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Effectiveness of Cinnamon (*Cinnamomum burmannii*) Ethanol Extract Against *Staphylococcus aureus* Growth

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Abstract: Cinnamon (*Cinnamomum burmannii*) is widely used by the public as a food ingredient and contains chemical compounds such as alkaloids, flavonoids, polyphenols, saponins, and terpenoids which function as an antibacterial against *Staphylococcus aureus*. This study aims to determine the Minimum Inhibitory Concentration and Minimum Bactericidal Concentration of cinnamon ethanol extract on *Staphyloccocus aureus*. This research is experimental with posttest only control group design through the tube dilution method. The results of the Minimum Inhibitory Concentration (MIC) study showed no clarity at concentrations of 30% and 40%. The results of the Minimum Bactericidal Concentration (MBC) obtained the number of colonies at a level of 10% by 51 CFU / plate, 20% by 27 CFU / plate, 30% by 6 CFU / plate and 40% by 0 CFU / plate. Based on the results of this study concluded that MIC cinnamon ethanol extract was 30%, and MBC cinnamon ethanol extract was 40%.
Keywords: cinnamon (*Cinnamomum burmannii*); *Staphyloccocus aureus*

INTRODUCTION

The most common bacteria found in cases of infection is *Staphylococcus aureus*[1]. Dr. Hospital Kariadi Semarang Indonesia recorded 23 cases of postoperative wound infections caused by *Staphylococcus aureus*[2]. *Staphylococcus aureus* produces the penicillinase enzyme so that it is easily resistant to penicillin groups, such as Methicillin-Resistant Staphylococcus aureus (MRSA) and Vancomycin-Resistant Staphylococcus aureus (VRSA)[3].

The existence of the resistant nature of *Staphylococcus aureus* encourages the discovery of new medicinal raw materials from natural ingredients as antibacterial. Natural materials such as propolis Trigona sp have been shown to have inhibitory properties against MRSA and VRSA[4]. Another natural element that can use as an antibacterial is cinnamon (*Cinnamomum burmannii*). Cinnamon is one type of spice plant that widely cultivates in Indonesia. Cinnamon improved for its bark, which usually used as a cooking ingredient[5].

Cinnamomum burmannii is astringent, aphrodisiac, antiseptic, alcoholic, aromatic, carminative, digestive, stimulant, hypertensive, sedative, tonic, and vasodilator[6], antidiabetic, antinociceptive, astringent, and diuretic[7]. Also, *Cinnamomum burmannii* is known to use as an antibacterial, anti-fungal, anti-inflammatory, analgesic,

antidiabetic, antioxidant, antitumor, and other activities. Chemical compounds suspected of acting as antibacterial are essential oils (ie, eugenol, safrol, cinnamaldehyde, and linalool) as much as 0.5-2%, polysaccharides as much as 10%, phenol components 4-10% (tannins) and flavonoids[8].

Research conducted by Shan et al (2007) informs the antibacterial properties and main bioactive components of *Cinnamomum burmannii* with Diameter of Inhibition Zone (DIZ) on the growth of Bacillus cereus (15.4 mm), Listeria monocytogenes (11.5 mm), *Staphylococcus aureus* (12.1 mm), Escherichia coli (8.7 mm) and Salmonella anatum (12.1 mm)[9].

It now that the inhibition of *Cinnamomum burmannii* against *Staphylococcus aureus* from previous research, but the study uses a barrier testing method of Kirby Bauer inhibition so that exploration of inhibitory test results is needed using different methods. The inhibition test method using MIC and MBC is expected to complete the information on the effectiveness of the ethanol extract of *Cinnamomum burmannii*. The purpose of this study was to determine the Minimum Inhibitory Concentration and Minimum Bactericidal Concentration of cinnamon ethanol extract (*Cinnamomum burmannii*) on the growth of *Staphylococcus aureus*.

MATERIALS AND METHODS

This type of research used in this study was an experiment with a Posttest Only Control Group Design, namely by examining the inhibitory and killing power of ethanol extract of cinnamon powder (*Cinnamomum burmannii*) at concentrations of 10%, 20%, 30%, 40%. It is then compared to the negative control group in the form of distilled water and positive control in the way of cefoxitin with the number of repetitions as much as three times.

The material used in this study was a cinnamon plant (*Cinnamomum burmannii*), which processed into ethanol extract. The independent variable in this study was the concentration of ethanol extract of cinnamon powder. The dependent variable in this study is the Minimum Inhibitory Concentration (MIC) and the Minimum Bactericidal Concentration (MBC).

Cinnamon in the form of 60 mesh powder macerated with 70% ethanol (100gr /300ml) for 3x24 hours. The thick extract from the filtrate is made of a 200% solution (20gr / 20 ml) and then diluted with distilled water so that it becomes a solution of 10%, 20%, 30%, and 40%. MIC uses the *Staphylococcus aureus* culture 24 hours 37^{o}C.

