

**B -09**

**INHIBITORY POWER TEST OF MEDICINAL PLANTS EXTRACT  
AGAINST BACTERIAL GROWTH METHICILLIN RESISTANT  
STRAINS OF *Staphylococcus aureus* (MRSA)**

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**Abstract**

*Staphylococcus aureus* is a normal flora in the human body, but if the bacteria is not in its proper place, it will lead to infection. *S. aureus* infections are treated with antibiotics  $\beta$ -lactam class, has a drug target in the cell wall. Bacteria strains of *S. aureus* are already resistant to Methicillin Resistant called *Staphylococcus aureus* (MRSA). One of the alternative that can be used is by using medicinal plants. It is necessary to see the ability of bacterial strains of MRSA. This study aims to determine the good inhibitory effects of plant extracts drug against MRSA strains of bacteria growth. This study is an experimental study with 9 treatments and 3 replications of medicinal plants, which performed at the Laboratory of Microbiology, Faculty of Mathematics Natural Sciences, Padang State University from April to May 2009. To determine the inhibition of medicinal plant extracts, was done by observing diffusion method of inhibition zone of each medicinal plant. By calculating the average diameter of the inhibition zone formed and conducted analysis ANOVA test. The results showed that all the medicinal plants can inhibit the growth of MRSA strains of bacteria with inhibition zones formed on each treatments. *Allium sativum* extract capabilities (garlic) and *Curcuma domestica* (turmeric) is better than Amphotericin, whereas other medicinal plants have the same ability to Amphotericin.

**Keyword:** *Staphylococcus aureus*, MRSA, Medicinal plants.

**INTRODUCTION**

*Staphylococcus aureus* is a Gram-positive bacteria that is composed sideways like grapes, about 0,5-1,0  $\mu$ , not moving, not encapsulated, and does not form spores (Yuliati, 2005).

*S. aureus* is a chemo-organotropic bacteria, aerobic, and facultative anaerobic. This bacteria is known as a commensal bacteria, because it can be isolated from most of the body surface, found on the skin and the nasal cavity. In addition, this bacteria is a normal flora of the mouth, urinary and genital tract, gastrointestinal tract, and vaginal mucous membranes (Yuliati, 2005; Anonymous, 2008).

If this normal flora, *S. aureus* is not in its proper place, this bacteria would be pathogenic and will cause infection, with many symptoms depend on the infected location. *S. aureus* infection causes the formation of a sac contains pus such as abscesses and ulcers.

*S. aureus* can cause disease because of its ability to reproduce in the body tissues, and produce hemolysin that can lysis red blood cells, leukocidin that can kills white blood cells,

enterotoxin that cause poisoning, coagulase that can coagulate blood plasma, exfoloasin are able to release and remove the outer layer of epidermis (Volk & Wheeler, 1990 (151-153); Jawetz, et al, 1996, 213-214).

Pathogenic ability of *S. aureus* is a combined effect of extracellular factors, toxins, and invasive strains of *S. aureus*. Germs infection can cause disease in human, infectious tissue cause the distinctive marks, includes inflammation, necrosis, and abscesses formation (Yuliati, 2005, 11).

*S. aureus* infections usually treated by giving antibiotics. Antibiotic much used is  $\beta$ -lactam group, includes penicillin, methicillin, an ampicillin, which works on the bacterial cell wall. However, many strains of *S. aureus* were found now, are resistant to  $\beta$ -lactam group of antibiotics. The standard used to test resistance of *S. aureus* to  $\beta$ -lactam group is Methicillin, so that it also called as Methicillin Resistant *Staphylococcus aureus* (MRSA) (Jawetz, et al., 1996 (168-187); Pelczar and Chan 2005, 525).

MRSA strains actually are not more dangerous or virulent than *S. aureus* strains, but if there is an infection, the treatment is very difficult, because it must use the stronger antibiotics, and the costs will be more expensive and large. MRSA in human body has two properties, colonization and infection. Colonization happen if MRSA is in the place of human body (skin, nose, and throat), it does not harm the body (Karen, in Yuliati, 2005:11).

The use of antibiotics will also cause side effects and new resistant problems. To overcome these problems, interesting to see the ability of antibacterial substances that contains in medicinal plants in preventing infections caused by MRSA strains.

