Phytochemical Screening and Antioxidant Activity of Crinum jagus Bulb Aqueous Extract: A Potential Indicator for Anti-Convulsive Syncope Properties

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ABSTRACT

Plants and their derivatives are essential to human and animal lives. They are used traditionally to treat various diseases. Crinum jagus (Amarylidaceae) plant is one of such plants. It is employed in the treatment of asthma, mental related illnesses, inflammation, diverse forms of convulsion etc. The most commonly used part of Crinum jagus plant for medicinal purposes is the bulb. Convulsive syncope is characterized by a sudden temporary loss of consciousness and involuntary muscle jerk due to reduced supply of oxygen to the brain. It is not the same as epilepsy, which normally occurs as a result of sudden electrical surge in the brain, but was reported to have cardivascular origin cause, and also leads to higher short-term mortality than epilepsy. This study screened Crinum jagus bulb crude aqueous extract for its phytochemicals namely alkaloids, saponnin, flavonoid, terpenoids, tannins, anthraquinones, phenols, steroids, cardiac glycosides, oxalates, and phytate; and also evaluated its antioxidant activity using different standard methods, in order to evaluate its anti-convulsive syncope potential as its being used locally. The results of the study revealed that Crinum jagus bulb is very rich in phenolic compounds, total flavonoids, cardiac glycosides and tannins. The terpenoids, oxalates, steroids, alkaloids, saponins, anthroquinone, and phytates were also present in appreciable proportion needed to support its anti-convulsive syncope property. The extract also displayed significant antioxidant activity in each of the different methods used, which also compliments its potential as an anti-convulsive syncope agent. Thus, Crinum jagus bulb crude aqueous extract could be developed into a potent anti-convulsive syncope agent that will be cheaper and readily available for the masses.

Keywords: Crinum jagus bulb, Phytochemicals, Antioxidants, Convulsive Syncope.

INTRODUCTION

Plants are origins of many substances used in maintaining humans' health. They are locally employed in the treatment of different types of diseases, which include inflammations, arthritis, asthma, fever, diabetes, bacterial infection, tuberculosis etc. Crinum jagus (Christopher lily) plant, of the Amarylidaceae family, is not an exception. The plant's bulb is widely used in Africa to treat diseases such as asthma, snake bite, convulsion, mental related diseases, etc (Alawode et al., 2019; da Silva et al., 2025; Jayawardena et al., 2025). Crinum jagus was reported to be used as an anti-diabetic, anti-obesity, anti-diarrheal, and in the treatment of gastrointestinal infections by traditional medicine practitioners (Kabir, et al., 2025). The bulb of Crinum jagus is combined with other herbs to treat memory loss and other illnesses relating to ageing traditionally (Igbari et al., 2023; Aliyu et al., 2025; Jayawardena et al., 2025).

In an experiment carried out by Santos et al. (2018) to investigate the cholinesterase inhibitory activity of some selected plants in order to determine their potentials in treating Alzheimer's disease, Crinum jagus amongst

others was found to possessed good anti-cholinesterase activity. A number of researchers have reported that Crinum jagus bulb displayed strong antimicrobial activity (Alawode et al., 2021; Jayawardena et al., 2025; Minkah and Danquah, 2021). Ibrahim et al. 2020; Amakor and Shagal 2024 and Gbolade, 2020 reported that Crinum jagus bulb crude extract demonstrated significant anti-snake venom activity against Naja nigricollis, Echis ocellatus and Bitis arietans venoms, and their mixed venom. In another study conducted by Opiyo and Njoroge (2024), it was revealed that Crinum jagus bulb extract completely inhibited the haemorrhagic activity of Echis ocellatus venom. Akinyele et al. (2022) evaluated the antimalarial activity of both the leaf and bulb extracts of Crinum jagus. The authors reported that both extracts exhibited moderate antimalarial activity.

The results of the study conducted by Kolawole et al. (2015) on mice infected with Plasmodium berghei showed that Crinum jagus bulb extract and its fractions administered to the mice possessed commendable anti-plasmodial activity, which makes it a potential antimalarial agent. This author attributed this activity to the scavenging and anti-oxidative power of the bulb extract. Atunwa (2023) reported that Crinum jagus bulb has neurocognitive and neuroprotective potentials amongst several other plants examined through ethno-pharmacological survey. Mariama et al. (2022) conducted a study to evaluate the protective potentials of Crinum jagus leaves aqueous and methanol extracts against oxidative stress damages induced on liver and kidney of rats using toluene, and found that both the aqueous and methanol leaves extracts of Crinum jagus protected the liver and kidney of the animals against the toluene-induced damages. Gildas et al. (2021) have reported the isolation of two alkaloids; 3-O-demethyltazettine and hippadine from Crinum jagus bulb.

Phytochemicals are non-nutritive, naturally occurring plant chemicals. Medicinally, they are human friendly, because they play vital roles in curing a number of diseases with little or no harm (Prajapati, 2019; Ahmed et al., 2022; Zhao, 2024). Antioxidants prevent free radicals generated in the body from damaging body cells by scavenging them (Gharu, 2022; Halliwell, 2024; Chandimali et al., 2025; Kokorelis and Rowe, 2025; Soker et al., 2025). Convulsive syncope was reported to have cardiovascular origin, and higher short term mortality than epilepsy (Bergfeldt, 2003; Kanjwal et al., 2009; Acampora et al., 2021). Its treatment is based on suspected underlying causes (Flevari et al., 2002; Scarabelli and Scarabelli, 2004; Behnoush et al., 2023). Various medications such as serotonin reuptake inhibitors (e,g fluoxetine), beta- blocker (e,g artenolol), midodrine etc, and pacemaker are used in managing convulsive syncope. Crinum jagus bulb is employed traditionally in the treatment of different kinds of convulsion in Western part of Nigeria. This study aimed to evaluate the anti-convulsive syncope potential of Crinum jagus bulb, using its phytochemical constituents and anti-oxidant activities as indicators.

