Journal of Postharvest Technology
2020, **08**(1): 75-81
www.jpht.in

MINI-REVIEW ARTICLE

Flowers: a potential source of human nutrition

Vivek Saurabh, Kalyan Barman

Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi 221 005, Uttar Pradesh, India

Received: 13.10.2019 Accepted: 21.12.2019

ABSTRACT

Flowers, besides its cultural significance were being consumed since ancient times in many cultures around the world. They were used in different culinary preparations or in various dishes as garnish or trimmings. In recent years, interest in consumption of fresh flowers has been renewed due their nutritional value and medicinal properties. A number of flowers such as rose, marigold, chrysanthemum, garden nasturtium, etc. can be consumed either as fresh or after drying or freezing. Apart from proving new colours, flavours and texture to the food, these edible flowers also serve as a potential source of several bioactive compounds like phenolics, flavonoids, pigments, etc. which exert very high antioxidant activity. These flowers also contain several minerals, the content of which are comparable with that of the fruits and vegetables. Further, recent studies have revealed that being a rich source of antioxidants, consumption of these flowers is effective as anti-inflammatory, antimicrobial, hepatoprotective, anticancer and antidiabetic agents. Therefore, flowers can be utilized as a source of new and promising foodstuff for wide application in human nutrition.

Keywords: Edible flower, bioactive compound, medicinal value, nutrition

Citation: Saurabh, V. and Barman, K. 2020. Flowers: a potential source of human nutrition. *Journal of Postharvest Technology*, **8** (1): 75-81.

INTRODUCTION

Flowers are the beautiful creation of nature. It is a sign of beauty, prosperity and happiness. Flowers also have extensive cultural significance; for worship, as a token of love or to pay homage to the departed soul. Besides that, according to the ancient literature flowers were consumed as food material and have been an integral part of human nutrition (Tanji and Nassif, 1995). They were used in different culinary preparations like sauces, liquors, beverages, etc. or in different dishes as garnish or trimmings (Pires et al., 2017). For example, Dahlia flowers are consumed in Mexico in dried soups. Calendula (*Calendula officinalis*) flowers were used as salad, or with cheese or omelet in France (Lara-Cortés et al., 2014). Dandelion (*Taraxacum officinale*) flowers were used in Europe to prepare drinks and salads (Mlcek and Rop, 2011). In ancient Rome, use of roses for preparation of puree and omelette has also been reported (Cunningham, 2015). Some flowers are also used in foodstuff to enhance the taste or aroma of the food and make it more palatable. Use of edible flowers in ancient Greece and Rome as flavour enhancer in sweet and savory dishes has also been reported (Melillo, 1994). Ethnic peoples in Northern Thailand consume *Cosmos*, *Bougainvillea*, *Tagetes erecta*, *Antigonon leptopus* flowers as salads or use them in preparation of flower teas (Kaisoon et al., 2012). Now, flowers of rose (*Rosa spp.*), acacia (*Robinia pseudoaccacia*) and borage (*Borago officinalis*) are used in pastry to enhance its aroma (Kopec and Balik, 2008). In India, roses are traditionally used in foodstuff and processed material such as Gulkand, GulabSharbat that has cooling effect and saffron are used to enhance taste of foodstuff. Flowers are also used as a garnish and/or trimmings of various meals and cold buffet food, and petals are used to decorate salads, sweet meals, fruit, ice-cream, drinks, etc. In recent years, researches regarding composition and nutritional value of

* *For correspondence*: K. Barman (Email: barman.kalyan@gmail.com)

ISSN: 2348-4330

different flowers have revealed that it contain variety of phytochemicals like phenolics, flavonoids, anthocyanins which exhibits antioxidant property (Loizzo et al., 2015). It also contains several macro and micronutrients (Rop et al., 2012). Nevertheless, studies have revealed that flowers also posses several medicinal properties like antimicrobial, anti-inflammatory, antiviral, antimutagenic, antitumor and hypoglycaemic activities.

