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Edible flowers-A supplementary source for human nutrition: A review

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Abstract

Globally, there is a growing demand for food that is not only delicious but also visually appealing. Both the quality of ingredients and their aesthetic appeal play crucial roles in the presentation of meals. Edible flowers not only add visual allure to dishes but also offer a compelling dietary incentive due to the growing understanding of their nutritional content and composition.

Based on the review, it is evident that edible flowers are abundant sources of essential macro- and microelements, with notable concentrations of phosphorus, potassium, and iron. Importantly, edible flowers tend to have low levels of heavy metals. Their significance in human nutrition is underscored by their richness in antioxidants, anti-carcinogenic compounds, vitamins, and various chemical constituents. Edible flowers also offer anti-diabetic, anti-inflammatory, and anti-microbial properties. They are not only valued for their aesthetic appeal but also as underexploited resources in the culinary world, often surpassing many fruit and vegetable species in terms of mineral content.

However, to fully harness the potential of edible flowers, it is imperative to conduct comprehensive evaluations of their nutritional content across various flower types. Public education and promotion of edible flowers are essential steps in popularizing them as prospective resources for the food industry and as promising additions to human nutrition. Standardizing recipes and food products incorporating edible flowers, along with research to enhance their nutritional value, as well as flower quality and size, should be prioritized in order to fully integrate these natural treasures into our diets and culinary practices.

Keywords: Fully harness, anti-carcinogenic compounds, vitamins

Introduction

On a global scale, there is a growing demand for food that not only tastes great but also looks appealing. The quality of ingredients and the visual presentation of dishes are both crucial factors in the overall dining experience. Edible flowers have emerged as a unique way to enhance the visual appeal and attractiveness of individual dishes. These flowers are cultivated not just for their aesthetic charm but also for their nutritive, medicinal, culinary, cosmetic, and aromatic qualities. They are consumed in their raw form with minimal processing, earning them the title of "edible flowers."

Edible flowers are abundant sources of a wide range of chemical compounds that play vital roles in various metabolic processes within the human body. Beyond their role in enhancing the aesthetics of food, edible flowers are actively utilized in cooking preparations. However, they are perhaps more renowned for their association with biologically active substances.

The significance of edible flowers derived from ornamental plants lies in their ability to contribute to the visual appeal of food. These flowers are not only visually appealing but also bring aromas and flavors that add to the overall dining experience. Additionally, consuming them is associated with potential health advantages, including antioxidant activity, the neutralization of reactive oxygen radicals, and possible cancer-fighting properties.

Moreover, the ongoing exploration of fresh insights into the composition and nutritional worth of edible flowers has firmly established their presence in the culinary domain. As a result, the consumption of edible flowers has been on the rise in recent years, reflecting their growing popularity and recognition in human nutrition.

History of edible flowers

Edible flowers have constituted a fundamental aspect of human nutrition for centuries, enriching culinary traditions across various cultures. In Central Europe, for instance, it's common to prepare dishes like fried batter-coated black elder (*Sambucus nigra*) flowers and dandelion flowers boiled with sugar.

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In recent times, the global demand for high-quality edible flowers for human consumption has been steadily rising, as noted by Mlcek *et al.* in 2012 [12].

Ancient civilizations such as the Greeks, Romans, and Chinese recognized the medicinal properties and nutritional value of flowers. In the realm of aromatherapy, flowers like roses, lavender, rosemary, and passionflower have found widespread use. In ancient times, edible fresh flowers were held in high regard and were even transported as prized spices. Flowers have been employed in the production of various cooked foods, including syrups, jellies, sauces, and desserts. They have also been featured in the composition of products such as liquors, vinegars, teas, beverages, honey, oils, candied forms, ice cubes, and salads. The petals of flowers were commonly consumed fresh in salads or as garnishes, enhancing the sensory characteristics of food by improving its color, taste, and aesthetic appeal.

Beyond their culinary and aesthetic appeal, edible flowers have emerged as a valuable pharmacological resource, demonstrating properties such as anti-anxiety, anticancer, anti-diabetic, anti-inflammatory, antioxidant, diuretic, anthelmintic, immunomodulatory, and anti-microbial effects, with defined effective dosages (As noted in the study by Arya *et al.* in 2014) [1]. The multifaceted benefits of edible flowers continue to make them an intriguing and versatile addition to human diets and well-being.