Inhibitory power of medicinal plants extract against microbes vary, depends on the type of plants and microorganisms in the test. Ability of medicinal plants to inhibit *S. aureus* growth happen because it has amount of active ingredients, as anti-microbial material such as essential oils, alcohol, aldehyde compounds, ketones, phenols and its derivatives. These compounds could serve as microstatic and microstatic (Sari, 2004:2-3).

Based on the composition of the active ingredients of medicinal plants, can be seen its potential to inhibit MRSA strains of bacteria growth, because these antimicrobial materials do not work on the cell wall. Essential oils and its derivatives in generally work on the ribosomes and and the cell membrane (Jawetz , et al. 1996:153-156; Murphy, 1999:569).

Several studies prove the ability of medicinal plants to inhibit *S. aureus* growth. Sari (2004), at a concentration of 10% garlic (*Allium sativum*) able to inhibit *S. aureus* growth, Elyoumi (2004), the extract of Temulawak rhizomes (*C. Xanthorrhiza*) inhibit *S. aureus* growth at a concentration of 100%. Medicinal plants that have been explored also can treat many diseases that have similar characteristics of *S. aureus* infection are *Curcuma domestica*, *Aloe vera*, *Zingiber officinale*, and *Alpinia galanga*.

## RESEARCH METHOD

This research was carried out from April to May 2010 in the Microbiology Laboratory of the Biology Department, Mathematics and Natural Science Faculty Padang State University. This research is an experimental study, using a completely randomized design (CRD) with 9 treatments and 3 replications, with treatment as follows: (1) ampicillin, (2) garlic rhizome (*Allium sativum*), (3) turmeric rhizome (*Curcuma domestica*), (4) temulawak rhizome (*C. Xanthorrhiza*), (5) ginger rhizome (*Zingiber officinale*), (6) betel leaves (*Piper bettle*), (7) salam leaves (*Syzygium polyanthum*), (8) aloe vera (*Aloe vera*), and (9) galangal rhizome (*Alpinia galanga*).

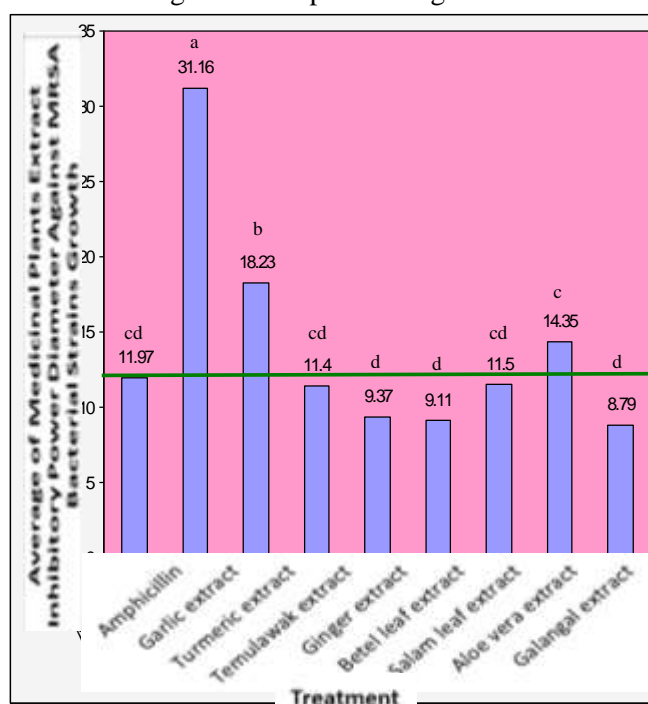
The tools used were a petri disk, test tubes, Bunsen, micropipette, needle oce, digital balance, Erlenmeyer (500 ml), autoklav, electric stove, tweezers, Pasteur pipette, blenders, measuring cups (250 ml), paper punch, calipers, cutter, laminar air flow, incubators, glass cup,

and oven.

The materials used are cotton, aluminum foil, paper newspaper, filter paper, gauze, distilled water, tissue, stick berkapas, NaCl 09 %, alcohol 70 %, Amphotericin, pure cultures of bacterial strains MRSA agar medium, Mueller Hinton, NA medium, Mc solution Farland 's 0.5, and medicinal plant extract according to treatment.

