

EDIBLE FLOWERS

ABSTRACT

Edible flowers are among the important plant sources in terms of their nutritional content as well as aesthetic appearance. This mini review is written to increase awareness on edible flowers. For the study a set of both printed and electronic academic materials were examined and the findings were presented. This study is a brief review on edible flowers and their prominence in human nutrition. Due to their richness of antioxidant, anti-carcinogen, vitamin, and chemical composition; many researchers have revealed that these flowers may have a vital role in human nutrition along with the increasing fresh use and even for decorative purposes in kitchens today.

Key words: Edible flowers, nutritional content.

INTRODUCTION

Edible flowers have gained popularity in kitchen magazines, cookbooks and visual media in recent years [1, 2, 3, 4, 5, 6, 7, 8]. Edible flowers have been used for centuries in many countries of the world in terms of nutritional value, medical effect, taste, shape, and aesthetic appearance [9]. It is known that some flowers in ancient Greeks, Romans, Chinese, Middle East and Indian cultures were used in the kitchen [10]. For example, the old Romans used flowers of many varieties of *Rosa spp.* in the kitchen, the *Calendula officinalis* in salads in old France; *Taraxacum officinale* flowers and *Sambucus nigra* flowers in salads and drinks; the *Viola odorata* is used as a sugar coloring in the kitchens [11].

Weed flowers and many edible flowers used for eating can be safely consumed, but some of the flowers are poisonous and inedible should not be forgotten. Like laurel (*Laurus nobilis*), yarrow (*Achillea millefolium*), and wolfberry (*Lycium barbarum*) flowers. It is also important that these edible flowers to be used for consumption do not contain pesticides [12]. Nevertheless, people have to know their allergic reactions to these flowers before they consume.

A flower can either be consumed as its pedicel or just its petals, sepals, stamen and pistil [Figure 1], [12]. These flowers can be consumed fresh, dried or processed (as vinegar, liqueur, tea, candy) [13, 14]. The source of the edible flowers can be vegetables, ornamental plants, flowers of some fruit trees as well as the flowers of some plants used for medical and aromatic purposes [Table 1], [12], [15, 7, 9]. Color of edible flowers may affect taste, sales [5]. In Table 2 the colors of the petals of the flowers are given.

It should be noted that edible flowers may be single or perennial depending on location, expected nutritional values, botanical characteristics, environmental wishes, growing wishes, and species of caterpillar.

For disease and pest control in edible flower breeding, organic solutions are recommended. Harvest in fresh edible flowers should be done with pedicel, receptacle, sepals, and petals, male and female organs in the morning at the time the flower is fully opened. The flower can be kept in cold weather at +1 or +4 °C for 2-14 days without losing time to protect the freshness of the flower [6].

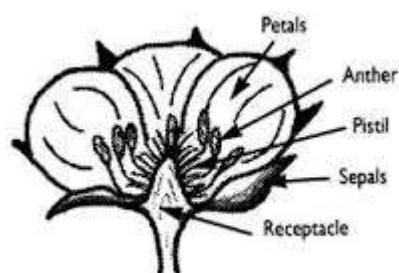


Fig.1. Edible flowers parts [12]

Table 1. Some edible flowers and colors of petal leaves [12]

