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Inflammation and Hyper glycemia: Multifaceted Intervention by Dioscorea Bulbifera

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Abstract: ***Dioscorea bulbifera L. (Dioscoreaceae), commonly known as the air potato, is an important medicinal plant traditionally used in Indian, Chinese, and Thai medicine for treating inflammation, wounds, diabetes, goiters, and certain cancers. Phytochemical studies reveal a diverse array of bioactive compounds, including steroidal saponins, flavonoids, phenanthrenes, tannins, glycosides, and essential minerals, which contribute to its broad pharmacological spectrum. Experimental evidence supports potent anti-inflammatory and antidiabetic properties, as demonstrated in rat and zebrafish models, where extracts significantly reduced edema and blood glucose levels. However, toxicological reports highlight risks such as hepatotoxicity, pulmonary toxicity, and neurotoxicity, primarily linked to furanoterpenoids like diosbulbin B and certain alkaloids. These dual aspects underscore both the therapeutic promise and safety concerns surrounding D. bulbifera. This review synthesizes its taxonomy, morphology, phytochemistry, pharmacological activities, and toxicological findings, emphasizing the need for future research on bioactive isolation, mechanism elucidation, and safe formulation development for clinical applications.***

Keywords: Dioscorea bulbifera, air potato, anti-inflammatory, antidiabetic, pharmacology, phytochemistry, toxicity.

I. INTRODUCTION

Dioscorea bulbifera(Linn), part of the Dioscoreaceae family, is a significant medicinal factory known as Air potato. Nearly every part of this factory is important for drug and has been traditionally used to treat colorful health issues. Its bulbils have generally been used in Thai folk drug as a diuretic and anthelmintic, for life medications, and for treating injuries and inflammation. This factory is also constantly set up in traditional Indian and Chinese drug for affections like sore throat, gastric cancer, rectal melanoma, and goiters. Crude excerpts from this factory have shown anti-hyperglycemic, antilipidemic, antimicrobial, antidiabetic, analgesic, andanti-HIV-1 integrase goods. The tubers were set up with a high quantum of protein, a good proportion of essential amino acids and appeared as a fairly good source of numerous salutary minerals.

Fig. 1 Dioscorea bulbifera

A. Taxonomical Bracket

- Kingdom: Plantae
- Subkingdom: Viridaeplantae
- Super division: Streptophyta
- Division: Tracheophyta
- Class: Magnoliopsida
- Superorder: Lilinana
- Order: Dioscoreales
- Family: Dioscoreaceae
- Genus: Dioscorea L.
- Species: Dioscorea bulbifera L.

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B. Morphological description

The tubers vary in shape. The bulbils are multitudinous, irregular, and roughly 2.5 cm or further across, with a brown, nodule- such like face. The stem twines to the left wing. The leaves are generally alternate, measuring about 10- 15 by 7.5- 10 cm, frequently larger or lower. They're elliptical with an acuminate tip and have a more or less deeply heart- shaped base. The lobes are rounded and have 7- 11 jitters. manly harpoons grow 5- 10 cm long and cluster in waterless panicles. There are six stamens. womanish harpoons can reach 10- 25 cm long in clusters of 2- 5. The capsule is 1.8- 2 cm long and oblong. The seeds have wings at the base.

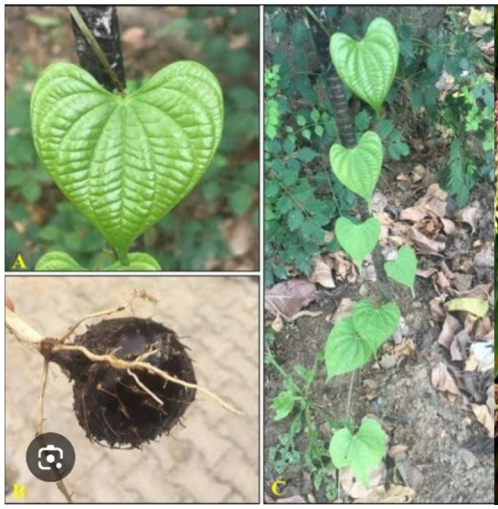

Fig. 2 D.bulbifera leaves, vine and tuber

Fig. 3 . D.bulbifera flowers

C. Bioactive composites

Dioscorea bulbifera contains steriod, disogenin and has been used as starting material of their manufactures for different artificial steroidal hormones similar as hormonal contraception and other coitus hormones. It also contains a number of flavonoids and isoflavonoids, which have oestrogenic, heart defensive, antioxidant and anti-cancer parcels. Phytochemical analysis of Dioscorea bulbifera has revealed alkaloids, glycosides, proteins, fats, sterols, polyphenols, tannins, flavonoids, and saponins. The composition can vary by country of origin. The inorganic micronutrients present include Fe, Cu, Zn, Mn, Co, Mo, V, B, Cl, I, Br, and Na.

