

Antimicrobial activity of Tea (*Camellia sinensis*)

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ABSTRACT

Antibacterial activities of tea extracts in various solvents were tested against six organisms, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Sarracia* sp., and *Bacillus subtilis* using agar-well method. Petroleum ether and chloroform extracts of tea showed strong antibacterial activities against *P. aeruginosa* and *B. subtilis* while other extracts were less active. The minimum inhibitory concentration (MIC) of chloroform extract of tea was found to be 25µg/mL. This study may establish the need for daily use of this product for medicinal purposes.

Key words: Tea, *Camellia sinensis*, antibacterial activity, extracts.

INTRODUCTION

Tea is a beverage and is of infusion of variously processed leaves of one of the varieties of an evergreen shrub, *Camellia sinensis* L. It is the most widely drunk beverage in the world¹. It is refreshing, mildly stimulating, and produces a feeling of well-being. These properties may be due to caffeine and tannins. These compounds are known to have stimulant and anti-soporific actions that elevate mood, decrease fatigue and increase capacity for work². However, other components of tea, notably, the polyphenols, may also contribute to the effects of tea, in view of their known pharmacological properties³. The complex of oxidized polyphenols in tea is often called 'tannin'⁴. From literature, it was observed that tea has wide range of antioxidant, anti-inflammatory, anti-carcinogenic and antibacterial activity against many pathogens^{3, 6-8}. Several reports of the antibacterial effects of tea *in vitro* and *in vivo*, mainly against intestinal pathogens were published by many researchers⁹⁻¹¹.

The aim of this paper describes the extraction of bioactive compounds from tea powder and antimicrobial testing against various microorganisms *in vitro*.

EXPERIMENTAL

Material and chemicals

Tea powder was purchased from local market with brand name of Red label[®]. The chemicals used for extractions were procured from Qualigens Fine Chemicals (Mumbai).

Bacterial strains and culture media

Bacterial cultures used for this study are *E. coli*, *P. aeruginosa*, *S. aureus*, *Sarracia* sp. and *B. subtilis*. These cultures were maintained on nutrient agar slants at 4°C and preserved as glycerol stocks at -20°C. The cultivation and maintenance media were procured from Himedia Laboratories (Mumbai).

Extractions

Tea powder (10 gm) was extracted in 100mL solvents like chloroform, petroleum ether, diethyl ether and methanol. The extracts were filtered through ordinary filter paper and the filtrates were dried at room temperature. The dried extracts then weighed and calculated the total yields. These extracts were dissolved separately in dimethyl sulfoxide (DMSO) solvent and used for further studies.

Antimicrobial activity

A loopful of bacterial cultures were inoculated in nutrient broth separately and incubated at 30°C for 24 hr. After full growth, 0.1 mL of cell broth was spread on nutrient agar plates. The antimicrobial activity of the extracts was done by agar well method¹². Dried extracts (20 mg/mL) were dissolved in DMSO solvent. In agar well added 0.1 mL of extract and the plates were incubated at 30°C for 24- 48 hr. After 48 hr, the zone of clearance around the well was observed and measured in mm.

Antibiotic effect of extract concentration on *Bacillus subtilis*

Chloroform extract was used to study its effective dose concentration (20-100µg/mL) against *B. subtilis* microorganism by agar well method. The plates were incubated at 30°C for 48 h and measured the zone of clearance around the well.

Minimum Inhibitory Concentration (MIC)

Minimum inhibitory concentration of the chloroform extract was measured by addition of increased concentration of extract followed by a loopful culture of *B. subtilis* inoculation in nutrient broth¹². These tubes were incubated at 30°C for 24 hrs and observed for turbidity. Tube concentrations having no turbidity were considered as MIC value of the extract for that organism.

Data analysis

All data used for this experimentation is obtained from duplicate experiments. Standard deviation was calculated by Microsoft excel.

RESULTS AND DISCUSSION

Tea is a plant material with numerous

biological activities. Highest % yield obtained with chloroform followed by petroleum ether, methanol and diethyl ether (Table 1).

The extraction yield reported by Shin et al.¹³ for green tea with water and ethanol was 21.9 and 30.7% respectively.

From Table 2 it was observed that, petroleum ether inhibited *P. aeruginosa* (25mm zone of inhibition) followed by chloroform extract inhibition of *B. subtilis* (18mm zone of inhibition). Other extracts inhibited the remaining microbial cultures in range of 10-14 mm zone of inhibition. Likewise, Mbata¹⁴ observed antimicrobial activities of processed Kenyan and Nigerian tea.

Inhibitory effect of chloroform extract on *B. subtilis* was increased linearly from 20-100 µg/mL with zone of inhibition 12±1 to 22±2 mm diameter. The results are summarized in Table 3.

MIC value of chloroform extract with *B. subtilis* was found to be 25µg/mL. However, Tiwari et al.¹⁵ observed the MIC value of tea extract in range of 9.09- 94.61mg/mL for *Shigella dysenteriae*, *Yersinia*, *E. coli*, *S. typhi*, *S. typhi Ty2a*, *S. typhimurium*.

Table 1: % Yield of extracts in various solvents

| Solvents used | Yields (%dry weight) |
|-----------------|----------------------|
| Chloroform | 3.28 |
| Diethyl ether | 1.05 |
| Petroleum ether | 2.08 |
| Methanol | 1.68 |

Table 2: Antimicrobial activity of different solvent extracts of tea

| Bacterial cultures | Zone of inhibition (mm) of extracts of different solvent | | | |
|--------------------------|--|---------------|-----------------|----------|
| | Chloroform | Diethyl ether | Petroleum ether | Methanol |
| <i>E. coli</i> | 14±1 | 10±2 | 14±2 | 12±2 |
| <i>P. aeruginosa</i> | 10±1 | 06±1 | 25±1 | 12±1 |
| <i>S. aureus</i> | 12±2 | 10±3 | 14±2 | 12±2 |
| <i>Serracia</i> sp. | 10±1 | 12±1 | 10±1 | 14±1 |
| <i>Bacillus subtilis</i> | 18±2 | 12±2 | 14±3 | 10±1 |

Table 3: Effect of chloroform extract concentration of tea on *Bacillus subtilis*

This study evident, tea extracts has promising antibacterial activity. The potential utilization of this property is especially in relieving relief from intestinal microorganisms which caused diarrhea and dysentery.

| Concentration (µg/ml) | Zone of inhibition (mm) |
|-----------------------|-------------------------|
| 20 | 12±1 |
| 40 | 15±2 |
| 60 | 19±1 |
| 80 | 21±1 |
| 100 | 22±2 |

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