Materials and Methods

Material: Crinum Jagus Bulb

Sample Collection Authentication

Crinum jagus bulbs were purchased from herbal shops at Oje market, Ibadan North-West Local Government area, Ibadan, and authenticated at Forest Research Institute of Nigeria, Ibadan, Oyo state, Nigeria.

Sample Preparation

The scaly coverings of the bulbs were removed and washed with clean water, then rinsed with distilled water. The bulbs were left on white tiles to allow the water that adhere to them dry completely.

Preparation of Crude Extracts

Five hundred grammes of thoroughly cleaned fresh Crinum jagus bulb was sliced into 1.5 litre distilled water for 72 hours at ambient temperature in one batch extraction as it is locally prepared, after which it was filtered using No.1 Whatman fitter paper. The filtrate was concentrated using rotary evaporator at 40^{o}C by pouring the filtrate into the rotary evaporator round bottom flask, and the flask was connected securely with the rotary evaporator by means of Keck clips. The flask was then lowered into the water bath and evaporation was done under a vacuum. The concentrated extract was kept at 4^{o}C in a refrigerator for further use.

Qualitative Phytochemicals Analysis

Qualitative phytochemicals analysis of the aqueous extract were carried out using standard methods as described by Sharma (2009), Adinortey et al. (2012), Sindhu et al. (2014), Kweku et al. (2018), Shaikh and Patil (2020) and Wang and Guo (2021).

Quantitative Phytochemicals Analysis

Quantitative phytochemicals analysis of the aqueous extract were done using procedures described by Sakulpanich and Gritsanapan (2009), Wu et al.(2009), Mbaebie et al. (2012), Narayan et al. (2012), Shoib and Shahid (2014), Adewole et al. (2015), Esan et al. (2020).

Antioxidant Activity Determination

Five different methods as described by Otitolaiye et al., 2023 and Cañas, et al., 2023, were used to determine the antioxidant activity of the aqueous extracts. These methods are:

a. **DPPH (1,1-diphenyl-2-picrylhydrazyl) scavenging assay: in which 0.135 mM DPPH in methanol was** mixed with 0.05 mg of the bulb extract. The percentage scavenging ability of the extract on DPPH was calculated using the equation below and the result was also expressed as mmol/gvit C equivalent:

DPPH scavenging activity (%) = $\frac{A_{blank} - A_{sample}}{A_{blank}} \times 100$

Where,

A_{blank} = the absorbance of a mixture of DPPH and methanol

A_{sample} = the absorbance of the reaction mixture

b. **Trolox equivalent antioxidant capacity.**

A volume of 2.94 ml of 2, 20-azino-bis-3-ethylbenzylthiazoline-6-sulphonic acid diammonium salt ($ABTS^{*+}$) complex formed from mixing equal volumes of 7mM ABTS stock solutions and 2.4 mM potassium persulphate together was mixed with 60µL of the extract and the mixture incubated for 25 minutes at 37ºC. Then the absorbance was measured. The percentage inhibition of $ABTS^{+}$ by the extract was calculated and the result was also expressed as mg trolox equivalent per 100g using the equation:

ABTS scavenging activity= $\frac{A\ blank - A\ sample}{A\ blank} \times 100.$

Where,

A_{blank} is the absorbance of $ABTS^{+}$ radical + methanol;

A_{sample} is the absorbance of $ABTS^{+}$ radical + sample extract.

c. **Ferric reducing power assay**

5ml of supernatant obtained from centrifugation of a mixture of 2.5 ml of 200 mM phosphate buffer (pH 6.6), 2.5 ml of 1% potassium ferric cyanide, 50 mg of the extract and 2.5 ml of 10% trichloroacetic acid, incubated for 20 minutes at 50ºC was mixed with a dilute solution of 0.1% ferric chloride, and the absorbance measured at 700 nm using ascorbic acid solution as standard. The result was expressed as mg ascorbic acid equivalent/100g of sample weight

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d. **Scavenging Activity Nitric Oxide**

Fifty milligrammes of the aqueous extract was incubated with 0.5 ml of 10 mM sodium nitroprusside in phosphate-buffered saline at room temperature for 2 hours 30 minutes. 1 ml 0.33% sulfanilic acid in 20 % glacial acetic acid was added, and then 1 ml of 0.1% naphthyl ethylene diaminedihydrochloride, followed by incubation

at ambient temperature for 30 minutes. The absorbance of the reaction mixture was read at 540 nm. Trolox standard curve was used to estimate the nitric oxide scavenging power of the aqueous extract, and the result expressed as milligramme trolox equivalent antioxidant capacity per 100g sample.

e. Total antioxidant assay

Fifty milligrammes of the aqueous extract was added to 3 ml of a mixture of 4 mM ammonium molybdate, 28 mM sodium phosphate, and 0.6 M sulfuric acid in a conical flask. The mixture was incubated for 1 hour thirty minutes at 95°C, during which the green phosphomolybdenum complex was formed. The absorbance of this green coloured complex was measured at 695 nm. A mixture of 4 mM ammonium molybdate, 28 mM sodium phosphate, 0.6 M sulfuric acid and 0.3 ml methanol was used as blank. Both ascorbic and gallic acids were used as standards. Concentrations of 20 to 100 µg/ml ascorbic acid and gallic acid were used as standards. The antioxidant activity was expressed as milligrammes equivalents of both ascorbic acid and gallic acid per gramme.

Statistical Analysis

All the methods were carried out in duplicate. The results were expressed as the mean and standard deviation. The significant difference between the means and where the difference lies were determined by one way ANOVA, and Benforroni post hoc analysis respectively.

RESULTS

The results of the analyses carried out on Crinum jagus bulb aqueous extract are as presented in Tables 1, Chart 1 an2.

