Chapter 8
Can *Dioscorea* species reduce oxidative stress?

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Abstract*: Oxidative stress created lot of health problems including cardiovascular, diabetic, neoplastic, cognitive disorders etc. These health problems are burning issues throughout the world might be due to lack of dietry items with antioxidants & modern life style. Therefore, need the consumption of food having high concentration of antioxidants from nature or food products. In this aspect, tubers and bulbils of Dioscorea species could be the prime choice as they are the source of high concentration of starch along with diverse secondary metabolites and historical evidences of consumtion by the many communities globally. Therefore, keeping this in view the chapter is designed to bring attention towards their bio-chemical components as a source of the bioagents that could be able to manage the oxidative stress to fight against many leathal health problems. The literature, field and experimental results revelaed that the plant parts of Dioscorea could be an important food and medicines in reducing the oxidative stress in cellular level in our body.*

Key words: Tuberous, bioactive compounds, medicinal values, antioxidant, nutraceutical

Introduction: Oxidative stress observed when reactive oxygen species (ROS) level suppresses the defence mechanisma of cell. ROS are continuously formed by mitochondrion in the body during metabolic reactions. When ROS level surpasses the defense mechanisms, a cell experiences “oxidative stress”. Several environmental stresses play central role in the excessive production of ROS, thereby causing progressive oxidative damage and can lead to cell death. The reactive oxygen species (ROS) form under normal physiological conditions and may have both beneficial and harmful role. Reactive oxygen species (ROS) are chemically unstable oxygen-containing molecules such as superoxide anions and hydroxyl radicals that are able to readily react with and inflict damage to cellular constituents. ROS are extremely harmful to organisms at high concentrations and very low ROS levels are required to sustain normal physiological functions. The balance between reactive oxygen species (ROS) production, and their scavenging depends on whether it will serve as a signaling molecules or will cause cause oxidative stress. The balanced antioxidant system of tissues includes several nonenzymatic as well as enzymatic antioxidants that play a key role in effective scavenging of ROS produced during environmental stresses (Juan et al. 2021). ROS are also produced due to pollutants and misuse of drugs. ROS species excessive build up due stress factors leads to oxidative stress, cell & tissue injury, cell death, and is probably at the basis of several ailments such as heart conditions, Alzheimer’s disease, cancer, as well as premature aging and cerebrovascular accidents. In order to diminish the potential damage by ROS, the body activates it innate antioxidant system which includes enzymatic antioxidant systems and non-

enzymatic systems. In addition to these innate defense systems, exogenous antioxidants provided through the diet and/or nutritional supplements may help protect the body from oxidative stress. Thus, the consumption such antioxidant rich compounds may decrease the risk of developing the above-mentioned diseases. An important class of plant-derived antioxidants is represented by phenolic compounds. The species belongs to the family *Dioscoreaceae* are rich with phenolic compounds and other natural antioxidants (Kumar et al. 2017a; Kumar et al. 2017b). Therefore, keeping the above-mentioned health problems & importance of *Dioscorea* species in mitigating them, an attempt has been made to validate the perception – "Can *Dioscorea* species reduce the oxidative stress" through the literature and field survey.

Figure 1: Fruits, flowers and bulbil of *Dioscorea bulbifera*

***Dioscorea* species:** The *Dioscorea* species are taken to consideration to be the foremost earliest of the Angiosperm used by human beings. They mainly occurs within the regions of Southern Asia, Africa and South America. In early as 50000 BC during the Palaeolithic era, domestication of yam started in many geographical areas. As per archaeologist, the actual cultivation of yam started in 3000BC. *D. rotundata*, *D. cayenensis*, and *D. dumetorum* are the preliminary cultivated *Dioscorea* in West and Central Africa, while in southeast Asia *D. alata* was first cultivated then quit 2000 years ago it had been shifted to India and Pacific Ocean. The word "YAM" only relate to the genus *Dioscorea* belongs to family Dioscoreaceae, order Discoreales and classified under monocotyledons. It is a perennial monocot belongs to family *Dioscoreaceae*. The vine is also known for its heart shaped leaves. It can mature up to 18 meters and reproduce vegetative through tuber or bulbils which are potato like structure and grows at the axils of the leaves. Tubers are various in shape and size. (Ummalyma et al. 2018; Swain et al. 2020; Mohanty et al. 2021). They have nutraceutical properties and can be a very important food. Tubers are the source of protein, fats and vitamins. Wild variety of yams are used for food purpose in time of deficiency or drought. The Asiatic species i.e. *Dioscorea hispida* closely related to *D. dumetorum*, used as food during the shortage in the many parts of India. A few varieties of yam may be eaten without cooking and some requires to cook or boil for detoxification before eating. Toxicity of the tuber or bulbils depends on the variety and renewed annually. The toxicity of the roots of *Dioscorea bulbifera* are considered to be poisonous and have been used as medicine as a remedy for sore throat and for stroma (Kumar et al. 2012; Kumar et al.

