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Nutritional Value of Some Flowers Found in Green Spaces as New Food Sources

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Abstract

Supplying safe, natural, and inexpensive food sources for the growing population of the world is a need of contemporary societies. Edible flowers are a new natural source in humans' food basket. In this regard, the nutritional value of five edible flowers including African marigold (*Tagetes erecta* L.), gladiolus (*Gladiolus*), yucca (*Yucca gloriosa*), chrysanthemum (*Chrysanthemum* ×*morifolium*), and *Hibiscus syriacus* were explored. According to the results, the African marigold flowers had the highest total flavonoids (16.13 mg CE g^{-1} F.W.), total phenols (14.48 mg GAE g^{-1} F.W.), antioxidant capacity (87.89 % DPPH inhibition), vitamin C (30.60 mg $100g^{-1}$ F.W.), and proteins (1.56 %). The highest carotenoids (482.57 µg g^{-1} F.W.), Fe (2.54 mg $100g^{-1}$ F.W.), and Zn (0.27 mg $100g^{-1}$ F.W.) were recorded in the yucca flowers. The chrysanthemum flowers exhibited the highest Ca (47.25 mg $100g^{-1}$ F.W.) and Mg (2.60 mg $100g^{-1}$ F.W.), and the *H. syriacus* flowers exhibited the highest anthocyanins (30.86 mg $100g^{-1}$ F.W.). In addition, the gladiolus flowers showed the lowest total flavonoids (11.17 mg CE g^{-1} F.W.), anthocyanins (2.14 mg$100g^{-1}$ F.W.), proteins (0.52 %), Fe (0.36 mg $100g^{-1}$ F.W.), Ca (9.11 mg $100g^{-1}$ F.W.), and Zn (0.14 mg 100 g^{-1} F.W.). The chrysanthemums had the lowest total phenols (0.54 mg GAE g^{-1} F.W.) and vitamin C (8.16 mg $100g^{-1}$ F.W.), the yuccas had the lowest antioxidant capacity (47.76% DPPH inhibition), and the *H. syriacus* flowers had the lowest carotenoids (362.17 µg g^{-1} F.W.). So, given the phenol and antioxidant compounds, minerals, and proteins of the studied flowers, they can be included in the food basket of households as natural food sources.

Keywords: Nutritional value, Ornamental plants, Phenol compounds, Vegetarianism.

INTRODUCTION

Edible flowers are low-calorie and rich in proteins, vitamins, minerals, and compounds with antioxidant activities (carotenoids, anthocyanins, phenol compounds, flavonoids, alkaloids, etc.) and are good for human health. It is suggested that the long-term consumption of edible flowers, especially those with high phenol and flavonoid content, reduces the risk of cardiovascular diseases, obesity, and cancer (Mlcek and Rop, 2011; Rop *et al.*, 2012; Navarro-González *et al.*, 2015; Lu *et al.*, 2016).

Edible flowers are used fresh, as cooked ingredients of various dishes, or as ingredients of desserts and beverages. However, the simplest and acceptable way for the consumption of edible flowers is to consume them fresh and raw (Mleck and Rop, 2011; Rop *et al.*, 2012; Fernandes *et al.*, 2017). Edible flowers are usually eaten fully, but in some cases, only parts of the flower are consumed such as nectar, pollens, or petals. Thus, the edibility of the whole flower or certain parts of it is determined by laboratory assays, which is crucial before the consumption of edible flowers (Mleck and Rop, 2011; Lauderdale and Bradley, 2014).

With an area of 1.64 million km^2, Iran hosts 7500-8000 plants species with medicinal and ornamental applications. The application of nutritionally and medicinally valuable plant species dates back to ancient times in Iran (Sharafzadeh and Alizadeh, 2012). However, people are hardly aware of the benefits of edible flowers. Marigolds, chrysanthemums, hollyhocks, gladiolus, and yuccas are famous edible flowers (Lauderdale and Bradley, 2014) that can be produced in Iran. Despite evidence on the edibility of these flowers, they are still dealt with distrust. Indeed, recognizing nutritional compounds and non-toxicity of edible flowers and supplying them in leading supermarkets can be comforting for consumers (Sotelo *et al.*, 2007; Mlcek and Rop, 2011). In this regard, the present research investigated the nutritional value of five edible flower species found in the green spaces of Rasht County, Iran.

