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BOTANY, ETHNOMEDICINAL USES, PHYTOCHEMISTRY AND PHARMACOLOGY OF *Crinum latifolium*: AN OVERVIEW

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ABSTRACT

Crinum latifolium, a prominent species of the Amaryllidaceae family, holds significant medicinal value in traditional and modern therapeutic systems. Known for its diverse pharmacological activities, including anti-inflammatory, antitumor, antiviral, and immunomodulatory properties, this perennial herb is extensively utilized in ethnomedicine across Asia and beyond. Its phytochemical profile includes alkaloids such as lycorine, crinamine, and haemanthamine, alongside flavonoids, saponins, and terpenoids, which contribute to its therapeutic efficacy. *Crinum latifolium* has been particularly recognized for its potential in managing conditions like benign prostatic hyperplasia, inflammatory disorders, and cancer. This review provides a comprehensive overview of the botany, ethnomedicinal applications, phytochemical constituents, and pharmacological activities of *Crinum latifolium*. Key studies highlight its immunomodulatory, hepatoprotective, and antioxidant properties, while toxicity evaluations underscore the importance of dose standardization to mitigate cytotoxic risks. Moreover, recent advancements in pharmacognosy and analytical chemistry have identified novel bioactive compounds, enhancing its pharmacological relevance. This synthesis of traditional knowledge and scientific findings aims to foster a deeper understanding of *Crinum latifolium*, emphasizing its potential as a sustainable resource for drug discovery and development. Future research directions are also identified, focusing on advanced clinical studies, molecular mechanisms, and formulation optimization.

Keywords: Medicinal plant, *Crinum latifolium*, ethomedicinal uses, phytochemistry, pharmacology, etc.

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INTRODUCTION

Medicinal plants have played a pivotal role in human health and wellness since ancient times, serving as a foundation for traditional and modern therapeutic systems. They are considered the most valuable natural resources for bioactive compounds and remain integral to pharmacology, ethnomedicine, and modern drug discovery [1]. Over 80% of the world's population relies on plant-based remedies for primary healthcare, particularly in developing countries, where traditional medicine systems such as Ayurveda, Traditional Chinese Medicine (TCM), and Siddha are still widely practiced [2,3]. Medicinal plants offer rich phytochemical diversity, including alkaloids, flavonoids, terpenoids, and phenolics, which exhibit a broad spectrum of pharmacological activities. These natural compounds form the basis for numerous synthetic drugs, underscoring the importance of exploring and conserving medicinal plant species for sustainable therapeutic solutions[4].

Among the diverse plant genera used for medicinal purposes, *Crinum*, a genus of the Amaryllidaceae family, holds significant therapeutic value [5,6]. *Crinum* is a large genus consisting of approximately 180 species distributed across tropical and subtropical regions worldwide, particularly in Asia, Africa, and South America[7]. Plants belonging to this genus are perennial, bulbous herbs often found in marshy areas, riverbanks, and coastal regions. Species of *Crinum* are well-recognized in traditional medicine for their extensive pharmacological properties, including anti-inflammatory, analgesic, antitumor, anti-viral, and immunomodulatory activities. The genus is rich in Amaryllidaceae alkaloids such as lycorine, crinamine, and haemanthamine, which are bioactive compounds renowned for their anti-cancer and anti-microbial potential [8]. These alkaloids are unique to the Amaryllidaceae family and have attracted global research interest due to their ability to inhibit tumor growth and modulate cellular pathways [9].

One of the most prominent species in this genus is *Crinum latifolium*, a perennial herb native to Southeast Asia, including regions of India, Vietnam, and Thailand [10]. *C. latifolium* is traditionally known as "Sudarsana" in Ayurveda and "Thap Sam" in Vietnamese medicine, where it is widely used for its therapeutic properties[11]. This plant is characterized by its long, lance-shaped leaves, trumpet-shaped pink to white flowers, and large underground bulbs that store essential bioactive compounds. *Crinum latifolium* has been extensively utilized in folk medicine for managing a variety of ailments, including inflammatory diseases, gastrointestinal disorders, and gynecological issues. Most notably, it has gained attention for its potential in treating benign prostatic hyperplasia (BPH), tumors, and immune-related conditions [12,13].

