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Review on Pharmacological Activity of *Dioscorea floribunda*

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

The medicinal herb *Dioscorea floribunda* (Linn.) is very significant. Varahikanda's medicinal properties are quite important. It is used to treat various diseases in Ayurvedic literature. Here is a summary of studies on the antiquity and ayurvedic qualities of varahikanda, i.e. *Dioscorea floribunda.* Varahikanda has a variety of pharmacological characteristics, according to the research. Jeevaneeya, Rasayana, Balya, Krumighna, Pramehaghna, Kushtaghna, Vrushya, Nadivrun, Visarpa, Udarshool, Raktapitta are all Ayurvedic terms. It has antimicrobial action, wound healing activity, antihyperglycemic activity, dyslipidemic activity, anticancer activity, immunomodulatory activity, antioxidant activity, antiinflammatory and analgesic activity, antihelmintic activity, and aphrodisiac activity, according to contemporary research.

Keywords: Varahikanda; Dioscorea floribunda; pharmacological.

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1. INTRODUCTION

The climbing plant *Dioscorea* species has rhizomatous roots. It is a member of the Dioscoreaceae family. *Dioscorea* is a genus in the division *Dioscorea*. There are 350-400 monocotyledon species. *Dioscorea* is found across the world's tropics and subtropics, with Africa accounting for 96% of output. South America, the Caribbean islands, and South East Asia are also producing hotspots [1]. *Dioscorea* is a perennial plant that may reach a height of 3 meters (10 feet). Rhizomes are asymmetrical, asymmetrical, and alternately organized ligneous rhizomes. Simple leaves, 5-11.5 cm long, 4-10.5 cm wide, triangular ovate, frequently heart-shaped, 7- 9 nerved, long pointed, smooth and glabrous on both sides, petiole thin, 5-10 cm long. Male blooms, 7.5-25 cm long, on leaf axils, solitary or occasionally branching, thin and flexible. Flowers are small and clustered, with six stamens and inferior anthers. Female blooms are solitary and slender, measuring up to 15cm in length. *Dioscorea* rhizomes, often known as wild yam, grow underground. *Dioscorea* has been found to be highly important in both private agencies and pharmaceutical companies, and the plant is mostly harvested in India, along with Himalayan plants [2,3]. *Dioscorea* is threatened in natural environments as a result of illegal trade, urbanization, and overuse by local people for household and trading uses [4]. In India, China, Nepal, Bhutan, Pakistan, Afghanistan, and Vietnam, the species (deltoidea) is mostly found. The plant species are primarily found in Kashmir and Assam, at elevations of 550-3100 meters [5]. It may be found in Arunanchal Pradesh, Sikkim, Assam, Meghalaya, Jammu and Kashmir, Himanchal Pradesh, and Uttarakhand in Indian Himalayan areas [1]. Diosgenin, a phytoestrogen that converts to the hormone progesterone, is found in the rhizomes of this plant, making it unique. Bodybuilders utilize diosgenin as a base for anti-infertility medicines like contraceptive pills, as well as sex hormones like testosterone and supplements to boost their testosterone levels and enhance muscular strength. *Dioscorea* tubers are shaped like zingers and are straight. *Dioscorea* tubers are used to treat a variety of ailments, including gastrointestinal problems, struma sour throat, diarrhea, irritability, stomach discomfort, wounds, burns, and anemia. Antimicrobial, antioxidant, stomachic, and hypoglycemic properties are also thought to be present in the tubers [6]. Aside from that, *Dioscorea* is commonly used to treat diarrhea, piles, and chronic liver discomfort [7].

1.1 Botanical Description [7]

Tubers come in a variety of sizes. Bulbils are many, irregularly shaped, 2.5 cm wide or larger, brown, and warted. To the left, the stem is twining. Leaves are generally alternating, oval, acuminate, base more or less deeply chordate, lobes rounded, 7-11 nerved, and measure approximately 10-15 by 7-5-10 cm, but can be considerably bigger or smaller. Male spikes 5-10 cm. long, clustered, axillaries of in leafless panicles. Stamens 6 Female spikes 10-25 cm, long in axillary clusters of 2-5. Capsule 1.8-2-2 cm long, oblong. Seeds winged at the base.

