



## Antibacterial potential of *Zingiber Officinale* and *Curcuma longa*

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### Abstract

The antimicrobial activity of *Zingiber Officinale* (Ginger) and *Curcuma longa* (Turmeric) tested with Agar Well Diffusion method. Four different bacterial strains (*Streptococcus pneumonia*, *Streptococcus mutans*, *Pseudomonas aeruginosa* and *Streptococcus pyogenes*) were used to test antimicrobial activity of Ginger and Turmeric. *Zingiber Officinale* (Ginger) and *Curcuma longa* (Turmeric) extracted in five different solvents viz. Methanol, Ethanol, Diethyl ether, Chloroform and Water. Extracts were directly applied against bacterial strains growth to reveal their antimicrobial activity. Methanolic extract showed maximum inhibitory effect against selected strains followed by Ethanol (for Ginger) and Diethyl-ether for (Turmeric) and vice versa. Chloroform depicted inhibitory effect at the second last position and Water extracts found to have least inhibitory potential. Among two species Turmeric made higher Zone of Inhibitions (ZI) than Ginger. There is another finding that there is present direct correlation with the concentration of extracts and ZI values. This study confirms the Folktales about these two plants that they have high antimicrobial activity and confirms their position as novel Plants among other Ethnobotanical species.

**Keywords:** antibacterial; *zingiber officinal*; ginger; *turmeric curcuma longa*; ZI; *pseudomonas aeruginosa*; *streptococcus pyogenes*; *streptococcus mutans*; *streptococcus pneumonia*

### Introduction

Plants are used as medicines to cure many human and cattle's ailments since prehistoric times. Plants are given more importance in medicinal field due to their easy availability, very cheap cost and effectiveness with zero side effects. plants are mostly used by herbalists in rural and less developed areas (Rashedul *et al.*, 2010) [12]. Plants were known to show antimicrobial properties from long time being. (Mahesh and Satish, 2008) [6]. Due to production of many secondary metabolites (i.e., phenol, alkaloid, terpenoids, glycosides, etc.) many plants show bactericidal, fungicidal, and pesticidal activities. Plants are still backbone for making traditional medicines and drugs. (Srinivasan *et al.*, 2001) [16]. Because of increasing resistance in Bacteria against currently available antibiotics and couple of other reasons there is deadly need of antimicrobial plant extracts for survival of human against microorganisms diseases. (Yasunaka *et al.*, 2005) [17]. Two species *Zingiber Officinale* (Ginger) and *Curcuma longa* (Turmeric) belongs to the family Zingiberaceae. Zingiberaceae family known to produce novel phytochemicals which have vast antimicrobial potentials. Curcuminoids are important antibacterial Phytochemicals found to be produce by *Zingiber Officinale* (Ginger) and *Curcuma longa* (Turmeric) known to retard bacterial growth. (Revathy *et al.*, 2011) [13]. Both species are used in pharmacology due to their antimicrobial activities (Anand, 2008) [2] Ginger and Turmeric are herbs. Their rhizome powder of Turmeric (underground stem) is used as a spice, flavour and also as a medicine. Ginger rhizome in powder form used as spice and also used as powerful antimicrobial agent in Asia, India, Jamaica and Nigeria and China since 2000 (Muaz *et al.*, 1999) [9] Ginger and Turmeric are used worldwide as herbal medicines for

curing bacterial ailments and known to have antimicrobial and antioxidant properties. (Masuda *et al.*, 2001, 2002;) [7, 8], anti-protozoal activity (Araujo *et al.*, 1998), anti-microbial activity (Negi *et al.* 1999) [3], anti-venom activity (Ferreira *et al.*, 1992), anti-HIV activity (Sui *et al.*, 1993), anti-tumour activity (Ozaki *et al.* 2000 [10]; Kim *et al.*, 2001), as an anti-inflammatory (Ammon and Wahl, 1991) [1], having a hepatoprotective effect (EL-Ansary *et al.*, 2006) [4].