MATERIALS AND METHODS

In the present research, African marigold (*Tagetes erecta* L.), white gladiolus (*Gladiolus*), (*Yucca gloriosa*), chrysanthemum 'Purple Spray', and *Hibiscus syriacus* were used as plant materials. The gladiolus and chrysanthemum flowers were procured from flower shops and the marigold, yucca, and H. syriacus flowers were collected from the parks and green spaces of Rasht in September 2020. All flowers were collected at the fully-open stage with 1 cm of peduncle at cool day hours and were transferred to a laboratory as soon as possible. The fully intact and uniform flowers were separated in the laboratory, packed in lid-closed containers, and kept in a refrigerator at 4°C until the measurement of their traits.

Assessment of traits

Total protein

To measure the petal protein content, 0.3 g of the petal was extracted with a mixed acid containing 100 mL of sulfuric acid + 6 mL of salicylic acid + 18 mL of hydrogen peroxide and was kept in a dark room for 24 hours. Then, it was filtered with a Whatman filter paper and was adjusted to 50 mL using hydrogen peroxide. The nitrogen content of the extract was measured by the Kjeldahl method. At the next step, the readings were put in the following equation to yield the nitrogen content:

$$\text{Nitrogen (\%)} = 0.56 \times t \times (a\text{-}b) \times \frac{V}{W} \times \frac{100}{DM}$$

in which t is the concentration of the acid used for titration in mol L^{-1}, a is the amount of acid used for the sample in mL, b is the amount of acid used as the control in mL, V is the volume of

the extract taken from the digestion process in mL, W is the weight of the plant sample used for digestion in g, and DM is the dry matter percentage of the plant. The protein content was obtained from the following equation:

$$\text{Protein (\%)} = \text{Nitrogen} \times 6.25$$

Minerals: Calcium (Ca), iron (Fe), zinc (Zn), and magnesium (Mg)

To measure the concentration of minerals, some petal from each flower was electrically oven-dried at 75°C. It was then powdered. At the next step, 2 g of the powdered sample was converted to ash in an electric furnace at 550°C. The ash was then extracted with distilled water and 3N hydrochloric acid (Kalra, 1998). Then, the minerals of the samples were measured with an atomic absorption device (Albakaa *et al.*, 2020).

Carotenoids

The petal carotenoid content was determined by Mazumdar and Majumder's (2003) method. So, 0.5 g of the petal was extracted with 50 mL of 80% acetone. Then, the absorbance was read at 440, 645, and 663 nm with a Japanese Shimadzu UV-120-02 spectrophotometer, and the pigment concentration was calculated in µg g^{-1} F.W. using the following equation:

$$\text{Petal carotenoid} = 4.69 \times A_{440} - 0.268 \times (20.2)A_{645} + (8.02)A_{663}$$

Anthocyanin

To measure the anthocyanin content, 0.5 g of the fresh petal was extracted with 96% ethanol and 1.5N hydrochloric acid. The absorbance of the filtered extract was read at 535 nm with a Japanese Shimadzu UV-120-02 spectrophotometer, and the pigment concentration was determined in mg 100 g^{-1} F.W. using the following equation (Mazumdar and Majumder, 2003):

$$\text{Petal anthocyanin} = \frac{e \times b \times c}{d \times a} \times 100$$

In which, 'e' is the sample weight, 'b' is the sample volume used for measurement, 'c' is the total volume of the solution made, 'd' is the volume of the sample taken, and a is the reading.

Vitamin C

The vitamin C content was measured using the titration method with 2,6-dichlorophenol-indophenol (DCIP) for which 2 g of the petals was extracted with 20 mL of 3% metaphosphoric acid and was mixed in a homogenizer for 30 minutes. The extract was filtered through a Whatman paper. At the next step, 15 mL of the filtered extract was titrated with DCIP until the emergence of pink color at which step the amount of DCIP applied for titration was recorded. Finally, the following equation was applied to determine the vitamin C content of the petals in mg 100 g^{-1} F.W. (Ghasemnezhad *et al.*, 2011):

$$\text{Vitamin C} = \frac{e \times d \times b}{c \times a} \times 100$$

In which, 'a' is the sample weight, 'b' is the volume of metaphosphoric acid used for extraction, 'c' is the volume of the solution taken for titration, 'd' is the color factor, and 'e' is the volume of the colored solution consumed.

Total phenols

The total phenol contents of the edible flowers were measured using the Folin–Ciocâlteu

method (Singleton *et al.*, 1999). So, 1 g of the petal was extracted with 10mL of 80% methanol. Then, 25 µL of the filtered extract was adjusted to 250 µL with distilled water, diluted by adding 2.5 mL of Folin, and was added with 2 mL of 7.5% sodium carbonate. The solution was kept in a dark room for 2 hours. Then, its absorbance was read at 760 nm with a Japanese Shimadzu UV-120-02 spectrophotometer. The standard solution was prepared with gallic acid. After the standard curve was drawn, the total phenol content was calculated in mg gallic acid equivalent (GAE) g^{-1} F.W.

