POTENTIAL OF ACTIVE CARBON OF BANANA STEM IN DECREASING LEVELS OF AMMONIA (NH3) IN THE BARITO RIVER AREA

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Abstract

Banana plants or the Latin name called *Musa paradisiaca L* is a commodity of high economic value in Indonesia, Banana stems have cellulose compounds that have a large enough potential to be used as activated charcoal, activated charcoal can be made by pyrolysis. This study was conducted to analyze the potential of activated carbon from banana stems in reducing ammonia levels in water, to analyze the amount of reduction in ammonia levels (NH3) in the Barito River by giving activated carbon from banana stems, to analyze the effect of the time of administration of activated carbon from banana stems to decrease ammonia. The manufacture of activated carbon from banana stems was carried out using a kiln, and for measuring the reduction in ammonia levels, it was carried out by Spectrophotometry Uv-Vis spectroquan 300. The results of this study indicate that activated carbon of banana stems can reduce ammonia levels in the Barito river area with the initial value of ammonia levels being 2.482 mg/L and after being given activated carbon of banana stems the decrease in ammonia levels obtained with 30 minutes is 0.860 mg/L or 65, 35%, time 60 minutes 0.146 mg/L or 94.11%, and time 120 minutes -0.020 or 100.80%. This study shows that activated carbon of banana stems can reduce ammonia levels in the Barito River area using UV-Vis Spectrophotometry

Keywords: Banana stem, Activated Carbon, Barito River, Ammonia, UV-Vis Spectrophotometry

Introduction

Residents along the Barito River are very dependent on the river, various kinds of activities are carried out on the river and as a support for the lives of the people on the banks of the Barito River, not only as a place for washing clothes, drinking and bathing, there are also other activities, namely as ferry transportation that connects between villages. , transportation of fishing vessels, especially ships carrying coal that send their mining products. Along with the development of industry around the river, it will greatly affect water quality and can interfere with community activities, especially the disposal of waste that can pollute the Barito River. Pollution occurs because of the above factors, the

rubber processing industry has three types of waste, namely solid waste, smoke waste, liquid waste, solid waste in the form of rubber residue, sediment and plastic,

According to Hikmah's research (2020) that the rubber factory industry and the existence of traditional markets as well as various kinds of activities carried out on the outskirts of the Barito River that have the potential to contain ammonia levels around the river, then the number of test samples that have a range that is too large and after doing research on the analysis of ammonia content at a distance of 2 meters there is a concentration 4,425 mg/L, a distance of 5 meters has a concentration of 3.198 mg/L and a distance of 10 meters has a concentration of 1.135 mg/L. Based on the Regulation of the Minister of Health No.492/Menkes/Per/IV/2010 the maximum value of ammonia in drinking water is 1.5 mg/L and the maximum value of pH in water bodies of water is 6-9(Permenkes, 2010).

According to Belladona's research (2017), Rivers that have been polluted by rubber factory waste can contain levels of ammonia (NH3) and nitrogen (N-Total). Ammonia is a chemical compound that has the molecular formula NH3 which is one of the environmental pollutants by emitting a very pungent odor, usually from microbial activity, rubber processing industry, waste industry and coal processing. This compound is usually a gas with a characteristic pungent odor. Ammonia compounds also play an important role in the presence of nutrients on earth, ammonia is a causative compound and can interfere with health (Yuwono & Biomed, 2010).

Banana plant or Latin name called *Musa paradisiaca L* is a high economic value commodity in Indonesia. Other parts of the banana plant, such as banana stems, are rarely used by the public. A small part of the community only uses banana stems as animal feed, while in large quantities it becomes waste. Therefore, to overcome the increase in waste from banana stems, it is necessary to develop efforts to process banana stem waste so that it has high economic value and produces environmentally friendly products. Banana stems have cellulose compounds that have a large enough potential to be used as activated charcoal, the manufacture of activated charcoal can be done by pyrolysis. Pyrolysis in short can be interpreted as combustion without contact with outside air, Pyrolysis generally begins at a temperature of 100 0C - 120 0C and lasts at a temperature of around 500 0C - 1000 0C. The absorption of activated charcoal can be increased by chemical activation using activating ingredients such as ZnCl2, CaCl2, NaCl, NaOH, and others. The factors that affect the quality of activation are activator concentration, immersion time, and material size. Soaking with activating material is intended to eliminate or limit the formation of lignin, because the presence of lignin can form tar compounds. This activated charcoal can be used as an adsorbent The factors that affect the quality of activation are activator concentration, immersion time, and material size. Soaking

