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Investigation of Antibacterial Potential of Turmeric (Curcuma Longa) on Enteric Pathogens

KEYWORDS: Turmeric, *Curcuma longa*, enteric bacterial pathogens, Antibacterial activity

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ABSTRACT *Turmeric is popularly believed to be useful for the enteric infection. This belief is based on traditional use, and some laboratory evidence that turmeric has antibacterial and antiviral properties. We looked for studies that investigated the use of turmeric for either preventing or treating people with the enteric infection. The extract showed concentration dependent and organic extract dependent antibacterial activity against enteric bacterial pathogens. The traditional use of turmeric for infectious diseases and for controlling enteric bacterial pathogens appears to be justified.*

INTRODUCTION:

In India, turmeric has been used traditionally for thousands of years as a remedy for stomach and liver ailments, as well as topically to heal sores, basically for its supposed antimicrobial property (Chaturvedi, 2009; Brennan, 2008). In the Siddha system turmeric was a medicine for a range of diseases and conditions, including those of the skin, pulmonary, and gastrointestinal systems, aches, pains, wounds, sprains, and liver disorders. A fresh juice is commonly used in many skin conditions, including eczema, chicken pox, shingles, allergy, and scabies (Khalsa SVK, 2013, Tambekar, et al, 2013).

Some research shows compounds in turmeric to have antifungal and antibacterial properties; (Ragasa et al, 2005, Tambekar and Khadase, 2002). The turmeric is being evaluated for its potential efficacy against several human diseases in clinical trials, including kidney and diseases, arthritis, several types of cancer and irritable bowel disease, Alzheimer's disease, diabetes, and other clinical disorders. The active compound curcumin is believed to have a wide range of biological effects including anti-inflammatory, antioxidant, antitumour, antibacterial, and antiviral activities, which indicate potential in clinical medicine (Mishra and Palanivelu, 2008, Boaz et al, 2008, Gregory et al, 2008, Chattopadhyay, et al, 2004)

There is extensive literature on the antibacterial effects of fresh turmeric extracts (aqueous and alcoholic), lyophilized powders, steam distilled oil and other commercial preparations of turmeric (Rahman, 2010, Singh, 2002). Topical and dietary turmeric has been used in the treatment of infection particularly digestive, respiratory and dermatologic infections- ranging from diarrhoea and vaginitis to colds and warts (Rath, 1999, Banerjee and Nigam, 1978). Due to these encouraging antibiotic properties of turmeric, attempt was made to reinvestigate the antibacterial potential of turmeric extracts against enteric bacterial pathogens.

Materials and Methods:

Collection of Turmeric bulb and Standardization of Inoculum: Dry turmeric bulbs were purchased from local market and standard bacterial cultures were procured from IMTECH, Chandigarh. For the standardization of inoculum 0.1 ml of bacterial culture was inoculated in 10-ml sterile nutrient broth, incubated it for 3 h at 37^{0}C and turbidity of culture was measure with the help of Nephlo-turbidometer and viable count was measure by SPC (Table 1). Rosacillin (Ampicillin 500 mg.5 mL) was used as reference standard antibiotic in the present study.

Table1: Inoculum size of Organisms.

Bacterial Pathogen with MTCC number	Turbido-metric Count (NTU)	SPC Count 10^8 dilution
E.coli 390	18.0 NTU	90 x 10^5 CFU/ml
E.coli 739	17.0 NTU	90 x 10^5 CFU/ml
Staphylococcus epidermidis435	20.0 NTU	89 x 10^5 CFU/ml
Klebsiella pneumoniae109	64.0 NTU	98 x 10^5 CFU/ml
Enterobacter aerogenes 111	56.3 NTU	90 x 10^5 CFU/ml
Staphylococcus aureus 96	8.0 NTU	78 x 10^5 CFU/ml
Salmonella typhi 733	13.5 NTU	90 x 10^5 CFU/ml
Pseudomonas aeruginosa 424	90.0 NTU	96 x 10^5 CFU/ml
Proteus vulgaris 426	20.0 NTU	98 x 10^5 CFU/ml
Salmonella typhimurium 98	23.0 NTU	110 x 10^5 CFU/ml

