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## ORNAMENTAL GINGERS: HIDDEN GEMS OF THE TROPICS

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### ABSTRACT

Plants with ornamental value belonging to the families Zingiberaceae and Costaceae are commonly described as ornamental gingers. These are recent introductions to the landscape as well as cut flower industries which are grown widely under tropical parts of the world. The important genera of ornamental ginger with high ornamental value include *Alpinia*, *Etlingera*, *Hedychium*, *Curcuma*, *Glozza*, *Boesenbergia*, *Kaempferia*, *Zingiber*, *Larsenianthus*, *Costus*, *Monocostus*, *Dimerocostus*, and *Tapeinochilos*. This comprehensive review explores the ornamental potential of gingers belonging to Zingiberaceae and Costaceae families. Ornamental gingers are becoming increasingly popular in the cut flower markets, landscaping, and as potted plants due to their vibrant colors, unique foliage, and extended blooming periods. Their long-lasting inflorescences and ability to thrive in partial shade make them ideal for intercropping in plantations. The article also highlights the rich diversity of ornamental gingers in India, with over 200 species documented. It explores the morphological variations among these species and how these variations influence their suitability for different applications. Beyond aesthetics, the article discusses the potential of ornamental gingers in other industries. Certain species possess edible flowers with high nutritional value, while others serve as sources of essential oils, natural dyes, and fibers. Some gingers even show potential for phytoremediation and medicinal uses. Thus there is a need for further exploitation of ornamental gingers in India. Despite their vast variety, many species remain underutilized due to challenges in propagation and lack of awareness among floriculturists.

**Keywords:** Ornamental ginger, cut flower, landscaping, phytochemicals, essential oil

### Introduction

Gingers hold a distinctive place in the plant world, praised for their graceful shapes, diverse textures, vibrant hues, and exquisite symmetry. Plants recognized for their aesthetic appeal, classified under the Zingiberaceae and Costaceae families, are referred to as ornamental gingers. About 53 genera and 1377 species of ornamental gingers are reported so far (Kong *et al.*, 2010). These species thrive in tropical regions across the globe. In contemporary times, ornamental gingers are garnering attention in both the cut flower markets and the landscaping industry. Their suitability as potted plants is also recognized, owing to their ease of cultivation, distinct foliage, and enduring, colorful inflorescences. The growing demand for

ornamental gingers underscores their rising popularity, positioning the development of such ornamental varieties as a viable option within various floricultural sectors.

Ornamental gingers are known for their captivating beauty and ornamental value. These plants are highly appreciated for their striking foliage, vibrant flowers, and overall aesthetic appeal, making them a popular choice for indoor and outdoor landscaping. They originate from tropical regions and thrive in warm, humid climates. Ornamental gingers are valued for their ability to add lushness and color to gardens, parks, and indoor spaces. One of the defining features of ornamental gingers is their wide range of shapes, sizes, and colors. They produce flowers in various

hues, including shades of red, pink, orange, yellow, and white, which can be subtly fragrant or boldly scented, depending on the species. Many ornamental gingers are well-suited to a variety of growing conditions, including both shaded and sunny areas, as well as moist or well-drained soils. Some species are even adaptable to container gardening, making them ideal choices for patios, balconies, and indoor spaces.

Beyond their decorative value, ornamental gingers also hold cultural significance in many tropical regions, where they are used in traditional medicine, cuisine, and religious ceremonies. Additionally, their ecological importance cannot be overlooked, as they provide habitat and food sources for various wildlife species.

In recent years, the popularity of ornamental gingers has surged, driven by a growing interest in tropical gardening and landscaping. Plant breeders and enthusiasts continue to introduce new cultivars with enhanced characteristics, further enriching the diversity and allure of these captivating plants. Overall, ornamental gingers represent a fascinating and vibrant aspect of tropical flora, offering endless possibilities for creative expression and enjoyment in both natural and cultivated settings.