Table 1. Qualitative Phytochemicals Analysis

S/N	Phytochemical	Inference
1.	Alkaloids	+
2.	Saponnin	+
3.	Flavonoid	+
4.	Terpenoids	+
5.	Tannins	+
6.	Anthraquinones	+
7.	Phenols	+
8.	Steroids	+
9.	Cardiac glycosides	+
10.	Oxalates	+
11.	Phytate	+

Key: Present

Chart 1. Quantitative Phytochemicals Analysis

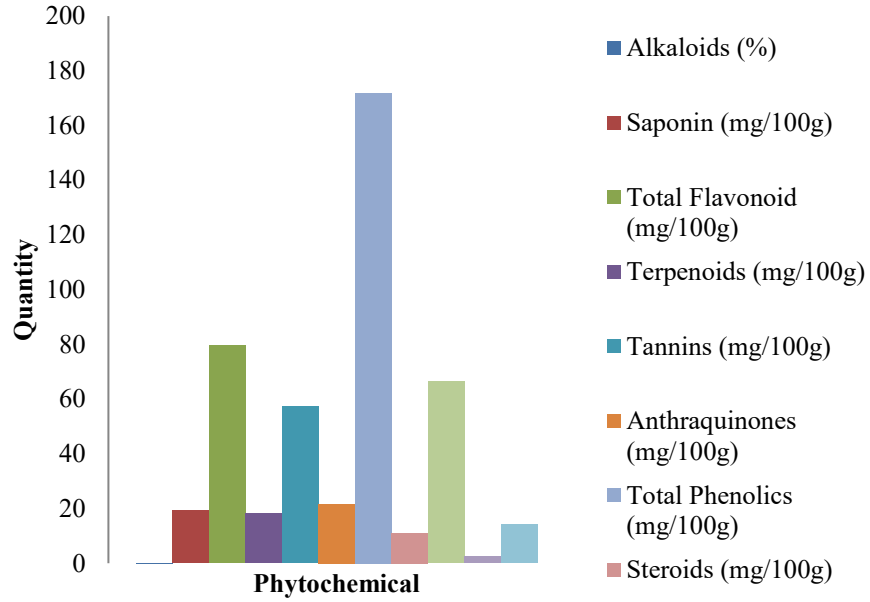
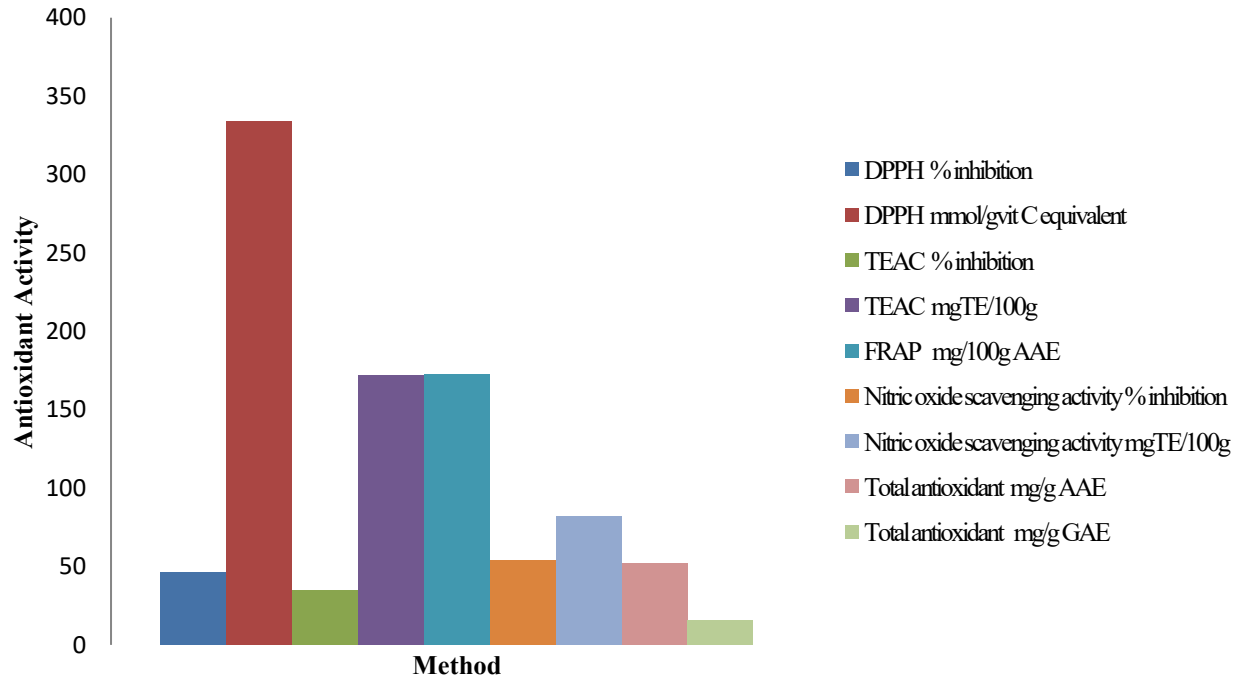


Chart 2. *Crinum jagus* Bulb Aqueous Extract Antioxidant Activity



DISCUSSION

Crinum jagus bulb contained phytochemicals of various medicinal abilities in significant quantity as shown in Tables 1 and Chart 1. It's very rich in phenolic compounds, total flavonoids, cardiac glycosides and tannins. The terpenoids, oxalates, steroids, alkaloids, saponins, anthroquinone, and phytates were present in significant amount as displayed in Chart 1. Udugbunam et al. (2015) reported the presence of alkaloids, glycosides, tannins, and saponins in methanol extract of Crinum jagus bulb screened for phytochemicals, which is similar to the result of this study. Mariama et al. (2022) also reported the presence of alkaloids, tannins, cardiac glycosides, saponins, phenolics, and flavonoids. Also, Alawode (2024), who screened n-hexane, ethyl acetate and methanol extracts of Crinum jagus bulb for their phytochemicals constituents, reported the presence of tannins, saponins, flavonoids, phenols, alkaloids and terpenoids. Kabir et al. (2025) reported the presence of cardiac glycosides, steroids, tannins, terpenoids, alkaloid, steroids, saponins, flavonoids and phenols across the various extracts of

