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EVALUATION OF ANTIMICROBIAL ACTIVITY OF GINGER (*ZINGIBER OFFICINALE)* AGAINST A GRAM POSITIVE AND GRAM-NEGATIVE BACTERIA

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ABSTRACT

Ginger is widely used for the treatment of various types of diseases and it is commonly used as spices and folk medicine due to its great potential, medicinal values and presence of some important phytochemical substances and good nutrients. They have various constituents that prevents and treat antimicrobial diseases. Ginger contains various compounds such as phenols, terpenes, and flavonoids. To study the antimicrobial activity of ginger, the Kirby Bauer disk method was performed and the standard antibiotic was used (Gentamicin). Gentamicin shows good inhibition zone against the gram-positive (*Bacillus subtilis*) and gram-negative (*Escherichia coli*). In the present study the zone of inhibition of plant extracts were observed. The antimicrobial activity of the ginger juice extract was found highest against *Escherichia coli* (7mm-23mm) while lowest activity was found against *B*acillus *subtilis* (3mm-15mm). The antimicrobial activity of the ginger leaves extract was found highest against *Escherichia coli* (6mm-18mm) while lowest activity was found against *Bacillus subtilis* (5mm-15mm). Both the extract showed good antimicrobial activity against the different bacteria. The zone of inhibition varied, according to the concentration of the extract. The presence of zingiberol, bisapolene, and shagols, the leakages of critical molecules and inhibits cell growth. The Aqueous extract is more effective against bacterial strains. In the present study, it is demonstrated extracts of *Zingiber officinale* inhibits the growth of *Escherichia coli* and *Bacillus subtilis.*

KEYWORDS: Antimicrobial, Antirheumatic, zingiberol, bisapolene, *Escherichia coli, Bacillus subtilis.*

INTRODUCTION

80% of the world population depends on the medicinal properties of plants. Ginger has been widely used for the treatment of many diseases, due to the high potential of sources such as bisapolene, zingiberene, and zingiberol. Ginger is widely used as a spice and folk medicine. It is a flowering plant that has ginger roots and a rhizome. Ginger has high medicinal values for the management and cure of various diseases.[1] It belongs to the family of *Zingiberaceae* and is also known as *Zingiber officinale*. It is a herbaceous plant and its medicinal values lie in its biologically active phytochemical substances. Ginger is used as a species for food preparation and it is also used for animal health care. Spices have contained high potential which has good medicinal properties. Herbs and spices are obtained from parts of a plant that are essential for the human diet and it also improves the odour, taste, colour of food products. They are also used as a preservative for many food items.[2]

Ginger is thick scaly, aromatic, branched, lobed structure and arises directly from rhizome roots on separate shoots. Ginger belongs to the family of *Zingiberaceae*, which also includes turmeric, cardamom, and galangal. Since ancient times ginger is used in folk medicine as a spice. Ginger is found in tropical rainforest areas in India to South Asia, and the species of plants show some genetic variation.[3] Ginger is one of the widely cultivated and traditionally used medicinal herbs in various countries such as India, China, Taiwan, Nigeria, Bangladesh, USA. In China, ginger is used for several years as a digestive aid and the treatment of nausea.[4] Ginger has also been used to treat various types of diseases such as throat infections, asthma, inflammation, constipation, arthritis, hypertension, migraines, bleeding, rheumatism, respiratory disorders, and many more, it mostly grows in warm climates.[5]

Ginger is also used for the treatment of cancer and it is also helpful to make chemotherapy drugs. The extract of the plant is worldwide used to treat various infectious diseases.[6] Ginger has various medicinal, nutritional, and antimicrobial properties and they are used as a spice, home remedy, and preservatives. Ginger is composed of different substances such as carbohydrates, fiber, protein, minerals, lipid and water.[7] The chemical compounds of ginger are obtained by different chromatography like gas chromatography-mass spectrometry, high-performance liquid chromatography, gas chromatography with flame ionization detection, and liquid chromatography-mass spectrometry.

Ginger contains the various minerals potassium, phosphorus, calcium, sodium, iron and some vitamins are also found like thymine, niacin, riboflavin and vitamin C.[8] Gingerol is

responsible to converts into shogals, when it exposed to heat and dehydration process its gives a pungent and spice-sweety fragrance.[9] Fresh ginger contain a higher amount of gingerol, due to the thermal and dehydration process of shogals and zingerone that result in increase in salt and carbonization.[10]

Ginger oil have used for medicinal purposes. The major substances present in ginger oil are sesquiterpenes, which contains bisapolene, zingiberene, zingiberol, and phenol, terpenes, flavanoid compounds are the secondary metabolite present in the plants and their concentration varies according to the growth of ginger.[11]

Some Antimicrobial activity of Ginger (*Zingiber officinale*)

Ginger has a high potential to work against infectious diseases, due to the presence of various bioactive compounds, which showed great antimicrobial activities and efficacy to control various types of microbial diseases such as viral, bacterial, and fungal. Ginger is also used for the preservation of food and they have also the presence of some phenolic compounds which have shows good antimicrobial properties.[12] Gingerols and gingerdiol were extracted from ginger powder, due to the presence of good efficacy against antifungal diseases.[8] Some of the ethanolic extracts of ginger (*Zingiber officinale*) were used to treat trypanosomiasis, which acts as anti-parasitic.[13,14] The various effect reduced due to heating but ginger showed good antimicrobial effects against gram-positive and gram-negative bacteria. Some of the reports have shown the antiviral efficacy of ginger.[15,16] Fresh ginger has contains good amount of oxygenated compounds such as geranial, neral, borneol, 1,8-cineole, α-terpineol, as compared to that dried ginger have low concentration and fewer compounds are found.[17] All the different compounds inhibit cell growth and affect the microbial cell which helps to fight against infectious diseases.