### Description

These plants typically manifest as perennial herbs, characterized by creeping horizontal or tuberous rhizomes. Their leaves are arranged alternately and in two vertical rows, with the base often sheathing and the blade typically linear to elliptic, exhibiting prominently ascending veins. Inflorescences typically take the form of spikes or racemes, which can emerge laterally, terminally, or both. The flowers themselves are bisexual, displaying strong zygomorphism, and are often accompanied by conspicuous floral bracts within a spike or raceme. These floral bracts may either open at the base or unite laterally to form pouches, arranged spirally along the axis. The perianth comprises two whorls, consisting of an herbaceous or membranous tubular calyx with three lobes, and a petaloid tubular corolla also featuring three lobes (Carr, 1999).

The androecium generally consists of a single fertile stamen, accompanied by a large petaloid labellum that represents two fused staminodia opposite the stamen, and two smaller petaloid staminodia on either side. The gynoecium features a compound pistil made up of three carpels, with a single style situated within a channel formed by the anther and filament of the fertile stamen. An inferior three locular ovary with numerous ovules arranged axially. however, in rare instances, the ovary can be unilocular with parietal

placentation. The fruit is typically a loculicidal capsule or has a berry-like appearance (Carr, 1999).

### Taxonomic Classification

Zingiberales stand out as a remarkably diverse and abundant order of monocots, boasting distinctive floral morphology and ecological significance. Classified within the suborder 'Zingiberineae' and further subdivided into the superfamily 'Zingiberoideae', they comprise notable families such as Zingiberaceae and Costaceae, encompassing approximately 53 genera and over 2000 species (Kress *et al.*, 2002). Ornamental gingers, belonging to this order, are indigenous to old world countries *i.e.* Southern and Eastern parts of Asia. In India alone, there are reports of around 200 ginger species distributed among 21 genera, predominantly found in Southern parts of India, North East India, and the Andaman and Nicobar Islands (Sabu, 2006).

Among the ornamental genera within the family Zingiberaceae, notable ones include *Alpinia* (Shell ginger), *Curcuma* (Hidden ginger), *Boesenbergia* (Island purple ginger), *Glozza* (Dancing ladies), *Hedychium* (Butterfly ginger), *Kaempferia* (Peacock ginger), *Etlingera* (Torch ginger), *Larsenianthus* (Praying mantis ginger), and *Zingiber* (Pine cone ginger/ Shampoo ginger). Ornamental genera of the family Costaceae include *Costus* (Spiral ginger), *Monocostus* (Lemon ginger), *Dimerocostus* (Crepe ginger) and *Tapeinochilos* (Pineapple ginger) (Sabu, 2006).

### Versatile Uses of Ornamental Gingers

The morphological characteristics of ornamental gingers can vary significantly among species, rendering them versatile for various commercial and landscape applications. Within the floriculture trade, ornamental gingers find utility in multiple forms, including cut flowers, loose flowers, cut foliage, and landscape uses. Beyond these conventional applications, they offer potential for the production of diverse products such as essential oils, natural dyes, and natural fibers. Ornamental gingers are also valued for their nutritional content and phytochemical composition, underscoring their potential utilization in the food and pharmaceutical industries.

### Floriculture industry

Ornamental gingers have recently become popular in landscaping and the cut flower industry. However, they have been cherished as ornamental plants in Asiatic countries for many centuries. These gingers are a diverse and adaptable group, gaining more attention in landscaping, potted plants, and cut flower markets.

Their striking foliage and flowers make them captivating ornamental plants.

### Cut flower and cut foliage

The market value of an ornamental plant is achieved when it is suitable for use as a cut flower or cut foliage. Key criteria for cut flowers include long stems, extended vase life, resilience during transportation, adaptability to various growing conditions, and appealing colors. Ornamental ginger fulfills these criteria, as they have attractive colors, long pedicels, and long vase life, making them perfect for use in bouquets and flower arrangements. According to Silva *et al.* (2009), *Alpinia purpurata* is considered the second most significant tropical cut flower species in economic terms globally, as well as among the tropical flowers exported from the State of Alagoas. Araújo *et al.*, (2018) recommend IAC 41 and the IAC Camburi genotypes of torch ginger suitable for cut flower production in Brazil. *A. zerumbet* genotypes are more adequate for use as cut foliage than other *Alpinia* species (Silva *et al.*, 2015). The inflorescence of *Zingiber* species can be used as cut-flowers because of their long lasting, long peduncles suitable for floral arrangement (Dum-Ampai and Chaisrichonlathan, 2016).

