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Alocasia macrorrhizos Linn. An integrative review of botanical profile, phytochemical constituents, traditional knowledge and experimentally reported biological activities

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Abstract
Alocasia macrorrhizos Linn. Commonly known as giant taro, is a perennial plant widely distributed in tropical and subtropical regions and traditionally utilized for both nutritional and medicinal purposes. The present review aims to provide an integrative overview of the botanical characteristics, phytochemical composition, traditional and medicinal uses, and experimentally reported biological activities of *A. macrorrhizos*. A detailed plant profile including taxonomy, morphology and geographical distribution is discussed to establish its botanical significance. Phytochemical screening studies reveal the presence of diverse bioactive constituents such as alkaloids, flavonoids, phenolics, tannins, saponins, and glycosides, which may contribute to its therapeutic potential. Ethnomedicinal evidence highlights its traditional application in the management of inflammatory conditions, gastrointestinal disorders, skin ailments, pain and infections. Furthermore, pharmacological investigations have demonstrated various biological activities including antioxidant, antimicrobial, anti-inflammatory, cytotoxic and antidiabetic effects. Despite its extensive traditional use, scientific validation and safety evaluation remain limited. This review emphasizes the need for systematic pharmacological and toxicological studies to support its traditional claims and explore its potential for future therapeutic and nutraceutical applications.

Keywords: *Alocasia macrorrhizos*, giant taro, phytochemical constituents, ethnomedicinal uses antioxidant activity, anti-inflammatory activity, anticancer activity, nutraceutical potential

Introduction

Herbal medicine represents one of the oldest forms of healthcare practiced by humanity and continues to play a vital role in both traditional and modern medical systems. It involves the use of plant-derived materials such as leaves, roots, bark, flowers and seeds for the prevention, management, and treatment of various diseases. For centuries, different cultures across the world have relied on medicinal plants as primary therapeutic agents due to their accessibility, affordability and perceived safety.

Alocasia macrorrhizos, commonly known as giant taro or elephant ear, is an ornamental plant native to the tropical regions of Asia and the Pacific. Beyond its aesthetic appeal, the species is recognized for its considerable nutritional and medicinal significance. This review focuses on its nutritional composition, health-promoting properties, pharmacological activities, traditional medicinal uses and phytochemical profile. *A. macrorrhizos* serves as a staple food in several communities due to its richness in dietary fibre, carbohydrates, essential vitamins, and minerals, particularly calcium, iron and potassium. Traditionally, different parts of the plant have been used to manage various ailments, including chronic constipation, oral ulcers, rheumatic arthritis, haemorrhoids, cough, malaria and jaundice. However, the plant contains toxic and anti-nutritional constituents such as calcium oxalate, phytates, tannins, polyphenols, amylase inhibitors and hydrogen cyanide, which necessitate proper processing before consumption. These compounds can be reduced through conventional methods like soaking, fermentation, frying, and ethanol extraction, as well as non-conventional techniques including microwave and ultrasound treatments. Although *A. macrorrhizos* is widely cultivated and admired for its large, attractive foliage, its full nutritional, therapeutic, and commercial potential remains underexplored. This review highlights the need for further scientific investigations into its nutritional value, health benefits, and possible applications in food and pharmaceutical industries [1].

Alocasia macrorrhizos, is an herbaceous plant belonging to the family Araceae. It is native to tropical regions and is commonly found growing in marshy areas of India, Bangladesh, and China. Traditionally, different parts of the plant have been widely used in folk medicine, especially for their anti-inflammatory effects. The juice extracted from the leaves is reported to possess digestive, laxative, diuretic, astringent, and antifungal properties and has been used in the management of rheumatoid arthritis. The leaves are nutritionally rich and are utilized to prevent iron deficiency, enhance eyesight, and provide a good source of protein. Furthermore, the whole plant has been traditionally employed in the treatment of jaundice and constipation. Scientific investigations have demonstrated that the leaf extract of *Alocasia macrorrhizos* exhibits significant antioxidant, antinociceptive, anti-inflammatory, laxative, diuretic, and hepatoprotective activities [2].

The leaf juice of this plant has long been used in traditional medicine for its astringent properties. In the Chittagong Hill Tracts region, the rootstock is commonly employed in the treatment of diarrhoea and stomach-related ailments. Phytochemical investigations have revealed that the plant contains a wide range of bioactive constituents, including carbohydrates, alkaloids, saponins, phytosterols, phenolic compounds, tannins, flavonoids, and proteins with essential amino acids. These constituents are responsible for diverse pharmacological activities such as thrombolytic, antimicrobial, and antioxidant effects. The proven success of antibiotics in controlling bacterial infections underscores

the importance of investigating plant-derived bioactive compounds as potential therapeutic agents [3].

Scientific classification [4]
Domine : Eukaryote
Kingdom : Plantae
Subkingdom : Tracheobionta
Phylum : Sprematophyta
Subphylum : Angiospermae.
Class : Monocotyledonae.
Oder : Arales
Family : Araceae
Genus : Alocasia
Species : *Alocasia Macrorrhizos.*

Vernacular name [4]
Kannada : Mundigida, Marsanige.
English : Elephant's Ear.
Hindi : Mankachu.
Tamil : Meruku
Telugu : Charakanda.
Bengali : Mankachu.
French : Alocasie
Sanskrit : Hastikarnah
Japanese : Dokuimo
Marathi : Mansacchu.