Crinum jagus bulb screened. In comparison with the results of this study qauntitatively, Mariama et al. (2022) reported higher values for tannins, saponins, flavonoids, phenols, alkaloids, cardiac glycosides and terpenoids. The phenolic compounds, anthocyanin and saponins contents of the aqueous extract of Crinum jagus bulb were far more than those of Sorghum vulgare (85.74 µg/g), Eremomastax polysperma (42.49 µg/g) and Brillantaisia owariensis (19.06µg/g) as reported by Akuru and Amadi (2018). According to the report of Ramatsobane and Anthony (2020), the aqueous extracts of wild and cultivated Alepidea amatymbica rhizomes has more percentage alkaloids, phenolic compounds and tannin than the aqueous extract of Crinum jagus bulb analyzed in this study. In a study conducted by Gbadamosi et al. (2024), Morinda lucida, Solanum erianthum and Dryopteris expansa were reported to be lower in oxalates and phytates contents than the aqueous extract of Crinum jagus bulb.

Alkaloids have been reported to possess the ability to prevent the onset of diseases such as cancer, inflammation, atherosclerosis, coronary heart diseases, etc., through their free radical scavenging activities, or their capacity to bind with the catalyst required for the oxidative reaction (Roy, 2017; Aryal et al., 2022; Rajput et al., 2022; de Lima et al., 2025). Phenols, flavonoids and tannins are antioxidants. Their antioxidant protection activity is mediated by the ability of the hydroxyl groups in their structure to donate electrons to the free radicals, thus acting as a reducing agent, and by so doing, scavenge free radicals (D'Amelia et al., 2018; Dias et al., 2021; Šamec et al., 2021), thereby lowering the risk of cardiovascular diseases that could lead to convulsive syncope. Flavonoids also act as vasodilators, which enhance adequate blood supply to the brain thus preventing convulsive syncope (Maleki et al., 2019; Al-Khayri et al., 2022; Rakha et al., 2022). Saponins are hypolipidemic agents, lowering cholesterol and low density lipoprotein concentrations in the blood by interacting with cholesterol and phospholipids in the cell membrane, thereby preventing dyslipidemia, an atherosclerotic cardiovascular disease development risk factor that could lead to convulsive syncope (Parmenter et al., 2020; Micek et al., 2021; Rojewska et al., 2023; Xiao et al., 2025). Cardiac glycosides are steroids with specific action on the cardiac muscle. They increase the force of heart contraction without increasing oxygen consumption, thus making the myocardium more efficient in pumping blood to meet the brain and body demands. (Patel, 2016; Hennissen, 2017; Dominic, 2022; Gupta, 2024; Ponce and Contreras, 2025). Anthraquinones increase the concentration of fluid in the large intestine and aid colon peristalsis due to their laxative property, thus permitting easy bowel movements and constipation relief, which help in maintaining internal balance of an individual, which is major in maintaining body posture and muscle tone, thus preventing syncope (Cirillo and Capasso, 2015; Enas and Christa, 2016; Nida, 2019; Ma et al., 2022; Chiarioni et al., 2023). Dietary phytate has been reported to prevent kidney stone formation, atherosclerosis and coronary heart diseases, which may be causes for convulsive syncope (Jasia et al., 2017; Ekramzadeh et al., 2023; Katoch et al., 2023; Upadhyay et al., 2023). Oxalates and phytates help in mopping up excess calcium and potassium in the body which could cause action potential that could trigger seizure, due to their ability to bind these ions (Mitchell et al., 2019; Crivelli et al., 2020; Ermer 2023; Liu et al., 2023). The presence of these phytochemicals and their functions are supportive evidences that Crinum jagus bulb possesses anti-convulsive syncope properties.

The antioxidant activities from different methods as shown in Chat 2 revealed that the aqueous extract showed significant antioxidant power against DPPH radical. It has high total antioxidant capacity and ferric reducing power. It also diplayed significant 2, 20-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid and nitric oxide scavenging activities. Udugbunam et al. (2015), reported significant antioxidant activity of methanol extract of Crinum jagus bulb as a means by which Crinum jagus bulb exhibited wound healing activity. Mvongo et al. (2016) also reported a similar result in their antioxidant and anti-diabetic activities studies of aqueous and water-ethanol extracts of Crinum jagus on rats induced with diabetes, as the extracts caused substantial lowering of fasting glycemia and restored difference in seric and urinary electrolytes. Similarly, Ode et al. (2010) reported that Crinum jagus extract possessed a significantly high antioxidant activity better than vitamin C. So also, Mvongo et al. (2015) stated that the aqueous and ethanol-water extracts of Crinum jagus showed significant antioxidant power against 1.1-Diphenyl-2-picrylhydrazyl activity, ferrous ions chelating ability and nitric oxide radical inhibiting activity. The study conducted by Alawode (2024) revealed that Crinum jagus bulb extract displayed significant antioxidant activity. The reports of these authors agree with the results of this study. Free radicals are generated by normal body processes, and they move about in the body damaging cells, causing a number of health conditions if there are no sufficient antioxidants in the body to scavenge their activities. The formation of plaque on the artery walls (atherosclerosis) caused by the accumulation of oxidized low-density

lipoproteins narrows arteries, which prevents heart arteries from delivering enough oxygenated blood from the lungs to the heart. This will prevent adequate blood supply from the heart to the brain, which may cause convulsive syncope (Indermuehle et al., 2011; Dalen et al., 2014; Anderson and Morrow, 2017; Al-Khatib et al., 2018; Ralapanawa and Sivakanesan, 2021; Babakr, 2025). Crinum jagus bulb aqueous extract possesses good antioxidant property that could be employed in the prevention and treatment of diseases that could be caused by the release of free radicals by various mechanisms in the body.

