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Dioscorea bulbifera: The Magical Herb with Great Pharmacological Potential

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ABSTRACT
Dioscorea bulbifera L., commonly known as air potato or yam, is a medicinally important plant belonging to the Dioscoreaceae family. Widely distributed across tropical and subtropical regions, it has been used traditionally in Ayurvedic and Chinese medicine for treating various ailments. The plant's tubers and leaves contain bioactive compounds like diosgenin, dioscin, and flavonoids that contribute to its therapeutic properties. D. bulbifera demonstrates potential in treating conditions such as diabetes, cancer, HIV, and gastrointestinal disorders. Its anti-inflammatory, antioxidant, and antimicrobial activities have been documented. The plant also shows promise in addressing reproductive health issues and boosting immunity. Cultivation of D. bulbifera is feasible in diverse climates, with specific soil and temperature requirements. Harvesting typically occurs during the dormant season when diosgenin concentration is highest. Various phytochemical constituents have been identified, including steroids, fatty acids, and benzene derivatives. While D. bulbifera offers numerous health benefits, some adverse effects have been reported, particularly related to kidney function and oxalate content. The plant is available in various marketed formulations, reflecting its growing popularity in herbal medicine. Future research should focus on clinical trials, standardization of herbal products, and further exploration of its therapeutic potential. The review highlights the need for a balanced approach in utilizing D. bulbifera, considering both its medicinal value and potential risks.
Keywords: *Dioscorea bulbifera* L., air potato or yam, flavonoids, anti-inflammatory, herbal products.

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INTRODUCTION

Dioscorea bulbifera L. Belonging to the family Dioscoreaceae regionally known as as 'Gitthi Kanda' via the tribals of Jharkhand, is generally discovered inside the hills and forests of Jharkhand (Figure 1) [1]. This plant has been employed as a supply of medicine and as herbal treatment on account that historical instances as documented in Vedas, especially in Rig Veda. Then, someday among 2,500 and 500 B.C., the usage of therapeutic vegetation became integrated into the Ayurvedic clinical gadget. Dioscorea species are determined all over India, except for the usa's parched northwest [2-5]. In the Himalayas, they typically grow at elevations among 8,000 and 15,000 toes. These florae are sour of their native surroundings. But whilst grown improperly, they grow to be less bitter, and their foremost purpose is to produce tubers which might be roasted and eaten. Tribal agencies, particularly the ones in Madhya Pradesh, Chattisgarh, Jharkhand, and Orissa, rely on the tuber as a meals source. There are about fifty species of Dioscorea in India, lots of which might be wild. Biological Sources:

Dioscorea bulbifera L. (Dioscoreaceae): A overview of its ethnobotany, pharmacology and conservation desires – Science Direct It includes dried tubers of plant Dioscorea. Dioscorea species is a climber herb with rhizomatous rootstock. It belongs to the own family Dioscoreaceae [6, 7]. The genus Dioscorea belongs to the department monocotyledon incorporates 350-four hundred species. Dioscorea is spread all around the tropics and subtropical areas in the global, with ninety-six % of manufacturing going on in Africa. Southern Africa, *Dioscorea bulbifera L.* Is often observed in family gardens and farmers' fields. There are many reports of this plant developing wild in Assam, the state of Arunachal Pradesh, Mizoram,

Karnataka etc. Table 1 shows the taxonomical classification and vernacular names of *Dioscorea bulbifera L.*

Figure1: *Dioscorea bulbifera* (A) Leaf (B) Tuber (C) Whole plant.

