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Quality Active Charcoal from Skin Peanut Land (*Arachis Hypogaea*) with Various Activation Methods

Ujang Hermawan[a)], Sutanto[a*)], Linda Jati Kusumawardani[a)]

[a)] *Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Pakuan, Bogor, Indonesia*
[*)] *Corresponding Author: sutanto@unpak.ac.id*

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ABSTRACT

Peanut shells (Arachis Hypogaea) are characterized by seeds enveloped in sufficiently hard skin. The peanut shell is composed of organic compounds with the potential to be converted into activated carbon. This research aims to determine the quality of charcoal active with various activation methods and evaluated based on SNI 06-3730-1995. Chemical activation was conducted by immersion in 0.1 M NaOH, 0.1 M H_2SO_4, and 0.1 M NaCl, while physical activation was at a temperature of 500 ºC and without activation as a control variable. The best test results show by activating with a temperature of 500 ºC with results water content amounting to 3.58%, the results of here ash content were 3.82%, volatile matter of 9.55%, carbon content of 83.05%, benzene absorption capacity of 17.5177%, iodine absorption capacity of 753.23 mg/g. FTIR analysis shows that charcoal active with activation 500 ˚C contains C=O functional group, and SEM analysis showing the presence of varying pore surfaces in activated charcoal.

Keywords: active charcoal, skin peanut land, chemical activation.

1. INTRODUCTION

Activated charcoal is produced in two stages. The first, carbonization, involves burning biomass using a pyrolysis tool under limited oxygen conditions [1]. Peanut shells, a type of agricultural waste, contain about 3.5% cellulose, making them potential candidates for conversion into activated charcoal. The absorption capacity of charcoal and existing materials can be made charcoal active with activation procedure. Surface characteristics Can differentiate between charcoal active And No. Hydrocarbon deposits cover Charcoal's surface, which can prevent level activeness, charcoal's active surface is usually free from deposits, and the pores and surface area are open and have sufficient absorption capacity[2].

The skin on peanuts can potentially be used as activated charcoal is part of the type of peanut farming waste and is not needed (Peanut Shells have cellulose as much as 3.5%, which makes it have the potential to become an adsorbent [3]. BPS data in 2014 shows that the production of peanuts in Indonesia is large 638,896 tons. The production yield is directly proportional to the quantity of skin Peanut land [4]. There is also a fantastic opportunity to use this waste as a basic material for making active carbon.

Content from skin peanut Soil composed of 35.7% cellulose, hemicellulose 18.7%, Lignin 30.2% and 5.9% ash indicate that peanut shells have potential material carbon Which is active to get maximum results on carbon-active peanut land, The activator is used chemistry and physics [5].

Activation in the process of making Activated charcoal aims to make physical changes and multiply surface activated carbon which is caused by the loss of hydrocarbons, water, and other substances in the activated charcoal. Activation can be carried out by chemical or physical means. The physical activation used is heated at 500°C. The purpose of this process is to increase the volume and widen the pore diameter which occurs during the carbonization process and can produce new pores[6].

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Chemical activation uses H_2SO_4, NaOH, and NaCl, respectively concentration of 0.1 M [7]. Activation uses H_2SO_4 in solution and removes some of the metal oxides that cover the surface of the activated charcoal. cause enlarging surface activation using NaOH, an alkaline solution that has a function in increasing porosity from carbon active. From size the cation, Na^+ is dominantly smaller than K^+, Na^+ is easily distributed and penetrates the ion into the carbon structure to become active [8]. Activation using NaCl functions as a dehydrating agent which can limit carbonization activities formation tar, which where can be formed in the carbonization process and the closing of the activated carbon pores, the surface area obtained is smaller which results in low adsorption power [9]. The best actives are generated with various activation methods based on SNI 06-3730- 1995 as well as to determine active from peanut shells [10].

