

Edible Flowers: A Nutritional Powerhouse for Health and Sustainability

Edible flowers, the non-toxic floral parts of the plants, are increasingly recognized as functional food due to their rich nutritional and bioactive properties. Historically, they have been utilised for decoration, cooking, and medicinal purposes. Evidence from ancient Roman, Greek, Chinese, and Ayurvedic traditions shows their importance for health and culinary practices. Edible flowers are rich in vitamin C and essential minerals like calcium, iron, and magnesium. Edible flowers also contain dietary fiber and bioactive compounds such as polyphenols, flavonoids, carotenoids and anthocyanins. These components are closely linked to several health benefits, such as antioxidant, anti-inflammatory, anticancer, liver-protective and cardiovascular diseases. Edible flowers such as *Calendula officinalis*, *Hibiscus*, *Rosa sinensis*, and *Tropaeolum majus* show immunomodulatory, digestive, and brain-protective properties. Cultivating edible flowers supports a sustainable food system, promotes biodiversity, reduces pesticide use and encourages urban agriculture. However, it is important to identify species carefully and manage contaminants to ensure safety. Overall, edible flowers have great potential to improve nutrition, health and environmental sustainability.

Keywords: Antioxidants; Bioactive compounds; Edible flowers; Floral nutrition; Polyphenols

EDIBLE flowers have been a significant part of human diets. Historical sources provide evidence of their gastronomic and nutritional qualities. These edible flowers contain nutrients and health-promoting

components that are safe for human consumption. Edible flowers, which were previously employed for aroma and decorative purposes, are now believed to be an essential component in the food chain. This recognition is



Photographs of common cultivated edible flower A) *Calendula*, B) *Chrysanthemum*, C) *Dianthus*, D) *Marigold*, E) *Pansy*, F) *Rose*, G) *Hibiscus* and H) *Nasturtium*

supported by historical and archaeological evidence that indicates their use as early as 3000 BC. Many culinary traditions have incorporated edible flowers, with European countries being among the first to acknowledge their potential. These flowers are often included in confections, preserves, and herbal infusions. Historical records from ancient Roman, Greek, Chinese, ayurvedic practices show their potential for both therapeutic and nutritional benefits. Hibiscus (*Hibiscus sabdariffa*) was often consumed as a drink to treat fever and high blood pressure. These traditional applications demonstrate an early understanding of the advantageous properties of flowers. Edible flowers are attractive and packed with essential vitamins and minerals that may improve overall health. These flowers are especially high in vitamin C, which is important for immune function, collagen production and skin health. Rose petals and hibiscus flowers have significantly higher vitamin C content, similar to citrus fruits. Additionally, edible flowers contain antioxidants that help reduce oxidative stress and lower the risk of chronic diseases. Calendula and chamomile are rich in antioxidants that have anti-inflammatory properties. Many edible flowers also contain essential minerals like calcium, iron and magnesium. For example, edible violets are high in calcium, while rose petals provide a good amount of iron. In addition, certain edible flowers are high in fibre, which promotes gut health and aids in digestion. Flowers such as nasturtium and marigold are particularly high in fiber. Additionally, polyphenols found in edible

flowers have anti-inflammatory and anti-cancer properties. These compounds are more concentrated in flowers like blueberries and elderflowers.

Common edible flowers: A wide range of edible flowers is currently available in commercial markets, and their consumer demand has increased considerably in recent years. Globally, edible flowers are reported to originate from approximately 97 plant families, 100 genera, and 180 species; however, the diversity and availability of edible flower species vary significantly across geographical regions. Studies on edible flowers are crucial because the global flora includes a vast diversity of plant species, yet only a limited number are safe and suitable for human consumption.

