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Research paper

The effect of tea drugs as a natural adsorbent on the purification of bioetanol from avocado seeds by the process adsorption-distillation

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Abstract

Starch and cellulose are high molecular weight polysaccharides consisting of carbon, hydrogen and oxygen compounds. One effort that can be made to increase profits from avocado seeds is to transform them into bioethanol. Avocado seeds contain 43.3% amylase, 37.7% amylopectin and 55.07% carbohydrates. The physical properties of waste tea dregs have large surface area and fast adsorption kinetics, which makes waste tea dregs good for use as an environmentally friendly adsorbent. The method is carried out using the Bioethanol Adsorption-Distillation process with activated tea lees. FTIR results of avocado seeds contain C-O, C=O, N=O groups, C=C double bonds, C=C triple bonds, C-H triple bonds and –OH groups, which are a group of carbohydrates containing polysaccharides which can be used as raw material for the manufacture of ethanol and tea dregs contain C-O, C=O, N=O groups, C=C double bonds, C= triple bonds C, C-H triple bonds and –OH groups are carbohydrates, so tea dregs can be used as a raw material to increase bioethanol levels. The results of bioethanol levels using adsorbent and distillation reached high values with a bioethanol refractive index of 1.7575 and an ethanol content of 28% compared to the initial ethanol content of 11.5%.

Keywords:*Avocado;Adsorption-Distillation; Bioethanol;Tea Lees.*

1. Introduction

Anthropogenic emissions of greenhouse gases (GHGs), particularly CO_2, CH_4 and N_2O, have significantly increased their atmospheric concentrations since the Industrial Revolution, causing progressive global climate change and triggering widespread harmful impacts around the world. whole (IPPC, 2021., IPPC 2022). Global warming is one of the main impacts of fossil fuels and the main source of environmental degradation (Sari et al, 2021). The high price of fossil fuels and environmental pollution also limit the use of fossil fuels and force us to resort to alternative solutions. The use of fossil fuels in vehicles is responsible for more than 70% of total carbon monoxide (CO) emissions, 40% of all nitrogen oxide (NOx) emissions, 19% of all carbon dioxide emissions. carbon dioxide (CO2) and 14% of all greenhouse gas emissions (Halder et al, 2019).
Bioethanol has become more attractive as an alternative fuel to gasoline (Srinophakun, 2022). Pure ethanol has an energy content of approximately 57% of the estimated specific energy of gasoline (Sugiarto, 2021; Mukherjee &Sovacool, 2014; Chen & Khanna, 2012; Karimi & Christi, 2007). In productive sectors, the greatest quantity of lignocellulosic comes from woody biomass, agricultural residues (rice straw, corn stalks, sugar cane bagasse), energy crops (switchgrass, miscanthus), cellulosic waste (municipal solid waste such as waste from pulp mills and sawmills).(Armah et al, 2022). Feedstocks referred to as second generation biofuels include lignocellulosics such as non-food plants, forest residues, woody biomass and municipal waste (Halder et al, 2019). According to the latest statistics, the global annual production of lignocellulosic biomass is about 181.5 billion tons, and only 8.2 billion tons of lignocellulosic biomass are used in various application fields (Singh et al., 2022) . The most abundant natural resource in the world. With a large potential for energy production based on bioproducts and chemicals (Martinez et al, 2022). Avocados are one of the most produced and consumed tropical fruits in the world, the demand for which has increased significantly in recent years (Tamayo-Ramos et al, 2022).
Avocados are only extracted from the fruit, while avocado seeds are just unused, discarded and still underutilized waste. According to Martinez et al 2022, the avocado oil extraction and guacamole processing industry produced avocado skins and seeds reaching 2 million tons in 2019, without any commercial applications. Avocado seeds contain starch, reducing sugars, fiber, arabinose, pentose and protein (Weatherby, 1934). Starch and cellulose are high molecular weight polysaccharides consisting of carbon, hydrogen and oxygen compounds. One effort that can be made to increase profits from avocado seeds is to transform them into bioethanol. Avocado seeds contain 43.3% amylase, 37.7% amylopectin and 55.07% carbohydrates (Guntama et al, 2020., Martin et al, 2022). In this research, Seduan tea waste (BTW), Seduan tea dregs, is organic waste from brewed tea leaves. Tea dregs are often thrown away without first being treated. Almost 90% of tea dregs contains cellulose at about 33.4% of its dry weight, so it is used as a green, cheap and abundant absorbent for separation by increasing the value of bioethanol content using the adsorption-distillation method. . BTW is applied as a natural adsorbent

(Ozdes et al, 2022). The physical properties of waste tea dregs have large surface area and fast adsorption kinetics, which makes waste tea dregs good for use as an environmentally friendly adsorbent (Azzahra, 2020).

