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Antimicrobial activity of spices against Gram positive and Gram negative organisms

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Abstract

Since ancient times, spices are one of the important part of the human diet. In addition, it is used for providing flavor to food and also it possess various preservatives and medicinal values. Spices like turmeric, ginger and chilli exhibit antimicrobial properties. Turmeric is useful for home remedies and is now becoming a great research of interest for its anti-cancerous property. Even in Ayurveda spices are used as main ingredients for preparation of various medicines. This research aimed at studying antimicrobial activity of turmeric, ginger and chilli against Gram positive and Gram negative organisms. Standard laboratory strains of *Escherichia coli, Staphylococcus aureus* and *Bacillus subtilis* were selected for this study. Extracts of spices were prepared using different concentrations of DMSO as solvent (50% and 100%). Disk Diffusion Method was employed for comparative study of each selected spice on selected standard strains. The result demonstrated that the extracts of spices with 100% of DMSO showed greater zones of inhibition as compared to 50%. Gram positive bacteria are more sensitive to chilli and turmeric extracts than Gram negative bacteria whereas Gram negative bacteria are more sensitive to ginger extracts than Gram positive. Various studies have shown that gingerol, a naturally occurring phenol found in ginger disrupts the cell wall of bacteria causing cytoplasmic leakage. Spices might have greater potential to be used as an antimicrobial agents. Also, spices other than turmeric, ginger and chilli can be screened for their antimicrobial activities against microbial pathogens.

Keywords: *Spices, dimethyl sulfoxide (DMSO), Extracts of spices, Antimicrobial activity*

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1. Introduction

Spices are one of the most important and an integral part of the human diet. It is becoming a great research of interest due to its wide range of applications. In addition to adding flavor to the food, it is known to possess various preservative and medicinal values (Dinesh Maharjan *et al.*, 2011). They have been used since centuries in home remedies and one can find them in ancient scriptures like Ayurveda where they have been used as main ingredients for preparation of various medicines.

Food poisoning is prevalent worldwide and is one of the common health problems faced by people of all age groups. It is an acute illness resulting after consumption of contaminated food or water containing infectious agents. However in some cases it might take a severe form. Some of the organisms responsible for causing food poisoning are *Escherichia coli, Salmonella typhi, Bacillus cereus and Staphylococcus aureus*. Some common household spices like turmeric, chilli and ginger powder were used for screening of their antibacterial activity against *Escherichia coli,* a representative of Gram negative group of organisms and *Staphylococcus aureus* and *Bacillus subtilis*, the representatives of Gram positive group of organisms. Turmeric scientifically known as *Curcuma longa* is the flowering plant of ginger family *Zingiberaceae*. Chilli scientifically called *Capsicum annum* is the member of nightshade family *Solanaceae* and Ginger, *Zingiber officinale* is the underground stem (*rhizome*) of the perennial herb. They have been used medicinally to treat a variety of diseases like arthritis, depression, heart ailments, nausea, indigestion etc. The medicinal property of turmeric, chilli and ginger might be due to the active components present in them like the curcumin, capsaicin and gingerol respectively. Furthermore certain studies states that curcumin, present in turmeric may be potential cancer remedy due to their effect on various biological pathways. The pathogenic strains used for this study are some of the organisms responsible for food poisoning. Hence, if the selected spices are effective against the organisms under study then it ultimately suggests that these spices might be used as preventive measures for controlling food poisoning in future.

2. Methodology

Sample of spices used

1. Turmeric powder
2. Chilli powder
3. Ginger powder

2.1. Preparation of extracts of spices

The spices used were bought in processed form from the local market. For preparation of extracts, dimethyl sulfoxide (DMSO) was used as a solvent. Two different concentrations of DMSO, i.e., 100% and 50% were used. The spice extracts with 100% of DMSO were made by adding 10 ml of DMSO and 0.1 gm of each selected spice into dilution tubes. Thus 1% concentration of each spice extracts were prepared. In the similar way, the extracts with 50% of DMSO (diluted) were prepared. 5 ml of DMSO with 5 ml of Distilled water and 0.1 gm of each selected spice was added to different dilution tubes. Thus 1% concentration of each spice extracts were prepared. The prepared extract solutions were stored in the refrigerator.