## RESULT AND DISCUSSION

The result of inhibitory power test of medicinal plants extract against the growth of MRSA bacterial strains growth analyzed statistically using ANOVA test, showed different result at the 5% level. Further test result using DMRT explain in Figure 1.



**Figure 1.** Average of Medicinal Plants Extract Inhibitory Power Diameter Against MRSA Bacterial Strains Growth

**Note:** Numbers on the top row followed by the same lowercase means no significantly different at the 5% level.

The figure showed that all of the medicinal plant tests can inhibit the growth of MRSA bacteria strains. Each medicinal plants have different capacities to inhibit the growth of MRSA strains of bacteria that can be seen from the high level difference of histogram.

Statistical analysis suggests garlic extract (31.16 mm) and turmeric (18.23 mm) have a good inhibition, compared with the control antibiotic Amphotericin (11.97 mm).

This study used strains of *S. aureus* resistant to methicillin called MRSA. Methicillin is an antibiotic that contain  $\beta$ -lactam ring. All groups of  $\beta$ -lactam antibiotic work on bacterial cell wall by inhibiting bacterial cell wall synthesis, which is an osmotic barrier between the environment inside and outside of the cell, so that the cell metabolism disrupted.

Bacteria that are initially sensitive to an antimicrobial, can be resistant to methicillin,

because the bacteria form  $\beta$ -lactamase enzymes. This enzyme can open  $\beta$ -lactam ring of methicillin, thus eliminating antimicrobial and reduce the active power of the antibiotics.

Based on the results of the inhibition test of medicinal plants extract, known that garlic and turmeric can inhibit the growth of MRSA bacterial strains, it is showed by the inhibition zone that formed. The difference of this ability is affected by several factors such as concentrations, types, amounts, and action mechanism of plant's antimicrobial active ingredients. Cases of MRSA is more influenced by the antimicrobial action mechanism of the active ingredients in these plants (Pelczar and Chan 2005, 447-458).

There are several mechanisms of antimicrobial active ingredients, includes the inhibition of bacterial cell wall synthesis, cell membrane function, protein synthesis and nucleic acid synthesis (Jawezt, et al. 2006). The mechanism explain in Table 1.

**Table 1.** Mechanism of Medicinal Plants Active Ingredients Against MRSA Bacterial Strains Growth

Medicinal Plants	Mechanism of Medicinal Plants Active Ingredients			
	Inhibition of cell wall synthesis	Inhibition of cell membrane function	Inhibition of protein synthesis	Inhibition of nucleic acid synthesis
Turmeric		√	√	
Temulawak		√		
Garlic	√	√	√	√
Aloe vera			√	
Ginger		√		
Galangal	√	√		
Betle leaf		√		
Salam leaf	√	√		

Source: Cowan, M.M (1999); Jawezt, dkk (1996); Anonimous (2008)

As noted, if a bacteria resistant to  $\beta$ -lactam group of antibiotics that the action mechanism target is on the cell wall, it is necessary to find medicinal plants that work not on the cell wall. According to Murphy (1999, 569), the active ingredients which work on the function of the cell membrane is essential oils and its derivatives.

However, when it compared with the results of this study, it showed that only garlic and turmeric which has good inhibitory power. From Table 1, can be seen that garlic inhibits cell wall synthesis, cell membrane function, protein synthesis and nucleic acid synthesis. While turmeric inhibits the function of cell membranes and protein synthesis.

Garlic contains antimicrobial active ingredients in inhibiting the synthesis of proteins and nucleic acids, such as alisin, ajone and metal-allyl disulfide (Siti, 2003, 11-12). In turmeric, antimicrobial active ingredient containing curcuminoids curcumin and its derivatives, work in inhibiting protein synthesis (Murphy, 1999).

## CONCLUSION AND SUGGESTION

All medicinal plants that treated, usable to inhibit the growth of MRSA bacterial strains. The good inhibitory effects of medicinal plants against MRSA bacterial strains growth are garlic (31.16 mm) and turmeric (18.23 mm).

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