Total flavonoids

To measure the total flavonoid content, 1 g of the petal was extracted using 10 mL of 80 % methanol. Next, 150 µL of the extract was mixed with 1700 µL of 3% ethanol, 75 µL of 0.3 µM aluminum chloride, and 75 µL of 0.5 µM sodium nitrite, and was kept at room temperature for 5 min minutes. Then, 500 µL of 1-M sodium hydroxide was added and mixed using a vortex for 15 minutes. Finally, the absorbance of the sample was read at 506 nm by a Japanese Shimadzu UV-120-02 spectrophotometer. The standard solution was prepared with catechin. Finally the standard curve was drawn, the total flavonoid content was reported in mg catechin equivalent (CE) $100g^{-1}$ F.W. (Du *et al.*, 2009).

Antioxidant capacity

The antioxidant capacity of the samples was determined by the free radical scavenging property of 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) (Brand-Williams et al., 1995). So, 1 g of the powdered fresh petal was extracted with 10 mL of pure methanol and was kept at room temperature for 1 h. Then, 50 µL of the filtered extract was mixed with 950 µL of the 0.1-M 2 2-diphenyl-1-picrylhydrazyl (DPPH). The sample was kept at room temperature for 15 minutes. Then, its absorbance was read at 515 nm with a Japanese Shimadzu UV-120-02 spectrophotometer. The antioxidant capacity was determined by the following equation in percent DPPH inhibition.

$$\text{Percent inhibition} = \text{DPPH} - (\text{DPPH absorbance} + \text{sample absorbance}) \times \frac{\text{DPPH absorbance}}{100}$$

Data analysis

All statistical analyses were performed in the SPSS 19 software package, the means were compared by the F-test, and the graphs were drawn in the MS-Excel software package.

RESULTS AND DISCUSSION

Petal protein

The studied flowers had significantly ($P < 0.01$) different protein contents (Table 1). . The highest (1.56, 1.30 and 1.15%) petal protein content was obtained in African marigold, yucca, and chrysanthemum flowers, respectively. On the other hand, the lowest petal protein content (Fig. 1).

Nutritionally, edible flowers are a combination of water, fiber, minerals, and carbohydrate, as well as protein and low fat content, like other edible plants (Mleck and Rop, 2011; Navarro-González *et al*., 2015). Navarro-González *et al*. (2015) reported that the total protein content of three edible flowers of marigold, nasturtium, and *Acmella oleracea* varied from 1.32 % in marigolds to 2.84 % in paracress. Grzeszczuk *et al.* (2016) reported that the total protein content of the violet, common daisy, evening primrose, lavender, and borage flowers was in the range of 0.88-9.51 %. The daily protein intake need of the human body is 0.8 g kg^{-1} body weight, which is mostly supplied from animals and some plants like soybeans. According to our results, the studied edible flowers can supply a part of our protein requirement.

Table 1. The analysis of variance for the measured traits of the studied edible flowers.

S.o.V	df	Proteins	Total carotenoids	Total anthocyanins	Vitamin C	Fe	Ca	Zn	Mg	Total phenols	Total flavonoids	Antioxidant capacity
Flowers	4	0.461**	964.5**	18.68**	273.1**	2.253**	725.47**	0.01**	2.01**	99.71**	13.52*	803**
Error	10	0.07	23.97	1.06	8.94	0.042	9.19	0.001	0.19	0.09	4.02	25.3
CV (%)		24.5	1.06	9.24	15.4	18.01	14.3	16.24	17.5	4.1	15.08	7.52

** and *: significant at the P < 0.01 and P < 0.05 levels based on the LSD test, respectively.

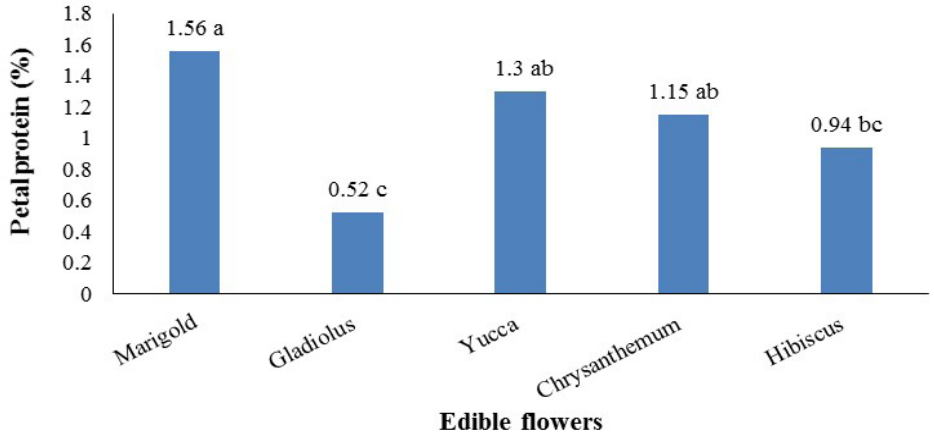

Fig. 1. The protein content of the studied edible flowers.

