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Utilization of Coconut Husk Waste (*Cocos Nucifera Linn*) as an Environmentally Friendly Disinfectant Material for The Prevention of COVID-19

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Abstract
Introduction: *In the midst of the outbreak of the spread of COVID-19 which is currently increasing, people are actively taking precautions, one of which is by sterilizing using disinfectants. But a problem arises among the people that mass spraying of disinfectants gives rise to environmental pollution. This is because the ingredients for making disinfectants come from chemicals that tend to be non-biodegradable by soil, plants, and microorganisms.* ***Objective:*** *The purpose of this study is to help the community to solve this problem by making environmentally friendly disinfectants from coconut husk waste materials.* ***Method****: In this study, the method used is a quantitative approach because this research is presented using aspects of measurement, concentration calculation, and certainty of numerical data* ***Results and Discussion:*** *A sap liquid is proven to have many benefits, namely as a biopesticide, insecticide, disinfectant, and preservative. The liquid smoke production process is also classified as environmentally friendly because all residues can be reused or zero waste. Based on the data obtained, the percentage of liquid smoke of 1.6% has a better ability to inhibit the growth of microorganisms than the percentage of liquid smoke of 0.4% and 0.8%.* ***Conclusion:*** *With this disinfectant, it is hoped that it can reduce the risk of environmental pollution, can effectively sterilize in the community environment for the prevention of COVID-19, and can reduce coconut husk waste*

Keywords: *Liquid Smoke; Disinfectant; Distillation; Pyrolysis; Coconut Husk;*

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Introduction

The spread of COVID-19, which is increasingly widespread, has led to the addition of a large number of positive cases of COVID-19. According to data from the kemkes.go.id page, the number of positive cases of COVID-19 in Indonesia on January 13, 2021 was 858,043 cases. (Muhidin, 2010) With the large number of positive cases of COVID-19, people in Indonesia are increasingly uneasy in facing this problem. Health workers, the government, and the COVID-19 task force have worked very hard to overcome the problem of the spread of COVID-19, but this is not enough to overcome this problem, so an active role of the community is needed to jointly prevent the transmission of COVID-19.

People are asked to continue to comply with health protocols, namely 3M: wearing masks properly, washing hands with soap regularly, and keeping a distance from others. In addition, people are also asked to sterilize using disinfectants in their respective environments to make the environment area free of harmful viruses and bacteria, and can prevent the transmission of COVID-19. Disinfectants are able to kill harmful pathogens because disinfectant ingredients which generally consist of sodium hypochlorite, chlorhexidine, and hydrogen peroxide are proven to have disinfection effectiveness in pathogenic microorganisms. (Indonesiabaik.id, 2020)

However, a problem arises among the public that sterilization using disinfectants causes the occurrence of environmental pollution problems. This is because the ingredients for making disinfectants come from chemicals that tend to be non-biodegradable by soil, plants, and microorganisms. One of the materials that make disinfectants is hydrogen peroxide which can cause water pollution. Therefore, the author wants to help the community in solving this problem by making environmentally friendly disinfectants from coconut husk waste materials.

Coconut husk was chosen because it is easy to get, environmentally friendly, and its substance content has the potential to be a disinfectant. In addition, coconut husk ethanol extract (*Cocos nucifera Linn*) is reported to inhibit the growth of *bacteria Escherichia coli* and *Shigella dysenteriae*. The minimum inhibitory level (KHM) against the two bacteria is 10 mcg/ml. In addition, coconut husk methanol extract can inhibit the bacteria *Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa, Salmonella thypi, Staphylococcus pidermidis,* and *Streptococcus mutans.* (Ismail et al., 2017)

Coconut husk can also be processed so that liquid smoke is formed. Liquid smoke is the result of the condensation or condensation process of steam from combustion. Liquid smoke is often used as a natural preservative because it contains phenol, carbonyl, and acid compounds that act as antimicrobials and antioxidants. According to research conducted in the health sector, liquid smoke can inhibit the growth of bacteria Streptococcus *sanguis, Streptococcus mutans, Enterococcus faecalis,* and *Porphyromonas gingivalis* as the cause of problems in dental and oral health. Then according to research conducted in the fish preservation food industry, liquid smoke can inhibit the growth of bacteria that can reduce the shelf life of food ingredients including

Pseudomonas aeruginosa, Bacillus subtilis, Eschericia coli, and *Staphylococcus aureus,* thereby improving the quality of fish smoking products. (Tools & Teeth, 2019)

The research above is used as a theoretical basis by the author to make disinfectants from coconut husk waste. With this disinfectant, it is hoped that it can reduce the risk of environmental pollution, can effectively sterilize in the community environment for the prevention of COVID-19, and can reduce coconut husk waste.

