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Research

Exploring the Antimicrobial Potential of *Plescospermum Spinosum* Extract: A Promising Natural Defense against Pathogens

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Abstract

The widespread misuse of antibiotics has led to the emergence of antibiotic-resistant bacteria (ARB), posing a significant global health threat. These resistant pathogens render previously effective treatments ineffective, potentially resulting in extended hospital stays, increased healthcare costs, and mortality. As the threat of antibiotic resistance intensifies, there is an urgent need to discover novel antimicrobial agents. Natural products are of particular interest due to their diverse bioactive properties and lower likelihood of inducing resistance. *Plecospermum spinosum*, a plant with traditional medicinal uses, has shown promise in combating microbial infections. This study investigates the antimicrobial potential of *Plecospermum spinosum* extract. Leaves were collected, extracted using a hydroalcoholic solvent, and subjected to preliminary phytochemical analysis and antimicrobial testing against both gram-positive and gram-negative bacteria. The analysis revealed the presence of phenols, tannins, flavonoids, glycosides, alkaloids, and terpenoids. The extracts demonstrated inhibition zones measuring 6 mm against Staphylococcus aureus and 10 mm against Escherichia coli. These findings suggest that *Plecospermum spinosum* possesses significant potential for inhibiting microbial growth.

Keywords: Traditional medicines, *Plecospermum Spinosum* Trec, Uses.

INTRODUCTION

The history of infectious diseases reflects an ongoing struggle between humans and microorganisms. For decades, we have relied on antibiotics, powerful drugs discovered in the mid-20th century, to combat bacterial infections. However, the landscape is changing. The widespread and often inappropriate use of antibiotics has fueled the emergence and spread of antibiotic-resistant bacteria (ARB). These resistant pathogens pose a significant threat to global health, rendering once-effective treatments ineffective and potentially leading to longer hospital stays, increased healthcare costs, and even death [1].

The escalating threat of antibiotic-resistant pathogens has intensified the search for novel antimicrobial agents [2]. In this context, natural products have garnered significant attention due to their diverse bioactive properties and lower likelihood of resistance development [3]. *Plecospermum Spinosum*, a plant with a rich history in traditional medicine, has emerged as a promising candidate in the fight against microbial infections [4]. This study aims to explore the antimicrobial potential of *Plecospermum Spinosum* extract, shedding light on its efficacy and mechanisms of action against a range of pathogenic microorganisms [5]. By investigating this natural extract, we hope to contribute to the development of new, effective antimicrobial strategies that harness the power of nature to combat persistent and emerging health threats [6].

MATERIALS AND METHOD

Plant Collection and Identification

Plecospermum spinosum Trec was collected in December from ABS Garden, Kaaripatti. Dr. N. Ayyappan, Director of ABS Botanical Conservation, Research & Training Centre, Kaaripatti, Salem, Tamil Nadu, taxonomically identified and authenticated the plant material.

Processing and Extraction of Plant Material

The leaves of *Plecospermum spinosum* Trec were shade-dried and pulverized. The coarse leaf powder underwent Soxhlet extraction using a hydroalcoholic solvent. This continuous extraction method involves repeated cycles of solvent evaporation and condensation. The powdered crude drug was placed in a thimble within the Soxhlet apparatus. Following extraction, the extract was filtered, and the solvent was removed through evaporation. The resulting dried extract was stored under refrigeration.

Preliminary Phytochemical Analysis [7]

The crude hydroalcoholic extract of *P. spinosum* was carried out qualitative chemical screening to identify various classes of active chemical constituents, including carbohydrates, tannins, saponins, cardiac glycosides, steroids/triterpenoids, flavonoids, and alkaloids. Standard methods were employed for this phytochemical analysis.

In Vitro Antimicrobial Activity

Test microorganisms

The study utilized *Staphylococcus aureus* (gram-positive) and *Escherichia coli* (gram-negative) microorganisms.

Media preparation

The antimicrobial potential of the plant's ethanolic extracts was determined using the standard agar disc diffusion technique, measuring zones of inhibition against the test microorganisms.

Disc diffusion method

Pure colonies of each microorganism were suspended in sterile saline to match the turbidity of McFarland tube number 0.5 (1.5 × 10^8^ CFU/ ml). A loopful from each adjusted organism was swabbed onto Mueller-Hinton agar. Sterile paper discs (6 mm in diameter) were impregnated with 100 µl of extracts, dried at 100 °C for two hours, and placed on the inoculated agar surface [8]. The plates were incubated according to each organism's growth requirements. Each sample was tested in triplicate, and antimicrobial activity was evaluated by measuring the zones of inhibition in mm (excluding the 6 mm disk) [9]. A parallel analysis with the commercial antimicrobial agent ampicillin (10 µg) was conducted for comparison.