### Landscape uses

Ornamental ginger is a versatile plant used in various landscaping applications. They are commonly used as accent plants, foundation plantings, background plants, for screening and privacy, group planting, mass planting, border planting and in corner plantings. These plants are also utilized in butterfly garden, fragrant garden and as potted plants. Careful planning that includes a diverse assortment of varieties and species from all genera of ginger can create an excellent landscape design.

Nearly all species of ornamental ginger can be used as accent plants because they each possess unique and distinguishable features, earning them the label of "specialty ornamentals. Ornamental ginger such as *Hedychium*, *Zingiber*, and *Alpinia* can be planted in fragrant gardens to enhance the olfactory experience. Cultivars of *Curcuma alismatifolia* and *C. thorelii* 'Chiang Mai Snow' were found to be suitable as cut flowers and potted plants, respectively. Additionally, *C. parviflora* 'White Angel' was found to be an ideal cultivar for potted plant (Roh *et al.*, 2006). Kobayashi *et al.* (2007) reported that red ginger works well as a tall hedge or screen and serves effectively as a background planting or foundation planting, particularly to cover the blank walls. It can be utilized as a specimen plant, for border planting and mass

planting. Larsen *et al.* (1999) reported that farms in Australia and Costa Rica are growing Red Button *Costus* (*Costus woodsoni*) and marketing it as cut flowers. This species is an outstanding option for landscapers in the southern regions and a highly attractive potted plant. Inflorescences of *Alpinia purpurata*, *Zingiber* sp., *Etlingera* sp., and *Curcuma* sp. were found ideal for enhancing flower arrangements and bouquets. Additionally, the tall-growing varieties of *Zingiber* sp., *Etlingera* sp., and *Costus* sp., are well-suited for use as accent plants, for privacy screening, in background plantings and in border and corner plantings (Femina, 2013).

### Source of phytochemicals

Ornamental ginger is abundant in a wide range of phytochemicals with various pharmacological effects, which is extracted from their plant extracts and essential oils making them a promising source of phytochemical compounds that could potentially be utilized in the prevention or treatment of various diseases.

*Etlingera elatior* flowers exhibit promising potential as a natural source of antioxidants for diabetes treatment. This is attributed to their high levels of total phenols and total flavonoids, both known for their potent antioxidant activity (Muhamad *et al.*, 2020). The oil extracted from the torch ginger flower is highly stable and shows antibacterial activity, which can be used in the food and pharmaceutical industries (Anzian *et al.*, 2020). The deficit in the antioxidant defense system was significantly compensated by the ethyl acetate leaf extract of *Alpinia purpurata* and induces the apoptotic mechanism in experimental confirmation in prostate cancer induced Wistar strain rats, and can be concluded that the *Alpinia purpurata* can be used as an anticancer agent for the treatment of carcinoma (Palanirajan *et al.*, 2022). Also The ethyl acetate extract of *A. purpurata* demonstrated notable antitumor activity in rats with ovarian cancer induced by 4-vinyl cyclohexane (Cinthamony *et al.*, 2024). Combination of *Zingiber zerumbet* extract with an antibiotic solution exhibited potent antibacterial activities against multidrug resistant (MDR) bacterial strains (*Streptococcus mutans*, *Lactobacillus acidophilus*, *Staphylococcus aureus* and *Enterococcus faecalis*) (Ramzan and Zeshan, 2023). Extract of *Alpinia zerumbet* was found to be an effective radioprotector with fewer side effects compared to synthetic cytoprotective agents (Shukla *et al.*, 2019).