Method

The author uses strategies or methods so that this writing can be completed on time. The approach in this writing is a quantitative approach because this research is presented using aspects of measurement, concentration calculations, and certainty of numerical data. The reason for using quantitative research methods is because this writing has the aim of obtaining an overview of the condition of the problem in a real, actual, and how to apply the solution. The following is the flow of research used:

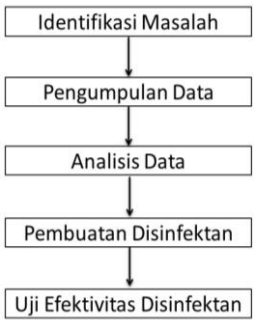

Figure 1. Flow of research

Problem Identification

The stage of problem identification is the initial stage in the preparation of this paper. The author found a problem in society that the use of disinfectants can pollute the environment. Therefore, the author provides a solution to the community about this problem by making environmentally friendly disinfectants using coconut husk waste. Through the stages of problem identification, it is hoped that it will be able to become the first foothold for the continuation of the process in completing this paper.

Data Collection

The stages of data collection aim to find data and information that have relevance to the problem that has been described in the problem identification stage. In this writing, the data collection method used is a literature study. Literature study is a stage carried out to find information about making environmentally friendly disinfectants using coconut husk waste from books, journals, articles, and official government websites. The data used on this write is secondary data. Secondary data are data obtained from various

reading sources. The author uses secondary data to strengthen and complete information as a solution to the problems raised.

Data Analysis

The data and theories that have been obtained are then connected with the problems that have been raised, so that the necessary explanations are obtained to describe the causes of the emergence of environmental pollution problems caused by disinfectants, along with the steps that have been taken to overcome these problems and the success of the solutions proposed by the author. This stage aims to achieve the purpose of writing, which is expected that the use of coconut husk waste as a material for making environmentally friendly disinfectants can reduce the risk of environmental pollution, can effectively sterilize in the community environment for the prevention of COVID-19, and can reduce coconut husk waste. The presentation of the final results and the test of the effectiveness of the use of coconut husk as a material for making environmentally friendly disinfectants is presented in the form of pictures, tables and graphs.

Disinfectant Manufacturing

The method of making disinfectants is obtained based on data analysis carried out on data and theories that have been obtained through literature studies. This method of manufacturing disinfectants is carried out by pyrolysis and distillation methods. Pyrolysis is a heating process without the presence of oxygen that degrades a biomass into charcoal, tar, and gas. With this pyrolysis technique, coconut husk waste can be processed to produce products in the form of charcoal and smoke. The smoke released is condensed using a condenser into condensate called liquid smoke, so that the process does not produce environmental pollution. (Fauziati & Haspiadi, 2016)

While distillation is a process to separate components from a mixture using the basis that some components can evaporate faster than other components. The resulting steam contains more volatile components, so the process of separating the components from the mixture can occur. Distillation of liquid smoke can be carried out at a temperature of 100 - 150°C. The distillation process of liquid smoke can remove unwanted compounds, namely tar compounds and aromatic polycyclic hydrocarbons. (Fauzan & Ikhwanus, 2017)

The manufacturing process of this disinfectant is carried out in the following way: coconut husk waste is put into the furnace drum with a temperature of 300 - 500 °C, then the pyrolysis process takes place on the pyrolysis reactor tool, about 25 minutes a clear colored liquid will come out which gradually becomes black. The black liquid is a liquid smoke with *grade* 3 quality. The burning of 1 drum of coconut husk can produce up to 20 liters of liquid smoke. (Reta & Anggraini, 2016)

Furthermore, deposition is carried out for a minimum of 24 hours to become *grade* 2 liquid smoke. Then the distillation process is carried out to become *grade* 1 liquid smoke. Grade 1 liquid smoke has the highest quality compared to other liquid smoke

fractions because it has the highest content of phenols and organic acids. (Erliza et al., n.d.)

