https://doi.org/10.48047/AFJBS.6.Si4.2024.4908-4913

African Journal of Biological Sciences

Ethno-Pharmacological values of *Drosera Indica* L.: A Carnivorous Plant of India

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Article History
Volume 6, Issue Si4, June 2024
Received: 15 June 2024
Accepted: 25 July 2024
Published: 15 Aug 2024
doi:10.48047/AFJBS.6.Si4.2024.4908-4913

ABSTRACT

A field survey was conducted in Odisha, Uttarakhand, and Munnar hills to understand the habitat and habit of *Drosera indica* (a carnivorous plant) during 2017 to 2023. Standard methods are adopted to collect the field information followed by detection of secondary metabolites and antimicrobial activities. Bioactive compounds and antimicrobial activities of *D. indica* are presented here. Ethnomedicinal uses are validated through the experimental works. Results revealed that it grows near poor quality of soil and used to treat asthma and other health problems. It was noticed that the methanolic extract of this plant showed an effective zone of inhibition against *Vibrio cholerae* (MTCC-3906). The present study bring attention towards the advanced work to isolate the active constituents for future drug formulation.

Keywords: Carnivorous plants, *Drosera indica*, phytochemical activity, antimicrobial activity

Introduction

Drug failure, drug resistance, and antimicrobial resistance (AMR) are the burning issues in the health care sector. They are major issues of concern globally. About 4.95 million deaths were recorded globally in 2019 and particularly more in developing countries. [1-3] Keeping in mind the importance of addressing these issues, in September 2024, a high-level meeting of the United Nations will be held to discuss AMR. [2] Researchers are also searching for the source of new antimicrobial agents. [3] Plant wealth is the best source of antimicrobial agents. [1] There are a number of plant groups that have been identified, and most of them are unexplored. [4] Carnivorous plants are such a group of

flowering plants where less work is carried out in the aspect of antimicrobial research. [5] Carnivorous plants represent one of the most extraordinary groupings within the plant kingdom, and carnivory has evolved independently at least six times in five angiosperm orders. [6-8] They have derived their name from their rare and extraordinary mode of heterotrophy found in the autotrophic group of plants, and insects are one of the most common prey items for these heterotrophic plants. [9-10] They have an adaptation to low-nutrient, waterlogged habitats, but they need sunshine. The majority are most likely to be found in damp heaths, bogs, swamps, and muddy or sandy shores where water is at least seasonally abundant and nitrogen materials are often scarce or unavailable because of acid or other unfavourable soil conditions.[11] They can attract, trap, digest, and absorb animal life forms (invertebrates, small frogs, and mammals) or nutrients, especially nitrogen and phosphorous, with the help of different digestive enzymes for their metabolic processes. To attract prey, carnivorous plants employed a variety of mechanisms, such as olfactory, nectar, and visual cues.[12] Botanists have identified over 800 different kinds of meat-eating plants from 20 genera of 12 families, including both monocotyledon and dicotyledon, and their numbers keep increasing. [13-14] Each year, many species are added to the world of carnivorous plants. The carnivorous plants of India belong mainly to three families: Droseraceae, Nepenthaceae, and Lentibulariaceae. They are divided into two types based on the trapping mechanism. These are: active trap and passive trap. [15] *Drosera* species show a great diversity (about 200 species) depending upon their size and habit. Only 3 species of this genus are reported from India (*Drosera indica, Drosera burmannii,* and *Drosera peltata*). Among them, *D. indica* is an herbaceous plant native to India, Africa, and Australia but absent from the neotropics. [16-17] They grow seasonally in acidic soil and wet habitats, which include bogs, fens, swamps, and marshes, and require a high level of sunlight. [18-19] The above facts, trapping mechanisms, and defence mechanisms show that they can be a good source of antimicrobial agents. Therefore, keeping in mind the problem of AMR and the importance of carnivorous plants, an attempt has been made to collect the ethnomedicinal uses from field surveys followed by phytochemical screening and antibacterial activities of the whole plant of *Drosera indica*.

