Mineral oil may be contained in the resulting soap carried away by the oil/triglyceride saponification process. Mineral oil contained in the soap can clog the pores of the skin because it cannot penetrate the skin barrier, thereby disrupting the process of excretion of toxins from the skin. This can lead to acne and other skin diseases (Achyar, 1986). Table 1 shows that all four types of mineral oil soaps are in accordance to standards established by the SNI of negative value (SNI, 1994).

**Total fatty acids**

Total fatty acids is the sum of all fatty acids in the fat or the soap that is not reacted with alkali (SNI, 1994). The basic ingredients of the oil affects the saturation level and the type of fatty acids they contain. Fatty acids derived naturally through hydrolysis of triglycerides. Fatty acids have a limited ability to dissolve in water.

According to SNI (1994), a good quality soap has a number of fatty acid content of at least 70%, this means that the ingredients are added as a filler in the manufacture of soap is less than 30%. The goal is to improve the efficiency of the cleaning process impurities such as oil or grease when soap is used. Fillers that commonly added are honey, glycerol, dyes, fragrances, and milk etc. Fatty acid has a role as a regulator of consistency in a formulation. Fatty acids have a limited ability to dissolve in water. This will make the soap to be more durable in the state after the soap is used.

Table 1 shows that the amount of fatty acids for all solid soap do not meet this SNI standard because the amount of fatty acid that is used as a base material soap is less, fillers are added exceeds 30%, in addition, Wijana and Harnawi (2009) stated that fatty acid has a tendency to decrease with increasing stirring time.

**Conclusions**

Solid soap made from olive oil, VCO palm oil and mixture of all three oils has characteristics in accordance with SNI standards, except water content of oil mixture soap. This is because the mixture oil has more types of fatty acids so that the possibility of hydrogen bonding between fatty acids in the oil mixture with water will be greater.

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**Antibacterial Activities Some Compounds Clove Leaf Oil Derivatives**

Ngadiwiyana, Purbowatininrum Ria Sarjono, Enny Fachriiyah, Nor Basid Adiwibawa Prasetya
Abstract

The use of clove oil is still very limited and mostly just exported in the form of crude oil as a result it gives less contribution regarding to its cheap price. On the other hand, clove oil is known to have antibacterial activity. Clove oil contains eugenol which has antibacterial activity. This fact will improve the marketability of clove oil. This study aims to obtain data on antibacterial activity of some clove oil derivative compounds. Previous study carried out the synthesis of clove oil derivative compounds i.e. isolation of eugenol from clove oil, eugenol methylation into methyleugenol and methyleugenol isomerization to be methylisoeugenol. The methylisoeugenol was then oxidized to be veratraldehyde. The next step was then to test the antibacterial activity of some clove oil derivative compounds against bacteria *Escherichia coli, Pseudomonas aerogenosa* and *Staphylococcus aureus*. The results showed that eugenol, methyleugenol, methylisoeugenol, and veratraldehyde can inhibit the growth of *E. coli* and *S. aureus*. The greater concentration will increase the inhibition ability. Clove oil and its derivatives inhibit Gram-positive bacteria more effective than Gram negative. Veratraldehyde, methyleugenol, and clove oil have the highest effect on the inhibition of the growth of *S. Aureus, E. coli, P. aerogenosa* respectively.

Keywords: clove oil, eugenol, eugenol derivative compounds, antibacteria.

Introduction

The use of clove oil is still very limited and mostly just exported in the form of crude oil as a result it gives less contribution regarding to its cheap price (Rizal and Dzajuli, 2006). While, there are some benefits of clove oil that can be explored more to increase its price. Cloves (*Syzygium aromatium* L Merr) is a herb plant that has been used in the cigarette industry, food, and medicine. The plant part that can be used as the flowers, the flower stalks, and the leaf (Nurdjannah, 2004). Meyer (2008) stated that clove oil obtained from the clove flowers, stems and leaf can inhibit the growth of microbes, insects and worms. Ayoola (2008) stated that the compounds contained in clove oil are eugenol, eugenyl acetate, caryophyllene, and alpha-humulene. Eugenol is a major compound that contained in clove oil. Lawless (1995) stated that clove oil contain 82-88% eugenol with little other elements.

It has been reported that clove oil has ability to inhibit microbial pathogens such as *S. enteridis, E. coli* and *S. aureus* (Beuchat, 2000; Cressy et al., 2003; Smith-Palmer et al., 1998). Frosch (2002) reported that clove oil showed antibacterial activity against the bacterial pathogen *P. intermedia, P. melaninogenica, C. gingivais* and *P. gingivais*. Clove oil is also able to inhibit *Candida albicans, E. coli* and *S. aureus*. This proved that the antibacterial activity of clove oil is influence highly by eugenol which as the main component of clove oil. by exploring the benefits of clove oil as an antibacterial compound will increase the sale value of clove oil.