In recent years, edible flowers have experienced a resurgence in popularity, thanks to their prominent presence in kitchen magazines, cookbooks, and visual media. However, their use dates back centuries across various cultures worldwide. Ancient civilizations such as the Greeks, Romans, Chinese, Middle Eastern societies, and Indians have long embraced edible flowers for their nutritional value, potential medicinal benefits, unique flavors, diverse shapes, and aesthetic qualities. For example, ancient Romans used *Rosa* species in their cuisine, while old France featured *Calendula officinalis* in salads. *Taraxacum officinale* and *Sambucus nigra* flowers appeared in salads and beverages, and *Viola odorata* was used as a natural sugar coloring agent. This enduring tradition highlights the timelessness of edible flowers in enriching culinary experiences.

Edible flowers hold a significant place among plant sources due to their nutritional richness and captivating aesthetic appeal. Researchers have unveiled their potential as valuable contributors to human nutrition, especially as the trend of incorporating fresh edible flowers for both culinary and decorative purposes gains momentum.

Several factors contribute to the continuous growth of interest in edible flowers. Globalization has played a pivotal role in raising consumer awareness about these blooms and reviving earlier lifestyles in which they held a prominent position. In cultures like China and Japan, edible flowers have been a dietary staple for millennia. Furthermore, advancements in food processing technologies, logistics, and efficient distribution methods have allowed us to revisit and reintegrate these traditional food resources into modern diets.

The increasing demand for edible flowers is closely linked to the efforts of food producers and manufacturers, particularly those offering ready-to-cook products. They strive to expand and enhance their product offerings, introducing new commodities that include edible flowers. Today, edible flowers are predominantly used as garnishes and are often

consumed fresh. However, they can also be enjoyed in various forms such as dried, incorporated into cocktails (as ice cubes), canned in sugar, preserved in distillates, and more. This versatility makes edible flowers a dynamic and appealing addition to modern culinary practices.

The nutritional composition of edible flowers, including proteins, fats, carbohydrates, and vitamins, is generally similar to that of other plant organs like leafy vegetables. However, the primary criteria for assessing the quality of edible flowers lie in their sensory characteristics. These include their visual appeal, size, shape, color, and, most importantly, taste and aroma. The vibrant colors of edible flowers are determined by a variety of chemical compounds, with carotenoids and flavonoids being the most influential. The high antioxidant capacity found in flowers is frequently closely associated with their flavonoid content.

Edible flowers are sourced from various plant categories, including vegetables, fruits, medicinal herbs, and ornamental plants. While many weed flowers and commonly used edible flowers are safe for consumption, it's crucial to be aware that some flowers are poisonous and inedible. Examples include *Laurus nobilis*, *Achillea millefolium* and *Lycium barbarum* flowers. Additionally, it's essential to ensure that edible flowers used for consumption are free from pesticides.

Individuals should also be aware of any potential allergic reactions to edible flowers before consuming them. Flowers can be consumed in different ways, either as a whole with their pedicel or by separating their petals, sepals, stamens, and pistils. These flowers can be enjoyed fresh, dried, or processed in various forms such as vinegar, liqueur, tea, or candy. Edible flowers can be sourced from a wide range of plants, including vegetables, ornamental plants, flowers from certain fruit trees, and plants used for medicinal and aromatic purposes. The color of edible flowers can significantly impact their taste and market appeal.

Edible Flowers and Nutrition

Edible flowers offer exceptional nutrient density, surpassing that of most fruits and vegetables. Each type of edible flower boasts a distinct composition and nutritional profile. Their abundant flavonoid content contributes to their remarkable antioxidant capacity, outshining other plant parts. Moreover, numerous edible flowers are abundant in vitamin C, vitamin A, and other essential nutrients, rendering them a valuable source of minerals, particularly phosphorus and potassium.

Reports on Edible Flowers

The pollen within flowers plays a pivotal role in determining their chemical composition, boasting an array of essential nutrients. It serves as a valuable source of protein, amino acids, carbohydrates, carotenoids, and flavonoids. In addition to that, these flowers are packed with fructose, glucose, sucrose, inorganic oils, and phenolic compounds. Furthermore, their vivid petals are rich in vitamins C, A, and E, as well as antioxidants and minerals. In a study, the authors discovered antioxidant activity ranging from 17.6% to 85.7% using the DPPH assay in 12 distinct edible fresh flowers. Notably, the authors emphasized that the petals of rose (*Rosa hybrida* cv. noble red) are a significant source of vitamins C and E, anthocyanins, antioxidants, carotenes, and phenols.

