

Impact of Organochlorine and Organophosphate Exposure on Diosgenin Levels in *Trigonella foenum-graecum* Seeds: An Analytical Comparison

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Abstract: The present study to establish the diosgenin profile from fenugreek, and related to develop powder from the harvested plant to prepare diosgenin secured plant part (seed). The seeds of fenugreek were analyzed for the diosgenin using GCMS. Fenugreek seed screened for diosgenin compounds seeds found to be a better peak area according to retention time and reducing ability of diosgenin content based on pesticide concentration. Results revealed that diosgenin content progressively decreased with higher treatment levels. The untreated control group showed the maximum concentration, while the most intense treatments led to reductions of up to 75.55% (OC) and 80% (OP).

Keywords: *Trigonella foenum-graecum*, GC-MS, Diosgenin, Hyperlipidemia, Steroidal Sapogenin

Introduction

Fenugreek plant (*Trigonella foenum-graecum* L.) is known for its medicinal and antioxidant property in the world. Fenugreek is with trifoliate leaflets, branched stem, root nodules, white flowers, with golden yellow seeds. It is also used in cooking for enhance flavour, colour and modify the texture of the food materials. It was well documented oldest medicinal plant, traditionally used in India to treat a variety of diseases (Khare 2004; Ahmad et al., 2016).

It was a good applicant for the development of novel therapeutic medications because of their antioxidant factors. The fenugreek abundance in a range of plant sources, including yams. In other side Dioscorea species underscores promise a cost-effective and environmental friendly replacement for synthetic drugs (Sharavan et al., 2025). The fragile raw leaves of fenugreek were used in salad making and cooking of many type of dishes in India. Fenugreek seeds and leaves are rich source of fibre, protein, b-carotene, vitamins, minerals, gums along with alkaloids, flavonoids, steroidal sapogenins, diosgenin, trigocoumarin, nicotinic acid, trimethylcoumarin and trigonelline. Fenugreek enraptured several medicinal properties like antimicrobial, antidiabetic, hypocholesterolemic, chemo preventive, gastroprotective, anti-inflammatory, anti pyretic, hepatoprotective, antioxidant, anticancer and good lactating aid in feeding mother etc. Diosgenin in fenugreek has covered to many way researchers due to its medicinal and other properties. (Khare, 2004; Naidu et al., 2011; Ahmad et al., 2016; Sarwar et al., 2020; Shinde et al., 2023).

Diosgenin also known as 25R-spirost-5-en-3 β -ol are naturally occurring chemical under the category of steroidal sapogenin. Because of its many pharmaceutical properties and expective, a wide spectrum of health-promoting qualities has been a lot of interest in the medical community (Arya et al. 2021). Due to low solubility in water and poor bioavailability, it is hard to explore the medicinal property of diosgenin (Cai et al., 2020). The food formulation may excellent alternative to provide diosgenin to the layman in a cost-effective manner. This information was help in deciding the best concentration of pesticide residue and hights peak area. The present study is mainly focused on the evaluation of diosgenin content using GCMS method. The extraction of diosgenin from fenugreek seeds has provoked a global response due to its potential therapeutic benefits. The focus of this research is to investigate and evaluate the extraction procedure to isolate diosgenin from fenugreek seeds.

A diverse range of sucking pests, including aphids, thrips, leaf miners and insect pests, attack green vegetables (yadav et al.,2018). In the fight against these pests, fenugreek growers mostly used pesticides. Farmers now primarily use novel as well as traditional insecticides since they are commonly available and extremely effective. There are presaentl current manner pesticides registered and recommended by CIB and RC to manage fenugreek pests on current manner (CIB RC, 2011).

Materials and methods

Selection, collection and processing of plant material

Fenugreek seeds were purchased from RCA (Rajasthan college of Agriculture Udaipur). Placed seeds in a container of water and let them soaked for 24 hours for seed viability test. Sunked seeds placed in controlled environment (moist paper/towels) and observing whether they germinate. Sunked germinated seeds dropping in autoclaved soil pots with appropriate 1.5cm depth.

Procurement of pesticides

Take a suitable organochlorine and organophosphate pesticides for solubility and the intended application. The accurate amount of pesticide OC and OP were prepared using distilled water. The stock solution was diluted to form solution of 0.25%, 0.5%, 0.75% and 1% concentrations prepared for both pesticide groups and stored all different concentration solution in 1000ml spray bottles.