Minerals (Ca, Fe, Zn, and Mg)

Table 1 presents the significance level of the minerals in the petals of the studied edible flowers. Based on the comparison of means, the yucca flowers had the highest Fe content (2.54 mg 100 g^{-1} F.W.). The white gladiolus and African marigold flowers had the lowest Fe content (0.36 and 0.53 mg 100 g^{-1} F.W., respectively), not differing from one another significantly (Fig. 2a).

Among the studied edible flowers, the chrysanthemum flowers exhibited significantly higher Ca content (47.25 mg 100 g^{-1} F.W.) than the other flowers. The lowest Ca content was 9.11 mg 100 g^{-1} F.W. recorded by the white gladiolus flowers, but it did not differ from that of the African marigold (11.57 mg 100 g^{-1} F.W.) and yucca flowers (14.16 mg 100 g^{-1} F.W.) significantly (Fig. 2b).

The Zn content was significantly higher in the petals of the yucca (0.27 mg 100 g^{-1} F.W.) and *H. syriacus* flowers (0.25 mg 100 g^{-1} F.W.) than in the petals of the white gladiolus (0.14 mg 100 g^{-1} F.W.), African marigold (0.15 mg 100 g^{-1} F.W.), and chrysanthemum flowers (0.17 mg 100 g^{-1} F.W.) (Fig. 2c). No statistically significant differences were observed among the studied flowers in Mg content, but the chrysanthemum and *H. syriacus* flowers recorded the highest Mg content (Fig. 2d).

Fe, Ca, Zn, and Mg are important nutrients required by the human body where they play an essential role in the immunity system and resistance to diseases. Edible flowers are a rich and invaluable source of minerals, so their consumption is good for human health (Rop *et al.*, 2012). The comparison of our results with those of broccoli shows that the yucca, chrysanthemum, and *S. syriacus* flowers have more Fe content than broccoli. The Ca content of 100 g of the chrysanthemum was almost as much as that of 100 g of broccoli. However, broccoli outperforms the studied flowers in Zn content although all five studied flowers exhibited more Mg content than broccoli. Indeed, the Mg content of the chrysanthemum and *H. syriacus* flowers was higher than that of broccoli by a factor of 10.

