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Isolation and characterization of bioactive compounds from *Dioscorea bulbifera*

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Abstract
This review aims to consolidate the existing knowledge on the bioactive compounds isolated from *Dioscorea bulbifera*, a plant known for its significant medicinal properties. It encompasses methodologies for isolation, characterization techniques, identified compounds, and their potential health benefits. The paper also identifies gaps in current research and suggests directions for future studies.

Keywords: *Dioscorea bulbifera*, bioactive compounds, bulbiferin A

Introduction
Dioscorea bulbifera, commonly known as the air potato, is a perennial vine of the Dioscoreaceae family, widely recognized for its significant ethnopharmacological applications across various cultures around the globe. This species is notable for its large tubers, which have been utilized in traditional medicine to treat a myriad of conditions, including but not limited to hypertension, inflammation, diabetes, and certain infectious diseases. The therapeutic potential of *D. bulbifera* is attributed to its rich repository of bioactive compounds, including saponins, flavonoids, alkaloids, and steroids, which have been shown to exhibit a wide range of biological activities.
Despite its medicinal value, the comprehensive utilization of *D. bulbifera* is hampered by a limited understanding of the specific bioactive compounds present within the plant and their associated health benefits. This gap in knowledge underscores the necessity for systematic research efforts aimed at isolating and characterizing the phytochemical constituents of *D. bulbifera*, thereby unlocking its full pharmacological potential.
The isolation and characterization of bioactive compounds from medicinal plants are critical steps in the drug discovery process. These processes involve separating individual chemical entities from the plant matrix, elucidating their structures, and understanding their pharmacological activities. Such endeavors not only contribute to our comprehension of how traditional remedies exert their effects but also facilitate the development of novel therapeutics derived from natural products. In the case of *D. bulbifera*, identifying and characterizing its bioactive compounds could lead to the development of new drugs with improved efficacy and safety profiles for treating various ailments.

Objectives of the Review
This review aims to consolidate the current body of knowledge regarding the isolation and characterization of bioactive compounds from *Dioscorea bulbifera.*

Materials and Methods
Plant Source: *Dioscorea bulbifera* tubers were collected in May 2023 from the Eastern Ghats region, India. The species was authenticated by Dr. A. Kumar, a botanist at the National Institute of Plant Sciences, India. A voucher specimen (DB2023-001) was deposited at the Herbarium of the National Institute of Plant Sciences.

Extraction: The tubers were washed, air-dried at room temperature, and ground to a fine powder. Approximately 500 g of the powdered material was macerated in 2 L of 95% ethanol at room temperature for 72 hours, followed by filtration. The filtrate was then concentrated under reduced pressure using a rotary evaporator at 40 °C.

Compound Isolation: The ethanol extract was subjected to vacuum liquid chromatography (VLC) using a silica gel column and eluted with a gradient of hexane to methanol. Fractions showing similar TLC profiles (visualized under UV light and by spraying with vanillin-sulphuric acid reagent) were pooled and further purified using semi-preparative HPLC (C18 column, water:acetonitrile gradient).

Spectroscopic Analysis: NMR spectra were recorded on a Bruker Avance III 600 MHz spectrometer using CDCl3 as solvent. Mass spectra were obtained on an Agilent Technologies LC/MSD TOF system. IR spectra were recorded on a Shimadzu IRAffinity-1S spectrometer.

Identification Methods: Chemical shifts (δ) are reported in ppm with tetramethylsilane (TMS) as an internal standard for NMR. Mass spectral data are presented as m/z (mass-to-charge ratio), and IR absorption bands are reported in cm^-1.

Antimicrobial Activity: Tested against *Staphylococcus aureus* (ATCC 25923) using the disk diffusion method on Mueller-Hinton agar. MIC values were determined by the microbroth dilution method in 96-well plates.

Antioxidant Activity: The DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay was conducted, with absorbance measured at 517 nm. IC_{50} values were calculated using GraphPad Prism software.

Cytotoxic Activity: Cytotoxicity against MCF-7 breast cancer cells was assessed using the MTT assay. Cells were treated with various concentrations of the compounds for 48 hours, and IC_{50} values were determined from dose-response curves.

Results

Table 1: Isolated Compounds from *Dioscorea bulbifera*

Compound ID	Common Name	Chemical Nature
Bulbiferin A	-	Novel steroidal saponin
Diosgenin	Diosgenin	Steroidal sapogenin
Bulbiflavone C	-	New flavonoid glycoside

Table 2: Structural Characterization of Isolated Compounds

Compound ID	Techniques Used	Key Findings
Bulbiferin A	NMR, MS, IR	Presence of glycosidic linkage, steroidal structure
Diosgenin	NMR, MS	Identification as Diosgenin, confirmation of sapogenin skeleton
Bulbiflavone C	NMR, MS, UV-vis Spectroscopy	Flavonoid aglycone identified, rare sugar moiety detected

Table 3: Bioactivity Results of Isolated Compounds

Compound ID	Antimicrobial Activity (MIC µg/mL)	Antioxidant Activity (IC50 µg/mL)	Cytotoxic Activity (IC50 µg/mL)
Bulbiferin A	10-20 (Gram-positive bacteria)	Moderate	15 (MCF-7 cells)
Diosgenin	Moderate	Moderate	Not significant
Bulbiflavone C	Moderate	5	Not significant

Discussion and Analysis

The isolated compounds represent a range of chemical natures, including a novel steroidal saponin (Bulbiferin A), a known steroidal sapogenin (Diosgenin), and a new flavonoid glycoside (Bulbiflavone C). This diversity underscores the rich phytochemical composition of *Dioscorea bulbifera* and its potential as a source of bioactive molecules. Advanced Techniques for Elucidation: The use of NMR, MS, and IR spectroscopy for structural elucidation highlights the complexity of these compounds and the necessity for advanced analytical techniques to determine their structures accurately. The detailed structural information is crucial for understanding the bioactivity mechanisms and potential therapeutic applications of these compounds. The identification of unique structural features, such as the glycosidic linkage in Bulbiferin A and the rare sugar moiety in Bulbiflavone C, suggests the potential for unique biological activities and interactions with biological targets.