These two species have common availability on world level and also reported to produce phytochemicals which are toxic to microorganism growth. (Ernest and Pittler, 2000) [5]. These two species will prove to help in finding new drugs in logical research strategies (Soforowa *et al.*, 1993) [15]. Both these species i.e., Ginger and Turmeric are ethnomedicinal and ethnobotanical plants which can be defined as direct or a precursor for producing drugs against different microorganisms ailments (Soforowa *et al.*, 1993) [15] Ginger is known to serve in the treatment of cataract, migraines, heart disease, struck bursitis, athletes foot, amenorrhea, cold, flu, chronic coughs, depression, fatigue, dizziness, erectile difficulties, fever, renal disease kidney stones, and viral infection (Peggy *et al.*, 2006) [11].

### Materials and Methods

**Materials:** Solvents viz., Methanol, Ethanol, Diethyl-ether, Chloroform and Water including different chemicals, Ager plates and other instruments were obtained from Biotechnology Lab of IIUI.

**Strains:** Four different strains; *Streptococcus pneumonia*, *Streptococcus mutans*, *Pseudomonas aeruginosa* and *Streptococcus pyogenes* are used to culture the ager plates for study.

**Plants Parts;** Rhizome powdered of both species were used.

**Methodology;** Antimicrobial effectiveness of plants extracts is measured by comparing the Zone of Inhibition values (in mm) of plants with standard antibiotic Gentamicin on the Agar media by well Diffusion method shown in Table no. 5 Bacterial strains, other chemicals and equipment were obtained from Biotechnology Lab of IIUI Islamabad, Pakistan. Bacterial strains labelled as B1, B2, B3 and B4 shown with full names in Table 5. Rhizomes of Turmeric and Ginger were crushed in five different Solvents labelled as E1, E2, E3, E4 and E5 elaborated with respective names in Table no. 4. Nutrient ager plates were incubated at 37 °C for 24 h. These plates were seeded and then sub seeded and sub cultured with the bacterial strains and again incubated for 24 h at 37 °C. Ager plates were then bored 10 mm in diameter and extracts were transferred to wells. Gentamicin Antibiotic is used as reference antimicrobial agent and positive control to measure the antibacterial activity of plants extracts by comparing with it. Zone of Inhibition (ZI) was measured after 2 days in millimetres using callipers for all five extracts including Gentamicin (results are shown in Table no. 3).

### Results and Discussion

When plants extract applied against Bacterial strains it is revealed that the growth of microorganisms was greatly inhibited by both Organic and Inorganic plant extracts compared with positive control Gentamicin (results are shown in Table no. 3 and pie- figure 3 and figure 6). The growth of B1 and B2 is highly inhibited by E1 and E2 of Turmeric while growth of B3 and B4 is greatly retarded by E3 and E4 of Ginger respectively shown in table no 1 and 1b. Moreover, study revealed that Organic solvent extracts have more

inhibitory potential than inorganic water solvent and in row of organic solvents methanol fits its position as royal extract because it showed maximum ZI values for both species and are elaborated by Pie- figure 4 and 5. The Zone of Inhibition shown by extracts of Ginger are E1> E2> E3> E4 >E5 compared in figure 1. and that by Turmeric are E1>E3> E2>E4>E5 compared in figure 2. The ZI values were measured in mm. More increase in concentration of Extracts caused increase in ZI values. So, concentration of extracts has direct increasing and decreasing relationship with ZI values. Folklore about the medicinal value of Turmeric and Ginger proved to be true and confirmed their ethnomedicinal specie status. Among E1 the Turmeric E1 show highest inhibitory effect against B2 i.e., 27 ±0.00 and E1 of Ginger show Highest inhibitory effect against B3 i.e., 26.77 ±0.35. Lowest Inhibitory effect among E1 is shown by E1 of Turmeric against B4 is 24 ±0.48 and lowest of Ginger is 23 ±0.49 for B1 shown in tables 1 and 1b. The highest ZI value shown by E2 of Turmeric was 20 ±0.47 for B4 and highest for E2 Ginger was 19 ±0.59 for B1. Turmeric E3 highest ZI potential was noted to 24 ±0.41 for B3 and Ginger highest value for E3 was 17.55 ±0.40 for B4. E4 Turmeric depicted 20 ±0.90 for B4 and highest ZI potential noted from E4 of Ginger was 19.2 ±0.51 for B2. E5 extract of Turmeric depicted highest of 13.01 ±0.01 for B2 and Ginger maximum ZI value noted for E5 was 12 ±0.00 for B2. Turmeric lowest ZI values of E2, E3, E4 and E5 were noted for B2, B1, B1 and B3 i.e., 18.30 ±0.01, 20 ±0.59, 17 ±0.07, 11 ±0.00 respectively shown in Table 2. The lowest values of ZI shown by Ginger for extracts E2, E3, E4 and E5 were noted for B2, B3, B4 and B2 i.e., 17.3 ±0.00, 15 ±0.47, 17.01 ±0.00 and 12 ±0.00 respectively shown in Table no. 1a.

