

Antimicrobial Activity of Ginger (*Zingiber officinalis*) *in vitro*

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The antibacterial activity of ginger extracts in various solvents were tested for activity against six organisms, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Serratia* sp., and *Bacillus subtilis* using the agar-gel diffusion method. The results obtained showed that petroleum ether extract showed highest antibacterial activity against *B. subtilis* while other extracts were also active but at less extent. The MIC of petroleum ether extract of ginger was found to be 25µg/mL. This study established the need for daily use of this product for medicinal purposes.

Key words: Ginger, *Zingiber officinalis*, Antibacterial activity, Solvent extracts.

Many foods present antibiotic functions that often, unbeknownst to the eater, have reduced or limited the growth of bacteria in their body. Among those antibacterial foods that are becoming more common in our western diet are green tea and ginger [Langner *et al.* (1998), White (2007) and Hoffman (2007)]. Ginger a common substance found increasingly in the diets of the global population, have known anti-microbial effects and are commonly used together in teas. Both of these

foods have been valued for anti-microbial properties for thousands of years in Asian cultures (Weil, 1995). As this tradition moves west, research is being done to back the anecdotal evidence of healing stories. In research done on the effects of ginger on angiogenesis, a process that is closely connected to tumor growth and metastasis, gingerol (a main ingredient in ginger) is cited as having anti-bacterial tendencies (Kim *et al.*, 2005). Similarly research on epigallocatechin-gallate, the main catechin in green tea extracts, was found to not only have anti-bacterial properties of its own but also to act in synergy to promote the antibacterial activity of tetracycline, a well known antibiotic (Roccaro *et al.*, 2004). Given the current research and many years of successful medicinal use as an anti-microbial, this study set out to test whether ginger will limit the growth of bacteria found in the human gastrointestinal system.

Present paper describes extraction of bioactive compounds from ginger in various solvents and to test its efficacy as antimicrobial agent against various microorganisms *in vitro*.

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MATERIAL AND METHODS

Material and chemicals

Ginger was purchased from local market. The chemicals used for extraction were procured from Qualigens Fine Chemicals (Mumbai). The cultivation and maintenance media were procured from Himedia Laboratories (Mumbai).

Bacterial strains and culture media

Bacterial cultures used for this study are *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Sarracia* sp. and *Bacillus subtilis*. These cultures were maintained on nutrient agar slants and preserved at 4°C.

Extractions

Ginger (10 gm) was extracted in 100mL of various solvents like chloroform, petroleum ether, diethyl ether and methanol. The extracts were filtered through ordinary filter paper and the filtrates were allowed to dry at room temperature. The dried extracts then weighed and calculated total yields. The extracts were dissolved in DMSO solvent and further used for antimicrobial studies.

Antimicrobial activity

A loopful of bacterial cultures were inoculated in nutrient broth separately and incubated at 30°C for 24 hr. After the full growth of bacterial cultures, 0.1 mL of cell broth was spread on nutrient agar plates. The antimicrobial activity of the extracts was done by agar well method (Zambare *et al.* 2004). Dried extracts (20 mg/mL) were dissolved in DMSO solvent. In agar well, added 0.1 mL of extract and the plates were incubated at 30°C for 24- 48 hr. After 48 hr, the zone of clearance around the well was observed and measured in mm.

Minimum Inhibitory Concentration (MIC)

Minimum inhibitory concentration of the petroleum ether extracts was measured by addition of increased concentration of extract in loopful inoculated culture of *B. subtilis* in nutrient broth (NCCLS, 2003). These tubes were incubated at 30°C for 24 hrs and observed the turbidity in the tubes. The tube concentrations having no turbidity were considered as MIC value of the extract for that organism.

Data analysis

All data used for this experimentation is

obtained from duplicate experiments. Standard deviation was calculated by Microsoft excel.

RESULTS AND DISCUSSION

Ginger is a promising plant material with numerous biological activities. Various solvents were used for extraction of bioactive compound from ginger and the extract yields were measured. Highest % yield obtained with chloroform followed by petroleum ether, methanol and diethyl ether (Table 1). The extraction yield reported by Priscila *et al.* (2007) for ginger with methanol was 1.7%.

Antimicrobial activity of these extracts was tested with different microorganisms by agar well method. From Table 2 it was observed that, petroleum ether inhibited *B. subtilis* (22mm zone of inhibition) followed by chloroform extract inhibition of *P. aeruginosa* and *Serracia* sp. (12mm zone of inhibition). Other extracts inhibited the remaining microbial cultures in range of 01-11 mm zone of inhibition. Samy (2005) used methanol extracts of ginger which did not present antimicrobial effect against *S. aureus* and *E. coli*. However, Indu *et al.*, using a different method of ginger extract preparation, verified an inhibitory action against *E. coli* as well as high antimicrobial activity of garlic extracts against *E. coli* and *Salmonella*. Gugnani & Ezenwanze (1985) and James *et al.* (1999) reported the effect of ginger extract on growth inhibition of *E. coli*, *Proteus* sp, *Staphylococci*, *Streptococci* and *Salmonella*.

MIC value of petroleum ether extract with *B. subtilis* was found to be 25µg/mL. Akoachere *et al.* (2002) calculated MIC value of ethanol extract of ginger against respiratory tract pathogen and ranged from 0.0003-0.7ig/mL while

Table 1. % Yield of extracts in various solvents

Solvents	Extract Yields (%dry weight)
Chloroform	3.01
Diethyl ether	2.21
Petroleum ether	2.91
Methanol	1.48

Table 2. Antimicrobial activity of ginger against different microorganisms

Microorganisms	Zone diameter of inhibition (mm) \pm S.D			
	Chloroform	Diethyl ether	Petroleum ether	Methanol
<i>Bacillus subtilis</i>	10 \pm 2	08 \pm 3	22 \pm 2	12 \pm 2
<i>Pseudomonas aeruginosa</i>	12 \pm 1	08 \pm 1	10 \pm 2	10 \pm 1
<i>Escherichia coli</i>	10 \pm 2	11 \pm 3	06 \pm 1	08 \pm 3
<i>Serratia</i> sp.	12 \pm 2	04 \pm 2	06 \pm 2	01 \pm 2
<i>Staphylococcus aureus</i>	06 \pm 3	08 \pm 2	10 \pm 3	08 \pm 3

minimum bactericidal concentration (MBC) ranged from 0.135-2.04 μ g/mL. The increased inhibitory concentration dose in microbes is because of increasing antimicrobial resistance traits.

The results of this testing shed light into the antimicrobial abilities of test substance, potentially providing ground for natural alternatives to pharmaceutical antibiotic medication.

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