



## **Therapeutic potential of *Dioscorea bulbifera* Linn.: Review**

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### **ABSTRACT**

Herbal plants are favored over manufactured pharmaceuticals today. The air potato, or *Dioscorea bulbifera*, is a medicinal plant with a common name in India. *Dioscorea bulbifera* Linn contains several chemical compounds, including alkaloids, glycosides, proteins, fats, sterols, polyphenols, saponin, flavonoids, and tannins. *D. bulbifera* has been shown in studies to be useful in treating a wide range of disorders, including pharyngitis, goitre, pyogenic skin infections, orchitis, and cancer. However, an increasing number of studies have found *D. bulbifera*-caused liver and renal damage. The current study summarizes the most important new publications on the phytochemistry and pharmacological effects of this medicinal and culinary plant in order to increase understanding of its bioactivity, toxicity, and detoxification procedures. The toxic effects of diosbulbin B and D on hepatocytes, inhibition of antioxidant enzymes in liver mitochondria, and inhibition of enzymes that normally digest the herb's components are all possible explanations for its toxicity. Synergistic compatibility detoxifying may aid in the reduction of toxic effects while also improving therapeutic outcomes.

**Keywords:** Herbal drug; *Dioscorea bulbifera*; Pharmacological activity.

Received 23.08.2022

Revised 06.11.2022

Accepted 04.12.2022

### **INTRODUCTION**

Herbal remedies derived from plants have been used since ancient times. Unani texts, Egyptian papyri, and Chinese texts all provide extensive documentation of the use of medicinal herbs in traditional medicine. In addition, there is proof that traditional formulations based on medicinal plants have been used to treat many therapeutic disorders in the European and Mediterranean medical traditions of Ayurveda and Unani. Medicinal herbs are being used more and more all over the world to treat a variety of conditions, since there is a growing demand for them as a safe and effective alternative to conventional treatment [1]. *D. bulbifera* has long been prized for its medicinal properties. It tastes harsh and salty, and the smell is very subtle. Tradition medicine holds that it has the ability to remove pathogenic heat and toxins, break up phlegm, loosen masses, and chill blood to halt bleeding. Hemorrhoids, epistaxis, pharyngitis, goitre, pyogenic skin infections, scrofula, trauma, orchitis, and even cancer have all been treated with it for a long time [2, 3]. In an effort to address that gap, this work provides a detailed review of what is currently known about the phytochemistry, pharmacology, and toxicology of *D. bulbifera*.

**Table 1. Taxonomical Classification**

Kingdom	Plantae
Sub-kingdom	Viridaplantae
Superdivision	Streptophyta
Division	Tracheophyta
Class	Magnoliopsida
Superorder	Lilinales
Order	Dioscoreales
Family	Dioscoreaceae
Genus	<i>Dioscorea</i> L.
Species	<i>Dioscorea bulbifera</i> Linn

### **MORPHOLOGY**

*Dioscorea bulbifera* is an aggressively twining, long-stemmed perennial vine with non-spiny, freely branching stems 20 metres or longer, spherical or slightly inclined internodes, and counter-clockwise

twining. Plants store food in two ways. The plant develops bulbils in the axils of its leaves, which become tubers. The tubers resemble small potatoes but taste harsher. *D. bulbifera* is called "air potato" because of its huge inflorescence of white, spherical to globose aerial tubers (called bulbils). These tubers can be 13 cm across. The alternating, heart-shaped leaves are attached to the stems by long petioles. The leaves are ovate-suborbicular, 15 to 20 by 7.5 to 10 centimeters, with a deeply cordate base and an acuminate to briefly caudate apex that is membranous, glabrous, and ribbed 9 to 11 times. Petiole can reach 20 cm. The leaf's petiole is attached in the middle, and from this point arching veins split the leaf into lobes. Flowers from *D. bulbifera* leaf axils are small, fragrant, and light green. Male flowers are arranged in pendulous panicles at the stalk tips; bracteoles are oblong and pointed [4].

#### **Phytochemical Constituents**

Phytochemical research of *Dioscorea bulbifera* has shown the presence of alkaloids, glycosides, proteins, fats, alkaloids, polyphenols and tannins, flavonoids and saponins. Inorganic micronutrients that are present includes Fe, Cu, Zn, Mn, Co, B, Cl, I, Br and Na [5].