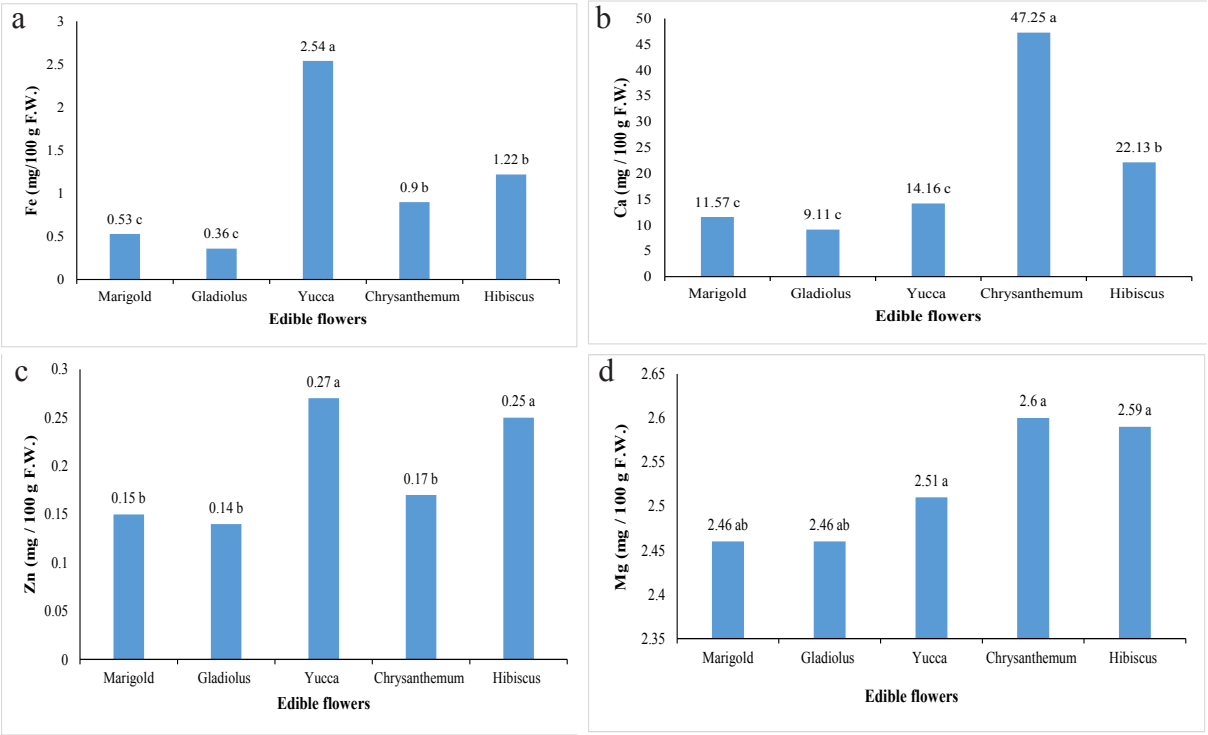

Fig. 2. The amount of (a) Fe, (b) Ca, (c) Zn, (d) Mg in the petals of the studied edible flowers.

Pigments

Petal carotenoids

The comparison of means showed that the carotenoid content was significantly ($P < 0.01$) higher in the yucca petals (482.5 µg g^{-1} F.W.) than in the other flowers (Table 1). The H. syriacus and white gladiolus flowers had the lowest petal carotenoid content (362.17 and 363.23 µg g^{-1} F.W., respectively), but they did not differ from one another significantly (Fig. 3).

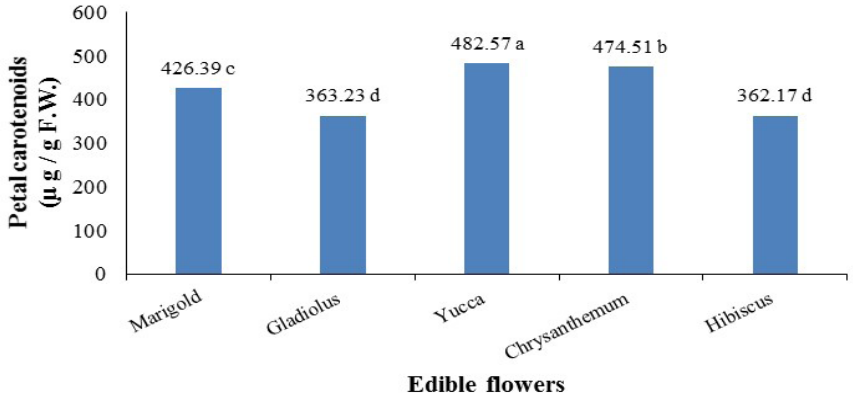

Fig. 3. The carotenoid content in the petals of the studied edible flowers.

As it was mentioned in the results, the yucca flowers, which were white to creamy, and the chrysanthemum flowers, which were purple, had the highest petal carotenoid content, whereas the African marigold flowers were expected to have the highest carotenoid content due to their orange color. The results, however, showed that flower color alone does not represent its carotenoid content. In a study on different cultivars of Osmanthus fragrans, Wang *et al.* (2018) recorded high carotenoid contents including β-carotene, lutein, and α-carotene in cultivars with yellowish-white petals.

A key way to adjust carotenoid content is to control their degradation and decomposition. The activity of the enzymes involved in carotenoid degradation and decomposition remarkably influences the final carotenoid content of plant tissues (Cazzonelli *et al.*, 2010). Consequently, we cannot expect that yellow to red flowers have high carotenoid contents. Furthermore, the diversity in the concentration of carotenoids is related to the expression of some genes and enzymes that are effective in their biosynthesis pathway and can influence total carotenoid content (Li *et al.*, 2001, 2006; Wang *et al.*, 2018). In a study on white chrysanthemums, Ohmiya *et al.* (2006) reported that carotenoids were synthesized in the tissues of this plant, but they were decomposed to colorless apocarotenoids. Therefore, carotenogenesis along with the retention of carotenoids is important for the production of color in tissues.

Petal anthocyanins

ANOVA revealed significant differences among the studied edible flowers in the petal anthocyanin content at the P<0.01 level (Table 1). Figure 4 displays that the petal anthocyanin content was significantly higher in the H. syriacus flowers (30.86 mg 100 g^{-1} F.W.) than in the other flowers. The white gladiolus and yucca flowers exhibited the lowest anthocyanin content (2.14 and 2.44 mg 100 g^{-1} F.W., respectively), not differing from one another significantly (Fig. 4).