Table 1

| <i>Zingiber Officinale</i> (Ginger) |                                     |             |             |             |             |             |
|-------------------------------------|-------------------------------------|-------------|-------------|-------------|-------------|-------------|
| S. No.                              | Bacterial Strain                    | ZI mm (E1)  | ZI mm (E2)  | ZI mm (E3)  | ZI mm (E4)  | ZI mm (E5)  |
| 1                                   | <i>Streptococcus mutans</i> (B1)    | 23 ±0.49    | 19 ±0.59    | 17.63 ±0.00 | 19 ±0.00    | 14.60 ±0.57 |
| 2                                   | <i>Streptococcus pyogenes</i> (B2)  | 24.90 ±0.00 | 17.3 ±0.00  | 15 ±0.51    | 19.2 ±0.51  | 12 ±0.00    |
| 3                                   | <i>Streptococcus pneumonia</i> (B3) | 26.77 ±0.35 | 19 ±0.00    | 15 ±0.47    | 18 ±0.33    | 12.01 ±0.52 |
| 4                                   | <i>Pseudomonas aeruginosa</i> (B4)  | 25 ±0.33    | 18.40 ±0.90 | 17.55 ±0.40 | 17.01 ±0.00 | 15 ±0.00    |

Table 2

| <i>Curcuma longa</i> (Turmeric) |                                     |             |             |            |             |             |
|---------------------------------|-------------------------------------|-------------|-------------|------------|-------------|-------------|
| S. No.                          | Bacterial Strain                    | ZI mm (E1)  | ZI mm (E2)  | ZI mm (E3) | ZI mm (E4)  | ZI mm (E5)  |
| 1                               | <i>Streptococcus mutans</i> (B1)    | 25 ±0.33    | 19.90 ±0.00 | 20 ±0.59   | 17 ±0.07    | 12.08 ±0.00 |
| 2                               | <i>Streptococcus pyogenes</i> (B2)  | 27 ±0.00    | 18.30 ±0.01 | 23.3 ±0.00 | 17.8 ±0.03  | 13.01 ±0.01 |
| 3                               | <i>Streptococcus pneumonia</i> (B3) | 26.55 ±0.00 | 19 ±0.09    | 24 ±0.41   | 18.02 ±0.34 | 11 ±0.00    |
| 4                               | <i>Pseudomonas aeruginosa</i> (B4)  | 24 ±0.48    | 20 ±0.47    | 22.7 ±0.51 | 20 ±0.90    | 13 ±0.90    |