2. METHODS

The research began by collecting peanut shells. Furthermore, the process of carbonation at 450 °C for 45 minutes after getting charcoal from peanut shells land next with physical activation, namely at a temperature of 500 °C, activation chemically with soaking for 24 hours using NaCl solution 0.1 M, H_2SO_4 0.1 M, And NaOH 0.1 M, without treatment as a control variable. Next tested with SNI 06-3730-1995, results test SNI 06-3730-1995. It is best to continue with SEM and FTIR tests to determine the surface morphology and clusters of peanut shell activated charcoal.

2.1 Making Activated Charcoal from Peanut Shells

After collection, peanut shells are shaped into small flakes and then carbonized. Once converted to charcoal, it is ground to approximately 100 mesh and divided into three samples for control, physical activation, and chemical activation

2.2 Making Solution for Activation

This is the procedure of making H_2SO_4 solution 0.1 M. First, fill the flask at a rate of 1 liter using as much distilled water 250 mL, then add 17 mL of concentrated sulfuric acid solution slowly. Homogenized, then distilled water was added up to the mark in the measuring flask. Then, when it is cold, transfer the solution to the reagent bottle. The measuring flask needs to be filled with distilled water to avoid spontaneous heating which causes an explosion.

2.3 Peanut Shell Activated Charcoal Activation

Activation of charcoal in dried peanut shells At a temperature of 105 °C in time 5 hours then put into a furnace at 450 °C for 45 minutes, the activated charcoal is sieved with 100 mesh Activation Activated charcoal is carried out by soaking 150 grams of activated charcoal from peanut shells using H_2SO_4 0.1 M, NaOH 0.1 M, And NaCl 0.1 M, during 24 hours. Charcoal active skin peanut land which has in activation, then in strain , and do the washing by using distilled water until the pH is neutral activated charcoal is dried in the oven at 100 °C for 4 hours.

2.4 Pore analysis

Charcoal active from skin peanut land before and after activation, SEM was tested to determine the shape and size of the particles that make up the composition, objects and semi-quantitative data on the compounds and element Which containing content on the object.

2.5 Functional Group Analysis

Activated charcoal shows the better than the SNI carried out by spectra analysis red, and several functional groups can be identified by mixing the powder Charcoal uses KBR in pellet form. Then the level uptake is in wavenumber from 60 to 4000 cm^{-1}.

2.6 Chemical Characteristics of Peanut Shell Activated Charcoal

The charcoal in activated peanut shells was tested chemical characteristics include analysis of ash, water, and volatile matter, carbon content, and power absorb iodine. Power absorbs steam benzene and absorption methylene blue. Activated charcoal analysis procedure referring to SNI 06-3730-1995 related technically activated charcoal [10].

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3.RESULTS AND DISCUSSION

3.1 Water content

The water content of the activated charcoal, determined by its hygroscopic properties, indicates that water vapor from the air can be absorbed into the pores during the cooling process [11]. If the levels are lower in water that can be contained in charcoal active and produces large pores, then the surface of the pores can be larger in activated carbon and can also increase to happen ability on absorption of an activated carbon [12].

Table 1. Rate of water

Activation	Rate Water (%)
Without Activation	6.51
H_2SO_4	14,11
NaOH	19.58
NaCl	11.92
500˚C	3.58

Activated charcoal without activation, activation 500 ˚C, solution salt NaCl 0.1 M, And solution Sulfuric Acid 0.1 M water in accordance with the Indonesian National Standard, namely below 15%, with results each 6.51 %, 3.58%, 11.92%, and 14.11%. Meanwhile, Activation uses NaOH 0.1M by showing the results of the water content analysis of 19.58%. The high-water content is due to activation by NaCl 0.1 M, NaOH 0.1 M, and H_2SO_4 0.1 M through a neutralization process followed by a rinsing process so that it is possible for a lot of water to be bound to the active carbon.

3.2 Ash content

Extraction In determine destination ash content to determine the level of vitamin content minerals in activated charcoal, which remain activation and carbonization take place.