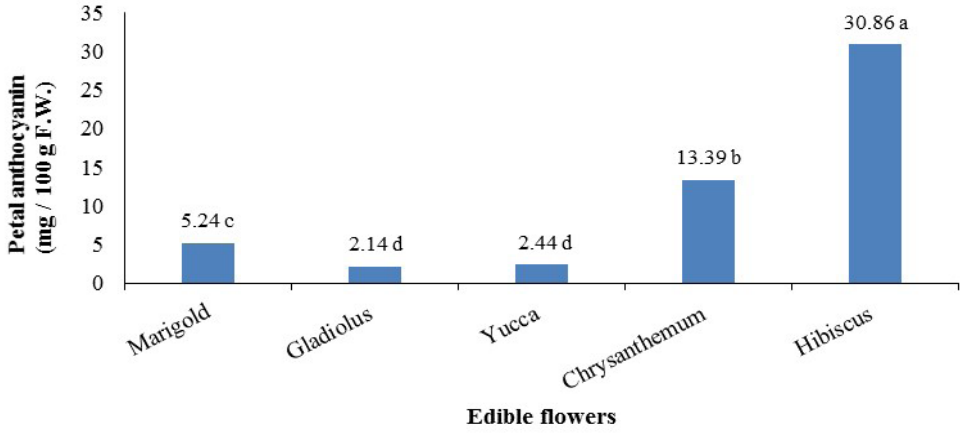

Fig. 4. The anthocyanin content in the petals of the studied edible flowers.

Reportedly, the average anthocyanin consumption is 12.5 mg/day for adults in the US (Wu *et al.*, 2006), 19.8 and 64.9 mg/day for men in parts of the Netherlands and Italy, and 18.4 and 44.1 mg/day for women in parts of Spain and Italy, respectively (Zamora-Ros *et al.*, 2011). Zamora-Ros *et al.* (2011) ascribed the high rate of anthocyanin consumption in Italy to the consumption of berries and other red and blue fruits. Based on our results, the consumption of edible flowers like *H. syriacus* can contribute to supplying our anthocyanin requirement and protecting our health.

Vitamin C

The results showed that the vitamin C content was significantly (P < 0.01) different among the studied flowers (Table 1). The African marigolds had the highest vitamin C content of 30.60 mg 100 g^{-1} F.W., but it did not differ from the yuccas (27.20 mg 100 g^{-1} F.W.) significantly. The chrysanthemums and H. syriacus had the lowest vitamin C content. They though did not differ in this trait significantly (Fig. 5).

Vitamin C is an essential compound for human growth and health. However, the human body is unable to biosynthesize vitamin C because it lacks the enzymes for the conversion of glucose to vitamin C. So, our daily vitamin C requirement should be supplied through the food

regime (Davies *et al.*, 1991). The comparison of the studied flowers and orange, which is a famous source of vitamin C containing 30-56 mg vitamin C 100 g^{-1} F.W. (Gazdik *et al.*, 2008), shows that the African marigolds and yuccas had over 50 % as much vitamin C as oranges. Even chrysanthemums, which had the lowest vitamin C content among the studied flowers, had almost 15 % as much vitamin C as oranges. So, the studied edible flowers can be placed in the food regime as a good source of vitamin C.

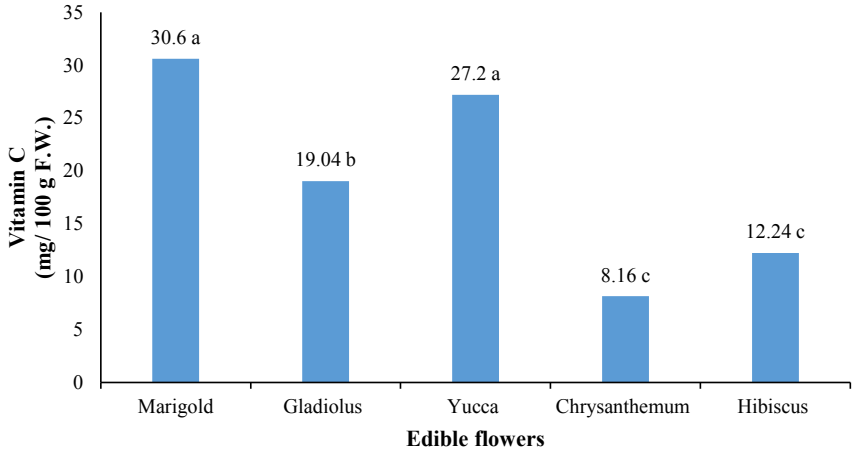

Fig. 5. The vitamin C content in the petals of the studied edible flowers.