2. Materials and methods

2.1. Ingredients

Avocado seed flour, baker's yeast, H2SO4 solution, Aquadest, bioethanol, NAOH and activated tea dregs. Tools: Erlenmeyer, measuring cup, beaker, stirrer, dropper pipette, pH meter, aluminum foil, hot plate, analytical balance, cork stopper, distillation tool set, pycnometer, glass funnel, heater and distillation adsorption tool series.

2.2. Research procedure

According to Chen et al 2022, performing saccharification as a separate step before in situ hydrolysis-fermentation is the right option, because it can reduce the viscosity of the slurry at high subtraction concentrations and the glucose in the Biomass can be increased using microorganisms. However, if catalytic hydrolysis and fermentation are carried out simultaneously, the activity of cellulolytic enzymes will be ineffective (Liu & Dien, 2022).

2.3. Avocado seed flour repair

a) First wash the avocado seeds until they are clean, then soak them in warm water so that the skin of the avocado seeds comes off easily.
b) Then the avocado seeds are sliced thinly and dried in the sun.
c) Then the dried avocado seed slices are ground using a blender.
d) The avocado seed flour is then sifted

2.4. Hidrolisis

a) Prepare the Erlenmeyer flask for the sample to be hydrolyzed
b) Each of them makes 5 samples for a 5% solution of 96% sulfuric acid with a volume of 1000 ml, according to the equation: V1.M1 = V2.M2
c) Weigh 100 grams of avocado seed flour for sample
d) Put the avocado seed flour in an Erlenmeyer flask prepared with a sulfuric acid concentration of 5% and then stir until smooth at a temperature of 120°C for 45 minutes

2.5. Fermentation

a) Take hydrolyzed samples for fermentation.
b) Then measure the pH of the solution, pH 4-5. It is necessary to measure the pH of the hydrolysis results because the yeast will be added to the hydrosilicate so that the pH is adjusted to 4-5, where the degree of acidity is suitable for the proper functioning of the SaccharomyycesCereciviae yeast. If the pH is acidic, neutralization is necessary by adding NaOH.
c) Add 25 grams of bread yeast with sourdough into the hydrolyzed porridge. Then stir for about 5 minutes until the mixture is smooth.
d) Then the Erlenmeyer flask containing the avocado seed pulp is connected to a rubber hose and the end of the hose is placed in water to avoid direct contact with air.
e) Then the solution is fermented for 5 days

2.6. Distillation

a) Prepare the distillation equipment and assemble the equipment properly.
b) Put the fermentation results into the flask and then install the flask into the existing distillation apparatus.
c) Set the temperature to 78°C and the distillation time is ± 4 hours.
d) Store the distillate obtained in a tightly closed bottle. Then weigh the distillate that has been stored

2.7. Tea lees activation process

a) The prepared tea leaf lees are washed under running water until clean, then filtered and the filtrate is discarded. The washed tea leaves are soaked in hot water for ± 15 minutes and filtered again. The lees from the tea leaves are dried in the sun until dry, then crushed and sifted. The tea lees powder is soaked in a 0.1 N NaOH solution for ± 24 hours. After that, filter and rinse with distilled water. The NaOH-activated tea leaf lees are dried until their weight is stable. The tea leaf lees biosorbent which has been activated by NaOH is weighed with varying masses of 2 grams, 4 grams, 6 grams, 8 grams and 10 grams.