Treatment protocol

Plantlets of fenugreek in the planters were foliar sprayed with both pesticides for 84 days at an interval of 7 days.

Harvesting, Drying and Storage

Mature fenugreek seeds were harvested from the pots and shade dried in a well-ventilated area. Dried plant seeds were grinded using pistal and mortar to produce fine powder and stored in glass bottles with clear labeling for use.

Preparation of plant extract

The dried powder of fenugreek seeds were used to prepare plant extract and after that sent for GCMS analysis.

Observation

Table: 1 Analytical Comparison of Diosgenin Concentration in Seed Samples of Organochlorines Treated *Trigonella foenum-graecum* with respect to control

Groups	Diosgenin Conc. by weight (g)	Reduction %
S ₁	0.045	0
S ₂ OC	0.040	11.11%
S ₃ OC	0.035	22.22%
S ₄ OC	0.026	42.22%
S ₅ OC	0.011	75.55%

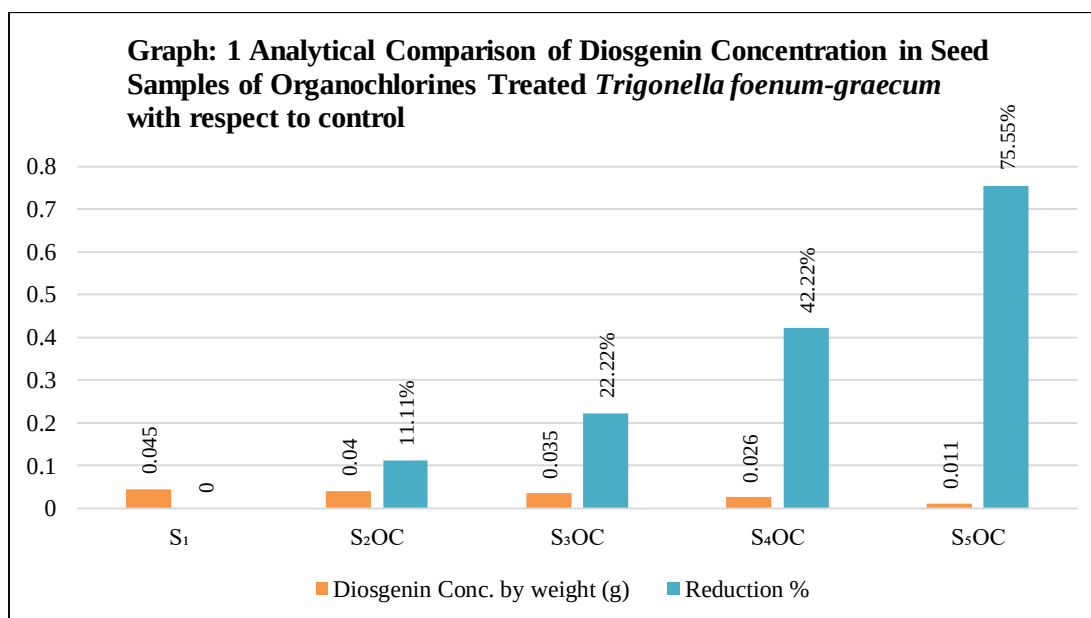
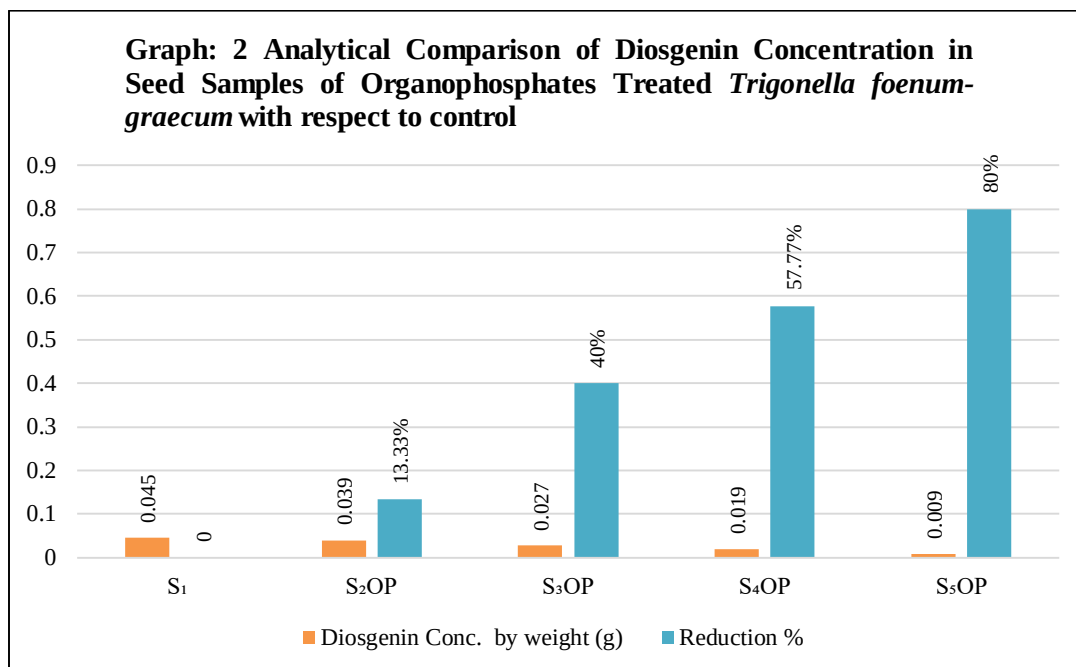


