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RESEARCH ARTICLE

EDIBLE FLOWERS OF KERALA AS FUNCTIONAL FOODS: NUTRITIONAL AND THERAPEUTIC PERSPECTIVES: A REVIEW

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Abstract

Edible flowers are an under-utilised reservoir of nutrients and bioactive phytochemicals that link culinary traditions to ethnomedicine. Edible flowers in Kerala represent a culturally embedded, nutritionally promising group of functional food ingredients. Integrating traditional knowledge with modern phytopharmacology can accelerate their transition from household recipes to evidence-based nutritional inventions and functional food products. This review synthesises nutritional, phytochemical, and pharmacological evidence for commonly consumed flowers in the region and frames them as functional food ingredients that confer health benefits beyond basic nutrition. This can be achieved by summarising the proximate composition, key micronutrients and documented bioactivities of selected edible flowers of Kerala. The review also evaluates value-added food preparational practices in Kerala and their nutraceutical benefits, as well as the importance of integrating ethnobotanical heritage with contemporary scientific inquiry to fully unlock the health-promoting potential of Kerala's floral diversity.

Keywords: Traditional cuisine, Bioactive compounds, Nutritional profile, Phytochemicals, Flora of Kerala, Therapeutic properties.

Introduction

Kerala's rich plant biodiversity and culinary traditions make floral ingredients a familiar element of local diets, from 'Vazhapoo' (Banana blossom) 'thoran' (a type of fry) to Moringa flower stir-fries. Flowers are not mere garnishes; many are nutrient-dense and contain concentrated phytochemicals, such as polyphenols, flavonoids, anthocyanins, and alkaloids, associated with antioxidant, anti-inflammatory, and other health-promoting benefits, which qualify them as functional foods under modern nutraceutical discourse [1,2]. *Moringa oleifera, Sebania grandiflora, Clitoria ternatea, Nelumbo nucifera, Musa paradisiaca, Hibiscus spp*, etc, are the most commonly used edible flowers of Kerala. For instance, the blossom of *M. oleifera* is widely recognised not only for its culinary versatility but also for traditional medicinal applications, and recent reviews noted its antioxidant, anti-inflammatory, hepatoprotective, and lipid-modulating potential [3].

Another widely used floral vegetable in Kerala is *Musa spp*. Mature banana flowers can be eaten as curry and stir-fry. It is recognised for being rich in fibres, minerals, proteins, and antioxidants [4]. Similarly, flowers of *Hibiscus spp.* are widely used in Kerala cuisine in the form of tea and chutneys. Nutritionally, *Hibiscus spp.* is rich in proteins, fibre, carbohydrate, β-carotene, and vitamin C [5]. Overall, edible flowers are far from being occasional delicacies; they constitute a culturally embedded, nutritionally promising group of functional-food ingredients. Their frequent use in daily cuisine aligns with traditional dietary practices. Emerging biochemical and pharmacological evidence underlines their potential role in nutraceutical diets, micronutrient supplementation and prevention of diseases to an extent. By systematically compiling the nutritional and pharmacological data, this review aims to underscore the value of common edible flowers used in Kerala as functional foods by advocating their scientific validation and promoting their integration into sustainable and culturally relevant food systems.

Materials and Methods

The present study reviews the literature available from the past ten years. A systematic review was carried out in public databases like Science Direct (www.Sciencedirect.com), Research Gate (www.Researchgate.com), and Springer (www.Springer.com).

Review of literature

1 Nutritional composition and proximate analysis

Fresh flowers typically consist of water, approximately 70-90% of their fresh weight and

flowers like banana blossom, pumpkin flowers, and Sesbania flowers have high moisture, contributing to their soft texture and suitability in curries and fritters [6]. When dried or processed, edible flowers often supply an appreciable amount of dietary fibre, proteins, carbohydrates, and minerals, making them comparable to conventional vegetables rich in micronutrients. Protein content varies from 1-6% and edible flowers are generally low-fat foods (0.3-1.5%). Carbohydrates vary from 5-18% range depending on the species. [7]. For instance, in a proximate composition study of several underutilised edible floral species, Kerala's most commonly used *Musa paradisiaca* blossoms reported substantial fibre and carbohydrate content, along with notable protein and ash (mineral) content [8]. The edible parts, especially the floral parts of *Moringa oleifera,* were found to be rich in carbohydrates, glycosylated flavonoids, and especially α-tocopherol (a form of vitamin E) at appreciable levels of approximately 18mg/100g dry weight, highlighting their potential as nutrient-rich food items [9]. However, the proximate micronutrient profiles vary strongly with species, cultivar, and environmental conditions. This variability, combined with a low number of systematic differences across many edible flower species, highlights that standardised nutrient databases for edible flowers remain limited.