Nutritional benefits of edible flower: Edible flowers are increasingly recognised not only for their aesthetic and culinary value but also for their significant nutritional and functional properties. From a nutritional perspective, pollen, nectar and floral tissues such as petals are the three primary constituents of edible flowers that contribute significantly to human nutrition. Pollen is a thick, concentrated, but quantitatively low fraction of the flower. Despite its restricted distribution, it contains high-quality proteins, essential amino acids, carbohydrates and both saturated and unsaturated lipids. It also contains bioactive compounds with antioxidant properties, such as flavonoids and carotenoids. Nectar is the main energy source in edible flowers and contains amino acids (mostly proline), proteins, inorganic ions, lipids, organic acids, phenolic

Table 1. Common edible flowers

S.no	Common name	Scientific name	Description
1	Anise Hyssop	<i>Agastache foeniculum</i>	A perennial herb that self-seeds and has a flavour and scent similar to anise.
2	Hollyhock	<i>Althea rosea</i>	Flowers have a subtle vegetal flavour and are mostly used as eye-catching decorations.
3	Tuberous Begonia	<i>Begonia tuberhybrida</i>	Slightly lemon-flavoured edible flowers have ophthalmic, anti-inflammatory, antispasmodic, and calming properties and are frequently used as a garnish.
4	Daisy	<i>Bellis perennis</i>	People with hay fever, asthma, or severe allergies should avoid mildly bitter foods, as they may trigger allergic reactions.
5	Calendula	<i>Calendula officinalis</i>	The slightly bitter petals help with digestion, boost immunity, lower fever, control menstruation, and have anti-inflammatory properties that are beneficial for gastrointestinal issues.
6	Chrysanthemum	<i>Chrysanthemum spp.</i>	Only the petals of <i>Chrysanthemum coronarium</i> are edible; the florets have a strong flavour. Traditionally used to treat infections, colitis, pneumonia, fever, constipation, and hypertension.
7	Carnation	<i>Dianthus spp.</i>	Bitter petal bases should be eliminated before using; sweet, clove-like flavour. For cooking, perennial species are favoured.
8	Hibiscus	<i>Hibiscus rosa-sinensis</i>	Rich in antioxidants and good for liver health and cholesterol control, these blossoms have a subtle citrus flavour and are used as ornamental edible garnishes.
9	Lavender	<i>Lavandula spp.</i>	Strongly fragrant, sweet, and fragrant, used in moderation. Helps reduce stress and encourages sleep, but using too much essential oil could be harmful.
10	Rose	<i>Rosa spp.</i>	Rich in vitamin C and offering anticancer, diuretic, laxative, and eye-health benefits, fragrant petals are used in salads and as garnishes after the bitter white base is removed.
11	Lilac	<i>Syringa vulgaris</i>	Petals, which are added to salads and have a lemony, floral taste, are believed to lower fevers and aid in removing internal parasites.
12	Marigold	<i>Tagetes spp.</i>	Flowers with a slight bitterness should be consumed infrequently and in moderation, as they are potentially dangerous in large quantities.
13	Dandelion	<i>Taraxacum spp.</i>	Young blooms taste sweet and are high in iron, calcium, phosphorus, and vitamins A and C.
14	Nasturtium	<i>Tropaeolum majus</i>	Antibiotic, disinfecting, wound-healing, expectorant, anticancer, and antiscorbutic qualities make these peppery-flavored blossoms and leaves useful in salads.