The medicinal importance of *C. latifolium* lies in its rich phytochemical composition. The plant contains a diverse range of bioactive compounds, including alkaloids (lycorine, crinamine), flavonoids, saponins, and terpenoids, which contribute to its therapeutic effects. Alkaloids, such as lycorine, have demonstrated potent anti-tumor and anti-inflammatory activities, making *C. latifolium* a promising candidate for cancer research. Additionally, flavonoids and phenolic compounds present in the leaves and flowers provide strong antioxidant properties, which are critical for combating oxidative stress-related disorders. In recent years, pharmacological studies have confirmed the ethnomedicinal claims of *C. latifolium*, highlighting its immunomodulatory, anti-inflammatory, hepatoprotective, and anti-cancer activities. Toxicological studies have also demonstrated its safety when administered in therapeutic doses, though higher concentrations warrant caution due to the cytotoxic nature of its alkaloids.

This review provides a comprehensive overview of the botany, ethnomedicinal uses, phytochemistry, and pharmacology of *Crinum latifolium*, aiming to bridge the gap between traditional knowledge and modern scientific understanding. It highlights the immense therapeutic potential of this medicinal plant while identifying future research opportunities for its sustainable utilization in medicine and drug discovery.

Botanical Description

Crinum latifolium is a perennial herbaceous plant belonging to the Amaryllidaceae family, known for its robust growth and medicinal properties. It has long, sword-like green leaves that can reach up to 1 meter in length, forming a rosette-like arrangement. The plant produces trumpet-shaped flowers, typically white to pale pink, arranged in umbels on long, erect scapes. Its underground bulb is large, fleshy, and capable of storing nutrients, enabling the plant to thrive in tropical and subtropical regions. This resilient plant is commonly found in coastal regions, marshy areas, and riverbanks, reflecting its adaptability to moisture-rich environments [14].

Ethnomedicinal Uses

S.No	Plant Part	Ethnomedicinal Use
1	Bulb	Used in traditional medicine for reducing inflammation, pain, and as a diuretic.
2	Leaves	Applied as a poultice for swelling, wounds, and joint pain.
3	Flowers	Utilized in decoctions for relieving respiratory disorders and improving immunity.

4	Roots	Used as a remedy for gastrointestinal issues, including ulcers and constipation.
5	Whole plant extract	Traditionally consumed as a tea for gynecological problems and prostate health.

Phytochemistry

The phytochemical profile of *Crinum latifolium* includes a wide range of bioactive compounds, primarily alkaloids, flavonoids, saponins, and terpenoids. The alkaloids, such as lycorine, crinamine, and haemanthamine, are particularly significant for their anti-cancer and anti-inflammatory properties. Flavonoids and phenolic compounds are abundant in the leaves and flowers, providing antioxidant and hepatoprotective effects. The bulbs contain high levels of lycorine and crinamine, which contribute to its immunomodulatory and anti-tumor activities. Saponins and tannins are found in the roots and leaves, supporting their role in traditional remedies for digestive and inflammatory conditions [15].

