

***DIOSCOREA DELTOIDEA* WALL. EX GRISEB. A HIGHLY THREATENED
HIMALAYAN MEDICINAL PLANT: AN OVERVIEW****L.R. DANGWAL AND AMIT SINGH CHAUHAN****Herbarium and Plant Systematic Laboratory, Department of Botany, H.N.B. Garhwal University
(A Central University), S.R.T. Campus, Badshahi Thaul, Tehri Garhwal, Uttarakhand, India.***ABSTRACT**

Dioscorea deltoidea belongs to family Dioscoreaceae which produce rhizomes or bulbils, having rich medicinal and economic value. *Dioscorea deltoidea* rhizomes used for the treatment of different diseases such as digestive disorders, sore of throat for struma, diarrhea, irritability, abdominal pain, wounds, burns, anemia, etc. The genus *Dioscorea* has recently gained much significant reputation as a source of steroidal saponins like diosgenin. These are significant starting material for synthesis of cortisone, which is useful for the treatment of rheumatic arthritis, and the preparation of sex hormones etc. Diosgenin is a precursor for the chemical synthesis of drug like steroids and it has great importance in the pharmaceutical industry. *Dioscorea deltoidea* has also been exploited for its potential role and various chemical components like cortisone and Diosgenin etc. The present paper's main aim is to search the detailed medicinal properties, phytochemical components, pharmacological properties and causes of threatened *Dioscorea deltoidea*.

KEYWORDS: *Dioscorea deltoidea*, Threatened Medicinal Plant, Phytochemicals, Diosgenin**AMIT SINGH CHAUHAN**Department of Botany, H.N.B. Garhwal University (A Central University), S.R.T.
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INTRODUCTION

Dioscorea deltoidea is a climbing herb with rhizomatous rootstock. It belongs to class spermatopsida and family Dioscoreaceae (Figure-2). The genus *Dioscorea* belongs to division monocotyledon, comprises 350-400 species, distributed throughout the tropics and subtropical regions in the world, mainly in West Africa, parts of Central America and the Caribbean, The Pacific islands and South East Asia¹. *Dioscorea deltoidea* is a perennial climber, growing upto 3m (10 ft) in height. It is a hairless vine, twinning clockwise. Rhizomes are ligneous irregular, alternately arranged. Leaves are simple, 5-11.5cm long, 4-10.5cm broad, triangular ovate, often heart-shaped, 7-9 nerved, long pointed, hairless above, velvety on the nerves beneath, leaf stalks slender, 5-10cm long. Male flower spikes solitary in leaves axils, simple or sometimes branched, slender, lax, 7.5-25cm long. Flowers small, distant in clusters; stamens 6, anthers inferior. Female flowers stalk solitary, slender upto 15cm long. Underground rhizomes of *Dioscorea deltoidea* commonly known as *wild yam* or *Singli-mingli* in Hindi and *Varahikand* in Sanskrit. The much demand of *Dioscorea deltoidea* has been observed in private agencies as well as pharmaceutical firms, and the plant excessively collected in India along with Himalaya^{2, 3}. *Dioscorea deltoidea* is threatened in natural habitats due to illegal use, urbanization, over-exploitation by local peoples for trading and domestic use¹⁰. The

species is mainly found in India, China, Nepal, Bhutan, Pakistan, Afghanistan and Vietnam. In India the plant species are mostly distributed in Kashmir to Assam at altitudes of 550-3100m⁴. In IHR (Indian Himalayan regions) it is found in Arunanchal Pradesh, Sikkim, Assam, Meghalaya, Jammu & Kashmir, Himanchal Pradesh, and Uttarakhand¹ (Figure-5). Although, *Dioscorea deltoidea* is also cultivated in some regions of Punjab, Maharashtra and Madhya Pradesh. *Dioscorea deltoidea* were named after the ancient Greek physician and botanist, Dioscorioids. This plant is special (threatened) because its rhizomes contain diosgenin, which is a phytoestrogen that convert into the hormone progesterone. Diosgenin is a basis for anti-infertility drugs such as contraceptive pills, and sex hormones, such as testosterone and supplements are used by body builders to increase their testosterone levels and build muscle mass. *Dioscorea deltoidea* tubers are horizontal and zinger like shaped. The tubers of *Dioscorea* is use for the treatment of different diseases such as digestive disorders, sour throat from struma, diarrhea, irritability, abdominal pain, wounds, burns and anemia, etc. The tubers are also believed to possess activities like antimicrobial, antioxidant, stomachic and hypoglycemic activities⁵. Furthermore, traditionally *Dioscorea deltoidea* is use extensively for dysentery, piles and chronic liver pain disease.