Statistical Analysis

Statistical analysis revealed that the difference in the scavenging activity of the extract across the methods used is significant, p-value < 0.05. Post hoc analysis revealed that the scavenging activity of the extract was significantly higher on DPPH than FRAP, TEAC and Total antioxidant power ($P < 0.01$), but the difference between the percentage scavenging activity of the extract against DPPH and nitric oxide was not significant ($P > 0.01$).

CONCLUSION

Crinum jagus bulb contains phytochemicals constituents that are of significant importance in the treatment of convulsive syncope, and also possesses good antioxidant activities as revealed by the results of this study. Based on the results of this study, further in vivo and clinical studies should be carried out on the aqueous extract to establish its anti-convulsive syncope property, which could bring about the motivation to develop this aqueous extract into a potent anti-convulsive syncope agent that will be cheaper and readily available for the masses

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Conflict of Interest

No conflict of interest

REFERENCES

1. Abubakar D. U. and Wakili, F. (2017). Phytochemical Screening and Elemental Analysis of the Crinum Jagus bulb. J. Chem. Soc. Nigeria, 42(2):53-55
2. Acampora, R., Marte, G., Scala, R., Lieto, M., Maida, P., & Mazzaferro, M. P. (2021). Recurrent convulsive syncope misdiagnosed as seizures due to a diaphragmatic hernia. Neurological Sciences, 42(11), 4727-4729.
3. Ahmed, M. B., Islam, S. U., Alghamdi, A. A., Kamran, M., Ahsan, H., and Lee, Y. S. (2022). Phytochemicals as chemo-preventive agents and signaling molecule modulators: current role in cancer therapeutics and inflammation. International Journal of Molecular Sciences, 23(24), 15765.
4. Akinyele, S. T., Elusiyan, C. A., Omisore, N. O., and Adewunmi, C. O. (2022). Antimalarial activities and alkaloids from Crinum jagus (Thomps) Dandy. Journal of Ethnopharmacology, 296, 115359.
5. Akuru U.B. and Amadi B.A. (2018). Phytochemicals and Antioxidant Properties of Some Selected Medicinal Plants**.** Journal of Pharmacognosy and Phytochemistry, 7(5): 283-285
6. Alawode, T. T. (2024). Phytochemical, Proximate and Mineral Analysis of Leaves and Bulb of Crinum jagus. International Journal of Basic Science and Technology, 10(3):283 – 291.
7. Alawode, T. T., Lajide, L., Owolabi, B. J., and Olaleye, M. T. (2021). Investigation of Bulb Extracts of Crinum jagus for Antibacterial and Antifungal Activities. Journal of Applied Sciences and Environmental Management, 25(1), 113-117.
8. Aliyu, I. M. A., Magaji, M. G., Yau, J., and Muhammed, D. N. (2025). Ethnobotanical survey of medicinal plants used in the management of asthma in North-Western Nigeria. Journal of Medicinal Plants Research, 19(6):85-91.