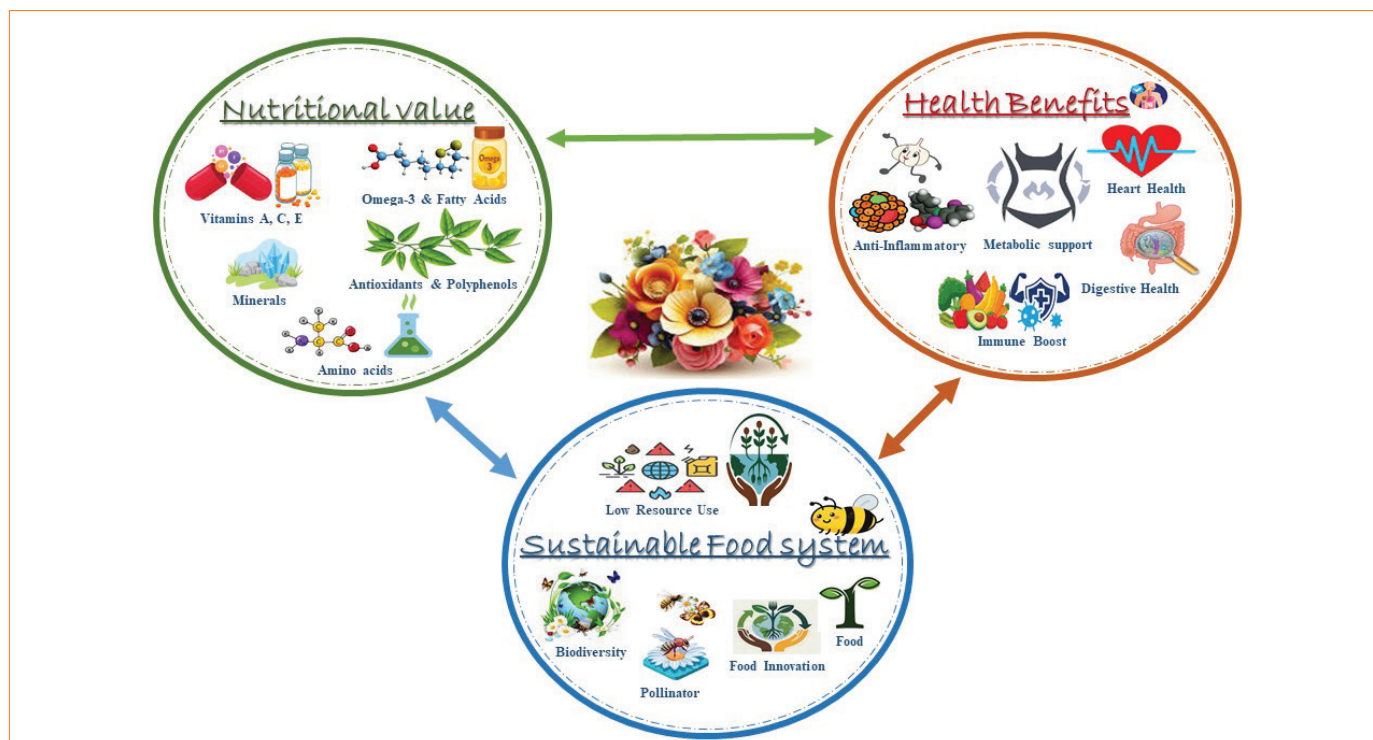
Table 2. Nutritional composition of edible flowers

Edible flowers	Moisture (%)	Ash (%)	Fat (%)	Total Carbohydrates (%)	Fibre (%)	Protein (%)
<i>Tegetus minuta</i>	12.28	8.79	23.82	11.31	34.03	9.75
<i>Costus afer</i>	18.63	11.47	1.83	55.83	21.16	2.73
<i>Tithonia diversifolia</i>	11.8	16.7	4.0	26.0	19.0	20.3
<i>Hibiscus rosasinesis</i>	12.37	2.64	4.7	61.11	17.27	1.90
<i>Matricaria chamomilla</i>	80.45	4.9	3.99	80.98	-	11.62
<i>Spilanthes oleracea</i>	81.74	1.44	0.41	13.56	10.11	2.84
<i>Moringa olerifera</i>	13.66	1.89	3.36	49.01	29.00	3.07
<i>Musa paradisiaa</i>	12.95	3.34	5.60	50.59	25.54	1.97
<i>Plumeria alba</i>	77.33	4.39	1.36	-	8.86	-
<i>Rhododendron arboreum</i>	79.40	2.30	1.52	12.20	2.90	1.68
<i>Rose hybrida</i>	-	2.47	3.80	73.31	6.19	14.23
<i>Fuchsia hybrida</i>	11.47	6.00	1.76	71.55	-	1.76
<i>Tropaelum majus</i>	89.32	0.63	0.33	7.14	4.51	1.99
<i>Acemella oleracea</i>	11.36	8.85	21.71	39.33	24.10	18.75
<i>Capparis decidua</i>	73.11	5.96	7.43	15.03	12.32	14.88
<i>Glycyrrhiza glabra</i>	2.24	5.10	2.61	68.43	15.77	5.85
<i>Bauhinia variegata</i>	2.10	5.97	10.58	58.12	12.97	10.26
<i>Malvaviscus arboreus</i>	21.22	7.23	10.82	48.12	17.86	12.60
<i>Tagetes erecta</i>	83.39	0.80	0.32	14.15	9.20	1.32
<i>Alcea rosea</i>	8.67	7.62	2.67	68.95	-	2.67
<i>Cassia auriculata</i>	8.11	6.83	3.03	64.45	7.82	9.76
<i>Jasminum grandiflorum</i>	92.76	2.94	2.56	-	3.60	-
<i>Tropaedum majus</i>	86.66	6.75	3.53	74.46	-	11.79