### **PHARMACOLOGICAL ACTIVITY**

#### **Anti HIV activity**

As a natural HIV-1 integrase inhibitor, bulbils from the plant *Dioscorea bulbifera* have been identified. Diosbulbin E-acetate, a novel clerodane diterpenoid, was isolated from the chloroform fraction through column chromatography, along with two other clerodane diterpenoids, four flavonoids, and one sterol glycoside. As an example, MIN was used to discover compounds with anti-HIV-IN properties and compared to suramin (IC<sub>50</sub>=2.24m). Flavonoids are more effective than diterpenoids and steroid drugs in inhibiting HIV-1 IN. With an IC<sub>50</sub> of 16.28g/ml, quercetin was the most effective compound against HIV-1 IN, followed by kaempferol (IC<sub>50</sub>=37.71g/ml) and catechin (IC<sub>50</sub>=62.36g/ml). Catechol, in particular, was found to be a hydroxylated aromatic compound that inhibited IN in bioassays [6].

#### **Anti-inflammatory and wound healing activity**

Inhibition of NO generation and antioxidant capabilities (as measured by DPPH radical and hydroxyl scavenging assays) were found in flavonoid compounds isolated from *D. bulbifera* bulbils. (+)- As the primary active ingredient responsible for *D. bulbifera*'s wound healing action, catechin has excellent promise for wound healing by enhancing the proliferation and migration of human fibroblasts. The antioxidant capabilities of this compound are likely responsible for this outcome. These results lend further credence to *D. bulbifera*'s historic role as a remedy for wounds and inflammation [7]. *Dioscorea bulbifera* L. aqueous and methanol extracts of dried bulbils were tested against acetic acid, formalin, and pressure-induced pain, as well as ibuprofen- and NSAID-induced inflammation in mice and rats. The extract had a strong pain relieving and inflammation reducing properties [8]. A study tested *Dioscorea bulbifera*'s anti-inflammatory and diuretic properties in albatross and albino rats. Negative control receiving 0.9mg/kg normal saline and aControl groups had the most urine but little Na<sup>25.79</sup> 1.124 +/K+ [9]. Folk remedies for wounds, leucoderma, and boils include *Dioscorea bulbifera* tubers. This study tested the effect of *Dioscorea bulbifera* tubers on a 22-day excision wound model in rats. The wound healing model shows that tuber extracts have equivalent wound healing activity, wound contraction rate, and epithelialisation duration to conventional ointment [10].

#### **Anthelmintic activity**

Ethnobotanical information from Nigeria specifies the usage of *Dioscorea bulbifera* L. (Dioscoreaceae) for treatment of parasitic diseases in human. This could be of value in preventing the development of resistance to common synthetic anthelmintics. The median lethal concentration values of the flesh and peel extracts of *D. bulbifera* were 39.67 and 30.40 mg/ml for earthworm and 61.73 and 41.79 mg/l for liverfluke [11].

#### **Antibacterial activity**

*D. bulbifera* is a novel source of bioactive compounds which do not only enhance the antibacterial properties, but also ascertain its health promoting qualities. High inhibition zones (between 17 and 22 mm) were recorded against 80% of the test organisms at 1000 µg/ml, except for 15 mm zone recorded against *Bacillus cereus* [12]. Extracts of *Dioscorea bulbifera* (bulbils) were tested for antibacterial activity against *Klebsiella pneumoniae*, *Escherichia coli*, *Bacillus aureus*, *Proteus vulgaris*, *Staphylococci* and *Aspergillus niger*. Petroleum ether and chloroform extracts were anti-*A. fumigatus*/*R. nigricans* and inhibited *K. pneumoniae*. Chloroform extract had weak anti-S action [13].

#### **Antidiabetic activity**

One of the most critical complications of diabetes is post-prandial hyper-glycemia (PPHG). Glucosidase inhibitor and α-amylase inhibitors are class of compounds that help in managing PPHG. Low-cost herbal treatment is recommended due to their lesser side effect for treatment of diabetes [14]. Diabetes is characterised by postprandial hyperglycemia (PPHG). -amylase and -glucosidase inhibitors seek new