Disinfectant Effectiveness Test

Effectiveness tests are carried out to test various concentrations obtained from the process of making environmentally friendly disinfectants from coconut husk waste. In this experiment, a test of the effectiveness of disinfectants was carried out with the diffusion method in order to plate with the *disc diffusion* technique (discs infusion). The working technique of this method is quite simple, that is, a disk containing antimicrobial agents (disinfectants) is placed on the agar media that has been planted with bacteria. Antimicrobial agents (disinfectants) will diffuse on the agar medium. Then there will appear aclear rea on the surface of the agar media indicating the presence of inhibition of bacterial growth by anti-microbial agents (disinfectants) on the surface of the agar. media (Harumy et al., 2016)

Results and Discussion

In the pyrolysis process the tool used for pyrolysis reaction is the pyrolysis reactor. Pyrolysis reactor is a biomass chemical decomposition process tool that is carried out by heating process without being directly related to the outside air. The heating temperature used is 300 - 500°C (Reta & Anggraini, 2016)

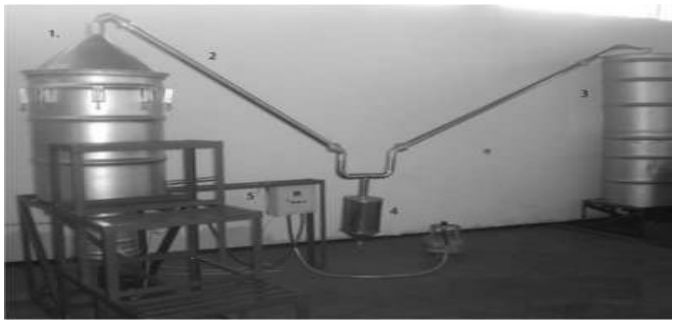

Figure 2. Pyrolysis process

Figure 3. Liquid smoke *grade* 3

The pyrolysis process involves various reactions, namely decomposition, oxidation, polymerization and condensation. It is in the condensation process that liquid smoke is formed through the chimney of the pyrolysis reactor. The process of condensing smoke into liquid smoke is very beneficial for the protection of air pollution caused by the pyrolysis process. This pyrolysis process also produces different pH values at a heating temperature of 300 - 500°C. The pH value is one of the quality parameters of liquid smoke. Measurement of the pH value in liquid smoke aims to determine the level of the decomposition process of raw materials to produce organic acids by pyrolysis. The following are the results of the study on the pH value of coconut husk liquid smoke (Sari, 2018)

Table 1
pH value of coconut husk liquid smoke

Sample Type	Pyrolysis Temperature	pH Value
Coconut Husk	300^{O}C	1,64
	350^{O}C	2,13
	400^{O}C	1,23
	450^{O}C	1,48
	500^{O} C	1,27

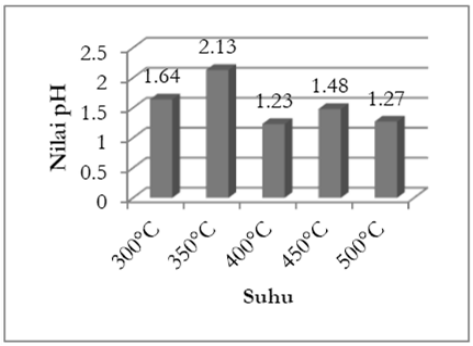

Figure 4. Graph of pH values of coconut husk liquid smoke

The largest pH value of liquid smoke was obtained at a pyrolysis temperature of 350°C of 2.13 and the lowest pH value was obtained at 400°C of 1.23. This shows that at a temperature of 400°C the resulting liquid smoke is highly acidic. This acidic property comes from the acidic compounds contained in liquid smoke, especially acetic acid and also the content of other acids. The lower the acidic properties contained in liquid smoke, the more it will improve the quality of the liquid smoke. The results of this study prove that coconut husk liquid smoke has good antimicrobial properties at a temperature of 400 ° C with a pH of 1.23. This is due to the low pH value which indicates that liquid smoke

is more acidic. Low pH values cause microbes to tend to be unable to live and multiply properly. (Sari, 2018)

The results obtained from this pyrolysis process are *grade* 3 liquid smoke. Grade 3 liquid smoke is a pyrolysis liquid smoke that has not undergone a purification process. Grade 3 liquid smoke has a blackish color because it contains tar. Tar is the result of thermal decomposition in the pyrolysis process. Tar is a viscous liquid because there are many solids, it is blackish brown, smells very hard, and has a high boiling point. This compound is carcinogenic, other contents possessed by *this grade* 3 liquid smoke are phenols and acids in small amounts, namely phenol levels of 0.59 - 0.64% and acid content of 8.08 - 18.92%

Grade 3 liquid smoke does not meet the standards if used as a disinfectant because there is still a tar content, and the phenol and acid levels are small. Phenols and acids serve as antimicrobial substances in liquid smoke. Grade 3 liquid smoke is commonly used in rubber processing as a deodorizer.

