org/10.2991/978-94-6463-148-7_5

as raw material for making cigarettes, while the stalks are only discarded or destroyed by burning. At the same time, tobacco stalks contain nicotine, so the smoke from the combustion can pollute the environment [3, 4].

Tobacco stalks contain lignocellulose so that they can be used as raw materials for the manufacture of biofuels, especially bioethanol. Conversion of tobacco stalks into bioethanol is a solution to environmental issues caused by burning tobacco stalks as well as to answer future energy challenges. The use of biomass as fuel is also in line with the government's seriousness in developing new and renewable energy, as stated in Government Regulation no. 22 of 2017 that the utilization of renewable energy is targeted at 23% by 2025. One of the renewable energy that is currently being developed is bioethanol. Bioethanol is an alternative energy option because it can increase combustion efficiency, reduce pollutant emissions, and has a high octane number [5]. Based on the World Bioenergy Association [6], world bioethanol production is 85,100 million liters with a distribution of 60 million liters in Africa, 74,300 million liters in America, 5,770 million liters in Asia, 4,740 million liters in Europe, and 190 million liters in Oceania.

Besides being used as a source of energy fulfillment, bioethanol is also needed as a raw material for production in the pharmaceutical and cosmetic fields [7]. The increasing need for hand sanitizers during the Covid-19 pandemic has caused the need for bioethanol to increase. This is because bioethanol is the raw material for making hand sanitizers. Therefore, the development of bioethanol production has a bright future opportunity.

The development of bioethanol from tobacco stalks requires four steps process, namely pretreatment, hydrolysis, fermentation, and distillation. In a previous study, pretreatment with acids, namely HCl and H_2SO_4, resulted in 6.23% and 6.99% cellulose, respectively [8]. Pretreatment in this study was carried out using an alkaline, namely NaOH, by varying the temperature, stirring speed, and concentration.

Alkaline pretreatment is an effective chemical pretreatment method in the delignification process of plants to separate the crystal structure of cellulose and increase the accessibility of decomposing enzymes to cell walls [9, 10]. In addition, alkaline pretreatment can also remove acetyl groups and various uronic acid substitutes, which can reduce the negative effect on ethanol fermentation [11]. During the alkaline pretreatment process, the silica in tobacco stalks can also be removed as dissolved silicate in the pretreatment liquid [1]. This study aims to determine the optimum conditions for the pretreatment of tobacco stalks with the alkaline pretreatment method.

2 Materials and Methods

2.1 Materials

The materials used in this study included tobacco stalks, NaOH, sulfuric acid, sodium chlorate, acetic acid, and distilled water.

2.2 Sample Preparation

Sample preparation begins with refining the raw material in the form of tobacco stalks using a chopping machine. Furthermore, the tobacco stalks are dried in the sun. After the drying process, the raw materials were sieved with a 120 mesh sieve to obtain the same size. Then the raw material is baked for 1 h at a temperature of 60–70 °C.

2.3 Alkaline Pretreatment

Pretreatment was carried out by placing a sample of tobacco stalks into a glass beaker and soaking it with NaOH with a concentration variation of 2–10%. Pretreatment was carried out with a temperature variation of 90–140 °C. The stirring speed was varied in the range of 50–150 rpm. The pretreatment process was carried out for 60 min. The sample was filtered and washed with distilled water. Then dried in the oven for 2–3 h at a temperature of 70 °C. After being baked, the sample was cooled to room temperature.