9. Al-Khatib, S. M., Stevenson, W. G., Ackerman, M. J., Bryant, W. J., Callans, D. J., Curtis, A. B., Deal, B. J., Dickfeld, T., Field, M. E., Fonarow, G. C., Gillis, A. M., Granger, C. B., Hammill, S. C., Hlatky, M. A., Joglar, J. A., Kay, G. N., Matlock, D. D., Myerburg, R. J., and Page, R. L. (2018). 2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. Circulation, 138(13), e210–e271.
10. Al-Khayri, J. M., Sahana, G. R., Nagella, P., Joseph, B. V., Alessa, F. M., and Al-Mssallem, M. Q. (2022). Flavonoids as potential anti-inflammatory molecules: A review. Molecules, 27(9):2901.
11. Amakor, A., and Shagal, M. H. Exploring the Antivenom Potentials of Crinum Jagus Bulbs in the Treatment of Snake Bite from Girei, Adamawa State, Nigeria. International Journal of Reseach and Scientific Innovation, XI (VII):790-794.
12. Anderson, J. L., and Morrow, D. A. (2017). Acute Myocardial Infarction. The New England journal of medicine, 376(21), 2053–2064.
13. Aryal, B., Raut, B. K., Bhattarai, S., Bhandari, S., Tandan, P., Gyawali, K., Sharma, K., Ranabhat, D., Thapa, R., Aryal, D., Ojha, A., Devkota, H. P., and Parajuli, N. (2022). Potential Therapeutic Applications of Plant-Derived Alkaloids against Inflammatory and Neurodegenerative Diseases. Evidence-based complementary and alternative medicine, 2022(1):7299778.
14. Atunwa, S. A. (2023). Evaluation of the neurocognitive and neuroprotective potentials of selected Nigerian medicinal plants in experimental models of dementia. Alzheimer's Dementia, 19: e080714.
15. Babakr A. T. (2025). Oxidized low-density lipoproteins and their contribution to atherosclerosis. Exploration of Cardiology, 3:101246.
16. Behnoush, A. H., Yazdani, K., Khalaji, A., Tavolinejad, H., Aminorroaya, A., Jalali, A., and Tajdini, M. (2023). Pharmacologic prevention of recurrent vasovagal syncope: A systematic review and network meta-analysis of randomized controlled trials. Heart Rhythm, 20(3), 448-460.
17. Bergfeldt, L. (2003). Differential diagnosis of cardiogenic syncope and seizure disorders. Heart, 89(3): 353-358.
18. Botts, S. R., Fish, J. E., and Howe, K. L. (2021). Dysfunctional vascular endothelium as a driver of atherosclerosis: emerging insights into pathogenesis and treatment. Frontiers in pharmacology, 12:3787.
19. Cañas, S., Rebollo-Hernanz, M., Bermúdez-Gómez, P., Rodríguez-Rodríguez, P., Braojos, C., Gil-Ramírez, A., and Martín-Cabrejas, M. A. (2023). Radical scavenging and cellular antioxidant activity of the cocoa shell phenolic compounds after simulated digestion. Antioxidants, 12(5):1007.
20. Chandimali, N., Bak, S. G., Park, E. H., Lim, H. J., Won, Y. S., Kim, E. K., and Lee, S. J. (2025). Free radicals and their impact on health and antioxidant defenses: A review. Cell death discovery, 11(1):19.
21. Chen, J. and Mehta, J. L. (2006). Interaction of oxidized low-density lipoprotein and the renin-angiotensin system in coronary artery disease. Current hypertension reports, 8(2):13.
22. Chiarioni, G., Popa, S. L., Ismaiel, A., Pop, C., Dumitrascu, D. I., Brata, V. D., and Surdea-Blaga, T. (2023). Herbal remedies for constipation-predominant irritable bowel syndrome: a systematic review of randomized controlled trials. Nutrients, 15(19):4216.
23. Cirillo C, and Capasso R. (2015) Constipation and botanical medicines: an overview. Phytotherapy Research 29(10):1488-1493.
24. Crivelli, J. J., Mitchell, T., Knight, J., Wood, K. D., Assimos, D. G., Holmes, R. P., and Fargue, S. (2020). Contribution of dietary oxalate and oxalate precursors to urinary oxalate excretion. Nutrients, 13(1):62.
25. D'Amelia, V., Aversano, R., Chiaiese, P., Carputo, D. (2018**).** The antioxidant properties of plant flavonoids: Their exploitation by molecular plant breeding. Phytochem. Review, 17:611–625.
26. da Silva, J. F. P., da Silva, T. R. L. P., de Santana, A. L. F., Gomes-Copeland, K. K. P., Gomes, J. V. D., Estrada-Semprun, O. E., and Silveira, D. (2025). The underexplored chemical diversity and biological potential of Amaryllidaceae from Cerrado. Discover Plants, 2(1):240.
27. Dalen, J. E., Alpert, J. S., Goldberg, R. J., and Weinstein, R. S. (2014). The epidemic of the 20(th) century: coronary heart disease. The American journal of medicine, 127(9):807–812.
28. de Lima, E. P., Laurindo, L. F., Catharin, V. C. S., Direito, R., Tanaka, M., Jasmin Santos German, I., and Barbalho, S. M. (2025). Polyphenols, alkaloids, and terpenoids against neurodegeneration: Evaluating the neuroprotective effects of phytocompounds through a comprehensive review of the current evidence. Metabolites, 15(2):124.

29. Dias, M. C., Pinto, D. C., and Silva, A. M. (2021). Plant flavonoids: Chemical characteristics and biological activity. Molecules, 26(17):5377.
30. Dominic, P., Ahmad, J., Awwab, H., Bhuiyan, M. S., Kevil, C. G., Goeders, N. E., and Olshansky, B. (2022). Stimulant drugs of abuse and cardiac arrhythmias. Circulation: Arrhythmia and electrophysiology, 15(1): e010273.
31. Ejelonu, Oluwamodupe Cecilia; Elekofehinti, Olusola Olalekan; Adanlawo, and Isaac Gbadura (March 2017). "Tithonia diversifolia saponin-blood lipid interaction and its influence on immune system of normal wistar rats". Biomedicine and Pharmacotherapy. 87:589–595.
32. Ekramzadeh, M., Moore, L. W., Kalantar-Zadeh, K., and Kopple, J. D. (2023). Phytate and kidney health: the roles of dietary phytate in inhibiting intestinal phosphorus absorption and Intravenous phytate in decreasing soft tissue calcification. Journal of Renal Nutrition, 33(2):225-227.
33. Enas M M. and Christa E M. (2016). Anthraquinones as Pharmacological Tools and Drugs. Med Res Rev 36(4):705-48.
34. Ermer, T., Nazzal, L., Tio, M. C., Waikar, S., Aronson, P. S., and Knauf, F. (2023). Oxalate homeostasis. Nature Reviews Nephrology, 19(2):123-138.
35. Flevari P, Livanis E.G, Theodorakis G.N, Zarvalis E, Mesiskli T, and Kremastinos D T H (2002). Vasovagal syncope. A prospective, randomized, crossover evaluation of the effect of propranolol, nadolol and placebo on syncope recurrence and patient's well-being. Journal of the American College of Cardiology; 40:499– 504.
36. Gbadamosi A. S. Oseni M.O. and Oseni O.A. (2024). Phytochemical Analysis, Antioxidant Properties, Anti-nutrient Contents and Antimicrobial Study of Aqueous Extract of Morinda lucinda, Solanum erianthun, and Dryopteris expansa. Asian Plant Research Journal, 12(5): 56-66.
37. Gbolade, A. A. (2020). Nigerian medicinal plants with anti-snake venom activity. A review. Journal of Malaria Research and Phytomedicine, 1(1):29-44.
38. Gharu, C. P. (2022). Defense mechanism of natural antioxidants against free radicals. Central Asian Journal of Medical and Natural Science, 3(5):163-170.
39. Gupta, N. S. (2024). Therapeutic Efficacy of the Plant Bioactive Phytochemicals with Special Reference to Alkaloids, Terpenoids, Phenolics and Cardiac Glycosides. International Journal of Plant and Environment, 10(01):22-30.
40. Halliwell, B. (2024). Understanding mechanisms of antioxidant action in health and disease. Nature Reviews Molecular Cell Biology, 25(1):13-33.
41. Hennissen, L., Bakker, M. J., Banaschewski, T., Carucci, S., Coghill, D., Danckaerts, M. and Adduce Consortium. (2017). Cardiovascular effects of stimulant and non-stimulant medication for children and adolescents with ADHD: a systematic review and meta-analysis of trials of methylphenidate, amphetamines and atomoxetine. CNS drugs, 31:199-215.
42. Ibrahim Sani et a (2020). Scholars International Journal of Traditional and Complementary Medicine, 3(6):111-117.
43. Igbari, A. D., Ejugwu, V. J., Nodza, G. I., and Ogundipe, O. T. (2023). Ethnobotanical survey and phytochemical screening of medicinal plants used in the management of asthma in Lagos Metropolis. Journal of Herbs, Spices and Medicinal Plants, 29(4):405-418.
44. Indermuehle, A., Crake, T. and Meier, P. (2011). Oxidized low-density lipoprotein cholesterol and coronary artery disease. Cardiology, 119 (2):106.
45. Inoue, T., Uchida, T., Kamishirado, H., Takayanagi, K., Hayashi, T. and Morooka, S. (2001). Clinical significance of antibody against oxidized low density lipoprotein in patients with atherosclerotic coronary artery disease. Journal of the American College of Cardiology, 37(3):775-779.
46. Jasia N., Tehmeena A., Naik H. R. and Hussain S.Z. (2017). A review phytic acid: As antinutrient or nutraceutical. Journal of Pharmacognosy and Phytochemistry, 6(6):1554-1560.
47. Jayawardena, T. U., Merindol, N., Liyanage, N. S., Gélinas, S. E., Lionel, B., Seydou, K. and Desgagné-Penix, I. (2025). Antiviral alkaloids from Crinum jagus: Extraction, synergistic effects, and activity against dengue virus and human coronavirus OC43. Heliyon, 11(4): e42580.
48. Kabir, S., Ogwuche, C. E., Tijjani, A., Gafar, M. K., Shah, S. A. A., and Mzozoyana, V. (2025). Phytochemical Pro-filing and Identification of Bioactive Phyto-Compounds Present in the Rhizome of Crinum Jagus. Journal of Molecular Genetics and Gene Research, 1(1):01-07.