Table 1: Some edible flowers and colors of petal leaves

Name of the Plant	Color of the Petals
<i>Abelmoschus esculentus</i>	Red, Yellow
<i>Agastache foeniculum</i>	Lilac
<i>Alcea rosea</i>	In Various Colors
<i>Allium schoenoprasum</i>	Red, Lilac, Purple
<i>Allium tuberosum</i>	White
<i>Anethum graveolens</i>	Yellow
<i>Anthemis nobilis</i>	White
<i>Anthriscus cerefolium</i>	White
<i>Begonia</i>	Pink, White, Red, Yellow
<i>Bellis perennis</i>	Purple, White
<i>Borago officinalis</i>	Purple, Blue, Lilac
<i>Brassica</i> spp.	White, Green, Yellow
<i>Calendula officinalis</i>	Orange, Yellow
<i>Carthamus tinctorius</i>	Red, Yellow
<i>Centaurea cyanus</i>	White, Blue, Pink
<i>Cercis canadensis</i>	Pink
<i>Chrysanthemum</i>	White, Yellow, Pink, Purple
<i>Cichorium intybus</i>	Lilac, Blue
<i>Citrus limon</i>	White
<i>Citrus sinensis</i>	White
<i>Coriandrum sativum</i>	White
<i>Cucurbita</i> spp.	Yellow, Orange
<i>Cynara scolymus</i>	Yellow
<i>Dianthus</i> spp.	White, Pink, Red
<i>Eruca vesicaria</i>	White
<i>Foeniculum vulgare</i>	Yellow
<i>Gladiolus</i> spp.	In Various Colors
<i>Hemerocallis fulva</i>	Orange
<i>Hibiscus rosa sinensis</i>	Red
<i>Hyssopus officinalis</i>	Pink, Blue, White
<i>Lavandula</i>	Pink, Lilac
<i>Levisticum officinale</i>	White, Yellow
<i>Malus</i> spp.	Pink, White
<i>Melissa officinalis</i>	White
<i>Mentha</i> spp.	Pink, Lilac, White
<i>Monarda didyma</i>	White, Red, Pink, Lilac
<i>Muscari neglectum</i>	Blue, Pink
<i>Ocimum basilicum</i>	Pink, White
<i>Origanum</i> spp.	White
<i>Pelargonium</i> spp.	White, Red, Pink, Lilac
<i>Phaseolus coccineus</i>	Red, Orange, White
<i>Pisum sativum</i>	Pink, White
<i>Prunus</i> spp.	Pink, White
<i>Raphanus sativus</i>	Pink, White, Yellow
<i>Rosa</i> spp.	Pink, White, Yellow, Purple
<i>Rosmarinus officinalis</i>	Pink, White, Dark Blue
<i>Salvia officinalis</i>	Lilac
<i>Syringa vulgaris</i>	Pink, White, Lilac
<i>Tagetes erecta</i>	Red, White, Gold
<i>Taraxacum officinale</i>	Yellow
<i>Trifolium pratense</i>	Lilac, Pink
<i>Tropaeolum majus</i>	White, Red, Yellow, Orange
<i>Viola odorata</i>	White, Lilac
<i>Yucca filamentosa</i>	Purple, White

Edible Medicinal Ornamentals

Throughout history, flowers have served both culinary and medicinal purposes, offering valuable nutrition and health benefits. Various cultures, such as the Orient, the Romans, Italians, Hispanics, and Asian Indians, have incorporated flowers like Daylily buds, *Chrysanthemums*, mallow, roses, and violets into their traditional dishes. In the Western world, salads have become a common platform for using edible flowers, but as people become more adventurous, they are

discovering the rich flavors and health potential of blooms and buds. Edible flowers offer substantial nutraceutical potential and can elevate the flavor and nutritional content of sauces, tarts, preserves, pickles, fritters, and soft cheeses.

Although numerous blossoms contain vitamin C and/or vitamin A, it's crucial to emphasize that not all flowers are suitable for consumption. Herb flowers generally exhibit similar flavors and characteristics as their edible leaves but may possess a milder taste. For individuals who suffer from asthma or have allergies to composite-type flowers such as calendula, chicory, *Chrysanthemum*, daisies, English daisies, and marigolds, it is advisable to refrain from consuming flowers to avoid any personal discomfort. If you are trying edible flowers for the first time, it is prudent to introduce them gradually into your diet to minimize the risk of digestive issues.