1.2 Chemical Constituents

The starch content of *Dioscorea* rhizomes is 75%. Due to their very bitter flavor, they are inedible. Diosgenin, a steroidal sapogenin (4 to 6%), and its glycosides, Smilagenin and -isomer yammogenin, are the major components of *Dioscorea*. Sapogenase is an enzyme found in rhizomes. Glycosides and phenolic chemicals are abundant in tubers. Saponin-dioscin hydrolysis produces diosgenin. [8]. Dioscin is made up of two L-rhamnose molecules and one D. glucose molecule. Gracillin is made up of two D. glucose molecules and one L-rhamnose molecule [9]. The flavonoid components Cyanidin-3-glucoside and the procyanidin dimmers B-1 and B-3 were discovered in *Dioscorea alata* L. by Ozo.et al. [10] in 1985. *Dioscorea* also includes dioscorins, which inhibit carbonic anhydrase and trypsin, according to a research [11]. Saponins, alkaloids, flavonoids, tannin, and phenols have been found in *Dioscorea floribunda* in other investigations [12]. Yoon et al [13] discovered Allantoin in *Dioscorea* rhizomes in 2008.

1.3 Pharmocological Actions

1.3.1 Wound healing activity [8]

Dioscorea floribunda tubers are used as a folk medicine for wounds, leucoderma, and boils. The purpose of this study was to see if the tubers of *Dioscorea floribunda* had any impact on an artificially generated excision wound model in rats over a period of 22 days. The wound healing model revealed considerable wound healing activity, a high rate of wound contraction, and a reduction in the time it takes for tuber extracts to epithelize, which is equivalent to standard ointment.

Table 1. Bioactive compounds present in *Dioscorea floribunda*

Compounds	Uses	Species
Diosgenin [14]	Raw material for steroidal drugs	*Dioscorea floribunda*
Sapogenin [15]	Reduce inflammation	
Saponin [16]	Skin disease	
Cyanidin [11]	Reducing trypsin level	
Flavonoids [12]	Antioxidant and skin disease	
Allantoin [17]	As detoxifying agent for ammonia	
Dioscorine [18]	For Birth control	
Ohenolic compounds [19]	Skin Disease	

1.4 Effect on Cardiovascular System

Diosgenin has been shown in several studies to have a significant effect on lipid levels by lowering total cholesterol (TC) and low density lipoproteins (LDL) levels in plasma and increasing the ratio of high density lipoproteins (HDL) to total cholesterol by decreasing cholesterol absorption and increasing cholesterol secretion. In superior mesenteric rings, diosgenin was discovered to have a concentration-dependent vasorelaxant effect when compared to phenylephrine as a control. In FURA-2-loaded mesenteric endothelial cells, diosgenin increases intracellular calcium concentrations. Furthermore, diosgenin raises the amount of nitric oxide (NO). Diosgenin was studied for its vasodilatory effect in the porcine resistance left anterior descending coronary artery, and it was discovered that diosgenin caused an acute endothelium-independent coronary artery relaxation by activating the protein kinase G signaling cascade and opening the BK (Ca) channel of arterial smooth muscle cells [20]. The effects of diosgenin on smooth muscle cell contraction and calcium signaling in isolated aorta were studied in mice using myography and confocal imaging. In the isolated aorta, diosgenin was found to offer potential therapeutic benefit for vascular diseases by decreasing receptor-mediated calcium signals and smooth muscle contraction [21].

1.5 Effect on Blood System

Using thrombotic rat inferior vena cava and pulmonary thrombosis mouse models, diosgenin was found to have anti-thrombotic effects in both in vitro and in vivo studies. It resulted in reduced platelet accumulation, thrombosis, and extended activated partial thromboplastin time (APTT), prothrombin time (PT), and thrombin time (TT) in the models, depending on the dose used. Diosgenin also has an anti-thrombotic effect, since it prolongs bleeding and clotting times [22-23].

