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Liquid Smoke Purification Process forBenzo (A) Pyrene Levels Lowering on Food Safety

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ABSTRACT

Outbreak of food products preserved with formalin makes people anxious to food products. A series of studies with the aim of getting quality content of the liquid smoke as an alternative to a food preservative at different operating conditions to get the grade 3 and perform purification of liquid smoke to get a grade 2, and grade 1 of the coconut shell raw material, will be held for 2 years. Liquid smoke produced can be applied to various kinds of materials in various ways such as spraying, dipping, or mixed directly into food that is safe to use for public health are targeted replacement of safe food preservative used.The purpose of this study was to determine the content of benzo (a) pyrene by using liquid smoke purification process so it would be safe to use as a replacement for the natural preservative as well as the reduction of aromatic hydrocarbons polisiklisbyredistillationof liquid smoke coconut shell on temperature and time. In this study using pyrolysis equipment for the manufacture of liquid smoke and distillation continued with active zeolite columns and columns containing activated carbon to obtain a liquid smoke product grade 2 and grade 1 through a purification process to obtain the characterization of liquid smoke such as yield, pH, and levels of total phenol then analyzed using GC/MS and LC/MS

KEYWORDS; coconut shell, pyrolysis, refining, liquid smoke

INTRODUCTION

The discovery of carcinogenic properties polisiklis aromatic hydrocarbons (HPA) in wood smoke have increased the number of studies in the analysis of smoke and smoked foods (Hamm, 1976) . One of a lot of HPAconcern is that benzo(a)pyrene. This compound is used as an indicator of HPA contamination in food because its spread is very broad in nature and are highly carcinogenic (Rhee and Bratzler,1968).Polisiklis aromatic hydrocarbons formationin the smoke and the food is influenced by various factors such as the composition of the wood , pyrolysis temperature (Tilgner , 1976) and fat content material (Doremire et al., 1979)

Outbreak of food products preserved with formalin worry consumers of the food product . The use of formalin is very dangerous so fatal to the body .Use of formalin much done because they are cheap and easy to use. In addition, knowledge about the dangers of the use of formalin as a preservative of food is very less so that more and more manufacturers or distributors of food ingredients using formalin to preserve food products for sale. In fact , the Food and Drug Administration banned the use of formalin to preserve food.

These conditions require a solution to solve it . One solution is to use liquid smoke (liquid smoke) in a way that also produces pyrolysis products such as charcoal than liquid smoke . Liquid smoke is a chemical distillation fumes from burning. Liquid smoke which contains a number of chemical compounds predicted as a potential feedstock preservatives, antioxidants, disinfectants, or as biopesticides(Nurhayati , 2000) . Indonesia is one of the main centers of commodities coconut (Cocosnucifera) . Increased oil production also raises several problems , among others, a lot of waste coconut shells or wasted in vain continue to accumulate so as to interfere with human health . The content of the compounds making up the liquid smoke will determine the organoleptic properties of liquid smoke and determine the quality of the product curing, so that the use of liquid smoke from coconut shell raw material that is not utilized. Composition and organoleptic properties of liquid smoke is highly dependent on the properties of wood, pyrolysis temperature , amount of oxygen, wood moisture, wood particle size and liquid smoke tool -making (Girard , 1992). The purpose of this study was to determinethe content of benzo(a)pyrene by using liquid smoke purification process so that it can be used as a substitute for the natural preservative with a reduction in aromatic hydrocarbons polisiklisredestilasi by coconut shell liquid smoke on temperature and time .

Liquid smoke having various functional properties . Primarily function is to give the stolen desired flavor and color of the product asapan played by phenol and carbonyl compounds . The next function is the preservation because the content of phenolic compounds and acids that act as antibacterial and antioxidant

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(Pszczola, 1995). Liquid smoke also contains harmful substances are tar and compound benzo (a) pyrene and toxins that are carcinogenic and cause damage to essential amino acids of protein and vitamins .

Redistilled is a way of purifying the liquid smoke is a separation process back a solution based on differences in their boiling points. Redistilled liquid smoke is done to eliminate the compounds of unwanted and dangerous, such as polycyclic aromatic hydrocarbons (PAH) and tar, boiling temperature settings in a way so that the smoke can be expected on a clear liquid, free of tar and benzo (a) pyrene.