a) Steroidal Saponins
b) Flavonoid Derivatives
c) Phenanthrene
d) Carotenoids
e) Fatty acids
f) Tannins
g) Volatile oils
h) Glycoside derivatives

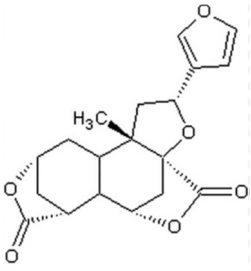

Fig. 4 Diosbulbin

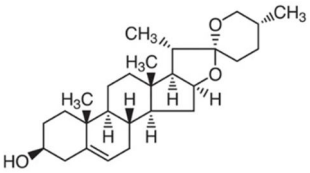

Fig. 5 Diosgenin

Fig. 6 Flavonoid(quercetin)

II. INFLAMMATION

Inflammation is the vulnerable system’s response to infections, poisons, or injuries. It works by removing dangerous stimulants and starting the mending process. Crack mending features three lapping phases seditious, proliferative, and redoing. These phases form and structure the towel, perfecting its strength grounded on the crack's inflexibility. When a crack occurs, the short- term inflammation, touched off by seditious intercessors and reactive oxygen species, frequently slows down the mending process. therefore, reducing the product of reactive revolutionaries is pivotal for attracting fibroblasts to the crack point, which starts the form phase.

Natural products with medicinal parcels have been used to treat numerous seditious conditions. These traditional remedies laid the root for creating Aspirin, the first synthetic anti-inflammatory medicine deduced from natural sources. Natural products offer structural diversity that synthetic composites warrant, making them a promising source of new, effective anti-inflammatory medicines.

III. DIABETES MELLITUS

Diabetes Mellitus(DM) is a serious condition characterized by severe physiological imbalances. It's substantially an endocrine and metabolic complaint marked by habitual high blood sugar situations that lead to multiple biochemical problems and oxidative stress. Type 2 diabetes mellitus(T2DM), also known as non-insulin-dependent diabetes mellitus(NIDDM), is a habitual metabolic complaint characterized by high blood sugar after eating(PPHG). Diabetes significantly increases the threat of unseasonable atherosclerosis, and oxidative stress is a factor since diabetic monocytes produce heightened situations of superoxide anions. multitudinous synthetic medicines for T2DM are available moment, but numerous come with serious long- term side goods, similar as medicine resistance, liver damage, pain, gas, and diarrhea. thus, there's a need for indispensable agents that can lower blood sugar in T2DM.

Natural medicines can effectively help and treat conditions related to insulin resistance, similar as diabetes. Insulin resistance is linked to several pathological processes, including abnormal insulin signaling, energy metabolism, and inflammation. composites like emodin, aloe-emodin, chrysol, and beranin are crucial active constituents in numerous natural medicines that target these processes. further medicines are now available for treating glucose and lipid metabolism diseases. Over the times, exploration has shown the unique benefits of natural medicines. In the future, they may come the favored system for precluding and treating diabetes due to their safety and broad range of targets.

IV. PHARMACOLOGICAL STUDIES

A. In vivo studies (Anti-inflammatory)

Wistar albino rats: 16 Wistar albino rats employed in this study was bought from the Veterinary Department, University of Nigeria, Nsukka, Enugu State, Nigeria and previous to the experimental period. Sixteen creatures for anti-inflammatory conditioning were aimlessly assigned was transported to the beast house, of the Department of Biochemistry, Michael Okpara University of Agriculture Umudike, Abia state. The creatures were handed a week adaptation period; the creatures were boxed in plastic coops and were given clean water and rat bullets into eight groups, each containing two creatures each. This was done according to the system described by ginger et al., 7.

