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QUALITATIVE ANALYSIS OF BLENDED FLORAL TEA DURING STORAGE

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ABSTRACT

The present study revealed the effect of blending material (dried ginger, dried lemon grass and ginger and lemongrass combination) on the biochemical stability and organoleptic evaluation of floral tea prepared from rose, chrysanthemum, hibiscus, butterfly pea and green tea. Prepared blended floral teas were stored at ambient room temperature and analyzed at 0,15, 30, 45 and 60 days for antioxidant activity (%), anthocyanin content (mg L^{-1}), microbial count (microbial count × 10^4 cfu g^{-1}) and sensory evaluation was also done. Experiment was laid out using a factorial completely randomized design which was replicated twice. Over a period of 60 days, antioxidant activity, anthocyanin content and sensory parameters were decreased. Microbial count was observed at 60 days after storage. Among blended floral tea combinations, maximum anthocyanin content was recorded in T_3B_2 (hibiscus blended with dried lemongrass), while highest antioxidant activity was observed in T_1B_3 (rose petals blended with dried ginger and lemongrass). The highest score for color, flavour, taste and overall acceptability was noticed in T_4B_2 (butterfly pea flowers blended with dried lemongrass), while the maximum score for viscosity was observed in T_3B_3 (hibiscus flowers blended with dried ginger and lemongrass). This reveals an opportunity to make flowers into a profitable and marketable product with significant nutritional and economic benefits.

Key words : Flowers, Blends, Antioxidant activity, Anthocyanins and Sensory.

Introduction

Flowers are highly versatile and serve purposes well beyond ornamentation. They are utilized in food, traditional medicine, aromatherapy, pharmaceuticals, perfumes, essential oils, as well as natural dyes and fragrances. Ecologically, flowers are crucial for attracting pollinators and sustaining biodiversity. Many varieties are edible and incorporated into drinks and culinary dishes like salads for their flavor, aroma and decorative appeal. With their nutritional and medicinal benefits, edible flowers are increasingly recognized as valuable sources of nutraceuticals (Sruthi *et al*., 2024).

Although, tea is the world's second most consumed beverage (Mukhopadyay *et al*., 2012) and has a history spanning nearly 5,000 years, herbal tea blends have recently gained attention due to their antioxidant and therapeutic potential. The practice of blending teas, first developed in ancient China, flourished during the Song Dynasty (960–1279 AD), when it became more refined and widespread. Combining herbs in tea not only enhances health benefits but also enriches sensory qualities. For example, ginger imparts a warm, robust flavour and is valued for its bioactive compound gingerol, which exhibits strong anti-inflammatory and antioxidant activity (Sofiah *et al*., 2022). Similarly, lemongrass has been traditionally used in India to add fragrance and flavour to tea, while also acting as a natural antibacterial agent and preservative (Pruthviraj and Harshal, 2024).

Materials and Methods

The flowers dried under tray dryer at 45^{0}C were used in this experiment. Dried ginger and lemon grass were collected from the local market of West Godavari district. Dried green tea leaves were procured from local market of Tadepalligudem, Andhra Pradesh and used in the experimental studies. Flowers and tea leaves were blended in 2:1 ratio consisting of 2 parts of flowers and

one part of dried ginger / dried lemon grass / dried ginger and lemon grass).

Treatment details

Factor I: Dried flower petals and green tea leaves (M_1)

T_1- Dried rose petals

T_2 - Dried chrysanthemum petals

T_3 - Dried hibiscus petals

T_4 - Dried butterfly pea petals

T_5 – dried tea leaves

Factor II: Blending materials

B_1- Dried ginger

B_2- Dried lemongrass

B_3- Dried ginger and lemongrass

S. no.	Treatment combinations	Treatment combination details
1	T_1B_1	Dried rose petals + Dried ginger
2	T_1B_2	Dried rose petals + Dried lemon grass
3	T_1B_3	Dried rose petals + Dried ginger and lemon grass
4	T_2B_1	Dried Chrysanthemum + Dried ginger
5	T_2B_2	Dried Chrysanthemum + Dried lemon grass
6	T_2B_3	Dried Chrysanthemum + Dried ginger and lemon grass
7	T_3B_1	Dried Hibiscus + Dried ginger
8	T_3B_2	Dried Hibiscus + Dried lemon grass
9	T_3B_3	Dried Hibiscus + Dried ginger and lemon grass
10	T_4B_1	Dried Butterfly pea + Dried ginger
11	T_4B_2	Dried Butterfly pea + Dried lemon grass
12	T_4B_3	Dried Butterfly pea + Dried ginger and lemon grass
13	T_5B_1	Dried tea leaves+ Dried ginger
14	T_5B_2	Dried tea leaves+ Dried lemon grass
15	T_5B_3	Dried tea leaves+ Dried ginger and lemon grass

Biochemical analysis

The prepared blended floral teas were analyzed for various parameters like Antioxidant activity, total phenol, total anthocyanin content and microbial count at the interval 15 days upto 2 months of storage period.

Antioxidant activity (%)

Results noticed that the mean antioxidant content decreased gradually from the initial days of storage to 60 days after storage.

The data revealed that different flowers and blending materials had significant effect on antioxidant activity. Among the flowers rose (T_1) recorded maximum antioxidant activity (89.205%) followed by butterfly pea flower (T_4) with 65.208%, whereas minimum antioxidant activity was observed in hibiscus (T_3) (34.392%) followed by green tea (T_5) (37.182%). Among the blending materials, maximum antioxidant activity was exhibited in dried ginger and lemongrass combination (B_3) with 56.607% followed by dried lemongrass (B_2) (55.161%) while minimum antioxidant activity was recorded in dried ginger (B_1) (52.907%). Among the interactions, significant difference in antioxidant activity was observed. The maximum antioxidants were recorded in rose blended with dried ginger and lemongrass combination (T_1B_3) (90.115%) followed by rose blended with dried lemongrass (T_1B_2) (89.785%) while minimum antioxidants were noticed in hibiscus blended with dried ginger (T_3B_1) (32.460) followed by hibiscus blended with lemongrass (T_3B_2) with 34.380%.

