Research Article

Antibacterial activity of dry ginger against methicillin-resistant *Staphylococcus aureus*

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ABSTRACT

Introduction: Methicillin-resistant *Staphylococcus aureus* (MRSA) is a Gram-positive, it is any strain of *S. aureus* that has developed, through horizontal gene transfer and natural selection, multiple drug resistance to beta-lactam antibiotics. It is a facultative anaerobe that can grow without the need for oxygen. Spread of *S. aureus* (including MRSA) generally is through human-to-human contact. The rise in antibiotic resistance has resulted in a decreasing number of fully active antimicrobial agents available to treat infections caused by multidrug-resistant bacteria that are the MRSA. The aim is to find out whether the dry ginger can suppress the activity of the MRSA. **Materials and Methods:** The extracts were prepared in different concentrations in sterile water, 5 mg/ml, 10 mg/ml, and 20 mg/ml. The screening of antibacterial activity of the dry ginger extract was carried out using the agar well diffusion method. Lawn culture of the test organism was made on the Muller-Hinton agar. A sterile cork borer was then used to make wells (6 mm diameter) for different concentrations of the extracts, 100 µl of the varying concentrations (500 µg/ml, 1000 µg/ml, and 2000 µg/ml) of the extracts were introduced into the wells with the help of micropipettes. The culture plates were incubated at 37°C for 24 h. After 24 h, antibacterial activity was determined by measurement of diameter of zones of inhibition (mm). **Results:** The investigation of antibacterial activity of dry ginger extract against, MRSA was done by agar well diffusion method. Mean zones of inhibition of different concentrations were measured and compared with the control. The extract showed good antibacterial activity at different concentrations with maximum zone of inhibition of 24 mm at concentration of 2000 µg/ml.

KEY WORDS: Agar well diffusion assay, Dry ginger, Methicillin-resistant *Staphylococcus aureus*, Zone of inhibition

INTRODUCTION

The rise in antibiotic resistance has resulted in a decreasing number of fully active antimicrobial agents available to treat infections caused by multidrug-resistant (MDR) bacteria. Intensive care physicians consider antibiotic-resistant bacteria a significant or major problem in the treatment of patients.[1] *Staphylococcus aureus* is an important cause of serious infections in both hospitals and the community. Methicillin-resistant *S. aureus* (MRSA) includes those strains that have acquired a gene giving them resistance to methicillin and essentially all other beta-lactam antibiotics. MRSA was first reported in 1961, soon after methicillin was introduced into human medicine to treat penicillin-resistant staphylococci. This group of organisms has emerged as a serious concern in human medicine. Although these organisms cause the same types of infections as other *S. aureus*, hospital-associated strains have become resistant to most common antibiotics, and treatment can be challenging.[2] This has necessitated a search for new antimicrobial agents. A vast number of medicinal plants have been recognized as valuable resources of natural antimicrobial compounds. Plants are rich source of bioactive secondary metabolites of wide variety such as tannins, terpenoids, alkaloids, and flavonoids, which are reported to have *in vitro* antibacterial properties.[3] Medicinal plant extracts offer considerable potential for the development of new agents effective against infections currently difficult to treat. Herbal remedies may offer novel treatment options which elicit little or no transferred resistance if used in optimal concentrations.[4]

There are approximately 3 million plant species in the world, among that only some are consumable and few have great medicinal and antibacterial value.[5,6] In that

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ginger (*Zingiber officinale*) is one of the medicinal plant roots consumed by both the humans and animals. Ginger is a flowering plant whose rhizome is widely used as a spice or a medicine. It is an herbaceous perennial plant. The fresh ginger (*Zingiber officinale*) rhizomes contain the gingerols were identified as the major active components and 6-gingerol 5-hydroxy-1-(4-hydroxy-3-methoxyphenyl) decan-3-one is the most abundant constituent in the gingerols series.[7,8] The powdered rhizome contains 3–6% fatty oil, 9% protein, 60–70% carbohydrates, 3–8% crude fiber, about 8% ash, 9–12% water, and 2–3% volatile oil. The volatile oil consists of mainly mono and sesquiterpenes, camphene, beta-phellandrene, curcumene, cineole, geranyl acetate, terpineol, terpenes, borneol, geraniol, limonene, linalool, alpha-zingiberene 30–70%, beta-sesquiphellandrene 15–20%, beta-bisabolene 10–15%, and alpha-farnesene.[9] In dried ginger powder, shogaol, a dehydrated product of gingerol, is a predominant pungent constituent up to biosynthesis 3–5. Oleoresin, which is isolated by acetone and ethanol extraction, contains 4–7.5% of dried powder, pungent substances, namely gingerol, shogaol, zingerone, and paradol. The oleoresin has also been found to contain zingiberol, the principal aroma contributing component as well as zingiberene, gingediol, diarylheptanoids, vitamins, and phytosterols.[10,11] Fresh ginger contains 80.9% moisture, 2.3% protein, 0.9% fat, 1.2% minerals, 2.4% fiber, and 12.3% carbohydrates. The minerals present in ginger are iron, calcium, and phosphorous. It also contains vitamins such as thiamine, riboflavin, niacin, and Vitamin C.[12,13]

