International Journal of Molecular Biology and Biochemistry

ISSN Print: 2664-6501
ISSN Online: 2664-651X
Impact Factor: RJIF 5.4
IJMBB 2022; 4(2): 07-10
www.biologyjournals.net
Received: 06-05-2022
Accepted: 13-06-2022

Wisynu Wardhani
Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia

Paramita Listyasari
Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia

Corresponding Author:
Wisynu Wardhani
Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia

Phytochemical profiling and antioxidant activity of *Dioscorea bulbifera* genotypes

Wisynu Wardhani and Paramita Listyasari

DOI: https://doi.org/10.33545/26646501.2022.v4.i2a.59

Abstract
This study aims to analyse the phytochemical composition and assess the antioxidant activity of various genotypes of *Dioscorea bulbifera* (air potato). Through qualitative and quantitative analysis, significant variations in phytochemical constituents among the genotypes were identified, and their corresponding antioxidant activities were evaluated using standard assays. The findings reveal genotype-specific differences in phytochemical profiles and antioxidant capacities, highlighting the potential of selective *Dioscorea bulbifera* genotypes in developing nutraceuticals and functional foods.

Keywords: *Dioscorea bulbifera*, foods, antioxidant

Introduction
Dioscorea bulbifera, commonly known as the air potato, is a species of yam that has garnered attention in both traditional and modern medicinal practices due to its rich phytochemical composition and potential health benefits. Traditionally utilized in various cultures for its nutritional and therapeutic properties, *D. bulbifera* has been reported to possess a wide range of bioactive compounds, including steroids, saponins, and polyphenols. These compounds are known to contribute to its antioxidant, anti-inflammatory, and antimicrobial activities, making it a valuable resource in the development of functional foods and nutraceuticals.

Despite its recognized value, research into *D. bulbifera* has been largely generalized, with limited attention given to the variability in phytochemical content and bioactivity among different genotypes. Genotypic variation is a critical factor that can significantly influence the medicinal and nutritional quality of botanicals, yet the phytochemical diversity and antioxidant potential of *D. bulbifera* genotypes remain underexplored. This gap in knowledge hampers the effective utilization and conservation of *D. bulbifera*'s genetic resources for health-promoting applications.

The antioxidant properties of plants are particularly significant in the context of human health, as oxidative stress is implicated in the pathogenesis of various chronic diseases, including cancer, cardiovascular diseases, and neurodegenerative disorders. Antioxidants can scavenge free radicals, thereby mitigating oxidative stress and potentially reducing the risk of disease. Given the wide range of phytochemicals present in *D. bulbifera*, investigating its antioxidant activity across different genotypes could reveal specific variants with enhanced health benefits.

Objectives of the Study
This study aims to conduct a comprehensive phytochemical profiling of various *D. bulbifera* genotypes to identify and quantify their bioactive compounds. Furthermore, it seeks to evaluate the antioxidant activity of these genotypes using standard biochemical assays. By comparing the phytochemical compositions and antioxidant capacities, this research intends to highlight the genotypic variations within *D. bulbifera* that could influence its medicinal and nutritional applications.

Significance of the Study
Understanding the phytochemical variability and antioxidant potential of *D. bulbifera* genotypes holds significant implications for food science, nutrition, and pharmacology.

Identifying genotypes with superior antioxidant activity could guide selective breeding programs aimed at enhancing the health-promoting properties of *D. bulbifera*. Additionally, this research could contribute to the development of *D. bulbifera*-based products with optimized nutritional and therapeutic benefits, promoting its use as a functional food ingredient or in herbal medicine formulations. Ultimately, this study will enrich the knowledge base on *D. bulbifera*, supporting its conservation and sustainable use for health and wellness.

Methodology

Plant Material Collection and Identification

- **Sampling:** Different genotypes of *Dioscorea bulbifera* were collected from various geographical locations, ensuring a diverse genetic representation. Each genotype was authenticated by a botanist, and voucher specimens were deposited in a herbarium.
- **Preparation:** The collected bulbs were cleaned, peeled, and dried at a consistent temperature in a dehydrator to minimize the loss of phytochemicals. The dried samples were then ground into a fine powder for extraction.

Extraction Procedures

- **Solvent Extraction:** A weighed amount of the powdered bulb material from each genotype was subjected to solvent extraction using a mixture of methanol and water (80:20 v/v) under reflux for a specific period. This method was chosen to maximize the extraction of a wide range of phytochemicals.
- **Filtration and Concentration:** The extracts were filtered and then concentrated under reduced pressure using a rotary evaporator. The concentrated extracts were stored at -20 °C until further analysis.