Some of the medicinally important edible ornamentals are:

Rose (*Rosa species*) Family: Rosaceae

Roses have held a special place in human culture for centuries, revered for their diverse uses in cooking, medicine, cosmetics, and aromatherapy. Two notable species, the apothecary rose (*Rosa gallica*) and the Dog rose (*Rosa canina*), have been employed in medicinal remedies. Dog rose hips, in particular, are highly regarded due to their high vitamin C content, along with flavonoids, tannins, and vitamins A, B1, B2, B3, and K. In the middle Ages, the Dog rose was revered as a notable remedy for chest-related ailments.

In modern times, the Damask rose is primarily cherished for its aromatic and cosmetic qualities. It is renowned for its soothing and mood-enhancing effects, making it valued for its sedative and antidepressant properties and it is also used to help lower cholesterol levels. In traditional Chinese medicine, *Rosa rugosa* is utilized as a tonic to promote liver function and as an antidote for specific forms of poisoning.

Rose oil plays a significant role in aromatherapy, where it is used to alleviate inflammation, reduce swelling, and control bodily humors. Additionally, it is incorporated into cooling and binding ointments and plasters.

Research by Zang *et al.* explored the anti-inflammatory and analgesic properties of *Rosa multiflora* Thunb hips. The study involved the extraction of Fructus *Rosa Multiflora* (FRM) hips using 75% ethanol. The dried extract (FRME) was then administered intragastrically at varying doses (100, 200, 400 mg/kg). The study's objective was to evaluate the anti-inflammatory effects in four distinct animal models and the analgesic effects in two animal models.

Hibiscus (*Hibiscus rosa-sinensis*) Family: Malvaceae

Hibiscus flowers and leaves are rich in nutrients and find extensive use in various culinary preparations. Chinese hibiscus, in particular, is a sweet, astringent, and cooling herb with various medicinal properties. It is known to control bleeding, soothe irritated tissues, and alleviate spasms.

The flowers of Chinese hibiscus have a range of therapeutic uses. They are considered aphrodisiac, demulcent (soothing to mucous membranes), emmenagogue (stimulating menstrual flow), emollient (softening and soothing to the skin), and refrigerant (cooling). Internally, hibiscus flowers and leaves are used for treating conditions such as excessive and painful menstruation, cystitis, venereal diseases, and for stimulating hair growth.

The leaves of this plant possess anodyne (pain-relieving), aperient (mild laxative), emollient, and laxative properties. A decoction of the leaves can be used as a lotion for treating fevers. Furthermore, a paste made from both the leaves and flowers can be applied topically as a poultice for cancerous swellings and mumps. Additionally, a paste made from the root is employed in the treatment of venereal diseases.

Table 2: Nutritional composition of Hibiscus flowers on dry weight basis (Water 0%)

Calories 353/100 g*	Minerals	Vitamins
Protein 3.9 g	Calcium 39 mg*	Thiamine (B1) 0.29 mg*
Fat 3.9 g	Phosphorus 265 mg	Riboflavin (B2) 0.49 mg
Carbohydrate 86.3 g	Iron 1.7 mg	Niacin 5.9 mg
Fibre 15.7 g	Ash 5.9 g	Ascorbic acid (C) 39 mg

The study conducted in Sangli, Maharashtra, India, focused on assessing the antipyretic (fever-reducing) activity of the ethanolic extract obtained from the flowers of two species of *Hibiscus rosa-sinensis*: Lahaina and China rose. The experiment involved using a brewer's yeast-induced pyrexia (fever) method in rats. The flower extracts from both species, when administered to the rats at a dose of 300 mg/kg, demonstrated notable antipyretic activity, as evidenced by a reduction in the elevated body temperature of the rats. These results were comparable to those achieved with the standard drug paracetamol.

Carnation (*Dianthus caryophyllus*) Family: Caryophyllaceae

Carnations provide a delicately peppery flavor, rendering them a nutritious addition to salads or an appetizing garnish for cheese-based dishes. Additionally, their antibacterial properties can have medicinal benefits, helping to alleviate gastric discomfort and support gastrointestinal health. Carnation flowers, known for their aromatic and stimulating qualities, were historically used in tonic cordials to treat fevers. In European herbal medicine, they are traditionally prescribed for coronary and nervous disorders. These flowers are regarded as alexiteric, meaning they boost the immune system, possess antispasmodic properties and are considered cardio-tonic, which is beneficial for heart health, diaphoretic (inducing sweating), and nervine tonic (supporting the nervous system). Additionally, the plant has been used as a vermifuge (to expel intestinal worms) in Chinese traditional medicine.