With further extended storage up to 60 days, rose (T_1) has shown highest antioxidant content of 82.993% followed by butterfly pea (T_4) (56.273%) while lowest antioxidants were recorded in hibiscus (T_3) (27.335%) followed by green tea (T_5) (29.765%). Among different blending materials, maximum antioxidant content was noticed in ginger and lemongrass combination (B_3) (50.302%) followed by dried lemongrass (B_2) (48.045%) while minimum antioxidant content was observed in dried ginger (B_1) with 45.700%. As per the interactions, maximum antioxidant activity was recorded in rose blended with dried ginger and lemongrass (T_1B_3) (85.555%) followed by rose blended with lemongrass (T_1B_2) (83.650%) however minimum antioxidant activity was recorded in hibiscus blended with ginger (T_3B_1) (25.835%) followed by hibiscus blended with lemongrass (T_3B_2) (27.235%) at 60th day after storage.

The data revealed that the maximum antioxidant activity was recorded in rose blended with dried ginger and lemongrass (T_1B_3). Irrespective of the treatments, there was a significant decrease in antioxidant activity during the storage period (Naithani *et al*., 2006). Avneet *et al*. (2019) reported that high antioxidant activity of the rose tea could be due to presence of phenolics like flavanols, kaempferol and quercetin present in rose petals mainly in glycoside-bound form. Combining different

medicinal plants showed higher antioxidant potential than using an individual plant (Yang *et al*., 2009).

Total anthocyanin content (mg g^{-1})

The analyzed data showed that there was a gradual decrease in the mean anthocyanin content (mg L^{-1}) from initial day to 60 days after storage.

At initial days of storage significantly higher anthocyanin content (62.458 mg g^{-1}) was noticed in hibiscus (T_3) followed by butterfly pea (T_4) (42.015 mg g^{-1}) whereas lowest anthocyanin content was observed in green tea (T_5) (0.872 mg g^{-1}) followed by chrysanthemum (T_2) (10.945 mg g^{-1}). Among blending materials, maximum anthocyanin content was recorded in dried lemongrass (B_2) (27.562 mg g^{-1}) followed by dried ginger (B_1) (26.939 mg g^{-1}) while minimum anthocyanin content was observed in ginger and lemongrass combination (B_3) (25.259 mg g^{-1}). The interaction between different dried flowers and blending materials were found significant. The maximum anthocyanin content was observed in hibiscus blended with dried lemongrass (T_3B_2) with 64.015 mg g^{-1} followed by hibiscus blended with dried ginger (T_3B_1) (63.275 mg g^{-1}) while minimum anthocyanin content was recorded in green tea blended with dried ginger and lemongrass (T_5B_3) (0.815 mg g^{-1}) followed by green tea blended with ginger (T_5B_1) (0.850 mg g^{-1}).

The highest anthocyanin content in flowers was observed in hibiscus (T_3) (58.642 mg g^{-1}) followed by butterfly pea (T_4) (37.228 mg g^{-1}), whereas lowest anthocyanin content was observed in green tea (T_5) (0.438) followed chrysanthemum (T_2) (6.823 mg g^{-1}). Among blending materials, maximum anthocyanin content was recorded in dried lemongrass (B_2) (24.160 mg g^{-1}) followed by dried ginger (B_1) (23.120 mg g^{-1}) while minimum anthocyanin content was observed ginger and lemongrass combination (B_3) (21.959 mg g^{-1}). The interaction effect between different dried flowers and blending materials were found significant. The maximum anthocyanin content was observed in hibiscus blended with dried lemongrass (T_3B_2) with 59.885 mg L^{-1} followed by hibiscus blended with dried ginger (T_3B_1) (59.365 mg g^{-1}) while minimum anthocyanin content was recorded in green tea blended with dried ginger and lemongrass (T_5B_3) (0.305 mg g^{-1}) followed by green tea blended with ginger (T_5B_1) (0.375 mg g^{-1}) at 60th day of storage.

The total anthocyanin content of herbal tea from different commercial flowers showed a significant decline with increasing storage duration. Anthocyanins are relatively unstable compounds and due to their high reactivity, they are easily degraded, resulting in the formation of colorless or undesirable brown pigments during extraction, processing and storage (Durst and Wrolstad, 2005).

Microbial count (microbial count × 10^4 cfu/g)

Significant difference in microbial count among various flowers and blending materials was noticed in 60th day of storage. Minimum microbial development (1.042 × 10^4 cfu/g) was noticed in green tea (T_5) followed by hibiscus (T_3) (1.102 × 10^4 cfu/g) whereas maximum microbial count recorded in butterfly pea (T_4) (1.172 × 10^4 cfu/g) followed by rose (T_1) (1.122 × 10^4 cfu/g). Among the blending materials, minimum microbial count was observed in dried ginger (B_1) (1.097 × 10^4 cfu/g) followed by dried ginger and lemongrass combination (B_3) (1.115 × 10^4 cfu/g) while maximum microbial count was noticed in dried lemongrass (B_2) (1.119 × 10^4 cfu/g). Among the interactions, minimum microbial count was recorded in green tea blended with dried ginger and lemongrass combination (T_5B_3) (1.015 × 10^4 cfu/g) followed by chrysanthemum blended with dried ginger (T_2B_1) (1.035 × 10^4 cfu/g) whereas maximum microbial count observed in butterfly pea blended with ginger and lemongrass combination (T_4B_3) (1.205 × 10^4 cfu/g).

