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Effect of fresh and dry petals of different commercial flowers on Anthocyanin content and sensory evaluation in herbal tea

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Abstract
A detailed investigation on "Effect of fresh and dry petals of different commercial flowers on Anthocyanin content and sensory evaluation in herbal tea" was carried out during 2021-22 at the Floriculture laboratory, College of Horticulture, Sri Konda Laxman Telangana State Horticultural University. Rajendranagar, Hyderabad-30. The experiment was laid out in Factorial Completely Randomized Design with sixteen treatments and replicated twice. They were evaluated for the Total anthocyanin content and sensory evaluation at period of 0,30,60 days of storage. It was observed that significant variation was recorded in herbal tea due to effect of different commercial fresh and dry petals. The study revealed that among different herbal teas, T_{13}: P_4S_1- Hibiscus tea (freshly prepared, 0-day storage) recorded maximum total anthocyanin content (25.72 mg/L^{-1}) Whereas, minimum (3.08 mg/L^{-1}) was recorded in T_8: P_2S_4- Marigold tea (dry petals at 60 days). In respect with organoleptic scoring T_2: P_1S_2- Rose tea (dry petals at 0 days) recorded maximum score in respect with flavor, taste and overall acceptability and T_5: P_2S_1- Marigold tea (freshly prepared, 0-day storage) showed enhanced colour among other treatments.

Keywords: Herbal tea, fresh petals, dry petals, anthocyanin

Introduction
Herbal tea is an infusion, commonly consumed beverage brewed from the leaves, flowers, seeds, fruits, stems or roots of plant species rather than *Camellia sinensis L.*, and it has been used for health care and diseases prevention. (Ravikumar, 2014) [7]. Generally, herbal tea has multiple beneficial effects, such as antioxidant, anti-inflammatory, antimicrobial, anti-carcinogenic, cardioprotective, hepatoprotective and neuroprotective activities and can be used for promoting human health and reducing the risk of chronic diseases.

Herbal tea as a value-added product can be prepared from commercial flowers like rose, chrysanthemum, marigold, jasmine, hibiscus and many other flowers. Tea is a rich source of polyphenolic flavonoids which exhibits antioxidant activity.

The anthocyanins, a subclass of flavonoids, are important flower pigments which are responsible for the intense red and blue colour in flowers. Among flavonoids, the anthocyanins are the main colorant molecules; derivatives of pelargonidin provide the basis for orange-red colours, derivatives of cyanidin for red colours and derivatives of delphinidin for lilac to blue colours.

Reactivity of free radicals is generally stronger than non-radical species though radicals are less stable and disrupt the biological function of biomolecules. These radicals destroy a lot of biomolecules such as proteins, lipids as well as nucleic acids and may cause mutation in living cell which cause diseases. Therefore, looking for anti-oxidative and hydroxyl radical, nitric oxide radical scavenger agents from natural products are still ongoing to discover these compounds from plants (Afify and Hassan, 2016) [1]. Phenolic compounds are a large and diverse group of phytochemicals, which includes many different families of aromatic secondary metabolites in flowering plants

Material and Methods
Experiment was carried out at Floriculture laboratory, College of Horticulture, Rajendra Nagar, Sri Konda Laxman Telangana State Horticultural University, Ranga Reddy District of Telangana during the year 2021-2022.

The experiment was laid out in Factorial Completely Randomized design consisted of two factors (flower petals and storage duration) each at four levels comprising of 16 treatments with two replications *i.e.* T_1: P_1S_1-Rose tea (freshly prepared,0- day storage), T_2: P_1S_2- Rose tea (dry petals at 0 days), T_3: P_1S_3- Rose tea (dry petals at 30 days), T_4: P_1S_4- Rose tea (dry petals at 60 days), T_5: P_2S_1- Marigold tea (freshly prepared,0-day storage),T_6: P_2S_2- Marigold tea (dry petals at 0 days),T_7: P_2S_3- Marigold tea (dry petals at 30 days), T_8: P_2S_4- Marigold tea (dry petals at 60 days), T_9: P_3S_1- Jasmine tea (freshly prepared,0-day storage), T_{10}: P_3S_2- Jasmine tea (dry petals at 0 days), T_{11}: P_3S_3- Jasmine tea (dry petals at 30 days), T_{12}: P_3S_4- Jasmine tea (dry petals at 60 days), T_{13}: P_4S_1- Hibiscus tea (freshly prepared, 0-day storage), T_{14}: P_4S_2- Hibiscus tea (dry petals at 0 days), T_{15}: P_4S_3- Hibiscus tea (dry petals at 30 days),T_{16}: P_4S_4- Hibiscus tea (dry petals at 60 days).

