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ANTIMICROBIAL ACTIVITY OF GINGER (*Zingiber Officinale*) EXTRACTS AGAINST FOOD-BORNE PATHOGENIC BACTERIA

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Abstract: Ginger (*Zingiber officinale*) has long been used as naturopathy due to their potential antimicrobial activity against different microbial pathogens. Moreover, in many countries like Bangladesh, ginger is used in different boiled food preparations. This study was conducted to determine the antimicrobial activity of soybean oil extract of dried ginger powder, using agar diffusion assay, against 24 isolates (4 of 6 different types) of food borne pathogens including *Escherichia coli*, *Pseudomonas aruginosa*, *Staphylococcus aureus*, *Vibrio cholerae*, *Klebsiella* spp. and *Salmonella* spp. The present study showed the potent antimicrobial activity of the ginger extract against the all tested bacterial pathogens. Soybean oil extract of ginger showed highest zone of inhibition (11.67±1.53mm) against *Salmonella* spp. and lowest zone of inhibition (8.0±1.73mm) against *Escherichia coli*. Ginger extract also showed lower zone of inhibition (8.67±2.52mm) against *Staphylococcus aureus* compared to the Gram-negative bacteria. Soybean oil extract of ginger at boiling temperature has potential antimicrobial activity and could be used in food preparation to get the synergistic effect of soybean and ginger.

Introduction

The increased usage of antibiotics has induced microorganisms to acquire resistance factors which have become a burning predicament (Abimbola *et al*., 1993). As a result there is an urgent need to find the alternative of chemotherapeutic drugs in diseases treatment particularly those of plants origin which are easily available and have considerably less side effects (Khulbe & Sati, 2009). The use of higher plants and their extracts for treating the infectious diseases has long been practiced in many parts of the world (Sofowora, 1984). The plant derived medicines may be used in many different forms including: powder, liquid or mixtures which could be raw or boiled such as, liniments, ointments and incisions (Apata, 1979).

Ginger (*Zingiber officinale*) is a medicinal plant that has been widely used all over the world, since antiquity, for a wide array of unrelated ailments including arthritis, cramps, rheumatism, sprains, sore throats, muscular aches, pains, constipation, vomiting, hypertension, indigestion, dementia, fever and infectious diseases (Ali, 2008). Ginger has

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direct anti-microbial activity and thus can be used in treatment of bacterial infections (Tan & Vanitha, 2004). Ginger belongs to Zingiberaceae family (Sharma, 2010). The Zingiberaceous plants have strong aromatic and medicinal properties and are characterized by their tuberous or non-tuberous rhizomes (Chen, 2008). Ginger is relatively inexpensive due to their easy availability, universally acceptable and well tolerated by the most people. It has also "Generally Recognized as Safe" (GRAS) by the US FDA (ICMR Bulletin, http://icmr.nic.in/BUJUNE O3nwe.pdf).

In many countries including Bangladesh, ginger is used in boiled food preparation. The objective of this study was aimed to extract the ginger in soybean oil at boiling temperature and determination of its antimicrobial activity against different food borne pathogenic bacteria.

Methods and Materials

Study materials

Soybean oils and ginger (*Zingiber officinale*) used in this study were purchased from the local markets of Dhaka city. For determining the antimicrobial activity of the ginger extracts following six bacterial species were used: *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Vibrio cholerae*, *Klebsiella* spp., and *Salmonella* spp. All of these bacteria species were previously isolated from the food samples and preserved in the Department of Microbiology, Stamford University Bangladesh.

Inoculum preparation

Tripticase soya broth (Himedia Laboratories Ltd. India) was inoculated with freshly subcultured bacteria and incubated at 37°C for few hour to match the turbidity to that of 0.5 MacFerland standard. Such prepared inoculum was used to spread onto Mueller Hinton Agar, MHA (Himedia Laboratories Ltd., India) using sterile cotton swab to make a lawn of bacteria.

Media used for disc diffusion assay

Mueller Hinton Agar, MHA (Himedia Laboratories Ltd., India) was used in study. MHA was supplemented with 0.5% (v/v) Tween-20 (Sigma, UK) to be used for disc diffusion assay.

Preparation of ginger extracts in soybean oil

10 grams of ginger powder was mixed with 40 ml soybean oil. Ginger mixed oil was boiled in a boiling water bath for 30 minutes, cooled at room temperature and filtered through Whatman filter paper and collected in a sterile container for further use. Extracts was kept at 4°C to preserve the antibacterial property before they were used for disc diffusion assay.

Antibacterial assay

Filter paper discs (6mm diameter) were prepared using a punch machine. Filter paper discs were sterilized in a dry heat sterilizer and kept in the refrigerator for further use. A lawn of each bacterial isolate was prepared on MHA plates using a sterile cotton swab from the inoculum showing growth of 0.5 MacFerland standard. MHA plates were dried for 15 minutes in the Laminar air flow cabinet. Three filter paper discs were placed one on top of other on dried MHA plates and ginger extracts (20 µl) were added on each disc separately. Soybean oil alone was used in order compare the antimicrobial activity with that of boiled extract. Commercially available Gentamicin discs (10 µg, Oxoid, UK) were used as control. All plates were incubated at 37^0C for 18-24 hours and the zones of inhibition (diameter in mm) were measured on the agar surface.