The drying process contributed significantly to reducing water activity, thereby lowering microbial contamination in herbal teas, ensuring safety for consumption and extending shelf life. The primary objective of dehydration is to remove sufficient moisture from the product to inhibit microbial survival. Similar findings were reported by Foline *et al*. (2011) in dehydrated moringa leaves. Among the samples, green tea consistently recorded the lowest microbial count, which can be attributed to its inherently low water activity (Vyshali *et al*., 2022), Amol *et al*. (2022) in rose and hibiscus tea.

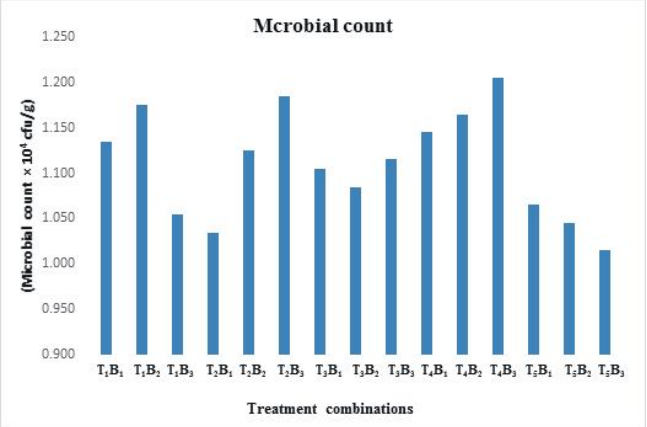

Fig. 1 : Effect of different blendings and storage on (Microbial count × 10^4 cfu/g) of floral teas.

Table 1 : Effect of blending materials on antioxidant activity (%) of dried flowers and green tea leaves at different days of storage.

Flowers & green tea leaves	Blending materials (B)											
	Days of storage											
	0 DAYS				15 DAYS				30 DAYS			
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	87.675 (69.448)	89.785 (71.361)	90.155 (71.714)	**89.205 (70.841)**	87.125 (68.972)	89.425 (71.023)	90.050 (71.613)	**88.867 (70.536)**	85.825 (67.883)	87.800 (69.556)	88.705 (70.362)	**87.443 (69.267)**
T_2	45.910 (42.654)	48.745 (44.281)	50.760 (45.435)	**48.472 (44.123)**	45.535 (42.438)	48.315 (44.034)	50.525 (45.301)	**48.125 (43.925)**	42.265 (40.550)	48.125 (43.925)	50.375 (45.215)	**46.922 (43.230)**
T_3	32.460 (34.732)	34.380 (35.898)	36.335 (37.070)	**34.392 (35.900)**	32.200 (34.573)	34.155 (35.762)	34.220 (36.233)	**33.525 (35.519)**	30.050 (33.242)	31.835 (34.348)	32.735 (34.900)	**31.540 (34.164)**
T_4	63.655 (52.924)	65.535 (54.051)	66.435 (54.595)	**65.208 (53.857)**	63.425 (52.788)	65.160 (53.825)	66.255 (54.486)	**64.947 (53.699)**	60.450 (51.032)	62.135 (52.023)	63.035 (52.556)	**61.873 (51.870)**
T_5	34.835 (36.172)	37.360 (37.678)	39.350 (38.851)	**37.182 (37.567)**	34.530 (35.988)	33.720 (36.703)	39.110 (38.710)	**35.787 (37.134)**	32.070 (34.493)	34.060 (35.705)	37.950 (38.027)	**34.693 (36.075)**
Means	**52.907 (47.186)**	**55.161 (48.654)**	**56.607 (49.654)**	***54.892***	**52.563 (46.952)**	**54.155 (48.269)**	**56.032 (49.267)**	***54.250***	**50.132 (45.440)**	**52.791 (47.112)**	**54.560 (48.212)**	***52.494***

Factor	T	B	T x B	T	B	T x B	T	B	T x B
SEm±	0.026	0.020	0.044	0.011	0.008	0.018	0.028	0.022	0.049
CD@5%	0.077	0.060	0.134	0.032	0.025	0.055	0.085	0.066	0.148

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending material (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger and lemongrass

Continued..

	Blending material (B)							
	Days of storage							
	45 DAYS				60 DAYS			
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	82.325(65.139)	85.560(67.666)	86.555(68.490)	**84.813(67.098)**	79.775(63.274)	83.650(66.1499)	85.555(67.663)	**82.993(65.695)**
T_2	39.870(39.155)	46.720(43.119)	50.460(45.263)	**45.683(42.512)**	39.555(38.971)	43.345(41.175)	48.235(43.988)	**43.712(41.378)**
T_3	28.250(32.107)	29.555(32.932)	30.835(33.730)	**29.547(32.923)**	25.835(30.549)	27.235(31.457)	28.935(32.541)	**27.335(31.516)**
T_4	57.750(49.458)	59.535(50.496)	61.435(51.610)	**59.573(50.521)**	54.450(47.553)	56.135(48.523)	58.235(49.739)	**56.273(48.605)**
T_5	30.460(33.497)	31.960(34.425)	34.815(36.160)	**32.412(34.694)**	28.885(32.510)	29.860(33.123)	30.550(33.553)	**29.765(33.062)**

Means	47.731(43.871)	50.666(45.728)	52.820(47.051)	*50.406*	45.700(42.571)	48.045(44.086)	50.302(45.497)	*48.016*

Factor	T	B	T x B	T	B	T x B
SEm±	0.053	0.041	0.092	0.050	0.039	0.087
CD@5%	0.161	0.125	0.125	0.152	0.118	0.263

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending materials (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger & lemongrass

Table 2 : Effect of blending materials on total anthocyanin content (mg L^{-1}) of dried flowers and green tea leaves at different days of storage.