RESEARCH METHODS

Materials and tools

The main materials used inThis research is coconut shell liquid smoke made at a temperature of 400^{o}C for 5 hours. Liquid smoke obtained is stored for one week to give the chances of tar and other insoluble compounds precipitate . Then passed through a column of activated zeolite and passed through the column followed by activated carbon.

The tools used in this study is pirolisator, distillation apparatus equipped with temperature control devices, and analytical tools used isGas Chromatography and Mass spectrometer Spectrometri (GC-MS) brands Hewlett Packard 6890 MSD 5973 GC equipped with a data base system and LC-MS Chemstation (Liquid Chromatography and Mass Spectrometri) .

Researchimplementation

At first 3 kg of coconut shell that has been cleared of its cover has been reduced in size and inserted into the pyrolysis reactor, heated to the temperature of 400^{0}C for 5 hours , to obtain 3 fractions: 1. Solid fraction in the form of charcoal with high quality, 2. Weight fraction in the form of tar, 3. Light fraction in the form of smoke and methane gas. Of light fractions we flush into the condensation pipe to obtain a liquid smoke while methane gas remains uncondensed (can be used as fuel). Liquid smoke obtained can not be used for food preservatives because they contain hazardous materials, so it needs to be purified liquid smoke aims to minimize the amount of tar in the liquid smoke.

Liquid smoke obtained from the condensation of smoke in the process of pyrolysis deposited over a week and then we take over the liquid and put in a distillation device at a temperature of about 150^{0}C , the results of our distillate tamping . Results of the distillate passed with active zeolite filtration aims to get liquid smoke completely free from harmful substances such as benzopyrene. You do this by passing the distillate liquid smoke into the active zeolite column thus liquid smoke filtrate obtained is completely safe from harmful substances such as benzopyrene. Subsequent filtration process is passed through a column of activated carbon to obtain filtrate liquid smoke with the smell of smoke is mild and does not sting, how filtrate of active zeolite filtration flowed into the column containing activated carbon so that we obtain a filtrate liquid smoke with the smell of smoke is mild and not hard smelled, then completed the liquid smoke as a food preservative which is safe, effective and natural.

Liquid smoke obtained were characterized by standard methods include the total phenols, and acid content of benzo(a)pyrene. Analysis is used to maintain the quality of the liquid smoke in the test by using GC/ S and LC/MS.

RESULTS AND DISCUSSION

Utilization of zeolite to absorb benzo(a) pyrene

Zeolites were Dehydrated when heated. Although the structure of the zeolite framework will shrink, the basic framework is not a real change, because H_2O molecules can be reversibly removed. Properties of dehydrated zeolites as adsorbents and molecular sieves, due to the hollow structure , so it is able to absorb a large number of molecules are sized accordingly. Selectivity and effectiveness of adsorption is also high . The use of zeolites as active as absorbent very effective in lowering the content of benzo(a)pyrene is present in the liquid smoke grade 1 .

Table 1 . The content of benzo(a) pyrene in Coconut Shell Liquid Smoke Pyrolysis temperature of 400^{0}C after skipped Zeolite Active Column

Sample Type	Liquid Smoke Grade	Benzo(a)pyrene (ppb)
Coconut shell	1	Not detected
	3	8,451

Table 1 shows that the use of active zeolite as an absorber on the results of the study indicate the content of benzo(a) pyrene after passing through the active zeolite filtration process is not detected . It appears the decline that occurred in the content of benzo(a) pyrene grade 3 to grade 1, from 8.451 ppb to undetectable the content of benzo (a) pyrene in grade liquid smoke 1. The decrease is due to the activation process will lead to an increase in the release of aluminum from the zeolite framework to increase the ratio of Si / Al (Trisunaryanti, 1991). Si/Al ratio that became larger will increase the adsorption of organic molecules which are

less polar and interact weakly with water and other molecules are polar (Barrer, 1978). Activation process also improves the crystallinity and surface area of zeolite, thus adsorption capacity will be higher.

Zeolites are adsorbents because it has a hollow structure, so that the compound tar and benzo(a)pyrene is present in the liquid smoke when bypassed active zeolite filter will be stuck in the cavity of the zeolite , here zeolite to absorb a large number of molecules that are smaller or in accordance with the size of the cavity . While the liquid smoke that much smaller molecules can pass through the cavity of zeolite -free filtrate out as tar compounds and benzo(a)pyrene , and zeolites can also release water molecules from the cavity surface, causing an electric field extends into the main cavity that causes mutual binding interactions between zeolite with tar and benzo(a) pyrene .