FLOWERS AS A SOURCE OF BIOACTIVE COMPOUNDS

Flowers contain several bioactive compounds like phenolics, flavonoids which exhibit high antioxidant activity. Consumption of edible flowers rich in these bioactive compounds is associated with reduced risk of negative effects caused by free radicals (Fu and Mao, 2008). These bioactive compounds also play an important role in delaying senescence of these flowers. Petals of rose (*Rosa rugosa, Rosa davurica*) contain gallic acid, quercetin and kaempferol which have high antioxidant activity (Mlcek and Rop, 2011). Chrysanthemum flowers contain flavonoid luteolin 7-O-(6''O-malonyl)-glucoside (Sugawara and Igarishi, 2009) and daylily flowers contain phenolic compounds catechin, chlorogenic acid, rutin and quercetin and phenolic glycosides phenethyl, orcinol, isorhamnetin, stelladerol and phloretin (Fu et al., 2009). Similarly, marigold flowers has been reported to contain bioactive compounds isoquercetin, rutin, quercetin-3-Orutinosyl rhamnoside, etc. (Bilia et al., 2001).

The attractive colour of flowers is due to presence of various pigments among which anthocyanin and carotenoids are most important. The red, purple, violet or blue colour of flowers are due to presence of anthocyanin pigments while, white or creamy coloured flowers contain higher amount of leucoanthocyanidins. Likewise, yellow or orange colours of flower are due to presence of carotenoid pigments. The level of these pigments is often associated with higher nutraceutical properties of the flowers. High content of anthocyanin pigment indicates higher level of flavonoids depicting high antioxidant activity. *Tropaeolum majus*, commonly known as garden nasturtium is popularly used as edible flower, contain high amount of anthocyanins (720 mg/ kg FW) particularly pelargonidin-3-sophoroside (Kelley et al., 2001c; Garzon and Wrolstad, 2009). Likewise marigold flowers, particularly orange coloured cultivars contain high amount of lutein than those of yellow or red coloured types (Bhattacharyya et al., 2008). Its consumption has been associated with reduced risk of macular degeneration and cataract (Snodderly, 1995; Moeller et al., 2000). Apart from lutein, other carotenoids present in flowers are antheraxanthin and violaxanthin in yellow coloured flowers and capsanthin in red coloured flowers (Yamagishi et al., 2010).

Pollens, although do not contributes a major portion of flower contain high amount of carbohydrates, proteins, carotenoids, amino acids, lipids, flavonoids, etc. (Parkinson and Pacini, 1995; Weber, 1996; Lunau, 1995; Dobson, 1988; Wiermann and Gubatz, 1992). Nectar present in flowers contain high amount of sugars like fructose, glucose and sucrose; proteins, amino acid (chiefly proline), organic acids, lipids, phenolic compounds, alkaloids, etc. (Nicolson et al., 2007).

FLOWERS AS A SOURCE OF MINERALS

In addition to bioactive compounds, flowers have also been reported to be rich in several minerals, particularly phosphorus and potassium. Studies by Rop et al. (2012) with some selected flowers revealed that potassium content in flowers ranged between 1842.61 mg/kg FW in *Begonia boliviensis* and 3964.84 mg/kg FW in *Viola x wittrockiana*, which is higher than several fruits and vegetables like pear, raspberry, cucumber, etc. Similarly, phosphorus content ranged from 202.11 mg/kg FW to 514.62 mg/kg FW in these flowers. These flowers also contain good amount of micronutrients. High calcium (491.89 mg/kg FW), iron (9.85 mg/kg FW) and copper (2.88 mg/kg FW) content were recorded in *Dianthus caryophyllus* while, magnesium (205.19 mg/kg FW) and sodium (131.97 mg/kg FW) content was found higher in *Tagetes patula* and *Viola x wittrockiana*, respectively.