Flowers & green tea leaves	Blending material (B)																			
	Days of storage																			
	0 DAYS				15 DAYS				30 DAYS				45 DAYS				60 DAYS			
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	16.830	17.815	15.285	**16.643**	15.535	16.425	14.025	**15.328**	14.225	15.175	12.835	**14.078**	13.535	14.355	11.725	**13.205**	12.465	13.720	10.615	**12.267**
T_2	11.025	11.975	9.835	**10.945**	10.085	10.625	8.645	**9.785**	9.425	9.985	7.355	**8.922**	8.025	8.785	6.430	**7.747**	7.170	7.975	5.325	**6.823**
T_3	63.275	64.015	60.085	**62.458**	62.130	63.830	59.870	**61.943**	61.835	61.575	58.765	**60.725**	60.305	60.815	57.420	**59.513**	59.365	59.885	56.675	**58.642**
T_4	42.715	43.055	40.275	**42.015**	41.175	41.720	39.145	**40.680**	38.565	40.870	38.430	**39.288**	37.320	39.815	37.615	**38.250**	36.225	38.585	36.875	**37.228**
T_5	0.850	0.950	0.815	**0.872**	0.650	0.885	0.600	**0.712**	0.575	0.805	0.515	**0.632**	0.485	0.765	0.415	**0.555**	0.375	0.635	0.305	**0.438**
Means	**26.939**	**27.562**	**25.259**	***26.587***	**25.915**	**26.697**	**24.457**	***25.690***	**24.925**	**25.682**	**23.580**	***24.729***	**23.934**	**24.907**	**22.721**	***23.854***	**23.120**	**24.160**	**21.959**	***23.080***

Factor	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B
SEm±	0.011	0.009	0.019	0.009	0.007	0.015	0.074	0.057	0.128	0.004	0.003	0.007	0.004	0.003	0.007
CD @ 5%	0.034	0.026	0.058	0.026	0.020	0.045	0.223	0.172	0.386	0.013	0.010	0.022	0.012	0.009	0.021

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending materials (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger & lemongrass

Organoleptic Evaluation

Colour

During storage, the mean acceptability scores of colour decreased from initial day to 60 days of storage.

The data revealed that butterfly pea flowers (T_4) exhibited well maintained colour (8.817) followed by hibiscus (T_3) (8.025) whereas minimum score was recorded in chrysanthemum (T_2) (6.147) followed by green tea (T_5) (6.698). Among blending materials, dried lemongrass (B_2) shown highest score (7.796) followed by dried ginger and lemongrass (B_3) (7.339) while minimum score was recorded dried ginger (B_1) in with 7.094. The interaction between flowers and blending materials revealed that, maximum score were obtained from butterfly pea flowers blended with dried lemon grass(T_4B_2) (8.945), which was on par with butterfly pea blended with dried ginger and lemongrass combination (T_4B_3) (8.765) and butterfly pea flowers blended with dried ginger (T_4B_1) (8.740) and hibiscus blended with dried lemongrass (T_3B_2) (8.770) whereas minimum score was recorded in chrysanthemum blended with dried ginger (T_2B_1) (5.845) followed by chrysanthemum blended with dried lemongrass (T_2B_2) (6.600) on initial day of storage.

By the 60th day of storage, butterfly pea (T_4) shown highest score for colour (8.155) followed by hibiscus (T_3) (7.380), while lowest score was recorded in chrysanthemum (T_2) (5.605) followed by green tea (T_5) (6.205). Among different blending materials, maximum score for colour was noticed in dried lemongrass (B_2) with 7.185 followed by ginger and lemongrass combination (B_3) (6.803) while minimum score was observed in dried ginger (B_1) (6.476). As per the interactions, highest score for colour was recorded in butterfly pea blended with dried lemongrass (T_4B_2) (8.240) which is on par with butterfly pea blended with dried ginger and lemongrass (T_4B_3) (8.140) and butterfly pea blended with dried ginger (T_4B_1) (8.085) and hibiscus blended with dried lemongrass (T_3B_2) (8.075) however minimum score was recorded in chrysanthemum blended with dried ginger (T_2B_1) (5.165) followed by chrysanthemum blended with dried ginger and lemongrass (T_2B_2) (5.585).

The reduction in color intensity of herbal teas during storage may be attributed to oxidative reactions and enzymatic browning, which lead to product discoloration. Similar results were reported by Nath (2007) in hibiscus tea. Sruthi *et al*. (2024) observed that the lowest color score was obtained in a blend of dried rose petals and dried ginger powder in a 1:1 ratio. These results are consistent with the findings of Sofiah *et al.* (2022) in butterfly pea blended with ginger powder and Amol *et al*. (2022) in rose and hibiscus teas.

Flavour

The mean scores for the flavour of the blended floral tea powder were decreased from the initial day to 60 days after storage.

At initial days of storage significantly higher score for flavour (8.118) was noticed in butterfly pea (T_4) followed by hibiscus (T_3) (7.480) whereas lowest score was observed in chrysanthemum (T_2) (6.267) followed by green tea (T_5) (6.498). Among blending materials, maximum score for flavour was recorded in dried lemongrass (B_2) (7.641) followed by ginger and lemongrass combination (B_3) (6.984) while minimum score was observed in dried ginger (B_1) (6.685). The interaction between different dried flowers and blending materials were found significant. The maximum score for flavour was observed in butterfly pea blended with dried lemongrass (T_4B_2) with 8.765 followed by hibiscus blended with dried lemongrass (T_3B_2) (7.880) while minimum score was recorded in green tea blended with dried ginger (T_5B_1) (5.885) followed by chrysanthemum blended with dried ginger (T_2B_1) (5.965).