2013a; Kumar et al. 2013b; Kumar et al. 2013b; Kumar and Jena 2014). The detail uses are gathered through field surveys in Odisha state of some common *Dioscorea* species are listed in the Table 1.

Phytochemical constituents: In many regions of the world, *Dioscorea* serves as important saccharide food stuff. The phytochemical study of *Dioscorea* have been disclosed a number of secondary metabolites like saponins, stilbenes, diterpenes, purine derivatives etc. Many studies reprted that yam consists of many phytochemical constituents like polysaccharides, amino acid, proteins, vitamins and mineral components. Organic acid like succinic acid, citric acid, oxalic acid and maleic acid are found in large amount in yam. Antidiosbulbin A and B, norclerodne diterpenes, 8-epidiosbulins E and G are present in *Dioscorea*. It is a supplier of proteins, fats, phenolics, vitamins, glycosides, sterols, alkaloid poly phenols, tannin and saponins (Kumar et al. 2015; Kumar 2015; Kumar and Jena 2017; Kumar 2017).

Browning activaties in *Dioscorea* species: Browning activities of *Dioscorea* species is observed due to the presence of natural phenols and oxidation which is catalysed by the polyphenol oxidase (PPO). Several polyphenols like (+)-catechin that may be a substrate of O-diphenol oxidase, anthocyanins, catecholamine, a leucoanthocyanidin and cinnamic compounds are known in several yam species (Kumar and Jena 2017; Kumar et al. 2017a; Kumar et al. 2017b).

Toxicity of *Dioscorea* species: During the collection of ethnomedicinal values (2009-2022, location-Odisha) of Dioscorea species, it was noticed that the tubers of some wild Dioscorea species are not consumed directly due to the presence of toxic compounds & anti-nutrational factors. Specially, wild yam is harmful and inedible, taste unpleasant and may cause vomiting and diarrhoea once an oversized quantity is eaten while not correct process or eaten uncooked. In some yam species dioscorine has been considered as harmful principle which is a harmful alkaloid. Dioscorine triggers the fatal paralysis of the nervous system. Histamine is also reported as the principal allergen that causes gentle irritation and discomfort. The unpleasantness and poisonousness of many yam species may be also caused by high level of saponins (Kumar and Jena 2017; Kumar et al. 2017a; Kumar et al. 2017b).

Table 1: Food and medicinal values of some common *Dioscorea* species

Species	Parts used	Uses
Dioscorea alata	Tuber & bulbils	Tuber and bulbils are edible Bulbil paste is used to cure piles and gonorrhoea.
Dioscorea bulbifera (Figure 1)	Tuber & bulbils	Tuber can be consumed after boiling. The powder of the tuber is used to cure dysentery.
Dioscorea deltoidea	Tuber	Juice of root tuber is taken in the treatment of roundworm.
Dioscorea dumetorum	Tuber	Juice of boiled tuber is used as cooling agent during summer.
Dioscorea esculenta	Tuber	Tubers are kept overnight in water and cooked as a vegetable.
Dioscorea glabra	Tuber	Tuber paste is used in wound healing.
Dioscorea oppositifolia (Figure 2)	Tuber	Tubers are edible.

Dioscorea pentaphylla	Tuber & bulbils	Tuber is consumed after successive boiling and bulbil paste is used to cure skin infections.
Dioscorea pubera	Tuber	Boiled tuber is consumed as a snack.
Dioscorea spinosa	Tuber	Tubers are edible.
Dioscorea villosa	Tuber	Tuber juice is used as birth control agent.
Dioscorea wallichii	Tuber	Tubers are consumed in stomach pain.

Figure 2: Fruits and leaves of *Dioscorea oppositifolia* in wild

Validation: The comprehensive works on the nutraceutical potential of yam through literature & field works validate that the species of genus *Dioscorea* has antioxidant potential and rich with phenolic compounds. Therefore, these species could be able to reduce the oxidative stress and associated helath problems.

Recommendations: The recommendations are:

1. There are a need of more exploration works on taxonomy of *Dioscorea* species.
2. There is a need of documentation on food & medicinal values of them.
3. Futhure, advance works on food chemistry and pharmacological values of *Dioscorea* species available in India.

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