1.5.1 Diosgenin as a raw material for steroid

For the commercial manufacture of 16-dehydropregnenolone acetate (16-DPA), a powerful steroid drug intermediate derived from diosgenin, there is a three-step efficient synthesis with a 60 percent overall yield. Acetolysis (isomerisation) of diosgenin 3 to pseudodiosgenin diacetate 4, oxidation of pseudodiosgenin diacetate 4 to Diosone 5, hydrolytic degradation of Diosone 5 to 16-DPA 1 are the stages involved [24].

1.6 Anticancer Activity [9]

Water extract (fraction A), ethanol extract (fraction B), ethyl acetate extract (fraction C), non-ethyl extract (fraction D), and compound diosbulbin B derived from *Dioscorea floribunda* Linn all have antitumor activity. In this investigation, [DB] found that fractions B and C both reduced tumor weight in S 180 and H22 tumor cell harboring mice, whereas friction A and B had no impact. In tumor-bearing mice, fraction C changed the weight of the spleen and thymus, as well as the number of total leukocytes, lymphocytes, and nutrophils. Furthermore, the chemical diosbulbin B displayed anticancer activity in a dose-dependent manner in vivo at doses ranging from 2 to 16 mg/kg without causing substantial toxicity. Furthermore, diosbulbin B was discovered to be the major antitumor effects which may be related to influencing the immune system for the first time, based on chemical analysis of the above extracts by high performance liquid chromatography (HPLC) with diode array detector (DAD), and the compound diosbulbin B is the major antitumor compound of *Dioscorea floribunda* [25-28].

1.7 Antimicrobial Activity [10]

In vitro antibacterial activity of *Dioscorea floribunda* (bulbils) extracts against *Klebsiella pneumoniae, Escherchia coli, Bacillus aureus, Proteus velgaris, staphylococcus aureus, Aspargillus niger,* and *Aspargillus flavus* was studied. *Rizopus nigricans* and fumigatus The extracts of petroleum ether and chloroform were shown to be effective against A. R. Fumigatus and Fumigatus Nigricans.

The petroleum ether and the distllied water extract both have strong anti-K action. Pneumoniae. The chloroform extract has just mediocre antibacterial action against *S. Aureus.*

1.8 Aphrodisiac Activity [11]

Male impotence, also known as erectile dysfunction, is described as a man's inability to develop and maintain an adequate erection for mutually satisfying intercourse with his partner. Sexual health and function are significant factors in determining one's overall happiness. Various natural aphrodisiac potentials are recommended to overcome the problem of sexual or erectile dysfunction. The purpose of this review is to explore the aphrodisiac potential of plants, as well as their biological sources, common names, parts utilized, and references. Which can aid researchers in the creation of novel aphrodisiac formulations. Linn is described as an aphrodisiac in Dioscorea bulbifera [29].

1.9 Antioxidant Activity [12]

Dioscorea bulbifera is a key staple food crop that is a yam species that is extensively spread in tropical and subtropical locations across the world. *Dioiscorea bulbifera* has long been used to decrease the glycemic index, resulting in more prolonged energy and greater protection against obesity and diabetes. It also possesses anticancer properties. The goal of this study was to look at Dioscorea bulbifera's antioxidant activities. The enzymatic and non-enzymatic activity of the ethanol extract of Dioscorea bulbifera tuber was tested. The levels of enzymatic antioxidants glutathion peroxidase (GPX), catalase (CAT), superoxide dismutase (SOD), glucose-6-phosphate dehydrogenase (G6PD), and glucose-s-transferase (GST) and glucose-6-phosphate dehydrogenase (G6PD) and glucose-6-phosphate dehydrogenase (G6PD) and glucose-s-transferas. Reduced glutathione (GSH), Vitamin C, and Vitamin E are among the non-enzymatic antioxidants found in *Dioscorea floribunda*. Our findings are significant because they improve *Dioscorea floribunda* innate antioxidant capacity, which is beneficial in meeting antioxidant requirements in the diet, and therefore *Dioscorea floribunda* achieves a high-value nutritive and natural antioxidant storage.