2.8. Adsorption-distillation process of bioethanol with activated tea lees

a) The adsorption-distillation process is carried out simultaneously by adding bioethanol and previously activated tea lees to a bicol, then stirring for 5 minutes so that the two are uniformly mixed. Then, temporary silence was observed for 30 minutes.
b) The bioethanol and tea dregs in the double-necked flask are then subjected to a distillation process and then heated until vapor forms to produce pure liquid bioethanol.
c) Heating is stopped when the distillate has been obtained following adsorption-distillation carried out simultaneously at a constant temperature of 78°C.

d) This distillate is then analyzed for bioethanol content

3. Results and discussion

3.1. Fourier transform infrared (FTIR) analysis of chemical composition of avocado seeds and pulp

1) Analysis of the chemical composition of avocado seeds.

FTIR analysis to determine the functional groups contained in avocado seeds so that they can be used as feedstock for ethanol

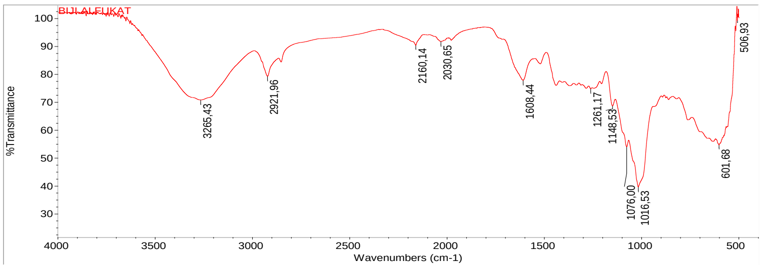

Fig. 1:FTIR (Fourier Transform Infra-Red) Spectrum of Avocado Seeds.

The spectral data in Figure 1. Looking closely at the wave absorption peak shown, one can analyze it at a wave number of 1016.53 cm-1 with a strong absorption band and width average found in the zone 1300 cm-1-1000 cm- which indicates the presence of an ester compound, namely C-O. Pada The wave number is 1608.14 cm-1 with a weak absorption band found in the region 1820cm-1 - 1600cm-1 indicating the presence of a carbonyl group, namely C=O. The wave number 1608.14 cm-1 is also found in the zone 1600cm-1 - 1500cm-1, which shows the presence of a nitro group N=O and is also found in the zone close to 1650cm-1, which shows the presence of a double bond/aromatic ring group C=C. At a wave number of 2160.14 cm-1, a weak but sharp absorption band is found in the region of 2150 cm-1, which indicates the presence of a triple bond in the C=C group, and is also found in an area that shows the presence of a triple bond in the C-H group. at a wave number of 3265.43 cm-1 with a broad absorption band found in the region 3400cm-1-2400 cm-1 which indicates the presence of acidic compounds with –OH groups. According to this explanation, avocado seeds contain C-O, C=O, N=O groups, C=C double bonds, C=C triple bonds, C-H triple bonds and –OH groups, which are a group of carbohydrates containing polysaccharides or starches. the flour thus shows that avocado seeds can be used as a raw material to make ethanol. This is supported by research carried out by Lubis (2008) which indicates that avocado seeds contain 22% fat, while within the fat structure itself there are carboxylate groups. Furthermore, according to Zahrotun and Liberty et al. (2012), avocado seeds contain ethanol. According to Martin et al, 2022, extracted grains produce 19.54% starch, 41.35% water, 0.33% ash, 4.64% titratable acidity, 1.68% lipids, 1 protein, 60% and carbohydrates 55.07%.

2) Analysis of the Chemical Composition of Tea Lees.

FTIR analysis was performed on tea lees to determine the functional groups contained in tea lees so that they could be used as an adsorbent material.

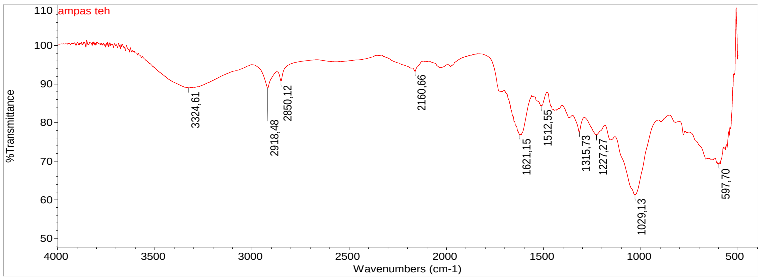

Fig. 2:FTIR (Fourier Transform Infra-Red) Spectrum of Tea Lees.