HEALTH BENEFITS OF FLOWERS

Being a rich source of phytochemical compounds, flowers have been reported to exert several health benefits like anti-inflammatory, antibacterial, antifungal, antiviral, antitumor and antimutagenic and hypoglycaemic activities (Mlcek and Rop, 2011; Ukiya et al., 2006; 2002; Wongwattanasathien et al., 2010; Loizzo et al., 2015). Faizi et al. (2008) reported that marigold flowers contain flavonoid patuletin which have antibacterial and antifungal properties. Moreover, it also shows anti-inflammatory effect due to presence of benzyl isothiocyanate. Carnation flowers have anti-inflammatory activities due to presence of terpene caryophyllene (Lyra et al., 2008). Similarly, the anti-inflammatory, antitubercular and anticarcinogenic activities of chrysanthemum flowers are due to presence of 3-monohydroxyterpens, and triterpensarnidiol, faradiol and heliantriol (Inoue et al., 1998; Akihisa et al., 1996; 2005). Lilac flowers also showed anti-inflammatory activities due to presence of isoprenoids (Oh et al., 2008). Furthermore, some flowers like *Malva sylvestris* and *Cichorium intybus* have been reported to have hypoglycaemic activities which have higher potency and fewer side effects than the commercial synthetic drug acarbose (Tundis et al., 2010; Loizzo et al., 2015). Tanner's Cassia (*Cassia auriculata)* is used as medicine for treatment of rheumatism, conjunctivitis and diabetes. It is consumed as tea that is prepared from their flower, which is also known as *kadha.* An ayurvedic medicine also prepared named '*Avarai panchanga choornam*' (Kumaran and Karunakaran, 2007). The flowers of monks cress (*Tropaeolum majus*) have been reported to have antibacterial, antitumour, antithrombotic activity, and hypotensive and diuretic effects. The flowers of the genera *Tagetes* and *Spilanthes* are used in human nutrition due to properties like antibacterial, anti-inflammatory, analgesic, vasodialation, hypotensive, diuretic, etc. (Navarro-González et al., 2015). In Ayurvedic system of medicine, flowers of *Michelia champaca* are given to patients suffering from distension of abdomen, while in Unani system of medicine, flowers of *Jasminum auriculatum* are given for normal heart functions (Ghosh, 2013).

CONSUMPTION OF FLOWERS

It is very important to identify the flower exactly before its consumption because; some flowers may have toxic effect on humans. In addition, flowers for consumption must be healthy, clean, free from diseases or pesticide residues and must be tested for its safety. Sometime, flower like chrysanthemum for edible purpose may be free from pathogen but may induce some allergic reactions in the sensitive people (Osimitz et al., 2006). Flowers that contain trypsin inhibitors affect their nutritional quality while in other cases, they may contain some compounds like hemaglutinnins, cyanogenic glycosides should not be consumed as these are harmful to consumers (Sotelo et al., 2007). Furthermore, consumption of flowers largely dependent on the sensory characteristics like taste, aroma, texture, etc. It has been observed that yellow to orange coloured flowers are more preferred than blue and other coloured flowers. Usually, flowers are consumed whole but sometimes; specific parts like petals (rose, chrysanthemum, tulip, etc.), buds (garden nasturtium, daisies) are only consumed (Kopec and Balik, 2008). These flowers should be harvested in the early morning hours in a container or plastic bags. Care should be taken to avoid contamination or loss of moisture. After cooling and cleaning of flowers, they are generally stored at low temperature (1 – 4°C) or dried or frozen (Kelley et al., 2003). Among different methods, sublimation drying is highly demanded because it does not affect appearance, colour and glossiness of flowers (Kopec, 2004).

CONCLUSION

A number of flowers commonly grown are rich in several bioactive compounds, minerals and have high antioxidant activity. These flowers also demonstrated to have promising health benefits by preventing or curing several human ailments. Thus,

edible flowers can be consumed as a functional food or can be applied as a dietary supplement or functional ingredient to meet human nutrition.

REFERENCES

Akihisa, T., Franzblau, S. G., Ukiya, M., Okuda, H., Zhang, F., Yasukawa, K., Suzuki, T., and Kimura, Y. 2005. Antitubercular activity of triterpenoids from asteraceae flowers. Biological and Pharmaceutical Bulletin, 28, 158-160.

Akihisa, T., Yasukawa, K., Oinuma, H., Kasahara, Y., Yamanouchi, S., Takido, M., Kumaki, K., and Tamura, T. 1996. Triterpene alcohols from the flowers of compositae and their anti-inflammatory effects. Phytochemistry, 43, 1255–1260.

Bhattacharyya, S., Roychowdhury, A., and Ghosh, S. 2008. Lutein content, fatty acid composition and enzymatic modification of lutein from marigold (*Tagetes patula* L.) flower petals. Journal of the Indian Chemical Society, 85, 942-944.

Bilia, A. R., Salvini, D., Mazzi, G., and Vincieri, F. F. 2001. Characterization of calendula flower, milk-thistle fruit, and passion flower tinctures by HPLC-DAD and HPLC-MS. Chromatographia, 53, 210-215.

Cunningham, E. 2015. What nutritional contribution do edible flowers make? Journal of the Academy of Nutrition and Dietetics, 115(5), 856.