Table: 2 Analytical Comparison of Diosgenin Concentration in Seed Samples of Organophosphates Treated *Trigonella foenum-graecum* with respect to control

Groups	Diosgenin Conc. by weight (g)	Reduction %
S ₁	0.045	0
S ₂ OP	0.039	13.33%
S ₃ OP	0.027	40%
S ₄ OP	0.019	57.77%
S ₅ OP	0.009	80%



Results and discussion

Diosgenin is a naturally occurring compound classified as a steroidal sapogenin, primarily found in plants like *Trigonella foenum-graecum* (fenugreek) and various species of yams (*Dioscorea* spp.). It is vital in as a raw material in the production of synthetic steroid hormones such as progesterone and corticosteroids. Beyond its industrial use, diosgenin is known for its therapeutic potential, including anti-inflammatory, antioxidant and lipid-lowering effects. However, its levels in plants can be significantly affected by environmental stressors or contaminants like organochlorines, which may lead to a marked reduction in its natural concentration (Thakur et al. 2024).

An analytical comparison of diosgenin concentration in seed samples of *Trigonella foenum-graecum* treated with different levels of organochlorines (OC), relative to the untreated control group (S₁) is shown in table- 1. The control group (S₁) exhibited the highest diosgenin content at 0.045 g, while all OC-treated groups showed a concentration decline. The diosgenin content progressively decreased with increasing treatment severity: S₂OC (0.040 g; 11.11% reduction), S₃OC (0.035 g; 22.22%), S₄OC (0.026 g; 42.22%), and S₅OC (0.011 g; 75.55%). This trend indicates a clear negative impact of organochlorine exposure on diosgenin biosynthesis in fenugreek seeds (Graph- 1).

The data reveal a progressive decline in diosgenin content with increasing levels or exposure to organophosphates. While the control group (S₁) maintained the highest diosgenin concentration at 0.045 g, treated samples showed significant reductions—ranging from 13.33% in S₂OP (0.039 g) to a drastic 80% reduction in S₅OP (0.009 g). These findings suggest that organophosphate exposure negatively impacts diosgenin biosynthesis or accumulation in fenugreek seeds (Table and graph- 2).

Conclusion

The study concludes that both organochlorine and organophosphate treatments negatively impact diosgenin biosynthesis in *Trigonella foenum-graecum* seeds. A consistent decline in diosgenin content was observed with increasing treatment levels. The highest concentration was found in the untreated control group, while the most severe treatments caused reductions of up to 75.55% (OC) and 80% (OP). These results highlight the inhibitory effect of pesticide exposure on diosgenin accumulation. Future studies should explore the molecular basis of pesticide-induced suppression of diosgenin. Developing eco-friendly practices or resistant cultivars may help sustain its medicinal value.

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