

Different Phytochemicals, and Their Therapeutic Value of Edible Flowers in Human Health: A Review

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Abstract:

The consumption of edible flowers promotes new trends in human nutrition. The determination of bioactive component content in their petals play an important role in estimating their significance as a natural source of antioxidant. Edible flowers can improve the flavour, taste, aroma, visual appeal, and color of food; they have also been used in many remedies and therapeutic formulation. There are a lot of edible flowers are available around the world. Edible flowers are high in phytochemicals (such as phenolic compounds, carotenoids, or terpenoids) that have a number of medicinal effects. Flowers may have been described as food in multiple cultures around the world. Edible flowers contain antioxidant, vitamins, and minerals that contribute to overall well- being to human health. Different flowers have different plant pigment (e.g., Anthocyanin, carotenoids, Chlorophyll, etc.) pigments play a vital role in food colorant as well as food nutrition. Therapeutic potential of edible flowers is: Anti septic, anti-inflammatory, Anti -diabetic, anti-obesity, anti-cancers etc. This review was aimed to study about phytochemical properties of edible flowers. And their therapeutic potential in human health.

Key Words: Edible flowers, pigments, Phytochemicals, Therapeutic value, Human Health.

Introduction:

Flowering plants contain a wide range of natural antioxidants, containing phenolic acids, flavonoids, anthocyanins, and many other phenolic compounds (Kaur et al., 2006). Edible flowers are gaining popularity as a rich source of bioactive chemicals due to their appealing and desirable visual qualities (M.R. Dhiman and colleagues 2017). Flowers have long been consumed in various cultures. Flowers were used medicinally and therapeutically by the ancient Greeks, Romans, and Chinese. Fresh flowers were used to heal multiple illnesses,

including open wounds. In aromatherapy, edible fresh flowers are recognized and carried as excellent spices. Flowers have been utilized for the manufacturing of a variety of prepared foods, comprising syrup, jellies, sauces, and several sweets. Flowers had been utilized in the development of vinegars, teas and other liquids, honey, oils, candied flowers, ice cubes, and salads. Flowers petals were usually consumed fresh in salads or as garnishes. Flowers in food may change the sensory properties of the cuisines. They contribute to improve the color, taste, and appearance of food. The most frequent edible flowers are Aparajita, hibiscus, rose, marigold, and chamomile. (Ivanka Petrova et al., 2016). Edible flowers tend to involve phenolic compounds containing different chemical structures, basically phenolic acids, flavanols, and anthocyanins, that exhibit antioxidant activities and protect against free radical damage (Kaur et al., 2006, Youwei 2008, and Song et al 2011). The use of petal extracts becomes more popular in the consumption of edible flowers. However, the bioactivity of extracts appropriate for culinary use remained uncertain. Despite several studies on fresh edible flowers, their usage in cuisine is limited for a variety of reasons, including availability and seasonality, safety and consumer perception, and the preservation of biological value during flower technological processing. Edible flower extracts may be able to eliminate some of the limitations of using fresh flowers in human nutrition. (Ivanka Petrova et.al 2020). Edible flowers are non-toxic flowers that are acceptable to be consumed by human beings for their introduced nutritional and therapeutic characteristics. (Alasalvar et al., 2013; Kaisoonet al., 2012). Secondary metabolites, which are found in edible flowers, are also found in other parts of plants and confer adaptive advantages, such as reducing damage caused by environmental stressing conditions (heat, lack of water, excessive UV radiation) and avoiding infection by plant pathogens. In this regard, look into the consistency of therapeutic uses. (Jacqueline Aparecida Takahashi and flava Augusta Guilheme Goncalves 2019). Several phytochemicals are responsible for edible flowers' beneficial effects in dealing with oxidative imbalance and cancer. Edible flowers are an effective source of antioxidants because they consist of carotenoids, terpenoids, flavonoids, anthocyanins, alkaloids, terpenoids, carotenoids, and other phenolic compounds. Epidemiological studies have indicated that antioxidant-rich edible flowers can help mitigate cancer by reducing the activities of several dysregulated mediators. (Sajad Fakhri et.al 2022).