Table 1. Taxonomical classification and vernacular names of *Dioscorea bulbifera L.*

Taxonomic Classification	Vernacular Names
Kingdom:- Plantae	English :- Potato, yam, Air potato
Sub-kingdom :- Viridaeplantae	Sanskrit :- Varahikanda, Aluka, Shukara
Super-division :- Streptophyta	Hindi :- Varahi kanda, Kadu kanda ,Ratalu
Division :- Tracheophyta	Guajarati:- Dukkarkanda
Class :- Magnoliopsida	Bengali:- Ratalu Ban Alu
Superorder :- Lilinanae	Tamil :- Kodikilanga, Kaattu-k-kaay-valli
Order :- Dioscoreales	Marathi :- Manakund, Kadu-Karanda, Varahi
Family :- Dioscoreaceae	Kannada :- Kuntagensu
Genus :- Dioscoreal	Konkani :- Karamdo
Species :- *Dioscorea bulbifera L.*	Malayalam :- Pannikizhangu, Kattukachil
	Oriya :- Pita Alu
	Telugu :- Adavi Dumpa

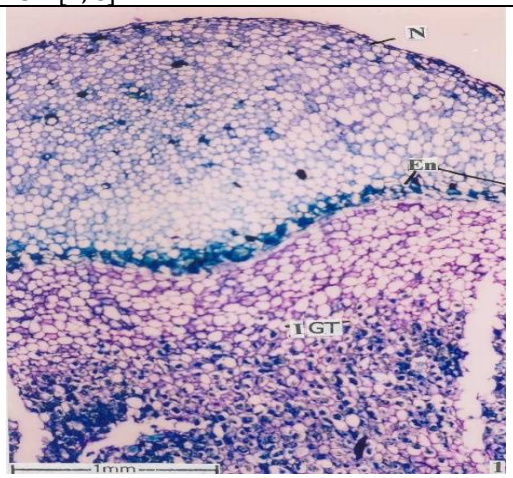
Microscopy of *Dioscorea bulbifera*

A cross-section through the bulb reveals the endodermoid layer, the homogenous parenchymatous ground tissue inside, and a darker area of the nodular component. Discrete cells comprise the endodermoid layer. The periderm is represented by the four or five layers of thick-walled, tubular-shaped solenoids that cover the outside of the nodule. The microscopic characteristics of *Dioscorea bulbifera*'s tubers and bulbil were described by Subasini in 2013. The tuber T.S. displayed triangular starch, vascular bundles, and large well-developed periderm cereals. The periderm, ground tissue, vascular bundle, and triangular starch grains are the main microscopic features of the bulb [8] (Figure 2).

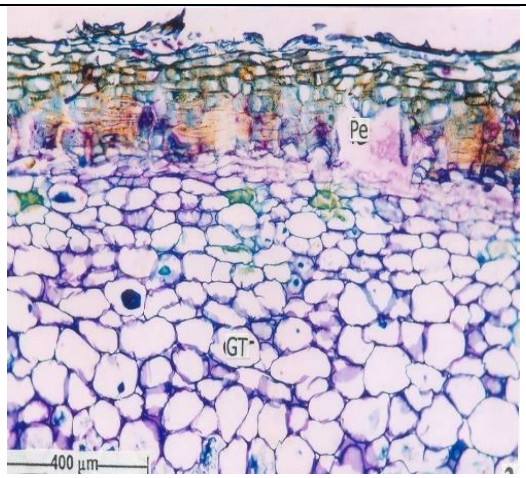
The majority of the tissue bulb's ground is made up of oval to polygonal cells with a few sporadic closed vascular bundles. Both cortex and ground tissues include an abundance of starch granules, with ground tissue having simple grains. The triangular, sometimes rounded angles or rod-shaped, discrete or in groups, and have of 11-28µ at the narrower is a hilum [8, 9]

Medicinal value of Tubers: Tuber is a prime staple medicinal food substitute for the majority of the rural and local people in most of the states of India. The rural indigenous people employ various customary methods and utilize them as dietary Supplements making them edible. To get rid of the bitterness, the tuber is typically immersed in water overnight or placed in a Prepared Stream overnight before being used as a vegetable. Maharashtra, and Uttar Pradesh. It grows between 550 and 3100 meters above sea stage. The plant is indigenous to the historical international's tropics, wherein it is able to be found in