2 Phytochemical and pharmacological properties of some commonly used edible flowers

Edible flowers have long been a part of traditional food and medicinal heritage, valued not only for their sensory attributes but also for their rich phytochemical composition and diverse pharmacological activities. A global review of edible flowers identified that many species are rich in both primary and secondary metabolites, many of which are responsible for their colour, aroma, flavour, and medicinal values, such as phenolic acids, saponins, flavonoids, carotenoids, tocols, anthocyanins, essential oils, and other bioactive compounds. Such compounds confer antioxidant, anti-inflammatory, and other major bioactive effects; these bioactive compounds contribute significantly to the health-promoting potential of edible flowers, positioning them as promising candidates for functional foods and natural therapeutics [10].

Clitoria ternatea, also known as butterfly pea, is a widely used edible flower in Kerala, and in recent research, its flowers have shown high levels of anthocyanins, flavonoids, and other polyphenols. *In vitro* assays demonstrated significant antioxidant activity and protection against oxidative stress [11]. Similarly, studies on *Musa sapientum* (Banana blossom) reported that different floral parts like bract, floret, and young blossom contain phenolics, flavonoids, tannins, saponins, alkaloids and anthocyanins. Moreover, the banana-blossom extract manifested high total phenolic content (168.88 mg GAE/g) in the ethanolic extract of its floret and also demonstrated lipid peroxidation inhibition *in vitro*, suggesting its powerful antioxidant potential [12]. In a recent study on the ethanolic extracts of *Moringa oleifera* flowers inhibited lipid peroxidation, suppressed inflammatory NO production, and demonstrated enzyme inhibitory effects [13]. Several studies have reported that petals of *Hibiscus spp* are a rich source of polyphenols and anthocyanins, and exhibited significant radical scavenging effects [14]. Extracts of *Nelumbo nucifera*, commonly known as Lotus, demonstrated significant antioxidant and anti-inflammatory effects *in vitro* [15].

3 Culinary forms of Kerala and functional delivery

Kerala's cuisine already contains multiple routine routes for delivering edible flower nutrients in the form of 'thoran', coconut-based stir-fry, curries, deep fry/fritters, and floral infusions/tea and across the regions, edible flowers are incorporated into daily meals, festival dishes, functional beverages, and traditional-medicine-based cuisines. In Kerala, Banana blossom is typically prepared as 'thoran', which integrates the flower with oil and coconut lipids, improving the absorption of lipophilic micronutrients such as provitamin A carotenoids [16]. *Sesbania grandiflora* or Agathi flowers, which are rich in minerals and polyphenols, are also prepared and served as 'thoran' [17]. Moringa flowers are usually served as stir-fries, and also added to 'sambar' (a special mixed vegetable curry), and light curries, which are traditional Kerala recipes that emphasise short cooking to maintain texture and floral aroma. This mild cooking method helps to release bioactive compounds [18]. *Clitoria ternatea,* or butterfly pea petals, are most often used as tea or infusions and are also employed for visually striking rice dishes in Kerala. Pumpkin blossoms are rich in antioxidants and have established pharmacological significance, and other cucurbit flowers are a common part of Kerala's traditional cuisine. Usually served as slow-cooked stir-fries, and hence preserving nutrients and carotenoids [19].

Conclusion

Edible flowers represent a vibrant yet underexplored component of Kerala's traditional food system, contributing not only colour, aroma, and culinary diversity but also significant functional and therapeutic value. Their pharmacological benefits include antioxidant, anti-inflammatory, cardioprotective, antidiabetic, neuroprotective, and digestive benefits, reiterating the relevance of these traditional foods in addressing modern dietary and health challenges. Culinary practices in Kerala, such as 'thoran', curries, fritters, teas, and fermented preparations, not only enhance palatability but also

influence the bioavailability of these key phytoconstituents. However, scientific evidence on optimal processing to preserve nutritional integrity remains limited, highlighting the need for systematic studies on preparation and phytochemical interactions. Furthermore, many edible flowers used in household or indigenous cuisines remain poorly documented despite their cultural permanence. Overall, documented edible flowers in Kerala represent a promising reservoir of culturally rooted functional foods with potential nutraceutical applications. Integrating these flowers into the contemporary diet can make a meaningful contribution to promoting nutritional security, enhancing wellness, and preserving Kerala's unique heritage. In addition, expanding research on underutilised floral species could therefore reveal novel bioactive compounds with therapeutic promise. Strengthening community-based documentation and ethnobotanical surveys can safeguard traditional knowledge for future generations.