Preparation of herbal tea

Fresh petals were collected and cleaned in water. Then cleaned petals are shade dried until water evaporates. Later petals were kept in Hot air oven at 80℃ for 2-3 hours. The dried petals were stored in air tight glass jars for further analysis. Tea infusions were prepared by boiling an accurately weighed (3 g) samples in 200 ml of water at a temperature of 90℃ for 10 min. Whereas, for freshly prepared tea, fresh petals were used for preparation of tea infusion.

Total anthocyanin content

Total anthocyanin content was measured by using a spectrophotometric pH differential protocol. The extracts were mixed thoroughly with 0.025 M potassium chloride pH 1 buffer in 1:3 or 1:8 ratio of extract to buffer and the absorbance of the mixture was measured at 520 and 700 nm against distilled water as blank. The extracts were combined similarly with sodium acetate buffer pH 4.5 and the absorbance of these solutions were measured at the same wavelengths (Lee *et al.*, 2005) [4]. The anthocyanin content was calculated by using the formula mentioned below and the results are expressed as cyanidin-3-gluciside equivalent in mg/l.

Calculation

Absorbance (A) = (A520nm – A700nm) pH 1.0 – (A520nm – A700nm) pH 4.5

The total anthocyanin content of samples was calculated using the formula given below:

$$\text{Total anthocyanin content (mg/L}^{-1}) = \frac{A \times MW \times DF \times 1000}{\varepsilon \times l}$$

Where,

A=absorbance,

MW= Molecular Weight

DF=Dilution Factor

ε = molar extinction coefficient, L x mol^{-1} x cm^{-1}

l = pathlength (1 cm)

Organoleptic evaluation

The tea infusions were subjected to sensory evaluation for their acceptability using 9-point hedonic scale for colour, flavour, taste and overall acceptability by 10 panelists.

9-point hedonic scale

Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Results and Discussion

Total anthocyanin content (mg/l^{-1})

The experimental findings regarding the total anthocyanin content (mg/L^{-1}) of herbal tea from different commercial flower petals are presented in the table 1.

Different flower petals were found to have a significant effect on total anthocyanin content (mg/L^{-1}) where P_4- Hibiscus petals significantly recorded the highest total anthocyanin content (20.12 mg/ L^{-1}) followed by P_1- Rose petals (7.50 mg/ L^{-1}). Significantly, the lowest total anthocyanin content was observed in P_2- Marigold petals (4.79 mg/ L^{-1}).

The four storage periods significantly influenced the total anthocyanin content (mg/L^{-1}) of herbal tea. Among the storage periods S_1- Freshly prepared tea at 0 days recorded significantly the maximum total anthocyanin content (11.69 mg/ L^{-1}), followed by S_2- Dry petals at 0 Days (10.57 mg/ L^{-1}). Whereas, significantly minimum value was recorded in S_4- Dry petals at 60 days (6.74 mg/ L^{-1}).

A significant interaction effect was observed between petals with storage periods on the total anthocyanin content (mg/L^{-1}) of herbal tea. Among the treatments highest total anthocyanin content (25.72 mg/L^{-1}) was recorded in T_{13}: P_4S_1- Hibiscus tea (freshly prepared, 0-day storage), followed by T_{14}: P_4S_2- Hibiscus tea (dry petals at 0 days) (22.27 mg/L^{-1}). Whereas, significantly the lowest total anthocyanin content (3.08 mg/L^{-1}) was recorded in T_8: P_2S_4- Marigold tea (dry petals at 60 days).