2.4 Cellulose, Hemicellulose, and Lignin Analysis

This study's analysis of cellulose, hemicellulose, and lignin in this study used the Chesson method. The 2 g of dry sample (mass a) was added to 150 mL of distilled water and heated using a hotplate stirrer at 100 °C for 2 h. The filtered residue is rinsed with distilled water and dried until it has a solid mass (mass b). The residue was added 150 mL of 1N H_2SO_4 and refluxed at 100 °C for 1 h. The result is filtered, and the residue is dried until it has a constant mass (mass c). The residue added H_2SO_4 72% as much as 100 mL and left at room temperature for 4 h. The residue is filtered and dried until it has a constant mass (mass d). Then the residue is heated at a temperature of 600 °C for 4–6 h and weighed the mass (mass e). After testing following the above procedure, the levels of cellulose, hemicellulose, and lignin can be calculated using the Eqs. 1, 2, and 3:

$$\text{Lignin content} = (de)/a \times 100\% \tag{1}$$

$$\text{Cellulose content} = (cd)/a \times 100\% \tag{2}$$

$$\text{Hemicellulose content} = (bc)/a \times 100\% \tag{3}$$

3 Results and Discussion

The raw materials used in this study were tobacco stalks taken from PTPN X, Ajung, Jember. Tobacco stalks are cut into small pieces with a size of 3–4 cm. Then dried in the sun for three days until the color is browned and baked at a temperature of 60–70 °C for 60 min until the water content reaches 15%. The drying process is shown in Fig. 1. After the drying process, the tobacco stalks were sieved in a size of 120 mesh as shown in Fig. 2.

Samples with a size of 120 mesh were pretreated with a temperature of 90–140 with a concentration of 2%-10% NaOH and a stirring speed of 50–150 rpm for 60 min. Running samples with three variables using Design Expert 12 with the Box Behken Design (BBD) method, as shown in Table 1.

The levels of lignin, cellulose, and hemicellulose that were obtained from the test results were then analyzed using ANOVA. ANOVA analysis aims to determine the influential variables in the alkaline pretreatment process. The maximum possible error value of $\alpha = 5\%$ or $\alpha = 0.05$ will be the basic parameter in determining the significance

Fig. 1. The drying process of tobacco stalks

Fig. 2. Sample in a size of 120 mesh

of the variables that can be expressed in the P-value of the lignin content in tobacco stalk powder that has been treated.

ANOVA analysis was used to determine the effect of variables (concentration, temperature, and stirring speed) on the lignin content of pretreated tobacco stalk powder. The hypotheses to be analyzed in this study are as follows:

H0: there is no variable that affects the response
H1: there is at least one variable that affects the response

The maximum possible error value of $\alpha = 5\%$ or $\alpha = 0.05$ will be the basic parameter in determining the significance of the variables that can be expressed in the P-value of the lignin content in tobacco stalks that have been treated. The temperature variable has a P-value of 0.909. The P-value > 0.05 (α), so the pretreatment temperature variable did not have a significant effect on decreasing the lignin content in tobacco stalks. The concentration variable has a P-value of 0.002. The P-value < 0.05 (α), so the pretreatment NaOH concentration variable had a significant effect on decreasing the lignin content in tobacco stalks. Variable stirring speed (rpm) has a P-value of 0.336. The P-value $<$ 0.05 (α), so the stirring speed variable in the pretreatment had a significant effect on decreasing the lignin content in tobacco stalks.

The effect of independent variables on lignin content in a three-dimensional graph can be seen in Figs. 3, 4, and 5.

Table 1. Content of lignin, cellulose, and hemicellulose

Run Order	Temperature (°C)	Concentration (%)	rpm	Lignin (%)	Cellulose (%)	Hemicellulose (%)
1	90	2	100	28.714	43.146	7.615
2	140	2	100	27.416	44.245	7.591
3	90	10	100	14.015	30.827	6.145
4	140	10	100	13.668	31.409	5.097
5	90	6	50	17.249	31.977	4.568
6	140	6	50	20.624	37.553	4.020
7	90	6	150	13.190	28.953	5.796
8	140	6	150	12.463	31.194	3.172
9	115	2	50	24.819	42.472	8.365
10	115	10	50	15.185	34.366	4.471
11	115	2	150	27.241	44.619	6.742
12	115	10	150	16.151	30.305	3.570
13	115	6	100	17.033	29.021	10.964
14	115	6	100	19.435	35.174	7.145
15	115	6	100	18.012	33.700	6.695