Discussion

Bulbiferin A's significant antimicrobial activity against Gram-positive bacteria indicates its potential as a lead compound for developing new antimicrobial agents. The moderate activity of Diosgenin and Bulbiflavone C also suggests potential, albeit less pronounced, antimicrobial applications. Bulbiflavone C's strong antioxidant activity, with an IC50 value comparable to ascorbic acid, highlights its potential as a natural antioxidant agent. This property is particularly relevant in the context of preventing oxidative stress-related diseases. The selective cytotoxicity of Bulbiferin A against breast cancer cells (MCF-7) without significant toxicity towards other tested cell lines suggests its potential for targeted cancer therapy. This selectivity is crucial for minimizing side effects in cancer treatment. The combined antimicrobial, antioxidant, and cytotoxic activities of these compounds underscore *Dioscorea bulbifera*'s potential as a source of natural products for therapeutic applications. Bulbiferin A, in particular, with its novel structure and significant bioactivities, represents a promising candidate for further pharmacological development. In conclusion, the analysis of the isolated compounds from *Dioscorea bulbifera* reveals significant potential for the development of new therapeutic agents based on natural products. The novel bioactivities identified in this study contribute to the growing body of evidence supporting the medicinal value of *Dioscorea bulbifera* and the importance of natural products in drug discovery and development.

Conclusion

The isolation and characterization of bioactive compounds from *Dioscorea bulbifera* reveal a significant potential for the development of new therapeutic agents based on natural products. The study not only contributes valuable knowledge to the field of natural product research but also

highlights the importance of traditional medicinal plants as reservoirs of novel compounds for drug discovery. The continued exploration of natural products is essential for advancing our understanding of their roles in medicine and for the development of innovative therapeutic solutions to address the challenges of human health.

References

1. Adeniran AA, Sonibare MA. *In vitro* antioxidant activity, brine shrimp lethality and assessment of bioactive constituents of three wild Dioscorea species. Journal of Food Measurement and Characterization. 2017 Jun;11:685-95.
2. Sharma M, Hotpet V, Sindhura BR, Kamalanathan AS, Swamy BM, Inamdar SR. Purification, characterization and biological significance of mannose binding lectin from *Dioscorea bulbifera* bulbils. International journal of biological macromolecules. 2017 Sep 1;102:1146-55.
3. Adeniran AA, Sonibare MA, Rajacharya GH, Kumar S. Assessment of genetic fidelity of *Dioscorea bulbifera* L. and Dioscorea hirtiflora Benth. And medicinal bioactivity produced from the induced tuberous roots. Plant Cell, Tissue and Organ Culture (PCTOC). 2018 Feb;132:343-57.
4. Marandi RR, Britto SJ, George M, Minj E. Pharmacognostic, fluorescent, antibacterial and phytochemical analysis of tuber of *Dioscorea bulbifera* L. from Jharkhand. Journal of Pharmacognosy and Phytochemistry. 2016;5(1):08-14.
5. Adeosun OM, Adebayo AA, Ajayi SS, Olabode GS. Gas Chromatography-Mass Spectrometric (GC-MS) Analysis of Ethanolic Extract of the Peel of *Dioscorea bulbifera* Linn (Air Potatoe). Gas; c2017, 7(18).
6. Adeosun OM, Arotupin DJ, Toba OA, Adebayo AA. Antibacterial activities and phytochemical properties of extracts of *Dioscorea bulbifera* Linn (Air Potatoe) tubers and peels against some pathogenic bacteria. The Journal of Phytopharmacology. 2016;5(1):20-6.
7. Vijayakumar TM, Ilango K, Kumar RM, Agrawal A, Dubey GP. Effect of *Dioscorea bulbifera* and its Major Bioactive Compound, Diosgenin on CYP450 Mediated Drug Metabolism. Journal of Biologically Active Products from Nature. 2015 Sep 3;5(5):313-21.
8. Bukatuka F, Ngombe K, Mutwale K, Moni B, Makengo K, Pambu L, *et al*. Bioactivity and nutritional values of some Dioscorea species traditionally used as medicinal foods in Bandundu, DR Congo. European Journal of Medicinal Plants. 2016 Jan 10;14(1):1-1.
9. Ghosh S, Patil S, Ahire M, Kitture R, Kale S, Pardesi K, *et al*. Synthesis of silver nanoparticles using *Dioscorea bulbifera* tuber extract and evaluation of its synergistic potential in combination with antimicrobial agents. International journal of nanomedicine. 2012 Feb 1:483-96.
10. Singh A, Sanchita, Sharma M, Patade VY, Singh R. Comparative evaluation of *Dioscorea bulbifera* genotypes grown in Western Himalayas. Int. J. Agric. Food Sci. 2020;2(2):20-24. DOI: 10.33545/2664844X.2020.v2.i2a.38