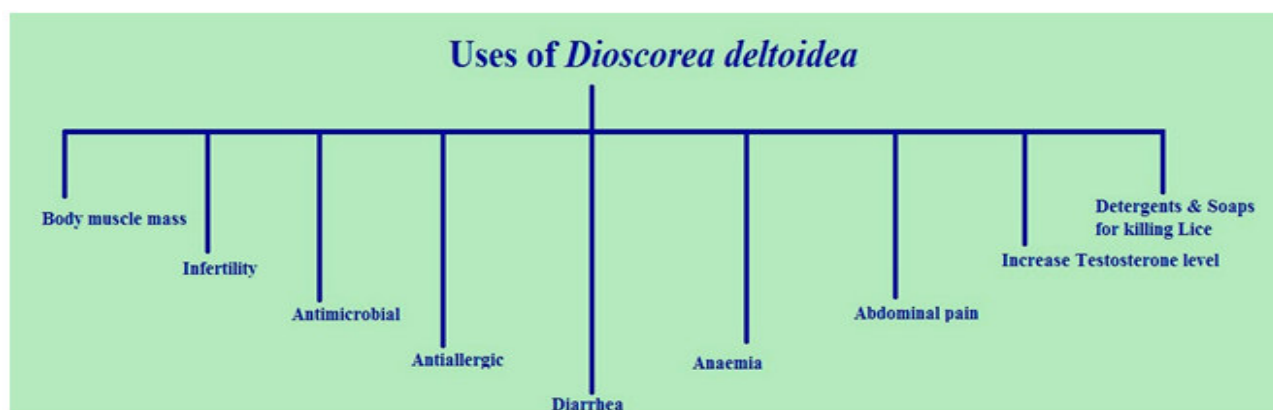


Figure 1
Some Important uses of *Dioscorea deltoidea*.

Figure 2
Classification of Dioscorea deltoidea.

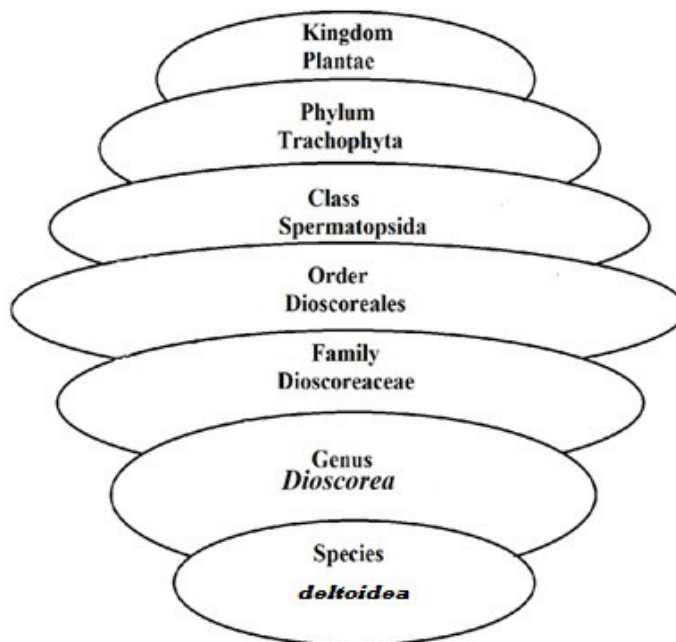


Figure 3
Natural habitat of Dioscorea deltoidea

Plant parts of *Dioscorea deltoidea*



Figure 4

(A) Whole plant of *Dioscorea deltoidea*. (B). Unequal round winged shaped Seeds of *Dioscorea deltoidea* (C) Matured Leaf (pointed Heart shaped 5-11.5cm long, 4-10.5cm broad) of *Dioscorea deltoidea*. (D) Underground Rhizomes of *Dioscorea deltoidea*.

Table 1

Botanical description and properties of different plant parts of *Dioscorea deltoidea*.