MATERIAL AND METHODS

Drosera indica was collected from Puri district of Odisha state. The plant was identified by authors followed by published literature. [20-21] The plant sample was collected and kept in poly bags tagged with the botanical name and sorted out as per standard sampling procedure. [1] The experimental plant species was properly washed and dried for experimental works. Soxhlet method was adopted to obtain the plant extracts using different solvents like n-hexane, methanol, di-ethyl ether and aqueous. [22] The powdered material of the experimental plant was kept in thimble and extraction was carried out using Soxhlet apparatus. The residues were collected and left for air drying and dried crude extracts were stored in refrigerator for further experimental work. [1] Phytochemical analysis was carried out on different extract of the whole plant (*Drosera indica*) using standard procedure to identify the bioactive compounds. [1, 22] Antimicrobial activity of methanolic extract of the *D. indica* (100 mg/ml, 200 mg/ml, 300 mg/ml, 400 mg/ml, 500 mg/ml) was determined by agar well diffusion method. The antimicrobials present in the plant extract interact with the test organisms. The resulting zones of inhibition are measured in millimetres. [1] The minimum inhibitory concentration (MIC) was performed by serial dilution technique using sterile test tubes. The different plant extracts (aqueous and acetone) were taken for MIC. Five sterile test tubes were taken each to perform the MIC using aqueous, acetone and methanol extract. First test tube was taken as control and contains 1ml of broth only. 2nd test tube contains 900 µl of broth with 100 µl of bacteria (900 µl broth + 100 µl bacteria). The 3rd test tube contains 800 µl broth, 100 µl bacteria and 100 µl of

drug having 100mg/ml concentration (800 µl broth+ 100 µl bacteria + 100 µl drug). 4th test tube contains 700 µl broth, 100 µl of bacteria with 200 µl of drug (700 µl broth + 100 µl bacteria + 200 µl drug). 5th test tube contains 600 µl of broth, 100 µl of bacteria and 300 µl of drug (600 µl broth + 100 µl bacteria + 300 µl drug).

RESULTS AND DISCUSSION

The present study is based on both field and laboratory work. The field survey revealed that whole plant is used to cure asthma. The dried plant is also used to treat wounds. The phytochemical screening revealed that tannin, flavonoids, phenolic compounds, terpenoids and steroids were detected in methanol extract of whole plant. The aqueous extract showed presence of flavonoids and phenolic compounds (Table 1).

Table 1: Qualitative screening of bioactive compounds

Bioactive Compounds	Solvents			
	n-hexane	Di-ethyl ether	Methanol	Aqueous
Tannin	-	-	+++	-
Saponin	-	-	-	-
Flavonoids	-	-	+++	++
Terpenoids	-	-	+++	-
Phenolic compounds	-	-	+++	+++
Reducing sugar	+++	-	+++	-
Steroid	-	-	+++	-
Alkaloids	-	-	+++	-
Carbonyl	-	-	-	-

(+: Present; -: absent)

Antimicrobial activity of methanolic extract of the experimental plant (*Drosera indica*) was determined by agar well diffusion method. The experiment was carried out by using gram negative bacteria *Vibrio cholerae* (MTCC-3906). The zones of inhibition are measured in centimetres. The result revealed (Table 2) that the plant extract showed activity at 50 mg/ml & 100 mg/ml against the tested bacteria, *Vibrio cholerae* (MTCC-3906). It is the first report on MTCC 3906 using the extract of a carnivorous plant, *D. indica* (Table 2).

Table 2: Antibacterial activity of methanol extract of *D. indica* against *V. cholerae*

Concentration	Zone of inhibition (cm, n=3, SD)	
	Apparent	Observed
100 mg/ml	2.1 ± 0.10	1.43 ± 0.05
200 mg/ml	2.6 ± 0.05	2.0 ± 0.05
300 mg/ml	2.46 ± 0.11	1.70 ± 0.10
400 mg/ml	2.6 ± 0.05	1.60 ± 0.11
500 mg/ml	2.3 ± 0.05	1.70 ± 0.10

Broth dilution was carried out using different concentration of acetone, methanol, and aqueous extract to determine the Minimum Inhibitory Concentration values of all the extract against *Vibrio cholerae* (MTCC – 3906). The result showed that the minimum inhibitory concentration for aqueous,

acetone and methanol extract is 300 mg/ml, 200 mg/ml, 200mg/ml respectively (Table 3). The results revealed that it can be used against AMR (Figure 1).

