

Original Research Article

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Comparative Evaluation of Antibacterial Activity of Turmeric (*Curcuma longa*) and Fennel (*Foeniculum vulgare*) Extracts

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ABSTRACT

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Drugs from natural medicinal plants products have important chemical compounds with pharmacological and toxicological value may use as a substitute to control microbial infections. In the present study ethyl acetate, methanol and benzene extracts of turmeric and fennel were studied for its antibacterial activity against *Staphylococcus aureus*, *Salmonella typhi* and *Escherichia coli*. The results showed that the plant extracts were specific in action against the growth of bacteria and showed zone of inhibition. The highest growth inhibition was found in the benzene extract of fennel against *S. aureus* whereas, it was lowest in ethyl acetate extract of turmeric against *E. coli*. The zone of inhibition in all three extract of fennel exhibited higher antibacterial activity as compared to turmeric. The fennel extracts displayed extensively a competitive inhibitory potency with the more effective benzene extract. The results of the study indicates that these plants possess phyto-constituents having antibacterial activity thus can be utilized as a natural plant based antimicrobials.

Introduction

The pathogenic organism has been developed resistant to many antibiotics because of indiscriminate use of antimicrobial drugs. The drugs which are already in use to treat infectious diseases are of concern because, drug safety remains an enormous global issue. Due to development of antimicrobial resistance and safety concern to the available antibiotics has led researchers to search and design new alternative drugs. Plant-based medicinal agents offer an alternative

approach. Drugs from natural medicinal plants products have important chemical compounds with pharmacological and toxicological value may use as a substitute to control microbial infections. Globally, plant extracts are employed for their antibacterial, antifungal and antiviral activities. It is known that more than 400,000 spp. of tropical flowering plants have medicinal properties and this has made traditional medicine cheaper than modern medicine (Odugbemi, 2006). In India there is 15 agro-climatic regions with 2500 medicinal plants which are

dispersed across all biogeographic areas, serve as a regular source of medicine. These medicinal plants have provided anti-infective agents in the form of alkaloids, flavonoids, phenols, tannins, steroids, terpenoids, saponins and phytosterol which are highly effective against pathogenic microbial.

Along with these plants also use in the treatment of diarrhoea or gastrointestinal disorder, urinary tract infections, skin infections, infertility, wound and cutaneous abscesses (Meyer *et al.*, 1996; Dimayuga and Gracia, 1991). Therefore, researchers are more and more turning their attention to plant-based medicinal agents, looking for fresh leads to develop better drugs against microbial infections. In the present study two plant species namely Turmeric (*Curcuma longa*) and Fennel (*Foeniculum vulgare*) are used.

Turmeric is perennial in nature from Zingiberaceae family and its rhizome is the part used both as medicine and spice. The active principles present in the turmeric rhizome are curcuminoids, such as curcumin (diferuloylmethane), α -ar-turmerone, methylcurcuminbis demethoxycurcumin, sodium curcumin and demethoxycurcumin. Another component named curcumin (Al-Mashhadani, 2015) ranged from two to five percent in turmeric (Bagchi, 2012). The curcumin included many therapeutic properties such as antioxidant, antibacterial, hypocholesteremic, hypolipidaemic and anticoccidial (Hussein, 2013; El-Khtam *et al.*, 2014), antidiabetic, anticoagulant and antiulcer (Rafatullah, *et al.*, 1990). It has additionally anti-inflammatory (Aggarwal, *et al.*, 2013), nematocidal, antiseptic, hepatoprotective and immunomodulatory property (Daneshyar *et al.*, 2011). Another herb is Fennel, i.e. *Foeniculum vulgare* seed contains phellandrine, fenchone, limonine, aldehyde of anisic and anisic acid. Of many

medicinal properties, it is used as antioxidant (Oktay *et al.*, 2003), hepatoprotective, anticancer, antimicrobial (Ruberto *et al.*, 2000) and for treatment against nausea. Further gastrointestinal calming impacts of fennel can be summarized as laxative, spasmolytic, carminative and stimulant on abdominal pain.

Fennel fruit essential oil (Salami *et al.*, 2016) may reduce the risk of inflammation-related diseases and have antimicrobial effect related with the content of trans-anethole. Therefore, the aim of the current research focuses to investigate the effects of these herbs on growth of *S. aureus*, *S. typhi* and *E. coli*.

Materials and Methods

Collection of Plant Material

The samples of Turmeric (rhizome) and Fennel (seed) were purchased from the shop of herbal medicine and were identified by a well-known taxonomist of Bikaner. The fresh sample of Turmeric (rhizome) and Fennel (seed) was dried separately, ground and used for further analysis.

Preparation of Extracts by Solvent extraction

Crude plant extract was prepared by soxhlet extraction method. Five grams of powdered Turmeric (rhizome) and Fennel (seed) was filled in thimble directly and were placed in soxhlet apparatus and extracted separately using methanol, benzene and ethyl acetate for 24hrs or till the solvent in siphon tube of an extractor become colourless. The extracts were then concentrated in preweighted vials on rotary evaporator below 50°C. Dried extract was weighted and reconstituted with a known volume of solvent and were stored in vials at 4°C for further experimental studies.