Next, *grade* 3 liquid smoke will be allowed to stand for 24 hours. This liquid smoke is allowed to precipitate some of the tar content contained in the liquid smoke solution. The result of this deposition is the formation of *grade* 2 liquid smoke. Grade 2 liquid smoke has a blackish-brown color. This *grade* 2 liquid smoke still contains tar, but in relatively small quantities. Grade 2 liquid smoke has a phenol content of 0.64% and an acid content of 43.96 - 44.24% (Noor et al., 2014)

This *grade* 2 liquid smoke also does not meet the standards to be used as a disinfectant because there is still tar content even in small amounts, and the phenol and acid levels are considered ineffective in inhibiting the growth of microorganisms. Grade 2 liquid smoke can be applied to the wood industry, namely as a wood preservative to be resistant to termites.

Figure 5. Liquid smoke *grade* 2

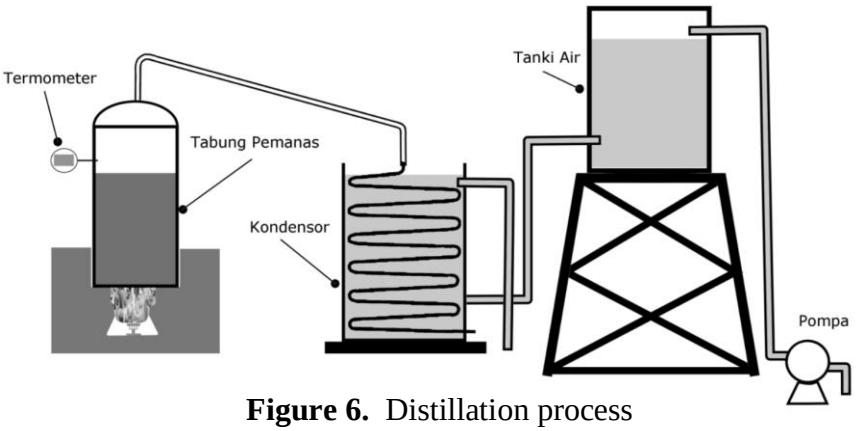

Figure 6. Distillation process

Figure 7. Liquid smoke *grade* 1

The next process is the distillation of grade 2 liquid smoke to remove tar, so that grade 1 liquid smoke is formed. The scheme of the tool and the distillation process are presented in figure 6. The heating tube has dimensions of 60 cm high and 40 cm diameter of *stainlesssteel* material. Distillation is carried out in stages by introducing 5 liters of *grade* 2 liquid smoke into the distillation reactor and heated so that it is always in the boiling stage. To obtain the distillation of liquid smoke with a characteristic yellow and clear color with a smoke aroma that is not strong, the liquid smoke is heated at a temperature of 101 - 125 °C in the heating tube. Heating is carried out on top of the furnace by means of LPG gas fuel. The steam formed from the heating tube then passes through the pipe that flows it to the condenser. Condenser as a coolant that will convert steam into a liquid phase. The result of distillation is a clear yellow liquid which is a *grade* 1 liquid smoke. The liquid is accommodated in a container of plastic. There are 3 concentrations of *grade* 1 liquid smoke produced in this process, namely concentrations of 0.4%, 0.8%, and 1.6% (Fauzan & Ikhwanus, 2017)

Grade 1 liquid smoke has the highest quality compared to other liquid smoke fractions because it has the highest phenol and acid content. This *grade* 1 liquid smoke

meets the standards if used as a disinfectant because it has a phenol content of 0.64 - 0.78% and an acid content of 58.63 - 59.93%. Phenols and organic acids function as antimicrobial substances in liquid smoke and their role will increase if the two compounds exist together (Noor et al., 2014)

The quality of liquid smoke produced in this study was determined by phenol levels and acid levels in liquid smoke because these two compounds have the greatest role as antimicrobial substances. Liquid smoke that has the highest quality (*grade* 1) has the lowest quantity because the water content in the liquid smoke is very low, thus increasing the concentration of active substances in it such as phenol and acetic acid. In contrast, liquid smoke with the lowest quality (*grade* 3) has the highest quantity because the water content in it is very high, thus reducing the concentration of the active substance in it.

