Chapter 1

Dioscorea pubera Blume, a nutraceutical from tribal Odisha for future urban food basket

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ABSTRACT

Nutraceutical is coined in 1989 but it is described in the mythological scripts of India since primitive era. Nutraceutical can be the therapeutic agents for many lethal diseases and disorders. The ancient cultures of India are home of such nutraceuticals. Keeping this in mind, an attempt has been made to gather the information on an unexplored food, *Dioscorea pubera*, locally known as Kukuai sanga. Information is also taken from the members of Ambika Prasad Research Foundation, Odisha, India. Results revealed that tuber of Kukuai Sanga is consumed by different tribal communities of Odisha as snacks and vegetable. It is rich with nutrients and secondary metabolites. The photographs are provided here for the easy identification in the field. Ethnomedicinal, pharmacological, bioactive compounds, ecological and economic aspects of Kukuai Sanga are discussed. The present study highlights the importance of this wild nutraceutical for future experimental works which could be helpful to do value addition and fight against food problems.

Keywords: Food Problems, Indigenous Traditional Knowledge, Value Addition, Wild Tubers

Introduction: Food is an essential part of day-to-day life. Food is obtained from agricultural land, forests, and home gardens directly or indirectly. In both cases, use of chemicals for high yield and adulteration are commonly observed leading lot of health issues. Most of health problems are being very common and deadly like diabetes, heart problems, high blood pressure etc (Sharma et al. 2022). Number of allopathic medicines are available to treat them which happened due to lack of foods, chemically influenced foods, junk foods etc having different types of side effects (Das et al. 2022). People are awaking particularly after COVID-19 pandemic globally. In COVID-19 pandemic,

immunity, good food, medicinal foods etc became popular and demanding but in this metallic life where urban people depend on cane and junk food, where they will get pure food or medicinal food.

Medicinal food has been using since long but modern people define them as nutraceutical (Kumar et al. 2021). Nutraceutical means, an edible stuff having both food and medicinal values (Kumar and Jena 2017). Again, the same question and situation, from where will get such food, how will know about them etc. For this situation, in research we can use the word reverse pharmacology. Reverse pharmacology refers that such science again should start from field and tribal communities. Researchers of different sections of biological sciences including ethnobotanists vesting to the rural, tribal and forest areas and interacting with local communities (Chakraborty et al. 2022). During interactions, they get the information about the plants and their uses. As per uses, plants are being selected for experimental works and scientific validation for accepting as food, medicines, and nutraceutical. There are number of such plants are available globally.

In India, several tribal communities use such plants as medicinal food and numbers of reports are available (Kumar 2017; Kumar et al. 2017). In Odisha state, about 62 tribal communities are identified and all have unique skill to get medicinal food from forest (Kumar 2015; Kumar et al. 2017). Among those medicinal food, *Dioscorea pubera* is such tuberous plant having food and medicinal uses. Locally it is known as Kuuaki sanga. Tribals of Odisha state use it as food and medicines (Manjula et al. 2022). Therefore, it could be a nutraceutical for future urban food basket. It is also coming under underutilized tuber crops. Keeping this in mind an attempt has been made to document its botany, distribution, food values, medicinal values, economic

values, ecological values, pharmacological values, and future aspect as a nutraceutical from literature survey.

General account on Yam: *Dioscorea*, sometimes known as the wild yam, is an invasive, deciduous, and herbaceous vine. Although this species is native to Asia, it is frequently found in Florida in the United States. They can reach lengths of more than 18 metres (60 feet).

Wild yams are a significant crop because they have long been used to treat general discomfort, stomach cramps, and menstrual cramps. Diosgenin, a plant-based oestrogen, was discovered in the roots of wild yams during the 1950s (Manjula et al. 2022).

Diosgenin may help with chemical protection against herbivores, according to a theory (Kumar and Jena 2017). In the 1960s, this was utilised to make the first birth control pills. Some *Dioscorea* species are also abundant in vitamins, minerals, and antioxidants (Swain et al. 2020).

***Dioscorea pubera* Blume.**

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

Synonyms: *D. anguina* Roxb. Fl. Ind. 3: 803. 1832; Hook. F. Fl. Brit. India 6:293. 1892; Haines, Bot. Bihar & Orissa 3: 1117 (1167). 1924; Fischer in Gamble, Fl. Madras#: 1513 (1057). 1928.

Origin: The native range of this species is Central Himalaya to W. Malesia. It is a climbing tuberous geophyte and grows primarily in the wet tropical biome. It is first published in Enum. Pl. Javae 1: 21 (1827).



Figure 1: Key inflorescences of *Dioscorea pubera* in wild



Figure 2: Tubers and leaves of *Dioscorea pubera*



Figure 3: Bulbils of *Dioscorea pubera* in wild

Botany: It has stem twining to right, densely pubescent, or tomentose, woody, unarmed having woody rootstock. Tuber (Figure 2) is directly produced from rootstock, cylindric and attached with stones (Kumar and Jena 2017). Tuber is 30-50 cm long, 1.2-1.5 cm thick and covered with rootlets. It shows the bulbils on stem. Bulbils are axillary and greenish in colour (Figure 3). They have no conspicuous eyes. Leaves are opposite, broadly ovate, or suborbicular, acute, acuminate, pubescent on the nerves beneath, 7 costae, cordate base and petiole is half to the leaf blade. Male spikes pubescent up to 3 cm long and densely flowered (Figure 1). Female spikes densely pubescent and up to 11 cm long. Capsule is up to 2 cm long and 3.4 cm broad, subcordate at top and bottom having wings on margins. Seeds are winged all round (Kumar and Jena 2017; Sharma et al. 2022).