By the 60th day of storage, shown highest score for flavour butterfly pea (T_4) (7.367) followed by hibiscus (T_3) (6.522) while lowest score was recorded in chrysanthemum (T_2) (5.570) followed by green tea (T_5) (5.835). Among different blending materials, maximum score was noticed in dried lemongrass (B_2) (6.907) followed by dried ginger and lemongrass combination (B_3) (6.202) while minimum score was observed in dried ginger (B_1) with 5.920. As per the interactions, maximum score for flavour was recorded in butterfly pea blended with dried lemongrass (T_4B_2) (7.910) followed by hibiscus blended with dried lemongrass (T_3B_2) (7.195) however minimum score was recorded in green tea blended with ginger (T_5B_1) (5.185) followed by chrysanthemum blended with ginger (T_2B_1) (5.195).

The above results indicated maximum score for flavour was recorded in butterfly pea blended with dried lemongrass (T_4B_2). Oduro *et al*. (2013) reported similar findings, noting that higher blends of *Cymbopogon citratus* were preferred due to its high essential oil content. The decline in flavour score during storage may be attributed to the loss of volatile aromatic compounds, as also suggested by Thakur and Barwal (1998). Flavour deterioration over prolonged storage can further be explained by the sensitivity of volatile compounds to high storage temperatures, along with enzymatic degradation of phenols and oxidative changes. Comparable observations of flavour deterioration with extended

Table 3 : Effect of blending materials on colour score of dried flowers and green tea leaves at different days of storage.

Flowers & green tea leaves	Blending material (B)																			
	Days of storage																			
	0 DAYS				15 DAYS				30 DAYS				45 DAYS				60 DAYS			
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	6.740	7.730	7.615	**7.362**	6.515	7.615	7.425	**7.185**	6.330	7.565	7.340	**7.078**	6.250	7.345	7.215	**6.937**	6.105	7.205	6.975	**6.762**
T_2	5.845	6.655	5.940	**6.147**	5.615	6.560	5.760	**5.978**	5.470	6.370	5.675	**5.838**	5.335	6.245	5.620	**5.733**	5.165	6.065	5.585	**5.605**
T_3	7.520	8.770	7.785	**8.025**	7.445	8.675	7.530	**7.883**	7.100	8.575	7.330	**7.668**	7.080	8.320	7.325	**7.575**	6.965	8.075	7.100	**7.380**
T_4	8.740	8.945	8.765	**8.817**	8.495	8.840	8.520	**8.618**	8.375	8.675	8.435	**8.495**	8.185	8.485	8.270	**8.313**	8.085	8.240	8.140	**8.155**
T_5	6.625	6.880	6.590	**6.698**	6.480	6.770	6.505	**6.585**	6.345	6.605	6.375	**6.442**	6.235	6.425	6.320	**6.327**	6.060	6.340	6.215	**6.205**
Means	**7.094**	**7.796**	**7.339**	***7.409***	**6.910**	**7.692**	**7.148**	***7.250***	**6.724**	**7.558**	**7.031**	***7.104***	**6.617**	**7.364**	**6.950**	***6.977***	**6.476**	**7.185**	**6.803**	***6.821***

Factor	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B
SEm±	0.052	0.040	0.090	0.073	0.056	0.126	0.066	0.051	0.114	0.068	0.053	0.118	0.077	0.060	0.134
CD@5%	0.157	0.122	0.272	0.219	0.169	0.379	0.199	0.154	0.344	0.205	0.159	0.355	0.233	0.181	0.404

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending materials (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger & lemongrass

Table 4 : Effect of blending material on flavour score of dried flowers and green tea leaves at different days of storage.

Flowers & green tea leaves	Blending material (B)																			
	Days of storage																			
	0 DAYS				15 DAYS				30 DAYS				45 DAYS				60 DAYS			
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	6.685	7.795	6.980	**7.153**	6.565	7.575	6.755	**6.965**	6.370	7.385	6.465	**6.740**	6.140	7.195	6.385	**6.573**	5.910	7.075	6.280	**6.422**
T_2	5.965	6.770	6.065	**6.267**	5.755	6.575	5.920	**6.083**	5.635	6.315	5.650	**5.867**	5.390	6.185	5.445	**5.673**	5.195	6.040	5.475	**5.570**
T_3	7.165	7.880	7.395	**7.480**	6.595	7.760	6.745	**7.033**	6.435	7.600	6.605	**6.880**	6.230	7.275	6.435	**6.647**	6.145	7.195	6.225	**6.522**
T_4	7.725	8.765	7.865	**8.118**	7.465	8.630	7.625	**7.907**	7.415	8.400	7.455	**7.757**	7.190	8.350	7.230	**7.590**	7.165	7.910	7.025	**7.367**
T_5	5.885	6.995	6.615	**6.498**	5.740	6.805	6.520	**6.355**	5.400	6.530	6.280	**6.070**	5.285	6.515	6.230	**6.010**	5.185	6.315	6.005	**5.835**
Means	**6.685**	**7.641**	**6.984**	***7.103***	**6.424**	**7.469**	**6.713**	***6.869***	**6.251**	**7.246**	**6.491**	***6.663***	**6.047**	**7.104**	**6.345**	***6.499***	**5.920**	**6.907**	**6.202**	***6.343***

Factor	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B
SEm±	0.055	0.042	0.095	0.061	0.047	0.105	0.058	0.045	0.100	0.065	0.050	0.112	0.059	0.046	0.103
CD@5%	0.165	0.128	0.285	0.183	0.142	0.317	0.174	0.135	0.302	0.195	0.151	0.338	0.178	0.138	0.309

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending materials (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger & lemongrass

Table 5 : Effect of blending materials on taste score of dried flowers and green tea leaves at different days of storage.

