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Original Article

STUDIES ON THE PHYTOCHEMISTRY, SPECTROSCOPIC CHARACTERIZATION AND ANTIBACTERIAL EFFICACY OF SALICORNIA BRACHIATA

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ABSTRACT

Objective: *Salicornia brachiata* is a euhalopytic plant belonging to the family Chenopodiaceae. The present study investigates the phytochemistry, characterization and antibacterial activity of methanolic extract of *S. brachiata*.

Methods: *S. brachiata* was collected from the back waters of Chennai, Tamil Nadu. The collected plant material was shade dried and pulverized. The plant material Was studied for phytochemistry, spectroscopic analysis i.e., UV- Visible, FT-IR and antibacterial activity.

Results: The phytochemical analysis indicates the presence of Tannins and Flavonoids in the plant. UV-Vis Spectrum, used for the quantitative analysis of the plant extract showed peaks at 280 and 290 nm. Identification of the functional groups was performed by FT-IR spectroscopy which confirmed the presence of phenolic, alcoholic and aromatic compounds.

Conclusion: The present study provides evidence that the methanolic extract of *S. brachiata* contains bioactive compounds that might pave a new avenue for the use of the plant as a novel preservative agent in various industries.

Keywords*: Salicornia brachiata,* Halophyte, Phytochemistry, UV-Vis, FT- IR, Antibacterial.

INTRODUCTION

India is one of the Nations with the oldest, richest and most diverse cultural traditions associated with the use of medicinal plants [1]. Plants have been identified to contain curative constituents which have potentially significant therapeutic applications against bacteria, fungi and viruses [2]. The use of phytochemicals as natural antimicrobial agents, commonly called 'biocides' is gaining popularity [3]. The most essential of these bioactive constituents of plants are alkaloids, tannins, flavonoids and phenolic compounds. Many of the indigenous medicinal plants are used as spices and food [4]. Phytoconstituents have found applications as naturally occurring antimicrobial agents in the field of preservation, pharmaceutics, phytopathology, etc. Increasing failure of chemotherapeutics and the resistance exhibited by pathogenic microbial infectious agents against antibiotics have led to the screening of medicinal plants for their potential antimicrobial activities. There are several reports regarding the antimicrobial activity of crude extracts prepared form plants [5]. Some of the active principles of the bioactive compounds are preferred for their therapeutic purposes either as a single entity or in combination, so as to inhibit the life processes of microbes [6-7]. Of recent times, most of the industries are focusing on the use of natural materials for preservation.

S. brachiata is a highly salt tolerant plant [8] that can grow in marshy lands. This halophytic shrub of coastal mud lands is a potentially high biomass producing marine ecosystem, recently innovated as a source of high valued vegetable salt known as saloni, making it suitable for patients with high blood pressure, besides the usage of its oil in industries [9]. Several species of *Salicornia* possess antibacterial and antihypertensive properties and are quoted in folk medicine for relief of toothache and chronic rheumatism [10], constipation, obesity, diabetes and cancer [11-12]. The present study focuses on screening the plant for phytoconstituents, its characterization using UV- Visible spectrum, FT-IR and evaluation of its antibacterial activity.

MATERIALS AND METHODS

Collection of Plant material

The halophytic plant, *S. brachiata* of Chenopodiaceae family was collected from the back waters of Ennore, Chennai, Tamil Nadu. The area falls within the latitude 13º-04'N and longitude 80º-17'E. The plant material was shade dried and made to coarse powder using mixer grinder.

Preparation of plant extract

The plant powder (50 g) was extracted with 500 mL of methanol. The sample was stirred in temperature-controlled shaker at 30 ± 2 ºC for 48 h. After incubation, the solution was filtered using Whatmann No.1 filter paper and concentrated, which was used for further experiments [13].

Phytochemical Analysis

The qualitative analysis for the phytoconsituents such as Tannins, Flavonoids, Saponins, Cardiac glycosides, Steroids, Phlobatannins and Terpenoids was performed by the method described by Evans, 1996 and Udaya Prakash et al., 2013 [14-15].