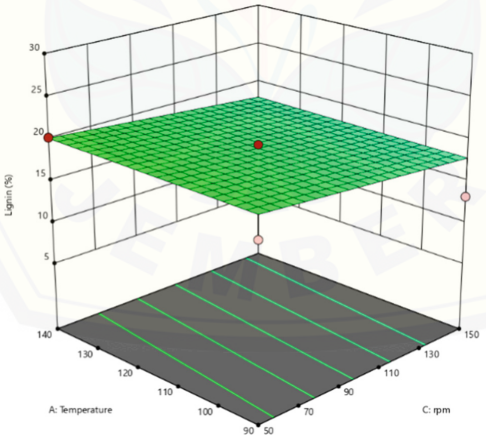

Fig. 3. Effect of temperature and rpm variables on lignin content

The temperature variable has a P-value of 0.250. The P-value $>$ 0.05 (α), so the pretreatment temperature variable did not have a significant effect on the cellulose content in tobacco stalks. The concentration variable has a P-value of 0.001. The P-value $<$ 0.05 (α), so the pretreatment NaOH concentration variable has a significant effect on the

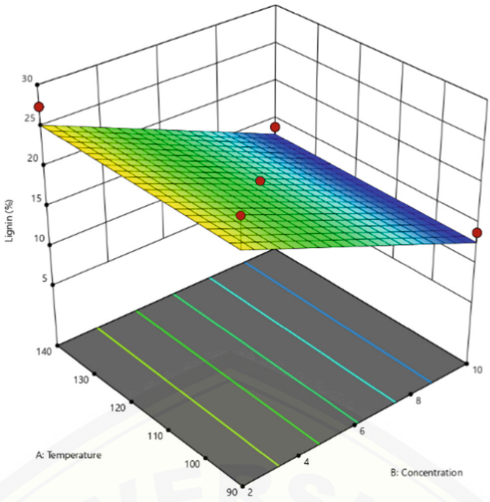

Fig. 4. Effect of temperature and concentration variables on lignin content

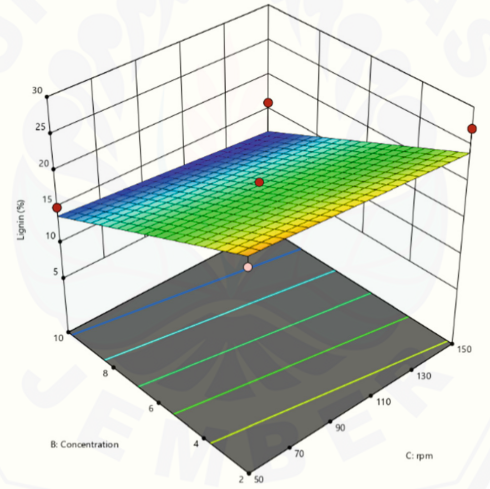

Fig. 5. Effect of concentration and rpm variables on lignin content

cellulose content of tobacco stalks. Variable stirring speed (rpm) has a P-value of 0.182. The P-value $>$ 0.05 (α), so the stirring speed variable in the pretreatment did not have a significant effect on decreasing the cellulose content in tobacco stalks. The effect of independent variables on cellulose content in a three-dimensional graph can be seen in Figs. 6, 7, and 8.

The temperature variable has a P-value of 0.408. The P-value $>$ 0.05 (α), so the pretreatment temperature variable did not have a significant effect on the hemicellulose content in tobacco stalks. The concentration variable has a P-value of 0.066. The P-value $>$ 0.05 (α), so the pretreatment NaOH concentration variable did not have a