Preparation of disc of various turmeric extract: Whatman filter paper (No1) disc (10mm) were used in the study. The prewashed and disinfected turmeric were crushed in mortar and pestle, filtered through muslin cloth and aqueous extract of 50%, 20%, 10%, 5% dilutions were made. Organic solvent extract of turmeric were made by using ethanol, methanol, benzene, xylene, ether and acetone. The turmeric powder was mixed with various organic solvents and allowed to treat for 24 h and separated by separating funnel. The separated solvent containing extract was evaporated to dryness and resulting powder was redissolved in water (100 mg/ml each). The disc containing extracts were applied to different test bacterial lawn prepared on nutrient agar using agar disc diffusion method. After incubation of 24 h at 37^{0}C zone of inhibition was measured.

Results and discussion:

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Table 2: Zone of growth inhibition in mm by aqueous and various organic solvent extract of turmeric against bacterial enteric pathogens.

Enteric Bacterial Pathogens	Ampicillin	Aqueous extracts					Organic solvent extracts					
		100%	50%	20%	5%	10%	Ether	Ethanol	Methanol	Xylene	Benzene	Acetone
E. coli (390)	15	19	18	17	15	12	17	18	23	19	21	22
E.coli (739)	16	20	18	18	15	12	21	22	23	22	24	18
Ent.aerogenes (111)	15	19	17	14	12	11	21	22	21	20	18	18
Kleb. Pneumoniae (109)	18	20	18	16	15	13	20	19	18	18	15	14
Pr. vulgaris (426)	15	22	21	18	14	12	18	18	19	18	16	17
Ps. aeruginosa (424)	15	19	18	16	13	10	20	21	20	18	20	20
Sal. typhi (733)	15	19	17	16	14	12	19	18	17	15	15	14
Sal. typhimurium (98)	15	18	16	16	14	12	22	20	21	19	19	19
Staph. aureus (96)	15	23	19	17	16	12	22	20	20	18	18	17
Staph. epidermidis(435)	16	20	19	17	14	12	22	21	20	18	20	16

The activity of turmeric was determined against the various test pathogens and found antibacterial against them. Turmeric was more effective than any of the test antibiotics against Staphylococcus, E.coli, Proteus, Pseudomonas and Klebsiella bacteria. Turmeric possesses curcuma, which is responsible for antibacterial activity of turmeric. The most important chemical components of turmeric are a group of compounds called curcuminoids, which include curcumin (diferuloylmethane), demethoxycurcumin, and bisdemethoxycurcumin (Henrotin et al, 2010). Moreover, turmeric extracts exhibited activity against both gram negative (E. coli, Salmonella species, Citrobacter, Enterobacter, Pseudomonas, and Klebsiella) and gram positive (S. aureus, S. pneumonia Group A streptococcus and Bacillus anthrax) all of which are causes of morbidity world wide (Garg and Jain, 1998, Luthra et al, 2001).

The study showed that 100% aqueous extract of turmeric (Table 2) was strongest antibacterial against *Proteus vulgaris*, *Staphylococcus aureus, Staphylococcus epidermidis*, *Klebsiella pneumoniae* (22-23mm zone of inhibition) where as least antibacterial against *Pseudomonas aeruginosa*, *Enterobacter aerogenes* (10-11 mm zone of inhibition). The 50% aqueous extracts of turmeric was strong antibacterial against *Proteus vulgaris* (21-mm zone of inhibition) whereas least antibacterial in *Salmonella typhi* (17-mm zone of inhibition). The 20% aqueous extract of turmeric showed highest antibacterial potential against *Proteus vulgaris, E.coli* 739 (18-mm zone of inhibition) and least against *Enterobacter aerogenes* (14-18 mm zone of inhibition).