Name of the plant	Color of the petals
<i>Abelmoschus esculentus</i>	Yellow, Red
<i>Agastache foeniculum</i>	Lilac
<i>Alcea rosea</i>	In Various Colors
<i>Allium schoenoprasum</i>	Lilac, Red, Purple
<i>Allium tuberosum</i>	White
<i>Anethum graveolens</i>	Yellow
<i>Anthemis nobilis</i>	White
<i>Anthriscus cerefolium</i>	White
<i>Begonia</i>	White, Pink, Yellow, Red
<i>Bellis perennis</i>	White, Purple
<i>Borago officinalis</i>	Blue, Purple, Lilac
<i>Brassica</i> spp.	Green, White, Yellow
<i>Calendula officinalis</i>	Yellow, Orange
<i>Carthamus tinctorius</i>	Yellow, Red
<i>Centaurea cyanus</i>	Blue, White, Pink
<i>Cercis canadensis</i>	Pink
<i>Chrysanthemum</i>	Yellow, White, Purple, Pink
<i>Cichorium intybus</i>	Blue, Lilac
<i>Citrus limon</i>	White
<i>Citrus sinensis</i>	White
<i>Coriandrum sativum</i>	White
<i>Cucurbita</i> spp.	Orange, Yellow
<i>Cynara scolymus</i>	Yellow
<i>Dianthus</i> spp.	Pink, White, 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>	Blue, Pink, White
<i>Lavandula</i>	Lilac, Pink
<i>Levisticum officinale</i>	Yellow, White
<i>Malus</i> spp.	White, Pink
<i>Melissa officinalis</i>	White
<i>Mentha</i> spp.	Lilac, Pink, White
<i>Monarda didyma</i>	Red, Pink, White, Lilac
<i>Muscari atlanticum</i>	Pink, Blue
<i>Ocimum basilicum</i>	White, Pink
<i>Origanum</i> spp.	White
<i>Pelargonium</i> spp.	Red, Pink, White, Lilac
<i>Phaseolus coccineus</i>	Orange, Red, White
<i>Pisum sativum</i>	White Pink
<i>Prunus</i> spp.	Pink, White
<i>Raphanus sativus</i>	White, Pink, Yellow
<i>Rosa</i> spp.	White, Pink, Yellow, Purple

<i>Rosmarinus officinalis</i>	White, Pink, Dark Blue
<i>Salvia officinalis</i>	Lilac
<i>Syringa vulgaris</i>	White, Pink, Lilac
<i>Tagetes erecta</i>	White, Red, Gold
<i>Taraxacum officinale</i>	Yellow
<i>Trifolium pratense</i>	Pink, Lilac
<i>Tropaeolum majus</i>	Red, White, Yellow, Orange
<i>Viola odorata</i>	Lilac, White
<i>Yucca filamentosa</i>	White, Purple

SOME STUDIES ON EDIBLE FLOWERS

The pollen content of the flowers is one of the most significant characteristics considering the chemical composition. It is an important source of protein, amino acid, carbohydrate, carotenoid, and flavonoid [16, 17, 18, 19, 20, 9]. The flowers contain fructose, glucose, sucrose, inorganic oils, and phenolic materials. The colored petals of the flowers are rich in C, A, and E vitamins, antioxidants, and mineral substances [9]. The authors found antioxidant activity in the range of 17,6 / 85,7 DPPH (%) in 12 different edible fresh flowers [21] and the authors stated that rose (*Rosa hybrida* cv. *noblared*) petals are an important source of C and E vitamins, anthocyanins, antioxidants, carotenes and phenols [22].

In a research on 12 different edible flowers (including begonia, chrysanthemum, violet, nasturtium flower, rose and velvet flower) on total antioxidant capacity, it was determined that petals have 4.21/6.89 (g ascorbic acid/kg fresh weight), a total phenolic content of 2.53/5.28 (g gallic acid/kg fresh weight) and a total flavonoid content of 1.35/2.04 (g/kg fresh weight). They revealed the macro-micro elements with the amount of phosphorus expressed as g/kg in fresh weight 215.46/534.48; potassium 1.96/3.80; calcium 239.10/491.89; magnesium 105.26/205.19; sodium 74.28/131.97; iron 2.65/9.83; manganese 2.29/7.93; copper 0.89/2.70; zinc 4.90/13.29 and molybdenum 0.29/0.84 while the amount of dry matter in the same flowers was 9.57/14.75 % and crude protein was found as 2.41/6.89 (g/kg fresh weight) [23].

In another researches, the content for antioxidant activity and phenolic compounds in the edible flowers in both fresh and processed material was found significant [24], on the other hand the nutritional content, antioxidant and antimicrobial properties of edible flowers have significant impact on human health [25].

The phenolic components and antioxidant activity of Indian wild pear (*Pyrus Pashia*) edible flowers have importance on human health as well [26].

It is mentioned that some edible flowers of Thailand have phenolic substances content and antioxidant properties with analgesic, antidiabetic, anti-inflammatory, antifungal, antioxidant, and antimicrobial activities [21].