Dobson, H. E. M. 1988. Survey of pollen and pollenkitt lipids - chemical cues to flower visitors. American Journal of Botany, 75, 170-182.

Faizi, S., Siddiqi, H., Bano, S., Naz, A., Lubna, A., Mazhar, K., et al. 2008. Antibacterial and antifungal activities of different parts of *Tagetes patula*: preparation of patuletin derivatives. Pharmaceutical Biology, 46, 309-320.

Fu, M. R., and Mao, L. C. 2008. *In vitro* antioxidant activities of five cultivars of daylily flowers from China. Natural Product Research, 22, 584-591.

Fu, M. R., He, Z., Zhao, Y., Yang, J., and Mao, L. 2009. Antioxidant properties and involved compounds of daylily flowers in relation to maturity. Food Chemistry, 114, 1192-1197.

Garzón, G. A., and Wrolstad, R. E. 2009. Major anthocyanins and antioxidant activity of nasturtium flowers (*Tropaelum majus*). Food Chemistry, 114, 44–49.

Ghosh, D. 2013. A feast of flower. Resonance, 1004-1024.

Kaisoon, O., Konczak, I., and Siriamornpun, S. 2012. Potential health enhancing properties of edible flowers from Thailand. Food Research International, 46, 563–571.

Kelley, K. M., Cameron, A. C., Biernbaum, J. A., and Poff, K. L. 2003. Effect of storage temperature on the quality of edible flowers. Postharvest Biology and Technology, 27, 341-344.

Kelley, K. M., Cameron, A. C., Biernbaum, J. A., Poff, K. L., 2003. Effect of storage temperature on the quality of edible flowers. Postharvest Biology and Technology, 27, 341–344.

Kopec, K. 2004. Jedlekvety pro zpestrenijidelnicku. Vyziva a Potraviny, 59, 151-152.

Kopec, K., and Balik, J. 2008. Kvalitologiezahradnickychproduktu. Brno: MZLU. PP. 34-40.

Kumaran, A., and Karunakaran, R. J. 2007. Antioxidant activity of *Cassia auriculata* flowers. Fitoterapia, 78(1), 46-47.

Lara-Cortés, E., Martín-Belloso, O., Osorio-Díaz, P., Barrera-Necha, L. L., Sánchez-López, J. A., and Bautista-Baños, S. 2014. Antioxidant capacity nutritional and functional composition of edible dahlia flowers. Revista Chapingo SerieHorticultura, XX (1), 101–116.

Lara-Cortés, E., Osorio-Díaz, P., Jiménez-Aparicio, A., and Bautista-Baños, S. 2013. Contenidonutricional, propiedadesfuncionales y conservación de flores comestibles. Archivos Latinoamericanos De Nutricion, 63, 197–208.

Loizzo, M. R., Pugliese, A., Bonesi, M., Tenuta, M. C., Menichini, F., Xiao, J., and Tundis, R. 2015. Edible flowers: a rich source of phytochemicals with antioxidant and hypoglycemic properties. Journal of Agricultural and Food Chemistry, 64(12), 2467-2474.

Lunau, K. 1995. Notes on the color of pollen. Plant Systematics and Evolution, 198, 235-252.

Lyra, C. C. G. V., Vieira, R. F., de Oliveira, C. B. A., Santos, S. C., Seraphin, J. C., and Ferri, P. H. 2008. Infraspectric variability in the essential oil composition of Lychnophoraericoides. Journal of the Brasil Chemical Society, 19, 842-848.

Melillo, L., 1994. Diuretic plants in the paintings of Pompeii. American Journal of Nephrology, 14, 423–425.

Mlcek, J., and Rop, O. 2011. Fresh edible flowers of ornamental plants– a new source of nutraceutical foods. Trends in Food Science and Technology, 22(10), 561-569.

Moeller, S. M., Jacques, P. F., and Blumberg, J. B. 2000. The potential role of dietary xanthophylls in cataract and age-related macular degeneration. Journal of the American College of Nutrition, 19, 522-527.

Navarro-González, I., González-Barrio, R., García-Valverde, V., Bautista-Ortín, A. B., and Periago, M. J. 2015. Nutritional composition and antioxidant capacity in edible flowers: characterisation of phenolic compounds by HPLC-DAD-ESI/ MS^n. International Journal of Molecular Sciences, 16(1), 805–822.