The antimicrobial activity was shown by a clear zone around the disc containing the extract. This inhibition zone was measured in millimeters using a scale. The experiments were repeated three times, and the average diameter of the inhibition zones, along with the standard deviation, was calculated.

RESULTS AND DISCUSSION

Fig 1: Plecospermum Spinosum Trecul

Appearance and percentage yield of *HAEPS*

The hydroalcoholic extract (50% ethanol + 50% water) yielded a dark green semi-solid product after solvent evaporation. The calculated percentage yield of this extract was 18.93%, as presented in Table 1.

Table 1: The percentage yield of *HAEPS*

Drug	*Plecospermum spinosum*Trecul
Solvent	Hydro alcohol (Ethanol 50% + Water 50%)
Color	Dark green
Consistency	Semi solid
Percentage yield	18.93%

Preliminary Phytochemical Screening

The hydroalcoholic extract of *Plecospermum spinosum* Trecul contains phenols, tannins, flavonoids, glycosides, alkaloids, and terpenoids.

Table 2: Preliminary phytochemical constituents present in HAEPS

Sl.No	Constituents	Ethanolic extract of *Plecospermum spinosum*
1.	Alkaloids	+
2.	Carbohydrates	-
3.	Protein	+
4.	Terpenoids	+
5.	Phenols	+
6.	Tannins	+
7.	Flavonoids	+
8.	Glycosides	+
9.	Saponins	+

+ indicates the presence – indicates the absence

In Vitro Antimicrobial Activity

The antimicrobial activity of the extract was evaluated, which revealed distinct inhibition zones for various bacterial strains. Specifically, for Staphylococcus aureus, the extract demonstrated an inhibition zone measuring 6 mm with a standard deviation of ±1.3 mm. In comparison, the positive control exhibited a significantly smaller inhibition zone of 3 mm with a standard deviation of ±0.5 mm. However, the negative control also showed an observable inhibitory effect, producing an inhibition zone of 1 mm with a standard deviation of ±0.03 mm.

When assessing the zone of inhibition against Escherichia coli, the extract exhibited a maximum inhibition zone of 10 mm with a standard deviation of ±0.3 mm, which was notably larger than the positive control's inhibition zone of 4 mm with a standard deviation of ±0.02 mm. The negative control, once again, displayed a significant inhibitory effect, with an inhibition zone measuring 2 mm with a standard deviation of ±0.02 mm. The Results are present in the table 3 & 4 and figure 4 & 5.

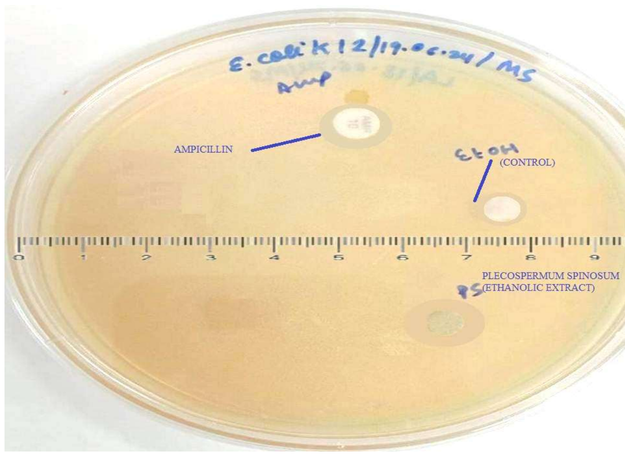

Fig 2: Displays the Zone of Inhibition of extract of *Plecospermum spinosum* against *Escherichia coli*

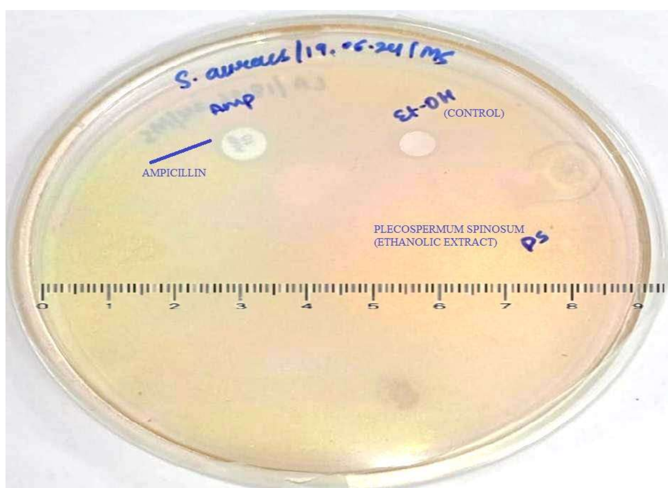

Fig 3: Shows the Zone of Inhibition of extract of *Plecospermum spinosum* against *Staphylococcus aureus*