MATERIALS AND METHODS

Test Microorganisms

Bacterial strains used are MDR MRSA. The organisms were obtained from the Department of Microbiology, Saveetha Dental College and maintained in nutrient agar slope at 4°C. The dry ginger extract was obtained commercially and used for the study.

Methodology

The extracts were prepared in the following concentrations in sterile water, 5 mg/ml, 10 mg/ml, and 20 mg/ml so that 100 µl of extract of different concentrations delivers 500 µg, 1000 µg, and 2000 µg, respectively.[14]

Assay for Antibacterial Activity using Agar Well Diffusion Method

The screening of antibacterial activity of the dry ginger extract was carried out using the agar well diffusion method. The bacterial strain was inoculated into nutrient broth and incubated at 37°C overnight. The culture was then adjusted to 0.5 McFarland turbidity standard. 23–26 lawn culture of the test organism was made on the Muller-Hinton agar (HiMedia M1084) plates using sterile cotton swab and the plates were dried for 15 min. A sterile cork borer was then used to make wells (6 mm diameter) for different concentrations of the extracts, 100 µl of the varying concentrations (500 µg/ml, 1000 µg/ml, and 2000 µg/ml) of the extracts were introduced into the wells with the help of micropipettes. The culture plates were allowed to stand on the working bench for 30 min for pre-diffusion and were then incubated in upright position at 37°C for 24 h.[15-17] After 24 h, antibacterial activity was determined by the measurement of diameter of zones of inhibition (mm). Standard antibiotic discs of amoxicillin (30 mcg/disc) and ciprofloxacin (30 mcg/disc) were used as positive control. All the tests were done in triplicate to minimize the test error.

RESULTS

The investigation of antibacterial activity of dry ginger extract against, MRSA was done by agar well diffusion method. Mean zones of inhibition of different concentrations were measured and compared with the control and tabulated in Table 1. The extract showed good antibacterial activity at different concentrations with maximum zone of inhibition of 24 mm at concentration of 2000 µg/ml.

DISCUSSION

MRSA remains as a major human pathogen. Often, MRSA infections occur exclusively in hospitals and are limited to immunocompromised patients or individuals with predisposing risk factors.[18,19] The present study investigates an antimicrobial activity of dry ginger against MRSA. Test microorganisms bacterial strains used are MDR MRSA. Dry ginger is a herbaceous root that has many therapeutic activities and shows a significant antibacterial activity against MRSA strains.[20,21] We have used an agar well diffusion method. Some of the advantages that herbal preparations have over the synthetic ones are that they do not act directly on the bacteria but create an adverse environment for them, thus threatening their survival and they have also been found to deter the development of resistant strains of microorganism.[22-24] The extract

Table 1: Anti bacterial activity of dry ginger extract on MRSA

Concentration of the extracts	Zone of inhibition (in mm diameter)
500 µg/ml	11
1000 µg/ml	16
2000 µg/ml	24
Amoxicillin (30 mcg/disc)	25
Ciprofloxacin (30 mcg/disc)	28

showed good antibacterial activity at different concentrations with maximum zone of inhibition of 24 mm at concentration of 2000 µg/ml.

CONCLUSION

The use of herbal medicine is increasing with the increase in the development of drug resistance among bacterial population. Herbal medicines are safe with no side effects and have significant action against bacteria and other microorganisms. In our study, dry ginger extract showed very good effect on MRSA.

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