### Source of nutrients

Almost all parts of ornamental ginger are utilized by humans as a source of food, including spices and

flavoring agents. The leaves of some ginger species are particularly important in Peninsular Malaysia, where they are key ingredients in spicy savory dishes (Larsen *et al.*, 1999). In Japan, the dried leaves of *Alpinia zerumbet* are used to make traditional herbal tea (Chan *et al.*, 2009). Additionally, the edible flowers of certain ornamental ginger species are increasingly acknowledged for their nutritional benefits in the food and nutraceutical industries. For instance, the inflorescences of *Etlingera elatior* and the flowers of *Alpinia galanga* are used in traditional Thai meat dishes. The inflorescences of *Curcuma* species are served as a side dish with chili paste. *Hedychium coronarium* flowers are eaten as vegetables and impart a unique aroma to scented tea, while flower buds of *Zingiber zerumbet* are consumed as vegetables and used as a spice. In Manipur, the rhizomes of butterfly ginger are used in the preparation of a traditional dish called 'Eromba'. Rachkeeree *et al.* (2018) evaluated the nutritional value of eight ginger species and found *Etlingera elatior* to be a rich source of antioxidants as well as calcium and potassium. The qualitative analysis of *Hedychium coronarium* by Paul *et al.* (2022) showed the presence of carbohydrates, proteins, amino acids, alkaloids, tannins, fixed oils, and fats. Total soluble carbohydrates, total proteins, total starch and total free amino acids were found highest in the dry rhizome. Qualitative phytochemical analysis of *Hedychium spicatum* extracts suggested the existence of phenolic compounds, carotenoids, flavonoids, reducing sugars (carbohydrate), alkaloids, proteins, steroids, saponins and oils (Upadhyay *et al.*, 2021).

### Other applications

Ornamental gingers are rich sources of essential oil, natural dyes, natural fibers and some species are reported to be used for the phytoremediation of waste water. Ornamental gingers like *Etlingera elatior*, *Alpinia purpurata*, *Alpinia zerumbet* as well as *Hedychium coronarium* are utilized for extraction of essential oil and are known to possess strong antibacterial, antifungal, antioxidant and insecticidal activity due to the presence of several bioactive compounds (Elzaawely *et al.*, 2007; Joy *et al.*, 2007; Santos *et al.*, 2012; Vairappan *et al.*, 2012; Sakhanokho *et al.*, 2013; Feng *et al.*, 2021). Presence of dodecanal and *n*-dodecanol in the essential oil of *Etlingera elatior* exhibited oviposition deterrent activity against female mosquitoes of *Aedes aegypti* (Bezerra-Silva *et al.*, 2016).

*Etlingera elatior* can be used to extract natural fibers and have the potential to be used as a raw material for textile industry (Wardinarsih *et al.*, 2022). Fibres extracted from *Alpinia zerumbet* are

utilized in the creation of over 20 commercially available products, including traditional Japanese paper, kariyushi-style clothing, and various fabrics (Tawata *et al.*, 2008). Marín-Muñiz *et al.* (2020) reported that the use of ornamental gingers such as *Hedychium coronarium* and *Alpinia purpurata* in wetlands enhanced the aesthetic view, enriched the biodiversity and removed the pollutants from rivers, where the wastewater was released untreated.

When torch ginger inflorescence essential oil (TGIEO) was incorporated in active packaging of chicken meat, it enhanced the safety and extended shelf life of chicken meat and thereby reducing the use of non-biodegradable packaging which results in environmental impacts. Marzlan *et al.* (2022) incorporated TGIEO into the starch-based edible film which potentially extended the quality of chicken meat during the cold storage period due to its antibacterial and antioxidant properties. Fish body colouration was enhanced by torch ginger powder without impacting its growth and feed intake. Torch ginger powder improved the performance and color of juvenile red tilapia (*Oreochromis* sp.), a widely farmed freshwater species. (Faudzi *et al.*, 2024). Torch ginger flower extract can also be used as a coloring agent in the formulation of lipstick preparations (Adliani *et al.*, 2012).