Table 2. Rate ash

Activation	Rate Ash (%)
Without Activation	7.61
H_2SO_4	11.65
NaOH	18.16
NaCl	8.96
500˚C	3.82

Remainder Minerals can trigger clogged pores on activated charcoal and influences absorption of what is happening [13]. In activated charcoal, the ash content is kept small because it is possible causing a decrease in the absorption capacity of the solution or gas [14].

Rate ash charcoal active without treatment, with physical activation treatment, and salt solution activation has an ash content in accordance with the Indonesian National Standard, namely below 10%, with respective results of 7.61%, 8.96% and 3.82%. Meanwhile, chemical activation with 18.16% NaOH, and H_2SO_4 activation 14,11% over standard. High ash content in activated charcoal without activation, activation H_2SO_4, and NaOH are caused the presence of these compounds remains consequence from immersion or activation of the sample, the high ash content influences many minerals in the sample [15].

3.3 Rate of Volatile Substances

The levels of volatile substances is the result of the decomposition of several substances which arrange charcoal without happen stage warmup on the composing process is not an internal component compile charcoal [16].

Table 3. Rate of Volatile Substances

Activation	Rate of Volatile Substances (%)
Without Activation	4.51
H_2SO_4	36
NaOH	22.97
NaCl	11.98
500˚C	9.55

Activated charcoal without treatment, treat activation at 500˚C, adding salt solution, and NaOH has appropriate levels of volatile substances with Indonesian National Standards, namely below 25%, with respective results 4.51%, 36%, 22.97%, 11.98% And 9.55%. High ash content on activation of H_2SO_4 0.1M which is possible due to immersion and imperfect flushing causes the less sulfur is burned on temperature 450 °C [17,18].

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3.4. Peanut Shell Activated Charcoal Carbon Content

The level of carbon is affected by the amount of water content, ash, volatile matter of the material [17].

Table 4. Rate carbon

Activation	Rate Carbon(%)
Without Activation	75.97
H_2SO_4	38.24
NaOH	39.29
NaCl	72.55
500˚C	83.05

Activated charcoal with activation treatment physics in accordance with SNI (Indonesian National Standards). Namely a minimum of 80%, with an Activation result of 500°C is 83.05%. Whereas, without activation show 75.97% for rate carbon, Activation in a way with NaOH 39.29%, Activation H_2SO_4 38.24% and activation by NaCl of 72.55% less than standard. Own carbon content is determined from 100% - (Water content + Ash content + volatile substances) so this carbon content really depends on the previous 3 parameters.

3.5 Power Absorb Iod

Level absorption is known from big iodine Number like number Which show the level of adsorbent that can adsorb iodine. The added iodine solution is absorbed by carbon active with adsorbent the iodine numbers show much iodine (mg) which can be absorbed by one gram of activated charcoal [19].

Table 5. Rate Power Neat Iod

Activation	Rate Power Neat Iod (mg/g)
Without Activation	720,21
H_2SO_4	679,04
NaOH	697,23
NaCl	717,33
500˚C	753,23

Activated charcoal with activation treatment physics has levels according to the standard Indonesian National, namely a minimum of 750 mg/g, with results of 500˚C 753.23 mg/g, NaCl 717.33 whereas chemical activation with NaCl 720.71mg/g, NaOH 697.23 mg/g, and Activation of H_2SO_4 679.04 mg/g, In the results of activated charcoal without treatment, NaCl activation, NaOH activation and H_2SO_4 activation below standard (SNI 06-3730-1995), which enters Standard i.e. at 500°C Activation Amounting to 753.23 mg/g.

3.6 Absorption Capacity for Methylene Blue

Methylene blue adsorption was carried out to determine capacity adsorption on biomass, carbon active and zeolite. Determination this aims to know ability adsorbent to absorb colored solutions and can also be used to determining wide surface on adsorbent. Structure from carbon active consists mostly of aromatic rings tends to have group nonpolar, while methylene blue is polar, which refers to the high solubility of methylene blue in water, so that the two interact via an induced dipole.