Morphology [5]
Alocasia macrorrhizos is a large, evergreen perennial herb belonging to the family Araceae, growing up to 3–5 meters tall. It has a thick, tuberous rhizome that supports vegetative propagation. The plant bears massive, glossy, arrow-shaped green leaves with prominent veins, often reaching 1–2 meters in length. It produces a typical araceous inflorescence with a spadix partially enclosed by a pale green spathe. The flowers are unisexual, with female flowers at the base and male flowers above. It thrives in tropical regions and is commonly cultivated as an ornamental for its striking foliage.

Traditional medicinal uses [5]
Alocasia macrorrhizos has long been valued in traditional medicine for its therapeutic uses. The rhizome is commonly applied as a poultice to treat wounds, boils, and skin infections due to its healing properties. In Ayurvedic and Southeast Asian practices, rhizome preparations are used to relieve rheumatism, joint pain, and inflammation. The plant sap is traditionally used to soothe insect bites and stings. In some indigenous systems, the cooked rhizome is taken in small amounts to improve digestion and appetite. The leaves are also used externally to reduce fever and aid recovery.

Phytochemical Screening [6]
A small amount of the methanolic extract and various fractions of *Alocasia macrorrhizos* were analyzed through preliminary phytochemical screening. Alkaloids were identified using Mayer's and Hager's reagents, while carbohydrates were detected by Benedict's and Fehling's tests. Glycosides were examined using Legal's and Borntrager's tests. Phytosterols were assessed by Salkowski's and Liebermann–Burchard tests, and proteins were detected using the xanthoproteic test. Flavonoids, tannins, saponins, and phenolic compounds were identified using standard tests such as alkaline reagent, gelatin, froth, foam, and ferric chloride tests.

Sl. No	Phytochemicals	Test	Result
1	Alkaloids	1. Wagner's test	+
		2. Hager's test	+
2	Carbohydrates	1. Hager's test	+
		2. Benedict's test	+
		3. Fehling's test	+
3	Glycosides	1. Legal's test	-
4	Saponin	1. Froth Test	+
5	Phytosterols	1. Libermann-Burchard's test	+
6	Phenol	1. Ferric Chloride Test	+
7	Tannins	1. Gelatin Test	+
8	Flavonoids	1. Alkaline reagent test	+
		1. Lead acetate test	+
9	Proteins and amino acids	1. Xanthoproteic Test	+
		2. Ninhydrin Test	+
10	Terpenes	1. Copper acetate Test	-

Reported activity

1. **Hyperlipidemia:** There is growing interest in identifying lipid-modifying agents from natural sources. This study assessed the hypolipidemic potential of a hydroalcoholic leaf extract of *Alocasia macrorrhizos* in rats with diet-induced hyperlipidemia. Hyperlipidemia was produced using a cholesterol-rich high-fat diet, and the extract was tested at doses of 250 and 500 mg/kg, with atorvastatin as the reference drug. The high-fat diet significantly elevated all lipid parameters, while atorvastatin reduced cholesterol and triglyceride levels. The plant extract significantly lowered triglycerides and VLDL-C at both doses but did not improve total cholesterol or HDL-C. Notably, LDL-C levels increased in a dose-dependent manner, suggesting limited suitability of the extract as a lipid-lowering agent [7].

2. **Anti-inflammatory and Anti-arthritic:** Rheumatoid arthritis is a long-term autoimmune disorder characterized by joint inflammation and systemic effects. The present study investigated the anti-arthritic activity of an aqueous extract of *Alocasia macrorrhizos* (EAAm) using an adjuvant-induced arthritis model in Holtzman rats. Arthritis was induced by administration of Freund's Complete Adjuvant, followed by treatment with EAAm (100 mg/kg) for nine days. Arthritic rats exhibited marked joint inflammation and systemic

symptoms. EAAm treatment significantly reduced knee swelling, inflammatory cell infiltration, and pro-inflammatory cytokine levels (IFN-γ, IL-6, and IL-12p70). These results indicate the potential of *Alocasia macrorrhizos* as a natural anti-inflammatory and anti-arthritic agent [8].

3. **Anti-diuretic activity:** *Alocasia macrorrhizos*, a member of the Araceae family, is reported to possess hepatoprotective, antioxidant, and anti-inflammatory properties and is traditionally claimed to have diuretic effects. This study investigated the diuretic activity of the hydroalcoholic leaf extract *A. macrorrhizos* in Wistar rats. The extract was administered orally at doses of 250 and 500 mg/kg, with furosemide used as the reference drug. Urine output and urinary electrolyte levels were measured over a 24-hour period. The extract produced a significant, dose-dependent increase in urine volume and enhanced sodium excretion while reducing potassium loss at the higher dose. These findings suggest promising diuretic activity, although further studies are needed to clarify the underlying mechanism [9].