### Conservation of Ornamental Gingers

Due to the high demand for ornamental gingers, both rhizomes and whole plants are being collected from the wild in large quantities. This indiscriminate collection, along with the disappearance of forests and grasslands, has led to the depletion of gingers in their natural habitats. To address this issue, ornamental gingers are being conserved at various institutions

The AICRP on Floriculture at the College of Agriculture, Vellanikkara, Kerala Agricultural University collects and maintains different species of ornamental gingers. The "Garden of Gingers" initiative by the ICAR-Indian Institute of Spices Research in Kozhikode, Kerala, aims to conserve the crop wild relatives of gingers collected from different parts of the nation, which includes a large number of gingers with ornamental value. Additionally, a Ginger House has been constructed at the Calicut University Botanical Garden, Kerala for the conservation of Indian gingers, which also houses a good collection of ornamental gingers.

### Conclusion

Consumer preferences within the floriculture industry are shifting towards unique and novel cut

flower options. India, characterized by diverse agro climatic zones, harbors a rich variety of ornamental gingers exhibiting significant phenotypic variation. These gingers possess the potential to be cultivated as both cut flowers for commercial trade and landscape plants for aesthetic purposes. The primary obstacle to large-scale cultivation lies in the fact that the majority of these ornamental gingers exist as wild populations. This presents difficulties in acquiring sufficient planting material for commercial production.

Additionally, the lack of awareness among floriculturists regarding the ornamental value of these gingers further hinders their widespread adoption. Unsustainable harvesting practices and habitat degradation due to deforestation and grassland conversion pose a significant threat to the wild populations of ornamental gingers. Implementing effective conservation measures is critical to prevent their potential extinction in the near future.

**Table 1:** Phytochemical constituents and pharmacological properties of ornamental gingers

Crop	Phytochemicals	Pharmacological activity	References
<i>Alpinia purpurata</i>	Alkaloids, Flavonoids, Saponins, Carbohydrates, proteins, phenols, resins, Glycosides and tannins, rutin, kaempferol	Antioxidant, antibacterial, cytotoxic and vasodilator activities, antimicrobial, treat tuberculosis	Chan and Wong, (2015), Devi <i>et al.</i> (2024)
<i>Alpinia zerumbet</i>	Flavanoids, phenolic acids, phenylpropanoid, sterols, terpenoids	Antioxidative, anti-inflammatory,	Chan <i>et al.</i> (2017)
<i>Curcuma alismatifolia</i>	Phenols, flavanoids, sesquiterpenoids	Antidiarrhoeal, antioxidant	Akter <i>et al.</i> (2010)
<i>Hedychium coronarium</i>	Alcohols, phenolics, aldehydes, ketones, glycosides, oxides, flavonoids, esters, saponins, diterpenes, and sesquiterpenes	Antioxidant, antitumor, antidiabetic, antiproliferative, antimicrobial	Arya <i>et al.</i> (2022)
<i>Costus woodsonii</i>	Flavonoid, terpenoid, tannin, ascorbic acid, phenols	Antioxidant, antidiabetic, antiproliferative	Ling <i>et al.</i> (2020)
<i>Etlingera elatior</i>	Flavonoids, terpenoids, saponins, tannins, carbohydrates, Kaempferol	Antioxidant, antimicrobial, antidiabetic	Lachumy <i>et al.</i> (2010), Chang <i>et al.</i> (2012)
<i>Zingiber zerumbet</i>	Zerumbone (sesquiterpenoid) Alkaloids, tannins and cardiac glycosides	Regulate cellular redox homeostasis and macrophage polarization Antioxidant	Yeh <i>et al.</i> (2022) Rout and Bhatnagar (2024)





Fig. 1 : Ornamental gingers of the family Zingiberaceae



Fig. 2 : Ornamental gingers of the family Costaceae





**Fig. 3 :** Ornamental gingers used in flower arrangement and bouquets



**Foundation planting**



**Accent plant**



**For screening purpose**



**Corner planting**



**Hedychium in fragrant garden**



**Background planting**



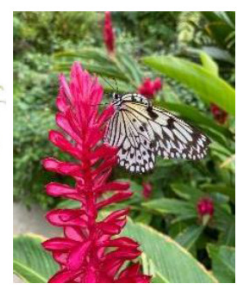
**Group planting at the base of the tree**



**Border planting**



**Potted plants**



**Butterfly garden**

**Fig. 4 :** Landscape uses of Ornamental gingers

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