The creatures were starved from feed for 12hours before the trial but were given access to pure drinking water throughout the experiment Group A was the negative control group, was convinced inflammation and wasn't given any of the treatment, Group B was given 500mg/ kg factory excerpt, Group C was given 250mg/ kg factory excerpt, Group D was given 125mg/ kg of factory excerpt, Group E was given 62.5 mg/ kg of factory excerpt, Group F was given 31.25 mg/ kg factory excerpt, Group G was given 15.5 mg/ kg of factory excerpt while Group H was the positive control which entered Aspirin. The factory excerpt and aspirin intra peritoneally were fitted.

The creatures were given the excerpt and aspirin in attention according to the group first also 30 minutes latterly 1 ml of fresh egg albumin was also fitted into the sub-plantar of the right hand paw of each of the rat. The periphery of the right hand paw was measured at 30minutes interval of 30 mins, 60 mins, 90 mins, 120 mins, 150 mins, and 180 mins independently using a Vernier caliper. The most extensively used primary test to screen ant- seditious agent measures the capability of a emulsion to reduce original oedema convinced in the rat paw by injection of an irritant agent10. Egg albumin convinced oedema has been generally used as an experimental beast model for inflammation.

Table 1 shows the effect of the colorful treatment groups with respects to the mean paw circumference. There's significance difference ($P< 0.05$) between the mean paw circumferences of group treated with 500mg/ mg attention of the ethanol excerpt and the negative control. The development of oedema in the right paw of the rat after injection of egg albumin is due to release of pro-inflammatory intercessors like histamine and prostaglandin11. The significant inhibitory exertion shown by the excerpt of Dioscorea bulbifera (500mg/ kg, 250mg/ kg, 125mg/ kg, 62.5 mg/ kg, 31.25 mg/ kg and 15.5 mg/ kg attention) at the final 30 twinkles interval was advanced to that displayed by the group treated with aspirin.

TABLE I
MORTALITY RATE OF MICE AFTER ADMINISTRATION OF PLANT EXTRACT

Conc. In mg	No. of animals	No. of mortality
1000	4	2\4
500	4	1\4
250	4	-
125	4	-
62.5	4	-

Average weight of mice = 25g

TABLE 2
RESULTS OF 6 DOSE LEVELS OF ETHANOL EXTRACT OF ADMINISTERED AT 500mg/kg CONCENTRATION HAD HIGHER ANTI INFLAMMATORY EFFECTS THAN REST OF THE EXTRACT CONCENTRATIONS

Dose	30 mins	60 mins	90 mins	120 mins	150 mins	180 mins
Negative Control	6.25±0.35	6.15±0.21	6.15±0.07	5.90±0.14	5.60±0.14	5.40±0.14
500mg/kg	5.25±0.35	5.20±0.28	5.05±0.07	4.85±0.21	4.50±0.14	4.30±0.14
250mg/kg	4.85±0.07	4.60±0.14	4.45±0.21	4.30±0.14	4.20±0.14	3.90±0.14
125mg/kg	4.65±0.07	4.45±0.07	4.30±0.14	4.10±0.14	3.80±0.14	3.60±0.14
62.5mg/kg	4.40±0.14	4.25±0.07	4.05±0.07	3.75±0.21	3.60±0.14	3.30±0.14
31.25mg/kg	4.35±0.07	4.05±0.07	3.80±0.14	3.65±0.21	3.45±0.21	2.90±0.14
15.5mg/kg	4.10±0.14	3.85±0.07	3.65±0.07	3.45±0.21	3.20±0.14	2.60±0.14
15.5mg/kg	4.10±0.14	3.85±0.07	3.65±0.07	3.45±0.21	3.20±0.14	2.60±0.14
Aspirin (100mg/ml)	5.25±0.35	5.25±0.35	4.25±0.35	4.00±0.14	3.75±0.21	3.35±0.21