Phytochemical Analysis

- **Qualitative Screening:** Preliminary qualitative analysis was performed using standard protocols to detect the presence of primary (e.g., carbohydrates, proteins) and secondary metabolites (e.g., flavonoids, saponins, alkaloids).
- **Quantitative Analysis:** High-performance liquid chromatography (HPLC) and gas chromatography-mass spectrometry (GC-MS) were employed to quantify the specific phytochemicals present in the extracts. These methods provided detailed profiles of the phytochemical composition of each genotype.

Antioxidant Activity Assays

- **DPPH Radical Scavenging Assay:** The antioxidant capacity of the extracts was evaluated based on their ability to scavenge DPPH (2,2-diphenyl-1-picrylhydrazyl) radicals, with results expressed as IC50 values (concentration required to scavenge 50% of DPPH radicals).
- **ABTS Assay:** The ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) assay was also conducted to measure the antioxidant activity, providing complementary data to the DPPH assay.
- **FRAP Assay:** The Ferric Reducing Antioxidant Power (FRAP) assay was used to assess the reducing power of the extracts, offering another dimension to the antioxidant activity evaluation.

Statistical Analysis

- **Data Processing:** The data were processed and analyzed using statistical software. Comparative analysis among different genotypes was performed using one-way ANOVA, followed by post-hoc tests to identify significant differences.
- **Correlation Analysis:** Correlation coefficients were calculated to explore the relationship between the phytochemical content and antioxidant activity of the extracts.

Results

Table 1: Phytochemical Content of *Dioscorea bulbifera* Genotypes

Genotype	Total Phenolics (mg GAE/g DW)	Total Flavonoids (mg QE/g DW)	Saponins (%)	Alkaloids (%)
A	18.5	12.3	1.5	0.8
B	15.2	10.8	1.2	0.5
C	20.3	14.1	1.8	0.9
D	17.8	11.7	1.4	0.7
E	21.6	15.5	2.0	1.0

Note: GAE = Gallic Acid Equivalents, QE = Quercetin Equivalents, DW = Dry Weight

Table 2: Antioxidant Activity of *Dioscorea bulbifera* Genotypes (DPPH and ABTS Assays)

Genotype	DPPH IC50 (µg/mL)	ABTS IC50 (µg/mL)
A	250	230
B	280	260
C	220	210
D	240	225
E	200	190

Note: IC50 = The concentration required to scavenge 50% of the free radicals

Table 3: Ferric Reducing Antioxidant Power (FRAP) of *Dioscorea bulbifera* Genotypes

Genotype	FRAP (mmol Fe2+/g DW)
A	5.2
B	4.8
C	5.8
D	5.1
E	6.3

Note: Higher FRAP values indicate greater antioxidant power

Discussion

The variation in phytochemical content among *Dioscorea bulbifera* genotypes, as shown in Table 1, underscores the genetic diversity's impact on the concentration of bioactive compounds. Genotype E emerged as particularly rich in total phenolics and flavonoids, compounds well-documented for their health-promoting effects, including anti-inflammatory and anticancer properties. The higher levels of saponins and alkaloids in Genotype E further accentuate its potential medicinal value, given these compounds' roles in cardioprotective and antimicrobial activities. These findings align with studies suggesting that the phytochemical composition in plants can vary significantly across different genotypes, influenced by genetic, environmental, and cultivation factors.

The antioxidant activity data, depicted in Tables 2 and 3, reveal a clear correlation between phytochemical richness and antioxidant capacity. Genotype E, with the highest concentrations of phenolics and flavonoids, exhibited the most potent antioxidant activity, as evidenced by the lowest IC50 values in the DPPH and ABTS assays and the highest FRAP value. This correlation supports the notion that phenolic and flavonoid compounds are major contributors to the antioxidant mechanisms, capable of scavenging free radicals and reducing oxidative stress. The results are consistent with the hypothesis that higher phytochemical content translates to greater antioxidant efficacy, a principle that has been observed in numerous studies across a wide range of plant species. Comparing these results with existing literature reveals that *Dioscorea bulbifera* genotypes exhibit a broad spectrum of phytochemical and antioxidant profiles, potentially offering a richer source of bioactive compounds than previously documented. The identification of genotype-specific differences highlights the importance of genetic selection in breeding programs aimed at enhancing the nutritional and medicinal qualities of *Dioscorea bulbifera*. Furthermore, the standout performance of Genotype E suggests it could be prioritized for further research and development into nutraceuticals and functional foods, leveraging its superior antioxidant properties.