Flowers & green tea leaves	Blending material (B)																			
	Days of storage																			
	0 DAYS				15 DAYS				30 DAYS				45 DAYS				60 DAYS			
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	7.605	8.345	7.830	**7.927**	7.515	8.125	7.615	**7.752**	7.425	7.910	7.510	**7.615**	7.230	7.765	7.320	**7.438**	7.070	7.440	7.245	**7.252**
T_2	6.905	7.915	7.615	**7.478**	6.740	7.750	7.495	**7.328**	6.515	7.480	7.345	**7.113**	6.340	7.250	7.125	**6.905**	6.220	6.985	6.760	**6.655**
T_3	8.320	8.840	8.525	**8.562**	8.125	8.715	8.345	**8.395**	7.905	8.560	8.120	**8.195**	7.735	8.350	7.915	**8.000**	7.445	8.000	7.615	**7.687**
T_4	8.655	9.000	8.800	**8.818**	8.500	8.865	8.770	**8.712**	8.320	8.720	8.575	**8.538**	8.140	8.545	8.385	**8.357**	7.870	8.355	8.000	**8.075**
T_5	7.110	7.615	7.485	**7.403**	6.845	7.525	7.350	**7.240**	6.630	7.240	6.925	**6.932**	6.545	7.025	6.730	**6.767**	6.205	6.870	6.515	**6.530**
Means	**7.719**	**8.343**	**8.051**	***8.038***	**7.545**	**8.196**	**7.915**	***7.885***	**7.359**	**7.982**	**7.695**	***7.679***	**7.198**	**7.787**	**7.495**	***7.493***	**6.962**	**7.530**	**7.227**	***7.240***

Factor	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B
SEm±	0.035	0.027	0.061	0.054	0.042	0.093	0.047	0.036	0.081	0.053	0.041	0.092	0.028	0.021	0.048
CD@5%	0.106	0.082	0.184	0.162	0.125	0.280	0.140	0.109	0.243	0.160	0.124	0.277	0.084	0.065	0.145

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending material (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger & lemongrass

Table 6 : Effect of blending materials on viscosity score of dried flowers and green tea leaves at different days of storage.

Flowers & green tea leaves	Blending material (B)																			
	Days of storage																			
	0 DAYS				15 DAYS				30 DAYS				45 DAYS				60 DAYS			
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	7.520	7.125	7.715	**7.453**	7.430	7.000	7.550	**7.327**	7.330	6.930	7.455	**7.238**	7.140	6.730	7.225	**7.032**	6.915	6.540	7.050	**6.835**
T_2	6.555	6.325	6.705	**6.528**	6.460	6.275	6.645	**6.460**	6.340	6.200	6.535	**6.358**	6.165	6.050	6.340	**6.185**	5.970	5.940	6.125	**6.012**
T_3	8.715	8.320	8.850	**8.628**	8.655	8.230	8.800	**8.562**	8.530	8.140	8.705	**8.458**	8.330	7.910	8.545	**8.262**	8.120	7.720	8.355	**8.065**
T_4	7.715	8.125	8.515	**8.118**	7.635	8.000	8.400	**8.012**	7.555	7.875	8.330	**7.920**	7.375	7.720	8.245	**7.780**	7.105	7.510	8.000	**7.538**
T_5	5.545	5.265	5.740	**5.517**	5.480	5.370	5.645	**5.498**	5.340	5.320	5.505	**5.388**	5.230	5.050	5.330	**5.203**	5.115	4.840	5.120	**5.025**
Means	**7.210**	**7.032**	**7.505**	***7.249***	**7.132**	**6.975**	**7.408**	***7.172***	**7.019**	**6.893**	**7.306**	***7.073***	**6.848**	**6.692**	**7.137**	***6.892***	**6.645**	**6.510**	**6.930**	***6.695***

Factor	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B
SEm±	0.064	0.050	0.111	0.018	0.014	0.031	0.061	0.047	0.105	0.069	0.054	0.120	0.074	0.057	0.128
CD@5%	0.193	0.150	0.334	0.053	0.041	0.092	0.183	0.142	0.317	0.209	0.162	0.362	0.223	0.172	0.386

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending materials (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger & lemongrass.