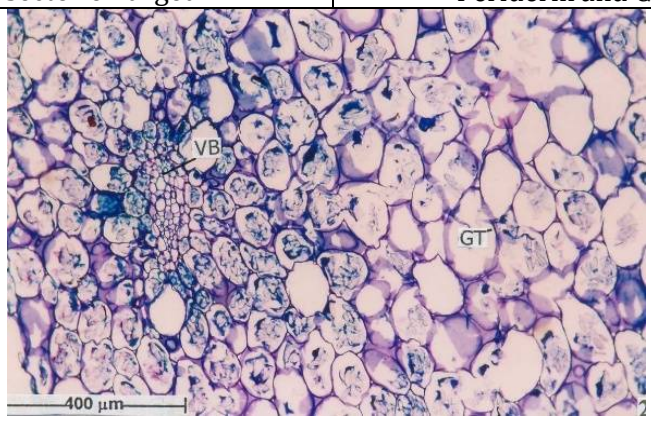
rainforests that stretch from Africa's west coast to the furthest island inside the location. It is standard all over India, growing as high as 6,000 toes in the Himalayas. In the arid region of India, it does now not flourish. [7, 8].



T.S of bulb a sector enlarged

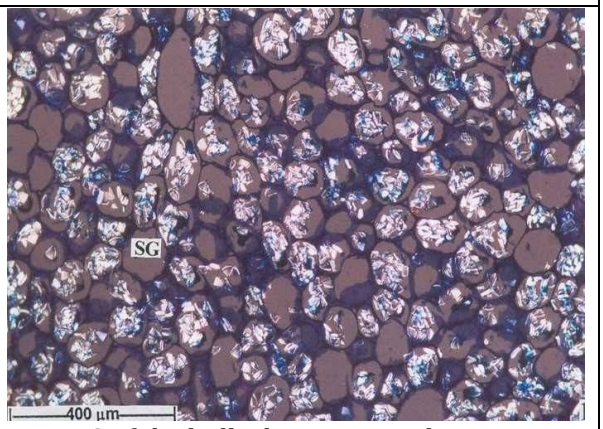


Periderm and Ground Tissue



Ground tissue and Vascular bundle

T.S of the bulb showing starch grains



T.S of the bulb showing starch grains

Figure 2: T.S of bulb

In the Ramayana, Shushruta mentions that tuber powder has anti-growing older properties and may be used to regenerate cells and tissues while combined with milk and honey. It is used as a Male/Female reproductive tonic to treat impotency and infertility and to growth the amount and fine of sperm and semen. In addition, by using balancing vata and Kapha, it complements Immunity, Vigor, Voice, and digestion. Apart from this, there are numerous other makes use of stated consisting of within the remedy of Leprosy, bronchial asthma, colds, coughs, indigestion, Tuberculosis (TB), constipation, muscle, discomfort, bone fractures, diarrhoea, sore throats, trauma, wounds, boils, cuts, injuries carbuncles, tumours, and also as are refrigerant helps cool the body in the summer season. Additionally, worm infestations, scrofula, haemorrhoids, polyuria, purgative, deflatulent. aphrodisiac, rejuvenating, and tonic

anthelmintic are all treated with these tubers. Children's laryngitis, insect bites, ringworm goitres, and fever can all be cured with fresh tuber decoction. [10] A component of indigenous tuberculosis medicine is root powder. Additionally, used to revitalize the functioning of the gastrointestinal tract, Spleen, and lungs, and improve metabolism and digestion. It helps maintain the proper kidney functioning. Children's typhoid is cured by bulbils. These tubers are used to treat leprosy in Bangladesh and tumours in China. [10-12]

The medicinal properties of *Dioscorea bulbifera* extend beyond its tubers, with the leaves also possessing significant therapeutic potential. While less studied, the leaves have demonstrated anti-inflammatory properties, potentially beneficial for treating conditions such as arthritis [13]. Traditional medicine practices utilize leaf extracts or poultices for wound healing, promoting recovery and preventing infection. Additionally, certain compounds in *Dioscorea bulbifera* leaves have shown promise in blood sugar regulation, suggesting anti-diabetic properties [14, 15]. Like many plant leaves, they contain antioxidants that may neutralize harmful free radicals in the body, potentially reducing the risk of chronic diseases. These diverse medicinal attributes highlight the importance of further research into the therapeutic applications of *Dioscorea bulbifera* leaves [16-18].