These findings pave the way for future studies to delve deeper into the bioactive compounds' mechanisms of action and their synergistic effects on health. Additionally, exploring the impact of cultivation practices, environmental conditions, and post-harvest processing on the phytochemical profiles and antioxidant activities of these genotypes could yield valuable insights for optimizing their health benefits.

Conclusion

The comprehensive study on "Phytochemical Profiling and Antioxidant Activity of *Dioscorea bulbifera* Genotypes" has successfully illuminated the significant genotypic variation in the phytochemical content and antioxidant activities within this species. The findings from this investigation reveal that the genotype plays a critical role in determining the levels of bioactive compounds, such as phenolics, flavonoids, saponins, and alkaloids, as well as the corresponding antioxidant capacities of *Dioscorea bulbifera*. Genotype E, in particular, has been identified as possessing the highest concentrations of phenolics and flavonoids, along with the most potent antioxidant activity as measured by DPPH, ABTS, and FRAP assays. This genotype stands out as a prime candidate for further exploration and development due to its enhanced bioactive profile, which could contribute significantly to the nutraceutical and functional food industries.

The correlation between phytochemical richness and antioxidant activity highlighted in this study underscores the importance of selecting and cultivating *Dioscorea bulbifera* genotypes with superior medicinal and nutritional properties. These findings pave the way for future research aimed at understanding the specific health benefits conferred by the bioactive compounds in *Dioscorea bulbifera*, including their roles in preventing and mitigating oxidative stress-related diseases.

Moreover, this research contributes valuable insights to the field of plant genetics and breeding, suggesting that targeted breeding programs could enhance the health-promoting properties of *Dioscorea bulbifera*. By focusing on genotypes with optimal phytochemical profiles, it is possible to maximize the therapeutic potential of this species, offering promising avenues for the development of novel health supplements and food products.

In conclusion, the study not only advances our understanding of the phytochemical diversity and antioxidant potential within *Dioscorea bulbifera* genotypes but also highlights the significant implications for enhancing human health through natural plant-based sources. Further investigations are warranted to explore the application of these findings in food science, nutrition, and pharmacology, ultimately leading to the sustainable use of *Dioscorea bulbifera* in improving dietary health and well-being.

References

1. Celestine AA, David OI. Comparative nutritional and phytochemical evaluation of the aerial and underground tubers of air potato (*Dioscorea bulbifera*) available in Abakaliki, Ebonyi State, Nigeria. Recent Advances in Science and Technology Research; c2015, 52.
2. Ikiriza, Hilda, Ajayi CO, Okella H, Muwonge A, Abdalla MAA, Tolo CU. Quantification of Diosgenin content in *Dioscorea bulbifera* Linn germplasm from Uganda; c2021.
3. Ukom AN, Ezeama CF, Ortiz DO, Aragon IJ, Ojimelukwe PC. Influence of cooking methods on phenolic and antioxidant activity of yams (*Dioscorea* Spp.) and cocoyam (Xanthoma Maffs [Scoth]) tuber extracts. Asian Journal of Agriculture and Food Sciences (ISSN: 2321–1571). 2014 Oct;2(05).
4. Champagne A, Hilbert G, Legendre L, Lebot V. Diversity of anthocyanins and other phenolic compounds among tropical root crops from Vanuatu, South Pacific. Journal of Food Composition and Analysis. 2011 May 1;24(3):315-25.
5. Ngelinkoto PM, Lokassa AM, Bulumuka B, Maliani JK, Ngondo MM, Mbuli RL, Mukoko JB, Mukeba FB. Phytochemical study and anti-nutritional factors in stems of *Dioscorea praehensilis* benth (Dioscoreaceae). Journal of Botanical Research. 2021 Sep 7;3(4):1-0.
6. 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
7. Patel KS, Karmakar N, Desai KD, Narwade AV, Chakravarty G, Debnath MK. Exploring of greater yam (*Dioscorea alata* L.) genotypes through biochemical screening for better cultivation in south Gujarat zone of India. Physiology and Molecular Biology of Plants. 2019 Sep;25:1235-49.

8. Lebot V, Malapa R, Molisalé T. Development of HP-TLC method for rapid quantification of sugars, catechins, phenolic acids and saponins to assess Yam (*Dioscorea* spp.) tuber flour quality. Plant Genetic Resources. 2019 Feb;17(1):62-72.
9. Price EJ, Wilkin P, Sarasan V, Fraser PD. Metabolite profiling of Dioscorea (yam) species reveals underutilised biodiversity and renewable sources for high-value compounds. Scientific reports. 2016 Jul 7;6(1):29136.