Plant part	Botanical Description/Properties
Stem	Glabrous , twinning clockwise
Leaf	Leaves simple, alternate, 5-11.5cm long, 4-10.5cm broad, ovate or triangular ovate usually 3 lobed, often heart shaped, the basal lobes rounded or sometimes dilated outwards.
Flower	Male flower spikes solitary in leaf axils, simple or sometimes branched, slender, lax, 7.5-25cm long. Flowers small, in distant clusters; stamens 6, antheriferous. Female spikes are solitary, slender, upto 15cm long, few flowered.
Seed	Rhizomes are ligneous, irregular.
Capsule	Capsule is 2cm long, 3cm broad, ovate or obcordate.

Threatened species

Dioscorea deltoidea is a rare and threatened medicinal plant through tropical and subtropical forest of Himalayan region. *Dioscorea deltoidea* is threatened in natural habitats due to illegal use, urbanization and over exploitation by local population for trade and domestic use⁶. *Dioscorea deltoidea* is categorized in India as vulnerable for Red Data Book of Indian Plants. It was assessed as critically endangered in 1998, after a survey by Molur and Walker was reported decline of 80% of its population in wild¹⁰. All CITES Appendix I and Appendix II plant species obtained from the wild is banned for export from India. Only cultivated/artificially propagated plant species listed under App. II

is allowed for export under cover of CITES export permit and Legal Procurement Certificate (L.P.C.), or certificate of cultivation from the designated authorities. Export of *Dioscorea deltoidea* requires 'certificate of cultivation or Legal Procurement Certificate' from the designated authorities of the Forest Department, as per MoEF (Minsitry of Environment and Forest) circular. According to the Export and Import Policy 1997-2002, Schedule 2-Appendix 2, the export of *Dioscorea deltoidea* whole plant, plant parts and their derivatives, and extracts as such obtained from the wild, except the formulations made there from, is prohibited.

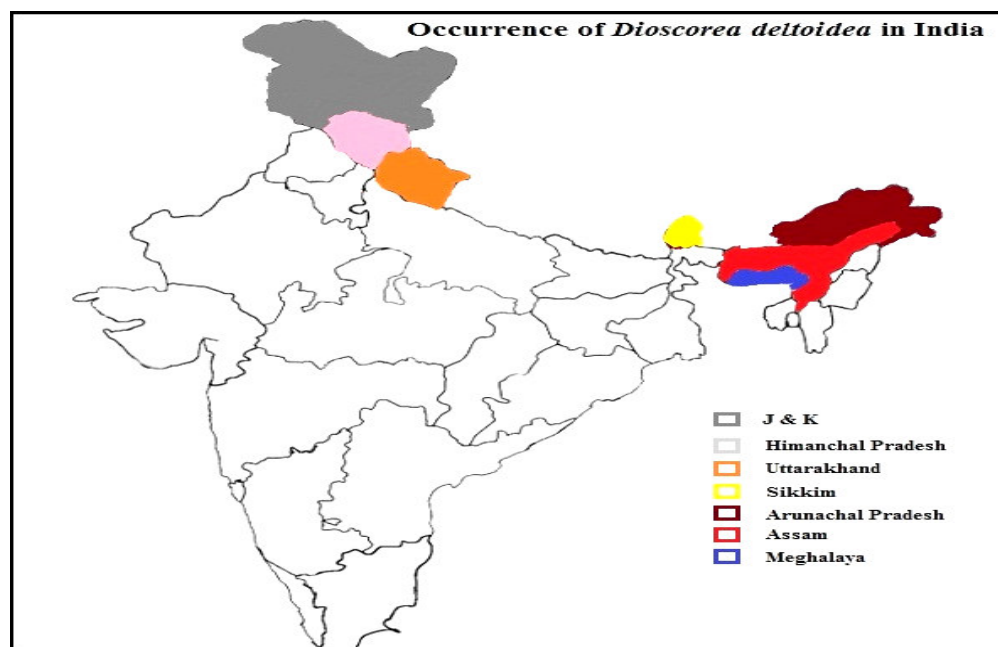


Figure 5
Occurrence of *Dioscorea Deltoidea* in India.
Rhizomes of *Dioscorea deltoidea*