Table 3

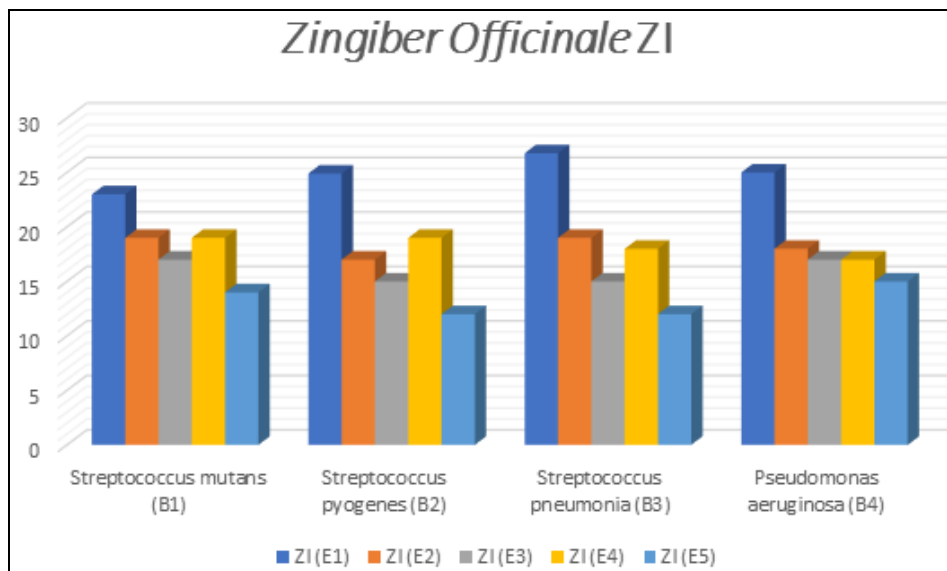
| Gentamicin |                                     |            |
|------------|-------------------------------------|------------|
| S. No.     | Bacterial Strain                    | ZI mm      |
| 1          | <i>Streptococcus mutans</i> (B1)    | 29±0.50    |
| 2          | <i>Streptococcus pyogenes</i> (B2)  | 31±0.47    |
| 3          | <i>Streptococcus pneumonia</i> (B3) | 27.99±0.09 |
| 4          | <i>Pseudomonas aeruginosa</i> (B4)  | 30.1±0.60  |

**Table 4**

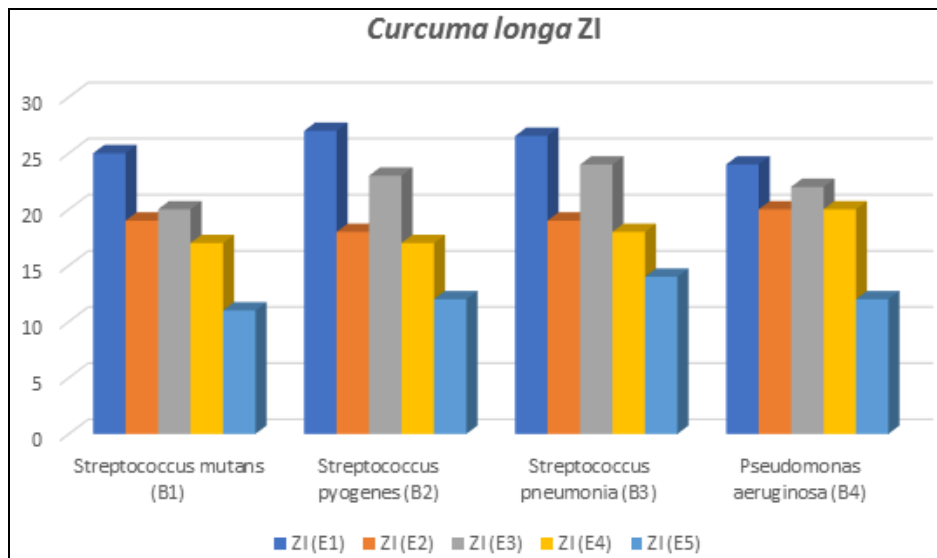
| S. No. | Name | Bacterial Strain               |
|--------|------|--------------------------------|
| 1      | B1   | <i>Streptococcus mutans</i>    |
| 2      | B2   | <i>Streptococcus pyogenes</i>  |
| 3      | B3   | <i>Streptococcus pneumonia</i> |
| 4      | B4   | <i>Pseudomonas aeruginosa</i>  |

