

Antimicrobial Activity of Tannin Rich Medicinal Plants

Sudipta Paine

Department of Microbiology Raiganj
University
Raiganj, West Bengal, India, 733134

Dr. Pradeep Kumar Das Mohapatra

Department of Microbiology Raiganj
University
Raiganj, West Bengal, India, 733134

Abstract— The molecular diversity found in popularly used medicinal plants is much higher than the one derived from chemical synthesis processes. Thus, vegetables constitute an excellent source for searching new antimicrobial drugs. The condensed tannins stand out among several chemical substances which present important pharmacological activities and are isolated from medicinal plants. The condensed tannins are constituted of catechin-type monomers, known as flavonoids. The therapeutic potential of the tannins is assigned to the phenolic hydroxyl group situated on the surface of tannins. This group binds to protein adhesins and promotes inhibition of enzymes, rupture of the plasma membrane and deprivation of the microbial substrate. An attempt was made to analyse the antimicrobial potential of 4 medicinally important plants extracts of *Vitex Negundo* (negundo), *Howardenia pubescens* (kurchi), *Mimosa pudica* (mimosa), *Heliotropium Indicum* (hirsute) against human bacterial pathogens viz., *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Salmonella typhi*, *Vibrio parahaemolyticus* and *Staphylococcus epidermidis*, *Enterobacter cloacae*. Antimicrobial study was carried out by disc diffusion method against the pathogens. The result of the present study showed wide spectrum of antibacterial activities against all the above bacterial pathogens studied. The maximum zone of inhibition observed to aqueous extract for each bacterium was as follows: *Salmonella typhi* (1.3cm), *Vibrio parahaemolyticus* (2.2 cm), *Staphylococcus epidermidis* (2.1 cm), *Staphylococcus aureus* (1.7 cm), and *Enterobacter cloacae* (1.7 cm). The present study indicates that the selected medicinal plants are potentially good sources of antibacterial agents against the tested pathogens. The phytochemical screening demonstrated the presence of different types of compounds like terpenoids, tannins, deoxy sugars, saponins, phenolic compounds, and flavonoids which may contribute to the antimicrobial action of the above medicinal plants.

Keywords— Antimicrobial activity; Tannin-rich plants; Phytochemical screening; Disc diffusion; Zone of inhibition.

I. INTRODUCTION

Tannins are biomolecules, astringent, bitter plant polyphenolic compounds which bind to proteins, amino acids, alkaloids and precipitate them. They are known antimicrobial biomolecules. The term "tannin" has arisen from tanner, meaning oak or fir tree. The term "tannin" means a large polyphenolic compound containing sufficient hydroxyls and other groups like carboxyl, to form strong complexes with various macromolecules.

Tannins and related compounds are widely distributed in many plant species, where they protect plants from predation, function as pesticides and aid in plant growth

regulation. They play an important role in ripening of fruits and aging of wine. Tannins are either gallic acid esters (molecular weight – 500 to 3,000) or proanthocyanins (molecular weight up to 20,000). Tannins include flavone-derived tannins with heavily hydroxylated base, polymerized to give the high molecular weight polyphenol motif that characterizes tannins. Tannins function as protein binders if they have at least 12 hydroxyl groups and five phenyl groups. Pomegranates, nuts, berries, herbs, spices, legumes, chocolates, tea and coffee are known sources of tannins.

Antimicrobial property of plant extract is an established fact that plants have healing powers and many medicinal plants have been identified to have such efficiencies. In 1950, antibiotics started being used regularly which resulted in plants being out of use as antimicrobial agents. Since ancient times, plants are always being used as raw resources for medicinal derivatives. Antimicrobial plant extracts are of interest as these phytochemicals may be included in the arsenal of antimicrobial drugs because of their extended life span and that of antibiotics being limited.

Moreover, mass awareness of problems with the overprescription and misuse of traditional antibiotics has increased. Since 1995, naturopathy and the use of plant extracts and other alternative treatments have become more popular. Green plants are known to have a broad spectrum of synthetic activity and are sources of many useful compounds. Higher plants, shrubs, and certain vegetables have been originally recognized as having antiseptic activity. Extracts of many medicinal plants have shown to be very active against pathogenic bacteria.

Tannins as the main physiologically active ingredient are being used for treatment of human diseases. Natural products are under scrutiny today as important anti-infective agents and the structures of tannins possessing antifungal, antiviral and antibacterial activity have been identified. Moreover, a synergistic relationship between active tannins and antibiotics has been demonstrated. Tannins and related compounds present themselves as new leads which may aid in the development of pharmacologically active and appropriate antimicrobial agents or their classes.

Tannins and polyphenolic compounds are components of medicinal and other plants, which have excellent properties, keep pathogens away, act as pro-and prebiotics, keep us active, healthy and enhance our immunity. Tannins may be responsible for the anti-microbial activity investigated in this paper. Selected four medicinal plants with tannins have

been studied in this research paper for their antimicrobial properties against common human pathogens.

In the past few decades, the search for new anti-infection agents has occupied many research groups in the field of ethnopharmacology. Medicinal plants are believed to be an important source of new chemical substances with potential therapeutic effects. The secondary metabolites of plants

were found to be a source of various phytochemicals that could be directly used as intermediates for the production of new drugs. Traditional medicine should be able to play an even greater role in the modern primary healthcare system of developing countries. The natural medicines are believed to be more acceptable to the human body when compared to modern synthetic drugs. Thus, the most important factor needed is to derive the maximum benefit from the traditional system of medicine for providing adequate healthcare services to rural people.