Diosgenin, a saponin-containing steroidal phytochemical found in the bulbils of *Dioscorea bulbifera*, has demonstrated anti-fertility properties.

In Ayurvedic medicine, varahikanda serves as a substitute for two Ashtavarga herbs, Riddhi and Vriddhi, and is utilized as an ingredient in chyawanprash preparations [19,20]. Several allied species of *Dioscorea bulbifera* have been identified, including *Dioscorea longipetiolata, Helmia bulbifera, Polynome bulbifera, Dioscorea rogersii, Dioscorea tamifolia, Dioscorea crispata, Dioscorea heterophylla, Dioscorea tenuiflora, Dioscorea hoffa, Dioscorea hofika, Dioscorea anthropophagorum, Dioscorea korrorensis, Dioscorea perrieri*, and *Dioscorea pulchella* [21].

GEOGRAPHIC DISTRIBUTION

Except inside the arid northwestern areas, Dioscorea species are located almost anywhere in India. The species can be found up to a thousand meters above sea level in tropical and subtropical areas. Although it prefers shade, this species also can thrive in open areas. In the Satpura Hilly Ranges in Maharashtra, the species Dioscorea is abundantly dispersed. Latitudes 21.15' N and 21. Forty-five' N, longitudes 760 fifty-seven' E and seventy-seven. 33' E and elevations 312 M to 1178 M above imply sea level are all where this plant may be discovered.

Among the major 5 species of Dioscorea, *Dioscorea bulbifera* is one. Air potatoes are local to tropical Asia and sub-Saharan Africa. Ancient Polynesians added them to most of the South Pacific. Wherein they are today regarded as invasive. During the slave change, it was transported from Africa to the Americas, and in 1905, it became transported to Florida. It may be determined everywhere in the State, from the Florida Keys to Escambia Country within the Panhandle a member of the yam circle of relatives is the air Potato. Yams are a chief commodity in Western Africa, in which they may be grown for their, safe to eat underground tubers. Uncultivated species, like air potatoes, however, are typically sour or even deadly. India is home to approximately 50 species of Dioscorea

A lot of them are discovered nearly everywhere in India, besides the arid northwest. In the Himalayas, they're seen developing at heights between 2000 and 15000 toes. It's rather bitter in its wild state. The plant will become less sour when cultivated, and it is in general planted for the suitable for eating, roasted tubers. The tribal human beings of significant India, especially in Madhya Pradesh, Chhattisgarh, "Jharkhand, and Orissa, use the tuber as a meals source. [22]

CULTIVATION AND COLLECTION

Climate: The following climates are maximum proper for the Dioscorea Rhizomes cultivation. The great perfect altitude is at one thousand-3000 meters above sea level for Dioscorea Rhizomes increase. The Soil requirement consists of Loamy, sandy clay soil; acidic impartial, or barely alkaline soil is desired. Temperature Warm greenhouse or sunny conditions are maximum proper. Moist soil is likewise best. It endures the all the time mountain climbing to a top of three meters. Given the drug's medicinal significance, it's been successfully grown all through India. It is grown commercially in lots of states of India such as West Bengal, Maharashtra, Tamilnadu. Jammu and Kashmir, and Karnataka. Agricultural - Although the crop may be grown from seeds this method has drawbacks including unpredictability in offspring and an extremely longer harvesting period. As a result, tubers that weigh among 70 to 80 grams alongside the crown are chosen for cultivation. They are sown in nursery beds after receiving a fungicide remedy to save you tuber rotting. Their sprouting process takes between thirty and forty days.