Pharmacological Activities

Zvetkova E, *et al.,* (2001) investigated the, hot aqueous extract of Crinum latifolium is used for antitumor activity in Vietnamese and Chinese traditional medicine. The genus Crinum is thought to possess antiviral and immunostimulative properties. Green and black teas derived from Camellia sinensis have similar qualities. A growing body of evidence suggests that moderate consumption of green and black tea may protect, e.g., against several forms of cancer, cardiovascular diseases, and bacterial infections. In this study, the immunomodulatory property of C. latifolium (L.) extracts should further be investigated and compared to those of black and green tea. Human peripheral mononuclear cells were cultured in the presence of tea extracts with or without mitogens or interferon-γ. The effect of plant extracts on cultured cells was assayed by neopterin production, a sensitive marker reflecting the activation of cell-mediated immunity. Our experiments showed that extracts of *C. latifolium* (L.) slightly enhance neopterin production in unstimulated peripheral mononuclear cells, whereas an effective reduction of neopterin formation in cells stimulated with concanavalin A (Con A), phytohemagglutinin (PHA), or interferon-γ (IFN-γ) was observed. Green and black tea extracts displayed similar immunomodulatory properties in our in vitro system, whereas C. latifolium (L.) extracts seemed to be more effective in reducing neopterin formation in stimulation [16].

Nguyen TNC, *et al.,* (2002) studied the "GC-MS of *Crinum latifolium* L. and reported that GC-MS analysis identified 15 alkaloids, 9 will be found for the first time in this plant. Almost

all alkaloids belonged to the crinane type. Substantial changes in the methylation and oxidation pattern of the alkaloids at and after flowering will be observed [17].

Yakandavala DMD*, et al.*, (2006) have been reported "an empirical study on the taxonomy of *crinum zeylanicum* (l.) L. and *Crinum latifolium* Linn. (amaryllidaceae) in srilanka. *Crinum latifolium* Linn. and *C. zeylanicum* (L.) is two *Crinum* species native to Sri Lanka, but their species delimitation has been a point of debate since their establishment as separate species. During the recent revision of the Sri Lankan Amaryllidaceae, both species have been recognized. The separation of the two species is based on the leaf undulation and the size of the leaves. Field experiences suggest the occurrence of *Crinum* species with other distinct characters, raising the question of their species limits. Therefore, a detailed taxonomic study on species limits of *C. latifolium* and *C. zeylanicum* will be carried out to solve the taxonomic ambiguity, based on empirical methods. Specimens will be collected from all possible geographical locations. Morphological characteristics with distinct character states will be studied at both macroscopic and microscopic level and coded into data matrices. Species limits will be determined by phenetic and phylogenetic methods. The results clearly suggested the occurrence of two morphologically distinct groups supporting the recognition of *C. latifolium* Linn. and *C. zeylanicum*(L.) L. Furthermore, two morphologically distinct forms of *C. zeylanicum*will be identified as occurring in Sri Lanka which had not been previously recorded. In view of the fact that the characters of these two types are stable and not dependent on the environment, formal taxonomic ranks could be offered [18].

Solanki J*, et al.*, (2011) examined that phytochemical evaluation of *Crinum latifolium* leaves would be subjected to successive solvent extraction using petroleum ether, chloroform, hydroalcoholic solution and water. These extracts will be then screened for presence of different chemical constituents. Thin layer chromatography (TLC) performed to determine the active principles. These studies are useful in identification, chemical characterization of *Crinum latifolium* and to explore its phytochemical and pharmacological potential [19].

Jenny M, *et al.*, (2011) studied *Crinum latifolium* Leave extracts suppress immune activation cascades in peripheral blood mononuclear cells and proliferation of prostate tumor cells and result revealed that *in vitro* antioxidant activity of an aqueous *Crinum latifolium* extract *by an* oxygen radical absorbance capacity (ORAC) value of 1610 ± 150μmol Trolox equivalents/g. Furthermore, significant anti-inflammatory effects of this extract will be shown by its potential to suppress indoleamine2,3-dioxygenase (IDO) mediated tryptophan degradation in un

stimulated- and mitogen-stimulated PBMC at IC50 doses of 241 ± 57 μg/ml and 92 ± 20 μg/ml, respectively [20].

