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Abstract. Liquid smoke is the condensation result of wood pyrolysis. It contains lots of compounds formed by the constituent pyrolysis process such as cellulose, hemicellulose and lignin. Lignin can be used to produce organic acids, phenols, carbonyl that become the compound of natural antibiotics, antioxidants, antibiotics, disinfectants, or as biopesticides and food preservation. Those compounds have different proportions such as type, wood moisture and pyrolysis temperature. This research uses a completely random design with three repetitions. The treatments were liquid smoke raw materials source: P0 = coconut shell, P1 = rice husk and P2 = coconut shell + rice husk (50:50). The parameters measured include pH, yield (%), total acid (%), polyphenols (%) and flavonoids (ppm). The result of this research on the production of liquid smoke that is produced by various raw materials shows: Various raw materials influence the performance of pyrolysis equipment, liquid smoke chemical and physical qualities. Based on this research, Liquid smoke from coconut shell has a percentage yield of 3.23% polyphenol 1.14%, total acid 0.54% and flavonoid 1.06 ppm. Liquid smoke from coconut shell and Liquid smoke maker very potential to be developed and produce, also partiularly to reach a higher temperature.

1. Introduction

Coconut shell and rice husk were known as agriculture by-product. Traditionally, it is used for cooking. The activity of burning coconut shell or rice husk for cooking may result in an increase in air pollution. The procedure of pyrolysis, followed by condensation, can produce high-quality liquid smoke from various material such as coconut shell and rice husk. The process involves the smoldering of coconut shell chips and rice husk (approximately 400ºC) and condensation under limited oxygen to get liquid smoke [1,2]. Liquid smoke was the result of condensation from pyrolysis of lignocellulosic material. It contains organic compounds such as acetic acid, alcohols, phenols and other compounds [3]. Phenol and carbonyl compounds in liquid smoke used as antibacterial that can control the growth of microbes such as *E. coli*, *Staphylococcus aureus*, and *Candida albican*, increase the length of storage of livestock products [1,2] and can be natural antibiotic [4].

2. Material and method

2.1 Material and Equipment

Coconut shell comes from central market Sungguminasa meanwhile rice husk come from agricultural waste around Polbangtan Gowa. Chemical material to analysis was buffer solution, phenolphthalein,

NaOH 0,1 N, H_3PO_4, $CuSO_4$, aquadest, NH_4Cl, amino antipyrine solution (NH_4OH), kalium ferricyanide, chloroform solution, natrium sulfate anhydrate, zeolite and active carbon.

Pyrolysis equipment consists of one set laboratory scale, 5 kg capacity liquid smoke maker that consists of aluminium kiln, condenser unit, cooling pipe, gas stove, water pump, measuring cup. distillation equipment set, filter, pH meter, analytic scales, 125 mL erlenmeyer and 500 mL beaker glass, filtration set consist of zeolite and active carbon and UV-Vis spectrophotometer (Shimadzu).

2.2 Method

Raw materials dry matter was measured by AOAC [5], the result of this research is 92.66% for coconut shell and 97.11% for rice husk. Pyrolisis liquid smoked, distillation and filtration, total acid and phenol percentage method according to Sari et al [6] and flavonoid based on Harborne [7] measured in Biochemistry Laboratory, Faculty Science and Mathematics Universitas Hasanuddin. The produced liquid smoke starts from the process of pyrolisis each raw material in the liquid smoke maker. The pyrolysis temperature was 180±20^oC for 12 hours. It was labelled as grade 3 liquid smoke. Grade 2 liquid smoke was produced from the re-distillation of the condensed grade 3 liquid smoke. Grade 1 was the result of further filtration using zeolite and activated carbon, the filtration process was measured in the Laboratory of Agricultural Product Gowa Agriculture Development Polytechnic.

This research uses a completely random design (CRD) with three repetitions. The treatments were liquid smoke raw materials source: P0 = coconut shell, P1 = rice husk and P2 = coconut shell + rice husk (50:50). The data is analyzed by using variant analysis (ANOVA), if it is different significantly, then it will be tested the difference between the treatment with Duncan Test on significance level 5% [8].

