Chapter 3
Dioscorea pubera (Dioscoreaceae): an economically important wild nutraceutical

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Abstract: Foods and medicines are considered as the most imperative aspects that are essential for the survival of human beings. These basic needs of an individual create a link between "nutrition" and "health", and thus the concept of "nutraceuticals" evolved. Several species of the genus *Dioscorea* are available throughout the world, used as food and medicines for various diseases and disorders. Among them, *Dioscorea pubera,* a common tuberous wild species is used as a food and medicine and indicates the elevation of the landscapes. It shows diverse bioactive compounds. Keeping this in mind, an attempt has been made to gather information on *D. pubera*, its food, economic and nutraceutical values. Morphological description, and the photographs are provided for identification which could open new avenues in the finding of capable nutraceuticals.

Keywords: Starch, Secondary metabolites, Tuberous plants, Tribal food

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Introduction: Foods and nutrients are the primary requirements for the normal functioning of the body which help to maintain health, improve immunity and also reduce the risk of various diseases. These needs of the population create a link between "nutrition" and "health", and thus the concept of "nutraceuticals" evolved (Rama et al. 2006; Verma and Mishra 2016). Nutraceuticals are essential food that is more than food but less than pharmaceuticals. This means it provides nutritional as well as medicinal benefits. In many countries, nutraceuticals are included in dietary supplements due to the presence of active compounds such as carotenoids, collagen hydrolysate, and dietary fibres. They are considered to be healthy sources for the prevention of many life-threatening diseases like diabetes, renal and gastrointestinal disorders, as well as diverse microbial infections (Telessy 2019; Ali et al. 2021). Various nutraceuticals have been playing a vital role in immune status and vulnerability to certain diseases. They also help to reveal disease adjusting indications related to oxidative stress including allergy, Alzheimer's disease, cardiovascular diseases, cancer, eye conditions, Parkinson's disease, obesity etc (Pandey et al. 2010; Nwosu and Ubaoji 2020). Many different terms, definitions, and meanings used for nutraceuticals vary from country to country. They have also been called medical foods, designer foods, functional foods, herbal products, processed products or nutritional supplements (Pise et al. 2012). Countries like United Kingdom, Germany and France were the first countries which considered that diet is a more important factor than exercise or hereditary factors in achieving sound health and immunity. Canada defined nutraceuticals as a product isolated or purified from foods but sold in pills, powders and other medicinal forms not generally associated with food and demonstrated to have a physiological benefit. It also provides benefits against chronic diseases. In Britain nutraceuticals are defined as "a food that has a component incorporated into it to give it a specific medical or physiological benefit, other than purely nutritional benefit". In India, nutraceuticals are food components made from herbal or botanical raw materials, which are used for preventing or treating different types of acute and chronic maladies (Cockbill 1994; Pandey et al. 2010). Worldwide, the local or tribal people near the forest areas use various wild edible roots and tuber crops as food resources. These are free and easily collected by the local people as a good source of nutrients and are rich in energy, minerals, vitamins, antioxidants and dietary fibres (Aigal et al. 2017; Suwardi et al. 2018) could be termed as nutraceuticals. *Dioscorea*, one such tuberous plant, popularly known as Yam, belonging to the family Dioscoreaceae, is a prime staple medicinal-food substitute for the majority of rural and local people of the state of India, having excellent medicinal and nutritional properties (Kumar et al. 2017). *Dioscorea pubera* is one of the efficient tuberous plants with food, medicinal and pharmacological values of these species along with nutraceutical importance (Ummalyma et al. 2018).

Taxonomical features of *D. pubera*

Dioscorea pubera Bl. Enum. Pl. Javae 1:21. 1827; Prain & BurkillAnn Roy. Bot. Gard. (Cutcutta) c14(2):402. tt. 138 & 143. 1938; Burkil in Steenis. Fl. Males. I.4:333. 1951.

Description: Stem twining to the right, densely pubescent. Rootstock woody, directly producing cylindrical tuber; tubers are 35-50 cm long, 1.6 cm in diameter at the neck, and 3.5-3.9 cm in the middle. Bulbils axillary, potato-like, 1.3-2.6 cm across, with greenish skin. Leaves are alternate at base and then opposite, entire, broadly ovate or suborbicular, 7.8-25 x 5-22 cm, acuminate or cuspidate, pubescent on the nerves beneath, base cordate, leaf surface have brown hairs, 2 most exterior lateral veins terminating halfway to margin, the 3 inner-most veins terminating at the apex. Petiole half to as long as the blade, slender, pubescent, 7.0 × 0.2–0.4 cm, brown hairs at base. Male inflorescence is composed of many cymules arranged in racemes, slender, axillary, flowers 1.5 mm long, stamen 6 perfect, small adnate to the inner perianth lobes. Female spikes are densely pubescent, 6-11 cm long, solitary axillary or mostly in short axillary panicles, 9-11 cm long. Perianth 1.1 mm long, thickened at the base with age, outer perianth lobes ovate rounded, inner rather smaller. Ovary densely pubescent or tomentose, not beaked. Capsule 1.2-2.3 cm long and 2.1-3.2 cm broad, sub cordate at top and bottom, the margin of wings thickened. Seeds winged at the periphery. Flowering: September to November; Fruiting: December to January (Ummalyma et al. 2019; Kumar and Dimri 2022; Plate 1-3).