Nguyen HY, *et al.,* (2013) investigated the total flavonoid extract, showed an inhibitory action on cancer cells via antioxidant activity. Alkaloid extracts inhibited the proliferation of lymphoma cells either by directly acting on tumour cells or by activating of the tumoricidal functions of syngeneic macrophages. The aqueous extract induced mRNA expression of tumour necrosis factor-α (TNF-α), interleukin-1β (IL-1β) and interleukin 6 (IL-6) indicating differentiation of macrophages into pro-inflammatory M1 polarized macrophages. The total flavonoid, alkaloid extracts and an alkaloid fraction induced the expression of the formyl peptide receptor (FPR) on the surface of the polarized macrophages that could lead to the activation of macrophages towards the M1 phenotype. Aqueous and flavonoid extracts enhanced NADPH quinine oxido-reductase 1 (NQO1) mRNA expression in polarized macrophages which could play an important role in cancer chemoprevention. All the samples studied will be non-toxic to normal living cells and the pure alkaloid tested, 6-hydroxycrinamidine, will be not active in any of the models investigated [21].

Dewan S, *et al.,* (2013) investigated the phytochemical nature (group determinant of plant extract) of crude methanolic extract of leaves of *Crinum latifolium* Linn. *Crinum latifolium* Linn. Leaves showed thrombolytic potential. Phytochemical analysis of the crude extract revealed the presence of alkaloid(s), carbohydrate(s), glycoside(s), phenol, tannin, protein(s), gum and mucilages. The thrombolytic nature of the plant will be found significant ($p < 0.001$) when compared with the negative control (water) at different doses. The plant showed moderate clot lysis, i.e. 14.64±0.540%, 18.01±0.766%, 21.78±1.039%, 28.43±0.982%, and 33.84±1.749% at 2, 4, 6, 8, and 10 mg/ml concentrations respectively, while the standard (streptokinase) showed 47.27±1.998% clot lysis. Therefore, the study tends to suggest good thrombolytic activity of crude methanolic extract of *C. latifolium* leaves *in vitro*; however, *in vivo* thrombolytic potentiality and active component(s) of the extract for clot lysis are yet to be discovered [22].

John Refaat *et al.,* (2013) have been reported that crinine-type alkaloids isolated from the genus *Crinum* in addition to their structural differences and distribution in different species. The extensive survey of literature presents crinine-type alkaloids as an endless source of bioactive principles. The major chemical constituents and 81 bases belonging to this alkaloid type were isolated and identified. Moreover, the unstudied species are still calling for phytochemical investigations that will add new members of these important bases [23].

Azizet A, *et al.*, (2014) studied in vitro evaluation of *Crinum latifolium* Linn for anthelmintic activity, total phenolic content and cytotoxic activity and reported that anthelmintic activity, total phenolic contents were found to be of the methanolic extract of the target plant [24].

Yadav M, *et al.*, (2016), have been reported the physicochemical and preliminary phytochemical studies on the leaves of *Crinum latifolium* Linn. of Amaryllidaceae family. Phytochemical analysis has recently yielded a vast array of compounds, including more than 150 different alkaloids, tannin, phenolic compound, flavonoids, terpenoids, amino acids, steroid, saponins and antioxidants. Hippadine, pratorinine, ambelline and lycorine, 2-epilyocorine and 2-epipancrassidine etc. have been isolated from this plant. The study revealed specific identities for the particular crude drug which will be useful in identification and control to adulterations of the raw drug [25].

Refaat J, *et al.*, (2018) investigated the *Crinum latifolium* is an important Amaryllidaceous plant have valuable biological and therapeutic activities of its chemical constituents, especially alkaloids. Many Crinum species have been commonly used in traditional medicines worldwide. It has been subjected to extensive chemical, cytological and pharmacological investigations. This work comprehensively comprised both the alkaloidal and non-alkaloidal principles of Crinums isolated from 1950 and up to now, together with various biological and toxicological studies conducted on both the total extracts and individual compounds. As being a major common class of Crinum alkaloids, the current part of this review work highlights the lycorine-type alkaloids isolated so far from this plant in addition to their distribution in different Crinum species [26].

