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ANALYSIS OF QUALITY OF ACTIVATED CARBON *(Myristica fragrans)* SHELL AS ADSORPTIVE AGENT

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ABSTRACT

The activated carbon made in this study is activated carbon in the form of powder and granules (a mixture of the two) by a chemical activation process using calcium oxide (CaO). The characterization of activated carbon refers to the Indonesian National Standard 06-3730-1995 concerning technical activated carbon with the indicators tested being moisture content, volatile matter content, total ash content, bound carbon content and iodine adsorption capacity. Based on research on the characterization of activated carbon, nutmeg shells have a moisture content of 0.6979 %, volatile matter content of 3.8781%, total ash content of 8.7323%, bound carbon content of 87.3896 % and iodine adsorption capacity of 325. 0694 mg/g. Iodine adsorption capacity aims to determine the adsorption capacity of activated carbon. Based on the technical quality standard of activated carbon regarding iodine adsorption capacity stipulated by SNI 06-3730-1995, researchers can explain that the pore capacity of nutmeg shell activated carbon is very good for use as an adsorbent. The important use of activated carbon in nutmeg shells as an adsorbent is expected to be utilized for water purification from bacteria, absorption of inorganic materials dissolved in water and cosmetic base ingredients.

Keywords: *nutmeg, adsorbents, activated carbon*.

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INTRODUCTION

Charcoal is a porous solid containing 85-90% carbon, which is produced by heating at high temperatures from carbon-containing materials. Besides being used as a fuel, charcoal can also be used as an adsorbent because it has a high adsorption capacity when activated and when activated, changes in physical and chemical properties occur, so it is referred to as activated carbon (Sembiring, 2003). Activated carbon contains other elements and forms organic functions with hydrogen and oxygen (Saygih et al, 2015). This is due to the perfect carbonization process and the chemical reactions that occur on the activated carbon surface during the activation process (Morawski et al, 1994: Papirer et al, 1991: Long et al, 2018. The use of activated carbon increases the catalytic activity of various chemical reactions and biochemical reactions (Narowska et al, 2019). Adsorption with activated carbon depends on the pore structure and surface area, concentration, and chemical properties of the raw material sources used for the activated carbon carbonization process (Marsh et al, 2006: Burchacka et al, 2019).

The nutmeg plant (Myristica fragrans) is a plant native to Indonesia which grows a lot in the Maluku area of the Banda Islands which is very potential as a trade commodity to foreign countries. Nutmeg has long been known as a spice and has an important position as a source of essential oils which are needed in various industries such as food, medicine, perfume, cosmetics, and others. The nutmeg plant produces nutmeg with a greenish-yellow ripe fruit color, with a hard texture. The diameter of the nutmeg varies around 3-9 cm. Part of the nutmeg fruit consists of flesh (83.3%) and seeds which consist of mace (3.22%), seed shell (3.94%), and seed flesh (9.54%) (Manialup, 2015). One part of the nutmeg that is often used as waste is the nutmeg shell.

Nutmeg shells can also be used as the simplest energy source, namely as fuel for cooking (Manialup, 2015). The use of nutmeg shells as a simple fuel is not able to improve the quality of nutmeg shells, so research to make nutmeg shells into activated carbon with a function as an adsorbent agent or often referred to as an adsorbent needs to be carried out with the aim of increasing the use value of nutmeg shell waste.

METHOD

This research is an experimental laboratory in the Chemistry Laboratory of Sam Ratulangi University.

Materials

The equipment used in this study were furnace, oven, hot plate, analytical balance, charcoal pounder (lumping and pestle), desiccator, stirrer, pH paper, 18, 100 and 125 ml porcelain cups and laboratory glassware. The materials used in this study were nutmeg shells from CV Indospice in Cereme, demineralized aqua, iodine (I_2) 0.125 N, whiting (C_aCO_3), sodium thiosulfate, ($Na_2S_2O_3$) 0.125 N, 1% starch solution.

Procedures

Preparation of activated carbon: nutmeg shells are cut into small pieces and carbonized at 400 °C for 1 hour. After carbonization, the resulting carbon is cooled. Then grind it using a mortar and pestle. The fine carbon powder was then sieved using a 50 mesh sieve to obtain a homogeneous particle size. The shell charcoal is weighed as much as 100 grams, then washed with demineralized aqua and then drained. The whiting was heated at 850^{o}C in a furnace for 15 minutes and then dissolved in 300 mL of water and stirred with a stirrer for 15 minutes. Set aside for 15 minutes until the quicklime is separated from the precipitate. The shell charcoal is then placed in a quicklime solution and heated at 100^{o}C for 60 minutes. The mixture that has been heated is drained so that the charcoal is separated from water and dirt. The charcoal is washed with flowing aqua demineralization until the pH reaches normal (pH = 7) using pH meter paper. The final stage of making activated carbon is drying the charcoal in an oven at 125^{o}C for 120 minutes and storing it in a desiccator (Qin et al, 2014. The characterization of activated carbon refers to the Indonesian National Standard 06-3730-1995 regarding technical activated.

Determination of water content

As much as 1 g of activated carbon was placed in an 18 mL porcelain cup whose mass was known, then dried in an oven at 105^{o}C until a constant mass was obtained. Activated carbon is then cooled in a desiccator (SNI, 1995).

Determination of volatile matter content

Dry activated carbon is heated in a furnace at 900^{o}C for 15 minutes, then cooled in a desiccator and then weighed [11].