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According to research by Yuliono et al (2017) related to the manufacture of activated charcoal from banana stem waste has been carried out to determine the adsorption capacity of banana stem activated charcoal to chromium VI metal ions with a carbonization temperature of 400 0C for 60 minutes using an alkaline activator in the form of NaOH with an activation time of 2 hours. From this study, the results of the analysis of the water content of 12.27% and ash content of 5.84% with the optimum contact time of adsorption of activated charcoal banana stems on Cr(VI) ions were 0.2139 mg/g obtained at a contact time of 120 minutes.(Yuliono et al, 2014).

According to research by Suziyana et al (2017) The Effect of Banana Stem Adsorbent Mass and Adsorption Contact Time on Fe Removal Efficiency and Adsorption Capacity in Peat Water Treatment The highest removal efficiency in reducing Fe metal content was obtained, namely 80.31% at 2.5 gram adsorbent mass with a contact time of 30 minutes. The adsorption capacity of the metal removal of Fe obtained the highest value of 0.027 mg Fe/gr, namely the adsorbent mass of 1 gram with a contact time of 30 minutes, while the lowest adsorption capacity value was 0.010 mg Fe/gr, namely the adsorbent mass of 2.5 grams with a contact time of 90 minute(Suziyana et al, 2017).

According to research Hidayah et al (2012) Adsorption of Iron Metal (Fe) in Barito River Using Adsorbent from Banana Stem, the best activation process is to produce a large decrease in (Fe) levels by carrying out a physical activation process followed by chemical activation, a greater reduction in Fe content is obtained from the use of KMnO4 activator and on the variation of the surface diameter of the adsorbent, the best reduction in Fe content was obtained at the size of 40 mesh and for variations in the stirring speed, the best reduction in Fe content was obtained at 150 rpm, variations in contact time obtained a decrease in Fe content under range for all variations. (Hidayah et al, 2012).

Based on the description of ammonia contamination in the Barito River and the potential for reducing activated carbon contained in banana stems, it is able to reduce ammonia levels, so the researchers wanted to examine "The Potential of Banana Trunk Activated Carbon in Reducing Ammonia Levels in the Barito River Area Using UV-VIS Spectrophotometry Method".

This study aims to determine the activated carbon of banana stems can reduce levels of ammonia (NH3) in the Barito River area. In addition, this study was also conducted to analyze the potential of activated carbon from banana stems in reducing ammonia levels in water; analyzed the amount of reduction in ammonia (NH3) levels in the Barito River by giving banana stem activated carbon and analyzed the effect of the time of administration of banana stem activated carbon on ammonia reduction. This research is expected to provide information about the potential of activated carbon from banana stems in reducing ammonia levels using UV-Vis spectrophotometry.

Materials and Methods

Sampling location Jl. Barito Hulu, Pelambuan Village, West Banjarmasin District, Banjarmasin City which contains ammonia to be precise in the Barito River which is adjacent to the Rubber Factory Industry and for taking banana plants it is carried out in Lampuyang Village, East Kotawaringin Regency, Central Borneo.The research was conducted from November 2020 to August 2021. The unit of analysis in this study was banana stems and water from the Barito River. The variables used in this study were the decrease in ammonia levels in Barito river water and the time of administration of activated carbon. The analytical method used in this research is univariate analysis and bivariate analysis. Univariate analysis was carried out to describe the state of the variables, while bivariate analysis was carried out to see differences in the decrease in ammonia levels according to time using the *One Way Anova* method.

