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Antibacterial Activity of Some Commonly Used Food Commodities Against *Escherichia coli, Salmonella typhi* and *Staphylococcus aureus*

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Abstract. The activity of commonly used spices and salt, sugar and pickles against *Escherichia coli*, *Salmonella typhi*, and *Staphylococcus aureus* was tested. The antibacterial activity was found to be in descending order like coriander>pickles>salt and sugar>clove>turmeric>black pepper>red chilli against *S. typhi* and garlic>clove>onion>ginger against *S. aureus*.

Keywords: spices, antibacterial activity, food commodities

Introduction

Due to the increasing microbial resistance to drugs, use of phytochemicals for pharmaceutical purposes has gradually increased (Erdogrul, 2002). According to World Health Organization (WHO) more than 80% of the world's population, at present, relies on botanical preparations to meet their health needs (Diallo *et al.*, 1999), usually in rural areas of many developing countries (Sandhu and Heinrich, 2005; Gupta *et al.*, 2005).

Among various diarrhoeagenic serotypes of *Escherichia coli*, enterohemorrhagic *E. coli* O157:H7 has been implicated in a large number of food-borne outbreaks in many parts of the world including developed nations and has low infective dose. Worldwide, annually 1.3 billion cases of human salmonellosis are reported with three million deaths. *Staphylococcus aureus* is a toxigenic pathogen capable of initiating clinical symptoms in humans, consumd through many foods commonly contaminated during handling; thus it is an indicator of unsanitary conditions during handling and or processing of foods (Indu *et al*., 2006).

Herbs and spices are generally considered safe and have proved to be effective against certain ailments. At least 35000 plant species are used in traditional herbal medicine throughout the world (Kong *et al*., 2003). Medicinal value of plants lies in the chemical substances having a definite physiological action on the human body (Edeoga *et al*., 2005). During the last few years, a number of studies were conducted in different countries to find out the medicinal value of different plants (Nascimento *et al.*, 2000; Fabio *et al*., 2003; Nanasombat and Lahasupthawee, 2005).

Flavonoids, such as quercetin are health supportive compounds produced by onions; they are active against a wide array of microorganisms. In humans, ginger is considered to act directly on the gastrointestinal system to reduce nausea. Traditionally, ginger has been used to treat intestinal infections, especially related to digestive problems. Ginger has the capacity to eliminate harmful bacteria, such as *E. coli*, responsible for most types of diarrhoea, especially in children (Azu *et al.*, 2007). Garlic also possesses antibacterial activity and is used as a remedy for many infections, digestive disorders, and fungal infections such as thrush (Sofia *et al*., 2007). Clove possesses antibacterial activity; it contains eugenol and is usually more bacteriostatic than other spices (Frazier and Westhoff, 1978). Cumin has moderate and red-pepper has a weak inhibitory activity against microbes (Agaoglu *et al*., 2007). Antimicrobial effect of turmeric is well documented (Marthi, 1999). Coriander seed oil has antibacterial properties and is used for treating colic, neuralgia and rheumatism. Salt and sugar tend to tie up moisture and thus have an adverse effect on microorganisms (Frazier Westhoff, 1978). The antibacterial effects of spices differ with the kind of spice, the microorganisms being tested, and the medium used (Frazier and Westhoff, 1978).

In the present study, the antibacterial effect of widely used spices such as turmeric, clove, black pepper, red chilli, coriander, cumin seed, garlic, ginger, onion and some other food commodities such as salt, sugar and pickles has been evaluated against the bacteria, *E. coli, S. typhi* and *S. aureus*.

Materials and Methods

Procurement of samples. Commonly used spices and foods, namely turmeric, clove, black pepper, red chilli, coriander, cumin seed, garlic, ginger, onion, salt, sugar and pickle were purchased from the local markets in whole form.

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Preparation of samples. Spices were powdered in a grinder whereas garlic, ginger, onion and pickles were blended using Waring Blender (Westpoint, Model TSK-242). 50 g of both powdered and blended samples were mixed with 450 ml of diluent (Butterfield phosphate buffer) to make 1:10 dilution, from which 10 fold serial dilutions were prepared (1:10, 1:100 and 1: 1000).

Sterilization of samples. Whatman filter paper was used to remove large particles from the 1:10 dilutions of all samples and then they were sterilized before preparation of further dilutions using membrane filter (cellulose nitrate, 0.45 µm).

Preparation of bacterial cultures. All the cultures were revived befor every experiment by inoculating nutrient broth with working cultures and then incubating at 35 °C for 18 h. *E.coli* was grown in nutrient broth for 2 h before use.

Agar well diffusion method. Antimicrobial activity was determined by agar well diffusion method (Zaika, 1988). Plates of Baird Parker agar, MacConkey's agar and Bismith sulphite agar were spreaded with 0.1 ml culture of *S. aureus*, *E. coli* and *S. typhi*, respectively. Wells were filled by adding 100 µl of food extracts of varying dilutions while sterile diluent was used as control. Plates were kept at room temperature for diffusion of sample dilution in the media then incubated at 35 °C. After 24 h, the diameter of inhibition zones were measured (including well) in mm with the help of antibiotic zone measuring scale.