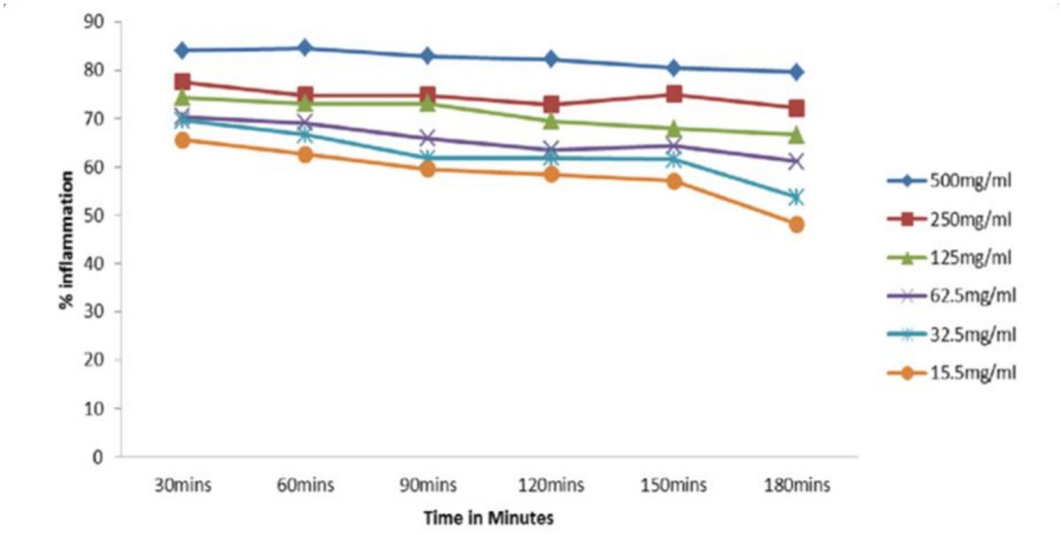

Fig. 7 Graphical representation of table 2

Result: Dioscorea bulbifera is revealed to have potent anti-inflammatory activity, confirming its traditional application and proposing bioactive constituents of interest.

B. In vivo studies (Anti diabetic)

1) Zebra fish

The Zebrafish model system is the most popular beast model used for experimental studies and it's fast turning into a promising model for medicine discovery and toxicological testing. The utility of the Zebrafish as a model organism is further multiplied. also, styles for the creation of transgenic lines, targeted mutation, and nuclear transfer have further enhanced the utility of the Zebrafish model to experimenters.

Hyperglycemia of type II diabetes is caused by an exertion of insulin to regulate gluconeogenesis. Glucose, when present in the diet, prompts insulin conflation by the pancreas and suppresses gluconeogenesis through downregulating genes within the pathway. During glucose absence in the blood, gluconeogenesis is initiated due to glucagon action. Insulin and glucagon are buried in the pancreas's β- cells and α- cells, independently. analogous to mammals, the Zebrafish pancreas also consists of two distinct glandular apkins, each performing vital physiological places. The endocrine towel plays a vital part in maintaining glucose metabolism by concealing insulin, somatostatin, and glucagon directly into the circulatory system. Exocrine part of the pancreas secretes digestive enzymes, similar as amylase and trypsin, which are transported to the gastrointestinal tract. Hyperglycemia in type II diabetes has a multifactorial etiology 1170 Acquisition of Japanese Language Proficiency to Enhance Manpower for Employment Overseas caused by blights in the stashing and action of insulin, differences in insulin perceptivity of target cells, and enhanced hepatic gluconeogenesis. The Zebrafish insulin and glucagon genes and other pivotal proteins involved in glucose metabolism regulation have been set up and show analogous pattern of regulation and exertion as their mammalian counterparts. This exploration was conducted to assess the splint excerpt of D. bulbifera antidiabetic eventuality through Zebrafish model. insulation of the active composites behind the anti-diabetic exertion is demanded for farther studies. The splint excerpt was taken in 4 different attentions 200 mg/ l, 400 mg/ l, 800 mg/ l, and 1600 mg/ l. 4 fish were taken for each group, and the fish were exposed to excerpt- treated water for 24 hours, and the casualty was checked.

TABLE 3
ANIMALS AND GROUPING

Tank	No. of fishes	Base	Group
1	5	Distilled Water	Normal Control (Saline Water)
2	5	Distilled Water	Standard Control (Metphormine Hydrocloride (500mg))
3	5	Distilled Water	Test with *Dioscorea bulbifera* extract (Low Dose – 200mg)
4	5	Distilled Water	Test with *Dioscorea bulbifera* extract (Low Dose – 400mg)