Natural plant Pigments Present in Edible Flowers:

Pigments have been determined in nearly every plant that provide fascinating color combinations as well as a role in enhancing food colors and their therapeutic properties. Plant pigmentation is brought about by the electrical structure of the pigment combining with sunlight to alter the wavelengths transmitted or reflected by the plant tissue. The name of many flowers pigment is e.g., Anthocyanin, Carotenoids and Chlorophyll.

Anthocyanin:

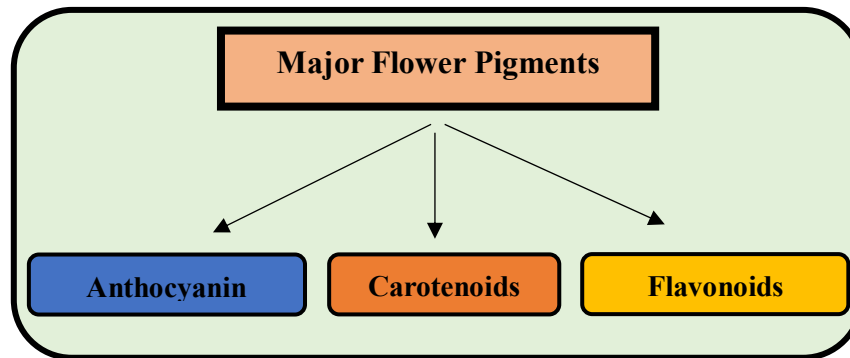
Anthocyanins are a group of objects of plant pigments that are abundant in nature. They can be found in plants as glycosides and acyl glycosides of anthocyanidins, also called aglycones. The different hydroxyl or methoxyl substitutions in the basic flavylum (2-phenylbenzopyrilium) structure distinguishes anthocyanidins. Anthocyanins have been discovered to have a considerable function in plant physiology, as well as in the food industry and human health. (Wu and Prior, 2005).

Carotenoids:

Carotenoid pigments provide many fruits and flowers prominent red, orange, and yellow colors as well as a variety of carotenoid-derived fragrances, making them commercially indispensable in agriculture, food manufacture, and the cosmetic industry. However, it is their roles in photosynthesis and nutrition that account for carotenoids' fundamental importance in the survival of plants and mammals alike. Carotenoids, in particular, are a ubiquitous component of all photosynthetic organisms given they are essential for the assembly and operation of the photosynthetic apparatus. Carotenoids, as antioxidants and precursors of vitamin A, are also vital elements of our diet. (Shrikant Baslingappa Swami et.al 2020).

Flavonoids:

Flavonoids pigments usually are freely soluble in polar solvents such as water, methanol and ethanol (Na Shen et.al.,2023). Flavonols are characterized by their chemical structure, which includes a 3-hydroxyflavone backbone. The most common flavonol found in plants is quercetin, but other flavonols include kaempferol, myricetin, and isorhamnetin, among others.



Phytochemicals in edible flower:

Edible flowers not only supply aesthetic and color to dishes, but they additionally contain a number of phytochemicals that can contribute to their nutritional and beneficial effects on health. Phytochemicals are naturally occurring molecules that are found in plants that have been proved to offer a variety of health impacts. Roses, lavender, calendula, hibiscus, blue pea, and marigold are some common edible flowers and their associated phytochemicals. These are just a few examples; there are numerous other edible flowers, each with its own phytochemical profile. These flowers' color, flavour, and possible health benefits have been improved by phytochemicals. They are constantly rich in antioxidants, anti-inflammatory compounds, and other bioactive substances that may be beneficial to human health. Some major phytochemicals of edible flower given in figure no.1