Calendula (*Calendula officinalis*) Family: Asteraceae

It has a tangy, peppery flavor perfect for salads, soups, and cream cheese sandwiches, adding a vibrant saffron hue to your dishes. Medicinally, it offers relief for ulcers, cramps, and colitis due to its antispasmodic properties. Its petals and pollen contain anti-inflammatory triterpenoid esters and antioxidants like flavoxanthin and auroxanthin, responsible for its yellow-orange color. The leaves and stems are primarily composed of lutein (80%), zeaxanthin (5%), and beta-carotene. *Calendula officinalis* is employed in the treatment of skin disorders, pain management, and as a bactericide, antiseptic, and anti-inflammatory agent. Cosmetic products frequently incorporate plant extracts, likely because of the presence of compounds such as saponins, resins, and essential oils.

Nasturtium (*Tropaeolum majus*) Family: Tropaeolaceae

Nasturtiums are a versatile and nutritious plant where all parts are edible. The flowers offer a sweet taste, while the leaves have a mustard cress flavor. Nasturtium seeds can be pickled as a caper substitute. Combining the flowers and leaves with pasta and snow peas creates an unusual and decorative salad dish.

Medicinally, Nasturtiums have several beneficial properties. They act as antiseptics and expectorants, making them useful for treating head colds. They are also effective in the prevention and treatment of urinary tract infections. They contain glucosinolates, a type of mustard-oil glycoside, and glucotropaeolin, which releases a disinfectant sulfur compound when mixed with water, providing antibiotic and anti-tumor effects. Furthermore, they have the ability to relieve respiratory congestion, stimulate the digestive system, and assist with hyperthyroidism. Nasturtiums are rich in flavonoids, which enhance the body's absorption of vitamin C, a nutrient present in abundance in these plants. They also contain spilanthol, oxalic acid, and the enzyme myrosin.

Lotus (*Nelumbo nucifera*) Family: Nelumbonaceae

Dried carpels of lotus are rich in nutrients, containing protein (16%), carbohydrates (66%), and minerals. Lotus leaves, carpels, and rhizomes contain three alkaloids known as nuciferine, roemerine, and nornuciferine.

A study conducted by Krishnamoorthy *et al.* (referenced as 18) investigated the antioxidant activity of *Nelumbo nucifera* (lotus) flowers. In their experiment, the researchers assessed the effect of flower extract on groups of isolated rat kidneys subjected to oxidative stress. They observed that the flower extract was able to reduce the activities of enzymes that induce oxidative stress, such as Glutamate oxaloacetate transaminase (GOT), catalase, Glutathione peroxidase (GPx), and Glutamate pyruvate transaminase (GPT) in the diseased rats.

Furthermore, when the animals were treated with the flower extract, oxidative stress was reduced, and the levels of antioxidants increased. The marker enzymes returned to their normal levels. Based on these findings, the researchers concluded that the flower extract of *Nelumbo nucifera* possesses significant antioxidant properties, indicating its potential for combating oxidative stress-related health issues.

Hydrangea (*Hydrangea macrophylla*) Family: Hydrangeaceae

The young leaves of Hydrangea possess a distinctive quality: when dried and rubbed between the hands, they turn remarkably sweet. These sweet leaves are used to prepare a special tea known as 'tea of heaven,' which holds significance in Buddhist ceremonies. This sweetness comes from a substance called phylodulcin, with the chemical formula C₁₆H₁₄O, making it an excellent natural sugar substitute. Even a small leaf can provide enough sweetness to flavor a cup of tea.

In addition to their culinary uses, older leaves of Hydrangea can be dried, powdered, and used as a flavorful seasoning for various foods. Furthermore, the young leaves and shoots are edible when cooked.

Medicinally, various parts of the Hydrangea plant, including the leaves, roots, and flowers, have valuable properties. They are known for their anti-malarial effects, ability to alleviate coughs (antitussive), and diuretic properties, which can help increase urine production.