The bacterial suspension was obtained by culture of *Staphylococcus aureus* for 4−8 hours at 37˚C. Determination of MIC by adding 1 mL of the solution of various concentrations with 1 mL of bacterial suspension so that the final level of the solution becomes half the initial concentration of 10%, 20%, 30%, and 40%. Incubate 37 ° C for 24 hours. Tubes that contain the lowest levels but are still able to inhibit bacterial growth marked by clear colored solutions expressed as MIC values[10].

Determination of MBC by taking a MIC suspension at each concentration of 50 ul then spread on agar Nutrien plates. Incubated 24 hours at 37 ° C. Colonies growing on SDA were counted[11].

RESULT AND DISCUSSION

Antimicrobial testing of cinnamon extract on the growth of *Staphylococcus aureus* showed the level of clarity in determining the Minimum Inhibitory Concentration (MIC), which can see in Table 1.

Table 1. Results of MIC of *Cinnamomum burmannii* Ethanol Extract on Growth *Staphylococcus aureus*

Concentration of Ethanol Extract of *Cinnamomum burmannii*	Treatment repetition			Conclusion of results
	I	II	III	
10%	Turbid	Turbid	Turbid	Turbid
20%	Turbid	Turbid	Turbid	Turbid
30%	Clear	Clear	Clear	Clear
40%	Clear	Clear	Clear	Clear

Based on the determination of the Minimum Bactericidal Concentration (MBC), it found that the growth of the colonies has decreased in the number shown in Table 2.

Table 2. Results of MBC of *Cinnamomum burmannii* Ethanol Extract on Growth *Staphylococcus aureus*

Concentration of Ethanol Extract of *Cinnamomum burmannii*	Treatment repetition			Conclusion of results
	I	II	III	
10%	51	45	56	51
20%	61	13	8	27
30%	6	3	11	6
40%	0	1	0	0

This study proves that there is inhibition of *Cinnamomum burmannii* against *Staphylococcus aureus* with a MIC value of 30%. In contrast to the results of Mubarak's (2016) study, the MIC value was at a concentration of 1.5% with Enterococcus faecalis bacteria and 96% ethanol solvent. The occurrence of differences is possible due to differences in the type of bacteria and the concentration of the solution used.

Making cinnamon extract in this study using maceration extraction method with 70% ethanol solvent, cinnamon made into dry powder. The purpose of making powder is to break down organs, tissues, and cell structures so that the active ingredients in it can come into direct contact with the ethanol. Also, the reduction in size is shown to increase the surface area, thereby increasing the mass transfer of active ingredients from plant parts to solvents[12].

According to Budiyanto (2017), cinnamon contains active substances such as alkaloids, flavonoids, polyphenols, saponins, and terpenoids[13]. The mechanism of

action of the alkaloid as an antibacterial is by interfering with the peptidoglycan component of the bacterial cell so that the cell wall layer is not formed intact and causes the death of the cell[14].

Flavonoids are a phenol group, and one of its functions is as an antimicrobial. Phenol compounds known as antiseptic substances can kill some bacteria[15]. Besides the mechanism of action of flavonoids as an antibacterial that can form complexes with bacterial extracellular proteins resulting in protein denaturation[14].

The mechanism of action of polyphenol compounds in killing bacterial cells there are three ways, namely denaturing bacterial cell proteins, inhibiting cell wall synthesis, and damaging bacterial cell membranes[16]. Besides cinnamon also contains terpenoids. The mechanism of terpenoids as an antibacterial is to react with porin (a transmembrane protein) on the outer membrane of the bacterial cell wall, forming a robust polymeric bond that causes damage to the porin. Damage to the porin which is the entry and exit point for the compound will reduce the permeability of the bacterial cell wall which will cause the bacterial cell to be deficient in nutrients so that bacterial growth inhibited or dead[17].

Chemical compounds that also act as antimicrobials in Cinnamomum are essential oils. Essential oils from Cinnamomum have been reported to have antifungal activity against Candida albicans[18]. The main component of Cinnamomum essential oil is Cinnamaldehyde, which is a phenylpropanoid that has proven its activity against microorganisms[19]. The research of Diego F. Firmino et al. (2018) shows that Cinnamaldehyde has antimicrobial and antibiofilm activity. Cinnamaldehyde has a MIC value of 0.25-0.50 mg/ml against *Staphylococcus aureus* and Staphylococcus epidermidis. While this study obtained MIC values (table 1) at a concentration of 30%. Because the active substance tested is in the form of ethanol extract, not a more specific component like the research of Diego F. Firmino[20].

CONCLUSION

Minimum Inhibitory Concentration of cinnamon powder (*Cinnamomum burmannii*) ethanol extract against *Staphylococcus aureus* found at a concentration of 30%. Minimum Bactericidal Concentration of cinnamon powder (*Cinnamomum burmannii*) ethanol extract against *Staphylococcus aureus* located at a level of 40%.

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