Results and Discussion

Most of the commodities showed good inhibitory activity against *S. typhi*. These included turmeric, coriander, pickle, salt and sugar at the conc. of 0.1%, whereas black pepper and red chilli showed inhibitory activity only at a concentration of 10%. Coriander and pickle gave strong antibacterial activity against *S. typhi* with 42 mm and 40 mm zones of inhibition, respectively, at a concentration of 10 %. Cumin seeds, garlic, ginger and onion had no antibacterial activity against *S. typhi* (Fig. 1). In a study carried out by Suresh *et al.* (2004), garlic exhibited very good antibacterial activity even in very low concentrations against *Salmonella* species whereas onion and ginger showed only moderate levels of inhibitory effect.

Clove and garlic exhibited good inhibitory activity at 1% concentration; garlic, clove, ginger, turmeric and onion also showed inhibitory effect against *E. coli* but at 10% concentration (Fig. 2). In a similar study of Adler and Beuchate (2002), addition of garlic to a food substance enhanced the inactivation of *E. coli* at varying temperatures including 35 ºC. On the contrary, black pepper, red chili, coriander, cumin seeds, pickle, salt and sugar did not show any antibacterial activity against *E. coli*.

Garlic displayed strong inhibitory activity against *S. aureus* with 25 mm zone of inhibition at a concentration of 10%. Clove, ginger and onion showed less inhibitory activity whereas turmeric, black pepper, red chili, coriander, cumin seed, pickle, salt and sugar did not show any antibacterial activity against *S. aureus*. (Fig. 3).

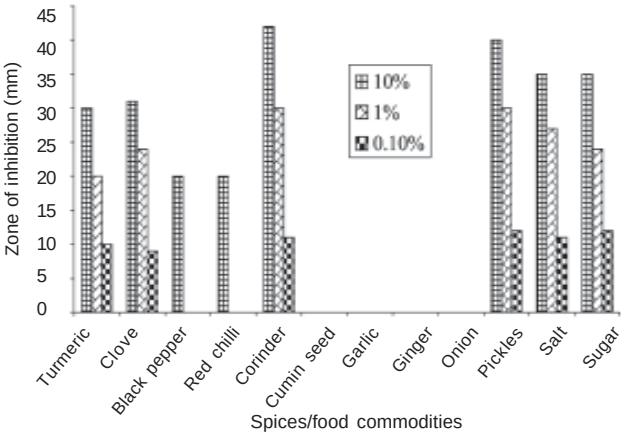

Fig. 1. Antibacterial activity of spices/food commodities against *S. typhi*.

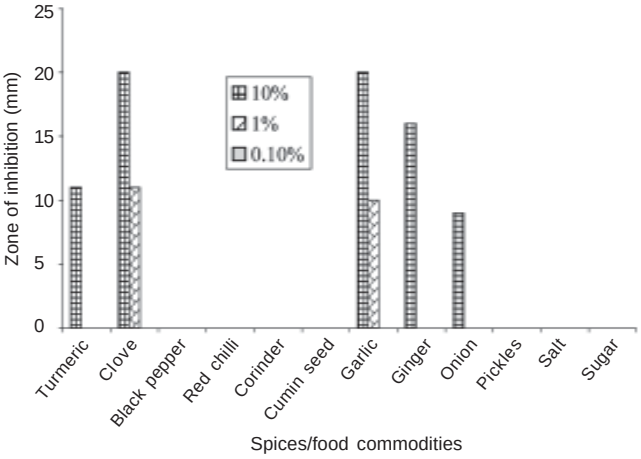

Fig. 2. Antibacterial activity of spices/food commodities against *E. coli.*

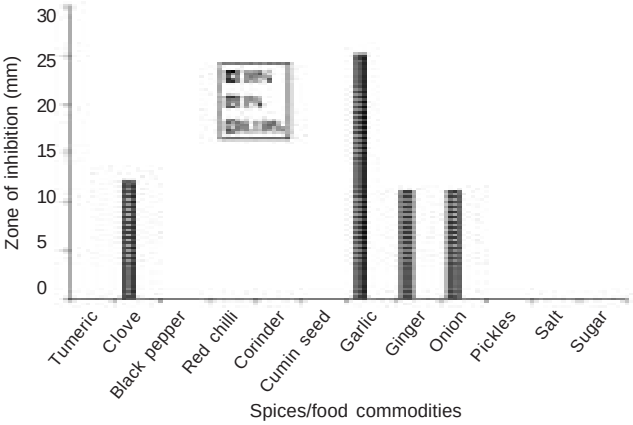

Fig. 3. Antibacterial activity of spices/food commodities against *S. aureus.*

Conclusion

The results confirm that tested spices and other commodities possess antimicrobial activity in varying degrees and they can act as natural food preservatives and natural therapeutics. In developing countries like India and Pakistan, where spices are produced and used as food additives, their use as antimicrobial agents and potential preservatives can be extremely useful.

The standard method for testing of *Salmonella*, described in the *Bacteriological Analytical Manual* (an Online USFDA Publication), recommends using higher dilutions for plating i.e. dilution of 1:100 in case of cinnamon, oregano, all spice and even dilution of 1:1000 in case of clove instead of regular 1:10 dilution for most of the food commodities other than these spices. The present study has shown that there are some other commodities as well, such as coriander, turmeric, pickles, salt and sugar which also require further dilutions to neutralize the effect of natural antagonism against *Salmonella* which was found to be the most sensitive organism among the tested organisms. Other organisms tested did not show sensitivity to these spices and food commodities to that extent.

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