Periwinkle (*Catharanthus roseus*) Family: Apocynaceae

Periwinkle has diverse traditional uses:

- 1. Brain Health:** It enhances brain blood flow, aiding arteriosclerosis and dementia.
- 2. Hemostatic:** It effectively stops bleeding, addressing various types of bleeding, including internal bleeding, heavy menstrual bleeding and nosebleeds.
- 3. Diabetes:** In the Philippines, it's traditionally used to treat diabetes, suggesting potential blood sugar-regulating properties.

Bougainvillea (*Bougainvillea spectabilis*) Family: Nyctaginaceae

Bougainvillea spectabilis leaf extracts, when administered to diabetic mice, exhibited significant hypoglycemic (blood sugar-lowering) effects. In diabetic rats, the oral administration of fresh green leaf juice, extracted using distilled water at a dosage of 1 g/kg body weight/day for 14 days, resulted in a significant reduction in blood sugar levels. It's worth noting that 1 g of the leaf yields approximately 1 ml of juice. These findings suggest the potential of Bougainvillea spectabilis as a natural remedy for managing diabetes.

Amaltas (*Cassia fistula*) Family: Caesalpiaceae

Amaltas has medicinal properties for treating skin diseases, inflammation, rheumatism, anorexia, and jaundice. It contains a newly discovered bioactive flavone glycoside with antimicrobial properties. Extracts from its bark exhibit hepatoprotective and hypoglycemic effects. Raju *et al.* conducted a study revealing significant anti-inflammatory and antioxidant activities in the bark extracts when tested on Wistar albino rats in both acute and chronic models.

Parijat (*Nyctanthes arbor tristis*) Family: Oleaceae

Parijat has various medicinal uses:

- 1. Piles Treatment:** The seeds are utilized in the treatment of piles.
- 2. Gout:** A decoction made from parijat flowers is used to address gout.
- 3. Cough Relief:** The leaves are effective against dry cough when consumed internally as a juice mixed with honey.
- 4. Skin Troubles:** An aqueous paste of parijat leaves is applied externally to treat skin-related issues, particularly ringworm.
- 5. Female Tonic:** Young parijat leaves serve as a female tonic.

Research by Karnik *et al.* found that Parijat exhibits anti-malarial properties. Patients suffering from malaria were administered an oral paste of five fresh leaves of Parijat three times a day for a period of 7-10 days, resulting in complete clinical and parasitic cure in 76.7% of cases within 7 days out of 120 patients.

Lagerstromia (*Lagerstroemia speciosa*) Family: Lythraceae

An experiment was conducted to assess the hypoglycemic (blood sugar-lowering) activity of Lagerstroemia speciosa leaves, known as Ambujakshi and Salma¹. The study involved diabetic rats induced with Alloxan (at a dose of 120 mg/kg). Glibenclamide, a commercially available diabetes medication, was used as a standard reference drug.

During the experiment, the toluene and methanolic extracts of

Lagerstroemia speciosa leaves were administered at a dosage of 500 mg/kg to the rats for a duration of 21 days. The results showed a significant reduction in both serum glucose and cholesterol levels in rats treated with the toluene and methanol-extracted drug, respectively.

Camel Foot Tree (*Bauhinia purpurea*) Family: Caesalpiaceae

The leaves of Bauhinia purpurea are employed in traditional medicine for various purposes. A paste made from the leaves is applied to treat jaundice and liver disorders. They are also utilized in ophthalmic treatments for conditions like night blindness, cataracts, conjunctivitis, and for improving vision. Moreover, the exudate obtained from the leaves and young twigs serves as an ointment to alleviate eye irritation and redness. Physicochemical analysis shows that these leaves contain a notable amount of potash, with a total ash value of 8.9%, insoluble ash at 1.32%, and water-soluble ash at 0.87%.

Ashoka (*Saraca asoca*) Family: Fabaceae

Ashoka bark has a long history of use in Indian traditional medicine for addressing uterine and menstrual issues, including hemorrhages, dysmenorrhea, and menorrhagia. It also affects the central nervous system. The bark is notable for its bitterness and cooling properties, which render it effective against various conditions such as inflammation, cervical gland enlargement, burning sensations, dyspepsia, intestinal worms, and animal poisoning. Additionally, Ashoka flowers are used in the treatment of bleeding piles, scabies in children, and various skin conditions.