Results and Discussion

Sampling coincided on Jl. Barito Hulu, Pelambuan Village, West Banjarmasin District, Banjarmasin City which contains ammonia to be precise in the Barito River which is adjacent to the Rubber Factory Industry and there are also many activities carried out by the community as a place for washing clothes, drinking and bathing, there are also other activities, namely as ship transportation. ferries that connect between villages, transportation of fishing boats, moreover ships that transport coal that send their mining products.

Result

1. Chemical Activation

   The results obtained in this study were pH 5.5 and after rinsing with NaOH the pH was 7.3, using 500 ml of 1 M HCl to soak 50 grams of activated carbon.

2. Characteristics of Banana Trunk Activated Carbon

a Water Content Test Analysis

The results of this study have a moisture content of 9.15% by taking 28.4 grams of banana stems which are inserted into the oven for 3 hours at a temperature of 105 - 110 0C.

b Ash Content Test Analysis

The results obtained in the analysis of the ash content test are 5.44% by heating using a furnace at a temperature of 800 0C for 1 hour.

3. Iodine absorption test

The results obtained in the iodine absorption test are 5,076.5 mg/g by weighing 1 gram of activated carbon then soaking with 50 ml of iodine solution and filtering then take 10 ml of filtered and then titrated with sodium thiosulfate until the yellow color and fades to faint and then became clear after adding 1 drop of starch, the normality of 0.1 N potassium chromate and 0.1 N sodium thiosulfate.

4. Methylene blue absorption test

The results of the absorption are indicated by the occurrence of color changes in methylene blue.

(a) (b) (c)

Figure 1. Methylene Blue Absorption Test

5. Quantitative Test

1) Ammonia Calibration Curve

The ammonia curve was determined using standard series, namely 3, 5, 7, and 9, from the ammonia mother liquor then added phenol, sodium nitropuside solution, and oxidizing solution, after which it was measured using a UV-Vis Spectrophotometer with a wavelength of 627 nm. The results obtained can be seen in the following table:

Table 1. Concentration and Absorbance Calibration of Ammonia

No	Concentration	Absorbent
1	3	0.314
2	5	0.497
3	7	0.586
4	9	0.716

(Prime source, 2021)

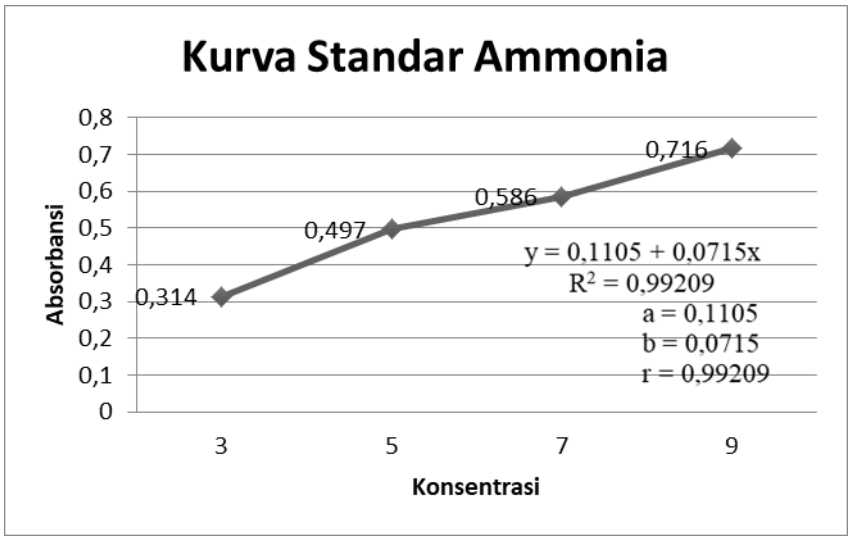

Figure 2. Ammonia Standard Curve

2) Ammonia Concentration (NH3)

Measurement of ammonia levels in river water before and after the addition of chemically activated banana stem activated carbon and calculating the sample concentration with the formula y= a+bx.