therapeutics. *Dioscorea bulbifera* and diosgenin are promising -amylase and -glucosidase inhibitors. *D. bulbifera* extracts include petroleum ether, ethyl acetate, methanol, and 70% ethanol (v/v). *Bulbifera* ethyl acetate extract inhibited -amylase 72.06 0.51 and -glucosidase 82.64 2.32. Ethyl acetate extract GC-TOF-MS showed strong diosgenin. Diosgenin was isolated, identified by FTIR, <sup>1</sup>H NMR, and <sup>13</sup>C NMR, and validated by HPLC. It inhibited -amylase and -glucosidase by 70.94 1.24 and 81.71 3.39 percent, respectively. Kinetic investigations validated diosgenin's noncompetitive binding to -amylase by reducing *K<sub>m</sub>* and *V<sub>m</sub>*. Diosgenin quenches the intrinsic fluorescence of -amylase. Circular dichroism spectrometry showed reduced negative humped peaks at 208 and 222 nm. Hydrogen bonds were found between Asp300's carboxyl group and -amylase's Tyr62, Trp58, Trp59, Val163, His305, and Gln63. Diosgenin interacted with -glucosidase's Asp352 and Glu411. This is the first paper to present a scientific rationale for diosgenin as a type II diabetes medication candidate [15]. In conclusion, *Dioscorea bulbifera* 'amala' flours displayed hypoglycemic and hypolipidemic effects in alloxan diabetic rats. The raw and steam-blanching *Dioscorea bulbifera* flour samples protected the liver and kidney of diabetic rats. The sulfite sample harmed the liver and kidneys of diabetic rats. This study suggests that aerial yam (*D. bulbifera*) can be used to treat diabetes, however sulphited samples should be used sparingly to avoid damaging the liver and kidneys [16].

### Anticancer activity

The authors synthesized novel platinum–palladium bimetallic nanoparticles (Pt–PdNPs) using a medicinal plant, *Dioscorea bulbifera* tuber extract (DBTE). High-resolution transmission electron microscopy revealed monodispersed PtNPs of size 2–5 nm, while palladium and platinum nanoparticles of size 10–25 nm [17]. Au-core Ag-shell nanoparticles from *D. bulbifera* inhibited *A. baumannii* biofilm 83.68 0.09%. *P. aeruginosa*, *E. coli*, and *S. aureus* biofilms were suppressed 18.93 1.94%, 22.33 0.56%, and 30.70 1.33%, respectively. SEM and AFM confirmed uncontrollable cellular efflux resulting to cell death [18]. The research that was described in this article demonstrated that an extract of *D. bulbifera* grown in methanol possessed robust antiproliferative activity when compared to a reference medication. The fact that the antioxidant properties demonstrated by the plant's methanol, ethyl acetate, and hexane extracts were substantial when compared with ascorbic acid indicates that the leaves of this species have the potential to operate as natural antioxidants. Therefore, the antiproliferative properties shown by leaf extracts legitimise the traditional applications of this herb against a variety of ailments, including breast cancer [19]. *D. bulbifera* vegetative organ chloroform and methanol extracts kill breast cancer cells (T47D). Leaf chloroform extract has the highest cytotoxic action (IC<sub>50</sub> 115.63 g/mL). F5 and F6 combined with ethyl acetate: methanol eluent has the highest cytotoxic efficacy against breast cancer (T47D). Both fractions' IC<sub>50</sub> was 14.55 g/mL. Potential fractions are cytotoxic to T47D cells but not SI > 10 Vero cells. Terpenoids and alkaloids were found in the potential fraction [20].

### CONCLUSION

*Dioscorea bulbifera* is a popular tropical aerial yam. Plants produce several aerial tubers or bulbils. Traditional medicine uses of *Dioscorea bulbifera* are documented below. It contains steroids, saponins, flavonoids, glycosides, tannins, alkaloid, fatty acids, and essential oils. The herb seems to treat many ailments. Various portions of the plant exhibit anticancer, anti HIV, antidyslipidemic, analgesic, anti-inflammatory, diuretic, gastroprotective, antioxidant, antimicrobial, antiviral, antifungal, anthelmintic, neuropharmacological, cardioprotective, anorexiatic, plasmid curing, and anti-hyperthyroid properties. The present review confirms *Dioscorea bulbifera*'s medicinal usefulness. Many polyherbal preparations comprise plant components. Less is known about the clinical investigation, standardisation procedure to avoid biological and geographical variance, advanced food processing, and detoxication techniques. If these claims are thoroughly and clinically evaluated, the plant can supply good treatments and benefit mankind with many ailments.

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#### CITATION OF THIS ARTICLE

Mahajan, P.S., Kamble, S. J., Shedbale, S.S. Therapeutic potential of *Dioscorea bulbifera* Linn.: Review. *Bull. Env. Pharmacol. Life Sci.*, Vol 12[2] Jan 2023: 67-70.