The rhizomes of *Dioscorea deltoidea* is very medicinally important and beneficial for treating diseases. Singh *et al.* first reported diosgenin and smilagenone from the rhizome of *Dioscorea deltoidea* being the Indian source of diosgenin. 8% of diosgenin was reported by Abrol *et al.*, and collected the rhizome from the Chenab River. The highest percentage of diosgenin ever reported in the species from the India. after that Stigmasterol, β -sitosterol, and campestrol, diosgenin; 25-D-spirostan-3, 5 diene⁸. They are generally use for steroidal and contraceptive drugs. In the duration of 1951-1960 Chakravarti *et al.* starts surveying for steroidal yielding plants Singh and Chakravarti reported diosgenin first time from the rhizomes of *Dioscorea deltoidea*⁹. It is observed that in Himalayan species diosgenin percentatge (8-10%) is higher as compared to other species of *Dioscorea* due to it contains

steroidal glycosides as active compounds that determines their biological activity to forms complexes with the sterols. Thus steroidal glycosides possess hemolytic, hypocholesterolemic, antitumor, fungicide, antimicrobial and other biological activities⁹. Many experiments found the presence of carbohydrates and glycosides, alkanoides, flavonoids, saponin, tannin, unsaturated triterpinoides, sterol and resin from the extract of *Dioscorea deltoidea*⁵. The preparations of *Dioscorea deltoidea* from tubers or rhizomes are used in the treatment and prevention of the diseases of the cardiovascular system, central nervous system, dysfunctional changes in the female reproductive system, disease of bones and joint metabolic disorders, skin diseases, oncology and immunodeficiency's and autoimmune diseases^{11,12}.

Table 2
Types of compounds and their active components present in *Dioscorea deltoidea*

Types of compound present	Products	Activities
Diosgenin	Cortisone, pregnenolone, progesterone	Diosgenin is the precursor for the synthesis of progesterone which in turn was used in early combined oral contraceptive pills. The unmodified steroid has estrogenic activity.
Stigmasterol	β -sitosterol, campesterol, ergosterol, brassicasterol, delta-7-stigmasterol and delta-7-avenasterol	Use as a precursor in the manufacture of semisynthetic progesterone for regulating and rebuilding tissue mechanism related to estrogen effects as well as an intermediate in the biosynthesis of androgens, estrogens and corticoids. And also use as a precursor for vitamin D3.
Sapogenins	Steroids or triterpenes	Steroidal sapogenins can serve as a practical starting point for the semi synthesis of particular steroid hormone.

Therapeutic uses of *Dioscorea deltoidea*

The *Dioscorea deltoidea* tubers contain diosgenin, which is a phytoestrogen that can be chemically converted into hormone basis antifertility drugs such as the progesterone, corticosteroids, and anabolic steroids¹³. The most important sapogenins are diosgenin, The conversion cannot take place in the body though. Diosgenin is the contraceptive pills, of cortisone and sex hormones such as testosterone and supplements are used by body builders to increase their testosterone levels and build muscle mass¹⁰.

Traditional use of *Dioscorea deltoidea*

Traditionally the plant has been used as an anti-rheumatic and to treat ophthalmic conditions. In the Western India it has been used as a source of steroid drugs¹⁴. It has also been used to rid the body of intestinal worms as well as parasites, and sometimes the women use it to wash shawls and woolen cloths¹⁶. But sometimes in Kumaun region of Uttarakhand, the powder from the rhizomes of the plant is taken orally to cures dysentery, abdominal pains and piles¹⁶. The peoples of the Garhwal region cut the *Dioscorea deltoidea* rhizomes in smaller pieces and

make vegetable or soup (Saag) on the holy occasion especially in Maha-Shivratri. Sometimes the powder mixed with milk used as a general tonic to improve health. Paste of rhizomes is also applied in hair to kill lice and allergic states¹⁶. As the saponins are toxic, rhizomes are also made into soap, used to kill lice especially among hill tribe communities in Jammu & Kashmir, India². A mixture of juice from the rhizomes is also sprinkled on river and streams water for the fish poisoning in Nepal¹⁷. In Nepal, auxiliary rhizomes from the upper part of the plants are boiled and the liquid is to treat gastric problems and bloody dysentery¹⁹. Boiled underground rhizomes taken in urinogenital disorder and also use as a detergent. Extract from the rhizomes are used to treat roundworm and have anti-rheumatic properties. TRAFFIC-INDIA and Shah found that *Dioscorea deltoidea* is not use in Ayurvedic medicine in India, but still is experimented in the cure of several diseases¹⁰.