30 minutes 60 Minutes 120 Minutes

(a) (b) (c)

Figure 3. Ammonia Concentration Time

Table 2. The effect of decreasing time and concentration calculation

No	Sample	Replication1 absorbance	Replication2 absorbance	Replication3 Absorbance	Average	Concentration (mg/L)
1	0 (not given activated carbon)	0.288	0.289	0.288	0.288	2,482
2	30 minutes	0.171	0.172	0.172	0.172	0.860
3	60 minutes	0.121	0.122	0.122	0.122	0.146
4	120 minutes	0.108	0.109	0.109	0.109	-0.020

(Prime source, 2021)

Table 3. Percent decrease in ammonia levels

No	Giving time	% reduction in ammonia

1	30 minutes	65.35%
2	60 minutes	94.11%
3	120 minutes	100,80 %

Discussion

1. Making Simplicia and Banana Trunk Activated Carbon

   Making banana stem simplicia the results obtained are 128.8 grams with the initial taking of 1000 grams or 1 kg banana stems washed thoroughly and the banana stems used must be good and not rotten so that evenly drying results are obtained. Clean banana stems are cut crosswise and then cut into small pieces, after the cutting process, the banana stems are dried in the sun until they turn brown in color. Banana stems that have been weighed are put in a round stainless container and then put into a kiln for the carbonization process at a temperature of 400 0C for 1 hour. Banana stems that have become charcoal and then mashed using a mortar, banana stems that have become activated carbon get 83.13 grams, After getting the results, then the activated carbon of banana stems was sieved with a 20 mesh sieve. The purpose of the sieve is to reduce the diameter of the size where the smaller the size, the greater the surface area on the activated carbon and the more effective the absorption will be.(Hidayah et al., 2012). Banana stems are an important component of banana trees, banana stems or often called gadebog are actually not stems but pseudo stems consisting of towering layered midribs, strengthening from the bottom up so that they can support banana leaves and fruit (Purwandi et al, 2018). Banana stems have cellular tissue with interconnected pores so that when the drying process is carried out they will become solid, banana stems are plants with a long shelf life and are found in many places as waste, banana stems contain 83.3% cellulose and 2 lignin. ,97%(Bahri, 2017). The kiln uses a combustion system that is not related to outside air or is called pyrolysis, pyrolysis is generally 200 0C and survives at a temperature of 450 0C-500 0C(Danarto et al, 2010). The pyrolysis process aims to break down the chemical compounds contained in banana stems using heat energy which encourages oxidation so that complex carbon molecules break down and then become in the form of charcoal or carbon. The carbonization process is by converting raw materials into carbon materials which are usually black in a closed space and limited air (Marsono, 2008).

2. Chemical Activation

Chemical activation in this study used 500 ml of 1 M HCl to soak 50 grams of activated carbon then stirred with a magnetic stirrer for 10 minutes and then allowed to stand for 24 hours, after that rinsed with distilled water to a neutral pH, the pH I got in this study is pH 5.5 and to get a neutral pH the activated carbon was rinsed again with NaOH and the pH obtained was 7.3. Chemical activation is a treatment of charcoal that aims to enlarge the pores, namely by breaking hydrocarbon bonds or oxidizing surface molecules so that the charcoal undergoes changes in properties, both physical and chemical, namely the surface area increases and affects the adsorption power (Sembiring, 2003). . Adsorption is the process of agglomeration of certain substances (soluble) in solution. by the surface of the substance or absorbent object, where there will be a physical chemical bond between the substance and its absorption, adsorption uses the terms adsorbent and adsorbate, where adsorbent is an absorption in the form of carbon compounds, while adsorbate is an adsorbed medium (Soedarsono and Syahputra , 2005). Chemical activation aims to open the charcoal pores which are closed when carbonization of residual substances is carried out during combustion so that chemical activation aims to increase the absorption of activated carbon (Atmoko, 2012). This study used 1M HCl activator as an organic mineral solvent so that the surface of the stems of canang is wider, The concentration of the activator where the greater the concentration, the stronger the solution to bind the tar compound from the remaining carbonization in the carbon pores which results in greater absorption, but if the concentration is too high it will cause structural damage to the activated charcoal (Atmoko, 2012). This chemical activation uses 1 M HCl activator because the absorption of activated carbon is the highest compared to other activators(Arung et al, 2014).

