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RESEARCH ARTICLE

Antimicrobial potential of the medicinal plant species of *Acacia Caesia*

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ABSTRACT

This study was designed to evaluate the antimicrobial activity of alcoholic root extracts of *Acacia caesia.* The plant extracts showed strong antibacterial and antifungal activity against both Gram positive and Gram negative microorganisms. The results of the study revealed that the used three alcoholic extracts showed varied degree of antimicrobial activity against the tested human pathogens. However the methanolic root extract exhibited higher inhibition zone (20.33 mm) against the bacterium, *Bacillus subtilis*, whereas the ethyl acetate and methanol extracts showed high degree of inhibition zone against the fungi, *Mucor rouxii* and *Rhizopus* sp. (28.53 and 20.63 mm respectively). Hence, the methanolic root extract was found to be most effective against tested pathogens. These plant extracts which proved to be potentially effective can be used as natural alternative to the various health problems.

Keywords: *Acacia caesia*, Alcoholic extracts, human pathogens, Disc diffusion method

1. INTRODUCTION

The need for less toxic, more potent and non-anti-infective antibiotics, as well as the evolving resistance of microorganisms are some of the medicinal areas that have posed a challenge to therapeutics since 1990s. A corresponding situation exists in the agricultural sectors. These factors have been combined effect of injecting a sense of urgency into the search for new bioactive compounds (1). In agriculture, the crop loss due to plant pathogens has become major concern. Increased usage of different chemicals based products to control these pathogens has resulted in problems like residual effect of chemicals in agri-based products, increased resistance for chemicals in target pathogens and environmental pollution. The plants have been an essential part of human society since the start of civilization.

Medicinal plants represent a rich source of antimicrobial agents. Plants are used medicinally in different countries and are a source of many potent and powerful drugs (2). Plants contain a variety of bioactive compounds that provide them antimicrobial properties, which can be used to develop novel antibiotics(3). Among the large number of plants, the important medicinal species, *Acacia caesia.* The leaves of the study species, *Acacia caesia* are used as vegetable. This part is used in the treatment of asthma and skin diseases (4). The powdered bark and pod are used as substitute for soap and their decoction is used as lice killer (5,6). Further, the bark extract is used as protective coat in boats and fishing nets against corrosive (4). Woody branches are used as tooth-brushes by tribal folk. The soft beaten bark of the plant has cleaning properties and protects the skin against microorganisms. The flowers are reported to be used by sandal women to treat menstrual disorders (7,8,9,10). The bark of the plant is used as shampoo for cleaning the hair, and shoots are used in the treatment of scabies (11). With these multiple values, this species is exploited severely by the local public in western districts of Tamil Nadu. As this plant species occurs principally on hill slopes, it has an important role in the protection of the integrity of the slopes by checking soil erosion. Hence, in the present study an attempt has been made to find out the antimicrobial properties of the root of the species and hence to assess its therapeutic potency.

2. MATERIALS AND METHODS

2.1. Plant Material

Fresh root parts were collected from the population of *Acacia caesia* present in the Maruthamalai Hills of oimbatore District and

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washed under running tap water, air dried and then homogenized to fine powder and stored in air tight bottles.

1.1. Preparation of Extracts

100g air-dried root powder was subjected to 250ml of methanol in soxhlet extraction for 8 hours (50-85°C). The extracts were concentrated to dryness in a flask evaporator under reduced pressure and controlled temperature (50-60°C) to yield crude residue. The crude residue was stored in the refrigerator. To obtain the other chemical extracts, the similar methods as used to obtain methanol extract was adopted by using the solvents *viz*., petroleum ether and ethyl acetate.

1.2. Media Used

Freshly prepared nutrient agar medium and PDA medium were used for the culture of bacteria and fungi respectively.