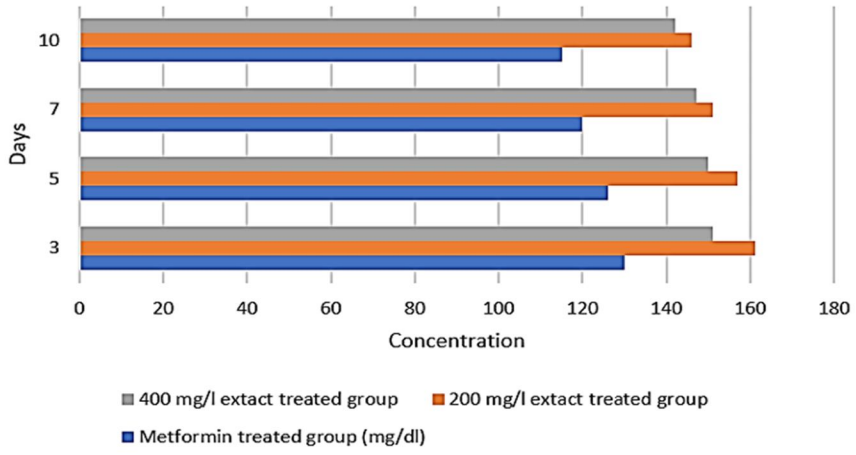

Fig. 8 Graphical representation of level of glucose

Result: A reduction in the blood glucose level was observed in the 200 mg/dl & 400 mg/dl extract treated group.

2) Rats

Factory material progressed tubers of Dioscorea bulbifera were gathered from cultivars in Afaha Atan Village, Ibiono Ibom Local Government Area of Akwa Ibom State, Nigeria in July, 2012. The factory species was linked and authenticated by a Factory Taxonomists; Dr.(Mrs.) M. E. Bassey in the Department of Botany and Ecological Studies, University of Uyo, Uyo. Herbarium sample (DBH 555) was submitted to the Department of Botany herbarium. progressed tubers of Dioscorea bulbifera sample were exfoliate dried over a laboratory bench for 2 weeks and ground into greasepaint by pounding the dried sample using mortar and

pestle. Twenty- five grams of the powdered sample was soddened in 70 ethanol (100mL) for 72 hours. The performing liquid filtrate was in- vacuo concentrated at 400C. They yield was 34.5 w/ w. The excerpt was cooled at-40 C until used to conduct this trial. Phytochemical Webbing of the excerpt was conducted following the standard styles (Trease and Evans, 2009). creatures Albino wister rats (120- 160 g) and Albino Swiss Mice (22- 33g) of both relations were sourced from the University of Uyo beast house. The creatures were fed on standard beast's bullets and water ad libitum. Determination of Median Lethal Cure (LD50) The median murderous cure (LD50) of Dioscorea bulbifera tuber excerpt was estimated in albino mice using intraperitoneal (i.p) route administration of varying boluses of500-4000 mg/ kg to five sets of 5 mice per set independently following starvation of the creatures for 24 hours grounded on the system of Lorke (1983). The IP route was used due to its perceptivity and quick results. The creatures were covered for implicit incarnation of physical toxin signs similar as writhing, reduced motor exertion, reduced body/ branch tones, reduced respiration and eventual death. Counts on the observed deaths were noted in each group within 24hours. LD50 was determined as the geometrical mean of the loftiest cure with 0 mortality (a) and smallest cure with 100 mortality (b). Antidiabetic exertion of the excerpt was estimated Induction of Diabetes Male wistar rats were convinced to diabetes by a single intraperitoneal (IP) injection of 150mg/ kg body weight alloxan monohydrate in sterile normal saline. The rats were kept on 5 glucose result for the posterior 24 hours to avoid hypoglycemia. On day 5, tail tone blood samples were taken and glucose situations were assessed to corroborate the onset of diabetes (250 mg/ dL and further). Diabetic rats were insulated into five groups, each having five creatures and treated in the following manner Group I Group II Group III Diabetic rats treated with 5 mL/ kg of saline water as the control Diabetic rats treated with Dioscorea bulbifera ethanol excerpt (380.0 mg/ kg/ day) Diabetic rats treated orally with Dioscorea bulbifera ethanol excerpt (760.0 mg/ kg/ day) in waterless result for 15days. Group IV result Group V Diabetic rats treated orally with mushroom excerpt (1140.0 mg/ kg/ day) in waterless Diabetic rats administered 10 mg/ kg of metformin for 15 days. Blood was drawn from the tail tone incontinently before and 1h, 3h, 5h and 7h after medicine administration for acute study. The exertion of Dioscorea bulbifera ethanol excerpt was also examined for extended treatment for 15 days.