**Table 5**

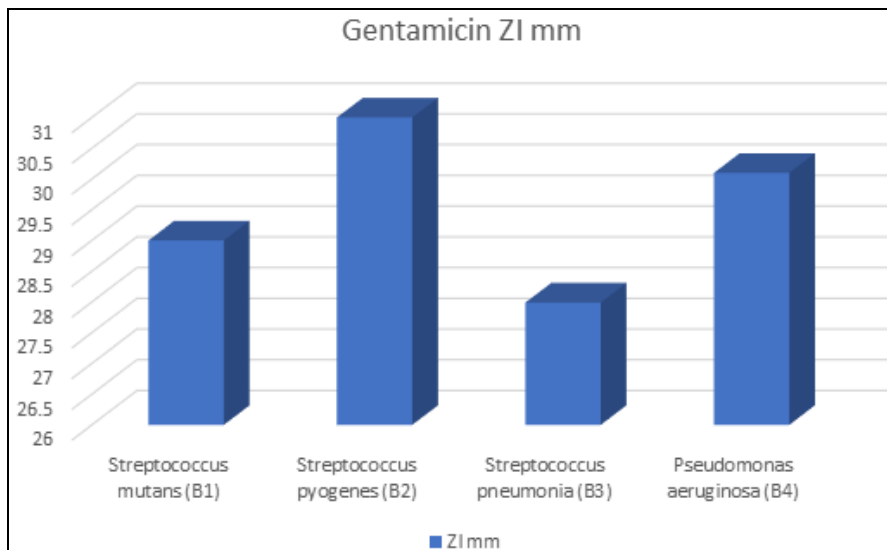
| S. No. | Name | Extract in    |
|--------|------|---------------|
| 1      | E1   | Methanol      |
| 2      | E2   | Ethanol       |
| 3      | E3   | Diethyl ether |
| 4      | E4   | Chloroform    |
| 5      | E5   | Water         |



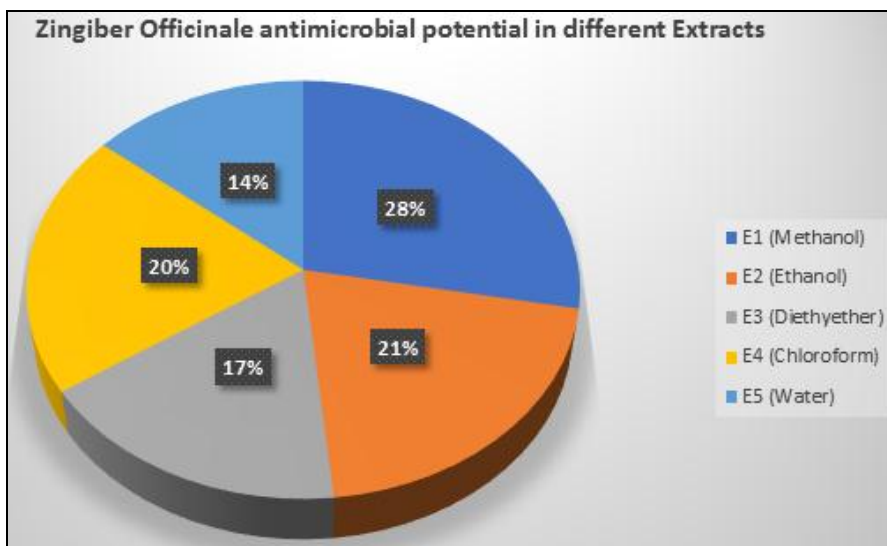
**Fig 1:** showing Zone of Inhibition made by *Zingiber officinalis* (Ginger) in different extracts.