Fig. 1: Antibacterial activity of various extracts of turmeric against bacterial enteric pathogens

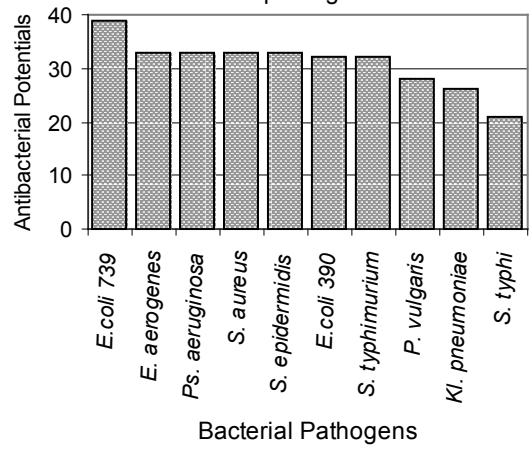
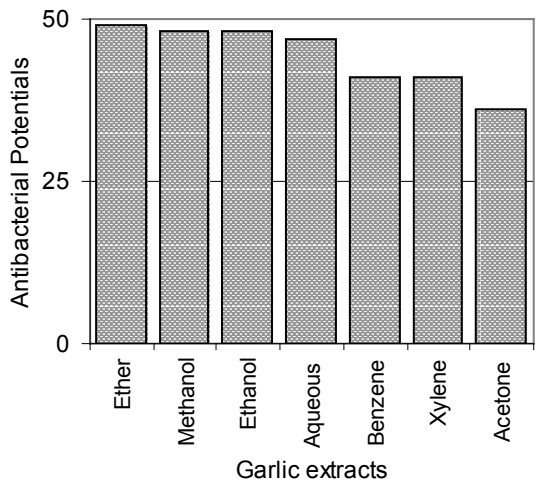


Fig. 2: Antibacterial potential of vaious turmeric extract



The ethanol extract of turmeric (Table 2) showed highest sensitivity against *Enterobacter aerogenes*, *E.coli* 739 (22-mm zone of inhibition) and least sensitivity against *Salmonella typhi, Proteus vulgaris, E.coli* 390 (18-mm zone of inhibition). Ether extract of turmeric showed the highest sensitivity against *Staphylococcus aureus, Staphylococcus epidermidis, Salmonella typhimurium* and least sensitivity against *E.coli* 390 (18-20 mm zone of inhibition). Methanol extract of turmeric showed highest sensitivity against *E.coli* 739 *E.coli 390 (22*-mm zone of inhibition) and least sensitivity against *Salmonella typhi* (17-mm zone of inhibition). Xylene extract of turmeric showed highest sensitivity against *E.coli 739, (22* zone of inhibition) and least sensitivity against *Salmonella typhi* (15-mm zone of inhibition). Benzene extract of turmeric showed highest sensitivity against *E.coli* 739. (24 mm zone of inhibition) and least antibacterial against *Salmonella typhi, Klebsiella pneumoniae* (15 mm zone of inhibition). The acetone extract of turmeric showed maximum zone of inhibition against the organism *E.coli 390* (22 mm zone of inhibition) and least sensitivity against the organism *Klebsiella pneumoniae, Salmonella typhi* (14-mm zone of inhibition) (Table 2).

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These antibacterial potential observed in both aqueous and solvent extract by comparing with antibiotic ampicillin as a standard. The efficiency of the aqueous turmeric extract was decreased after some periods which may due to volatile properties of curcumin (Arora and Kaur, 1999). The study showed that *E.coli*, *Enterobacter aerogenes, Pseudomonas aeruginosa*, *Staphylococcus aureus, Staphylococcus epidermidis* and *Salmonella typhimurium* were very much sensitive to turmeric extract as compare to other tested pathogens (Fig. 1). Out of the various aqueous and solvent extracts of turmeric's ether, ethanol, methanol and aqueous extracts were highly potential antibacterial as compare to acetone, xylene and benzene (Fig. 2). The effectiveness of turmeric is comparable with that of commercial antibiotics and some times more effective than broad spectrum antibiotic moreover don't evolve to build up a resistance to it as they do too many modern antibiotics. This also makes it potentially effective against hospital superbugs or at least less likely to contribute to their evolution. Therefore turmeric consumption may be used as an economic way for patients or hospital workers to prevent infection. This result clearly indicates that aqueous and solvent extract of turmeric possesses antimicrobial activity and daily use of turmeric as food ingredient can prevent enteric infections. The use of turmeric in daily diet can uplift the immune system of a person and help to improve his health at low cost.

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