Validation of tribal claims on *Dioscorea bulbifera* and *D. oppositifolia* using phytochemical analysis

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Abstract: *Dioscorea* species is used for curing various diseases and ailments in different regions of the world. The tubers of *Dioscorea bulbifera* and *D. oppositifolia* are used as food and medicines among different ethnic groups of India. The tubers are can be used as a birth control agent. Presently, the use of chemically synthesized pills for birth control promote many health problems. So, the present study deals with tubers of *D. oppositifolia* and *D. bulbifera* as traditional agent. The tubers were collected and subjected for phytochemical screening to validate the medicinal claims. The analysis of phytochemical screening of the tuber extracts showed the presence of Saponin. The results might be responsible for their medicinal potential as birth control agent.

Keywords: Birth control agent, Yam, Medicinal plants

Introduction: The use of natural products with therapeutic properties by common people is as ancient as human civilization and for long, plant products were the main source of traditional medicines (Kumar and Jena 2017; Atanasov 2021). The industrial revolution and the development of organic chemistry resulted in preference for synthetic products for pharmacological treatments (Rats 2001). The history of birth control also known as contraception and fertility control, used different methods or devices that have been historically used to prevent pregnancy. From 1550 BC to 1550 BC, people used honey and acacia leaves to be placed in the vagina to block sperm (Lipsey et al. 2005). In Kahun, Gynecological Papyrus from about 1850 BC, describes various contraceptive pessaries, include the application of gummy substances to cover the “Mouth of the womb”, a mixture of honey and sodium carbonate applied to the inside of the vagina and a pessary is made from crocodile dung (Lipsey et al. 2005). Chemically synthesized drugs are also used to check the pregnancy. They create different types of side effects. Hence, there is a need of an herbal product for safe intake. Keeping the ethnomedicinal uses of *Dioscorea bulbifera* L., (Figure 1) and *Dioscorea oppositifolia* L., (Figure 2) tubers as natural birth control agents, their tubers have been selected for the experimental works

for validation. *Dioscorea,* commonly known as Yam, is a genus of over 600 species of flowering plants in the family Dioscoreaceae. Most of the species are tropical with only a few species extending into temperate climates (Govaerts et al. 2007; Wilkin et al. 2009). These are tuberous herbaceous perennial lianas growing up to 2-12 meters or more tall. The leaves are spirally arranged, mostly broad heart shaped and flowers are individually inconspicuous, greenish yellow with six petals. The fruit is a capsule in most species, a soft berry in a few species.



Figure 1: Habitat and leaves of *Dioscorea bulbifera* in wild



Figure 2: Leaves and flowers of *Dioscorea oppositifolia* in wild

D. bulbifera and *D. oppositifolia* are commonly available in Indian subcontinents (Kumar 2015; Kumar 2017; Kumar and Jena 2017; Goverts et al. 2007). They are selected as per their ethnic uses as birth control agent in different regions of India (Kumar and Jena 2017). The present study highlights the importance in mitigating side effects of chemically synthesized birth control pills.

Methodology: During 2017 to 2022, under different project & survey works, authors visited selected states (Odisha, Manipur, Sikkim, Assam, Jharkhand, and West Bengal) of India and collected the ethnomedicinal information on *Dioscorea* species (Kumar et al. 2012; Kumar et al. 2013a; Kumar et al. 2013b; Kumar and Jena 2014; Kumar et al. 2015; Kumar 2015; Kumar and Jena 2017; Kumar 2017; Kumar et al. 2017a; Kumar et al. 2017b; Kumar et al. 2017c; Ummalyma et al. 2018; Swain et al. 2020; Mishra and Kumar 2021; Mohanty et al. 2021; Snehalata et al. 2022; Kumar et al. 2022; Sharma et al. 2022). It was observed that most of the ethnic tribes use tubers of *Dioscorea* species as birth control agents. Keeping the ethnic uses in mind, validation of this common claim was designed through phytochemical screening of tuber extracts. *D. bulbifera* and *D. oppositifolia* were selected and their tubers are collected from Jhumka dam, Odisha and subjected to phytochemical screening using standard method. As per polarity index, two solvents (aqueous and methanol) were selected for Soxhlet extraction method. The powder of tubers was poured in the thimble at the ratio of 20 g per 250 ml of solvent at the temperature of 60°C (methanol) and 100°C (aqueous). Collected residues were then dried at room temperature. Quantitative detection of the bioactive compounds was carried out by the method described by Kumar et al. (2013).