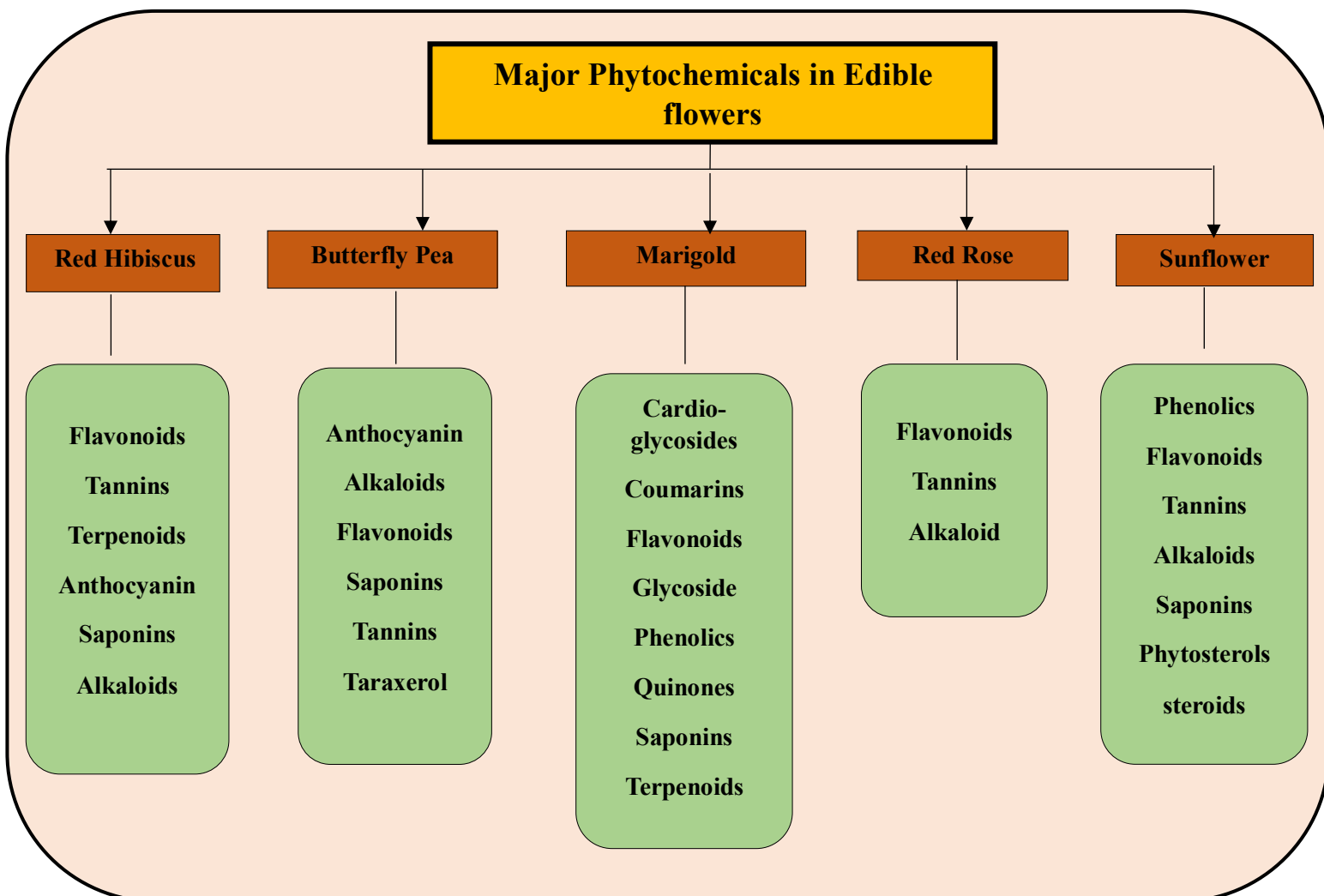


Figure 1. Phytochemicals Present in Edible flowers

Phytochemicals in edible flowers and their applications in food:

Edible flowers not only add visual appeal to dishes but can also provide distinctive Flavors and beneficial phytochemicals. Phytochemicals are natural compounds found in plants that have potential health benefits. Here are some common phytochemicals found in edible flowers, in addition to their food applications: Overall, incorporating a variety of edible flowers into your diet can not only add a blow of color and flavour to your dishes but also introduce different phytochemicals that can support your health and well-being.