1.10 Anthelmintic Activity [13]

Ethnobotanical information from Nigeria specifies the use of *Dioscorea floribunda* linn in the treatment of parasitic diseases in humans, suggesting that it could be useful in the development of resistance to common synthetic anthelmintic activity of methanol extract of the flesh and peel of *Dioscorea floribunda* bulbils on *Fascicola gigantica* and Perithima posthama at concentrations ranging from 10 to 1 mg/kg. Albendazole was used as a standard reference medication and normal saline was used as a control in the test. In comparison to gallic acid and querectin, methanol extracts of meat and peel of *Dioscorea floribunda* bulbils were screened for secondary metabolites using thin layer chromatography. The median fatal concentrations of *Dioscorea floribunda* meat and peel extracts for earthworm and liver fluke, respectively, were 39.67 and 30.40 mg/ml for earthworm and 61.73 and 41.79 mg/ml for liver fluke. At 100 mg/ml, the peel was more powerful, producing paralysis in 5.6 0.51 minutes and death in 100.455 minutes in earthworms. The results of this investigation reveal that *Dioscorea floribunda* has an in vitro anthelmintic chemical that is suitable for testing [30].

1.10.1 Antihyperglycemic and dyslipidemic activity [14]

The air potato, *Dioscorea floribunda*, has been used in Chinese medicine to treat diseases of the lungs, kidneys, and spleen, as well as many forms of diarrhea. Yams are the common name for these tubers. These plants have long been used to decrease the glycemic index, giving a more long-lasting source of energy as well as improved protection against obesity and diabetes. The purpose of this study was to assess the antihyperglycemic activity of aqueous extracts of *Dioscorea floribunda* tubers (DBE A003) in glucose primed and streptozocin (STZ) treated wistar rats, as well as the antidyslipidemic potential in high fat diet fed C57BL/6J mice. The antihyperglycemic state was

achieved by priming wistar rats with 1.59/kg P.O. glucose and then infecting them intraperitoneally with STZ (45mg/kg). C 57 BL/65 mice were given a high fat diet to induce dyslipidemia. DBEA003, given at dosages of 250, 500, and 1000 mg/kg for 3 weeks to STZ-treated rats and 4 weeks to high-fat diet-fed C57BL/6J mice, had substantial antihyperglycemic and dyslipidemic effects [31].

STZ was used to cure diabetic rats. In DBEA003 treated high fat diet fed mice, the 7 week DBEA003 therapy resulted in a significant drop in blood glucose levels and an increase in body weight serum glucose and lipid levels were returned to normal.

1.10.2 Immunomodulatory activity [15]

At high dosages, the cancer chemotherapy drug cyclophosphamide (CTX) promotes immunosuppression and tissue oxidative stress. Some polysaccharides have been demonstrated to have anti-tumor, anti-inflammatory, and/or anti-oxidant effects as possible protective agents. The effects of oral therapy with *Dioscorea floribunda* polysaccharides (DBLP at 100 or 150 mg/kg) in U14 cervical tumor-bearing mice treated with CTX (25 mg/kg) were investigated in this work. While CTX alone reduced tumor development (65.4%) and DBLP alone inhibited tumor growth (25.6% at 100 mg/kg or 37.6% at 150 mg/kg), the CTX+DBLP combination generated tumor inhibition rates that were 5.6 (for 100 mg/kg DBLP) or 9 percent (for 150 mg/kg) greater than CTX alone. While the tumor and CTX therapy decreased the thymus and/or spleen/body weight indices, DBLP alone or in combination with CTX and DBLP mitigated this reduction. The CD4+/CD8+ ratio of peripheral blood T-cell subpopulations was reduced by DBLP, and the combination of DBLP and CTX reduced the efficacy of CTX in raising the CD4+/CD8+ ratio. The tumor and CTX therapy enhanced oxidative stress (lower superoxide dismutase, higher lactate dehydrogenase, and higher malondialdehyde levels in blood and tissues), which was reduced by DBLP treatment, and the DBLP+CTX combination inhibited CTX-induced oxidative stress. In U14 cervical tumor-bearing mice, combining DBLP with CTX might potentially increase CTX anti-tumor activity while also reducing CTX-induced immunosuppression and oxidative stress [32].