Tubers are transplanted inside the field after to a few months of growth; the sphere has previously been dealt with a pesticide when planting, space the tubers are 30 by way of 60 centimeters apart. At first, the veins are fragile and feeble requiring assistance to develop to their full capability for that reason 2. Five m high tronsses are available. Given the acute exhaustion of the tubers, a heavy dosage of farmyard manure more or less 5 to ten lots consistent with hectares initially administered the next step is to apply equal dosages of organic fertilizers one month apart. Every ten days, irrigation should be carried out. There are no significant pests associated with Dioscorea. On the other hand, precautions against mites and white-bugs should be taken. Legume intercropping is a possibility. From two crops fresh tuber yields up to 18 per hectare anticipated.

Collection: During the dormant season, harvesting involves deep ploughing since the diosgenin concentration is higher than in other seasons. Rhizomes dry up and lose almost 50% of their weight. [23]

PHYTOCONSTITUENTS

Table 2: showing some of the major phytochemical compounds present in *Dioscorea bulbifera*

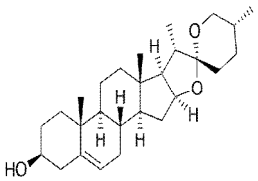
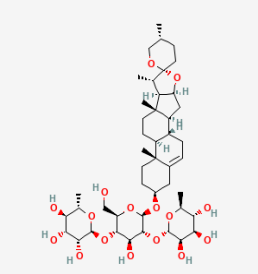
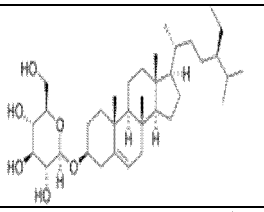
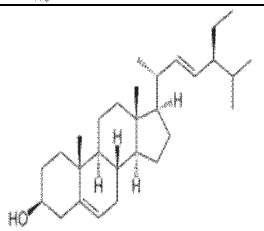
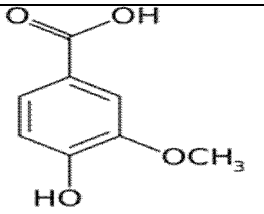
Sr.No.	Phytochemical Constituents	Class of Phytochemical	Structures	Part of the Plant	Uses
1	Diosgenin	Steroid		Corm, Bulb	Antidiabetic, Antibacterial
2	Dioscin	Steroid derivative		Rhizome	Antifungal, Hepatoprotective, Anti-tumor, Anti-obesity
3	Daucosterol	Steroid		Rhizome	Anti-cancerous
4	Stigmasterol	Steroid derivative		Tubers	Anti-Alzheimer's
5	Palmitic Acid	Fatty Acid		Rhizome	Nutrition and Food
6	Vanillic acid	Benzene derivatives		Rhizome	Anti-hypertension

Table 2 showing some of the major phytochemical compounds present in *Dioscorea bulbifera* [24-28]. Diosgenin is a chemical substance that is largely an aglycone found in *Dioscorea bulbifera* and is utilized commercially within the drug industry. Table 1 shows the principal phytochemical compounds found in *Dioscorea bulbifera*. [4, 9-14]. Phytochemical materials like carbohydrates, protein, sugars, amino acids, and starch are beneficial as a reserve food. Apart from those, there are numerous other most important phytochemical elements are found in *Dioscorea bulbifera* like Napthofurans, napthopyrans, Flavonoids, Carboxylic acids, phenol lipids, steroids, steroid derivatives, benzene derivatives, and trepenoids. [29-32].