2.2. Standard laboratory bacterial cultures

The three different bacterial strains selected for the study were as follows:

1. *Escherichia coli*
2. *Staphylococcus aureus*
3. *Bacillus subtilis*

The cultures were maintained on Nutrient agar slants and were subcultured after every one week.

2.3. Screening of Antibacterial activity of prepared spice extracts

The antimicrobial activity of prepared extracts against the selected bacterial strains was studied by Disk Diffusion Method. Sterile Nutrient agar plates and Sterile Whatman filter paper disc of pore size-11 μm with 6 mm of diameter were prepared. Each selected strain was aseptically swabbed on each different sterile nutrient agar plates. After swabbing, the plates were left to dry at room temperature for 8-10 min so that excess moisture gets absorbed. Then using alcohol dipped and flame sterilized forcep, the disc was dipped into prepared spice

extract and it was aseptically placed and gently tapped on a nutrient agar plate which was already swabbed with selected test organisms. This procedure was repeated for all selected organisms using all the selected spice extracts. After placing the disc these plates were incubated for 24 h at 37 °C. After incubation, zones of inhibition were observed and recorded in mm (millimeter).

3. Results and discussion

After incubation, the zones of inhibition were recorded in Table 1. It was observed that the zones of inhibition for 100% DMSO (Dimethyl sulfoxide) are greater as compared to 50% DMSO concentration. The probable reason for this might be the polarity of DMSO. In 100%, i.e., undiluted DMSO, active component of selected sample diffuses properly and thus more efficient results are obtained. Figures 1 and 2 shows the results obtained during this study. Extracts of turmeric and chilli both showed the highest inhibitory action against *Bacillus subtilis*. The extracts of turmeric showed zones of inhibition of 39 mm and 49 mm for 50% and 100% DMSO respectively that of chilli extracts showed zones of inhibition of 36 mm and 40 mm for 50% and 100% DMSO respectively. Also, these extracts (turmeric and chilli) showed better antibacterial activity against *Staphylococcus aureus* as compared to *Escherichia coli*. Turmeric extracts exhibited zones of inhibition having diameter 33 mm and 41 mm and chilli extracts exhibited zones of inhibition as 36 mm and 40 mm for 50% and 100% DMSO respectively. The zones of inhibitions exhibited by turmeric and chilli extracts were small against *Escherichia coli* amongst the three selected organisms. Ginger exhibited larger zones of inhibition against *Escherichia coli* 43 mm and 44 mm for 50% and 100% of DMSO concentration respectively as compared to *Staphylococcus aureus* and *Bacillus subtilis* which exhibited (34 mm, 41 mm) and (37 mm, 40 mm) for 50% and 100% DMSO respectively.

Table 1: Observed zones of inhibition (in mm)

S. No.	Strains Samples	*Escherichia coli*		*Staphylococcus aureus*		*Bacillus subtilis*	
	Concentrations of DMSO	**50%**	**100%**	**50%**	**100%**	**50%**	**100%**
1.	Turmeric	36 mm	40 mm	33 mm	41 mm	39 mm	49 mm
2.	Ginger	43 mm	44 mm	34 mm	41 mm	37 mm	40 mm
3.	Chilli	31 mm	32 mm	36 mm	40 mm	36 mm	40 mm