Treatment Dose (mg/kg)	0h	1h	3h	5h	7h
5mL/kg saline water (control)	152±4.23	163±3.45	176±4.23	170±8.11	172±6.15
380.0	134+3.06	131+7.28	127+5.51*	119+2.31	114+4.21
760.0	130+6.55	126+3.16*	121+7.27	110+4.05*	103+1.73
1140.0	125+5.64	118+9.30*	108+3.54*	83+5.20*	90+3.51**
10 mg/kg/metformin (standard drug)	133+5.12	109+4.21*	93+2.90*	65+3.07*	80+4.51**

Data are expressed as mean ± SEM. of 5 replicates. p<0.05 and p<0.01 when compared to control.

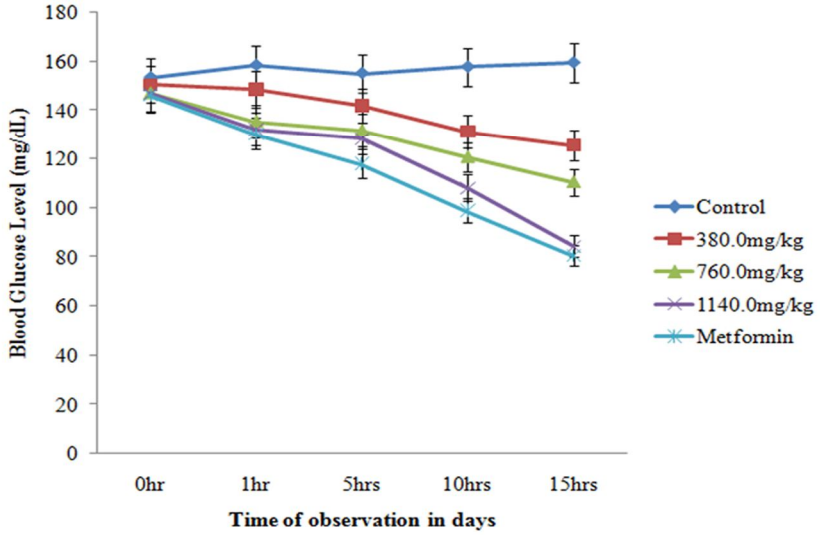

Fig. 9 Dose chart and observation of glucose level

Result: The result of the prolonged treatment (15-days) of Dioscorea bulbifera produced a sustained significant ($p<0.05$) reduction in BGL of the hyperglycemic rats when compared with that of the control. The potent and progressive reduction activity of BGL of the extract with the pretreatment and treatment values confirms the antidiabetic potential of Dioscorea bulbifera.

V. ADVERSE EFFECTS

1) Mice treated with THP and DB excerpt, heart necropsies displayed invariant red staining of cardiac myocytes, loose alignment of cardiac filaments, muscle fiber dislocation and easily light staining.

2) DIOB affects lipid metabolism in the lung substantially by controlling three metabolic pathways, which are sphingolipid metabolism, arachidonic acid metabolism, and glycerophospholipid metabolism.

3) D.bulbifera excerpt will induce liver injury and intrahepatic downregulation of P- gp expression. A mouse study was suitable to confirm that DIOB (Diosbulbin B) was the major element of Air Potato Yam to be responsible for the liver toxicity reported in the literature.

4) In certain regional varieties, dioscorine (a neurotoxic alkaloid) and histamine (an allergen causing mild inflammation or itching) have been implicated in adverse reactions in related Dioscorea species. However, in some wild Nepali D. bulbifera samples, these toxins were not detected; instead, oxalates might account for occasional irritation or inflammation.

ADVERSE REACTION	CAUSES
Hepatotoxicity	DSB & EEA (furanoterpenoids)
Pulmonary Toxicity	Diosbulbin B
Bitter/Gastro Effects	Diosbulbins A & B, possible oxalates
Neurotoxicity/Allergy	Dioscorine (alkaloid), histamine
Other Species Risks	Related Dioscorea species

VI. CONCLUSION

Dioscorea bulbifera L., widely recognized as the air potato, represents a plant of considerable ethnomedicinal and pharmacological importance. Traditionally valued in Indian, Chinese, and Thai medicine for its use in inflammation, diabetes, cancer, and wound healing, modern investigations confirm many of these applications. Phytochemical studies reveal a broad spectrum of bioactive compounds, including steroidal saponins, flavonoids, phenanthrenes, and tannins, which collectively contribute to its antioxidant. Experimental studies in rodents and zebrafish further validate its therapeutic promise, particularly for reducing edema and regulating hyperglycemia. However, despite these benefits, significant safety concerns remain. Compounds such as diosbulbin B and related furanoterpenoids have been associated with hepatotoxicity, pulmonary toxicity, and other adverse effects, highlighting the need for cautious and regulated use. The dual nature of D. bulbifera—as both a therapeutic agent and a potential toxicant—underscores the importance of targeted research. Future directions must focus on isolating active compounds, clarifying mechanisms of action, and developing standardized formulations that ensure efficacy while minimizing toxicity. With rigorous scientific validation and safety profiling, Dioscorea bulbifera holds promise as a valuable resource in modern phytotherapy and integrative medicine.