Kadamba (*Neolamarckia cadamba*) Family: Rubiaceae

Kadamba is endowed with a wide range of medicinal properties. The bark is characterized by its bitterness, astringency, cooling nature, and possesses anti-inflammatory, digestive, carminative, expectorant, and tonic properties. It is employed to alleviate various conditions including fever, cough, diarrhea, vomiting, burning sensations, wounds, and ulcers. The fruits are considered aphrodisiac and cooling, making them suitable for addressing gastric issues in children. Furthermore, a decoction made from the leaves is used for gargling to combat throat infections.

Temple Tree (*Plumeria* spp) Family: Apocynaceae

Plumeria alba's latex is utilized topically for treating ulcers, herpes, and scabies. The entire plant functions as a febrifuge and is employed in tribal medicine to manage cholera and indigestion. The flowers of *Plumeria alba* contain α and β -amyrins and are used as contraceptives. On the other hand, *Plumeria rubra* latex serves as a purgative and is applied externally to alleviate itching and rheumatism. The bark extract is used for addressing diarrhea and leprosy. Furthermore, the root bark exhibits potent anti-herpetic properties, acts as a purgative, and is effective against venereal sores.

Aromatherapy for Health

Aromatherapy means "treatment using scents". It is a holistic treatment method that involves using pleasant-smelling botanical oils like rose, lemon, lavender, and peppermint. These essential oils can be added to baths, massaged into the skin, inhaled directly, or diffused to fragrance an entire room. Aromatherapy is employed for various purposes, including

pain relief, skincare, stress reduction, fatigue alleviation, and overall body invigoration.

Mahua (*Madhuca longifolia*) plays a significant role in the diet and economy of tribal communities. The edible corolla of Mahua flowers is a vital part of tribal diets, and the tree serves multiple purposes. Over 70% of tribal populations are involved in collecting, drying, and selling Mahua flowers. This tree is predominantly found in the Santhal Pargana area of Jharkhand, as well as in several other states.

Mahua flowers have a unique fragrance and are used for making alcohol, providing livelihoods to many. They also have diverse applications as herbal medicines. Mahua is a crucial resource for tribal households for about four months each year.

However, its significance as a food source is diminishing due to urbanization, the lack of value addition technologies, and changing dietary preferences. Presently, the most common use of Mahua is for alcohol production, and a lack of knowledge about value-added technologies leads to distress selling. Efforts are being made to encourage people to shift from hazardous alcohol consumption to value-added products. A study conducted by Karuna *et al.* in 2018 assessed and

refined technologies related to Mahua, particularly in the form of laddoo (sweet balls) and pickles. The study was conducted in Jamtara district, involving 20 families across 20 villages to demonstrate these technologies' potential benefits.

Table 3: The nutritional value of Mahua flower (100 gms)

Nutrient	QTY
Protein	4.4 g
Fat	0.6 g
Minerals	2.7 g
Fiber	1.7 g
Carbohydrate	72.0 g
Energy	311 Kcal
Calcium	140 mg
Phosphorus	140 mg
Iron	15.0 mg
Carotene	23 ug.
Thiamin	0.03 mg
Riboflavin	0.80 mg
Niacin	5.2 mg
Vitamin C	7 mg

Source: National Institute of Nutrition, Hyderabad

Table 4: Organoleptic evaluation of Mahua pickle & Mahua Ladoo

Technology Option	Shelf Life (Days)					Shelf Life	B:C
	Colour	Taste	Flavor	Appearance	Acceptability		
Farmers Practice	2.57±0.13	2.74±0.15	2.42±0.13	1.57±0.13	2.52±0.13	30	
TO-1	4.57±0.16	4.57±0.10	4.57±0.21	3.57±0.10	4.49±0.0	180	1:3.5
TO-2	4.71±0.13	4.57±0.14	4.42±0.18	4.28±0.0	4.32±0.0	15	1:2.6

Sensory score scale- (5 = Excellent, 4 = Very good, 3 = Good, 2 = Fair and 1 = Poor.)