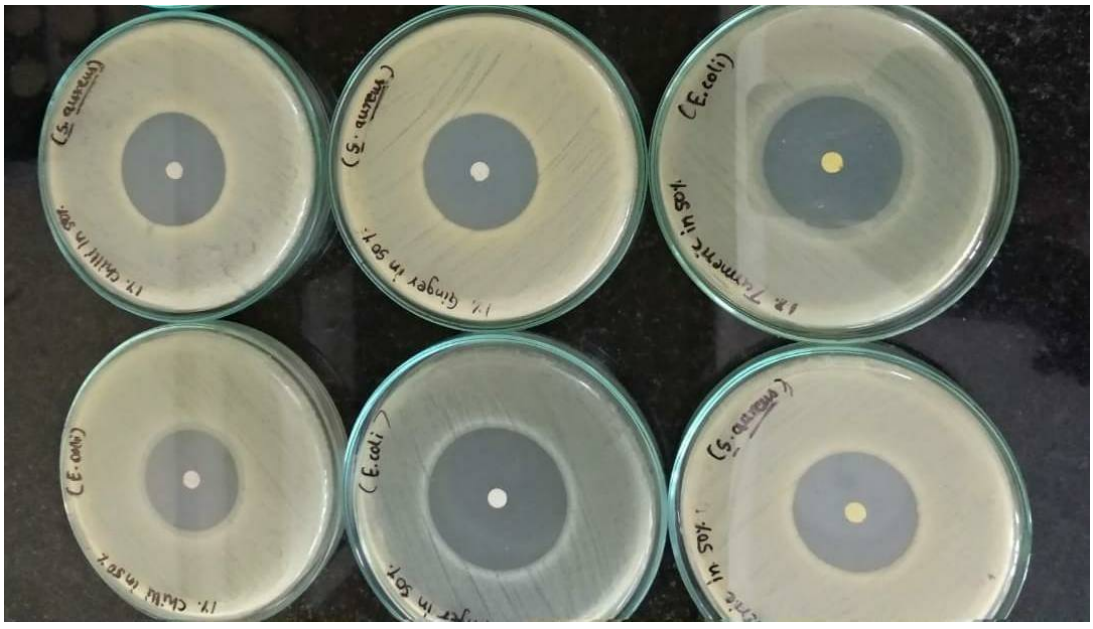

Figure 1: Zones of inhibition exhibited by 1% spice extracts prepared in 50% of DMSO

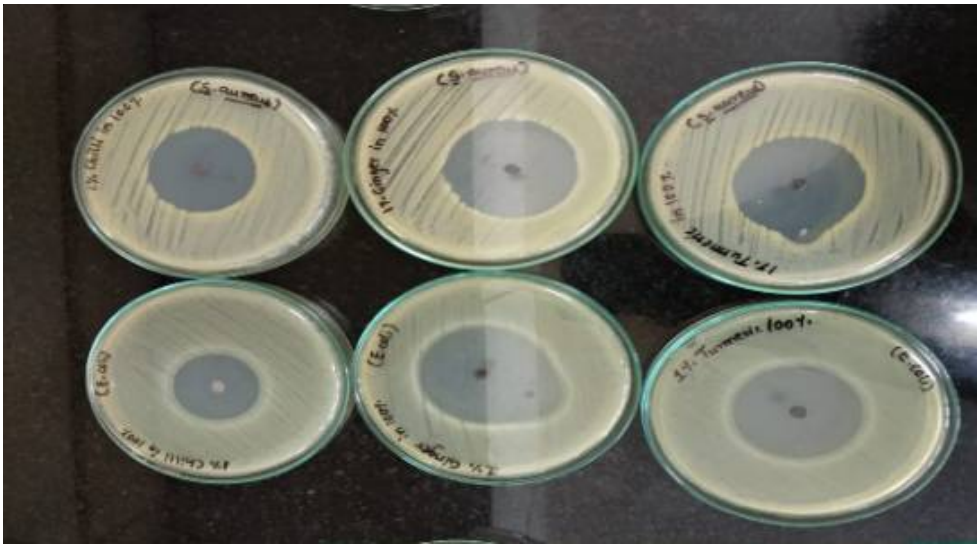

Figure 2: Zones of inhibition exhibited by 1% spice extracts prepared in 100% of DMSO

4. Conclusion

From the results obtained, we can conclude that spices selected for the study were found to be effective against both Gram positive and Gram negative organisms. However, Gram positive bacteria like *Bacillus subtilis* and *Staphylococcus aureus* were found to be more sensitive to turmeric and chilli extracts than Gram negative bacteria whereas Gram negative bacteria, i.e., *Escherichia coli* was found to be more sensitive towards ginger extract than Gram positive bacteria. Other higher concentrations of spices like 5%, 10%, etc. can be screened for their antibacterial activity. Antimicrobial activity of various other spices such as clove, cinnamon, etc can also be examined. Mixtures of two or more spices can also be screened for their antibacterial activity to check their combined effect on microbial pathogens and medical isolates can also be used for further study.

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