Biological Archives, Volume I; ISBN: 978-81-970898-9-3

Chapter 5

Antifungal activity of *Dioscorea bulbifera*: a wild yam of India

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Abstract

During the floristic survey in Odisha and Jharkhand states, the therapeutic claims of *Dioscorea bulbifera* were observed, as their parts are used to treat fungal infections. Keeping this in mind, an attempt has been made to document the antifungal activity of the leaf, stem, and tuber of *D. bulbifera*, and results revealed that tuber extracts showed an excellent zone of inhibition (ZI) against *Candida parapsilosis* (MTCC 2513). The present study validates the ethnomedicinal claims of *D. bulbifera*. Further, more experimental work should be designed to characterize the active secondary metabolites for future drug development.

Keywords: Ethnomedicinal claims, wild tuberous plants, antifungal activity

Introduction

The use of phytoresources by humans is as ancient as their existence on this earth (Das *et al.,* 2022). From the ethnic to the modern age, man has tried to explore the bio-resources available around him and the proper use of these resources (Kumar *et al.,* 2012; Saha *et al.,* 2022). There are a number of wild medicinal foods available that remain unexplored (Kumar *et al.,* 2021; Devi *et al.,* 2024). Some of them have excellent food as well as medicinal values (Swain *et al.,* 2020). Adequate food and medicines for a healthy life are major challenges for third-world countries like India (Kumar, 2015). These two problems need to be addressed properly (Kumar and Jena, 2017). A proper scientific investigation could find a solution by searching for alternate sources of food and medicines from bio-wealth (Nayak and Kumar, 2023). India is the harbour of biodiversity in general and phytodiversity in particular. In several floristic works in Odisha and Jharkhand states, authors found that *Dioscorea bulbifera* (Figures 1-3) is used as food and medicine (Kumar *et al.,* 2017; Kumar,

2017; Mishra and Kumar, 2021). It is an unexplored medicinal tribal food. It not only provides energy supplemented food as sources of starch but also medicines to fight against various diseases and disorders (Kumar *et al.,* 2013; Kumar *et al.,* 2022). Moreover, indigenous knowledge of *Dioscorea* is gradually declining with the increase in modernization and migration to urban areas (Kumar and Jena, 2014; Kumar *et al.,* 2015; Dimri *et al.,* 2024). The knowledge of tribal practitioners and millions of aboriginals from generation to generation flows into the main stream, which has emerged as a traditional therapeutic system (Snehalatha *et al.,* 2022; Manjula *et al.,* 2022). However, the modern scientific mind cannot reach a conclusion and accept the same unless such tribal knowledge is experimentally substantiated. The curative properties of medicinal plants are due to the presence of certain secondary metabolites in them. Keeping this in mind, an attempt has been made to validate scientifically the claims made by tribals about *Dioscorea bulbifera* through the evaluation of antifungal activities.

Methodology

Collection of plant sample and preparation of extracts

Leaves, stems and tubers were collected from Mahanadi River areas of Cuttack, Odisha and stored for experimental works. Collected plant (*Dioscorea bulbifera*) was identified by the senior author. The Soxhlet method of extraction was adopted using three solvents for antifungal activity (Devi *et al.,* 2023).



Figure 1: Leaves of *D. bulbifera* in wild



Figure 2: Stem of *D. bulbifera*



Figure 3: Collected tubers of *D. bulbifera*

Antifungal activity using disc diffusion assay

The extracts of *D. bulbifera* (leaves, stems and tubers) were screened for antifungal activity against *Candida parapsilosis* (MTCC 2513). Antifungal activity was done using slight modification of standard methods of disc diffusion method (Pakshir *et al*., 2009; Mathur *et al.,* 2011). Each extract was dissolved in Dimethyl sulfoxide. The sets of three dilutions (25, 50 and 100 mg/mL) of experimental plant parts extracts and standard drugs were prepared. 6 mm of discs were kept in the drugs for 12 h before placing to the swabbed petri plates. The zones of growth inhibition around the disks were measured after 18 to 24 hours of in incubation at 37°C. The sensitivities of the microbial species to the plant extracts were determined by measuring the sizes of inhibitory zones (including the diameter of disk) on the agar surface around the disks, and values less than 8 mm were considered as not active against microorganisms.

Media used

The media used for antifungal test was Sabouraud's dextrose agar/broth of Hi media Pvt. Bombay, India.

Preparation of working slant

Stock culture of MTCC 2513 was maintained at 4 °C on slants of semi-solid media. Active working cultures for experiments were prepared by transferring a loopful of culture mass from the stock. Slants were incubated for 24 h at 36 ± 1.0 °C.