Table 3: Broth dilution assay of *Drosera indica* against *Vibrio cholerae*

Concentration	Acetone	Aqueous	Methanol
Broth	No growth	No	No
Bacterial broth	Growth	Growth	Growth
100 µl	Growth	Growth	Growth
200 µl	MIC	Growth	MIC
300 µl	No growth	MIC	No growth

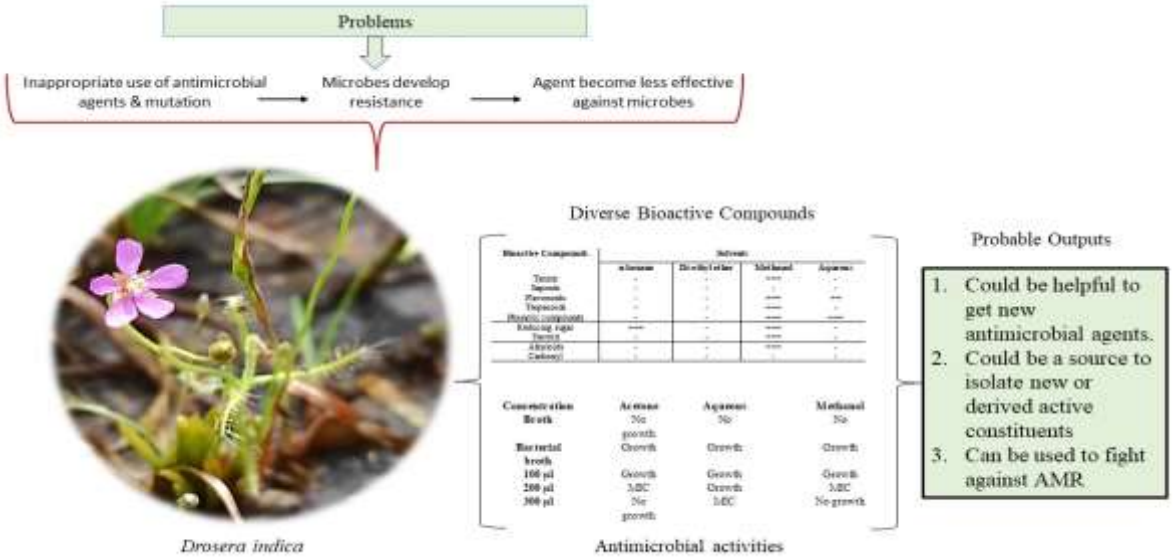

Figure 1: Future aspect of *Drosera indica* against AMR

Less reports are available on *D. indica*. Jayaram and Prasad (2006) reported the medicinal uses of *D. indica* and *D. burmannii* from Andhra Pradesh, India. [23] Asirvatham and Christina (2018) reported the antioxidant activity of *D. indica*. [24] Goswami et al. (2019) reported the phytochemical aspects and ethnomedicinal values of *Drosera* species. [25] Kumar and Verma (2020) reported the distribution and ecology of *D. burmannii* from Jharkhand state, India. Mishra (2020) discussed on medicinal carnivorous plants of Odisha state, India. in 2023, Mishra et al. (2023) reported the carnivorous plants of Jamtara Forest Division, Jharkhand, India. [26]

Conclusion: Present study concludes that *Drosera indica* is used as medicinal agent by different tribal communities of Odisha state, India. It has diverse secondary metabolites and shows antibacterial activities. Therefore, there is a need of more exploration work followed by evaluation of advanced experimental work to isolate active compounds as new or derived antimicrobial agents.

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