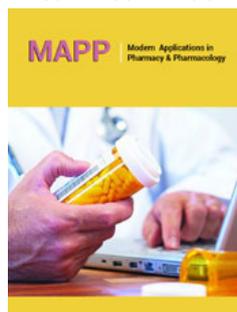


Dioscorea Bulbifera Medicinal Plant: Phytochemistry and Salutary Potential

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Abstract

The Conventional Primary Healthcare is used to treat the majority of the world's population (70 percent) for a variety of diseases. The use of herbal medicines by the cosmeceutical, biopharmaceutical, and drug companies is gaining popularity all over the world. *Dioscorea bulbifera* is one of 600 species in the Dioscoreaceae family that have found use in traditional medicine across the world. It is also known as potato yam, air yam, aerial yam, cheeky yam, bitter yam, and parsnip yam. *Dioscorea bulbifera* have preventative and therapeutic capabilities against a variety of diseases such as cancer, arthritis, diabetes. The presence of bioactive compounds is responsible for the plant's therapeutic potential. The present review highlights recent scientific advances on ethnomedicinal uses, pharmacology, toxicological, and the possible application of *Dioscorea bulbifera* in modern plant biology.

Keywords: *Dioscorea bulbifera*; Therapeutic; Ethnomedicinal and bioactive compounds

Introduction

Long before the ancient period, plants were employed as a source of herbal treatments [1]. It is the Rig Veda where the utilization of restorative plants was referenced first. Later on, between 2,500 and 500 B.C the utilization of restorative plants was consolidated in Ayurvedic system of treatment[2]. Significant traditional curative use of medicinal plants is abundantly documented in Ayurveda, Mediterranean system, and Unani systems. They have used medicinal herbs in the form of traditional formulations to treat various therapeutic ailments. Aside from that, there is evidence that Unani texts, Egyptian papyruses, and Chinese literature have been using herbal treatment [1]. Medicinal plants are a very rich source of different phytochemicals with complex medicinal potential [3]. A growing demand for herbal medicines due to their safety and lack of adverse effects has resulted in the use of medicinal plants all over the world [1]. *Dioscorea bulbifera* is one of 600 species in the *Dioscoreaceae* family that have found use in traditional medicine across the world [3]. *Dioscorea bulbifera* (Family: *Dioscoreaceae*) is a traditional medicinal herb native to Asia, tropical Africa, America, and Northern Australia. It is also known as potato yam, air yam, aerial yam, cheeky yam, bitter yam, and parsnip yam [1]. It gets its name from the fact that it develops potato-like aerial bulbs in the axils of a leaf [4]. The plant is often found in India [5]. The species is commonly found in tropical and subtropical regions (up to 1000m in elevation). It is a basically a shade-loving plant but it can also thrives in open regions [6]. It is found in the Indian Himalayan states of Himachal Pradesh, Arunachal Pradesh, Sikkim, Assam, Uttarakhand, Jammu and Kashmir, Himanchal Pradesh, and Meghalaya [7]. It is a big perennial climber with tubers that are quite enormous, roundish, and white on the interior. The stem is four-angled and glabrous. Leaves are alternate