1.10.3 Analgesic and anti inflammatory activity [16]

In mice and rats, aqueous and methanol extracts from the dry bulbils of *Dioscorea floribunda* L. var sativa (Dioscoreaceae) were evaluated orally at doses of 300 and 600 mg/kg against pain induced by acetic acid, formalin, pressure, and inflammation induced by carrageenan, histamine, serotonin, and formalin, demonstrated a dose-dependent reduction of pain and inflammation, with the aqueous extract having a maximal impact of 56.38 percent, 73.06 percent, and 42.79 percent on pain caused by acetic acid, formalin, and pressure, respectively. At the same dose, the methanol extract suppressed these pain models by 62.70 percent, 84.54 percent, and 47.70 percent, respectively. Oral treatment of aqueous and methanol extracts had a substantial anti-inflammatory effect on histamine, serotonin, and formalin-induced paw oedema. The current findings demonstrate that *Dioscorea floribunda* bulbils have significant analgesic and anti-inflammatory properties. Inflammatory mediators such as histamine, serotonin, and prostaglandins may be inhibited, resulting in these actions. As a result, the analgesic effect of *Dioscorea floribunda* bulbils may be connected to its anti-inflammatory activity.

These properties can be compared as follows:

Table 2. Ayurvedic & modern properties of *Dioscorea*

Sr. No.	Ayurvedic Properties	Modern Properties
1.	*Pramehaghna*	Antidiabetic activity
2.	*Jeevaneeya*	Antioxidant activity
3.	*Rasayana, Balya*	Immunomodulatory activity
4.	*Prvahika**,**Visarpa, Kushtghna*	Antimicrobial activity
5.	*Nadivruna*	Wound healing activity
6.	*Raktapitta**,** Raktatisar*	Anticancer activity in blood cancer
7.	*Medohar*	Dyslipidemic activity
8.	*Udarshool, Nadivrun*	Anti-inflammatory and

Fig. 1. Leaf, tuber & rhizome of *Dioscorea*

The Ayurvedic refrences shows that the plant *Varahikanda* possesses, *Rasayana*, *Jeevaneeya*, *Pramehaghna*, *Kushtaghna*, *Balya*, *Vrushya*, *Raktapittahar*, *Udarshoolahar*, *Pravahikahar, Nadivrunhar, Medohar* and Krumiroghar properties. Modern studies states the properties of *Varahikanda* as Immunomodulatory activity, wound healing activity, Antioxidant activity, Antidibetic activity, Dyslipidemic activity, Analgesic and Anti inflammatory activity, Aphrodisiac activity, Anthelmintic activity, anti carcinogenic activity, Antimicrobial activity.

2. CONCLUSION

The literary study of Varahikanda from Ayurvedic texts and modern researches concludes that Varahikanda i.e. *Dioscorea bulbifera* Linn has following properties. According to Ayurveda *Rasayana*, *Jeevaneeya*, *Pramehaghna*, *Kushtaghna*, *Balya*, *Vrushya*, *Raktapittahar*, *Udarshoolahar*, *Pravahikahar, Nadivrunhar, Medohar* and Krumiroghar and according to modern immunomodulatory activity, wound healing activity, antioxidant activity, antidibetic activity, dyslipidemic activity, analgesic and anti inflammatory activity, aphrodisiac activity, anthelmintic activity, anti carcinogenic activity, antimicrobial activity.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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