Results and discussion

During the field and literature survey, it was observed that peels of tubers of *D. bulbifera* are used to cure fungal skin infections. Traditionally, the tribal communities of Odisha and Jharkhand collect the tubers from the wild and dry them. The upper part of the tubers is peeled off and macerated. The paste is applied externally to cure fungal skin infections. To validate this claim, antifungal activities were carried out, and results revealed that tuber extracts showed better results than leaf and stem extracts (Table 1).

Table 1: Antifungal activity (Zone of inhibition in mm; mean ± SD; n=3) of *Dioscorea bulbifera* (leaf, stem, tuber) against MTCC 2513

Plant parts	Concentration (mg/ml)	Aqueous	Methanol	Ethanol
Leaf	25	ZI ≤ 7.0	ZI ≤ 7.0	ZI ≤ 7.0
	50	8.16 ± 0.28	9.0 ± 0.50	9.16 ± 0.28
	100	10.16 ± 0.28	10.50 ± 0.50	11.16 ± 0.76

Stem	25	ZI ≤ 7.0	ZI ≤ 7.0	ZI ≤ 7.0
	50	ZI ≤ 7.0	ZI ≤ 7.0	ZI ≤ 7.0
	100	7.83 ± 0.78	8.50 ± 0.50	9.16 ± 0.28
Tuber	25	8.16 ± 0.28	9.33 ± 0.28	9.50 ± 0.50
	50	10.16 ± 0.28	11.00 ± 0.50	12.00 ± 0.50
	100	11.16 ± 0.28	12.33 ± 0.28	13.00 ± 0.50

(mm: millimetre; SD: standard deviation; n: replica; ≤: less than or equal to)

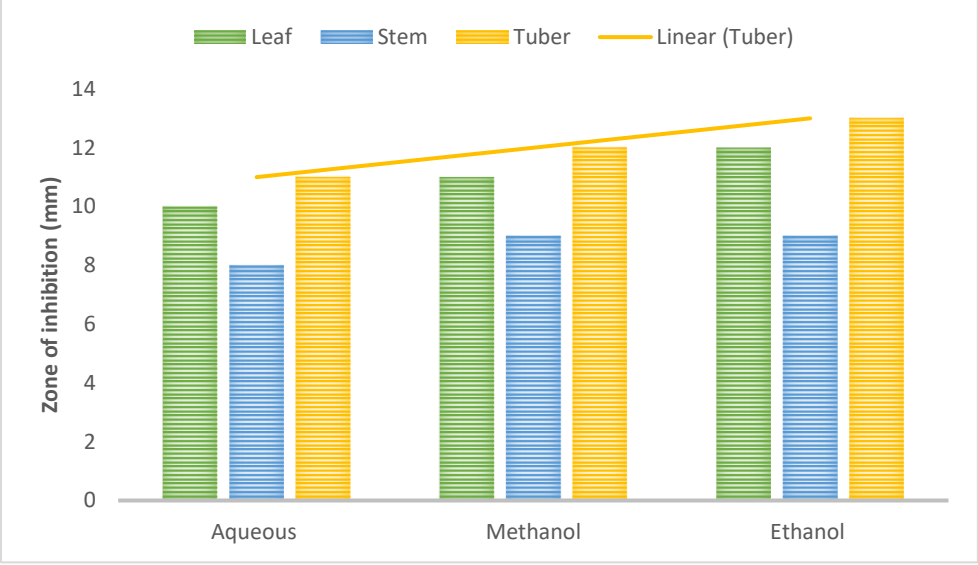

Figure 4: Antifungal activity of leaf, stem, and tubers of *D. bulbifera* against MTCC 2513 at 100 mg/ml concentration

It was noticed that the ethanol extract of tubers showed the highest activity at 100 mg/ml against MTCC 2513. The linear forecast showed that the ethanolic extract of tubers had the highest activity, followed by methanol and aqueous extracts (Figure 4). Other researchers have also reported the antibacterial (Sanguansermsri *et al.,* 2024) but less or no antifungal activities of leaves, stems and tubers of *D. bulbifera* are reported.

Conclusion

The present field and literature survey revealed that tubers of *Dioscorea bulbifera* are consumed by tribal communities, and its plant parts have ethnomedicinal values

that should be explored. The antifungal activity of leaves, stems, and tubers showed medicinal potential as well as validated the tribal claims. Further, more field and lab work are needed to highlight its importance as a nutraceutical.

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