or opposite, three to five veined from the base of the leaf, roughly oval or ovate triangular, 6-15x4-10cm, with a cordate, sharp base. The bulbils develop near the base of the plant's leaves [5]. These are dark brown in colour having spherical in shape. Flowers are placed in spikes that might be hanging, axillary and solitary [6]. The colour of the flowers are somewhat greenish white. Capsules are with two semi-circular flat lobes and seeds are winged [5]. The 'air potato,' *Dioscorea bulbifera*, has been used in Chinese medicine to cure disorders of the spleen, lungs, kidneys, and as well as effective in many forms of diarrhoea. These plants have traditionally been used to reduce the glycemic index, resulting in more sustained energy and improved protection against diabetes and obesity [8]. Among other medicinal ingredients, the yam species is said to be high in diosgenin which is a steroid saponin. It is having preventative and therapeutic capabilities against a variety of diseases such as cancer, arthritis, diabetes (as listed above also), gastrointestinal problems, inflammation and high cholesterol [4]. It has a wide range of uses in Indian traditional medicine, including piles, ulcers, discomfort, and inflammation. To treat infected ulcers and sinuses, crushed tubers and decoction have been homogenized into oil. It is widely used as a herbal medicine to treat stomach cancer, rectum carcinoma, and goitre in both Indian and Chinese phytotherapy. Toxins are known to be dissolved by dried yam, and it is used to treat carbuncles, scrofula, and purulent diseases. In China, it is used to treat dog bites, snake bites, and food poisoning, as well as hepatic fibrosis by preserving the liver [9]. Diosgenin (steroid saponin) is a well-known bioactive ingredient in synthetic birth control tablets [4]. It has also been used to detoxify toxins and coagulate blood to halt bleeding. Several phytoconstituent analyses have confirmed the existence of phytochemical compounds of tubers that are closely related to various therapeutic applications [1]. This plant is exceptional on the grounds that its rhizomes contain Diosgenin (as discussed earlier), which is a phytoestrogen that proselyte into the chemical progesterone. Diosgenin is a reason for against barrenness medications like prophylactic pills, and sex chemicals, like testosterone and supplements are utilized by jocks to expand their testosterone levels and develop muscle fortitude. Diosgenin is additionally explored to show chemo-preventive/restorative impact against tumors of a few organs, also this has set up the high significance of this particle as a possible antitumor agent. The starch content of *Dioscorea* rhizomes is 75%. They are inedible due to their extremely harsh flavour. Sapogenase is an enzyme found in rhizomes. Glycosides and phenolic chemicals are also abundant in tubers [7]. Interestingly, *Dioscorea bulbifera* formulation has been utilized for memory upgrade, against maturing, obstruction and fever, and has additionally been utilized as a mixture to apply to cuts and sores because of its high organization of the tannin speed up the wound healing in a flamed membrane. *Dioscorea bulbifera* has a faint smell and a severe pungent taste. It contains a higher healthy benefit compared to other *Dioscorea* species with the most significant levels of calcium, magnesium, sodium and zinc, most elevated upsides of nutrients

B1, B3 and C and most noteworthy protein content. Regardless of the extraordinary therapeutic application and healthy benefit of *Dioscorea bulbifera*, food inclination is to a great extent given to the kind of other sweet potato species [10].

Taxonomic position [7]

Kingdom- Plantae
Clade- Angiosperms
Clade- Monocots
Order- Dioscoreales
Family- Dioscoreaceae
Genus- Dioscorea
Species- Bulbifera

Botanical description and distribution pattern

Dioscorea bulbifera is plant local to tropical Asia, Northern Australia, America and sub-Saharan Africa. The species is disseminated all through tropical and subtropical regions, up to 1000m elevation. It is a shade-adoring species yet fills well in open regions as well [6]. In Asia, this herbaceous plant has been energetically suggested for treating diabetes problems [1,8]. In Chinese home grown medication it is additionally named as "Huangdu" and "Huangyaozi". It is herbaceous, lasting climber which grows up to 10-20m long with various stringy roots [1].

Morphological attributes of *Dioscorea bulbifera*

It is a big perennial climber with tubers that are quite enormous, roundish, and white on the interior. The stem is four-angled and glabrous. Leaves are alternate or opposite, three to five veined from the base of the leaf, roughly oval or ovate triangular with a cordate, sharp base. The bulbils develop near the base of the plant's leaves [5]. Axillary bulbils are round, tubercle, and colour is brown-green in appearance. Blossoms are organized in hanging, axillary, singular or fascicled spikes. Capsules are elliptical and winged, while seeds of the plant are winged at the base. Perianth is cylindrical and natural product i.e., fruit is three-valved. Blossoming and fruiting happen from September to November [6].