Synonyms: *Dioscorea anguina* Roxb., *Dioscorea combilium* Buch. -Ham. ex Wall., D*ioscorea cornifolia* Kunth.

Ecology: *D. pubera* grows in hilly regions with moderate temperatures.

Distribution: *Dioscorea pubera* is native to the Indo-China region and distributed throughout the temperate, tropical regions of Bangladesh, Eastern Himalaya of India, Jawa, Myanmar,Bhutan, Nepal and Sumatera (Kumar et al. 2017; Kumar and Dimri 2022).

Food values: Yams have been considered to have a considerable amount of various dietary nutrients in comparison to other tropical tuber crops. The tuber of yams is reported to have a good source of essential nutritional components such as starch, proteins, lipids, vitamins, and minerals, etc**.** The food values of *Dioscorea pubera* are least explored throughout the globe. In some places, tubers are boiled, mixed with rice, salt, and eaten as famine food. Many tribal communities of the Indo-Burma Biodiversity hotspot of the country used the tubers of *D. pubera* to get instant energy. In Odisha, tribal communities use their tuber as chips, vegetables, salad, main meal with rice. The tubers contain good amounts of carbohydrates, low-level fats, fibers, and other nutrients, which makes them a good dietary source. It is used widely as traditional leafy and tuber food in many parts of Karbi Anglong district in Assam. Consumption of this tuber is well known among the tribe till today and many of the households now grow this plant in their homestead garden; consumed mostly as breakfast and evening tea item (Terangpi et al. 2015; Dutta 2015; Ummalyma et al. 2019).



Plate 1: Habitat of *Dioscorea pubera*



Plate 2: Tuber of *Dioscorea pubera*



Plate 3: Vegetative parts of *Dioscorea pubera* and discussion with local people

Nutraceutical values: The tuber of *D. pubera* is used as food and other vegetative parts of this climber are used to treat skin infections. Tribal people use the tuber to get instant energy. The climber having nutraceutical values as well bulbils of *D. pubera* are cooked and taken to cure colic pain. They use tubers as food and medicine. Tubers are taken to reduce weakness. The tuber pastes and Karanja oil (*Millettia pinnata*) is applied twice a day to get recovery from wounds and other skin infections. Dried tubers of *D. pubera* are chopped in water overnight and boiled with rhizome of Haldi (*Curcuma officinalis*) and the water is taken during delivery to reduce labour pain. Ethnobotanical studies revealed that the tubers are used in single or multiple formulations against various common and lethal diseases (Ummalyma et al. 2018; Ummalyma et al. 2019; Kumar et al. 2017; Figure 1).