Hong HTH, *et al.*, (2018) reported three new crinane-type alkaloids, namely, 6 methoxyundulatine (1), 6-methoxycrinamidine (2), and undulatine N-oxide (3), along with the known compounds 6-hydroxyundulatine (4), 6- hydroxybuphanidrine (5), undulatine (6), crinamidine (7), ambelline (8), filifoline (9), augustamine (10), and perlolyrine (11), were isolated from the leaves of Crinum latifolium by using various chromatographic separations. Their structures were established by extensive analysis, including 1D and 2D NMR, HR-QTOF-MS, and CD data [27].

Ming-Xin Chen, *et al.*, (2018) reported the four novel and potently bioactive Amaryllidaceae alkaloids, 4,8-dimethoxy-cripowellin C (1), 4,8-dimethoxy-cripowellin D (2), 9-methoxy-cripowellin B (3), and 4-methoxy-8-hydroxycripowellin B (4), together with one known alkaloid, cripowellin C (5) were isolated from the 95% EtOH extract of the bulbs of *Crinum*

latifolium. Structural elucidation of all the compounds were performed by spectral methods such as 1D and 2D (H- H COSY, HMQC, and HMBC) NMR as well as spectroscopy high resolution mass spectrometry. All isolates were in vitro evaluated for their cytotoxic activity against seven lung cancer cell lines, in addition to antimicrobial activity for eight bacteria, scavenging potential using ABTS and DPPH test, and anti-inflammatory activity for Cox-1 and Cox-2 which had not previously been tested for crinane-type alkaloids with the cleavage between C-1 and C-13. Consequently, alkaloids 1–5 exhibited potent cytotoxicity against all of seven tested tumor cell lines with (IC < 30 nM). Alkaloids 3 and 4 displayed the significant antimicrobial activity with IC values <0.50 mM and antioxidant activity in the ABTS and DPPH test. Additionally, Alkaloids 1–5 exhibited comparable inhibition of Cox-1 (>64%) and Cox-2 (>90%) with positive control [28].

Shukla PK, *et al.*, (2018) studied the pharmacognostical study along with the development of a quantitative HPTLC method for *Crinum latifolium* and evaluation of its traditional claims. The quantification of three marker compounds oleanolic acid, linoleic acid, and lupeol was done through HPTLC. *In vitro* antioxidant activity was determined by six different models, namely total phenolic and total flavonoid content, DPPH radical scavenging assay, ferric reducing power, antioxidant capacity and hydroxyl radical scavenging assay. *In vitro* antidiabetic activity was evaluated by α-amylase inhibition assay based on starch iodine and DNS method and result revealed that content of oleanolic acid, linoleic acid, and lupeol were found to be higher in aerial parts like 0.015%, 0.048%, and 0.028% respectively, while in root extract 0.006%, 0.027% and 0.025% respectively on a dry weight basis. Free radical scavenging activity was done by DPPH assay, showing the IC50 value of 410±1.105 µg/ml in roots and 441.95±1.788 in aerial parts. *In vitro* antidiabetic potential of both the parts were assessed by starch iodine color assay and DNS method of alpha-amylase inhibition model. In 3,5 DNS assay, IC50 of extract from aerial parts was 282.21±2.151µg/ml whereas in root extract it was 193.33±2.45µg/ml. Iodine-starch assay of *C. latifolium* (aerial part) shown the IC50 value of 340.81±0.49 µg/ml and *C. latifolium* (root) of 74.64±1.28 µg/ml. The results indicate that the aerial parts of the plant possess more antidiabetic potential in comparison to the root. Thus, the aerial part can be used to get better results as a drug and roots can be used as an alternative [29].