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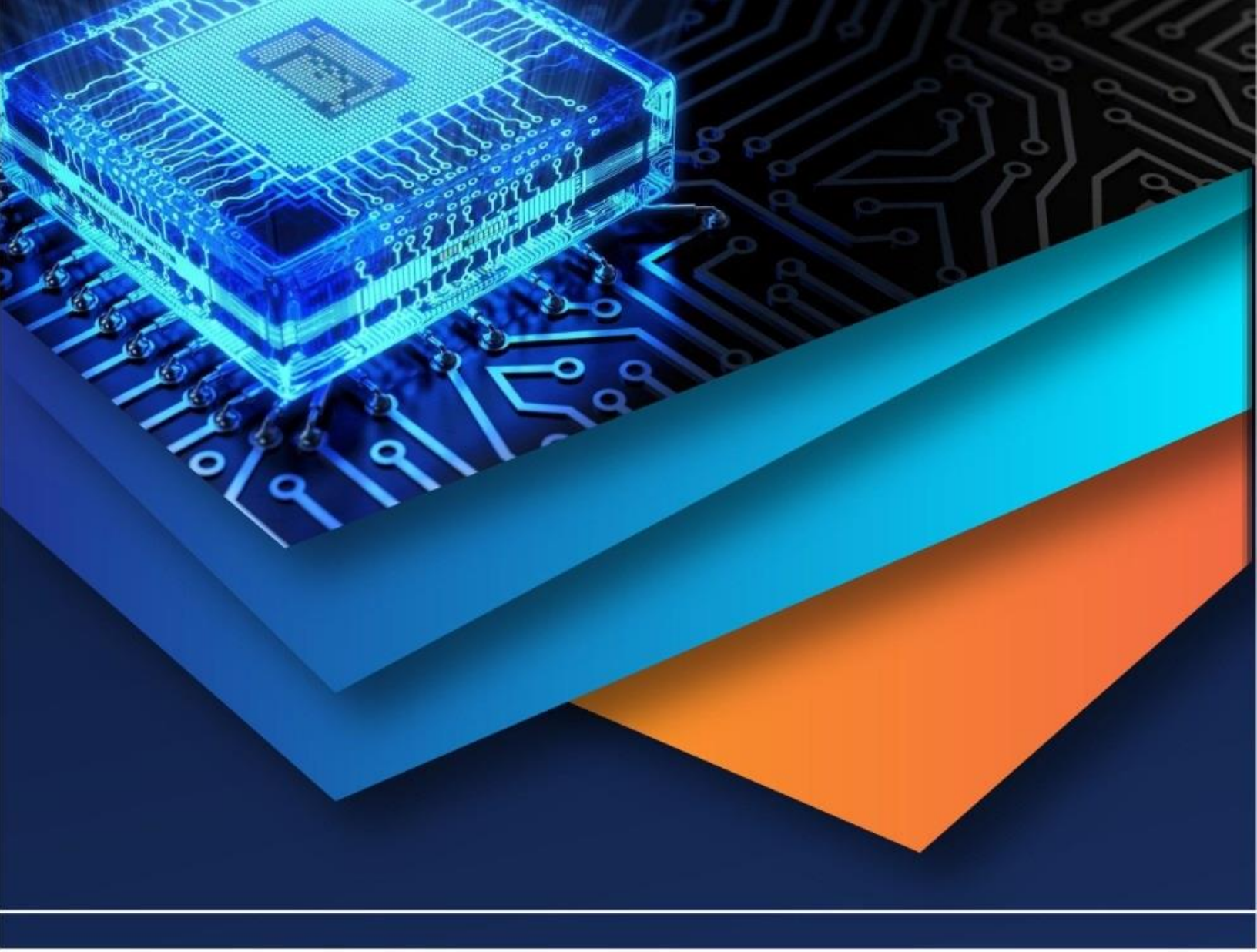

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