Statistical Analysis

All the experimental results were performed in triplicate and the results were expressed as mean ± Standard Deviation (SD) for 4 isolates of every type of bacterium. Calculation was done using Microsoft Excel 2010 software.

Results

The antimicrobial activity of the soybean extract of ginger varied depending on the bacterial species used.

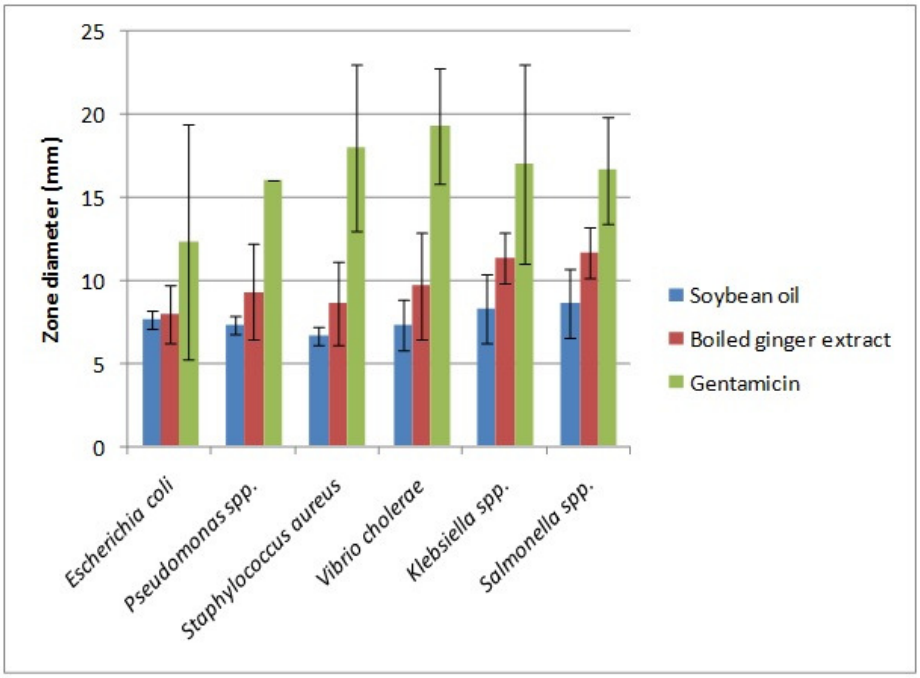

Figure 1: Antimicrobial activity of boiled ginger extract in soybean oil against foodborne pathogens

The diameter of the zone of inhibition varied ranging from (8.0±1.73 mm) to (11.67±1.53 mm) for ginger extract as compared to (12.33±7.09 mm) to (19.33±3.51 mm) for gentamicin (Figure 1). The antimicrobial activity of the ginger was found highest against *Salmonella* spp. while lowest activity was found against *Escherichia coli*. *Staphylococcus aureus* showed lower sensitivity to ginger extract as compare to the most other Gram-negative bacteria. This result also indicated that soybean extract of ginger was more effective as an antimicrobial agent compared to the soybean alone.

Discussion

The present study was done to determine the antimicrobial activity of ginger extract at boiling temperature in soybean oil. In many countries like Bangladesh, ginger is widely used in food preparation by cooking. Soybean oil is also used as edible oil in different food preparations. This study emphasizes on the synergistic antimicrobial effect of soybean and ginger at boiling temperature.

The result showed the good antimicrobial activity of soybean extract of ginger against the tested food borne pathogens- *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Vibrio cholerae*, *Klebsiella* spp. and *Salmonella* spp. Antimicrobial activity of crude ginger at both room temperature and boiling temperature was studied previously by Pankaj *et al*. (2012). However, they found that boiling temperature treated ginger extract (crude) lost its antimicrobial activity against *Klebsiella peumoniae*, *Escherichia coli* and *Staphylococcus aureus*. On the other hand in our study we have extracted the ginger in soybean which may protect the antimicrobial activity of ginger at high temperature and as a result good antimicrobial activity was found. Onyeagba *et al*. (2004) found the synergistic effect of ethanol extract of ginger and garlic against *Bacillus* spp. and *Staphylococcus aureus*. They also found the antimicrobial activity of the ethanol extract of ginger, lime and garlic against broad range of bacteria including *Bacillus* spp., *Staphylococcus aureus*, *Escherichia coli*, and *Salmonella* spp.

The synergistic antimicrobial effect of soybean and ginger at boiling temperature against food borne pathogens indicates the thermostable antibacterial property of ginger extracts. This thermostable property can be further investigated with different types of oils and extraction temperatures. Boiled ginger extracts can be used in food preparation as well as against pathogenic bacteria during active infection.

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