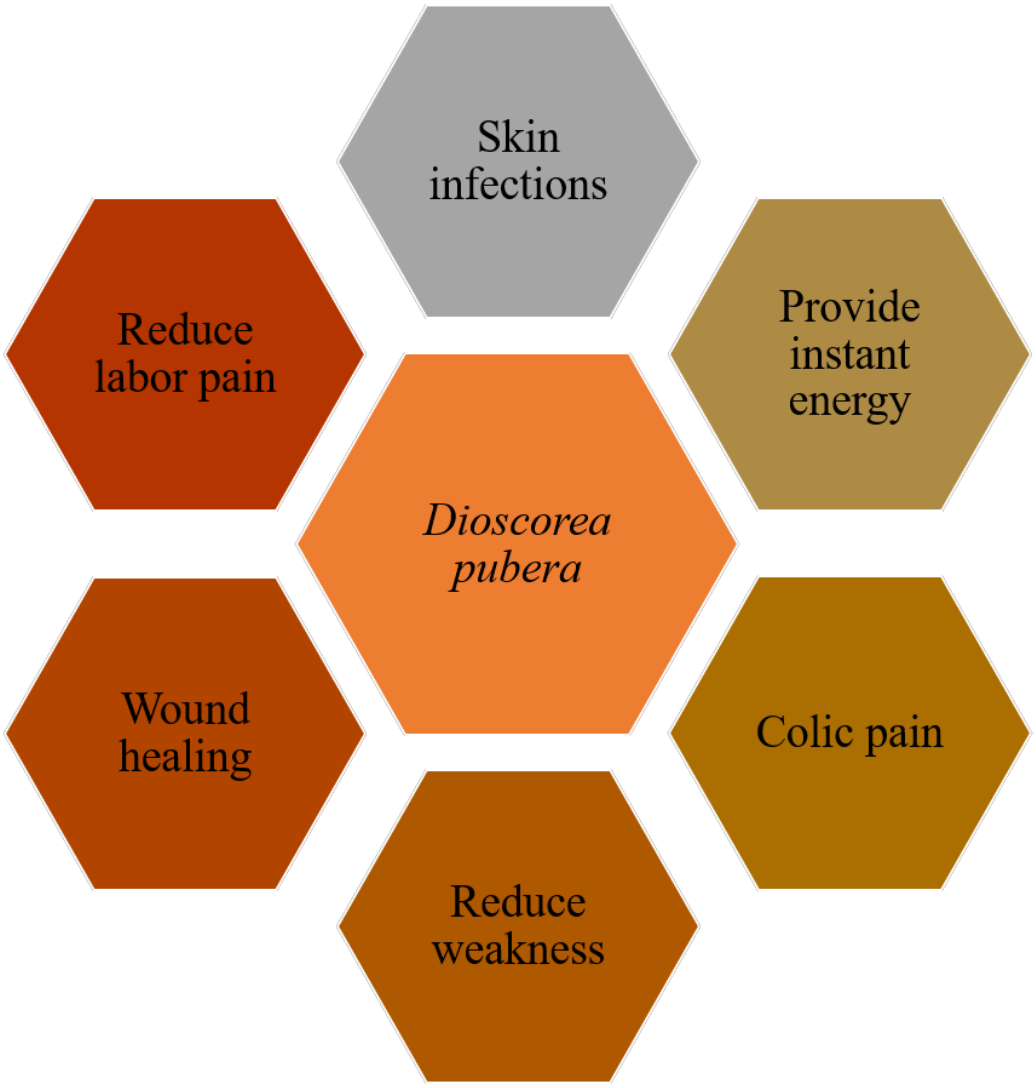

Figure 1: Medicinal values of *Dioscorea pubera*

Economic values: Many yam species are widely cultivated in Africa, Asia, and South America. This traditional staple crop is very important for regional food security and also to get financial support. Tubers of *Dioscorea pubera* are sold in local market. Tubers are collected from the forest, for food and medicine by tribal people of Odisha. The boiled tubers of *D. pubera* are also sold in the local market of Odisha state (Plate 4).

Future aspects as an economically important nutraceutical: It is well known that many fruits and vegetables are rich sources of nutraceuticals that are responsible for our health benefits. Due to these health benefits of nutraceuticals, they might regularly be taken to cure or reduce the risk factors such as high cholesterol, high blood pressure, diabetes etc (Nasri et al. 2014).

More nutraceuticals are being explored day by day and the list is changing continually and reflects ongoing market developments, research, and consumer interest. These developments require a multidimensional approach in the form of product development by incorporating the whole food which contains the desired property into the product during processing or by active component separation.

This technique involves isolation or purification of the active compound from the food and it is incorporated in other food to have a physiological benefit or provide protection against diseases (Kumari 2015). With rapidly increasing interest in nutraceutical consumption, substantial researches are absolutely necessary to warrant that nutraceuticals usage is safe and effective. There are several factors influencing the growth of the Nutraceutical Ingredients market and its economic status. COVID-19 pandemic is one of the key influencing factors in both positive and negative manner in the Nutraceutical Ingredients market. Several foods are available used to help fight against or reduce the risk of cardiovascular diseases, obesity, diabetes, hypertension dyslipidemia, and many other fatal diseases. Nowadays, nutraceuticals have received high interest as they have potential in nutrition and safety profile as well, other than therapeutic capability. Pharmaceutical and nutritional companies are aware of the changing trends which are due to the advantages of these compounds (Alissa and Ferns 2012).

In this scenario, *Dioscorea pubera* is one of the best suggestions to enlist in the nutraceuticals. The tubers are very much crucial for the diets of the feminine, and children as well for the economy of marginal farmers. It contains biologically active components that have the potential to optimize physical and mental well-being and which may also reduce the risk of disease**.** So that can be used as novel sources for developing modern nutraceuticals and functional foods. Nowadays people are more conscious about their food habits, health, and lifestyle. Encouraging these types of wild tuberous plants may lead to a healthy lifestyle both in nutritional and economical aspects (Kumar 2017; Kumar et al. 2017).



Plate 4: Tubers of *D. pubera* in local markets of Odisha, India

Conclusion: The world is becoming more sophisticated and interesting. Healthy foods are becoming more crucial, appealing and fortified to meet the increasing demand for our nutrition. In the present scenario, nutraceuticals are the major source of health benefits and potential for disease prevention, which should be taken according to their acceptable recommended intake. From the above studies, *D. pubera* has proven its health benefits and disease prevention capabilities. Diosgenin is the most important compound from *Dioscorea* members, used in the synthesis of steroidal drugs, however other potential uses of this compound and related compounds such as estrogenic, anti-inflammatory, and anticancer potential need to be studied extensively. The secondary metabolites from *D. pubera* like alkaloids, saponin, flavonoids, tannins and phenols make it more potent in disease prevention. Bioprospecting of this plant will open new avenues in finding of capable nutraceuticals. New phytochemicals, from this plant, will provide lead molecules for pharmaceutical industries. Exploration and research should be encouraged in this field.

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