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Antimicrobial Activity of Indian Tea (*Camellia Sinensis*) Against Some Pathogenic Bacteria

Sudhir Kumar Jain[1*], Neelam Maida[2], Akhilesh Kumar Pandey[3]

[1,2]School of Studies in Microbiology, Vikram University, Ujjain (M.P.) 456010, India
[3]Department of Biosciences, Rani Durgawati University, Jabalpur (MP) and Vice Chancellor, Vikram University, Ujjain (MP) 456010, India

**Corresponding Author: sudhirkjain1@rediffmail.com*

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Abstract— Every morning starts with a cup of tea and this tea lead to freshness in mouth and body. Even every guest came to the house is welcomed by a cup of tea. From ancient time, biological activity of tea is well documented by the above-mentioned effects of tea on body. Present studies were deals with, antibacterial activity of tea, against various pathogenic bacteria. The antibacterial activity of Indian tea preparation (Kadha) was studied. Antibacterial activity of green and black tea extracts was accessed by standard microbiological methods to validate traditional use of tea (*Camellia sinensis*) as an antibacterial agent.

Keywords— Antimicrobial, Camellia sinensis

I. INTRODUCTION

From ancient time, the use of plants as medicine is common to all societies. It is little bit enigmatic to know about the appropriate medicinal application of plant or plant parts. One ancient way was to look for "natural signature". These were the shapes and pattern in plant organ similar in shape or pattern to organ of animal or human body[1]. Various plants are used to treat several bacterial infections[2]. Indian folklore is also rich in various plants of medicinal importance. The tribes are using various plants for the treatment of various drastic diseases. As well as, antimicrobials derived from plants are receiving increasing attention, due to ineffectiveness of synthetic antibiotics against bacteria and properties of bacteria to acquire resistance against these synthetic antibiotics. Indian Tea has its own value throughout the world. Tea has been shown to have wide range of antioxidant, anti-inflammatory, anti carcinogenic and antibacterial substances[3, 4, 5, 6, 7, 8]. Traditional use of some varieties of Indian tea (*Camellia sinensis*) for controlling common cold, fever and fatigue is well documented in literature. Beside India, it is also well documented in other countries; like Japanese folklore has it that drinking green tea 'makes the mouth clean'[9], so there is a tradition, that those who drink large amount of green tea have less tooth decay[10]. While, Indian belief that drinking "Kadha" (Concentrated tea) is boon to any type of inflammation, fever and infection, even it can eradicate any infectious agent (micro organism). Anti cariogenic properties of tea have been reported throughout the world.[11, 12, 13, 14] But no such work has been reported on the truth of olds saying about "Kadha". To prove this truth, the present study was conducted to access antibacterial activity of some samples of Indian green tea and black tea against certain clinically important Gram-positive and Gram-negative pathogenic bacteria.

II. MATERIALS & METHODS

The pathogenic bacterial strains used in this study were isolated from different clinical sources. The bacteria used in this study are *Bacillus subtilis, E. coli, Haemophilus influenzae, Neisseria catarrhalis, Proteus vulgaris, Pseudomonas aeruginosa, P. fluorescens, Salmonella enteritidis, Salmonella typhi, Staphylococcus aureus.* Strains were maintained on Nutrient Agar slants for daily use. Cultures were maintained for long term storage by repeated sub culturing and storage at 4^0C.

Two types of tea were used in the study, green tea and black tea. Green tea was obtained from the north east hilly areas of Jammu & Kashmir, India and black tea was Nandini brand (granular tea), commercially available in India. Tea samples were stored in plastic bags at 4^oC. Aqueous extracts were prepared by adding 100 ml boiling distill water with 20gm of tea to get 20% (w/v) concentration. It was allowed to brew for two minutes and then centrifuged at 15000 rpm for 10 minutes. The pH of supernatant fluid was adjusted to 7.0 with 2.5M NaOH and 2.7M HCl. This supernatant fluid was used as tea extract.
Antibacterial activity of the tea extracts was studied by agar diffusion method. The bacterial suspensions were cultured in Nutrient broth for three hours and 200 µl of this broth cultures were spread on Petri dishes containing Mueller-Hinton agar (Hi Media Ltd. Mumbai). Wells of 6mm diameter were prepared by the use of sterilized stainless steel borer. 100 µl of each green and black tea

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extract were loaded in different wells. The plates were incubated for 24 hours at $37^0C \pm 1^0C$ and the diameter of any resulting zone of inhibition was measured. A set of control was also checked in the same way for each test organism using 250 ppm augmentation. Beside that, three replicates of each extract were checked and average of three independent observations was recorded for each treatment. The mean zone of inhibition was compared with that of control.