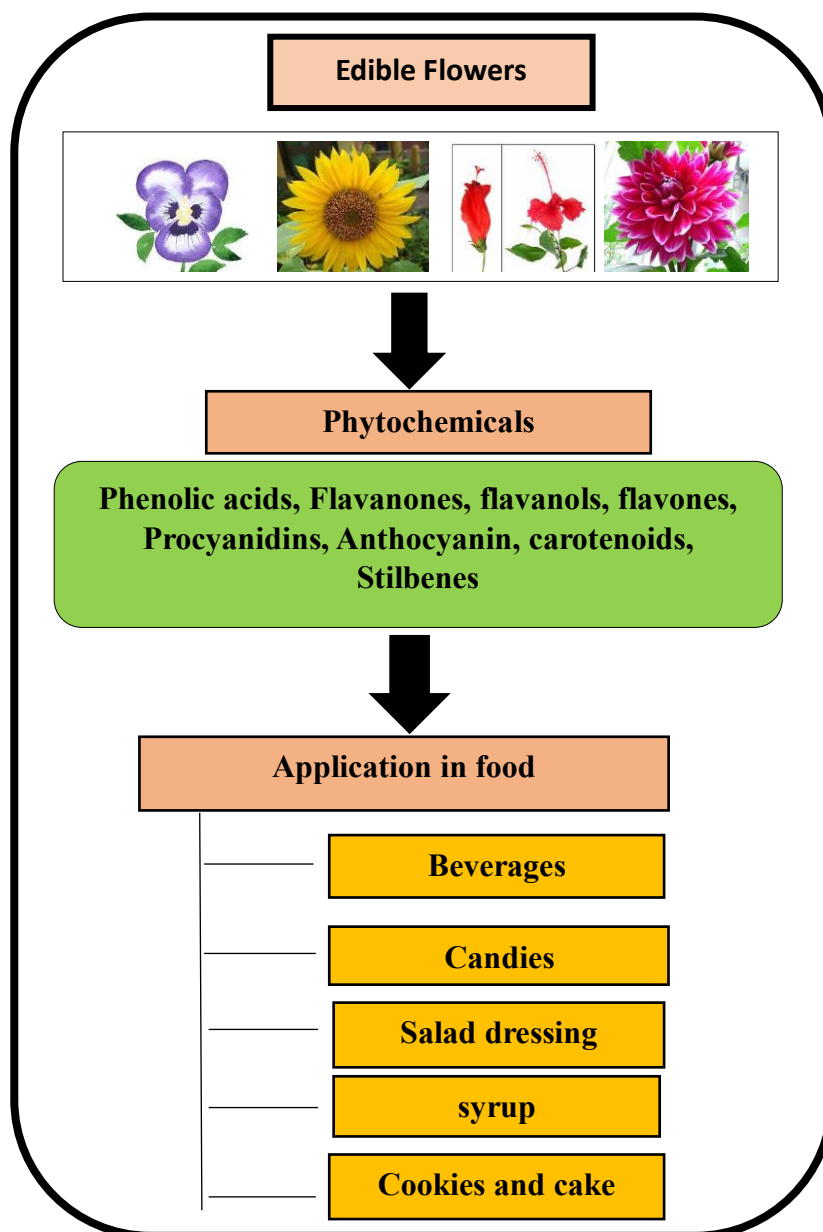


Figure 2. Phytochemicals and Their Applications in food

Some edible flowers, along with their common and scientific names:

Flower consumption as food is an ancient practice, but many flowers, or parts of them, had a significantly broader value in the past as then do today. (Mlcek et.al.,2011, Fernandes et.al.,2017 and Scariot et.al.,2018). Some common examples of edible flowers are Aparajita (*Clitoria ternate*), Gurhal (*Hibiscus ross sinensis*), Indian Rose (*Rosa Indica*), Chamomile (*Matricaria chamomilla*), marigold (*Tagetes erecta*) etc. Edible flowers have their own colors and flavour due to its coloring properties edible flowers were used as a component of coloring