49. Kanjwal, K., Karabin, B., Kanjwal, Y., and Grubb, B. P. (2009). Differentiation of convulsive syncope from epilepsy with an implantable loop recorder. International journal of medical sciences, 6(6), 296.
50. Katoch, R., Sanadya, S. K., Pathania, K., and Chaudhary, H. K. (2023). Nutritional and nutraceutical potential of rice bean (Vigna umbellata)–a legume with hidden potential. Frontiers in Nutrition, 10: 1126544.
51. Kokorelis, C., and Rowe, P. C. (2025). Seizure Versus Convulsive Syncope: A Case Report. Clinical pediatrics, 64(2):161-164.
52. Li, J., Lin, S., Vanhoutte, P. M., Woo, C. W., and Xu, A. (2016). Akkermansia muciniphila protects against atherosclerosis by preventing metabolic endotoxemia-induced inflammation in Apoe−/− mice. Circulation, 133(24):2434-2446.
53. Liu, Y., Lu, S., Meng, J., Xiang, H., Korma, S. A., Cacciotti, I., and Cui, C. (2023). Complexation between egg yolk protein hydrolysate, phytic acid and calcium ion: Binding mechanisms and influence on protein digestibility and calcium uptake. Lwt, 184: 114986.
54. Ma, Q., Wang, C. Z., Sawadogo, W. R., Bian, Z. X., and Yuan, C. S. (2022). Herbal medicines for constipation and phytochemical comparison of active components. The American Journal of Chinese Medicine, 50(03):723-732.
55. Maleki, S.J., Crespo, J.F. and Cabanillas, B. (2019).Anti-inflammatory effects of flavonoids. Food Chem. 299: 125124.
56. Mariama Salihu, Gaber El-Saber Batiha, Keneth Iceland Kasozi, George D. Zouganelis, Souty M.Z. Sharkawi, Eman Ibrahim Ahmed, Ibe Michael Usman, Halima Nalugo, Juma J. Ochieng, Ibrahim Ssengendo, Olatayo Segun Okeniran, Theophilus Pius, Kyobe Ronald Kimanje, Eric Simidi Kegoye, Ritah Kenganzi and Fred Ssempijja (2022). Crinum jagus (J. Thomps. Dandy): Antioxidant and protective properties as a medicinal plant on toluene-induced oxidative stress damages in liver and kidney of rats, Toxicology Reports, 9: 699-712.
57. Micek, A., Godos, J., Del Rio, D., Galvano, F., and Grosso, G. (2021). Dietary flavonoids and cardiovascular disease: a comprehensive dose–response meta-analysis. Molecular nutrition and food research, 65(6):2001019.
58. Minkah, P. A. B., and Danquah, C. A. (2021). Anti-infective, anti-inflammatory and antipyretic activities of the bulb extracts of Crinum jagus (J. Thomps.) Dandy (Amaryllidaceae). Scientific African, 12:e00723.
59. Mitchell, T., Kumar, P., Reddy, T., Wood, K. D., Knight, J., Assimos, D. G., and Holmes, R. P. (2019). Dietary oxalate and kidney stone formation. American Journal of Physiology-Renal Physiology, 316(3):F409-F413.
60. Mvongo C., P. A Noubissi, R. Kamyang, C. S. Minka, A. Mfopa, S.B Abhijit and Y. M. Ramkrishna (2015). Phytochemical analysis, antioxidant potential of two different extract of crinum anti antibacterial properties of some selected Indian jagus. Int. J. Pharm. Sci. Res., 6(5): 2354-2359.
61. Nida T. K. (2019) Anthraquinones-A Naturopathic Compound. Journal of New Developments in Chemistry, 2(2):25-28.
62. Ode O. J, Nwaehujor C. O. and Onakpa M.M. (2010): Evaluation of anti-hemorrhagic and antioxidant potentials of Crinum jagus bulbs. International Journal of Applied Biology and Pharmaceutical Technology, 1(3):1330–1336.
63. Opiyo, S. A., and Njoroge, P. W. (2024). Plant extracts and terpenes with antivenom properties. IOSR Journal of Applied Chemistry, 17(3)1:31-41.
64. Otitolaiye, C., Omonkhua, A., Oriakhi, K., Okello, E., Onoagbe, I., and Okonofua, F. (2023). Phytochemical Analysis and in vitro Antioxidant Potential of Aqueous and Ethanol Extracts of Irvingia gabonensis Stem Bark. Pharmacognosy Research, 15(2): 363-372.
65. Parmenter, B. H., Croft, K. D., Hodgson, J. M., Dalgaard, F., Bondonno, C. P., Lewis, J. R., and Bondonno, N. P. (2020). An overview and update on the epidemiology of flavonoid intake and cardiovascular disease risk. Food and function, 11(8): 6777-6806.
66. Patel S (2016). "Plant-derived cardiac glycosides: Role in heart ailments and cancer management". Biomedicine & Pharmacotherapy. 84:1036–1041.
67. Ponce, A., Flores-Maldonado, C., and Contreras, R. G. (2025). Cardiac Glycosides: From Natural Defense Molecules to Emerging Therapeutic Agents. Biomolecules, 15(6):885.
68. Prajapati, M., Jayswal, S., and Maitreya, B. (2019). Phytochemical screening and comparative study of antioxidant activity of Cuminum cyminum L. and Nigella sativa L. Int J Basic Appl Res, 9:1305-15.