The antibacterial activity of isolated eugenol from clove oil, methyleugenol from eugenol methylation and methylisoeugenol, caryophyllene, and veratraldehyde are also tested in this research. Those clove oil derivative compounds were tested their ability in inhibiting the growth of *E. coli, P. aerogenosa*, and *S. aureus*. It is expected that eugenol modification will increase the inhibition of the growth of pathogenic bacteria.

Methodology

Stages of the study are as follows:

**Antibacterial activity test of modified compound**

Activity test of modified compounds was carried out by measuring the minimum inhibitory concentration (MIC) against *E. coli, P. aerogenosa*, and *S. aureus*, in the following order (Piezcar and Chan, 1988; Gupte, 1990):

a. Preparation of Bacteria cultures stock

One colony of *E. coli, P. aerogenosa*, and *S. aureus* were taken by using a sterile needle nose, they were then implanted to Nutrient media by scraping, and then they were incubated in an incubator at a temperature of 36 ± 1°C for 18-24 hours.
b. Bacterial inoculum preparation

The stock cultures of *E. coli*, *P. aerogenosa*, and *S. aureus* that has grown were then taken with needle loop and suspended in sterile test tubes containing 10 mL of sterile distilled water and the absorption was measured using a spectrophotometer at a wavelength of 580 nm until the bacterial suspension has a transmittance of 25% meaning the concentration of the bacterial suspension was 9108 cfu/mL (POM DG, 1995).

c. Making Solvent Exacts

Dilution of the synthesized products were done using distilled water to get tested concentration of 100 mg/mL, 50 mg/mL, 10mg/mL, 5 mg/mL, 1 mg/mL and 0.5 mg/mL.

d. Antibacterial Activity Test by Paper Disc Method

0.1 ml of bacteria inoculum was introduced into a sterile petri dish, then nutrient media was pour for up to 20 mL with temperatures of 40-50 °C. Then the dish was shaked over the surface of the table, so that the media and the suspension was mixed. Paper discs with 6 mm in diameter were dipped in synthetic products with a concentration of 100 mg/mL, 50 mg/mL, 10mg/mL, 5 mg/mL, 1 mg/mL and 0.5 mg/mL. The controls were 55mg/mL tween-20 (as negative control) and 0.1 mg/mL tetracycline (as positive control) which were allowed for 15 minutes. Paper discs were then placed on the surface of the nutrient medium which were inoculated with a bacterial suspension. They were then incubated in an incubator at a temperature of 36±1 °C for 18-24 hours, after that the diameter resistance area (clear zone) around the paper disk were measured.

Results and Discussion

The test results of the antibacterial activity of clove oil and its derivatives with various concentrations using paper disc method to *E. coli* are presented in Figure 1.

Figure 1 shows that the clove oil extracts and its derivative compounds can inhibit the growth of *E. coli* bacteria that are gram-negative bacteria. The higher the concentration of the extract, the higher the inhibition of the growth of *E. coli*.

At a concentration of 100%, methyleugenol showed the highest inhibition zone than eugenol. This showed that methylation of eugenol will increase the inhibition on the growth of *E. coli* for the value of the minimum inhibitory concentration (MIC) of clove oil showed the smallest power of inhibition at concentrations of 6% which is still able to inhibit the growth of *E. coli*, whereas for the other compounds have almost entirely 25% for the MIC. Burt (2004) reported that the ability of clove oil to inhibit bacterial growth due to the high content of eugenol. Eugenol has hydrophobic properties in which this property has an important role in the inhibition of bacteria, especially in gram negative bacteria. This hydrophobic property able to get into the lipopolysaccharide found in the cell membrane of gram-negative bacteria and could damage its cell structure. This is the reason why all compounds containing eugenol structure especially after methylation can enhance the inhibition activity against *E. coli*. On the other hands veratraldehyde as oxidation product frommethyl isoeugenol able to inhibit the growth of *E. coli*. The veratraldehyde shows the highest zone inhibition at 100%, 50% and also at 25% concentration of veratraldehyde. Methyl isoeugenol asisomerisation of methyl eugenol product shows smaller zone inhibition than methyl eugenol. The deference structure between methyl eugenol and methyl isoeugenol is double bond position at propenyl group. This deference give a different to inhibit *E. coli*.

The test results of the antibacterial activity of clove oil and its derivatives with various concentrations using paper disc method against bacteria *S. aureus* is presented in figure 2 as follows:

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Figure 2. Graph of inhibitory activity of clove oil and its derivative compounds against S. aureus bacteria

Conclusions

Clove oil can inhibit the growth of E. coli and S. aureus. Clove oil and its derivatives inhibit Gram-positive bacteria more effective than Gram negative. Methyleugenol has the highest effect on the inhibition of the growth of both bacteria. Modification of eugenol structure is effective to increase antibacteria activities.

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