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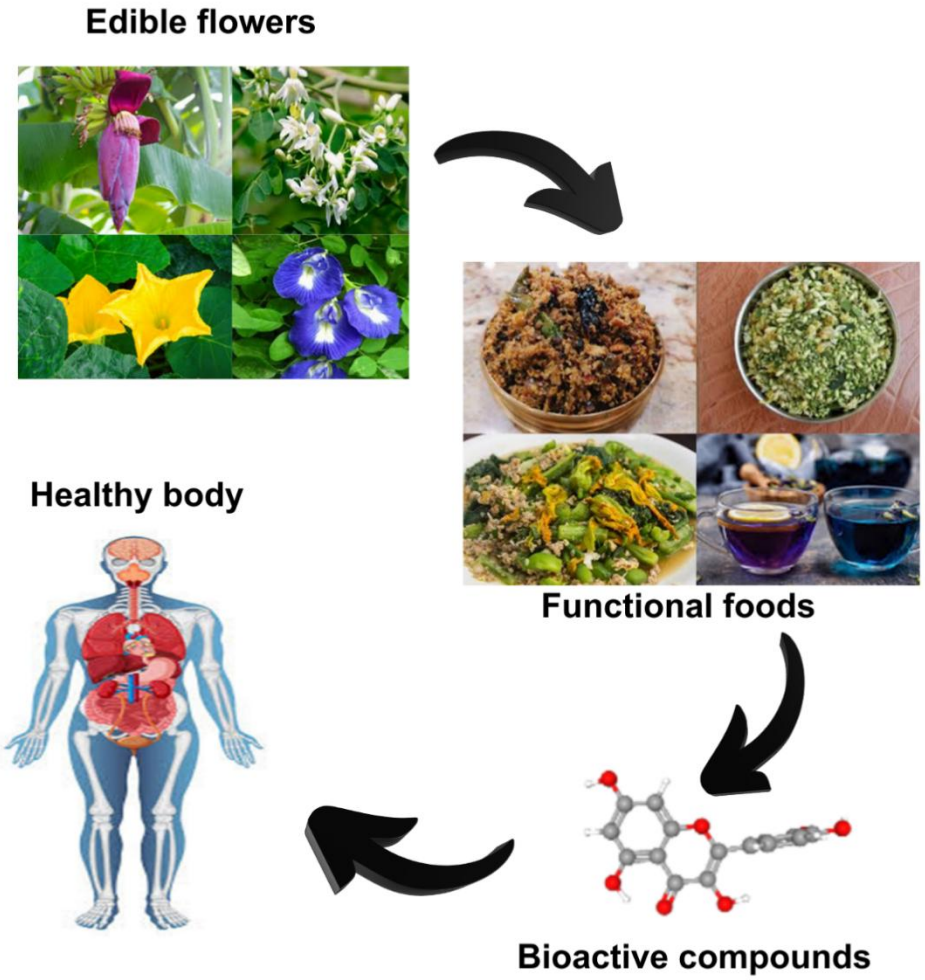

Figure 1: Conceptual illustration of edible flowers as functional foods

Table 1. Important edible flowers of Kerala used as functional foods

Sl.No	Scientific Name	Common name	Family	Culinary Use	Pharmacological Significance
	Moringa oleifera	Drumstick flower	Moringaceae	Stir-fries, curries, fritters	Nutrient-dense, antioxidant, anti-inflammatory, hepatoprotective, lipid-modulating
	Sesbania grandiflora	Hummingbird tree flower	Fabaceae	Stir-fries, curries, lentil mixes	Rich in vitamins and antioxidants.
	Clitoria ternatea	Butterfly pea	Fabaceae	Herbal tea/infusion, blue rice, salads	Anthocyanin-rich, antioxidant, neuroprotective
	Musa paradisiaca	Banana blossom	Musaceae	Stir-fries, cutlet,fritters	Antioxidant
	Hibiscus rosa-sinensis	Hibiscus	Malvaceae	Tea, chutney, salads	Antioxidant, cardioprotective, anti-inflammatory
	Cucurbita maxima	Pumpkin flower	Cucurbitaceae	Fried-fritters, stir-fries	Rich in carotenoids, Osteoprotective
	Legenaria siceraria	Bottle guard flower	Cucurbitaceae	Curries, stir-fries	Digestive health, detoxifying [20]
	Rosa spp.	Rose	Rosaceae	Jam, Squash	Antioxidant, anti-inflammatory [21]
	Carica papaya	Papaya flowers	Caricaceae	Stir-fries	Antihelminthic, digestive aid [22]
	Amaranthus spp.	Amaranth flower	Amaranthaceae	Curries, stir-fries	Antioxidant [23]