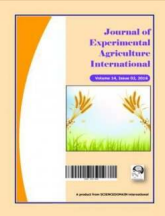

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Edible Flowers

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Mini-review Article

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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.

Keywords: Edible flowers; nutritional content.

1. 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;

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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 [Fig. 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 1 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℃ for 2-14 days without losing time to protect the freshness of the flower [6].

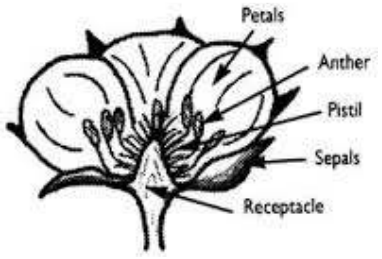

Fig. 1. Edible flowers parts [12]

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

Name of the plant	Color of the petals
Abelmoschus aesculentus	Yellow, Red
Agastache foeniculum	Lilac
Alcea rosea	In Various Colors
Allium schoenoprasum	Lilac, Red, Purple
Allium tuberosum	White
Anethum graveolens	Yellow
Anthemis nobilis	White
Anthriscus cerefolium	White
Begonia	White, Pink, Yellow, Red
Bellis perennis	White, Purple
Borago officinalis	Blue, Purple, Lilac
Brassica spp.	Green, White, Yellow
Calendula officinalis	Yellow, Orange
Carthamus tinctorius	Yellow, Red
Centaurea cyanus	Blue, White, Pink
Cercis canadensis	Pink
Chrysanthemum	Yellow, White, Purple, Pink
Cichorium intybus	Blue, Lilac
Citrus limon	White
Citrus sinensis	White
Coriandrum sativum	White
Cucurbita spp.	Orange, Yellow
Cynara scolymus	Yellow
Dianthus spp.	Pink, White, Red
Eruca vesicaria	White
Foeniculum vulgare	Yellow

Name of the plant	Color of the petals
Gladiolus spp.	In Various Colors
Hemerocallis fulva	Orange
Hibiscus rosa sinensis	Red
Hyssopus officinalis	Blue, Pink, White
Lavandula	Lilac, Pink
Levisticum officinale	Yellow, White
Malus spp.	White, Pink
Melissa officinalis	White
Mentha spp.	Lilac, Pink, White
Monarda didyma	Red, Pink, White, Lilac
Muscari atlanticum	Pink, Blue
Ocimum basilicum	White, Pink
Origanum spp.	White
Pelargonium spp.	Red, Pink, White, Lilac
Phaseolus coccineus	Orange, Red, White
Pisum sativum	White Pink
Prunus spp.	Pink, White
Raphanus sativus	White, Pink, Yellow
Rosa spp.	White, Pink, Yellow, Purple
Rosmarinus officinalis	White, Pink, Dark Blue
Salvia officinalis	Lilac
Syringa vulgaris	White, Pink, Lilac
Tagetes erecta	White, Red, Gold
Taraxacum officinale	Yellow
Trifolium pratense	Pink, Lilac
Tropaeolum majus	Red, White, Yellow, Orange
Viola odorata	Lilac, White
Yucca filamentosa	White, Purple

2. 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. *noblered*) 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].

3. 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.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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