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(RESEARCH ARTICLE)

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Phytochemical Screening and Antimicrobial Activity of *Bryophyllum pinnatum* Leaf Extract

Shivani suryawanshi *, Avadhesh kumar, Dipali deshmukh, Ayush jain, Ayush tiwari, Bhanu pratap Vaishya, Bittu kumar singh, Chouhan suraj Ravindra and jagdish Chandra Rathi

NRI Institute of pharmaceutical sciences, sajjan singh nagar, raisen road, Bhopal, M. P. 462022, India.

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Abstract

Bryophyllum pinnatum (Lam.) Kurz, perennial herb from the Crassulaceae family, is widespread in tropical Africa, tropical America, India, China, and Australia, and is extensively utilized in traditional medicine. Both native and exotic, the plant is important to traditional healers for treating a range of ailments including kidney stones, high blood pressure, asthma, colds, abscesses and bleeding disorders. Renowned for its haemostatic and wound healing properties, it has become a staple in traditional medicine for treating various ailments.The methanol extractsof *Bryophyllum pinnatum* were investigated for their phytochemical constituents and activity against selected microorganisms. Phytochemicals found present were reducing sugars, saponins, steroids, tannins, alkaloids, flavonoids and phenols. The test microorganisms were Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Shigella dysenteriae, Salmonella typhi, Pseudomonas aeruginosa, Candida albicans, Aspergillus fumigatus, Aspergillus niger, Microsporum spp and Trichophyton rubrum. This article reviews and discusses pharmacological studies, highlighting that diverse extracts from *Bryophyllum pinnatum* demonstrate pharmacological activities, including immunomodulation, CNS depression, analgesia, antimicrobial effects, anti-inflammatory responses, antiallergic and antianaphylactic properties, antileishmanial activity, antitumorous effects, antiulcer properties, antibacterial and antifungal actions, antihistamine and antiviral effects, febrifuge activity, gastroprotective qualities, immunosuppression, insecticidal properties, and muscle relaxation, along with sedative effects.

Keywords: Phytochemical' Screening; Antimicrobial; *Bryophyllum pinnatum*; Leave

1. Introduction

Bryophyllum pinnatum plant belongs to family of the Crassulaceae, commonly used as traditional medicines. The term *Bryophyllum pinnatum* is derived an ancient greek word where bryo means to sprout out and next i.e, phyllon means the leaf. The secondary metabolites obtained from different parts of this plant such as alkaloid, flavanoid, tannin, glycoside, phenolic compounds, which have therapeutic value. The pharmacological studies shows that it exerted many pharmacological effects including anticancer, antioxidant immunomodulating, antibacterial, anthelmentic, antiprotozoal, neurologica, anti-inflammatory, analgesic, diuresis, antiurolithitic, nephroprotective, hepatoprotective, anti-peptic ulcer, hypotensive, antidiabetic, wound healing and other pharmacological effects. The present review is based on the systematic review on the *Bryophyllum pinnatum*. It is a perennial herb which is about 1m tall. Stem is fleshy and cylindrical and youngest stem are reddish in colour. It is growing primarily in rain forests and distributed worldwide. It is astringent and sour in taste . The nutritive value of fresh and dried leaves of *Bryophyllum pinnatum* shows that the carbohydrate values were the highest and ash had the least value. Calcium and potassium levels are high and lead and zinc levels are law in both fresh and dried samples. Presence of large amount of various chemical constituents in the plant *Bryophyllum pinnatum* shows various pharmacological actions. While the antimicrobial

* Corresponding author: Shivani suryawanshi

research on ***Bryophyllum pinnatum*** is more focused on bacterial and fungal pathogens, there is some evidence to suggest that it may also have **antiviral properties**. Some studies have indicated that the plant's compounds can inhibit the replication of certain viruses. However, these findings are less extensive, and further research is needed to confirm its effectiveness as an antiviral agent. Its also has demonstrated significant anti-inflammatory effects, which is one of the primary reasons it has been used in traditional medicine. The plant's leaves are often applied topically to reduce inflammation associated with injuries, joint pain, or skin conditions. This anti-inflammatory activity is likely due to the presence of flavonoids, alkaloids, and other bioactive compounds that can inhibit the production of pro-inflammatory cytokines and other inflammatory mediators.