Table 5: Chemical composition of Mahua pickle and Mahua Ladoo per 100 gm

Observation Parameter	Value Added Product of Mahua Flower		
	Dried Mahua Flower	Pickle	Ladoo
Energy (k cal)	311.00±1.14	375.808±1.56	518.581±2.10
Protein (g)	4.40±0.05	4.047±0.07	5.230±0.06
Fat (g)	0.60±0.4	4.240±0.22	7.960±0.15
Carbohydrate (g)	72.00±0.22	60.550±0.31	17.310±0.42
Calcium (mg)	140.00±1.83	139.000±1.90	130.000±1.76
Phosphorus (mg)	140.00±0.14	127.200±0.12	157.200±0.76
Iron (mg)	15.00±0.10	12.708±0.09	9.720±0.16
βcarotene (µg)	23.00±0.88	30.365±0.28	239.324±0.10

Candy Flowers

To candy flowers, gather these items: a small paintbrush, a bowl, a cake rack, a fork, finely ground granulated sugar, and an egg white. Follow these steps:

1. Choose perfectly shaped, newly opened flowers with enough stem to place them in water comfortably. Wash the flowers a few hours before using, allowing them to dry completely.
2. In a small bowl, lightly beat the egg white. Hold a flower by the stem and gently apply a thin coat of egg white to the petals, ensuring all parts of the flower are covered (uncovered areas may wilt and discolor).
3. Sprinkle sugar generously, covering the flower completely.
4. Place the sugared flower on a cake rack, arranging the petals naturally.
5. Allow the flowers to air-dry in a warm, dry location for a few hours.
6. After a few days, the candied flowers should be fully dry and ready to use or store in a sealed container.

Candied flowers make delightful decorations for cakes, cookies, and ice cream.

Conclusions from Case Studies

In a study by Rop *et al.* in 2012^[12], the antioxidant capacity of 12 ornamental species was examined, showing values ranging from 4.21 to 6.96 g of ascorbic acid equivalents (AAE) per kilogram of fresh mass (FM). Among these species, *Chrysanthemum*, *Dianthus* and *Viola* flowers displayed the highest mineral element levels. Potassium was the most abundant element, with concentrations ranging from 1,842.61 to 3,964.84 mg/kg of FM.

In another study by Navarro-González *et al.* in 2015^[10], the nutritional composition and phenolic compound profiles of three edible flowers—monks cress (*Tropaeolum majus*), marigold (*Tagetes erecta*), and paracress (*Spilanthes oleracea*)—were investigated. These edible flowers shared a composition similar to other plant foods, characterized by high water and total dietary fiber (TDF) content, low protein content, and minimal total fat. However, significant

differences were observed among the samples.

The study discovered that *Tithonia erecta* exhibited the highest levels of total phenolic compounds (TPC) and antioxidant capacity, followed by *Spinacia oleracea* and *Tropaeolum majus*. A total of 39 distinct phenolic compounds were provisionally identified, with flavonols being the predominant compounds in all samples, followed by anthocyanins and hydroxycinnamic acid derivatives. Additionally, in *T. erecta*, small quantities of gallotannin and ellagic acid were also identified.

Grzeszczuk *et al.* conducted a study in 2018 to compare the content of macro nutrients (N, P, K, Na, Ca, Mg, S) and microelements (Fe, Zn, Cu, Mn) in the flowers of various species and cultivars of ornamental plants. The dried flowers used in the study included species like *Mimulus × hybridus* L. (Magic Yellow, Magic Red), *Antirrhinum majus* L. (Cavalier), *Dianthus chinensis* L. (Chianti), *Hemerocallis × hybrida* Hort., *Paeonia officinalis* L. (Sarah Bernhardt, Dr Aleksander Fleming, Karl Rosenfield), *Monarda didyma* L., *Monarda fistulosa* L., and *Monarda citriodora subsp. austromontana*.

The results of the chemical analyses revealed that *Monarda* and *Mimulus × hybridus* L. flowers had significantly higher levels of both macro and microelements compared to the other species. Among the microelements, potassium had the highest average concentration at 30.03 g Kg⁻¹ dry matter, and among microelements, iron had the highest average concentration at 154.93 mg Kg⁻¹ dry matter.

Conclusion

Edible flowers are a valuable source of both macro and microelements, with notable concentrations of phosphorus, potassium, and iron. These flowers are characterized by relatively low levels of heavy metals. They play a significant role in human nutrition, offering antioxidants, anti-carcinogenic compounds, vitamins, and diverse chemical compositions. Additionally, they exhibit anti-diabetic, anti-inflammatory, and anti-microbial properties. Edible flowers are often underutilized but represent a rich resource in terms of nutrition. They are also appreciated for their aesthetic appeal in gardens and for culinary purposes, making them a versatile addition to diets and gardens.

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