Vo TT, ***et al.*, (2019)** reported four bacterial strains were strongly inhibited by using the CL – AgNPs in antibacterial and anticancer activity Biosynthesis of silver nanoparticles (AgNPs) and gold nanoparticles (AuNPs) by using aqueous extract from *C. latifolium* leaf [30].

K K Pereira, *et al.,* (2020) reported that callogenesis on leaf explants of C. americanum cultivated in vitro for future production of alkaloids. Leaf explants were grown on a culture medium (solid) Murashige and Skoog (1962) supplemented with different concentrations and combinations of plant growth regulators, auxin 2,4-dichlorophenoxyacetic acid and cytokinin 6-benzylaminopurine and their effect on callogenesis assessed for percentage oxidation and explants responsive to callus induction. Callus formation started 10 days after hormone inoculation, and within 30 days after inoculation the best callogenesis and callus biomass growth were observed in medium containing 2.5 mg L-1 of 2,4-dichlorophenoxyacetic acid and 10 mg L-1 of 6-benzylaminopurine. The lowest percentage of oxidation was observed on explants cultivated on medium containing 5 mg L-1 of 6-benzylaminopurine and 2.5 mg L-1 of 2,4-dichlorophenoxyacetic acid. The calli obtained were compact and embryogenic [31].

Shweta Parihar, *et al.,* (2021) reported that *Crinum latifoliuma* well-known ornamental species and home-grown herb in India, that belong to the Amaryllidaceae family. *Crinum latifolium* is known as "Sudarshana" or Sukhdarshan in Ayurveda. The *Crinum latifolium* roots, stems, flowers and leaves are employed in herbal therapy, and also used as different home remedies [32].

CONCLUSION

Crinum latifolium exemplifies the therapeutic potential of medicinal plants, bridging traditional practices with modern pharmacological insights. Its diverse bioactive constituents, particularly the unique Amaryllidaceae alkaloids, position it as a valuable candidate for treating various ailments, from inflammatory and immune disorders to cancer. Ethnomedicinal uses corroborate with scientific findings, validating its role in integrative healthcare. Toxicity studies highlight the need for careful dose regulation, ensuring safety while maximizing therapeutic benefits. Despite its demonstrated efficacy, gaps remain in translating preclinical research into clinical applications. Further investigations are warranted to elucidate its molecular mechanisms, optimize extraction methods, and develop standardized formulations. By addressing these challenges, Crinum latifolium could play a pivotal role in the development of novel, plant-based therapeutics. This review underscores the importance of preserving and studying medicinal plants like *Crinum latifolium*, advocating for their sustainable use in global healthcare systems.