Table 6. Methylene Blue Absorption Capacity

Activation	Methylene Blue Absorption Capacity (mg/g)
Without Activation	84.82
H_2SO_4	34.70
NaOH	48.82
NaCl	52.35
500˚C	120,117

Activated charcoal without treatment or treatment Physical activation has a level of absorption capacity methylene blue complies with National Standards Indonesia that is as big as min 120 mg/g, with results respectively 84.82 mg/g, and 120.11 mg/g. Meanwhile, chemical activation is not suitable with a standard NaCl value of 52.35 mg/g, NaOH 48.82 mg/g, and H_2SO_4 activation 0f 34.70 mg/g From the results of the absorption test research methylene blue in the results of the power test research absorb incoming methylene blue according to SNI (06-3730-1995) without treatment was 84.82 mg/g and at 500 ° C activation of 120.11 mg/g, that is, it can absorb methylene blue, it can used as a cheap adsorbent in removes methylene blue. On activated charcoal without treatment, NaCl activation, NaOH, and H_2SO_4 ,

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does not enter the standard (SNI 06-3730- 1995) because of the activation charcoal results cannot absorb methylene blue with well, as is the cause of the height ash content and pore water - closed activated charcoal pores by many water molecules and minerals formed during the activation process as well flushing so the sera power of the active machete will reduce.

3.7 Absorption Capacity for Benzene

Activated charcoal with activation treatment physics and with the addition of salt solutions has benzene absorption levels in accordance with The Indonesian National Standard is a minimum of 25%, with results of 17.33%, 17.51%, and respectively 4.99%. Chemical activation with NaOH 13%, and H_2SO_4 Activation 9.03%. On results benzene absorption capacity of activated charcoal without treatment, activation temperature 500 ˚C, NaCl 0.1 M, NaOH 0.1M, and H_2SO_4 0.1 M does not meet the standards quality charcoal active Because value not enough from 25% (SNI 06-3730-1995), this shows that the activated charcoal results from this study are not effective if used as a gas adsorption chart.

Table 7. Benzene Absorption Capacity

Activation	Benzene Absorption Capacity (%)
Without Activation	17,33
H_2SO_4	9,03
NaOH	13
NaCl	4,99
500˚C	17,51

The size activated charcoal's absorption capacity for benzene Reflecting the surface of activated charcoal is more characteristic non-polar so it can be used for absorbs pollutants that are also non-polar like carbon tetra chloride. Increased absorption capacity This shows the surface of the activated charcoal more is non-polar.

3.8 The SEM Results of Peanut Shell Charcoal After Activation

Analysis morphology and components of active carbon through SEM observations carried out on activated carbon without treatment, chemical and physical activation. The samples analyzed were activated carbon that had been activated at a temperature of 500 ˚C. Figure 1-3 show the results of SEM analysis with magnifications of 200x, 1000x, and 2500x respectively.

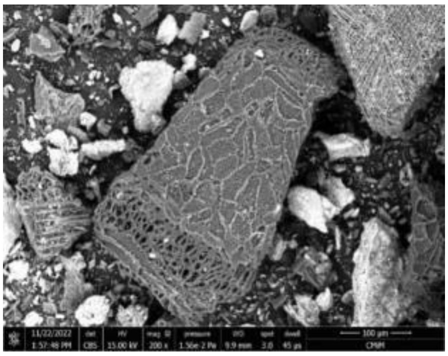

Figure 1. Activated charcoal with activation physically, the magnification is 200x

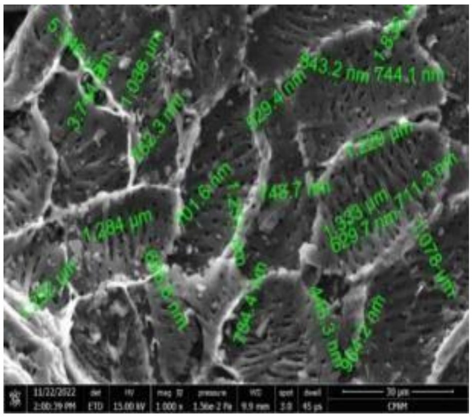

Figure 2. Activated charcoal with activation physically, the magnification is 1000x