THE THERAPEUTIC POTENTIAL OF *DIOSCOREA BULBIFERA* IN TRADITIONAL MEDICINE

Dioscorea bulbifera, commonly known as air potato or yam, has been a cornerstone in traditional Chinese and Indian medicine for treating various ailments. This versatile plant has demonstrated efficacy in addressing disorders of the spleen, lungs, and kidneys, as well as in managing different types of diarrhea. Its ability to lower the glycemic index has made it valuable in diabetes and obesity prevention. Rich in diosgenin, a steroid saponin, *D. bulbifera* exhibits preventative and therapeutic properties against cancer, arthritis, diabetes, gastrointestinal disorders, inflammation, and high cholesterol. Traditional applications include treating piles, ulcers, pain, and inflammation, with crushed tubers used in decoctions and oils for inflamed ulcers and sinuses. In both Indian and Chinese phytotherapy, it is employed to combat stomach cancer, rectum carcinoma, and goiter. Additionally, dried yam is believed to dissolve toxins and is used to treat carbuncles, scrofula, and purulent diseases, showcasing its broad spectrum of medicinal applications.

Anti HIV pastime: As a natural HIV-1 integrase inhibitor, bulbils from the plant *Dioscorea bulbifera* have been diagnosed. Diosbulbin E-acetate, a singular clerodone diterpenoid, become remoted from the chloroform fraction via Column chromatography, together with different clerodane diterpenoids, 4 flavonoids, and one sterolglycoside. As an instance, MIN was used to discover compounds with anti-HIV-IN properties and compared with suramin (IC50=2.24m). Flavonoids are extra effective than diterpenoids and steroid capsules ininhibiting HIV-1 IN. With an IC50 of sixteen.28g/ml, quercetin become the simplest compound against HIV-1IN, accompanied through kaempterol (IC50=37.71g/ml) and catechin (IC50 sixty-two.36g/ml). Catechol, specially, became located to be a hydroxylated aromatic compound that inhibited IN in bioassays [33, 34] Anticancer activity: The authors synthesized novel platinum–palladium bimetallic nanoparticles (Pt–PdNPs) the use of a Medicinal plant, *Dioscorea bulbifera* tuber extract (DBTE) High-decision transmission electron Microscopy revealed monodispersed PtNPs of length 2–5 nm, whilst palladium and platinum nanoparticles of length 10–25 nm [17]. Aucore Ag shell nanoparticles from *Dioscorea bulbifera* inhibited A. Baumannii biofilm eighty-three.68 0.09%. P. Aeruginosa, E. Coli, and S. Aureus biofilms have been suppressed 18.93 1.94%, 22.33 zero. Fifty six%, and 30.70 1.33%, respectively. SEM and AFM confirmed uncontrollable cell efflux ensuing to cell Death [18]. The studies that was defined in this article proven that an extract of *D. Bulbifera* Grown in methanol possessed robust ant proliferative interest whilst in comparison to a reference medicine. The truth that the antioxidant residences verified through the plant's methanol, ethyl acetate, and hexane Extracts have been substantial whilst as compared with ascorbic acid indicates that the leaves of this species have the capability to perform as herbal antioxidants. Therefore, the anti-proliferative homes proven by leaf extracts legitimize the traditional programs of this herb against a variety of illnesses, along with breastCancer [19]. *Dioscorea bulbifera* vegetative organ chloroform and methanol extracts kill breast most cancers cells (T47D). Leaf chloroform extract has the very best cytotoxic action (IC50 a hundred and fifteen.63 g/mL). F5 and F6 combined with ethyl acetate: methanol eluent has the highest cytotoxic efficacy against breast most cancers (T47D). Both Fractions' IC50 changed into 14.55 g/mL. Potential fractions are cytotoxic to T47D cells but no longer SI > 10 Vero cells. Terpenoids and alkaloids had been found inside the capability fraction [35]

ADVERSE EFFECTS

The steroidal saponins brought on dose-established standard behaviour damaging consequences, mortality and liver histopathological modifications in the intense toxicity observe. In the sub-chronic toxicity take a look at, 510 mg/kg/day of steroidal saponins extended overall bilirubin (TBIL) in serum and decreased protein content material inside the liver drastically.