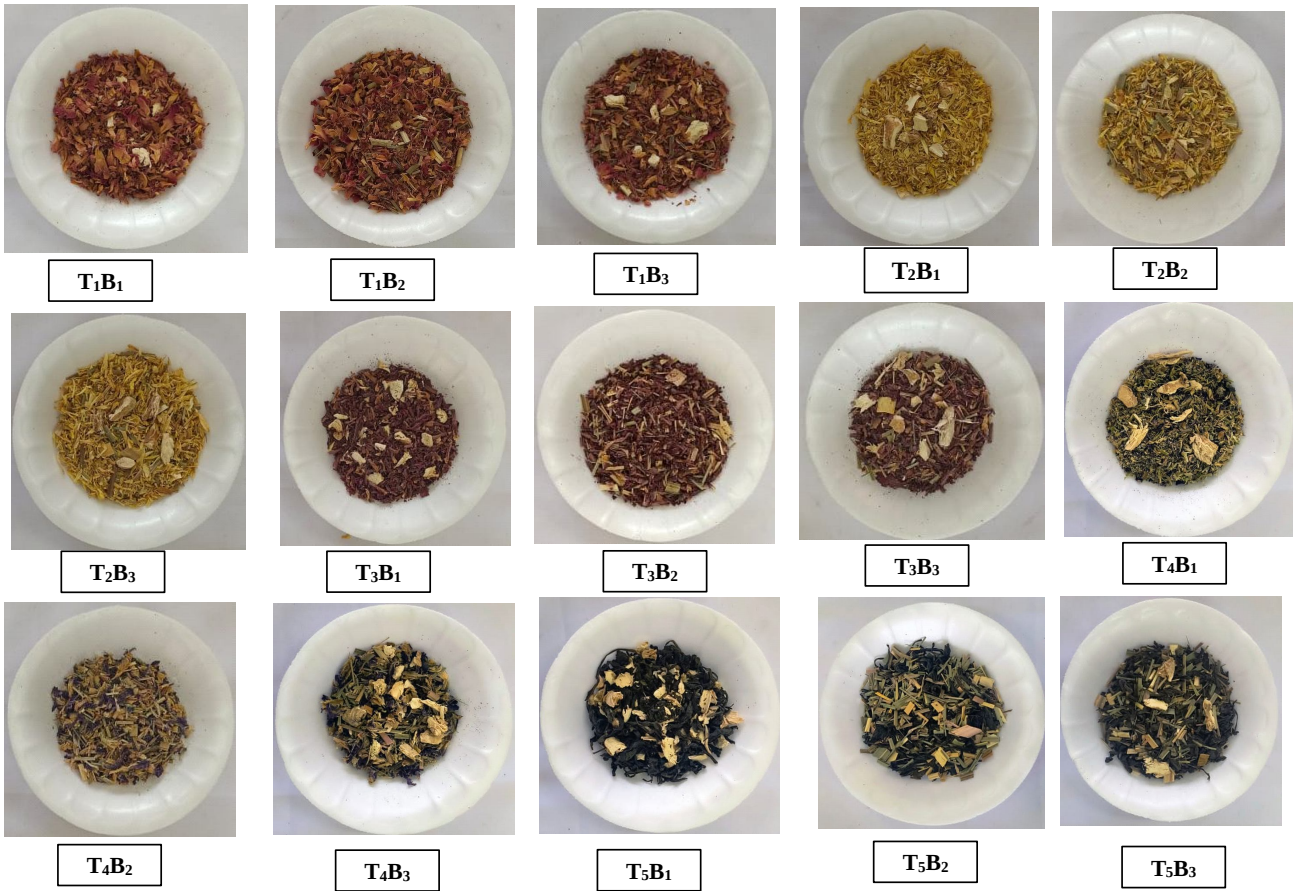

Plate 1 : Blends of flowers with dried ginger, lemongrass and ginger–lemongrass combination.

storage were reported by Aggarwal and Kaur (2017) in rose extract incorporated into various value-added products and by-products.

Taste

Mean acceptability scores for taste decreased during storage from initial to 60 days after storage.

The data revealed that butterfly pea flowers (T_4) exhibited highest score (8.818) followed by hibiscus (T_3) (8.562) whereas minimum score was recorded in green tea (T_5) (7.403) followed by chrysanthemum (T_2) (7.478). Among blending materials, dried lemongrass (B_2) shown highest score (8.343) followed by dried ginger and lemongrass combination (B_3) (8.051) while minimum score was recorded in dried ginger (B_1) with 7.719. The interaction between flowers and blending materials, maximum score was obtained from butterfly pea flowers blended with dried lemon grass(T_4B_2) (9.000), which is on par with hibiscus blended with dried lemongrass (T_3B_2) (8.800) whereas minimum score was recorded in chrysanthemum blended with ginger (T_2B_1) (6.905) followed by green tea blended with ginger (T_5B_1) (7.110) at initial day of storage.

By the 60th day of storage, butterfly pea (T_4) shown highest score for taste (8.075) followed by hibiscus (T_3) (7.687) while lowest score was recorded in green tea (T_5) (6.530) followed by chrysanthemum (T_2) (6.655). Among different blending materials, maximum score for taste was noticed in dried lemongrass (B_2) (7.530) followed by dried ginger and lemongrass combination (B_3) (7.227), while minimum score was observed in dried ginger (B_1) with 6.962. As per the interactions, highest score for taste was recorded in butterfly pea blended with dried lemongrass (T_4B_2) (8.355) followed by butterfly pea blended with ginger and lemongrass combination (T_4B_3) (8.000) and hibiscus blended with dried lemongrass (T_3B_2) (8.000) however minimum score was recorded in chrysanthemum blended with dried ginger (T_2B_1) (6.220) followed by green tea blended with dried ginger (T_5B_1) (6.205).

The above results pointed to the fact that highest score for taste was recorded in butterfly pea blended with dried lemongrass (T_4B_2). The infusion of lemongrass imparts an aromatic drink with a characteristic lemon flavour (Figueirinha *et al.*, 2008), which likely contributed to its higher score. The reduced astringency of this blend might have also enhanced its overall taste profile, leading to higher preference, as similarly reported by Moodley *et*

Table 7 : Effect of blending materials on overall acceptability score of dried flowers and green tea leaves at different days of storage.

Flowers & green tea leaves	Blending material (B)																					
	Days of storage																					
	0 DAYS				15 DAYS				30 DAYS				45 DAYS				60 DAYS					
	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means	B_1	B_2	B_3	Means
T_1	7.620	8.380	7.860	**7.953**	7.425	8.000	7.535	**7.653**	7.290	7.935	7.415	**7.547**	7.175	7.845	7.210	**7.410**	7.000	7.635	6.900	**7.178**
T_2	6.985	7.945	7.615	**7.515**	6.645	7.625	7.240	**7.170**	6.555	7.510	7.155	**7.073**	6.360	7.430	7.040	**6.943**	6.255	7.225	6.820	**6.767**
T_3	8.330	8.825	8.520	**8.558**	8.065	8.585	8.200	**8.283**	7.790	8.435	8.090	**8.105**	7.735	8.375	7.995	**8.035**	7.600	8.110	7.660	**7.790**
T_4	8.530	9.000	8.840	**8.790**	8.320	8.740	8.765	**8.608**	8.170	8.610	8.490	**8.423**	7.995	8.430	8.415	**8.280**	7.920	8.320	8.135	**8.125**
T_5	7.145	7.625	7.340	**7.370**	6.935	7.455	7.140	**7.177**	6.840	7.235	7.020	**7.032**	6.595	6.990	6.870	**6.818**	6.385	6.765	6.710	**6.620**
Means	**7.722**	**8.355**	**8.035**	***8.037***	**7.478**	**8.081**	**7.776**	***5.556***	**7.329**	**7.945**	**7.634**	***7.636***	**7.172**	**7.814**	**7.506**	***7.497***	**7.032**	**7.611**	**7.245**	***7.296***