Nevertheless, in a study on the total phenolic and total flavonoid contents with antioxidant capacities of 23 edible flowers, it was found that 3 of them (i.e. *Osmanthus fragrans*, *Papaver rhoeas* and *Rosa rugosa*) had the strongest antioxidant capacities [27].

Rose petals have important effects on anti-inflammatory [28], antibacterial [29], antifungal [30] and antiviral [31] for human health.

Broccoli flowers have been proven to contain a high amount of antioxidants and have been incorporated into many dietary menus [32,33].

Tagetes petals extract contained 27% carotenoids with β -carotene 0.4%, cryptoxanthin esters 1.5% and xanthophyl esters 86%. Thus the latter are the major carotenoid constituents. *Tagetes erecta* petals had more carotenoid than did the seeds or sepals and 200 times more than yellow corn. The major components of commercial interest are the pigments which can be used as natural colorants in food and feed. The two major classes of pigments present in *Tagetae* are the flavonoids and carotenoids [34, 35].

In a research was determined that rose petals contain relatively high levels of antioxidants, which can attribute to their development as a new crop with significant health benefits [36].

CONCLUSION

This mini-view gives a brief overview of edible flowers and the prominence of edible flowers in human nutrition. Many researchers have revealed that these flowers play a vital role in human nutrition due to their richness of antioxidant, anti-carcinogen, vitamin, and chemical composition along with the increasing fresh use and even for decorative purposes in kitchens nowadays.

REFERENCES

1. Barash CW. Edible Flowers: Desserts and drinks. Colorado: Fulcrum Publishing; Golden. 1997; p. 96.
2. Barash CW. The Flavors of flowers. Herb Companion. 1998a; 10(4): 32-37.
3. Barash CW. Please eat the flowers. Horticulture. 1998b; 95(5): 36-40.
4. Rusnak J. Overcoming organic supply issues. Produce Business. 1999; 15(6):60, 63-64.
5. Kelley KM, Behe BK, Biernbaum JA, Poff KL. Consumer preference for edible flower color, Container Size and Price. Hortscience. 2001; 36(4): 801-804.
6. Kelley KM, Cameron AC, Biernbaum JA, Poff KL. Effect of storage temperature on the quality of edible flowers. Postharvest Biology and Technology. 2003; (27): 341-344.
7. Kopec K, Balik J. Kvalitologie zahradnickych produktu. Brno: MZLU. 2008; p.34-40.
8. Neugebauerova J, Vabkova J, Jedle Kvety Soucasti Food Stylingu. Zahradnictvi. 2009; 83: 22-24.
9. Mlcek J, Rop O. Fresh edible flowers of ornamental plants a new source of nutraceutical foods. Trends in Food Science and Technology. 2011; (22): 561-569.
10. Belsinger S. Flowers in the kitchen. Loveland, Colorado: Interweave Press. 1991.
11. Kopec K. Jedle kvety pro zpestreni jidelnicku. Vyziva a Potraviny. 2004; (59): 151-152.
12. Newman SE, O'Connor AS. Edible flowers, Colorado State University, Extension. 12/96, Fact Sheet no. 7.237. 2009.
13. Kendall P, Rausch J. Flavored vinegars and oils. CSU extension fact sheet 9.340, 2006.
14. Anderson R. Edible Flowers. UK cooperative extension serves, CCD crop profiles, Extension Specialist. 2012.
15. Takeoka G. Flavor chemistry of vegetables. Flavor chemistry, Thirty years of progress. New York: Kluwer Academic/Plenum Publisher. 1999; p. 287-304.
16. Dobson HEM. Survey of pollen and pollenkitt lipids, chemical cues to flower visitors? American Journal of Botany. 1988; (75):170-182.
17. Wiermann R, Gubatz S. Pollen wall and sporopollenin. International Review of Cytology. 1992; (140): 35-72.
18. Parkinson B, Pacini EA. Comparison of tapetal structure and function in pteridophytes and angiosperms. Plant System and Evolution. 1995; (149): 155-185.
19. Lunau K. Notes on the color of pollen. Plant Systematics and Evolution. 1995; (198): 235-252.
20. Weber M. The existence of a special exine coating in Geranium robertianum pollen. International Journal of Plant Sciences. 1996; (157):195-202.
21. Kaisoon O, Siriamornpun S, Weerapreeyakul N, Meeso N. Phenolic compounds and antioxidant activities of edible flowers from Thailand. Journal of Functional Foods. 2011; (3): 88-99.
22. Lee JH, Lee HJ, Choung MG. Anthocyanin compositions and biological activities from the red petals of Korean edible rose (*Rosa hybrida* cv. *Noblered*). Food Chemistry. 2009; (129): 272-278.
23. Rop O, Mlcek J, Jurikova T, Neugebauerova J, Vabkova J. Edible flowers-a new promising source of mineral elements in human nutrition molecules. 2012; (17): 6672-6683.