Results and discussion: There are lots of commercially synthesized birth control pills available in market. They have side effects and create a lot of health problems. The herbal products have no or less side effects. The survey results showed that the tribal communities of Odisha, Manipur, Sikkim, and Assam use the tubers as birth control agent (Table 1). They also use the leaf of *D. oppositifolia* to treat snake bite, scorpion sting. From the qualitative analysis of bioactive plants, it was observed that Tannin, Saponin and Phenolic compounds are detected in aqueous extract of both yam species (Table 2). It was noted that methanol extracts of tubers showed Saponin, Terpenoids, Tannins and Phenolic compounds (Table 2). As Saponin is present in aqueous extract of the tuber of *D. bulbifera* and *D. oppositifolia*, it might be responsible for curing skin infections and due to the presence of Diosgenin which is a naturally occurring steroid *i.e* Saponin, tubers of both species could be used as a contraceptive agent (Table 3). In 2018, Singh et al. documented some plants having anti-fertility properties.

Some other literature also revealed that plants viz. *Aegle marmelos, Cuminum cyminum, Foeniculum vulgare, Mimosa pudica, Moringa olerifera, Piper nigrum, Sesbania sesban* and *Solanum xanthocarpum* have contraceptive, abortive and antifertility activity (Kadam and Balasaheb 2015). It was observed that rhizomes of *Trillium govanianum* are rich source of steroids which can be hydrolyzed to obtain diosgenin and has antifertility effects (Sharma et al. 2016). Anti-fertility effects of *Bougainvillea spectabilis* or Paper flower is also reported by Ghogar and Jiraungkoorskul (2017). The alcoholic extract of Hibiscus flower exhibit inhibition of pregnancy too (Nayaka et al. 2014; Nivsarkar et al. 2018).

Table 1: Ethnomedicinal uses of *D. bulbifera* and *D. oppositifolia*

Plant part(s)	Name	Uses	Collection site(s)
Tuber	*D. bulbifera*	Tuber juice is taken orally as birth control agent.	Odisha, Manipur, Sikkim, and Jharkhand
Tuber	*D. oppositifolia*	Tuber juice is taken orally as birth control agent.	Odisha, Assam, and Manipur

Table 2: Detected bioactive compounds in tubers of *D. bulbifera* and *D. oppositifolia*

Plant name	Solvent	Detected bioactive compounds
D. bulbifera	Methanol	Saponin, Terpenoids, Tannins and Phenolic compounds
	Aqueous	Tannin, Saponin and Phenolic compounds
D. oppositifolia	Methanol	Saponin, Tannins and Phenolic compounds
	Aqueous	Tannin, Saponin and Phenolic compounds

Table 3: Correlation of tribal claims with detected bioactive compounds

Plant part	Tribal claims	Correlation with bioactive compounds
Tubers of *D. bulbifera* and *D. oppositifolia*	Birth control agents	The presence of saponin in aqueous and methanolic extracts of *D. bulbifera* & *D. oppositifolia* tuber might be responsible for birth control potential. The availability of Diosgenin is reported in *Dioscorea* species which is a steroidal saponin.

Conclusion: The aqueous extract of the tubers of both selected species of *Dioscorea* contains saponin which imparts an indication that the tubers might contain Diosgenin, and it is known that Diosgenin is a type of saponin that is identified in *Dioscorea* species. Diosgenin is a precursor of steroidal drugs that are available in the market but synthetic chemical drugs are prone to side effects or user discomfort. Herbal contraceptives are not as much effective as pills but can be used as an alternative with lower side effects. The herbal contraceptive methods offer alternative for women who

have problems with or lack of access to modern contraceptive options. The present study does not recommend to take any type of drugs (herbals or chemically synthesized) for abortion and as birth control agent, but it highlights the importance of ethnic therapeutic practices.

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