The spectral data in Figure 2. Looking at the wave absorption peak, it can be analyzed that at wave number 1029.13 cm-1 with a strong absorption band and the width of the medium is within the zone 1300 cm-1-1000 cm-1, which indicates the presence of an ester compound, namely C-O. At wave number 1512.55 cm-1 with a weak absorption band found in the region 1650cm-1 – 1450cm-1 indicating the presence of a double bond/aromatic ring of C=C Wave number 16021 .15 cm-1 with a weak absorption band is found in the region 1820 cm-1 – 1600 cm-1 indicates the presence of a carbonyl group, namely C=O. At a wavenumber of 2160, 66 cm-1 with a weak but sharp absorption band found in the 2150 cm-1 area which indicates the presence of a triple bond, the C=C group, and there is also in the area showing the presence of a triple bond of the C-H group. at a wavenumber of 3324.61 cm-1 with a broad absorption band found in the region 3400cm-1-2400 cm-1 which indicates the presence of acidic compounds with –OH groups. According to this explanation, tea dregs contain C-O, C=O, N=O groups, C=C double bonds, C=C triple bonds, C-H triple bonds and –OH groups which are a class carbohydrates in the form of polysaccharides containing cellulose. shows that tea dregs can be used as a raw material to increase bioethanol levels.

3.2. Analysis of the bioethanol content of avocado seeds before adding an adsorbent

The raw material of ethanol, namely avocado seeds, was analyzed using a refractometer to obtain refractive index results to analyze the ethanol content value.

Table 1: Ethanol Content of Avocado Seeds

Avocado seed flour(gr)	Sulfuric acid(%)	Saccharomyces cere-visiae(gr)	Fermentation time(day)	Aquadest volume(ml)	Indeks bias	Content ethanol (%)
100	5	25	5	1000	1,5067	11,5

According to Table 1, the value of refractive index is 1.5067 and the value of ethanol content of avocado seed flour is 11.5% before adding the adsorbent of activated tea dregs. According to Woldu et al 2015, bioethanol obtained by dilute acid hydrolysis from avocado seed waste is very good at 6.365%, to be used as raw material for biofuel manufacturing. In the hydrolyzate fermentation process with 15% yeast and 40% catalyst, the highest bioethanol yield was 83.755% of the theoretical maximum with simultaneous catalytic hydrolysis and fermentation (Rahman et al, 2023). The production of ethanol with a combination of hydrolysis based on dilute sulfuric acid and fermentation by the yeast Saccharomyces cerevisiae is very effective in increasing the production of bioethanol from avocado seeds by 50.94 g/L for produce 6.46 v/v of bioethanol (Vargas-tah, 2023).

3.3. Analysis of the bioethanol content of avocado seeds after addition of activated tea lees adsorbent

Bioethanol from avocado seeds was added with activated tea lees adsorbent and then analyzed using a refractometer to obtain refractive index results for analysis of ethanol content values.

Table 2: Ethanol Content of Avocado Seeds and Adsorbent

Bioethanol(ml)	Adsorbent tea dregs(grams)	Content Bioethanol(%)
100	2	13
	4	17
	6	23,5
	8	25
	10	28

From Table 2, the refractive index values and ethanol content values for each sample were obtained with variations in the amount of tea lees adsorbent of 2 gr, 4 gr, 6 gr, 8 gr, 10 gr with a temperature of 78 ℃ variations in the amount of tea lees adsorbent of 2 grams of tea lees. Tea obtained a refractive index value of 1.5295 and an ethanol content of 13%, an adsorbent sample of 4 grams of tea lees with a refractive index of 1.5903 and an ethanol content of 1.5903. ethanol of 17%, an adsorbent sample of 6 grams of tea lees with a refractive index value of 1.6891 and an ethanol content of 23.5%, the adsorbent sample of 8 grams of tea lees has produced a refractive index value of 1.7119 and an ethanol content value of 25% and a variation of the adsorbent of 10 grams of tea lees obtained a refractive index value of 1, 7575 and an ethanol content value of 28%.

Fig. 3: Results of the Bioethanol Absorption and Distillation Process.