Hibiscus petals found to be recorded highest anthocyanin content among all the flower petals might be due to the bright colour. Similar findings were recorded by Vankar and Srivastava (2010) [8] in Evaluation of Anthocyanin Content in Red and Blue Flowers and It was observed that anthocyanins with high antioxidant properties tend to be brightly colored the blue-colored flowers showed the highest anthocyanin content.

There was a significant decrease in the total anthocyanin content of herbal tea from different commercial flowers with an increase in storage duration. Anthocyanin is relatively unstable and because of its high reactivity, it may be easily degraded and form colorless or undesirable brown-colored compounds during extraction processing and storage (Durst and Wrolstad, 2001) [4]. Indeed, temperature, pH, light, oxygen, metals, organic acids, sugars, enzymes, sulfur dioxide, co-pigmentation, and interactions with food components may affect both the structure and stability of anthocyanins (Idham *et al*., 2012) [3].

A similar decrease trend of total anthocyanin content was also observed by Ramya *et al.* (2021) [6] in hibiscus tea and reported that anthocyanin content of hibiscus tea freshly prepared (72.13 mg/l) decreased gradually to (62.42 mg/l) at 90 days of storage.

Table 1: Effect of fresh and dry petals of different commercial flowers on Total Anthocyanin content (mg/L^{-1}) of herbal tea

PETALS	Storage Period				Mean(P)
	S_1- Fresh, 0 days	S_2- Dry, 0 Days	S_3- Dry, 30 days	S_4- Dry, 60 days	
P_1- Rose	9.09^{e}	8.73^{f}	6.93^{g}	5.23^{j}	7.50^{b}
P_2- Marigold	5.85^{h}	5.40^{i}	4.84^{k}	3.08^{l}	4.79^{d}
P_3- Jasmine	6.13^{h}	5.87^{h}	5.22^{j}	4.74^{k}	5.49^{c}
P_4- Hibiscus	25.72^{a}	22.27^{b}	18.58^{c}	13.93^{d}	20.12^{a}
Mean(S)	11.69^{a}	10.57^{b}	8.89^{c}	6.74^{d}	
	P	S	P*S		
S.Em±	0.02	0.02	0.04		
CD at 5%	0.06	0.06	0.11		

Organoleptic scoring

Colour

The data pertaining to colour intensity of different commercial flower petal herbal teas stored at different periods is represented in the table 2.

Among the petals P_1- Rose petals registered the highest score (7.51) followed by P_2- Marigold petals (7.43).

A significant difference was also observed among the four storage periods that influenced the colour of herbal tea. Among the storage periods S_1- Freshly prepared at 0 Days, significantly registered the highest score (7.74) followed by S_2- Dry petals at 0 Days (7.50). The lowest score was registered in S_4- Dry petals 60 days (7.09).

The data indicated a significant interaction effect between petals and storage periods on the colour of herbal tea. Among the treatments T_5: P_2S_1- Marigold tea (freshly prepared,0-day storage) significantly registered the highest score (8.30) followed by T_1: P_1S_1- Rose tea (freshly prepared,0-day storage) (7.70). while significantly the lowest score was registered in T_8: P_2S_4- Marigold tea (dry petals at 60 days) (6.60).

Table 2: Effect of fresh and dry petals of different commercial flowers on Organoleptic scoring on Colour and Flavor of herbal tea

PETALS	Colour				Mean (P)	Flavor				
	S_1- Fresh, 0 days	S_2- Dry, 0 Days	S_3- Dry, 30 days	S_4- Dry, 60 days		S_1- Fresh, 0 days	S_2- Dry, 0 Days	S_3- Dry, 30 days	S_4- Dry, 60 days	Mean(P)
P_1- Rose	7.70^{b}	7.60^{b}	7.50^{b}	7.25^{c}	7.51^{a}	7.50^{c}	8.60^{a}	7.40^{c}	7.20^{d}	7.68^{a}
P_2- Marigold	8.30^{a}	7.60^{b}	7.20^{c}	6.60^{d}	7.43^{a}	5.50^{g}	6.60^{e}	6.20^{f}	6.10^{f}	6.10^{d}
P_3- Jasmine	7.60^{b}	7.30^{b}	7.30^{b}	7.25^{c}	7.36^{a}	6.80^{e}	8.20^{b}	8.40^{a}	6.70^{e}	7.53^{b}
P_4- Hibiscus	7.35^{c}	7.50^{b}	7.45^{c}	7.25^{c}	7.39^{a}	7.70^{c}	6.80^{e}	6.40^{f}	5.70^{g}	6.65^{b}
Mean(S)	7.74^{a}	7.50^{b}	7.36^{c}	7.09^{d}		6.88^{c}	7.55^{a}	7.10^{b}	6.42^{d}	
	P	S	P*S			P	S	P*S		
S.Em±	0.04	0.04	0.08			0.06	0.06	0.13		
CD at 5%	0.12	0.12	0.24			0.19	0.19	0.37		