Total phenol

The studied edible flowers differed significantly ($P < 0.01$) in the total phenol content. Fig. 6 showed, the total phenol content was the highest in the African marigolds (14.48 mg GAE g^{-1} F.W.) and the lowest in the chrysanthemums (0.54 mg GAE g^{-1} F.W.). According to the results, African marigolds and then white gladiolus (11.66 mg GAE g^{-1} F.W.) are more appropriate sources of phenols (Fig. 6).

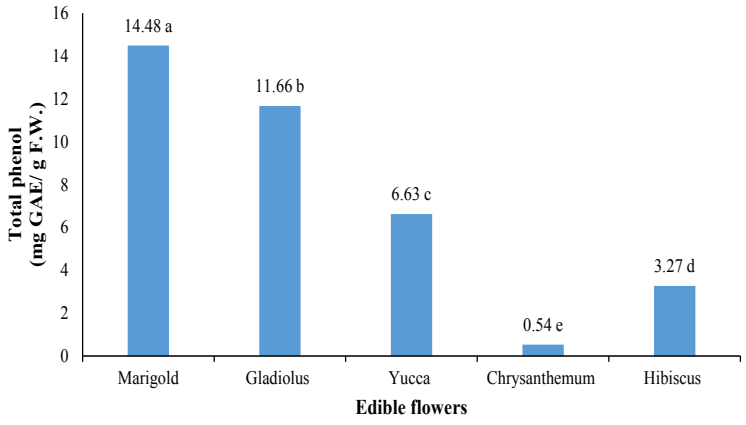

Fig. 6. The total phenol content in the petals of the studied edible flowers.

Phenol compounds include simple phenols and polyphenols. These compounds are mainly characterized by their antioxidant property and their capability of scavenging free radicals (Falleh *et al.*, 2012). These compounds constitute a significant part of the human food regime owing to their therapeutic and anti-cancer activities (Kwok *et al.*, 2010). The source of phenol supply differs in different parts of the world depending on people's food regimes. For example, the source of phenol compounds is green tea in Japan and China, potatoes and onions in western countries, and vegetables and pickles in eastern countries (Wach *et al.*, 2005).

Denga *et al.* (2013) studied the antioxidant capacity and total phenol content of 56 common vegetable species. The comparison of the phenol content of the flowers studied here with the results reported by Denga *et al.* (2013) showed that the petals of the African marigolds and white gladiolus contained over 99 % as much phenols as the daily consumed vegetables. The total phenol of African marigolds and white gladiolus is as much as that of soybeans and even more than that of broccoli, spinach, cabbage, potatoes, and tomatoes. The phenol content of yuccas is also as much as the zucchini, green beans, fresh chives, purple eggplants, onions, cabbages, and white turnip. Similarly, a study on the total phenol and flavonoid content of several local and imported plant species by Fazeli Nasab and Mirzaei (2017) revealed that the total phenol content in the dry extract of oranges (local and imported), lemons (local and imported), tangerines (imported), Bergamot oranges, and grapefruits was lower than that in *H. syriacus* and purple chrysanthemums. So, these flowers are cheap phenol sources that can replace many fruits and vegetables.

Total flavonoid

The difference of the edible flowers in total flavonoids was significant at the $P < 0.05$ level (Table 1). Based on the comparison of means, the African marigold and chrysanthemum flowers had the highest total flavonoid contents of 16.13 and 14.86 mg CE g^{-1} F.W., respectively. The lowest was 11.17 mg CE g^{-1} F.W. observed in the white gladiolus flowers (Fig. 7).

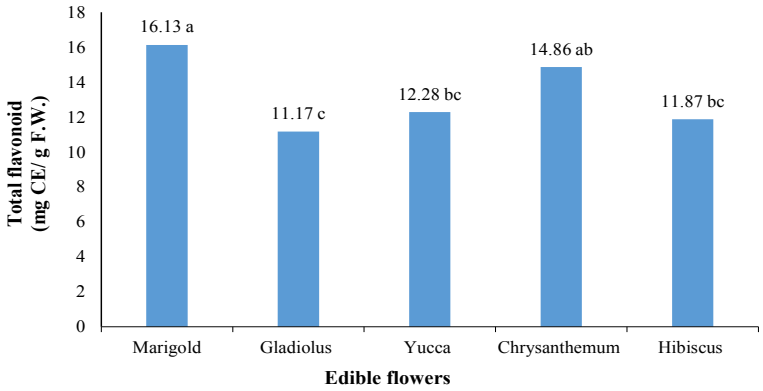

Fig. 7. The total flavonoid content in the petals of the studied flowers.