3. Result and discussion

Chemical characteristics of liquid smoke production from several raw materials that consists of coconut shell and rice husk shown in figure and table 1.

3.1. pH

The principle in the testing degree of acidity (pH) by using pH meter equipment is a pH measurement method based on hydrogen ion activity measurement potentiometrically/ electrometrically by using a pH meter. Coconut shell has hemicellulose component and cellulose bigger than coconut fibre so that the amount of acid is produced bigger. In liquid smoke pH value, the lower pH is better because its antibacterial force also becomes higher it is accordance with Sutin research [9]. The result of this research shows that liquid smoke pH from pyrolysis of three raw materials Coconut shell, rice husk and combination of coconut shell and rice husk are shown in figure 1. The lowest pH from this research reach P0 (4.50), followed by P2 (4.60) and P1 (4.66).

Following the explanation Haji et al measurement of pH values in liquid smoke is indicated to know the level of raw materials decomposition process by pyrolysis [11]. If the pH value is low, it means that produced smoke has high quality, especially in terms of using as food preservatives [10]. The value of durability and storability of a product influence by the low pH value. This difference in pH value caused by the different raw materials types that used, difference pyrolysis temperature and water content of raw materials. This is following the opinion from Darmadji [12]. The liquid smoke pH value in this research result was 4.50–4.61, the average pH is almost similar if compared with the result of research by Komarayati et al [14] about 3.2–6.80. Then Nurhayati and Adellina [13], about 4.3–4.7, but it was higher from the result of research done by Amperawati et al [15] with pH value ranges from 2.91.

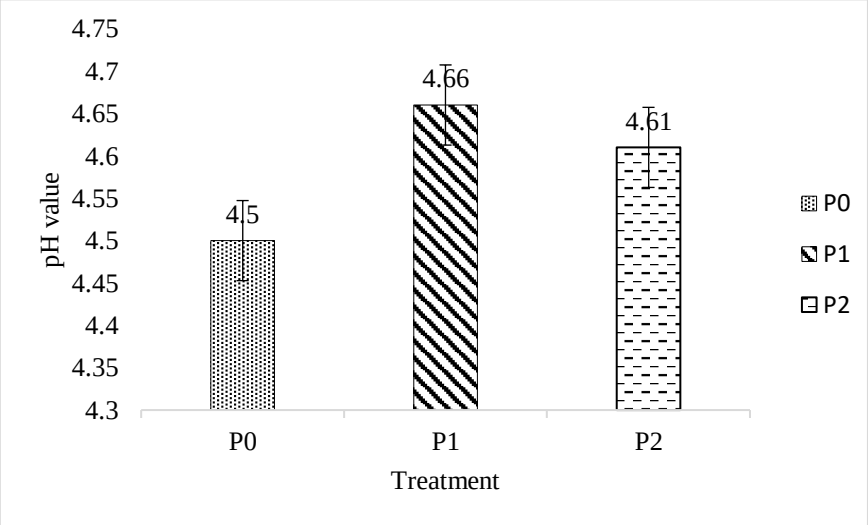

Figure 1. The liquid smoke pH value of P0: coconut shell; P1: rice husk; P2: coconut shell+rice husk

Chemical characteristics from the result of research of liquid smoke production from several raw materials that consists of coconut shell and rice husk shown in table 1.

Table 1. Precentage of yield, total acid, polyfenol and flavonoid of liquid smoke.

Parameters	Treatment		
	P0	P1	P2
Yield (%)	3.23[a]	2.35 [b]	3.14 [a]
Total Acid (%)	0.54[a]	0.37 [c]	0.41 [b]
Polyphenol (%)	1.14 [a]	0.84 [b]	1.11 [a]
Flavonoid (ppm)	1.06	0.88	0.71

[abc]Different superscripts on the same row showed significant differences (P<0.05).