1.3. Microorganisms

In vitro antimicrobial activity was examined for the chemical extracts of root part of the study plant, against ten bacterial species which include the gram positive strains *viz*., *Micrococcus* sp., *Lactobacillus sp., Bacillus subtilis*, *B. thuringiensis*, and gram negative strains like *Pseudomonas aeruginosa, P. stutzeri, Escherichia coli, Klebsiella pneumoniae, Servatia* sp. and *Moraxetta* sp. and fungal species *viz., Aspergillus niger, A. flavus, A. baumannii*, *Fusarium oxysporum, F. solani, Mucor rouxii, Alternaria alternata, Candida albicans, Cladosporium* sp. and *Rhizopus* sp. All these microorganisms were obtained from the Department of Microbiology, Hindustan college of Arts and Science and Dr. N.G.P College of Arts and Science, Coimbatore. All the microorganisms were maintained at 4°C on nutrient agar slants (for bacteria) and PDA slants (for fungi).

1.4. Antimicrobial Assay

The alcoholic extracts were tested for their effect against pathogenic bacteria and fungi by disc diffusion method (12). The organisms bacteria and fungi tested were inoculated into nutrient agar and PDA media respectively. After an incubation period of 24 hrs at a temperature of 35^0C, three or four colonies isolated from these media were inoculated into 4ml of nutrient broth and incubated for 2 hrs at 35^0 C. The cultures were adjusted with sterile saline solution to obtain turbidity. Petri dishes containing Muller- Hinton agar and PDA medium were streaked with these microbial suspensions of bacteria and fungi respectively. Disks of 6mm diameter were impregnated with different extracts *viz.,* petroleum ether, methanol and ethyl acetate. Tetracycline is used as positive control. After equilibrium at 4^0 C, the plates were incubated overnight at 37^0 C and the diameter of any resulting zones of inhibition was measured. Each experiment was repeated at least three times.

2. RESULTS AND DISCUSSION

The results obtained in the present study relieved that the tested medicinal plant extract possess potential antimicrobial activity against ten bacteria and fungi and the findings are summarized. The roots of *Acacia caesia* collected from Maruthamalai hills were dried and powdered. Powdered roots were extracted successively using polar solvents *viz*., petroleum ether, ethyl acetate and methanol. The inhibition effect of alcoholic root extracts of this species is given in Table 1. The study reports that the methanol extract showed highest inhibitory activity against the growth of the bacteria, *Bacillus subtilis* (20.33 mm diameter inhibitory zone) and *B. thuringiensis* (15.87mm diameter inhibitory zone). The other extracts also exhibited the moderate activities against the growth of Bacterial culture used. Petroleum ether extract also showed higher inhibitory zone against the bacterium, *B. thuringiensis* by producing 12.67 mm diameter inhibitory zone and ethyl acetate extract showed maximum zone of inhibition against the bacterium, *Serratia* sp. 12.16 mm diameter inhibitory zone. The antifungal activity of the various alcoholic extracts of root part of the species, *A. caesia* against ten fungal species tested showed the following results: The inhibition effect of alcoholic root extracts of this species is given in Table 2. The study exhibited that the ethyl acetate extract showed highest inhibitory activity against the growth of the fungus, *Mucor rouxii* by producing 28.53 mm diameter inhibitory zone. Petroleum ether and methanol extracts showed higher inhibitory zone against the fungi, *Alternaria*

alternata (20.77 mm diameter inhibitory zone) and *Mucor rouxii* and *Rhizopus* sp. (20.63 mm diameter inhibitory zone) respectively.

The overall study on antimicrobial activity reports that the plant species containing adequate active compounds to reduce or check the growth of microbial colonies. The beneficial medicinal effects of these plant materials typically results from the combinations of secondary products present in the plant. These compounds are mostly secondary metabolites such as alkaloids, steroids, tannins, phenol compounds *etc.* which are synthesized and deposited in specific parts of the study species (13). The heterogeneity of these secondary compounds in wild species is reported to be wide (14). Based on this concept, it is explained that the study species due to the heterogeneity of secondary compounds owing to their wildness could be with higher antimicrobial activity. The higher antimicrobial activity of alcoholic extracts of the present study species may further indicates that the antimicrobial principles/chemical constituents which are either polar or nonpolar can be effectively extracted only through the organic solvent medium (15,16,17,18,19). The positive outcomes observed in the antimicrobial tests coupled with the presence of bioactive compounds in these extracts establish a promising foundation for pharmaceutical exploration (20). It can therefore be suggested that crude extracts contain potential antimicrobial compounds and the obtained results may also be useful for evaluating substances of interest.