Table 3: shows Zone of Inhibition of extract of *Plecospermum spinosum* against *Staphylococcus aureus*

Samples	Zone of Inhibition (mm)±SD
Crude Extract	6±1.3
Negative control	1±0.03
Positive control	3±0.5

Table 4: Displays Zone of Inhibition of extract of *Plecospermum spinosum* against *Escherichia coli*

Samples	Zone of Inhibition (mm)±SD
Crude Extract	10±0.3
Negative control	2±0.05
Positive control	4±0.02

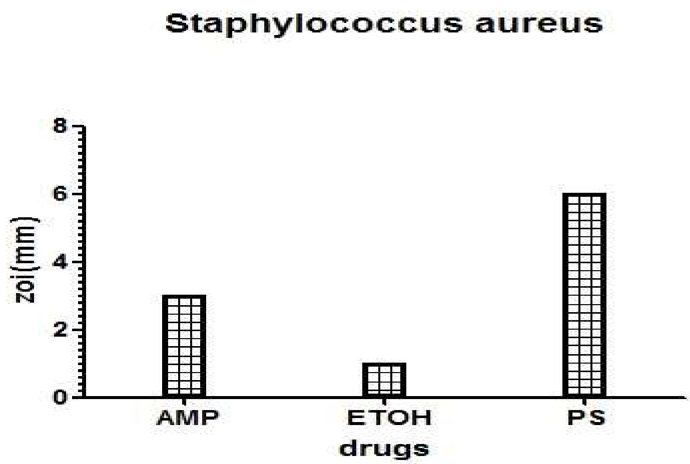

Fig 4: Graph Displays Zone of Inhibition of extract of *Plecospermum spinosum* against *Staphylococcus aureus*

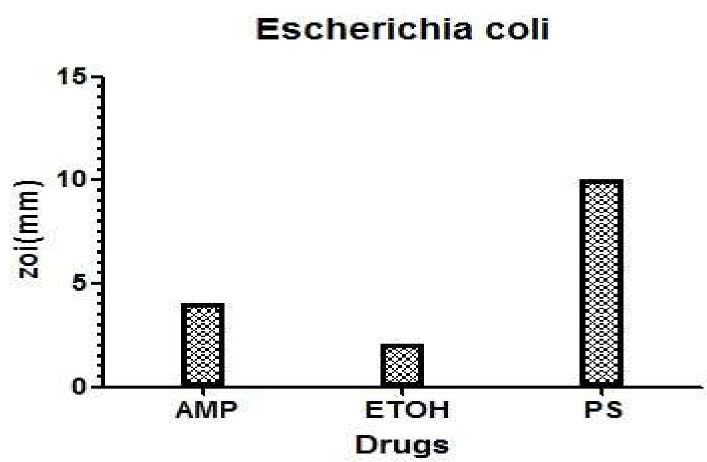

Fig 5: Graph Displays Zone of Inhibition of extract of *Plecospermum spinosum* against *Escherichia coli*

These findings align with those reported by Pushparaj A *et al*.[10], who demonstrated that the ethanolic extract of *Plecospermum spinosum* exhibited maximum inhibitory activity, with a zone of inhibition measuring 9 ± 0.7 mm against all tested bacteria. In our study, the ethanolic extract of *Plecospermum spinosum* Trecul was prepared at a concentration of 100 mg/ml, guided by toxicity studies conducted by G. Sumithira et al., which identified an LD50 value of 100 mg/kg (i.p.), corresponding to an ED50 value of 1/10[11].

The potent antimicrobial effect observed with the *Plecospermum spinosum* extract likely stems from its secondary metabolites, particularly the phenolic compounds present in the plant. These compounds are known for their significant antimicrobial properties, which could explain the extract's effectiveness in inhibiting bacterial growth.

CONCLUSION

Plecospermum spinosum has demonstrated significant potential in inhibiting microbial growth. The plant may contains novel compounds that warrant further investigation. Future studies should focus on isolating these phytochemicals and evaluating their potent biological activities through clinical and animal trials.

Declaration of Interest

The authors declare no conflicts of interest related to this work. The responsibility for the content and writing of this paper lies solely with the authors.

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