24. Koike A, Barreira JCM, Barros L, Santos Buelga C, Villavicencio ALCH, Ferreira ICFR. Edible flowers of *Viola tricolor* L. as a new functional food: antioxidant activity, individual phenolics and effects of gamma and electron-beam irradiation. *Food Chemistry*. 2015; (179): 6-14.
25. Fernandes L, Casal S, Pereira JA, Saraiva JA, Ramalhosa E. Edible Flowers: A review of the nutritional, antioxidant, antimicrobial properties and effects of human health. *Journal of Food Composition and Analysis*. 2017; (60): 38-50.
26. He J, Yin T, Chen Y, Cai L, Tai Z, Li Z, Liu C, Wang Y, Ding Z. Phenolic compounds and antioxidant activities of edible flowers of *Pyrus pashia*. *Journal of Functional Foods*. 2015; (17): 371-379.
27. Chen GL, Chen SG, Xie YQ, Chen F, Zhao YY, Luo CX, Gao YQ. Total phenolic, flavonoid and antioxidant activity of 23 edible flowers subjected to in vitro digestion, *Journal of Functional Foods*. 2015; (17): 243-259.
28. Choi EM, Hwang JK. Investigations of anti-inflammatory and antinociceptive activities of *Piper cuceba*, *Physalis angulata* and *Rosa hybrida*. *Journal of Ethnopharmacology*, 2003; (89): 171-175.
29. Perez C, Anesini C. In vitro antibacterial activity of Argentine folk medicinal plants against *Salmonella typhi*. *Journal of Ethnopharmacology*, 1994; (44): 41-46.
30. Tripathi SC, Dixit SN. Fungi toxic properties of *Rosa Chinensis* Jacq. *Experimentia*, 1977; (33): 207-209.
31. Mahmood N, Piacente S, Pizza C, Burke A, Khan AI, Hay AJ. The anti-HIV activity and mechanisms of action of pure compounds isolated from *Rosa damascene*. *Biochemical and Biophysical Research Communications*, 1996; (229): 73-79.
32. Cao GH, Russell RM, Lischner N and Prior RL. Serum Antioxidant Capacity is Increased by Consumption of Strawberries, Spinach, Red Wine or Vitamin C in Elderly Women, *Journal of Nutrition*, 1998; (128): 12, 2383-2390.
33. Grossman S, Reznik R, Tamari T and Albeck M. New Plant Water Soluble Antioxidant (NAO) from Spinach, In: K. Asada and T. Toshikawa, Eds., *Frontiers of Reactive Oxygen Species in Biology and Medicine*, Elsevier Science, Amsterdam, 1994; 57-73.
34. Benk E, Trieber H and Bergmann R. Detection of *Tagetes* extract in orange concentrates considering raw materials and beverages. *Riechst, Aromen und Koerpen.*, 1976; 26:(10), 216-221.
35. Vasudevan P, Kashyap S, Sharma S. *Tagetes*: A multipurpose Plant. *Bioresource Technology*, 1997; (62): 29-35.
36. Friedman H, Rot I, Agami O, Vinokur Y, Rodov V, Reznick N, Umiel N, Dori I, Ganot L, Shmuel D, Matan E. Edible flowers: new crops with potential health benefits. *ISHS Acta Horticulturae* 755: 2007, International Conference on Quality Management in Supply Chains of Ornamentals.