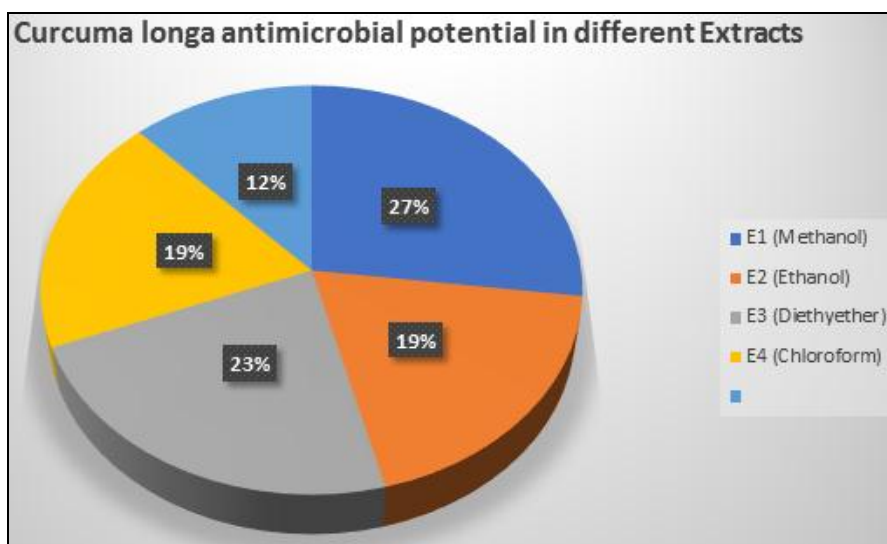
**Fig 2:** showing Zone of Inhibition made by *Curcuma longa* (Turmeric) in different extracts



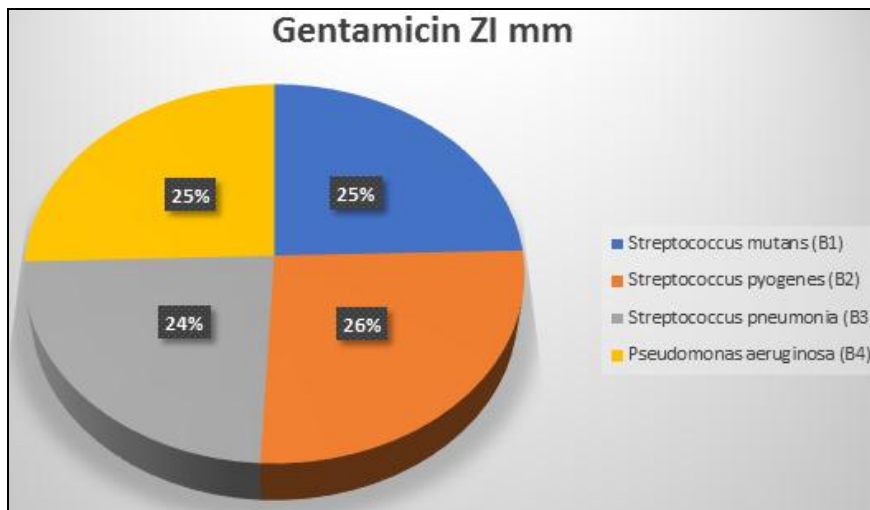
**Fig 3:** showing Zone of Inhibition made by Gentamicin



**Fig 4:** Showing Inhibitory Potential of *Zingiber officinalis* (Ginger) in different extracts



**Fig 5:** Showing Inhibitory Potential of *Curcuma longa* (Turmeric) in different extracts



**Fig 6:** Showing Inhibitory Potential of Gentamicin

### Conclusions

It is clear cut conclusion that Ginger and Turmeric contain precious high-quality Antimicrobial bio-oregano agents that have vast antibacterial potential. Among these, Turmeric have higher Antimicrobial activity than Ginger. Moreover, Methane extracts of Turmeric and Ginger have Highest Antimicrobial activity and water contains the least. Concentration of plant Extracts and ZI values are also directly proportional to each other. It can be concluded form our research that these two plants fit their position at a good rank among Ethnobotanical and Ethnomedicinal Plants due to their Antimicrobial and antibacterial Potential and activities.

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