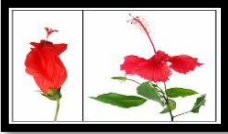









agent in food preparation. The major edible flowers and their scientific name are listed in the given table no.1

Table no.1 Edible flowers and their respective common name and scientific name

S. NO	COMMON NAME	SCIENTIFIC NAME	FAMILY	PIGMENTS
1	Gurhal	Hibiscus Rosa sinensis	Malvaceae	Anthocyanin
2	Aparajita	Clitoria ternatea	Fabaceae	Anthocyanins
3	Indian Rose	Rosa indica	Rosaceae	Carotenoids and Anthocyanin
4	Marigold	Tagetes erecta	Asteraceae	carotenoids
5	Chamomile	Matricaria chamomilla	Asteraceae	flavonoids
6	Pansy	Viola tricolor	Violaceae	Anthocyanin
7	Lavender	Lavandula angustifolia	Laminaceae	Anthocyanin
8	Squash Blossom	Cucurbita pepo	Cucurbitaceae	β - Carotene
9	Sun flower	Helianthus annus	Asteraceae	β - Carotene
10	Dahlia	Dahlia pinnate	Asteraceae	Anthoxanthin

Table No.2 Bio-logical activity and Morphology of Edible flowers

S. No	Edible flower	Bio-logical Activity	Morphology	References
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1.	Hibiscus Rosa sinensis	Antioxidant, Anti-diabetic, and wound-healing		(Pillai and Mini 2018)
2.	Rose	Antioxidant, Anti-bacterial and anti-septic		(Yusra Safdar and Taqdees malik 2020)
3.	Aparajita	Antioxidant, anti-inflammatory actions		(Nadzirah Jamil and Furzani Pa'ee 2018)
4.	Chamomile	Digestive relaxant, Anti-fungal, Neuroprotective activity		(Ionita et.al.,2019)
5.	lavender	Anti-septic, Anti-Inflammatory		(Grzeszczuk et.al.,2016 and Kaisoon et.al.,2012)
6.	Marigold	Anti- Inflammatory		(Meurer et.al.,2019)
7.	Dahlia	Antibiotic, Anti-inflammatory		(Estrella Lara- cortes et.al.,2014)
8.	Squash Blossom	Neurological support		(Mukesh Yadav et.al 2010)
9.	Sun flower	Anti-diabetic, Immunity booster, Antioxidant Activity		(Bartholomew Saanu Adeleke and Olubukola Oluranti Babalola 2020)
10.	Pansy	Purification of blood and stimulate metabolism		(Payal Mittal et.al.,2015)

Therapeutic Potential of edible flowers:

Flowers have been used in food for a number in many cultures, include European, Asian, East Indian, Victorian English, and Middle Eastern. Fresh edible flowers can be used as a garnish or as an ingredient in a cuisine, such as a salad. Some flowers can be stuffed or served with (Belsinger, 1991). Many flowers have been used since ancient times, and their medicinal and therapeutic properties have been explained.