Flavonoids are a group of plant compounds that are usually found in fruits, vegetables, grains, tree barks, roots, stems, flowers, and teas (Prasad *et al.*, 2009). They have antioxidant, anti-inflammation, and anti-cancer properties (Koga and Meydani, 2001; Arts and Hollman, 2005). In a study on the food regime of over 53,000 Danish collected over 23 years, Bondonno *et al.* (2019) showed a negative relationship between death caused by cardiovascular diseases and cancer and the regular consumption of flavonoid-rich nutrients. They found that this effect would culminate with a daily intake of about 500 mg flavonoids.

So, it is recommended to consume flavonoid sources both raw and cooked. Although Bondonno *et al.* (2019) recommended the consumption of 500 mg flavonoids for human health, the appropriate rate of their consumption is still a hot topic. It is argued that any amount of flavonoids can be effective in reducing the risk of diseases versus their non-consumption (Bondonno *et al.*, 2019). So, the studied edible flowers, especially African marigolds and purple chrysanthemums, can be a good source of flavonoids for the human body.

Antioxidant capacity

The antioxidant capacity was significantly ($P< 0.01$) different among the studied five flowers (Table 1). The African marigolds had the highest and the white yuccas had the lowest antioxidant capacity (87.89 % and 47.76 DPPH inhibition, respectively (Fig. 8).

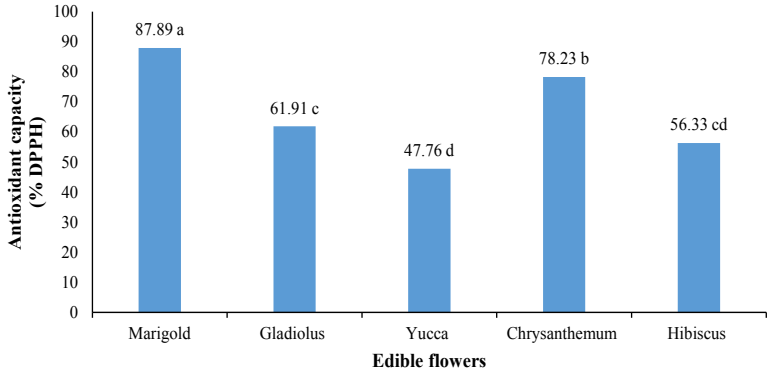

Fig. 8. The antioxidant capacity of the studied edible flowers' petals.

Antioxidants play a key role in protecting the tissues against the oxidizing effect of free oxygen radicals and other reactive species so that they are effective in preventing multiple diseases including cancer, diabetes, Alzheimer's, and Parkinson (Pham-Huy *et al*., 2008; Zhao, 2009; Bajaj and Khan, 2012). The flavonoid compounds of plants are among the best natural antioxidants. Many research studies have found a positive relationship between antioxidant activity and the amount of flavonoid compounds (Kaur and Kapoor, 2002; George *et al*., 2005). Similarly, we found that the African marigold had the highest total phenols and flavonoids and subsequently, the highest antioxidant capacity, which is consistent with these researchers. However, there is a relationship between the flavonoid content and the antioxidant activity of the studied flowers, reflecting the dependence of the antioxidant capacity to the flavonoid content.

In a study on the chamomile, fennel flower, Persian shallot, Shirazi thyme, purslanes, *Echinophora platyloba*, *Punica granatum*, and Stachys lavandulifolia, Mortazaei *et al*. (2013) reported that Punica granatum and Shirazi thyme had the highest antioxidant capacity of over 70% and Stachys lavandulifolia and fennel flower had the lowest one of 50 %. Grzeszczuk *et al*. (2016) reported that the antioxidant capacity of the violet, common daisy, common sage, vervain, angel wing begonia, evening-primrose, lavender, and borage was in the range of 3.63-84.95 %. The comparison of these results with ours shows that the studied flowers have equal or higher antioxidant capacity than most medicinal plants.

CONCLUSIONS

Based on the results, the African marigold is a good source of proteins, carotenoids, vitamin C, and antioxidant compounds, such as phenols and flavonoids, and the yucca is a rich source of Zn, Fe, carotenoids, vitamin C, flavonoids, and proteins. Also, the chrysanthemum can supply Mg, Ca, carotenoids, flavonoids, and proteins adequately and shows a good antioxidant capacity. The Zn, Mg, and anthocyanin contents of *H. syriacus* and the total phenols and antioxidant capacity of the white gladiolus were found to be remarkable. So, these flowers can be included in the human food regime as new, natural, and nutritional sources of food.

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