Figure 1 *Bryophyllum pinnatum*

2. Materials and methods

Whole plant of B. Pinnatum, including leaves, bark, stem, and flowers, was collected from the Local area. The plant parts were cleaned and dried for 7 days and then fine powder was prepared of the whole plant by grinding. About 500 gm of dry powder was extracted with 100 mL of methanol, ethanol and chloroform (80%) by using the soxhlet apparatus. The extracted portion of ethanolic, methanolic and chloroform extract was filtered and a hot air oven was used to evaporate solvents. The residue was stored separately in air containers and preserved in deep freezer.

2.1. Microwave Assisted Extraction of Samples

A microwave assisted extraction was carried out using a domestic microwave oven according to methods described by [18]. The pulverized plant (150 g) was extracted by adding hexane, ethyl acetate and methanol (800 mL each) successively. The mixture of the plant material and solvent was heated for three minutes in (70 Watts/Defrost Function) using a modified domestic kitchen microwave (Mio-star, Model 7173.295, Germany) and repeated ten times with 14 minutes cooling intervals so the temperature does not rise above 70°C. The extracts were thereafter allowed to cool to ambient temperature (32 - 35°C).Pressure build up was vented after every successive heating. The extracts were filtered, air dried and then stored until required.

2.2. Phytochemical Screening

Leave extracts were subjected to phytochemical tests for the presence of anthraquinones, saponins, tannins, steroids, terpenes, reducing sugars, flavonoids and alkaloids using standard procedures as described by

2.3. Test for Antimicrobial Activity

The antimicrobial activities of the hexane, ethyl-acetate and methanol extracts of the wood stem and stem bark were determined using clinical isolates of some pathogenic microbes obtained from Department of Medical Microbiology Ahmadu Bello University Teaching Hospital Zaria. A Diffusion method was used for screening the extracts. Mueller Hinton Agar was used as growth medium for microbes, sterilized at 121°C for 15 mins, poured into sterile petri dishes and allowed to cool and solidify The extracts (0.4 g) were dissolved in 10 mL of DMSO to obtain a concentration of 40 mg/mL. The sterilized medium was then seeded with the standard Inoculum (0.1 mL) of test microbes spread evenly over the surface of the medium with sterile swabs. Using a 6 mm standard cork borer a well was cut at the center of each inoculated medium. A concentration of 5 mg/mL of the extract was then introduced into each well on the inoculated medium. The inoculated medium was incubated at 37°C for 24 hr, after which the medium was observed for the zones of inhibition of growth. The zones were measured with a transparent ruler.

2.4. Minimum Inhibition Concentration (MIC)

The minimum inhibitory concentration was determined using the Broth dilution method. Mueller Hinton broth was prepared 10 mL by dispensing into test-tubes, sterilized at 37°C for 6 hours and allowed to cool. McFarland's turbidity standard scale number 0.5 was prepared to give a turbid solution. Dilution of the test microbes was in normal saline until turbidity matched that of the McFarland's scale and the concentration of the test microbes was taken to be 105×10^{8}cfu/mL. The extracts in the sterile broths were diluted serially to obtain 40 mg/mL, 20 mg/mL, 10 mg/mL, 5 mg/mL and 2.5 mg/mL concentrations. The initial concentration of the extract was obtained by dissolving the extract (0.1 g) in the sterile broth (40 mL).The test microbes were then inoculated into the different concentrations [21] and incubated at 37 °C for 24 hr. There after the test tubes were observed for turbidity or growth. The lowest concentration of extracts in the sterile broth which showed no turbidity was recorded as the minimum inhibition concentration (MIC).