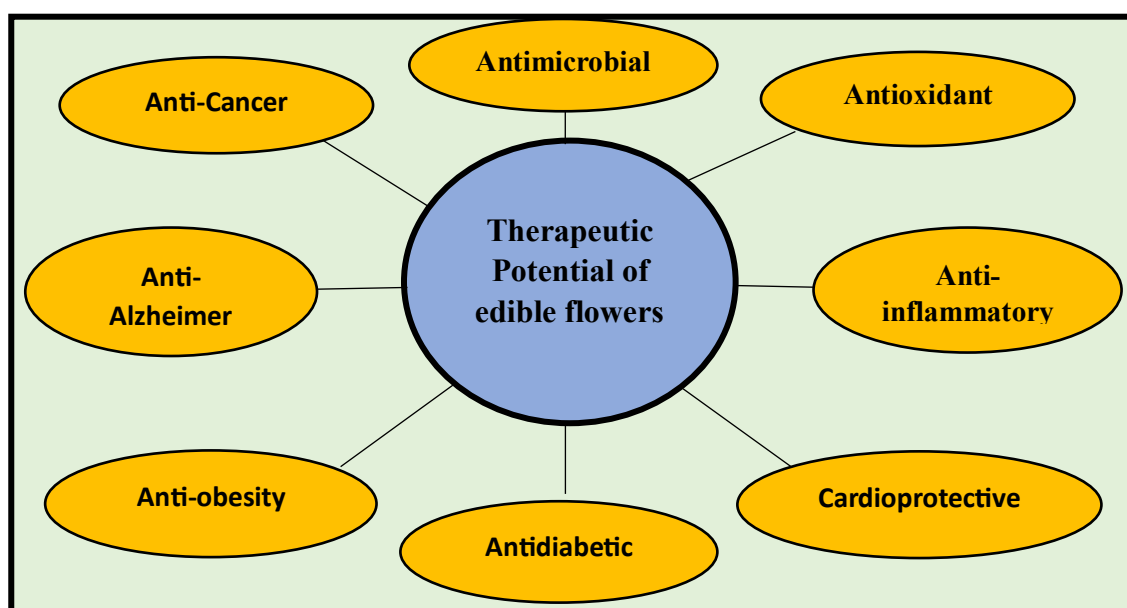


Figure 3. Therapeutic potential of edible flowers

Anti-cancer:

One-third of all cancer deaths in the United States can be caused by dietary habits that are incorrect (Willett, 2002). Epidemiological studies consistently show that a high diet of fruits and vegetables has been associated to a lower risk of chronic diseases. (Davies and Espley, 2013). Edible flowers exerted potent activities against cancers of the liver, bladder, prostate, breast, and colon; these flowers include roselle (Chang et al., 2005; Lin et al., 2005; Hou et al., 2005b; Lo et al., 2007), Hangzhou white chrysanthemum (Xie et al., 2009), wild chrysanthemum (Wang et al., 2010; Yang et al., 2011), jasmine (Kalaiselvi and Narmadha, 2011), rose (Hu et al., 2013; Gao et al., 2013), and honeysuckle (Yip et al., 2006). Phytochemicals highly contributed to the anti-cancer activities of edible flowers.

Antioxidant Activity:

Almost every edible flower was discovered to have high anti-oxidant activity (Kaisoon et al., 2011; Li et al., 2014; Navarro-Gonzalez et al., 2014; Zeng et al., 2014). Extracts of various edible flowers were found to have an improved capacity to scavenge free oxidative radicals than other plant tissues and bioactive plants, including tea plant (Mato et al., 2000; Zeng et al., 2014). Phytochemicals found in edible flowers such as anthocyanins, flavonoids, phenolic acids, alkaloids, and glycosides have been shown to have substantial anti-oxidant activity (Cichewicz et al., 2002; Li et al., 2009). The addition of flavonoids, alkaloids, triterpenoids, steroids, and carbohydrates in combination could explain the observed anti-oxidant potential of edible flowers (Navarro-Gonzalez et al., 2014).

Anti-microbial:

Edible flowers not only provide beauty and color to dishes, additionally they also have a number of health benefits, including antimicrobial qualities. Based to various research, several edible flowers may have antibacterial abilities against particular bacteria and fungi. Here some of the edible flowers with antimicrobial activity properties: Among the numerous popular flowers are lavender, hibiscus, and rose. Lavender blossoms (*Lavandula angustifolia*) have therapeutic properties. Previously, lavender oil obtained from flowers had been shown to have antibacterial and antifungal properties. (Lis-Balchin.M and Cavangh HM, Wilkins JM 2002). Lavender oil is known to be effective against a variety of bacteria, including antimicrobial-resistant forms such as methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus* (VRE). (2006) Moon and colleague. Lavender flowers are widely known for their pleasant aroma as well as their antimicrobial properties. They contain antibiotic use and antifungal essential oils such as linalool and linalyl acetate. Hibiscus blooms involve a number of compounds that are bioactive, including flavonoids and polyphenols, both of which are antimicrobial. Essential oils in rose petals have antibacterial activity against specific microorganisms. They have been used in traditional medicine due to potential therapeutic effects.