Ultraviolet Visible Spectrophotometer

One g of plant powder was boiled with 10 mL of distilled water and then filtered. An aliquot of the filtered sample was scanned using UV- Visible Spectrophotometer (Cyberlab, USA), at a range of 200 - 800 nm, to detect the characteristic wavelength of the plant extract.

Fourier Transform Infra Red Spectroscopy

The plant sample was dried at 40°C and ground to fine powder through mortar and pestle. The sample was mixed with KBr (FT-IR grade) at a ratio of 1:100 and pressed to a pellet. The pellet was immediately put into the sample holder of Perkin Elmer Spectrophotometer (Spectrum RX1, FT-IR V.2.0) and operated in the range 4000 – 480 cm^{-1}. From the spectral data obtained, the functional groups were detected.

Antibacterial activity

Methanolic extract of the plant was tested against four strains of bacteria - two Gram positive species (*Bacillus subtilis* MTCC 121 and *Streptococcus* sp.) and two Gram negative species (*Klebsiella pneumoniae* MTCC 1320 and *Vibrio parahaemolyticus* MTCC 451) by Micro broth dilution method. The initial concentration of the plant extract was taken as 100 mg/mL and then diluted to the wells

thereafter, to yield successive concentrations of 50, 25, 12.5, 6.25, 3.125, 1.5625 and 0.78125 mg/mL. 10 µl of 24 h microbial culture was added to all the wells. The plate was incubated at room temperature for 24 h. The bactericidal activity of the plant extract was compared with the antibiotic (in µg/mL).

RESULTS AND DISCUSSION

Phytochemical analysis of *S.brachiata*

The active constituents of plants are the major source for the development of new chemotherapeutic agents [4 & 16]. The methanolic extract of *S. brachiata* was subjected to phytochemical screening for various phytoconstituents, which revealed the presence of tannins and flavonoids (Table 1). Phytomedicine has been used for the treatment of chronic diseases. Phenolic compounds have been reported to be potential free radical scavengers [17]. The plants rich in tannins have significant activity in cancer prevention and are used in treating intestinal disorders [18-20]. Flavonoids are known to possess a wide range of biological activities such as antioxidant, antimicrobial, anti-inflammatory and anticancer activities [17; 21-26]. The presence of tannins and flavonoids in methanolic extract of *S. brachiata* suggests the potential isolation of the phytochemicals and their use in industries.

Uv-vis spectroscopic analysis

The UV-VIS profile (Fig.1) of the plant extract was studied at a wavelength range of 200 to 800 nm. Two major bands were recorded at 280 and 290 nm with absorbance values of 0.28 and 4 respectively.

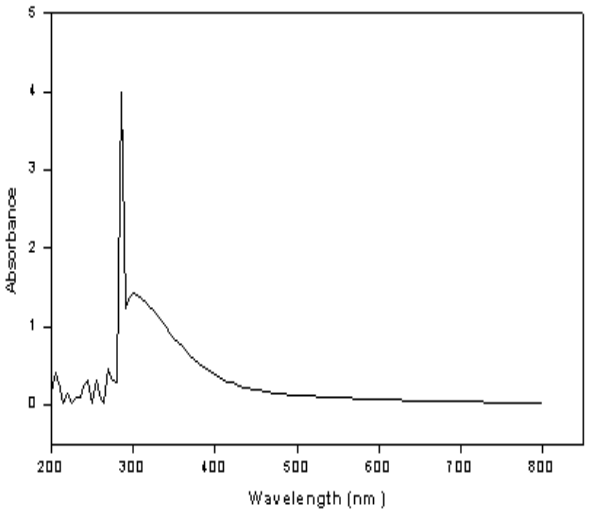

Fig. 1: UV-Vis Spectra of methanolic extract of *S.brachiata*

The spectra for phenolic compounds (tannins) and flavonoids typically lie in the range of 230-290 nm [27]. The result of UV-VIS spectroscopic analysis confirms the presence of tannins and flavonoids in the methanolic extract of *S. brachiata.*