Screening of Plant Extracts for Antibacterial Activity

Antibacterial activities of different extracts were examined by the well diffusion method. Pure cultures of bacteria maintained in the nutrient broth medium. The test organisms used are *Staphylococcus aureus*, *Salmonella typhi* and *Escherichia coli*. Stock cultures were maintained at 4 °C in nutrient broth. Active cultures for experiments were prepared by transferring a loopful of cells from the stock cultures to test tubes of nutrient broth for bacteria that were incubated without agitation for 24 h at 37 °C. Media was prepared by dissolving 0.5% Peptone, 0.3% beef extract/yeast extract, 1.5% agar, 0.5% NaCl and dissolved in 100ml distilled water and autoclaved at 121 °C for 15min. Standard well diffusion method was carried out to screen the antibacterial activity. In vitro antibacterial activity was screened by using nutrient agar media.

The nutrient agar plates were prepared by pouring 10ml to 15ml of molten liquid media into sterile Petri plates. The plates were allowed to solidify for a few minutes and 0.1% inoculum suspension was swabbed uniformly and the inoculum was allowed to dry for 10min. wells were prepared on agar plates and 100µl extract and solvent in control

well was inoculated and the plates were kept for incubation at 37 °C for 24h. At the end of incubation, inhibition zones formed around the wells were measured with a transparent ruler in millimeter.

Results and Discussion

In the present investigation, in vitro antibacterial activities of the crude extracts of two plants were qualitatively assessed on the basis of the inhibition zone. The inhibition effect on growth of *S. aureus*, *S. typhi* and *E. coli* by three extracts of turmeric and fennel was measured (Table 1). The results showed that the plant extracts were specific inaction against the growth of bacteria. The zones of inhibition of solvents (control) were negligible. Against *S. aureus* in the zone of inhibition was 11±0.24mm and 17±0.14mm by ethyl acetate extract of turmeric and fennel, respectively. In methanol extract of turmeric and fennel the zone of inhibition against *S. aureus* was 10±0.5mm and 19±0.17mm respectively. In benzene extract of turmeric, the zone of inhibition was 12±0.24mm whereas; it was 23±0.67 in benzene extract of fennel against *S. aureus*. On comparison of mean values of zone of inhibition, the all three extract of fennel exhibited higher antibacterial activity as compared to turmeric.

Table.1 Mean inhibitory (mm) values by the various crude extract of Turmeric and Fennel against tested microorganism

Bacterial organism	Turmeric (<i>Curcuma longa</i>)			Fennel (<i>Foeniculum vulgare</i>)		
	EA	M	B	EA	M	B
<i>S. aureus</i>	11±0.24	10±0.5	12±0.24	17±0.14	19±0.17	23±0.67
<i>S. typhi</i>	12±0.22	16±0.4	15±0.25	15±0.29	18±0.21	17±0.32
<i>E. coli</i>	8.5±0.5	15±0.5	17±0.34	15±0.22	17±0.54	19±0.14

The zone of inhibition against *S. typhi* was 12±0.22mm and 15±0.29mm in ethylacetate extract of turmeric and fennel,

respectively. On comparison of mean value it was observed that the higher antibacterial activity was showed by ethyl acetate extract

of fennel. In methanol extract of turmeric and fennel the zone of inhibition against *S. typhi* was 16 ± 0.4 mm and 18 ± 0.21 mm, respectively. *S. typhi* was more sensitive for the methanol extract of fennel. In benzene extract of turmeric, the zone of inhibition was 15 ± 0.25 mm whereas; it was 17 ± 0.32 in benzene extract of fennel against *S. typhi*. The benzene extract of fennel have more zone of inhibition against *S. typhi* as compared to turmeric.

Against *E. coli* the zone of inhibition was 8.5 ± 0.5 mm and 15 ± 0.22 mm by ethyl acetate extract of turmeric and fennel respectively. In methanol extract of turmeric and fennel the zone of inhibition against *E. coli* was 15 ± 0.5 mm and 17 ± 0.54 mm respectively. In benzene extract of turmeric, the zone of inhibition was 17 ± 0.34 mm whereas; it was 19 ± 0.14 in benzene extract of fennel against *E. coli*. All three extracts of fennel have more antibacterial activity against *E. coli* as compared to turmeric.

Curcumin, the main yellow bioactive component of turmeric powder, has been shown to have several biological effects such as antimicrobial activity (Chattopadhyay *et al.*, 2004; Di Mario *et al.*, 2007). Tajbakhsh *et al.*, (2008) reported that curcumin was effective against *S.aureus* and *S. epidermidis*, Nisar *et al.*, (2015) also reported the antimicrobial activity of *Curcuma longa* against various bacterial strains viz *E.coli*, *S.typhi*, *S. aureus* and *Vibrio cholera*. These data of antibacterial activity of fennel obtained in present investigation was coincide with those of Cantore *et al.*, (2004), Roby *et al.*, (2013) and Chang *et al.*, (2016) who also reported that fennel essential oil indicated significant antibacterial activity, as determined through agar diffusion method.

From the result obtained it can be concluded that ethyl acetate, methanol and benzene

extracts of both plants have a marked antibacterial activity against all three microorganism tested. The fennel extracts displayed extensively a competitive inhibitory potency with the more effective benzene extract. The result of this study also supports the traditional application of the plant and suggests that the plant extracts possess compounds with antibacterial properties that can be used as antibacterial agents in novel drugs for the treatment of various diseases.

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