Nicolson, S. W., Nepi, M., and Pacini, E. 2007. Nectaries and nectar. Dordrecht: Springer.

Oh, S. Y., Du, S. H., Kim, S. J., and Hong, J. 2008. Rapid determination of floral aroma compounds of lilac blossom by fast gas chromatography combined with surface wave sensor. Journal of Chromatography, 1183, 170-178.

Osimitz, T. G., Franzosa, J. A., Maciver, D. R., and Maibach, H. I. 2006. Pyrethrum allergic contact dermatitis in humans-Real? common?, or not documented? An evidence-based approach. Cutaneous and Ocular Toxicology, 25, 287-308.

Parkinson, B., and Pacini, E. A. 1995. Comparison of tapetal structure and function in pteridophytes and angiosperms. Plant System and Evolution, 149, 155-185.

Pires, T. C., Dias, M. I., Barros, L., Ferreira, I. C. 2017. Nutritional and chemical characterization of edible petals and corresponding infusions: Valorization as new food ingredients. Food Chemistry, 220, 337–343.

Rop, O., Mlcek, J., Jurikova, T., Neugebauerova, J., and Vabkova, J. 2012. Edible flowers— a new promising source of mineral elements in human nutrition. Molecules, 17(6), 6672-6683.

Snodderly, D. M. 1995. Evidence for protection against age related macular degeneration by carotenoids and antioxidant vitamins. American Journal of Nutrition, 62, 1448-1462.

Sotelo A., López-García S., Basurto-Peña F. 2007. Content of nutrients and antinutrients in edible flowers of wild plants in Mexico. Plant Foods for Human Nutrition, 62, 133–138.

Sugawara, T., and Igarishi, K. 2009. Cultivar variation in flavonoid components and radical scavenging activity of polyphenol fractions among edible chrysanthemum flowers. Journal of the Japanese Society for Food Science and Technology, 56, 600-604.

Tanji, A., and Nassif, F. 1995. Edible weeds in Morocco. Weed Technology, 9(3), 617-620.

Tundis, R., Loizzo, M. R., and Menichini, F. 2010. Natural products as alpha-amylase and alpha-glucosidase inhibitors and their hypoglycaemic potential in the treatment of diabetes: An update. Mini-Reviews in Medicinal Chemistry, 10, 315–331.

Ukiya, M., Akihisa, T., Tokuda, H., Suzuki, H., Mukainaka, T., Ichiishi, E., Yasukawa, K., Kasahara, Y., Nishino, H., 2002. Constituents of compositae plants: III. Anti-tumor promoting effects and cytotoxic activity against human cancer cell lines of triterpene diols and triols from edible chrysanthemum flowers. Cancer Letters, 177, 7–12.

Ukiya, M., Akihisa, T., Yasukawa, K., Tokuda, H., Suzuki, T., Kimura, Y., 2006. Anti-inflammatory, anti-tumor-promoting, and cytotoxic activities of constituents of marigold (*Calendula officinalis*) flowers. Journal of Natural Products, 69, 1692–1696.

Weber, M. 1996. The existence of a special exine coating in *Geranium robertianum* pollen. International Journal of Plant Sciences, 157, 195-202.

Wiermann, R., and Gubatz, S. 1992. Pollen wall and sporopollenin. International Review of Cytology, 140, 35-72.

Wongwattanasathien, O., Kangsadalampai, K., Tongyonk, L., 2010. Antimutagenicity of some flowers grown in Thailand. Food and Chemical Toxicology, 48, 1045–1051.

Yamagishi, M., Kishimoto, S., and Nakayama, M. 2010. Carotenoid composition and changes in expression of carotenoid biosynthetic genes in tepals of Asiatic hybrid lily. Plant Breeding, 129, 100-107.

Yusakawa, K., Akihisa, T., Inoue, Y., Tamura, T., Yamanouchi, S., and Takido, M. 1998. Inhibitory effect of the methanol extracts from compositae plants on 12-O-tetradecanoylphorbol-13-acetate-induced ear oedema in mice. Phytotherapy Research, 12, 484-487.

Yusakawa, K., Akihisa, T., Inoue, Y., Tamura, T., Yamanouchi, S., and Takido, M. 1998. Inhibitory effect of the methanol extracts from compositae plants on 12-O-tetradecanoylphorbol-13-acetate-induced ear oedema in mice. Phytotherapy Research, 12, 484-487.

.