Some scientist have reported another concentration of Ginger which was varied according to the concentration of different solvent.

Presentation	**Bacteria**		**Concentration**	**Minimum inhibitory Concentration**		**Reference**
	E.coli	***B.subtilis***		***E.coli***	***B.subtilis***	
Aqueous Extract			1-100µg/mL	20.2µg/mL	11.5µg/mL	[19]
Ethanol Extract				34.0 µg/mL	10.7µg/mL	
Methanol Extract				26.31µg/mL	8.17µg/mL	
Acetone Extract				37.5 µg/mL	10.5µg/mL	

MATERIALS AND METHODS

Study material

Ginger was purchased from the local market of Ghaziabad, UP. For the determination of antimicrobial activity of ginger extract following species were used: *Escherichia coli, Bacillus subtilis. Bacillus subtilis* is a gram-positive bacteria and *Escherichia coli* is a gram-negative bacterium. All of the culture is obtained from Microbiology Department of Institute of Applied Medicine & Research, Duhai, Ghaziabad, UP. The stock culture is streaked on agar plates and incubated at 37 ^{0}C for 24 hours. After the culture is transferred to the nutrient broth for 24 hours at 37 ^{0}C.

Chemical used-nutrient agar media, antibiotic discs, DMSO (Dimethyl sulfoxide), Ethanol, filter paper discs.

Preparation of Ginger extract

The fresh Ginger were obtained from the local market of Ghaziabad, UP and washed with distilled water, cleaned the ginger properly. 50 grams of ginger extract was homogenized using a sterile mixer grinder and the extract is filter out by using cheese cloth. The final extract is 100% concentration of ginger. The concentration of 300mg/ml, 500mg/ml, 700mg/ml and 900mg/ml were prepared by mixing of appropriate volume of distilled water to make a aqueous solution of ginger. It was stored in a cool place to maintain the antimicrobial activity of the extract.

Preparation of leaf extract

Fresh leaves were obtained from plants and cleaned properly until all dust particle are removed from them. After the leaves were mashed with the help of sterile mixer grinder and was made into a thick paste, Ethanol was added in appropriate amount for 10-15 days, after that was filtered out with the help of cheese(muslin) cloth. The 100% concentration of the ethanol leaves extract was obtained. Again, the filtrate was kept undistributed for 72 hours to evaporate ethanol. After the evaporation, all the semisolid extract were weighed. Different concentration of ethanol leaves extract 300mg/ml, 500mg/ml, 700mg/ml and 900mg/ml were prepared by mixing of appropriate amount of DMSO. It was stored in cool place to maintain the antibacterial activity of the extract.

Media used for the disc diffusion method

Nutrient media was used for the study which was composed of peptone, agar, beef extract, sodium chloride and distilled water.500ml nutrient agar media were prepared, sterilized by autoclaving at 15 lbs pressure (121 ^{0}C) for 15 minutes.

Disk diffusion method

Filter paper discs (Whattman no.4) of 6mm diameter were prepared by the help of punching machine and sterilized in dry heat sterilizer and stored in refrigerator. The discs was dipped into different concentration of aqueous juice and ethanol leaves extract for 24 hours, kept in vials and capped tightly. A lawn of bacterial strains was prepared by the help of sterile cotton swabs, and inoculums the culture on nutrient agar media. Nutrient media plates were dried in laminar air cabinet for 15-20 minutes. One plate for both organisms were kept as a control in which antibiotic discs were placed. Using a sterile forceps to place the discs aseptically placed over the nutrient agar plates. The plates were incubated in an upright position at 37^0 C for 24 hours. The diameters of inhibition zone were measured in millimeter (in mm).

RESULT

The antimicrobial activity of ginger in different solution is varied due to the different bacterial strains and its also varied according to the different concentration of the solutions. The leaves extract and juice extract both were prepared. Ethanol is good solvent and was used to prepare both extract for good and effective result. The antimicrobial activity of the ginger juice extract was found highest against *Escherichia coli* (7mm-23mm) while lowest activity was found against *Bacillus subtilis* (3mm-15mm). The antimicrobial activity of the ginger leaves extract was found highest against *Escherichia coli* (6mm-18mm) while lowest activity was found against *Bacillus subtilis* (5mm-15mm). In the present study, comparison between the ginger juice extract or leaves extract was shown in table 1 and table 2.