Phytochemical composition of *Dioscorea bulbifera*

The phytochemical analysis of *Dioscorea bulbifera* shows articulate variety according to its topographical area, parts or portions of plant and the solvent utilized for extraction [9]. For instance, in a study extraction utilizing Ethyl acetic acid derivation dissolvable part of 75% ethanol concentrate of *Dioscorea bulbifera* from China has demonstrated the presence of flavanol aglycones, specifically kaempferol-3, 5-dimethyl ether, catechin, and caryatin. All the more along these lines, the study from the aqueous methanolic concentrate of bulbs of *Dioscorea bulbifera* from India reveals the presence

of 8-Epidiosbulbin Eacetic Acid derivation (EEA). Phytochemical investigation of *Dioscorea bulbifera* give away the presence of steroidal saponins, saponins, sterols, polyphenols, glycosides, tannins, and flavonoids [10]. Diosgenin a chemical substance which is basically an aglycone found in *Dioscorea bulbifera* and are utilized commercially in drug industry. Aside from diosgenin, dioscin, dioscorin, and different types of alkaloids are additionally found in *Dioscorea*

bulbifera. Roots of the herb contains alkaloids, tannin, some phyto-sterols, and rich wellspring of starch. Other organic and inorganic substance found are beta-carotene, ascorbic corrosive, debris, niacin, protein, riboflavin, thiamine, highest level of- sodium, calcium, magnesium, zinc. Some extra organic substances present are- potassium, aluminium, chromium, cobalt, iron, manganese, selenium, silicon, phosphorus, tin etc [2,10].

Table 1: Table showing phytochemical compounds present in *Dioscorea bulbifera* [3,4,10-14].

Sr. No.	Phytochemical Constituents	Class of Phytochemical	Part of the Plant	Uses
1	Diosgenin	Steroid	Corm, Bulb	Antidiabetic, Antibacterial
2	Dioscin	Steroid derivative	Rhizome	Hepatoprotective, Anti-obesity Anti-tumor, Anti-fungal
3	Pennogenin	Steroid derivative	Rhizome	Antitumor, Antifungal
4	Stigmaterol	Steroid derivative	Tuber	Anti-Alzheimer's,
5	Daucosterol	Steroid	Rhizome	Anti-cancerous
6	Diosbulbin A, B, C	Naphthofurans	Tuber, stem, leaf	Emulsifier, Surfactant
7	Diosbulbin E, G	Naphthopyrans	Leaf, stem, rhizome,	Emulsifier, Surfactant
8	Diosbulbin D	Carboxylic acids	Tuber, stem, leaf	Emulsifier, Surfactant
9	Diosbulbin F	Prenol lipid	Tuber, rhizome, leaf, stem	Emulsifier, Surfactant
10	Kaempferol-3,5-dimethyl ether	Flavonoid	Rhizome	Anti-tumorous
11	Kaempferol	Flavonoids	Rhizome	Anti-tumor
12	Caryatin	Flavonoids	Rhizome	Anti- tumorous
13	Myricetin	Flavonoids	Rhizome	Anti- tumorous
14	Hyperoside	Flavonoids	Rhizome	Anti-tumorous, Anti- inflammatory, Anti-oxidant, Anti-viral and Anti-fungal
15	Quercetin	Flavonoids	Tuber	Neuroprotective, Chemopreventive
16	Isorhamnetin	Flavonoids	Tuber	Anti-tumor, Anti-inflammatory
17	Vanillic acid	Benzene derivatives	Rhizome	Anti-hypertension,
18	Protocatechuic acid	Benzene derivatives	Rhizome	Anti- cancerous, Cardioprotective
19	Palmitic acid	Fatty acid	Rhizome	Nutrition and Food
20	Bafoudiosbulbin	Diterpenoids	Tuber, bulbils	Anti-Salmonella

Table 1 showing phytochemical compounds present in *Dioscorea bulbifera* [4,9-14]. Phytochemical constituents like carb, protein, sugars, amino corrosive and starch structure functions as a reserve food. Restorative importance is because of the presence of optional metabolites like glycosides, steroids, alkaloids, flavonoids, tannins, benzene derivatives and phenolics [5]. Some anti-tumour properties of the plant were explored in vivo in a study using the water extricate (A), ethanol extricate (B), ethyl acetic acid derivative extricate (C), non-ethyl acetic acid derivative extricate (D) and compound Diosbulbin B segregated from *Dioscorea bulbifera* L. [15-17]. Blossoms of *Dioscorea bulbifera* has wide scope of steroidal saponins to be specific, dioscoreanosides (A-K) [9].