Key characters: The important observed key characters are the stems twinning to right, pubescent, and unarmed stems, sometimes observed absence of bulbils, hairy spikes, green flowers with ovate bracts, hairy and yellowish green capsules, and the seeds are winged. Among the species of the genus, *D. pubera* is morphologically related to *D. alata* Linnaeus (1753: 1033), *D. bulbifera* Linnaeus (1753: 1033), *D. pubera* Blume (1827: 21) and *D. wallichii* Hooker (1892: 295) by the glabrous and simple leaves, with often alternate phyllotaxis, stems twining to right (except by *D. buldifera*), and by the tubers varying among cylindrical and globose. *Dioscorea pubera* is native to the Indo-China region (Kumar et al. 2017) and distributed throughout the temperate, tropical Americas, China, wet regions of Himalayas and are used as a food & tonic by the tribal communities of India (Manjula et al. 2022).

Distributions: It is distributed in Nepal, Myanmar, and Malaysia. Assam, Bangladesh, East Himalaya, India, Jawa, Myanmar, Nepal, Sumatera. In India, it is distributed in Western Ghats, Eastern Ghats, and Himalayas. In Odisha,

it is distributed through the state in hilly areas. It believes that it was originated with *Dioscorea bulbifera*. It is commonly known as air potato, originated from Africa and Southern Asia (Kumar 2017; Sharma et al. 2022).

Ecology: *D. pubera* is found in hilly regions where temperature is moderate and found to be grown associated with *D. bulbifera, Cissamplex pereiyara, Smilex ovalifolia, Curcuma aromatica, Celastrus paniculata, Lygodium flexuosum, Melastoma malabathricum* etc (Present study; Sharma et al. 2022).

Food values: It has food values. In Odisha state, tribal people collect the tubers from the nearby forest areas and wash them. Washed tubers are boiled and consumed as snacks. Tubers are also left in running water for 4-5 hours and then cooked as a vegetable and consumed with meals (Present study; Sharma et al. 2022).

Ethnomedicinal values: The boiled tubers are consumed as a tonic for getting good health. The tubers are also consumed to reduce the gastric problems (Present study; Sharma et al. 2022).

Pharmacological values: Kumar et al. (2017) reported the available bioactive compounds in the tuber of *Dioscorea pubera*. The antibacterial activities of tuber extracts are tested against five pathogenic bacteria and results are produced (Manjula et al. 2022). The results revealed that, extracts of tuber inhabited the selected pathogenic bacteria. Snehalata et al. (2022) also showed the browning activities of *D. pubera* and co-related with anticancer activities.

Ecological values: The tuber of *D. pubera* is consumed by the Asian elephant and wild boar. It also indicated a good amount of humus in the soil. Usually, it occurs after 1000 msl altitude. The leaves are the home of many spiders, spittlebug, and moths (Sharma et al. 2022; Manjula et al. 2022).

Economic values: The tubers are sold in only local markets. Per 5-6 boiled tuber cost may be Rs. 20-30 only (Present study). Others reports are available which showed highest price is Rs. 20 per 5-6 boiled tubers of *D. pubera*.

Future recommendations

1. Evaluation of population status in India: The population of *D. pubera* is not estimated and still it is under not evaluated. Therefore, need the population inventory across the country.
2. Study in its geographical variations: The leaves and bulbils show the variations as per the habitat. Hence, there is a need of study on its geographical impacts on the morphology and yield of the tubers.
3. Documentation of traditional food practices: Very few practices are documented on its traditional food values. Need the documentation for further bio-chemical works.
4. Exploration works on its ethnomedicinal uses: The ethnomedicinal uses are only reported from South India, Odisha, Assam, and Manipur (Ref). Therefore, there is un urgent need to do exploration works for the ethnomedicinal uses.
5. Evaluation of nutritional values for its tubers: Kumar et al. (2013; 2014) reported its nutritional values which is not sufficient to make it nutraceutical. Hence, need to analyse its nutritional values.
6. Pharmacological analysis of its plant parts: Very less works has carried out on its pharmacological values.
7. Isolation of active bioactive compounds: No active compounds have been isolated from the plant parts of *D. pubera*. It is a gap in the research of Yam.
8. Development of its cultivation techniques: As it has food, medicinal and economic values, the cultivation techniques should be developed.

9. Tissue culture techniques development: It has sound medicinal values and could be the raw materials for many pharmaceuticals. Therefore, tissue culture techniques should be developed.
10. Value addition of its edible and medicinal parts: Tubers are the food of tribal communities and need to do value addition for the sustainable utilization and development.

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