To test the effectiveness of *grade* 1 liquid smoke as a disinfectant, an effectiveness test was carried out using the diffusion method agar *plate* with the disc *diffusion* technique (disc infusion) whose results were as follows:

Table 2.
Grade 1 liquid smoke inhibition activity in test bacteria (Ahmad, 2012)

Concentration (%)	Average diameter of test bacterial resistance (mm)					
	Bacteria Test					
	St	Sa	Ec	Pa	Vb	Sd
0,4	0	0	0	0	8,01	9,66
0,8	11,46	9,26	8,85	9,45	10,06	9,6
1,6	11,47	9,42	9,42	11,56	11,76	10,03

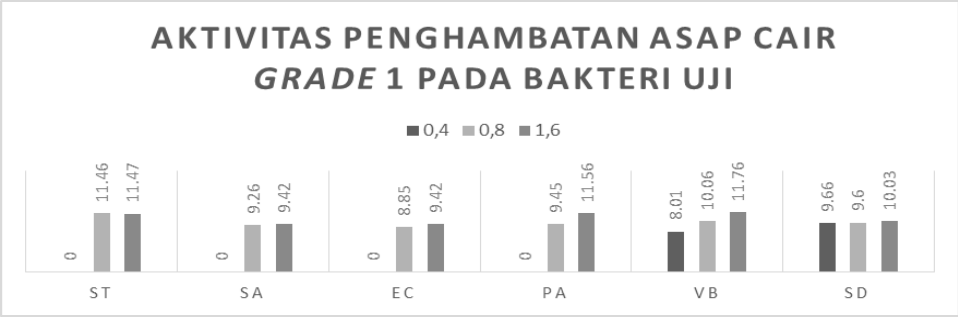

Figure 8. Graph of *grade* 1 liquid smoke inhibition activity in test bacteria

Information:
St: *Salmonella typhi* Sa: *Staphylococcus aureus*
Ec: *Escheria coli* Pa: *Pseudomonas aeruginosa*
Vb: *Vibrio sp* Sd: *Shigella dysentriae*

From the tables and graphs, it can be seen that *grade* 1 liquid smoke with a concentration of 1.6% has the best average inhibitory diameter against test bacteria compared to concentrations of 0.4% and 0.8%. This is due to the fact that the content of acids and phenols at a concentration of 1.6% is greater than that of 0.4% and 0.8%. The higher the phenol content and acid content of liquid smoke, the higher the ability to inhibit bacterial growth.

From these tables and graphs, it can also be seen that the greater the diameter of the inhibitory formed, the more effective the ability of *grade* 1 liquid smoke to inhibit bacterial growth. Although in this experiment bacteria were used as effectiveness test agents, based on research conducted by the *World Health* Organization (WHO) that some disinfectant products based on ethanol or phenol have a high enough percentage of effectiveness to inhibit the growth of viruses such as SARS-CoV2 (Organization, 2020) Thus, it can be concluded that liquid smoke *grade* 1 can inhibit the growth of microorganisms, namely bacteria or viruses.

Conclusion

The use of coconut husk waste as a material for making environmentally friendly disinfectants can reduce the risk of environmental pollution because there are no chemicals that can pollute the environment. With the use of this environmentally friendly disinfectant, it will preserve the environment.

Disinfectants made from coconut husk waste that have undergone a pyrolysis and distillation process are classified as effective in sterilizing in the community environment for the prevention of COVID-19. This is in accordance with the results of the disinfectant effectiveness test, namely at a concentration of 1.6% has the best average inhibitory diameter against test bacteria, so it is concluded that with a disinfectant concentration of 1.6% it is effective in inhibiting the growth of microorganisms, namely bacteria or viruses.

The use of coconut husk waste as a material for making environmentally friendly disinfectants can help reduce coconut husk waste. Moreover, the production process is also classified as environmentally friendly because all residues can be reused or *zero waste* and can help maintain environmental sustainability.

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