3. Water Content Test Analysis

Test the moisture content by drying in the oven for 3 hours at a temperature of 105-110 0C until a constant weight is obtained. The results of this study I obtained the results of 13.75% which meets the standard, according to the Indonesian National Standard a good water content is 15% (SNI 06-3739-95)(Alimah D, 2017), if the water content is more than 15%, the surface activated carbon will be smaller so that the pores of the activated carbon are few and cannot absorb so that it affects the hygroscopicity of the activated

charcoal, the hygroscopic nature causes under certain conditions and humidity to reach a balance of water content, because water content is a hygroscopic measure (Hendraway, 2003). Analysis of water content is testing the water content on activated carbon of banana stems, the water content test can determine the quality of activated charcoal which aims to determine the amount of water content contained in activated carbon (Novita, 2012). The water content test also aims to determine the hygroscopic nature of activated carbon that can be used as an adsorbent(Sahara et al., 2017).

4. Ash Content Test Analysis

   The ash content test in this study obtained an ash content of 5.44% by using combustion at a temperature of 800 0C for 1 hour because for the formation of ash it must be at a high temperature so that the results obtained are good. (Sunartaty & Yulia, 2017). According to the Indonesian National Standard, the ash content should not be more than 10% (SNI 06-3730-95)(Alimah D, 2017), if the ash content is more than 10% it will reduce the absorption of activated charcoal both in solution and gas, because the mineral content in the ash such as potassium, calcium, sodium, and magnesium will spread in the activated charcoal grid so that the performance of activated charcoal decreases. (Lempang et al, 2012). Ash content is the amount of metal oxide content consisting of minerals in a material that cannot evaporate in the ashing process, ash content is also very influential on the quality of activated carbon because excessive ash content will cause blockage of activated carbon pores, so absorption activated carbon is reduced(Sahara et al, 2017).

5. Iodine Absorption Test

   Iodine absorption test results obtained are 5,076.5 mg/g with normality of 0.1 N potassium chromate and 0.1 N sodium thiosulfate, the results obtained are not in accordance with the Indonesian National Standard, which is 750 mg/g (SNI 06 -3730-95) (Alimah D, 2017), due to factors that affect the lack of immersion time so that the iodine is not perfect and the presence of impurities present during filtering. Activated carbon from banana stems is soaked in iodine solution for 1 hour then iodometrically titrated and filtered then titrated with sodium thiosulfate to obtain a slightly faint yellow solution and starch is added as an indicator where the solution will turn blue after the titration again

becomes clear (Laos et al. 2016). Iodine absorption test aims to determine how much activated carbon absorbs solutes, where the greater the iodine absorption rate, the greater the ability of activated carbon to absorb dissolved substances.(Sahara et al, 2017).

6. Methylene Blue Absorption Test

   The methylene blue absorption test was carried out by immersing 1 gram of activated carbon with 100 ml of methylene blue solution for 1 hour and after being filtered the results obtained showed a clear color, the methylene blue absorption test aimed to determine the adsorption ability of activated carbon produced against colored solutions, at This test can also be used to determine the surface of the adsorbent (Suhendarwati et al., 2014).

7. Quantitative Test

   The first quantitative test was carried out by testing the level of ammonia (NH3) which determined the wavelength of ammonia which was carried out at the Pharmaceutical Chemistry Laboratory, Sari Mulia University, Banjarmasin, which was carried out by laboratory laboratory workers using the UV-Vis spectroquan 300 Spectrophotometry instrument and the maximum wavelength was 627 nm, From the standard ammonia hydroxide 30 ppm, pipetted to make concentrations of 3, 5, 7 and 9, screening aims to determine the wavelength of ammonia using 30 ppm ammonia hydroxide as raw material made by researchers and screening wavelengths from 400 - 640 nm(Azizah & Humairoh, 2015). Ammonia was tested using the phenate method because of the determination of the level of ammonia that reacts with hypochloride (NaOCI) the function of hypochloric compounds is commonly used as a bleaching liquid (a liquid that can be clear) then forms a compound or as an oxidizing agent that removes electrons (NH2CL) its function as a dilute solution in water which is often used as a disinfectant and also reacts with phenol (C6H5OH) which has acidic properties, can release H+ ions from its hydroxyl group and is catalyzed by sodium nitropuside (C5FeN6Na2O) which functions as a reagent which will produce a blue color of blue indopenol. identified by UV-Vis spectrophotometry(Murti & Purwanti, 2014).