Factor	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B	T	B	T x B
SEm±	0.045	0.035	0.078	0.038	0.029	0.066	0.045	0.035	0.078	0.056	0.043	0.097	0.056	0.043	0.096
CD@5%	0.136	0.105	0.235	0.115	0.089	0.198	0.135	0.105	0.234	0.169	0.131	0.293	0.167	0.130	0.290

Best treatments obtained from first experiment (T): T_1 – Rose; T_2 – Chrysanthemum; T_3 – Hibiscus; T_4 – Butterfly pea; T_5 – Green tea
Blending materials (B): B_1 – Dried ginger; B_2 – Dried lemongrass; B_3 – Dried ginger & lemongrass.

al. (2015). Similar results were recorded by Sruthi *et al*. (2024) in blended rose tea.

Viscosity

The mean acceptability scores for viscosity of the blended floral teas are decreased from the initial day storage to 60 days after storage.

During initial days, among flowers maximum score for viscosity was recorded in hibiscus (T_3) (8.628) followed by butterfly pea (T_4) (8.118) whereas minimum score was recorded in green tea (T_5) (5.517) followed by chrysanthemum (T_2) with 6.528. Among blending materials highest score for viscosity was observed in dried ginger and lemongrass combination (B_3) (7.505) followed by dried ginger (B_1) (7.210) whereas lowest score was observed in dried lemongrass (B_2) (7.032). Among the interactions, maximum score for viscosity was observed in hibiscus blended with dried ginger and lemongrass (T_3B_3) with 8.850 which is on par with hibiscus blended with ginger (T_3B_1) (8.715) while minimum score was observed in green tea blended with dried lemongrass (T_5B_2) (5.265) followed by green tea blended with dried ginger (T_5B_1) with 5.545.

The highest score for viscosity was observed in hibiscus (T_3) (8.065) followed by butterfly pea (T_4) (7.538) whereas lowest score was observed in green tea (T_5) (5.025) followed chrysanthemum (T_2) (6.012). Among blending materials, maximum score was noticed in dried ginger and lemongrass combination (B_3) (6.930) followed by dried ginger (B_1) (6.645) while minimum score was observed in dried lemongrass (B_2) (6.510). The interaction between different dried flowers and blending materials were found significant. The maximum score for viscosity was observed in hibiscus blended with dried ginger and lemongrass (T_3B_3) (8.355) which was on par with hibiscus blended with dried ginger (T_3B_1) (8.120) and butterfly pea blended with dried ginger and lemongrass (T_4B_3) (8.000) while minimum score was recorded in green tea blended with dried lemongrass (T_5B_2) (4.840) followed by green tea blended with ginger (T_5B_1) (5.115) at 60th day of storage.

Overall acceptability

The average score for the overall acceptability of the blended floral tea powder was decreased gradually from the initial day of storage to 60 days after storage.

The data revealed that different flowers and blending materials had significant effect on overall acceptability. Among the flowers butterfly pea (T_4) recorded maximum score (8.790) followed by hibiscus (T_3) with 8.558 whereas minimum score was observed in green tea (T_5)

(7.370) followed by chrysanthemum (T_2) (7.515). Among the blending materials, maximum score for overall acceptability was exhibited in dried lemongrass (B_2) with 8.355 followed by dried ginger and lemongrass combination (B_3) (8.035) while minimum score was recorded in dried ginger (B_1) (7.722). Among interactions, maximum score was recorded in butterfly pea flowers blended with dried lemongrass (T_4B_2) (9.000) which is on par with butterfly pea blended with dried ginger and lemongrass (T_4B_3) (8.840) and hibiscus blended with dried lemongrass (T_3B_2) (8.825) while minimum score was noticed in chrysanthemum blended with dried ginger (T_2B_1) (6.985) followed by green tea blended with dried ginger (T_5B_1) with 7.145.

By the 60th day of storage, butterfly pea (T_4) shown highest score for overall acceptability (8.125) followed by hibiscus (T_3) (7.790) while lowest score was recorded in green tea (T_5) (6.620) followed by chrysanthemum (T_2) (6.767). Among different blending materials, maximum score for overall acceptability was noticed in dried lemongrass (B_2) (7.611) followed by dried ginger and lemongrass combination (B_3) (7.245) while minimum score was observed in dried ginger (B_1) with 7.032. As per the interactions, highest score for overall acceptability was recorded in butterfly pea blended with dried ginger and lemongrass (T_4B_3) (8.320) which was on par with butterfly pea blended with lemongrass (T_4B_2) (8.135) and hibiscus blended with dried lemongrass combination (T_3B_2) (8.110) however minimum score was recorded in chrysanthemum blended with dried ginger (T_2B_1) (6.255) followed by green tea blended with dried ginger (T_5B_1) with 6.385.

From the above data, it could be concluded that highest score for overall acceptability was recorded in butterfly pea blended with dried ginger and lemongrass (T_4B_3). These findings are in agreement with Vinokur *et al*. (2006), who also reported higher consumer preference for blends with complementary flavours. The decline in overall acceptability with prolonged storage can be attributed to the gradual deterioration of sensory attributes such as colour, flavour, taste and viscosity, all of which directly influence consumer perception. Similar results were observed by Amol *et al*. (2022) in hibiscus and rose tea.

Conclusion

Highest antioxidant activity was observed in rose blended with dried ginger and lemongrass whereas highest anthocyanin was observed in hibiscus blended with dried lemongrass while highest scores for colour, flavour, taste and overall acceptability were noticed in butterfly pea flowers blended with dried lemongrass and lowest microbial count was noticed in green tea blended with dried ginger and lemongrass combination.

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