III. RESULTS

The results are presented in table 1. The Black tea is more active against to Gram positive bacteria *Bacillus subtilis* with 13mm zone of inhibition in comparison to 12mm zone of inhibition obtained from green tea leaves extracts while it is showing potent antimicrobial activity like control. In case of Gram negative bacteria, the green tea extract is more active with 14mm zone of inhibition in comparison to 12 mm zone of inhibition obtained by black tea extract against *Haemophilus influenzae* and *Neisseria catarrhalis*. But this extract is less active in comparison to control. But both of the extracts were not showing any inhibitory activity against other organisms. Perhaps heat denaturation lead to loss of some antimicrobial component of the tea and solvent extraction should be carried out for assessing the activity of tea extracts against these organisms. But our study is specifically relevant to assess antibacterial activity of 'Kadha', which is boiled extract of tea.

Table 1: Antibacterial activity of tea (*Camellia sinensis*) extracts.

Name of Bacteria	Diameter of Inhibition Zone (mm)		
	Green Tea	Black Tea	Control*
Bacillus subtilis	12	13	14
E. coli	R	R	14
Haemophilus influenzae	14	12	20
Neisseria catarrhalis	14	12	18
Proteus vulgaris	R	R	18
Pseudomonas aeruginosa	R	R	18
P. fluorescens	R	R	08
Salmonella enteritidis	R	R	16
Salmonella typhi	R	R	26
Staphylococcus aureus	R	R	20

Each datum in table is an average of three determinations.

R= Resistance**,*Control =** Augmentation (250 ppm) 100 µl

IV. DISCUSSION

The main chemical difference between green and black tea is that green tea consist of high concentration of catechin such as (0)- epicatechin (EC), (0)- epigallocatechin (EGC), (0)- epicatechingallate (ECG), and (0)- epigallocatechin gallate (EGCG)[8], while in case of black tea these compounds oxidized and condensed to larger dark colored molecules including theoflavins and thearubigins, during a manufacturing process known as 'fermentation'. However, black tea still has simple catechin, examples of which are epicatechin (EC), epicatechin gallate (ECG) and epigallocatechin gallate (EGCG).[15] A cup of green tea prepared in the normal way contains 0.5-1.0 gm of catechins / Liter[9] and black tea prepared in the same way have one third catechin to this figure. The catechin and theoflavins (in black tea) are microbiologically active components.[16] Different bacterial strains shows, difference in susceptibility to tea extract and this susceptibility has shown to be related with difference in cell wall components[17]. Catechins interact with lipid bilayer membrane of bacteria and result in, loss of cell structure and function and finally lead to cell death[17, 18]. Several papers have reported the inhibitory and bactericidal activity of tea extract and catechin derived from these tea extracts against *S. mutans* and *S. sobrinus* [9, 11, 12, 19]. Differences in the antimicrobial activity of tea also found, to be related with the kind and degree of fermentation of tea[20] Kubo et al. and Muroi & Kubo, studied the ten most abundant flavour compounds in green tea. These were volatile terpenes or terpene like compounds. They have shown inhibitory activity for some and synergy between certain pairs[13, 21].

Pharmacokinetic studies have shown that after rinsing the mouth with tea, catechin can be found in the saliva for up to 60 minutes[22] and that of the enzymatic breakdown of starch on food particles trapped in the mouth was markedly reduced[23] . We can conclude that green tea sips are more active against three major oral pathogenic bacteria whereas both types of tea extracts were unable to produce any antibacterial effect against *S. aureus, Streptococcus pneumoniae, Pseudomonas aeruginosa, P. fluorescens, E. coli, Salmonella enteritidis, Salmonella typhi.* It can be hypothesized that it may be due to some mutational changes in cell wall component and permeability, porosity of outer membrane structure of above-mentioned bacteria. But it is proved that incorporation of tea in to chewing gums, toothpastes; mouthwash and dental floss will defiantly helps in prevention of various oral pathogenic bacteria.

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