The highest carotenoid content in marigold fresh petals enhanced the colour intensity of herbal tea and light pink colour of fresh rose petals is also pleasing to the eye which might have resulted in highest score.

The colour reduction of herbal tea with an increase in storage might be due to oxidation and enzymatic browning which results in discoloration of the product.

These findings are in line with the reports of Nath (2007) [5] in hibiscus tea. At room temperature colour showed a significant decrease from zero to 60 days. Scores decreased from an initial score of 4.2 on zero days to 3.2 after 60 days

Flavor

Flavor of herbal tea from different commercial flower petals with different storage periods was found to be significantly different and represented in the table 3.

Different flower petals influenced the flavor of herbal tea significantly. Among the petals P_1- Rose petals recorded the highest score (7.68) followed by P_3- Jasmine petals (7.53) which is at par with P_4- Hibiscus petals (6.65). whereas, significantly lowest score was recorded in P_2- Marigold petals (6.10).

The impact of four storage periods on herbal tea flavor was found to be significant. Among the storage periods S_2- Dry petals at 0 Days significantly recorded the highest score (7.55) followed by S_3- Dry petals at 30 days (7.10). Whereas, lowest score in S_4- Dry petals at 60 days (6.42) of storage.

The interaction effect of different flower petals and storage periods was found to have significant variation. The treatment T_2: P_1S_2- Rose tea (dry petals at 0 days) recorded the highest score (8.60) which is a par with T_{11}: P_3S_3- Jasmine tea (dry petals at 30 days) (8.40). Whereas, lowest score was recorded in T_5: P_2S_1- Marigold tea (freshly prepared, 0-day storage) (5.50) which is at par with T_{16}: P_4S_4- Hibiscus tea (dry petals at 60 days) (5.70).

The present results are in accordance with Vinokur *et al.* (2006) [9] where dry rose petals are found to be efficient for preparation of caffeine-free beverages.

The deterioration of flavor with a longer storage period was attributed to the loss of highly volatile aromatic compound which was very sensitive to high storage temperature as well as enzymatic degradation of phenols and oxidative changes.

Similar results of deterioration of flavor with an increment of storage period were also observed by Aggarwal and Kaur (2017) [2] in rose extract in different value-added products and by-products.

Taste

The mean data recorded on the taste of herbal tea from different commercial flower petals at different storage periods is presented in 4.3.

A significant difference was observed in the taste of herbal tea from different petals. Among the petals P_1- Rose petals recorded the highest score (7.58) followed by P_3- Jasmine

petals (6.90. The lowest score was found in P_2- Marigold petals (5.21).

The four storage periods influence the taste of herbal tea significantly. Among the storage periods, S_2- Dry petals at 0 Days noticed the highest score (7.48) followed by S_3- Dry petals at 30 days (6.66). The lowest score was noticed in S_1- Freshly prepared at 0 Days (6.10).

A significant interaction effect was observed between petals and storage periods on the taste of herbal tea. Among the treatments T_2: P_1S_2- Rose tea (dry petals at 0 days) noticed the highest score (8.50) which is at par with T_1: P_1S_1- Rose tea (freshly prepared,0-day storage) (8.30). The lowest score was noticed in T_5: P_2S_1- Marigold tea (freshly prepared,0-day storage) (4.60).

Our current results are in accordance with the findings of Aggarwal and Kaur (2017) [2] in rose extract in different value-added products and by-products.