TABLE I. PLANT SPECIES CONTAINING TANNINS AND THEIR MEDICINAL USE.

Plant Species	Parts	Major Components	Medicinal Use
Krameria triandra L.	Root	Tannic acid, rhataniatannic acid, krameric acid, proanthocyanidins	Chronic diarrhea, menorrhagia, urinary diseases, bleeding bowels, bad throat
Potentilla erecta	Roots	Pentadigalloylglucose, catechins, proanthocyanidins	Inflammations, wound healings, diarrhea, bacterial/ viral infections
Sanguisorba officinalis L.	Root	Sanguiin H-6	Dysentery and insect bites
Syzygium cumini	Bark	Corilagin, ellagitannins	Bad throat, asthma, dysentery, and ulcers
Quercus robur L.	Bark	Grandinin, castalagin, glucogallin	Diarrhea, itching, and burning sensations

II. AIMS AND OBJECTIVES

The specific objectives of the present study are:

- Literature survey and selection of medicinally important plants.
- Extraction and estimation of tannin content from selected medicinally important plants.
- Study of antimicrobial activity of the plant extracts against pathogenic bacteria.

III. MATERIALS AND METHODS

A. Collection of plant samples

The healthy plant leaves of *Vitex Negundo* (negundo), *Howardena pubescens* (kurchi), *Mimosa pudica* (mimosa), and *Heliotropium Indicum* (hirsute) were collected from the medicinal plant garden of Raiganj University, West Bengal.

B. Preparation of the plant extract

The sun-dried leaves (20g each) were finely powdered and extracted with 100 ml distilled water. Samples were overnight incubated under room temperature, boiled for 10-15 min, and filtered through Whatman No. 1 paper. The extracts were then centrifuged at 10,000 rpm and stored in a refrigerator.

C. Tannin estimation

Tannins were determined by the Folin-Ciocalteu method. 0.2ml of plant extract was mixed with 8.3ml of distilled water and 0.5 ml of Folin-Ciocalteu reagent. After 5 min, 1 ml of 15% Na₂CO₃ was added. Absorbance was measured at 700nm using an UV/Visible spectrophotometer.

D. Antimicrobial activity assays

Six microorganisms (*Enterobacter cloacae*, *Staphylococcus aureus*, *Salmonella typhi*, *Staphylococcus epidermidis*, *Vibrio parahaemolyticus*, *Klebsiella pneumoniae*) were pre-cultured overnight. Antibacterial activity was measured using the standard disc diffusion method on nutrient agar plates with different concentrations (10 to 100 ul) of leaf extracts. Inhibition zones were measured after 24 hours of incubation at 37°C.

IV. RESULTS AND DISCUSSION

The quantitative estimation revealed that *Howardena pubescens* contains the highest amount of tannin (121.71 mg/g), followed by *Vitex Negundo* (86.26 mg/g), *Heliotropium Indicum* (78.98 mg/g), and *Mimosa pudica* (65.25 mg/g) as shown in Table 2.

TABLE II. TANNIN CONTENT OF SELECTED MEDICINAL PLANTS.

Plant Species	Tannin Content (mg/g)
Howardena pubescentis (kurchi)	121.71
Vitex Negundo (negundo)	86.26
Heliotropium Indicum (hirsute)	78.98
Mimosa pudica (lajjaboti)	65.25

The leaf extracts showed substantial antibacterial activity against 5 out of the 6 tested bacterial strains. The zones of inhibition are detailed in Table 4. Howardena pubescentis

showed maximum efficacy against *Vibrio parahaemolyticus* (2.2 cm), while *Vitex Negundo* excelled against *Staphylococcus epidermidis* (2.1 cm).

TABLE III. PHYTOCHEMICAL PROFILES AND TRADITIONAL USES.

Plant Species	Major Components	Medicinal Uses
Vitex Negundo	Casticin, isoorientin, luteolin, chrysophenol	Cough remedy, regulating menstrual cycle, skin pests
Howardena pubescentis	Coumarin, ergosterol, flavonoids, saponins, tannins	Amoebic dysentery, diarrhea, kidney stones prevention
Mimosa pudica	Flavonoids, glycosides, alkaloids, tannins, saponins	Hemorrhoids, urinary infections, glandular swellings
Heliotropium Indicum	Pyrrolizidine alkaloids, indicine, heliotrine	Wounds, skin ulcers, furuncles, conjunctivitis eye drops

TABLE IV. ANTIMICROBIAL ZONE OF INHIBITION DIAMETER (CM).

Bacterial Strain	V. Negundo	H. Indicum	M. pudica	H. pubescentis
S. epidermidis	2.1	1.6	-	1.0
E. cloacae	-	1.6	-	-
S. aureus	-	1.7	1.5	-
V. parahaemolyticus	-	-	1.5	2.2
S. typhi	-	-	-	1.3
K. pneumoniae	-	-	-	-

V. CONCLUSION

It is concluded that this study can contribute to the identification of valuable natural compounds to formulate new and more potent antimicrobial drugs. Further studies are required to isolate specific active molecules and fully evaluate their therapeutic profiles against a broader array of human pathogens.

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