3. CONCLUSION

The plant extracts have great potential as antimicrobial compounds against microorganisms. Thus, they can be used in the treatment of infectious diseases caused by resistant microbes. The result showed the potential antimicrobial effects against tested bacterial and fungal microorganisms. Further investigation need to isolate and purify the active compounds to formulate new drugs.

REFERENCES

1. Franco, C.M.M. and L.E.L. Coutinho, (1991). Detection of novel secondary metabolites. *Critic.Rev.Biotech.* 193 – 276.
2. Srivastava, J., J. Lambert and N. Vietmeyer, (1996). Medicinal plants: An expanding role in development. World Bank Technical Paper. No. 320.
3. Mrityunjoy Acharjee, Nagma Zerin, Touhida Ishma, Md Rayhan Mahmud, (2022). *In-vitro* anti-bacterial activity of medicinal plants against Urinary Tract Infection (UTI) causing bacteria along with their synergistic effects with commercially available antibiotics. *New Microbe and New Infect* 24(51):101076. doi: 10.1016/j.nmni.2022.101076
4. Paulsamy, S., P. Senthilkumar, A.M. Anandakumar and P. Sathishkumar, (2010). Utilization of forest flora as agricultural tools and other domestic goods by the villagers adjoining the foot hills of Anamalais, the Western Ghats, Coimbatore district. *Journal of Non-Timber Forest Products* 17(3): 339-334.
5. Thammanna and K. Narayana Rao, (1990). Medicinal Plants of Tirumala, Department of Gardens, Tirumala Tirupati Devasthanams, Tirupati.
6. Krishnamurthy, T. (1993). Minor Forest Products of India, Oxford & IBH, New Delhi.
7. Warrier, P.K., V.P.K. Nambiar, C. Ramankutty and R. Vasudevan Nair, (1996). *Indian Medicinal Plants*, *A Compendium of 500 species*, Orient Longman, Vol. 1 p. 430.
8. Pullaiah, T. 2002. *Medicinal Plants in Andhra Pradesh, India*, Daya Books, pp.1-262.
9. Pullaiah, T. 2006. *Encyclopaedia of World Medicinal Plants*, Daya Books, pp.1-2442.
10. Rashtravardhana, (2008). *Direct uses of Medicinal Plants and their Identification,* Sarup & Sons, p. 370.
11. Jose Boban, K. (1998). Tribal Ethnomedicine continuity and change, medicinal practices and healing rituals within the tribal community of Kerala, India, APH, pp. 173 - 254.
12. Bauer, S.W., W. M. Kirby, She & JC and M. Thurck, (1966). *American Journal of Pathology,* 45: 493-496.
13. Sathishkumar P, Paulsamy S, Anandakumar AM and P. Senthilkumar, (2009). Effect of habitat variation on the content of certain secondary metabolites of medicinal importance in the