3.2. Yield (%)

The percentage of the liquid smoke amount produced by a raw material through the pyrolysis process to the weight of raw materials before the beginning of pyrolysis was called by liquid smoke yield. Total liquid smoke yield that produced on the pyrolysis process depends on the type of the raw materials. The temperature that used also relies heavily on pyrolysis, and influence yield percentage. According to Iskandar and Rofiatin [16], the value of lignin (%) and cellulose (%) content of coconut shell was 36.51 and 29.6 and rice husk was 20.90 and 58.85. In this research pyrolysis temperature was 180±20ºC. The result of research on table 1 liquid smoke raw materials difference treatment P0 and P2 gives the influence of significant difference to yield to P1 (P<0.05). P0 has the highest percentage of yield, according to Baduraga et al [17] lignin decomposition happens at high temperature, so that if the material consists of lots of the lignin fraction, then it will increase the produced yield. The difference in yield percentage that is acquired is caused by the diverse lignin and cellulose contents of each material among others. Several factors, such as climate, season, age of the plant, type of the plant, raw materials and way of burning influence the high and low of liquid smoke yield on pyrolysis process.

3.3. Total acid (%)

The result of total acid variance analysis liquid smoke can be seen in table 1, there is a significant difference (P<0.05) between raw materials treatments. Coconut shell total acid is the highest than other raw materials followed by a combination of coconut shell and rice husk and rice husk was the lowest.

Accordance Baduraga et al [17] total acid of coconut shell smoked liquid with pyrolysis temperature 200±10ºC was 0.62±0.035%. The difference of total acid depends on raw materials types that used, difference pyrolysis temperature and water content on raw materials. Darmadji [12] mentions that organic acid, phenol, carbonyl as the compounds that have an important role in food preservatives will produce by the pyrolysis process on wood constituents such as cellulose, hemicellulose and lignin. Those compounds have different proportions such as depending on pyrolysis temperature, wood water content, and the type of raw materials. Acids have a general effect on the overall organoleptic quality [18] and their derivatives have potential as natural preservatives [19]. The range of acidity values that are acquired (0.41%–0.54%) is lower than the result of research of Darmadji [12], Amperawati et al [15], Kadir et al [20] and Apituley and Darmadji [21].

3.4. Polyphenol (%)

The result of variance analysis shows that liquid smoke raw materials difference treatment P0 and P2 gives the influence of significant difference to polyphenol-content to P1 ($P<0.05$). Liquid smoke polyphenol-content data shown in table 1 polyphenol-content. The average of polyphenols-contents of P0 (1.14%) was highest than other raw materials followed by P2 (1.11%) and the lowest was P1 (0.84%). Girard [18] mentions that the composition of chemical substances that are contained in liquid smoke can depend on several factors, such as water-content from the material, temperature and duration of burning, type of wood or raw materials that used, condensation temperature and purification type that used. According to Demirbas [22] phenols content of liquid smoke usually between 0.2– 2.9%. The quantity and quality of phenol compound that can be found on liquid smoke is related with lignin-content and pyrolysis temperature [18]. Phenol is the result of wood component disintegration, which is lignin, the more lignin content in the wood, then the greater of phenols content on liquid smoke. The range of values from the result of research that is acquired (0.84%–1.14%). The actual temperature of pyrolisis in this research about 180±20ºC is lower than the result of research done by Baduraga [17]. Furthermore, lignin degradation occurs at temperature 310– 500ºC, if the temperature has not been reached then it will influence lignin degradation and phenol content from liquid smoke that is produced [22].

3.5. Flavonoids (ppm)

The result of variance analysis shows there is no influence of significant actual difference raw materials difference treatment to liquid smoke flavonoids contents. Flavonoids content of P0 (1.06 ppm) was highest followed by P1 (0.88 ppm) and P2 (0.71 ppm). Based on Sukadana and Santi [23] flavonoid has microbial activity such as antibacterial, antifungiantioxidant and antivirus. Flavonoids mechanism inhibits bacterial growth is by inhibiting the synthesis of nucleic acids, interfere withs cytoplasmic membrane function and metabolism energy so that bacteria cannot reproduce [24].

4. Conclusions

The results of research on the characteristics of liquid smoke produced by coconut shell, rice husk and a combination of coconut shell and husk indicate that various raw materials affect the chemical properties of liquid smoke. Liquid smoke from coconut shell showed the best chemical properties of liquid smoke.

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