REFERENCES

1. Sofowora, A., Ogunbodede, E., & Onayade, A. (2013). The role and place of medicinal plants in the strategies for disease prevention. *African journal of traditional, complementary and alternative medicines*, *10*(5), 210-229.
2. Rizvi, S. A., Einstein, G. P., Tulp, O. L., Sainvil, F., & Branly, R. (2022). Introduction to traditional medicine and their role in prevention and treatment of emerging and re-emerging diseases. *Biomolecules*, *12*(10), 1442.
3. Pan, S. Y., Litscher, G., Gao, S. H., Zhou, S. F., Yu, Z. L., Chen, H. Q., & Ko, K. M. (2014). Historical perspective of traditional indigenous medical practices: the current renaissance and conservation of herbal resources. *Evidence-Based Complementary and Alternative Medicine*, *2014*(1), 525340.
4. Roy, A., Khan, A., Ahmad, I., Alghamdi, S., Rajab, B. S., Babalghith, A. O., & Islam, M. R. (2022). Flavonoids a bioactive compound from medicinal plants and its therapeutic applications. *BioMed Research International*, *2022*(1), 5445291.
5. Chahal, S., Lekhak, M. M., Kaur, H., Shekhawat, M. S., Dey, A., Jha, P., ... & Kumar, V. (2021). Unraveling the medicinal potential and conservation of Indian Crinum (Amaryllidaceae) species. *South African Journal of Botany*, *136*, 7-15.
6. Danquah, C. A., Minkah, P. A. B., Agana, T. A., Moyo, P., Ofori, M., Doe, P., & Gibbons, S. (2022). The phytochemistry and pharmacology of Tulbaghia, Allium, Crinum and Cyrtanthus:'talented'taxa from the Amaryllidaceae. *Molecules*, *27*(14), 4475.
7. Refaat, J., Kamel, M. S., Ramadan, M. A., & Ali, A. A. (2012). Crinum; an endless source of bioactive principles: a review. Part III; crinum alkaloids: Belladine-, galanthamine-, lycorenine-, tazettine-type alkaloids and other minor types. *International Journal of Pharmaceutical Sciences and Research*, *3*(10), 3630.
8. Fennell, C. W., & Van Staden, J. (2001). Crinum species in traditional and modern medicine. *Journal of ethnopharmacology*, *78*(1), 15-26.
9. Cahlíková, L., Breiterová, K., & Opletal, L. (2020). Chemistry and biological activity of alkaloids from the genus Lycoris (Amaryllidaceae). Molecules, 25(20), 4797.
10. Chaichompoo, W., Rojsitthisak, P., Pabuprapap, W., Siriwattanasathien, Y., Yotmanee, P., & Suksamrarn, A. (2024). Amaryllidaceae alkaloids from the bulbs of Crinum latifolium L. and their cholinesterase inhibitory activities. *Phytochemistry*, *217*, 113929
11. Thongphichai, W., Uttarawichien, T., Chanvorachote, P., Pitiporn, S., Charoen-Ame, T., Kwankhao, P., ... & Sukrong, S. (2022). Standardization of the ethanolic extract of Crinum latifolium leaves by two bioactive markers with antiproliferative activity against TGF-β-

promoted prostate stromal cells (WPMY-1). *BMC Complementary Medicine and Therapies*, *22*(1), 139.

12. Jenny, M., Wondrak, A., Zvetkova, E., Tram, N. T. N., Phi, P. T. P., Schennach, H., ... & Fuchs, D. (2011). Crinum latifolium leave extracts suppress immune activation cascades in peripheral blood mononuclear cells and proliferation of prostate tumor cells. *Scientia Pharmaceutica*, *79*(2), 323.
13. Jenny, M., Wondrak, A., Zvetkova, E., Tram, N. T. N., Phi, P. T. P., Schennach, H., & Fuchs, D. (2011). Crinum latifolium leave extracts suppress immune activation cascades in peripheral blood mononuclear cells and proliferation of prostate tumor cells. *Scientia Pharmaceutica*, *79*(2), 323.
14. Goyal, A., Devgun, M., Dahiya, L., Bisyan, S., Saini, G., & Kumar, D. (2023). Crinum latifolium: An Updated Review on its Pharmacognosy, Phytochemistry and Pharmacological Profile. Biological Forum-An International Journal,15(2),656-664.
15. de Araujo, R. L., de Pinho, C. L. C., Farias, F. O., Igarashi-Mafra, L., & Mafra, M. R. (2022). Crinum L. species as a potential source of alkaloids: Extraction methods and relevance for medicinal and pharmacological applications. *South African Journal of Botany*, *151*, 720-734.
16. Zvetkova, E., Wirleitner, B., Tram, N. T., Schennach, H., & Fuchs, D. (2001). Aqueous extracts of *Crinum latifolium* (L.) and *Camellia sinensis* show immunomodulatory properties in human peripheral blood mononuclear cells. *International Immunopharmacology*, *1*(12), 2143-2149.
17. Tram, N., Mitova, M., Bankova, V., & Handjieva, N. (2002). GC-MS of *Crinum latifolium* L. alkaloids. *Zeitschrift für Naturforschung*, *57*(3-4), 3-4.
18. Yakandawala, D., & Samarakoon, T. (2006). An empirical study on the taxonomy of *Crinum zeylanicum* (L.) L. and *Crinum latifolium* L. (Amaryllidaceae) occurring in Sri Lanka. *Sci Pharm*, *79*(2), 323–335.
19. Solanki, J., Dhiman, A., Nanda, A., & Dhankhar, A. (2011). Pharmacognostic and preliminary phytochemical evaluation of the leaves of *Crinum latifolium*. *International Journal of Pharmaceutical Sciences and Research*, *2*(12), 3219-3223.
20. Marcel, J. (2011). *Crinum latifolium* leaf extracts suppress immune activation cascades in peripheral blood mononuclear cells and proliferation of prostate tumor cells. *Scientia Pharmaceutica*, *79*(2), 323-335.
21. Dewan, S., & Das, A. (2013). Investigation of in vitro thrombolytic potential and phytochemical nature of *Crinum latifolium* leaves growing in the coastal region of

