IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 04, 2022

A STUDY ON ANTIMICROBIAL PROPERTY OF BAUHINIA PURPUREA (L.) EXTRACTS AGAINST COMMON PATHOGENS

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ABSTRACT:

Traditional medicine, rooted in centuries of use, remains a cornerstone of healthcare in many developing countries, where plants have long been valued for their medicinal properties. As global interest in the pharmacological potential of medicinal plants continues to rise, research has increasingly focused on their role as rich sources of bioactive compounds, particularly those with antimicrobial properties. Plant extracts are at the forefront of efforts to identify new agents capable of combating the growing issue of antimicrobial resistance (AMR), which has led to the rise of multi-resistant bacterial strains. Among the vast biodiversity of plants present in the Gadchiroli district in Maharashtra, India, Bauhinia purpurea has also been traditionally used by local tribes for its ethnomedicinal properties. The present study investigates the antimicrobial potential of various phytochemical extract fractions of Bauhinia purpurea (methanol, hexane, acetone extracts) against common bacterial pathogens. This study highlights the importance of ethnobotanical knowledge and the therapeutic potential of plants in addressing the growing challenge of antibiotic resistance.

Keywords: antimicrobial resistance, Bauhinia purpurea, medicinal plants, bioactive compounds

INTRODUCTION

Traditional medicine has been practiced for centuries by a significant proportion of the global population to treat various human ailments. Over time, interest in studying medicinal plants as sources of pharmacologically active compounds has grown worldwide (Kumar et al., 2015). In some developing countries, traditional knowledge about plants as food and medicine is well recognized in common folklore and documented in ancient scriptures (Pandey and Tripathi, 2014).

Plant extracts represent an ongoing effort to discover new compounds capable of combating multi-resistant bacteria (Cowan, 1999). Approximately 20% of the world's plant species have undergone pharmacological or biological testing, and a considerable number of new antibiotics introduced to the market are derived from natural or semi-synthetic sources (Marino et al., 1999; Paulo et al., 2010). Antibiotics remain essential for combating harmful bacterial infections in vivo. Over the last decade, infectious diseases have significantly contributed to millions of deaths globally, particularly in developing countries like India (Davies and Davies, 2010).

The emergence of antimicrobial resistance, driven by mutagenic events and the transmission of resistance plasmids, has enabled pathogenic bacteria to develop resistance to various antibiotics, rendering some treatments ineffective. An increasing number of pathogens have

acquired resistance to multiple antibiotics (Multiple Drug Resistance), posing a serious threat of becoming untreatable (Davies and Davies, 2010; Fair and Tor, 2014). This alarming situation underscores the critical need to discover novel antimicrobial agents. The indiscriminate use of antibiotics has exacerbated this issue, leading to a surge in antibiotic-resistant microorganisms and necessitating the development of new antimicrobials (Ventola, 2015).

For centuries, plants have been used as remedies for human diseases due to their therapeutic components. They are natural sources of antimicrobial agents, largely because of their vast biodiversity and the abundance of bioactive metabolites they produce (Copp, 2003; Singh, 2005, Yu et al., 2011). The acceptance of traditional medicines as alternative healthcare options has encouraged researchers to investigate the antimicrobial properties of medicinal plants (Zaika, 1998; Singh et al., 2005; Khameneh et al., 2019). Medicinal plants are relied upon by 80% of the global population, and in India, their use as therapeutic agents remains a crucial part of traditional medicine (Zafar, 1994; Zavala et al., 1997).

Extensive research has been conducted to identify the antimicrobial and phytochemical constituents of medicinal plants and their potential to treat microbial infections as alternatives to synthetic drugs, which have become increasingly ineffective against resistant microorganisms (Dorman and Deans, 2000; Scazzocchio et al., 2001). Recently, the search for potent antibacterial agents has increasingly focused on plants, particularly higher plants (Mothana and Lindequist, 2005). Many plants have proven effective in treating various diseases, and their antimicrobial efficacy often exceeds expectations. It is estimated that about 10% of all flowering plants on Earth have been used at some point by local communities worldwide, yet only 1% have gained recognition from modern scientists (Yu et al., 2011; Kumar et al., 2015).

Gadchiroli district, located in the southeastern part of Maharashtra, India, is renowned for its rich biodiversity, particularly its diverse plant species. The district's extensive forest cover, accounting for over 76% of its geographical area, provides a habitat for a wide variety of flora (Kumar et al., 2018). Several plant species have been found to be ethnobotanically important as used by the Gond and Madiya tribes of Gadchiroli District. One among these plants, Bauhinia purpurea, commonly known as the butterfly tree, purple orchid tree, Kachnar or Kachna, Chameli, Pasau (local names), is a fast-growing, deciduous tree belonging to the Fabaceae family. It is used in the present study to investigate the antimicrobial property of different extracts on common bacterial pathogens.

MATERIALS AND METHODS

Collection

The leaves of Bauhinia purpurea (L.) were collected from the well grown wild plants near Forest Department Nursery of Gachiroli district. The leaves collected were washed to remove dirt, and shade dried at room temperature for 10-15 days. The dried leaves were ground in mixer to a fine powder.

Extract Preparation

Solvents (Methanol, Hexane, Acetone) were used for the extraction of bioactive compounds. The dried leaf powder (10g) of Bauhinia purpurea were first defatted with petroleum ether in a Soxhlet apparatus. The defatted sample were dried and then extracted with methane, hexane

and acetone in a Soxhlet apparatus. The different extracts obtained were evaporated by using vacuum rotary evaporator. The concentrated extracts were used for testing of antimicrobial activity against common bacterial pathogens.