4. **Antitumor activity:** The rhizome of giant taro (*Alocasia macrorrhiza*), a widely adaptable plant used in traditional Chinese medicine, was investigated for its antiproliferative components. Phytochemical analysis led to the isolation of six novel and four known piperidine alkaloids, whose structures were characterized using spectroscopic techniques. These compounds were evaluated for anticancer activity using the MTT assay against HepG2, AGS, and MCF-7 cell lines. Several alkaloids exhibited notable antiproliferative effects, with compounds 3–5 significantly reducing colony formation and promoting apoptosis in AGS cells. In particular, compound 4 induced cancer cell death through a pro-apoptotic mechanism. The findings support the antitumor potential of giant taro alkaloids and their relevance for future drug development [10].

5. **Karyotype analysis** plays a crucial role in the genetic identification and improvement of plant species. In this study, the cytogenetic characteristics of *Alocasia macrorrhizos* were examined to establish its chromosomal features. The species was found to have a diploid chromosome number of 2n = 28, with a total chromosome length of approximately 98.83 µm and individual chromosomes showing a gradual size variation. The karyotype exhibited an asymmetric arrangement with a centromeric formula of 18 metacentric, 4 submetacentric, and 2 acrocentric chromosomes. Interphase nuclei showed a complex chromocenter type, while prophase chromosomes displayed a gradient pattern. Limited DAPI banding suggested a low abundance of AT-rich regions, confirming the species' distinct cytogenetic identity [11].

6. **Anticancer activity:** *Alocasia macrorrhiza* is traditionally used in southwestern China for the treatment of cancer, prompting scientific evaluation of its anticancer potential. This study investigated the effects of its aqueous extract against hepatocellular carcinoma using *in vitro* and *in vivo* models. The extract significantly suppressed cancer cell proliferation, reduced colony formation, inhibited DNA synthesis, and induced apoptosis in liver cancer cells. Tumor growth inhibition was also observed in animal models following oral administration. Mechanistic studies revealed cell cycle arrest at the G_0/G_1 phase and activation of apoptotic pathways. These effects were associated with altered expression of key regulatory genes, supporting the extract's potential as an anticancer agent [12].

7. **Antihyperglycemic, antioxidant and cytotoxic activities*:*** *Alocasia macrorrhizos*, a commonly cultivated edible plant in Bangladesh, is also known for its medicinal value. This study evaluated the antihyperglycemic, antioxidant, and cytotoxic activities of a methanolic rhizome extract. In alloxan-induced diabetic mice, oral administration of the extract at 250 and 500 mg/kg significantly reduced blood glucose levels, with the higher dose showing an effect comparable to metformin. The extract also demonstrated notable antioxidant activity, with an IC_{50} value of 693.0 µg/mL. Additionally, cytotoxic potential was observed in the brine shrimp lethality assay, yielding an LC_{50} of 188.14 µg/mL. These results highlight the therapeutic potential of *A. macrorrhizos* rhizomes [13].

8. **Toxic and anti-fertility activity:** Rodent management in agriculture and public health remains a major challenge, and the extensive use of chemical rodenticides poses risks to humans and the environment. This study explored plant-based alternatives by evaluating ethanolic leaf extracts of *Alocasia macrorrhiza* and *Calotropis procera* as natural rodenticidal agents. The toxic effects of these extracts on the liver, kidney, and testes of male albino mice were assessed through biochemical and histopathological analyses. Prolonged administration of high doses resulted in significant hepatic, renal, and reproductive toxicity. Phytochemical screening revealed the presence of several toxic constituents that disrupted spermatogenesis. These findings suggest that the extracts possess rodenticidal potential but exhibit considerable organ toxicity at elevated doses [14].

Future Perspectives

Future research on Alocasia macrorrhizos should prioritize systematic scientific validation to bridge the gap between traditional knowledge and modern therapeutic application. Although preliminary pharmacological studies demonstrate promising antioxidant, anti-inflammatory, antidiabetic, anticancer, and antimicrobial activities, detailed mechanistic investigations are required to elucidate the molecular pathways involved. Standardization of extraction procedures, identification and characterization of active phytoconstituents, and establishment of quality control parameters are essential for reproducibility and safety. Comprehensive toxicological, pharmacokinetic, and dose-optimization studies must be conducted to ensure safe therapeutic use, particularly considering the presence of anti-nutritional factors such as calcium oxalate. Furthermore, well-designed preclinical and clinical trials are

necessary to validate efficacy in humans. Exploration of its potential applications in nutraceuticals, functional foods, and phytopharmaceutical development may open new avenues for commercial and therapeutic utilization.

Conclusion

Alocasia macrorrhizos is a botanically significant and therapeutically promising plant widely used in traditional medicine across tropical regions. The available literature highlights its rich phytochemical composition, including alkaloids, flavonoids, phenolics, tannins, saponins, and glycosides, which are associated with diverse pharmacological activities such as antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anticancer, anti-arthritic, and diuretic effects.

Although preclinical investigations provide supportive evidence for many traditional claims, comprehensive clinical validation and standardized safety assessments remain insufficient. Furthermore, the presence of anti-nutritional and toxic constituents necessitates careful processing and dosage consideration.

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