Therapeutic potential of *Dioscorea bulbifera*

i. Anti-cancerous activity

Cancer treatment with steroidal compounds is becoming an appealing option for researchers and scientists, and several active molecules have demonstrated this activity. Indigenous people in the Tully district in Northern Queensland use *Dioscorea bulbifera* decoction to treat skin cancer. It is also used in traditional Chinese medicine to treat cancer. The antitumor activity of the chemicals Kaempferol, Caryatin, Myricetin, Quercetin on mouse epidermal JB6 cell lines was reported. Diosgenin is also being studied for its anti - carcinogenic effect against malignancies of various organs,

which now has developed the great importance of molecule as a potential anticancer agent [9,7,18].

ii. Anti-diabetic activity

Dioscorea bulbifera has traditionally been used to lower the sugar levels in people suffering with diabetes [9]. *Dioscorea bulbifera*, which is widely used in Chinese and Indian conventional healers for its anticancer, antioxidant, analgesic, and anti-inflammatory properties, was found to have anti-diabetic characteristics in studies [12]. Numerous studies have demonstrated that sources of food that included the Diosgenin, such as fenugreek and yam rhizome, have anti-diabetic impacts in preclinical animals. Diosgenin significantly reduced glucose concentration in stz-induced diabetic rats when compared to certain other diabetic controls. The steroid present in *Dioscorea bulbifera* leads to activation of key enzymes involved in glucose metabolism, which is significantly changed by diabetes [7,8].

iii. Anti-inflammatory and analgesic activities

In China, *D. bulbifera* is often used to treat inflammation associated with the displacement of "lumps," hernia, stress fracture, multiple injuries, and testicular inflammatory disorders [3]. Diosbulbin B, a terpenoid derived from *D. bulbifera*, has also been shown to impede both intense and sub - acute inflammation [18]. The aqueous and methanol crude extract of *Dioscorea bulbifera* bulbils have such a strong analgesic effects against chemical pain and discomfort caused by acetic-acid or formalin, as well as a weak activity against mechanical pain caused by pressure. These crude extract also had significant anti-inflammatory repercussions on severe oedema caused by histamine, carrageenan, serotonin and formalin, as well as chronic oedema caused by formalin [19].

iv. Antifungal and Antiviral activities

Plant extracts, particularly *Dioscorea bulbifera* phytochemical, represent a new source of bioactive substances that could be used to develop new antibacterial and antifungal agents. The efficacy of an ethanolic extract of the peel of *Dioscorea bulbifera* as a antiviral was also established [20]. Its fluid concentrate showed unrivaled action against *Escherichia coli* while ethanol extricate was viewed as powerful against *Candida albicans* and *Staphylococcus aureus* [9].

v. Anti-leishmanial activity

Fast blend of monodispersed round Cu nanoparticles was effectively obtained from *Dioscorea bulbifera* tuber extricate [21]. A combination of gold and silver nanoparticles was synthesised from *Dioscorea bulbifera* extricate. The utilization of *Dioscorea bulbifera* tuber extricate combined Au and Ag nanoparticles has powerful antibiofilm and antileishmanial properties. It showed compelling antileishmanial action against *L. donovani* [9].

Conclusion

To summarise, *Dioscorea bulbifera* has long been used as traditional medicine for the treatment a variety of therapeutic ailments all throughout the world. The tremendous medical benefit of *Dioscorea bulbifera*, as noted in this review, is a reflection of its enormous worldwide restorative potential. Numerous pharmacological-based activities have demonstrated that *Dioscorea bulbifera* has therapeutic potentials all over the world [18]. According to the findings, *Dioscorea bulbifera* contains a variety of phytochemicals or secondary metabolites including flavonoid, diosgenin, saponin, quercetin, dioscorin, as well as other significant constituents. These compounds have a wide range of actions including antidiabetic, anticancer, antibacterial, anti-inflammatory, and many others [7]. *D. bulbifera* show critical hindrance with porcine pancreatic amylase and rough murine glucosidase just as unadulterated α -glucosidase. This may have therapeutic benefits in the management of type-2 Diabetes and might be utilised as an efficient medicinal herbs in combinatorial therapy, which can be taken up in additional examinations [22].

Declaration of Competing Interest

The authors proclaims no conflict of interest whatsoever.

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