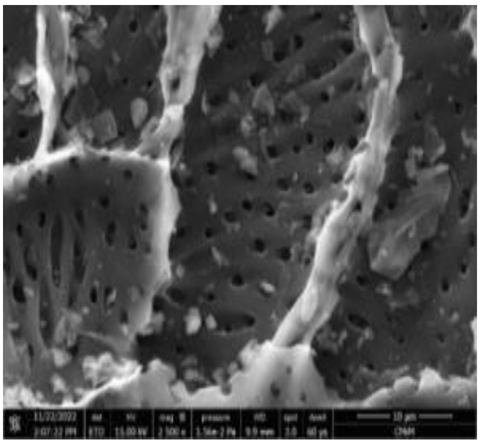

Figure 3. Activated charcoal with activation physically, the magnification is 2500x

The activation of cause material volatiles (substances that easily fly) is released from the charcoal, causing the structure to open mobile Which remaining and resulting in pore formation [20]. The size of the pore which formed on carbon active will affect the surface area and adsorption capacity of activated carbon. Several factors influence pore formation, namely carbonization temperature, imperfect washing, and pores being closed by impurities due to the heating process. after washing on activated carbon. The absorption capacity of activated carbon is not only influenced by pore size, but is also influenced by surface area, volume carbon active, and the size of the adsorbent.

3.9 Analysis Functional groups using FTIR

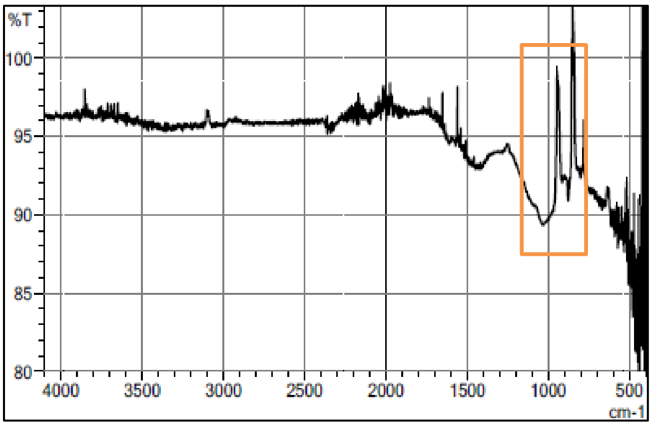

Figure 4. FTIR Spectra of Activated Charcoal

The Infrared Spectrum of activated charcoal produced with an activation time of 500 ˚C indicates its presence uptake on orange circle area in the area 1690.29 cm^{-1} which is suspected to be a C=O double bond. Absorption around 1651.37 cm^{-1} is suspected to be caused by vibrations of the C=C double bond. The results of FTIR analysis show that charcoal is active from activated peanuts using a temperature of 500 ˚C shows its presence C=O, and C=C groups. Thus, it is known that this activated carbon can be used as an adsorbent.

4. CONCLUSION

Based on research that has been carried out, Quality charcoal active skin peanut land The best according to SNI 06-3730-1995 is charcoal active with Activation temperature 500˚C. Activated charcoal with activation of 500˚C is in accordance with the standards set for parameters of water content below 15%, namely 3.58%, ash content below 10%, namely 3.82%, volatile substances 25% in lower 9.55% , rate carbon above 80%, namely 83.05%, iodine absorption capacity 753.23 mg/g with minimum 750mg/g, methylene blue absorption capacity above 120 mg/g, namely 120.117mg/g. Meanwhile, the level of benzene absorption capacity does not comply with SNI, at least 25%, namely 17.5177%, and activated charcoal with an activation temperature of 500˚C has a porous surface morphology with a size of 1 µm - 700 nm and has C=O and C=C groups.

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