leaves of the plant, *Acacia caesia* Wild. *Journal of Advances in Plant Sciences* 22 (11): 451-453.
14. Balandrin, M.F.J., A. Kjocke, E. Wurtele, (1985). Natural plant chemicals: sources of industrial and mechanical materials. *Science* 228: 1154-1160.
15. Eseawi, T. and M. Srour, (2000). Screening some Palestinian medicinal plants for antibacterial activity. *J. of Ethanopharmacol*. 70: 343-349.
16. Raskin, I.D.M. Ribnicky, S. Komarnitsky, N. Ilic, A. Poulev, N. Borijuk, A. Brinker, D.A. Moreno, C. Ripol, N. Yakobi, J.M. O'Neal, T. Cornwell, I. Pastor and B. Fridlender, (2002). Plants and human health in the twenty-first century. *Trends Biotechnol*. 20: 522-531.
17. Aiyelaagbe, O.O., B.A. Adeniyi, O.F. Fatunsin and B.D. Arimah, (2007). *In vitro* antimicrobial activity and photochemical analysis of *Jatropha curcas* roots. *Intern. J. Pharmacol*. 3(1): 106-110.
18. Zakaria, Z.A., A.M. Desa, K. Ramasamy, N. Ahmat, A.S. Mohamad, D.A. Israf and M.R. Sulaiman, (2010). Lack of antimicrobial activities of *Dicranopteris linearis* extracts and fractions. *African Journal of Microbiology Research* 4(1): 071-075.
19. Rahul, R.D., A.K. Asha, D.R. Anjali, S.P. Priya, A.A. Kulkarni, R.D. Nirmala, P. Jyoti and P. Salvekar, (2011). Antimicrobial activity of different extracts of *Juglans regia* L. against oral microflora. *Int. J. Pharm. Pharm. Sci.* 3(2): 200-201.
20. Mulgeta A., E.Lulekal, Z. Asfaw, B. Warkineh, A. Debella, A. Abede, S. Degu and E. Debebe, (2024). Antibacterial activity and phytochemical screening of traditional medicinal plants most preferred for treating infectious diseases in Habru District, North Wollo zone, Amhara Region, Ethiopia. *Plos One* 19(3): 1-15.

Table 1. Antibacterial activity of certain alcoholic root extracts of the species, Acacia caesia.

Plant extract	Diameter of zone inhibition (mm)									
	Gram positive bacteria				Gram negative bacteria					
	Bacillus subtilis	***B. thuringiensis***	***Micrococcus* sp.**	***Lactobacillus* sp.**	***Klebsiella pneumoniae***	***Escherichia coli***	***Pseudomonas stutzeri***	***P. aeruginosa***	***Serratia* sp.**	***Moraxetta* sp.**
Standard *	27.23 ± 0.49	30.67 ± 0.61	23.23 ± 0.49	25.03 ± 0.65	9.77 ± 0.93	25.06 ± 0.70	12.13 ± 0.42	26.63 ± 0.60	30.57 ± 0.67	27.16 ±0.37
Petroleum ether	-	8.63 ± 0.65	9.07 ± 0.40	-	-	6.93 ± 0.40	-	-	12.16 ± 0.37	8.66 ± 0.61
Ethyl acetate	7.87 ± 0.90	12.67 ± 0.61	10.03 ± 0.55	8.97 ± 0.35	8.03 ± 0.45	8.97 ±0.55	8.07 ±0.50	9.06 ± 0.21	11.03 ± 0.65	10.03 ± 0.45
Methanol	20.33 ±0.76	15.87 ± 0.85	10.16 ± 0.38	7.77 ±0.75	-	10.03 ± 0.35	-	10.03 ± 0.35	11.03 ± 0.25	9.83 ± 0.80

*** Tetracycline**

Table 2. Antifungal activity of certain alcoholic root extracts of the species, *Acacia caesia*.

Plant extract	Diameter of zone inhibition (mm)									
	Aspergillus niger	***A. flavus***	***A. baumanii***	***Fusarium oxysporum***	***F. solani***	***Mucor rouxii***	***Alternaria alternata***	***Candida albicans***	***Cladosporium* sp.**	***Rhizopus* sp.**
Standard *	27.03 ± 0.21	30.63 ± 0.60	26.77 ± 0.65	30.67 ±0.61	25.63 ± 0.57	28.67 ±0.65	27.77 ±0.71	9.67 ± 0.65	12.77 ± 0.71	33.67 ± 0.61
Petroleum ether	7.73 ± 0.54	12.73 ± 0.75	-	-	-	10.77 ±0.75	20.77 ±0.75	-	-	10.73 ±0.67
Ethyl acetate	14.77 ±0.58	10.73 ± 0.70	9.77 ± 0.71	10.73 ±0.70	8.73 ± 0.67	28.53 ±0.55	10.73 ±0.70	7.63 ± 0.60	-	13.63 ±0.57
Methanol	19.63 ± 0.49	13.63 ± 0.65	15.67 ± 0.61	15.67 ± 0.65	12.13 ± 0.32	20.63 ±0.80	14.73 ±0.67	-	15.73 ±0.67	20.63 ± 0.60

*** Tetracyclin**