Dosage

The plant products are considered safe with low toxicity, fresh powder from the rhizomes up to 1-2gm boiled with water and after boiling about 4-5ml thrice a day is an effective dose for abdominal pain and throat struma. The extract should be used at a level of between 20-40ml per week (1:2)¹⁹. Crushed rhizomes (Tincture) with 10-30 drops mixed with water and taken three to four times in a day is an effective dose for the treatment of diarrhea, bleeding dysentery as well as all gastrointestinal problems²⁰.

Conservation and Cultivation

Dioscorea deltoidea can be easily propagated by aerial bulbs or rhizomes. Vegetative propagation is the best method for the cultivation of *Dioscorea deltoidea* in natural habitats²². *Dioscorea deltoidea* is very immense potential in the pharmaceutical industry as well as in traditional medicinal system. But due to over exploitation and unsustainable use, natural calamities, shifting of climate, urbanization, etc., this plant is degraded day by day. Thus, for the conservation of the species or proper balance between demand and supply of pharmaceutical industries and local communities. There is urgent need to aware

the local inhabitants for their commercial demands and uses, regarding the sustainable growth of the plant need to highlighted and provision of *Dioscorea* rhizomes to be established by the Government and Non Governmental agencies in the montane to buffering zones².

Harvesting and Processing

In India, the optimum time to harvest the rhizomes of *Dioscorea deltoidea* is considered to be when the plants have going reached their maximum size after three years, and when they are dormant form in the month November-December³. According to Chauhan the optimum harvest season is from November-March²⁵. During this dormant stage, before new buds emerge, the diosgenin and yamogenin contents are highest¹⁰. Regeneration of the rhizomes has been often more successful as compared to seed germination, but harvesting inhibits both¹⁰. Rhizomes collection mainly takes place in cool, moist, and shady places in temperate regions, particularly among shrubs, on rocky substrates, secondary forest and forest edges. Rhizomes were collected from the wild especially in Jammu & Kashmir, Himanchal Pradesh and Uttarakhand¹¹. In Jammu & Kashmir, hill communities collect the species as an opportunistic activity. After harvesting tubers are washed in running water and dried in an open space under shade for a few days depending upon the temperature and humidity. The dried tubers are then stored in moisture free bags and stored at room temperature²⁷.

National Market of *Dioscorea deltoidea*

A study in the Kullu district, Himanchal Pradesh found *Dioscorea deltoidea* is used only for commercial purpose but not use locally. It is collected from wild and sold by the villagers to brokers about 20-30 rupees per kilogram. The brokers sold it about Rs. 60-65 in the market. An annual total of 5370 kg of *Dioscorea deltoidea* were obtained from the Kullu region in 1997¹². In a trade survey started in 1997 by TRAFFIC- INDIA, *Dioscorea deltoidea* was found to be regularly available in the markets of Delhi, Amritsar and Kolkata. An Indian Trade Organization estimated India's annual demand at 700 tons in 1997. This figure is very high in comparison with other estimates.

The dried plants rhizomes were sold at INR 40-65/kg (USD 0.5- 1.9/kg), the fresh plants at INR12-30/kg (USD0.3-0.8/kg). Amritsar was considered the only significant market, with trade there estimated at 40 tons per year. Plant materials offered for sale in Amritsar were sourced from Jammu & Kashmir and Himachal Pradesh. The demands within India were estimated at 150 tons per year in 2002, of which India was only able to supply 60 tons¹¹. The plant species are mainly sold in Amritsar, Delhi and Kolkata, which also supply smaller markets elsewhere. Prices of the species are fixed on the basis of diosgenin content which are present in the rhizomes¹⁹.

CONCLUSION

The present study provide comprehensive information on the therapeutic use, traditional use , dosage , chemical compounds responsible for treating disease, conservation and cultivation , harvesting and processing ,

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trading , cause of threatening, and status of *Dioscorea deltoidea*. based on this study it can be concluded that this plant having many nutritional and as well as therapeutic activities. The major use of this medicinal plant is infertility, antimicrobial, antiallergic, building body muscle mass, control of testosterone level and anaemia. It is a threatened medicinal plant having potential role in curing different diseases. For proper supply of raw materials to pharmaceutical industries it is needed to develop new techniques for cultivation of *Dioscorea deltoidea* in a large scale. Local communities need to create awareness of the sustainable use and conservation assessment of the *Dioscorea deltoidea*.

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