S57Anti-inflammatory:

Several flowers have been studied for their anti-inflammatory effects, and some of them contain compounds that may aid in the decrease of inflammation in the body. Chamomile extracts were observed to lower both the inflammatory impact and leukocyte infiltration.

Chamomile was examined for anti-inflammatory properties. (Aishwarya Jaya and Ekta Singh Chuachan, 2017.) Chamomile flowers include flavonoids and terpenoids, both of which have anti-inflammatory properties. Chamomile tea is a prominent traditional treatment for treating gastrointestinal pain and creating calm.

Cardioprotective:

Rather than studies prominently testing the effects of bioactive substances discovered in different flowers on human heart health. However, several edible flowers have been associated with chemicals that may have cardioprotective properties. Here are a few such examples: Calendula, hibiscus, and rose. Because edible flowers may contain bioactive compounds with possible cardioprotective qualities, they should be seen as part of a heart-healthy diet and lifestyle, rather than as a stand-alone cure for problems related to the heart.

Anti-obesity:

some edible flowers include bioactive compounds that could provide health benefits, their direct impact on weight loss or obesity management stay unknown. It is essential to recognize that no single item or substance can effectively treat obesity or replace a healthy diet and active lifestyle. Obesity is caused by an excess of fat deposition in adipose tissue, pancreatic islets, muscles, the liver, and other organs involved in metabolism. In addition, the overall incidence of obesity is influenced by a variety of factors, including changes in lifestyle, genetics, employment and position in society, avoidance of physical activities, and a greater intake of high-calorie foods. (Goyal et al., 2006). Shunth, an ayurvedic preparation of Zingiber officinale, has been used traditionally for decades in the treatment of obesity (Paranjpe et al., 1990). However, there are several ways that incorporating edible flowers in your diet can help with losing weight and overall health.

Anti-Diabetic:

Edible flowers have been studied for their possible anti-diabetic benefits, particularly in respect to bioactive compounds. While the research is still in its early stages, olive flowers have been examined for their anti-diabetic potential due to their significant number of bioactive compounds, including polyphenols. These compounds could serve to improve insulin sensitivity and glucose regulation. Despite other curative choices, herbal medications are now strongly recommended for the treatment of diabetes. Diabetes is cured with traditional plant medicines across the world. (Venkatesh et.al.,2007).

Anti-Alzheimer:

Like other diets that are based on plants, edible flowers include bioactive compounds that have been related with potential cognitive health benefits. Antioxidants and anti-inflammatory medications, for example, may contribute to overall brain health and may protect against age-related cognitive decline. Oxidative stress is crucial in the pathobiology of Alzheimer's disease. Age and Alzheimer's disease can create an increase in free radical generation, which leads to oxidative damage. Another molecular target, transcription factor EB (TFEB), has been studied thoroughly for the therapy of neurological disorders. This TFEB provides an important role in autophagy and the lysosomal biogenesis pathway. (S.N. Rai et.al.,2021). Herbal remedies play a role in the development of medicine, and multiple advanced medications have already been developed. Numerous studies have supported the consumption of herbal remedies comprising phytoconstituents to treat. (A.K. Singh et al.,2021). Flavonoids, which are antioxidants with potential neuroprotective qualities, are found in chamomile and hibiscus. These compounds may help in decreasing the levels of oxidative stress and inflammation in the brain, both of which have been linked to Alzheimer's disease.

Conclusion:

Edible flowers are plentiful natural plant resources worldwide. And most of them contain various bioactive compounds with potential health benefits, which has fascinated more attention. While different edible flowers are traditionally used as herbs to cure human related diseases i.e., Diabetes, Alzheimer, cardiovascular etc. in this study we confirmed therapeutic value of some edible flowers like Aparajita, Hibiscus, marigold, roses etc. there are various edible flower all over the world that only a small part of them have been studies. And we suggest the more studies should be conducted to full utilization and usage and dosages of edible flowers, eventually enhance the acceptability of edible flowers as natural ingredients in human diet and avoid potential chemical hazards in food.

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