Table 1: Antibacterial activity of Ginger *(zingiber officinale)* Juice Aqueous Extract.

S. no	Concentration Of the extract	Method	Zone of Inhibition (diameter in mm)		Control
	Juice aqueous extract (mg/ml)	Discs diffusion Method	*Escherichia coli*	*Bacillus subtilis*	Gentamicin
1.	300mg/ml		7mm	3mm	34 mm
2.	500mg/ml		11mm	7mm	
3.	700mg/ml		16mm	10mm	
4.	900mg/ml		23mm	15mm	

Table 2: Antibacterial activity of Ginger (*zingiber officinale*) Ethanol leaves Extract.

S. no	Concentration Of the extract	Method	Zone of Inhibition (diameter in mm)		Control
	Leaves Ethanol Extract (mg/ml)	Discs diffusion Method	*Escherichia coli*	*Bacillus subtilis*	Gentamicin
1.	300mg/ml		6mm	5mm	34mm
2.	500mg/ml		9mm	7.5mm	
3.	700mg/ml		14mm	12mm	
4.	900mg/ml		18mm	15mm	

Figure : Zone of inhibition in *Escherichia coli* (Ginger Juice Aqueous Extract).

Figure: Zone of inhibition in *Bacillus subtilis* (Ginger Juice Aqueous Extract).

Figure: Zone of inhibition in *Escherichia coli*(leaves Ethanol extract).

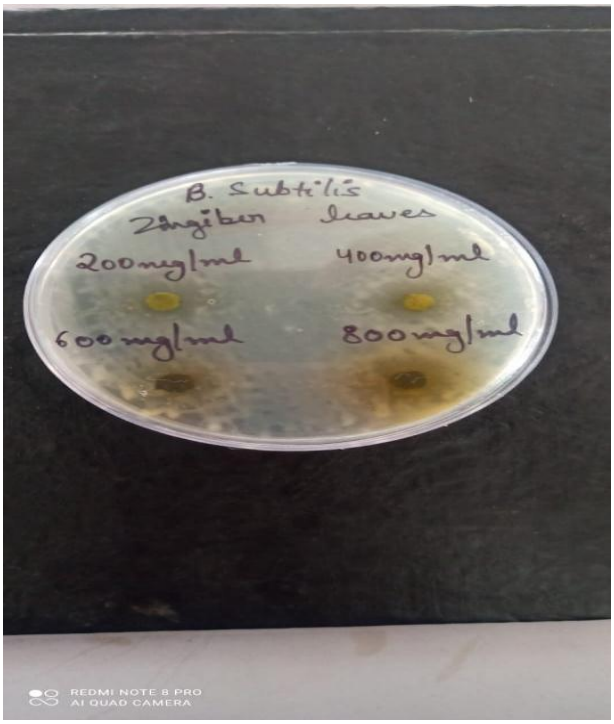

Figure: Zone of inhibition in *Bacillus subtilis* (leaves Ethanol extract).

DISCUSSION

The current study has shown the antibacterial efficacy of ginger juice extract and ginger leaves extract by the presence of zone of inhibition. The antimicrobial activity of ginger is totally depends on their composition, method, procedure and the extract which were prepared for the experiment.[19] It has been reported that Sesquiterpenoids and phenolic compounds are responsible for antimicrobial activity.[11] Ginger have also contains some oxygenated compounds which caused leakages of critical molecules and their inhibition of ions and microbial cells. Both the extract were differently prepared, by using different solvent but it

has been reported that the aqueous extract is a good solvent comparative to ethanol extract and it gives better result to study the antimicrobial activity. The results were helpful to treated various infectious diseases. It has been reported the zone of aqueous extract and leaves extract is close to the standard antibiotic which may proves that the leaves and aqueous extract is used to treat various microbial diseases. Ginger was found to be really effective, which may reduce consumption of the medicines of this era and it is also useful to treat different infectious diseases naturally. In the present study, the comparison of the extract was varied according to the concentration of the solvent. Ginger have showed high antimicrobial activity against *Escherichia coli* while low against *Bacillus subtilis*.

CONCLUSION

Many chemical constituents and extract shows for antimicrobial, anticonvulsant, analgesic, anti-inflammatory, antiulcer, fever, gastric problems, cold and antidiabetic etc, and other beneficial activities. According to observation ginger showed high antimicrobial activity against pathogenic gram positive and gram-negative bacteria. The antimicrobial activity of the ginger juice extract was found highest against E. coli (7mm-23mm) while lowest activity was found against *Bacillus subtilis* (3mm-15mm). The antimicrobial activity of the ginger leaves extract was found highest against *Escherichia coli*(6mm-18mm) while lowest activity was found against *Bacillus subtilis*(5mm-15mm). Aqueous solution gives better results compare to ethanol. In future, ginger can be reduced as medicine, due to the presence of various bioactive compounds such as bisapolene, zingiberene and zingiber. Ginger were used in industries to make various useful products which leads cell death or inhibit the microbial growth and it also used for medicinal purpose syrups, soaps and creams, that helps us to fight against pathogenic microbes.

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