Table 2 . Active components of Liquid Smoke

Sample Type	Grade	Ingredients	
		Phenol (%)	Acid (%)
Coconut shell	1	0,67	58,76
	3	0,59	8,12

In Table 2.The analysis showed that zeolite also absorb other components in the liquid smoke. Decrease in the content of benzo(a)pyrene apparently followed, among others, changes in functional compounds such as phenolic compounds and acids . At grade 1 is liquid smoke that has the highest quality , while grade 4 is the liquid smoke that has the lowest quality.

Grade 1 is the liquid smoke produced from the distillation at a temperature of 150°C to 200°C. Grade 1 has the highest quality compared to other fractions of liquid smoke because it contains phenols and organic acids are highest. This Liquid smoke grade 1 has a phenol content of 0.67 % and 58.76 % of the acidity. This occurs because the process of pyrolysis in this study lasted for 5 hours making it possible for the components of the wood to decompose completely into compounds constituent of liquid smoke , including organic acids . If the burning is done quickly , then there is a possibility of the wood components are not completely decomposed . Pyrolysis at 400 ° C would result in compounds that have high organoleptic quality and at higher temperatures will occur condensation reaction and the formation of new compounds and oxidation condensation products followed a linear increase in tar compounds and aromatic hydrocarbons polisiklis (Girrard, 1992 ;Maga , 1988) . According Darmadji (1995), phenols and organic acids serve as antimicrobial agents in liquid smoke , and its role will increase if there are two compounds together.

Grade 3 is a liquid smoke coming from the distillation at a temperature of 100°C to 125°C. Grade 3liquid smoke has a quality below grade 1liquid smoke quality because it has a phenol content and lower acid levels . Grade 3 liquid smoke has a phenol content of 0.59% and amounted to 8.12% acid levels. This is because liquid smoke grade 3 have components in large amounts of water, so the water can reduce the concentration and quality of liquid smoke .

Liquid smoke Quality produced in this study is determined by phenol and acid levels in the liquid smoke because the two compounds that have the greatest role as an antimicrobial agent. The higher levels of phenol and acid levels of liquid smoke, then the ability to suppress the growth of microorganisms from the liquid smoke will be higher . Liquid smoke with the highest quality (grade 1) had the lowest quantity because the water content in the liquid smoke is so low that increasing concentrations of the active substance in it such as phenol and acetic acid . In contrast, liquid smoke with the lowest quality(grade 3) had the highest quantity , because the water content in it is very high resulting in lower density of active substances in it . This means that the temperature affects the value of phenol distillation from liquid smoke obtained .Acidity of liquid smoke is also influenced by the levels of phenol in the liquid smoke. The higher levels of phenol , then liquid smoke will become more acidic , this can be evidenced in Table 2

Phenol levels

Phenol is an active substance which can provide antibacterial and antimicrobial effects on liquid smoke . In addition, phenol can also give effect to the antioxidant foods to be preserved. Identification of phenol to the quality of the resulting liquid smoke is expected to represent the quality criteria of the liquid smoke , so the results can be applied to all products fogging . Phenol content in liquid smoke also determines the application of liquid smoke.

Acidity

Acid levels is one of the chemical properties that determine the quality of the liquid smoke produced . Organic acids have a high role in the liquid smoke is acetic acid . Acetic acid probably formed part of the lignin and part of the carbohydrate component of the cellulose.

Acidic compounds in liquid smoke has antimicrobial properties. The antimicrobial properties will increase if there is an organic acid together with a phenol compound. Organic acid compounds formed from the pyrolysis of wood components such as hemicellulose and cellulose at a certain temperature.

This occurs because the process of pyrolysis in this study lasted for 5 hours making it possible for the components of the wood to decompose completely into compounds constituent liquid smoke, including organic acids . If the burning is done quickly , then there is a possibility of the wood components are not completely decomposed .

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

1. Content of benzon(a)pyrene grade 3liquid smoke contained was 8.541 ppb while in liquid smoke grade 1not detected any content of benzo(a) pyrene at a temperature of 400^{o}C pyrolysis of coconut shell .
2. Decrease in the content of benzo(a) pyrene affects the quality of the other functional compounds, namely phenol and acid in grade 1 of 1.67 % and 58.76 % , while the third grade of 0.59% and 8.12% .

Suggestion

On further research needs to be done on evaluating the maximum of liquid smoke from various types of agricultural waste materials , so it will be utilized primarily for the community.

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