compounds, alkaloids and terpenoids. It is primarily composed of soluble sugars, including fructose, glucose and sucrose. These components are present in high amounts and together give nectar its distinctive, gentle and sweet flavour. Petals, together with other floral structures, constitute the vast majority of the edible components and are a significant source of micronutrients. Edible flowers are also rich sources of essential vitamins, particularly vitamin C, which plays a significant role in immune defence, collagen synthesis and skin health. Flowers such as rose petals and hibiscus are reported to have higher vitamin C content than citrus fruits. Additionally, edible flowers contain abundant antioxidants that reduce oxidative stress and may lower the risk of chronic diseases; species such as calendula and chamomile exhibit notable anti-inflammatory properties. Despite being low in calories, edible flowers are usually high in dietary fibre, which supports digestive health, as seen in flowers such as nasturtium and marigold. Studies on flowers, including *Agave salmiana*, *Cucurbita pepo*, *Yucca filifa*, *Aloe vera*, dahlia, rose and calendula have shown that their nutritional profiles are similar to those of leafy vegetables. In terms of nutrition, edible flowers generally have a high moisture content (over 80%), low fat and protein, and varying amounts of carbohydrates, sugars, minerals and fibre depending on the species and flowering stage. Such flowers often contain organic acids such as quinic and

malic acid. Moreover, flowers such as *Yucca elephantipes* are known for their significant amounts of dietary fibre and unsaturated fatty acids. Fully opened flowers are valuable sources of minerals and bioactive compounds, including polyphenols, carotenoids, anthocyanins and vitamin C. This highlights their potential to improve dietary quality and support human health.

Health benefits of edible flowers: Integrating edible flowers into the diet can provide various health benefits. The high levels of vitamin C in edible flowers strengthen the immune system, helping the body fight infections and illness. These flowers are also rich in antioxidants and polyphenols, which have anti-inflammatory effects. This may help reduce inflammation and lower the risk of chronic diseases, including heart disease and diabetes. The high fiber content in edible flowers supports healthy digestion, relieves constipation and promotes the growth of healthy gut bacteria. In addition, the antioxidants and vitamin C in these flowers help protect the skin from damage caused by free radicals. Edible flowers contain polyphenolic compounds known for their anti-inflammatory and anticancer effects. These effects are particularly pronounced at higher concentrations, as in elderflower and blueberry flowers. They support collagen production, which is important for keeping skin firm and elastic. However, flowers rich in polyphenols may also support heart health by lowering cholesterol and



Edible flowers for nutrition, health and sustainability

enhancing vascular function.

Sustainability and the food system: Edible flowers are important in sustainable food systems because they offer health benefits for people. They require minimal resources for cultivation, have short growing periods, and can thrive in limited spaces. These characteristics make them particularly suitable for urban agriculture and vertical gardens. Growing flowers alongside other crops can increase overall production and reduce the need for pesticides and fertilizers. Additionally, this practice encourages biodiversity by providing habitats for pollinators like bees and butterflies, which helps sustain ecosystem health and enhances pollination of various crops. Additionally, edible flowers can be utilized to develop innovative culinary products, helping to reduce food waste and improving the nutritional value of meals. Flower-infused oils, teas, and jams can improve both flavor and nutritional content in a variety of dishes. Edible flowers have cultural importance. They can be used to develop unique and valuable food items, thereby strengthening local economies by supporting small-scale farmers and producers who focus on flower-based products.