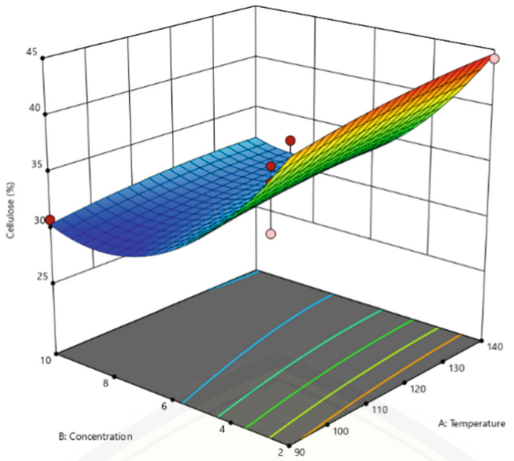

Fig. 6. Effect of temperature and concentration variables on cellulose content

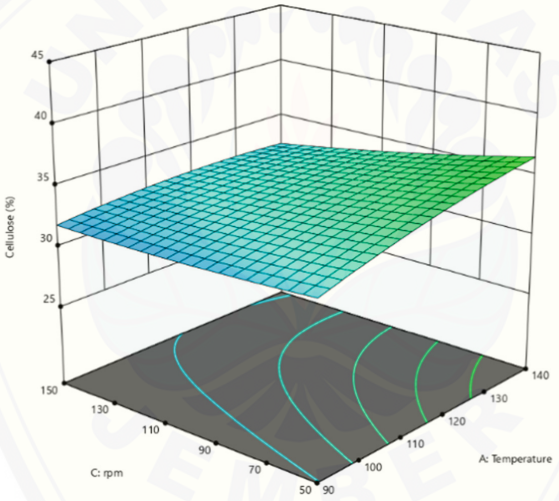

Fig. 7. Effect of temperature and rpm variables on cellulose content

significant effect on the hemicellulose content in tobacco stalks. Variable stirring speed (rpm) has a P-value of 0.667. The P-value > 0.05 (α) so that the stirring speed variable in the pretreatment did not have a significant effect on the hemicellulose content in tobacco stalks. The effect of independent variables on hemicellulose content in a three-dimensional graph can be seen in Figs. 9, 10, and 11.

The mathematical equation presented the relationship between the independent variable and the response. In Eqs. 4, 5, and 6, A is the temperature variable (°C), B is the NaOH concentration variable (%), and C is the stirring speed variable (rpm).

$$\text{Lignin} = 1.1 + 0.473\text{A} - 4.54\text{B} + 0.178\text{C} - 0.00174\text{A}^2 + 0.2425\text{B}^2$$

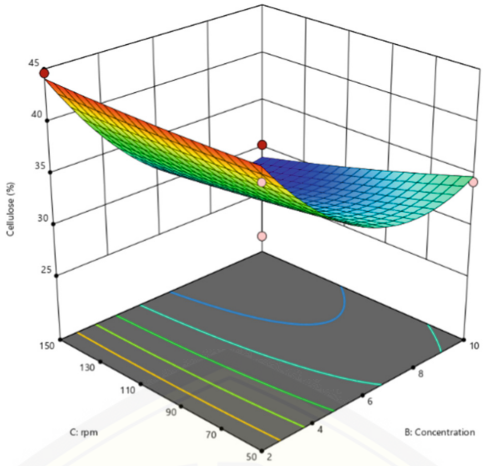

Fig. 8. Effect of concentration and rpm variables on cellulose content

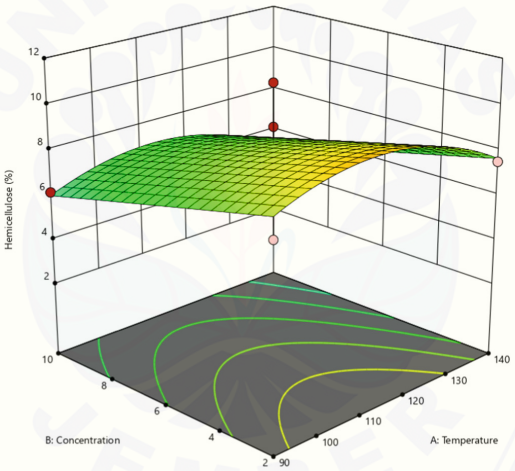

Fig. 9. Effect of concentration and temperature variables on hemicellulose content