Microorganisms

Bacterial strains of Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Salmonella typhi and Pseudomonas aeruginosa, purchased from MTCC, Chandigarh were used for the present study. The bacteria were maintained on nutrient agar and antimicrobial assay was performed on Muller Hinton Agar (MHA) medium.

Antimicrobial activity

Antimicrobial activity was determined by Kirby-Bauer method (1966). A loopful of bacteria were inoculated in fresh nutrient broth and incubated at 37^0C with stirring. The fresh culture was then spread inoculated to sterile Muller Hinto Agar surface. The paper discs (6 mm diameter) impregnated with (20µl) solvent extracts were placed on the Muller Hinton Agar surface previously inoculated with above mentioned Gram positive and Gram-negative bacteria. Paper discs with respective solvents without plant extracts served as negative control and tetracycline as positive control. Plates were incubated at 37°C for 24 hours. After the incubation period, the diameter of the inhibition zone around the plant extracts discs were measured.

RESULTS AND DISCUSSION

The antimicrobial activity of Bauhinia purpurea extracts against various bacterial species was assessed using methanol, hexane, and acetone as solvents. The zone of inhibition, measured in millimetres (mm), indicates the effectiveness of each extract against the test bacteria. The Bauhinia purpurea solvent extracts (Methanol, Hexane and Acetone) have shown varying antimicrobial activity against gram-positive and gram-negative bacteria used in the study (Table 1).

Table 1. The antimicrobial activity of leaf extract of Bauhinia purpurea.

	Bauhinia purpurea extracts		
	Methanol	Hexane	Acetone
Test Bacteria	Zone of inhibition (mm)#		
S. aureus	8	5	4
B. subtilis	7	4	4
E. coli	5	3	5
S. typhi	4	4	3
P. aeruginosa	4	4	5

#Average rounded off to nearest number

The methanol extract showed the highest overall antimicrobial activity, particularly against Staphylococcus aureus (8 mm) and Bacillus subtilis (7 mm). This suggests that methanol fraction may contain effective bioactive compounds from Bauhinia purpurea with antibacterial

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properties. In comparison, the hexane and acetone extracts demonstrated lower efficacy, with zones of inhibition for S. aureus of 5 mm and 4 mm, respectively.

Against Escherichia coli, the acetone extract exhibited the same level of inhibition as the methanol extract (5 mm), indicating the potential of acetone extracted containing phytochemicals for targeting Gram-negative bacteria. For Salmonella typhi and Pseudomonas aeruginosa, the zones of inhibition were generally smaller, with methanol extract showing moderate activity (4 mm for both species) and the other extracts displaying minimal effects (Figure 1).

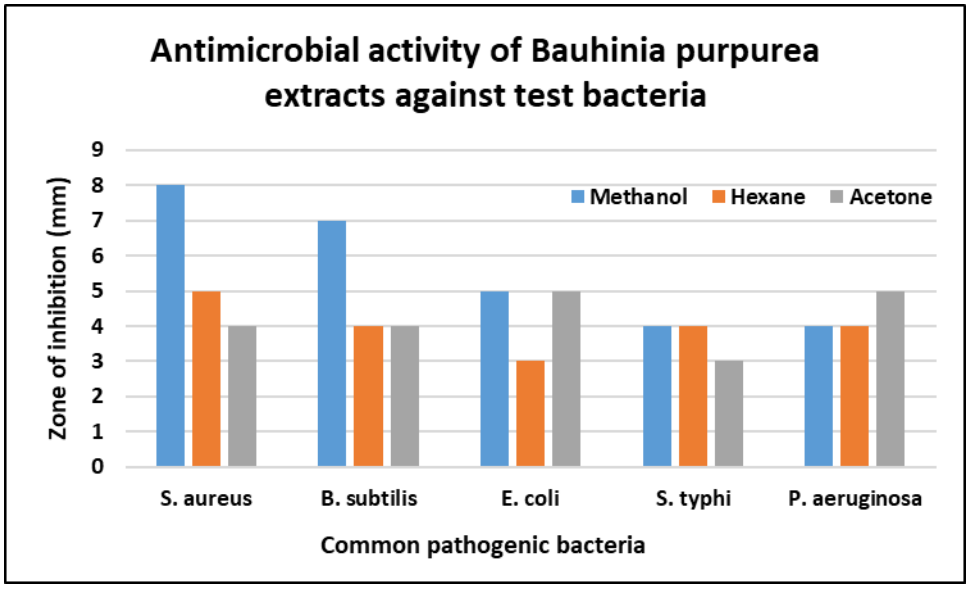

Figure 1. The antimicrobial profile of different extracts against common pathogenic bacteria.

These results highlight that methanol is the most effective solvent among the three tested, likely due to its ability to solubilize a broader range of polar and nonpolar bioactive compounds. The varying efficacy of the extracts against different bacterial species suggests specificity in the different types of antibacterial compounds present in Bauhinia purpurea. The limited activity against S. typhi and P. aeruginosa suggests that these bacteria may possess resistance mechanisms or that the effective compounds against them are not extracted efficiently using the tested solvents.

CONCLUSION

The study demonstrates that Bauhinia purpurea extracts possess measurable antibacterial activity, with methanol extracts showing the highest efficacy across most tested bacterial strains. The notable activity against Staphylococcus aureus and Bacillus subtilis highlights the potential of methanol-extracted compounds as effective agents against Gram-positive bacteria. However, the lower activity observed against Salmonella typhi and Pseudomonas aeruginosa indicates a need for further investigation into extraction methods or the potential development of combination therapies. Overall, these findings underscore the promise of Bauhinia purpurea as a source of bioactive compounds and its potential application in combating bacterial

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infections, particularly against antibiotic-resistant strains. Future research should focus on the isolation and structural elucidation of the active components and their mode of action.

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