Table 3: Effect of fresh and dry petals of different commercial flowers on Taste and Overall acceptability of herbal tea

PETALS	Taste				Mean (P)	Overall acceptability				
	S_1- Fresh, 0 days	S_2- Dry, 0 Days	S_3- Dry, 30 days	S_4- Dry, 60 days		S_1- Fresh, 0 days	S_2- Dry, 0 Days	S_3- Dry, 30 days	S_4- Dry, 60 days	Mean(P)
P_1- Rose	8.30^{a}	8.50^{a}	7.00^{d}	6.50^{e}	7.58^{a}	7.80^{b}	8.30^{a}	7.50^{c}	7.45^{c}	7.76^{a}
P_2- Marigold	4.60^{i}	5.50^{g}	5.45^{g}	5.30^{g}	5.21^{d}	5.60^{g}	6.75^{e}	6.60^{e}	6.45^{f}	6.35^{d}
P_3- Jasmine	5.20^{h}	8.20^{b}	7.70^{c}	6.50^{e}	6.90^{b}	7.25^{c}	6.60^{e}	6.35^{f}	6.25^{f}	6.61^{c}
P_4- Hibiscus	6.30^{f}	7.70^{c}	6.50^{e}	6.5^{e}	6.75^{c}	7.45^{c}	7.25^{c}	7.05^{d}	6.80^{d}	7.14^{b}
Mean(S)	6.10^{c}	7.48^{a}	6.66^{b}	6.18^{c}		7.03^{b}	7.23^{a}	6.88^{c}	6.74^{d}	
	P	S	P*S			P	S		P*S	
S.Em±	0.05	0.05	0.09			0.04	0.04		0.08	
CD at 5%	0.14	0.14	0.28			0.13	0.13		0.25	

Overall acceptability

A significant difference was observed among the treatments for overall acceptability of herbal tea preparation and is presented in the table 4.

Among the different flower petals P_1- Rose petals significantly recorded the highest score (7.76) followed by P_4- Hibiscus petals (7.14). Whereas, significantly the lowest score was recorded in P_2- Marigold petals (6.35).

A significant variation was found among the four storage periods. S_2- Dry petals at 0 Days recorded the highest score (7.23) followed by S_1- Freshly prepared at 0 Days (7.03). While the lowest score was recorded in S_4- Dry petals 60 days (6.74).

A significant interaction effect was observed between petals and storage periods on this parameter. Among the treatments T_2: P_1S_2- Rose tea (dry petals at 0 days) significantly recorded the highest score (8.30) followed by T_1: P_1S_1- Rose tea (freshly prepared,0-day storage) (7.80). Whereas, lowest score was recorded in T_5: P_2S_1- Marigold tea (freshly prepared, 0-day storage) (5.60).

Similar results were reported by Ramya *et al*. (2021) [6] in hibiscus and green tea infusions. Among all the tea infusions, treatment T_3 (Green tea+ Hibiscus tea freshly prepared, 0 day storage) was mostly preferred by all consumers due to its bright appetising red colour with good flavour, taste and overall acceptability.

The observations on sensory evaluation confirm that dry petals at 0 day storage were found to be acceptable as compared to the freshly prepared herbal tea. However, as the storage period of dry petal increases the overall acceptability decreased.

The findings are also in accordance with vinokur *et al*. (2006) [9]. The degradation in overall acceptability with an increment of storage was due to the decline of color, flavor, texture, and taste with an increased storage period. Present findings are in a similarity to Aggarwal and Kaur (2017) [2] in rose syrup.

Conclusion

From above results the present investigation "Effect of fresh and dry petals of different commercial flowers on Anthocyanin content and sensory evaluation of herbal tea" can be concluded that Hibiscus tea (freshly prepared, 0-day storage) found to be best in total anthocyanin content (25.72 mg/L-1). In respect with organoleptic scoring T_2: P_1S_2- Rose tea (dry petals at 0 days) found to be best with flavor, taste and overall acceptability and T_5: P_2S_1- Marigold tea (freshly prepared,0-day storage) found to be best with colour.

Future scope

Based on the present study Anthocyanin content found to be maximum in different commercial flower petals so that further studies may be carried out on preparing blends of tea infusions by adding petals in different proportions, to arrive at best nutritive herbal tea.

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Conflict of Interest: None.

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