Safety considerations of edible flowers: Consumers are increasingly interested in foods that offer improved nutritional and functional benefits. However, it is important to carefully consider the safety of edible flowers. Many studies have explored the nutritional and beneficial properties of these flowers. It is important to recognise that some flowers can be hazardous if misidentified or collected from inedible species that contain harmful compounds. Moreover, edible flowers might be contaminated with biological agents, such as harmful microbes or with chemical residues from fertilisers and pesticides. These contaminants can occur during cultivation, harvesting,

processing or as a result of soil conditions. As consumers increasingly demand foods with specific nutritional and functional benefits, maintaining the safety of edible flowers remains crucial. While numerous studies investigate the nutritional and bioactive qualities of these flowers, it is important to remember that misidentifying or consuming non-edible species that contain toxic compounds can pose health risks. Additionally, flowers may carry biological contaminants such as harmful microorganisms or chemical residues from fertilisers and pesticides. These contaminants may be present due to cultivation, harvesting, processing methods or soil conditions. Edible and non-edible flowers mainly differ in their chemical composition, particularly their alkaloid content. Non-edible flowers may contain alkaloids that are stimulant, psychotropic, or toxic, emphasising the need for precise botanical identification and evaluation of their chemical and microbiological properties before consumption. A study by Egebjerg found that many flowers contain potentially toxic or unknown compounds. However, commonly edible species such as calendula (*Calendula officinalis* L.), nasturtium (*Tropaeolum majus* L.), and Viola (*Viola tricolor*) may pose a significant risk to sensitive individuals due to their high levels of methyl salicylate. Proper identification and monitoring of edible flowers are important to ensure their safety as food ingredients while also considering their nutritional and functional benefits.

Innovative food solutions: Edible flowers offer a distinctive way to boost nutrition and support sustainable practices in today's food system. Their application goes beyond mere decoration, delivering health benefits and culinary options that can enhance everyday meals while promoting environmentally friendly food choices. Rosehips and calendula are particularly valued for their high content of essential fatty acids and antioxidants.

These compounds support heart health and protect immune cells. These essential oils can also be incorporated into cooking or salad dressings, enhancing flavour while providing beneficial nutrients. Edible flowers are often used in tea production. Chamomile and hibiscus teas are popular for their calming effects and are suitable for hot or cold consumption. Their floral infusions offer antioxidants and vitamins, promoting health and relaxation. Beyond beverages, these flowers can be used to make jams and preserves. Rose petal and violet jams add a unique floral sweetness and nutrients to foods such as yoghurt, cheese and toast. Similarly, flavoured waters infused with flowers such as cucumber or strawberry provide a refreshing and hydrating alternative to sugary beverages. These drinks often contain essential vitamins and minerals that promote overall health. Edible flowers are a charming addition to cuisine and promote sustainability by enhancing nutrition and environmental health. They can be used in infused oils, teas, jams and flavoured waters. Consequently, this demonstrates their potential to transform everyday meals into healthy, environmentally responsible choices.

SUMMARY

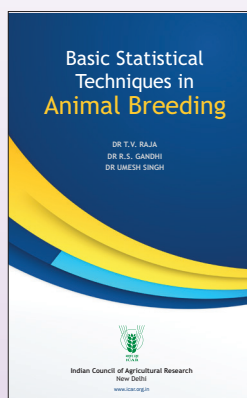
Edible flowers are increasingly favoured in

international cuisine for enhancing the sensory qualities of food, such as flavour, aroma, colour, appearance and nutrition. They are widely recognised as natural sources of nutrients and health-beneficial compounds. However, proper chemical and biological identification is essential to reduce potential health risks. Edible flowers have great potential for nutrition and health because they may help protect against diseases related to oxidative stress. However, further research is necessary to confirm these benefits in humans. The nutritional and functional properties of edible flowers can vary based on factors such as species, growing conditions, geographical origin and the methods used to extract their bioactive compounds. This highlights the great potential of edible flowers as nutrient-dense functional foods that can improve dietary quality, increase nutritional diversity, and play an essential role in maintaining and promoting physiological well-being and overall human health.

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