Bangladesh. *International Journal of Biological & Pharmaceutical Research, 4*(1), 2229-7480.

22. Nguyenhy, E. (2013). Extracts of *Crinum latifolium* inhibit the cell viability of mouse lymphoma cell line EL4 and induce activation of anti-tumor activity of macrophage. *Journal of Ethnopharmacology, 123*, 123-127.
23. Aziz, A., Sarwar, R. G., Das, A., Ahmed, J., & Moghal, M. M. (2014). Evaluation of in vitro anthelmintic activity, total phenolic content, and activity of *Crinum latifolium* L. *Advances in Pharmaceutics Bulletin, 2*(1), 159.
24. Yadav, M., Meena, A. K., & Rao, M. M. (2016). Physicochemical and preliminary phytochemical studies on the leaves of *Crinum latifolium* Linn. *Pharmacology Online, 1*, 497-512.
25. John, R., Mohamed, S., Mahmoud, A., & Ahmed, A. (2013). *Crinum*: An endless source of bioactive principles: Part 1—Crinum alkaloids: Lycorine-type alkaloids. *International Journal of Pharmaceutical Sciences and Research, 3*(9), 3091-3100.
26. John, R., Refaat, M. S., Ramadan, M. A., & Ali, A. A. (2018). *Crinum*: An endless source of bioactive principles: Part 1—Crinum alkaloids: Lycorine-type alkaloids. *International Journal of Pharmaceutical Sciences and Research, 6*, 25-30.
27. Tran, T. H. H., Do, H. A., & Phan, T. T. (2018). Crinane, augustamine, and β-carboline alkaloids from *Crinum latifolium*. *Phytochemistry Letters, 24*, 27-30.
28. Chen, M.-X., & Huo, J.-M. (2018). Amaryllidaceae alkaloids from *Crinum latifolium* with cytotoxic, antimicrobial, antioxidant, and anti-inflammatory activities. *Fitoterapia, 130*, 48-53.
29. Shukla, P. K., Kumar, M., & Misra, A. (2018). Pharmacognostical and pharmacological evaluation of *Crinum latifolium* L. *International Journal of Pharmacy and Pharmaceutical Sciences, 10*(11), 28.
30. Vo, T. T., Nguyen, T. T., Huynh, T. T., Vo, T. T., Nguyen, T. T., Nguyen, D. T., Dang, V. S., Dang, C. H., & Nguyen, T. D. (2019). Biosynthesis of silver and gold nanoparticles using aqueous extract from *Crinum latifolium* leaf and their applications for antibacterial effect and wastewater treatment. *Journal of Nanomaterials, 15*, 282.
31. Kicia, K. (2020). Induction of callus in leaf explants of *Crinum americanum* L. (Amaryllidaceae). *European Journal of Medicinal Plants, 236*, 15-28.
32. Shweta, P., & Sharma, D. (2021). A brief overview on *Crinum latifolium*. *International Journal of Science and Research, 254*, 10-12.