3. Results and discussion

Phytochemical screening of the leave extracts of *Bryophyllum pinnatum* showed the presence of reducing sugars, saponins, tannins, flavonoids and phenolic compounds in the methanol, steroids and terpenoids in hexane and ethyl acetate while alkaloids were only detected in ethyl acetate and methanol (Table 1) extracts. The stem wood extracts showed the presence of saponins, tannins, flavonoids and phenols in the methanol while steroids and terpenoids were detected in the hexane, ethyl acetate and methanol, reducing sugars and alkaloids in the ethyl acetate and methanol. Antraquinones were not detected in any of the extracts (Table 1).

Table 1 Qualitative analysis of Phytochemicals present in different extracts of *Bryophyllum pinnatum* Plants Extracts

Plant Extract	Alkaloids	Terpenoids	Coumarin	Tanin	Flavonoid	Phenol	Cardiac glycosides	saponins
Ethanol extract	+	+	-	+	+	+	+	+
Methanol Extract	+	+	-	+	+	+	+	+
Chloroform extract	_	_	-	+	+	_	_	_

3.1. Antimicrobial activity and compounds of *B. pinnatum* responsible for therapeutic properties

Based on isolation method, colony and cultural characteristics and biochemical properties, the isolates have been confirmed as *S. aureus E. coli, and C. albicans*. Antibiotic sensitivity test against the isolates showed a high sensitivity to vancomycin and clindamycin for experimenting against bacteria and fluconazole for fungi. Antimicrobial action of different plant extracts of *B. pinnatum* were tested against three microorganisms, mentioned in Table 4 along with a standard drug comparison. In the present study, methanol, ethanol and chloroform portions of *B. pinnatum* plant showed antibacterial and antifungal properties in contradiction of organisms, *namely S. aureus, E. coli, and C. albicans*. This antibacterial and antifungal action may be accredited to the occurrence of phytochemical classes such as alkaloids, steroids, glycosides, terpenoids, saponins, flavonoids.

Table 2 Zone of inhibition of Ethanol extract of *Bryophyllum pinnatum* along with concentration

Zone of inhibition of Ethanol extract of *Bryophyllum pinnatum* along with concentration				
PATHOGENS	10	5	2.5	1.25
E. coli	19	10	10	-
S. aureus	16	11	11	-
C. albicans	15	12	12	-

Table 3 Zone of inhibition of Methanol extract of *Bryophyllum pinnatum* along with concentration

Zone of inhibition of Methanol extract of *Bryophyllum pinnatum* along with concentration				
PATHOGENS	10	5	2.5	1.25
E. coli	20	12	8	-
S. aureus	18	9	8	-
C. albicans	18	9	6	-

Table 4 Zone of inhibition of Chloroform extract of *Bryophyllum pinnatum* along with concentration

Zone of inhibition of Chloroform extract of *Bryophyllum pinnatum* along with concentration				
PATHOGENS	10	5	2.5	1.25
E. coli	16	9	8	-
S. aureus	18	15	9	-
C. albicans	18	16	8	-

4. Conclusion

The plant extract of *B. pinnatum* showed noteworthy inhibitions of clinically significant microorganisms that contain active phytochemicals such as alkaloids, glycosides, saponins, flavonoids and phenols. The compounds investigated through GC/MS were responsible for their antimicrobial properties. Additionally, the methanolic plant extract was the most potent against three organisms and the ethanolic extract showed the minimum inhibitory concentration against S. aureus. . Different plant extracts were also compared with standard drugs, where it depict that novel compounds isolated from *B. pinnatum* are of comparable therapeutic agents compared to antibiotics which were used for the study. Hence from the above study, it can be concluded that *B. pinnatum* holds therapeutic properties to produce novel drugs. It is seen that *B. pinnatum* contains various bioactive compounds which are responsible for antimicrobial properties. However, further studies will be undertaken to ascertain the synergistic role of plant extracts of *B. pinnatum* along with the antibiotics used in this study.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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