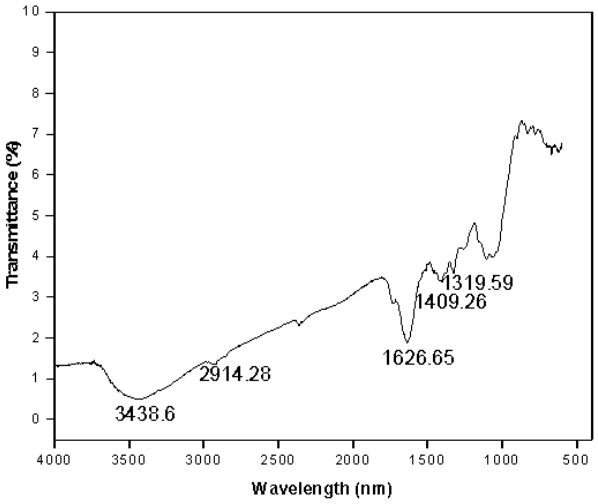

Fig. 2: FT-IR Spectra of methanolic extract of *S.brachiata*

Spectroscopic analysis- FT- IR

The FT-IR spectrum was performed to identify the functional groups present in *S. brachiata* based on the peak values in the region of infrared radiation. FTIR studies enable the identification of the chemical constituents and elucidation of the structures of compounds [28]. The major bands were observed at 3438.6, 1637.4, 1404 and 1319.59 cm^{-1} (Fig 2). The peak at 3448.4 cm^{-1} indicates the O-H stretch that might be due to the presence of phenols and alcohols. The bands at 1637.4 cm^{-1} and 1404 cm^{-1} corresponds to the C-C stretch, confirming the presence of aromatic compounds. The peak at 1319.59 cm^{-1} represents C-O stretch which shows the presence of alcohols, carboxylic acids, esters and ethers. In addition, some weak absorption bands were also recorded in the spectra.

Antibacterial Activity

The antibacterial activity of methanolic extract of *S.brachiata* against the test organisms is not significant, when compared with the antibiotic. The plant has inhibited the growth of the bacterial strains at high concentrations which shows the poor ability of the plant against bacteria. Similar report regarding the bactericidal action of *S. brachiata* has already been reported [29]. The results imply that the halophyte studied is not a better antibacterial agent. However, different solvent systems may enable characterisation of other phytoconstituents which might contribute to better activities of the plant.

Table 1: Phytochemical analysis of methanolic extract of *S. brachiata*

Tannins	Phlobatannins	Saponins	Terpenoids	Steroids	Cardiac glycosides	Flavonoids
+	-	-	-	-	-	+

Table 2: MIC recorded for methanolic extract of *S. brachiata*

Bacteria	*Bacillus subtilis*	*Klebsiella pneumoniae*	*Streptococcus* sp.	*Vibrio parahaemolyticus*
S. brachiata (mg/mL)	25	50	12.5	100
Antibiotic (µg/mL)	12.5	25	25	>100

CONCLUSION

The present study was carried to detect the phytoconstituents, followed by the spectroscopic characterization and the antibacterial efficacy of the methanolic extract of *S. brachiata*. The qualitative analysis of the phytochemicals showed the presence of tannins and flavonoids in the methanolic extract of *S. brachiata*. The peaks obtained in UV-Vis spectra confirm the presence of the same. FT-IR spectra represented the existence of phenolic compounds, alcohols and aromatic compounds in the plant. The methanolic extract of the

plant was found to be inactive against the bacteria tested. This might be due to the selection of the solvent system. However, selection of the dosage and solvent system is recommended for further studies against microbes. The study leads to a broader perspective for industries, in usage of a new class of preservative agent for food, pharmaceutical and leather industries. Further studies are crucial towards isolation, identification and characterization of bioactive compounds of industrial importance.

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