Determination of total ash content

As much as 1 g of activated carbon was placed in a porcelain cup, heated in an oven at 105 oC until a constant mass was obtained. The sample in the cup is then put into the furnace and incubated at 650 oC for 4 hours, then cooled in a desiccator. The ash formed is weighed (SNI, 1995).

Determination of bonded carbon content

The carbon content can be determined by the difference in the total percentage with the total percentage of water content, volatile matter content, and ash content of activated carbon (SNI, 1995).

Determination of ion adsorption capacity

As much as 1 g of activated carbon was put into the Erlenmeyer flask, then 25 mL of 0.125 N iodine solution was added. The solution was stirred for 15 minutes then the Erlenmeyer was closed and stored in a dark place for 2 hours. The solution is then filtered, then the filtrate is pipetted 10 mL, put into a clean Erlenmeyer flask and titrated with Na_2S2O_3 solution so that the solution is light yellow. A total of 1 mL of starch indicator was added to the filtrate and the titration was continued until the blue color disappeared. The volume of the $Na_2S_2O_3$ solution used was recorded and the absorption capacity of activated carbon for iodine was calculated in mg/g (SNI, 1995).

Data analysis

The average data obtained from each of the three repetitions in this study will be compared with data from the Indonesian National Standard 06-3730-1995 regarding technical activated carbon

DISCUSSION RESULT

The results of the research on the quality analysis of nutmeg shell activated carbon in the form of characterization tests in the laboratory with several test indicators such as tests for water content, volatile matter content, total content, bound carbon content and ion adsorption capacity can be seen in table 1.

Table 1. Data on the results of a comparison of the characteristics of the nutmeg shell activated carbon test and SNI 06-3730-1995

Activated Carbon Type	Water content (%)	Volatile matter content (%)	Total ash content (%)	Bonded carbon content (%)	Iodine absorption (mg/g)
SNI 06-3730-1995 Powder	< 15	< 25	< 10	> 65	> 750
SNI 06-3730-1995 details	< 4,4	< 15	< 2,5	> 80	> 750
Nutmeg shell	0,6979	3,8781	8,7323	87,3896	325,0694

The activated carbon made in this study is activated carbon in the form of powder and granules (a mixture of the two) by a chemical activation process using calcium oxide (CaO). Based on the results of the research in table 1, the average moisture content of activated carbon in nutmeg shells compared to SNI 06-3730-1995 activated carbon has good quality. The water content of the activated carbon of the nutmeg shell is still below the maximum standard of water content set by SNI 06-3730-1995 with standards both in powder and granular form. Volatile matter levels are changes in the components of a material (shell, wood, etc.) when carbonized at high temperatures (Pari et al, 2009). Based on the research results in table 1, the average volatile matter content of the activated carbon of nutmeg shells compared to SNI 06-3730-1995 activated carbon has good quality. The volatile matter content of the nutmeg shell is still below the maximum standard for volatile matter content set by SNI 06-3730-1995 with standards both in powder and granular form. Ash is an inorganic compound produced from the residue of burning charcoal which consists of calcium, magnesium, sodium and potassium (Pari et al, 2009).

Based on the research results in table 1, the average total ash content of nutmeg shell activated carbon compared to SNI 06-3730-1995 activated carbon has good quality. The total ash content of nutmeg shells is still below the maximum standard of ash content set by SNI 06-3730-1995 with standards both in powder and granular form. Bonded carbon content is the carbon element that remains besides ash and volatile matter in the material (wood, shell and other materials) when carbonation is carried out other than ash and volatile matter [12]. Based on the research results in table 1, the average bonded carbon content of nutmeg shell activated carbon compared to SNI 06-3730-1995 activated carbon has good quality. The bonded carbon content of the nutmeg shell is still above the minimum standard of bonded carbon content set by SNI 06-3730-1995 with standards both in powder and granular form. Determination of iodine absorption aims to determine the adsorption capacity of activated carbon. In addition, to determine the ability of activated carbon to absorb colored solutions with a molecular size of less than 10 Å or 1 nm (Pari et al, 2009). Based on the results of the research in table 1, the average level of iodine absorption from activated carbon of nutmeg shells compared to SNI 06-3730-1995 activated carbon has a quality that is still below the quality standard. The ability to absorb iodine can be explained by the fact that the pores of activated carbon are more suitable for use as an adsorbent than as an absorbent.

The adsorption process only occurs on the pore surface while the absorption process takes place inside the pore or trapping. Based on the technical quality standards of activated carbon stipulated by SNI 06-3730-1995, it can be explained by researchers that the pore capacity of nutmeg shell activated carbon is very good for use as an adsorbent. The important use of activated carbon of nutmeg shell as an adsorbent is expected to be utilized for water purification from bacteria, absorption of inorganic materials dissolved in water and used as cosmetic base ingredients, thus activated carbon of nutmeg shell can increase the use value of nutmeg shell which was previously only used as waste or Simple fuels can be converted into adsorbents that have high use value and are expected to become mass-produced goods to improve the people's economy. Based on the results of the research conducted, it can be concluded that nutmeg shell waste can be used as activated carbon with a function as an adsorbent. The quality of activated carbon in nutmeg shells includes a moisture content of 0.6979%, a volatile matter content of 3.8781%, a total ash content of 8.7323%, a bound carbon content of 87.3896% and an adsorption capacity of iodine of 325.0694 mg/g. The hope of this research is that nutmeg shells have a use value that can be increased as activated carbon because nutmeg shells are usually only used as waste in the community and nutmeg shell activated carbon can be mass produced to increase people's income.

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