People with kidney problems have to avoid eating sweet potatoes due to the fact a wrong-functioning kidney cannot dispose of potassium from their frame, inflicting excessive potassium tiers that can be harmful to them. Sweet potatoes incorporate excessive amounts of oxalates which could boom the danger

of calcium-oxalate crystal formation. Headache, Fever, and Dizziness are among the alternative adverse outcomes.

Marketed Formulations

Table 3 presents a selection of marketed formulations of *Dioscorea bulbifera*, showcasing the diversity in product types, brands, quantities, and pricing. These products range from tablets to powders, offering consumers flexibility in their choice of consumption method. The availability of such diverse formulations underscores the growing popularity and demand for *Dioscorea bulbifera*-based products in the herbal supplement market [36- 38].

Table 3: Table showing some of the marketed formulations of *Dioscorea bulbifera*

Type	Brand Name	Company Name	Quantity (Tablets/ gms)	Price (Rupees)
Tablets	BHARAT Herbal Varahikand - ***Dioscorea bulbifera*** - Air Potato - Varahi Kand - Bitter Yam Extract Tablets-120 Tablets Pack. Pure Natural and Organic	BHARAT Herbal	120 tablets	310.00
Powder	Trust Herb Varahikand - ***Dioscorea bulbifera*** - Air Potato Powder 	Trust Herb	250 gms	356.00
Powder	Nutrixia Varahikand-*Dioscorea bulbifera*-Varahi-kand-Cheekyyam-Potato Yam 100 Gms 	Nutrixia	100 gms	162.00

Homemade Remedies

Varahi Kand Curry: A warming and flavorful dish that combines cooked Varahi Kand with a blend of traditional spices and coconut milk

Air Potato Stir Fry: A quick and easy recipe involving diced Varahi Kand stir-fried with vegetables, garlic, and a splash of soy sauce

Roasted Varahi Kand: The tubers can be sliced and roasted with a drizzle of olive oil and a sprinkle of your favorite herbs and spices.

Varahi Kand Soup: A nourishing and comforting soup that's made by boiling the tubers with vegetables and spices of your choice.

Varahi Kand Herbal Tea: A potent decoction can be prepared by boiling chopped Varahi Kand with water. Once cooled, it can be consumed for its therapeutic properties.

Dioscorea bulbifera (Family-Dioscoreaceae) has been found to possess profound therapeutic potential. It is commonly used in traditional Indian, African and Chinese medicine in the treatment of sore throat, [39] breast cancer [40].

Through clinical trials, it has been found that D. bulbifera has proved effective in the treatment of sub-acute thyroiditis. [41].

D. bulbifera therefore stands a high chance as a candidate in the treatment of HIV. It's no wonder that it is one of the wild foods commonly eaten by the HIV patients as an accompaniment to staple foods [42]. Where by Dioscorea supplementation increases serum dehydroepiandrosterone sulfate (DHEAS) in humans and modulates lipid levels in older people.

CONCLUSION

In conclusion, *Dioscorea bulbifera* L. emerges as a plant of significant medicinal and cultural importance, with a rich history of traditional use across various regions. This review highlights its diverse therapeutic applications, ranging from treating common ailments to potentially addressing more complex health issues such as cancer and HIV. The plant's phytochemical profile, particularly its content of diosgenin and other bioactive compounds, underscores its potential in modern pharmacology. The wide geographical distribution and cultivation practices of *D. bulbifera* demonstrate its adaptability and importance in different ecosystems. Its use in traditional medicine systems, particularly in Ayurveda, further emphasizes its historical significance in healthcare. However, while the plant shows promise in various therapeutic areas, more rigorous scientific studies are needed to fully understand its efficacy and safety profile. The review also points out some adverse effects and contraindications, highlighting the need for careful consideration in its use. The availability of D. *bulbifera* in various marketed formulations indicates growing commercial interest, but also underscores the need for standardization and quality control in herbal products. Future research should focus on clinical trials, standardization methods, and addressing biological and geographical variations to harness the full potential of *Dioscorea bulbifera* in modern medicine while ensuring its safe and effective use.

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