Analysis of the ethanol levels obtained in this study was carried out using a refractrometer. A refractometer is a salinity measuring instrument which is quite commonly referred to as measuring the refractive index of a liquid. The refractive index is one of several important optical properties of a material, the refractive index of a material or solution is a very important characteristic parameter. which is linked to temperature, concentration, etc. (Hidayanto, 2010)

Table 3: Effect of Refractive Index on Ethanol Content Values from Avocado Seeds with the Addition of Tea Lees Adsorbent

No	Adsorbenttea dregs(grams)	Indeks Bias	Ethanol content(%)
1	2	1,5295	13
2	4	1,5903	17
3	6	1,6891	23,5
4	8	1,7119	25
5	10	1,7575	28

In Table 3 you will find the refractive index values obtained from bioethanol from avocado seeds. After being analyzed with a refractometer using the standard calibration equation, the value of the content of ethanol was obtained. Bioethanol with a refractive index of 1.5295 has an ethanol content of 13%, bioethanol with a refractive index of 1.5903 has an ethanol content of 17%, bioethanol with a refractive index of 1. 6891 has an ethanol content of 23.5%, bioethanol with a refractive index of 1.7119, the ethanol content value is 25%, and bioethanol with a refractive index of 1.7575, the value of ethanol content is 28%.

This is consistent with the literature which states that the increase in the concentration of a solution is directly proportional to the refractive index of the solution (Parmitasari&Hidayanto, 2013).

3.4. GC-Ms analysis of sample 5 (bioethanol from avocado seeds plus 10 grams of tea lees adsorbent)

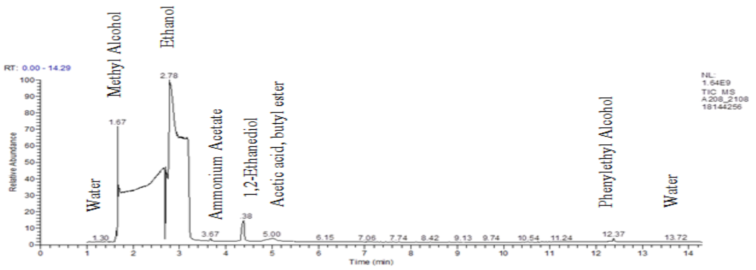

Fig. 4: Chromatogram of Bioethanol Content.

Table 4: Results of GC-MS Analysis of Bioethanol Content of Avocado Seeds

Reaction time	Composed content	Chemical formula	% Area
1.30	Water	H2O	0.09
1.67	MethylAlcohol	CH3OH	17.82
2.78	Ethanol	C2H5OH	27.17
3.67	Ammonium Acetate	NH4CH3	0.22
4.38	1,2-Ethanediol	C2H6O2	3.08
5.00	Acetic acid, butyl ester	C6H12O2	1.04
12.37	Phenylethyl Alcohol	C8H10O	0.36
13.72	Water	H2O	0.04

Source: FMIPA Laboratory of Sriwijaya University.

As shown in Figure 4 and Table 4, the GC-MS analysis results indicate that there is ethanol in the bioethanol sample. The results of the analysis in the form of a chromatogram show that there are eight peaks. detected in the GC-MS analysis indicate the type of ethanol compound. The peaks detected in the GC-MS analysis show the type of ethanol compound contained in bioethanol. The GC-MS analysis results show that there are two peaks belonging to the hydroxyl group. of ethanol with the highest values at all retention times, namely ethanol (C_2H_5OH) and methanol (CH_3OH).

4. Conclusion

1) FTIR Results: Avocado seeds contain acidic compounds with –OH groups. According to this explanation, avocado seeds contain C-O, C=O, N=O groups, C=C double bonds, C=C triple bonds, C-H triple bonds and –OH groups, which are a group of carbohydrates containing polysaccharides or starches. the flour thus shows that avocado seeds can be used as a raw material to make ethanol and the FTIR results of tea dregs contain C-O, C=O, N=O groups, C=C double bonds , C=C triple bonds, C-H triple bonds and – OH groups are a class of carbohydrates in the form of cellulose-containing polysaccharides, demonstrating that tea dregs can be used as a raw material to increase bioethanol levels
2) The results of bioethanol content of avocado seeds using adsorbent and distillation reached a high value with a refractive index of bioethanol of 1.7575 and an ethanol content of 28% compared to the initial ethanol content by 11.5%.

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