The results of the concentrations that have been made from 3, 5, 7 and 9, namely the greater the concentration, the higher the absorbance results can be seen in table 4.3 of these values then entered in the excel system which aims to determine the linearity of the a value curve of (0, 1105) values of b (0.0715) and r (0.99209). The value of the straight line equation between the absorbance lines has a correlation coefficient (r) of 0.99209, where a good r value is a value close to 1. The results of the calculation of the test sample using the formula y=a+bx before being given activated carbon are 2,, 482 mg/L and after being given activated carbon at 30 minutes 0.860 mg/L or 65.35%, at 60 minutes 0.146 mg/L or 94.11%, and 120 minutes -0.020 mg/L or 100.80%.

Contact time is a determining factor in the adsorption process, the molecular adsorption force of a solute will increase if the contact time with activated carbon is longer, a long contact time allows the diffusion process and attachment of the adsorbed solute molecules to take place better, the solid surface in contact with a solution tends to accumulate a layer of solute molecules on its surface so as to produce monomolecular chemical adsorption, the determination of the contact time that produces the maximum adsorption capacity occurs at equilibrium. Equilibrium time is influenced by biomass type (number and type of binding space), size and physiology of SS biomass (active or not)(Syauqiah et al., 2011). In this study, the maximum contact time for absorption of ammonia levels was at 60 to 120 minutes because at 120 to 180 minutes the absorption of ammonia began to decrease.

The use of banana stems is also used in various ways, in this study showed that the use of banana stems as activated carbon media can be used as a Zn metal absorber, at the optimum conditions the absorption capacity of kapok banana stems (Musa acuminate balbisiana Colla) against metal ions Zn (II) is obtained.) of 1.58 mg/g. Based on these results, it can be concluded that the stems of banana kepok (Musa acuminate balbisiana Colla) can be used as a metal ion absorber.(Elfia M and Sapryanti H, 2019).

Utilization of banana stem waste as a bioadsorbent in crude oil (CPO) processing to reduce Free Fatty Acid (FFA) with a variable mass of bioadsorbent where banana stems can be used as an absorption medium with the percentage of FFA levels absorbed is 9.142% and R2 =

0.9784. The process of decreasing the concentration or levels of FFA was made using the Freundlich equation with R2±0.9(Hermanti M et al, 2019).

Based on the results of the study, it was found that the activated carbon of banana stems was able to absorb ammonia levels with the results obtained that the decrease was at 30 minutes 0.860 or 65.35%, 60 minutes 0.146 or 94.11% and 120 minutes -0.020 or 100.80 % while at 180 minutes the absorption decreased so that the optimal time for absorption of activated carbon from banana stems occurred at 120 minutes, activated carbon from banana stems was also absorbed not only in ammonia but also in iron, Fe, Cr, Cu and Zn ions. This research was conducted only on reducing ammonia levels using activated carbon from banana stems with a significant value of 0.009, if Ha <0.05 then there is a significant effect between the time interval for reducing ammonia levels or the hypothesis is accepted, with a significant value of 0,

Conclusion

Based on the results of research on the potential of activated carbon from banana stems in reducing ammonia (NH3) levels in the Barito River area in a quantitative test using UV-Vis spectrophotometry, the results obtained are activated carbon from banana stems can reduce ammonia levels in Barito River water where before added activated carbon levels Ammonia in the river is 2.482 mg/L, after being given activated carbon, the reduction in ammonia levels is obtained in 30 minutes 0.860 mg/L or 65.35%, in 60 minutes 0.146 mg/L or 94.11%, and 120 minutes -0.020 or 100.80%.

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Declaration of Interest Statement

The authors declare that they have no conflict of interests.

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