69. Rajput, A., Sharma, R., and Bharti, R. (2022). Pharmacological activities and toxicities of alkaloids on human health. Materials Today: Proceedings, 48:1407-1415.
70. Rakha, A., Umar, N., Rabail, R., Butt, M. S., Kieliszek, M., Hassoun, A.,and Aadil, R. M. (2022). Anti-inflammatory and anti-allergic potential of dietary flavonoids: A review. Biomedicine and Pharmacotherapy, 156:113945.
71. Ralapanawa, U., and Sivakanesan, R. (2021). Epidemiology and the Magnitude of Coronary Artery Disease and Acute Coronary Syndrome: A Narrative Review. Journal of epidemiology and global health, 11(2):169–177.
72. Ramatsobane Maureen Mangoale and Anthony Jide Afolayan (2020). Comparative Phytochemical Constituents and AntioxidantActivity of Wild and Cultivated Alepidea amatymbica Eckl and Zeyh. Hidawi Research International journal, 2020:13.
73. Ridwanto, R., Trizaldi, A., Rani, Z., Daulay, A. S., Nasution, H. M., and Miswanda, D. (2023). Antioxidant Activity Test of Methanol Extract of Gaharu (Aquilaria Malaccensis Lam.) Bark with DPPH (1, 1 Diphenyl-2-Picrylhydrazyl) Method. International Journal of Health and Pharmaceutical (IJHP), 3(2): 232-240.
74. Rojewska, M., Smułek, W., Grzywaczyk, A., Kaczorek, E., and Prochaska, K. (2023). Study of interactions between saponin biosurfactant and model biological membranes: phospholipid monolayers and liposomes. Molecules, 28(4):1965.
75. Roy, A. (2017). A review on the alkaloids an important therapeutic compound from plants. International Journal of Pharmaceutical Biotechnology, 3(2):1-9.
76. Šamec, D.; Karalija, E.; Šola, I.; Bok, V.V.; Salopek-Sondi, B. (2021).The role of polyphenols in abiotic stress response: The influence of molecular structure. Plants, 10:118.
77. Santos, T. C. D., Gomes, T. M., Pinto, B. A. S., Camara, A. L., and Paes, A. M. D. A. (2018). Naturally occurring acetylcholinesterase inhibitors and their potential use for Alzheimer's disease therapy. Frontiers in Pharmacology, 9:1192.
78. Scarabelli C.C. and Scarabelli T.M (2004). Convulsive syncope. British Medical Journal, 329: 336– 41.
79. Shan, K., Jiang, Q., Wang, X. Q., Wang, Y., Yang, H., Yao, M. D. and Yan, B. (2016). Role of long non-coding RNA-RNCR3 in atherosclerosis-related vascular dysfunction. Cell death and disease, 7(6): e2248-e2248.
80. Soker, E. B., Erdem, M., Ozdogru, D., Coddu, C., and Gulen, M. (2025). The Role of Serum Biomarkers in Differential Diagnosis of Epileptic Seizures, Functional/Cognitive Seizure and Syncope: A Cross-sectional Study. Clinical Neurology and Neurosurgery, 258:109123.
81. Udegbunam, S. O., Udegbunam, R. I., Nnaji, T. O., Anyanwu, M. U., Kene, R. O. C., and Anika, S. M. (2015). Antimicrobial and antioxidant effect of methanolic Crinum jagus bulb extract in wound healing. Journal of Intercultural Ethnopharmacology, 4(3):239.
82. Upadhyay, J., Tiwari, N., Durgapal, S., Jantwal, A., and Kumar, A. (2022). Phytic acid: As a natural antioxidant. In Antioxidants effects in health, Elsevier, page 437-450.
83. Xiao, M. Y., Li, S., Pei, W. J., Gu, Y. L., and Piao, X. L. (2025). Natural Saponins on Cholesterol-Related Diseases: Treatment and Mechanism. Phytotherapy Research, 39(3):1292-1318.