$$- \ 0.000477C^2 + 0.0024AB - 0.00082AC - 0.00182BC \qquad (4)$$

$$\text{Cellulose} = 30 + 0.259A - 4.42B + 0.082C - 0.00060A^2 + 0.3218B^2 - \ 0.000064C^2 - 0.0013AB - 0.00067AC - 0.00776BC \qquad (5)$$

$$\text{Hemicellulose} = - \ 34.7 + 0.598A - 0.04B + 0.225C - 0.00244A^2 - 0.0081B^2 - \ 0.000941C^2 - 0.00256AB - 0.000415AC - 0.00090BC \qquad (6)$$

Before pretreatment, the cellulose content in tobacco stalks was 41.714%. After alkaline pretreatment, the most optimal content was 31.194%, followed by a decrease

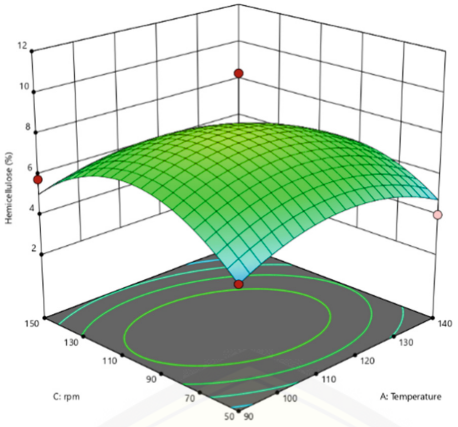

Fig. 10. Effect of rpm and temperature variables on hemicellulose content

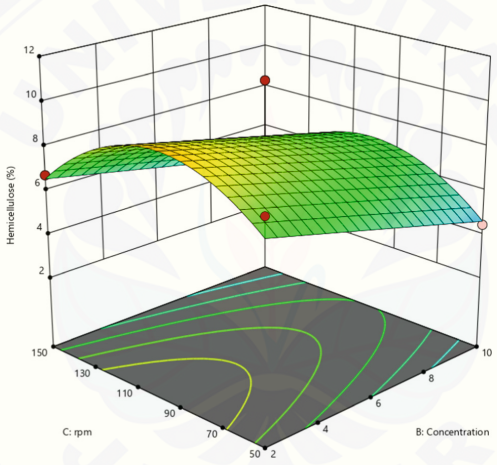

Fig. 11. Effect of rpm and concentration variables on hemicellulose content

in the amount of hemicellulose and lignin. The decrease in cellulose in the pretreatment process was 25.219%. This is because, in the lignin degradation process, there is cellulose which is also degraded and dissolved with lignin. According to Ingrid et al. [12], the increase and decrease in cellulose content can be caused by several things. First, the cellulose content in each run sample is different, while the cellulose content calculation uses the same initial content for each run.

The most effective pretreatment treatment with cellulose content was found in the experimental NaOH concentration of 6%, the temperature of 140 °C, and the stirring speed of 150 rpm for 1 h. From Fig. 6, it is known that the smaller the NaOH concentration and the rotating speed, the higher the cellulose content will be. However, the high content of cellulose was not followed by a decrease in lignin content according to the purpose of delignification, namely the removal of lignin content. This is presumably because OH- is

not selective in attacking lignocellulose. OH- can break the bonds of lignin to cellulose because, in the process of severing lignin, the cellulose bonds can swell and enlarge. If OH- continues to attack, it will reduce the level of cellulose that dissolves with NaOH [13].

4 Conclusion

The conclusion of this research is the optimum conditions in this study were a NaOH concentration of 6%, a temperature of 140 °C, and a rotational speed of 150 rpm with the yield of lignin 12.463%, cellulose 31.194%, and hemicellulose 3.172%.

Acknowledgments. The author is grateful to Research Institutions and Community Service (LP2M) Universitas Jember for research support through the lecturer research grants (PDP).

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