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Studies on guava leaf based herbal tea

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Abstract
The present investigation entitled "Studies on guava leaf based herbal tea" was conducted at Post Harvest Technology, College of Horticulture, Dr. Y.S.R Horticultural University, AP in a Completely Randomized Factorial Design with two factors at unequal levels and replicated thrice. Guava leaves, lemon grass, mint leaves, moringa leaves, tulsi leaves and curry leaves are dried using cabinet tray dryer. These dried powders are made into different blends in different proportions and green tea used as control. The physico-chemical parameters of the guava leaf based herbal tea powder was evaluated at monthly intervals up to 90 days of storage period. The treatment combination (T_9) 50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder performed well in terms of phenol content (111.90 mg GAE g^{-1}), antioxidant activity (90.33%) whereas (T_{10}) 100% guava leaf powder (121.37 mg 100 g-1) recorded the highest ascorbic acid content.

Keywords: Guava tea blends, lemon grass, mint, moringa, tulsi, curry leaves

Introduction
Tea (hot water infusion of *Camellia sinensis* L.) is one of the Chinese herbs mentioned in ancient literature. Tea is supposedly originated in China, and was discovered to be an antidote for poisonous herbs by a great herbalist, Shen Nong, about 4700 years ago, when tasting unknown herbs to find plants with medicinal value. Tea is one of the world's oldest beverages and its consumption dates back almost 5,000 years. Tea is the second most extensively consumed beverage in the world stated by Mukhopadyay *et al*. (2012) [4].
Guava leaf extract powder mainly contains flavonoids mainly from quercetin that gets hydrolyzed in the body which gives a glyconequercetine that is responsible for spasmolytic activity of the leaves. It also protects from intestinal movement and reduces capillary permeability in the abdominal cavity.
The nutritional value of drumstick dry leaves include protein 5.27 g 100 g^{-1}, carbohydrates 11.15 g 100 g^{-1}, iron 2.32 mg 100 g^{-1}, calcium 151 mg 100 g^{-1}, ascorbic acid 31 mg 100 g^{-1}, vitamin A 7013 IU. Drumstick is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when the other foods are typically scarce stated by Woods *et al*. (1994) [8].
Lemongrass gives approximately 22.2 calories along with 4.59 g protein, 0.96 g sugar and 1.80 mg ascorbic acid per 100 g of powder. It is mainly grown for its fragrant leaves and stalks which are use as a flavouring agent.
Peppermint leaves (fresh and dried) are used in many food, cosmetic and pharmaceutical dried peppermint typically has volatile oil containing menthol, menthone, menthyl acetate, menthofuran and 1,8-cineol.
Curry leaves (*Murraya koenigii*) are leafy vegetable of rutaceae family. Pharmacological functions of plants, such as cardiovascular activity, reducing properties of anti-diabetic and cholesterol, antimicrobial activity, antioxidant properties, anti-diarrheal activity. It is rich in vitamins A, B, C, calcium and iron in plenty Singh *et al*. (2014) [6].
Tulsi (*Ocimum sanctum* L. synonymously *Ocimum tenuiflorum* L.) also referred to as holy basil, the queen of herbs, mother medicine of nature, elixir of life. Traditionally tulsi leaves are used for the preparation of cosmetics, perfumeries and teas.

Material and Methods
The present investigation entitled "Studies on guava leaf based herbal tea" was carried out during January 2022 to April 2022 at Post Harvest Laboratory, College of Horticulture, Dr.

Y.S.R Horticultural University, Venkataramannagudem. The experiment was conducted in Completely Randomized Factorial Design with two factors at unequal levels and replicated thrice. The guava leaves, lemon grass, mint, moringa leaves, tulsi leaves, curry leaves used for the experimental studies. The guava leaves, lemon grass, mint, moringa leaves, tulsi leaves, curry leaves were harvested from the plants. The twigs were first separated from the stem, and then leaves were stripped of the branches and taken for dehydration. These leaves were dried by using cabinet tray dryer. Objectives studied during this research work are a) To study the effect of different blends of guava leaf powder with moringa leaf powder, lemon grass, mint, basil, curry leaves. b) To study the physico chemical and organoleptic quality of guava leaf based herbal tea. Observations were recorded on physico-chemical parameters like phenol content (mg GAE g^{-1}) antioxidants (% DPPH) and ascorbic acid (mg 100 g^{-1}) from initial day of storage to 90 days of storage.

Results and Discussion

Phenol content (mg GAE g^{-1})

The data related to the phenolic content of guava leaf based herbal tea powder at 0, 30, 60, 90 days of storage under ambient conditions are presented in table 1.

Data revealed that mean phenolic content steadily decreased from initial day (89.01) to 90 days after storage (79.50 mg GAE g^{-1}). Among the various treatment combinations there was significant difference in the phenolic content was observed. Significantly highest phenolic content (111.90 mg GAE g^{-1}) was recorded in T_9 (50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder. The lowest phenolic content (69.92 mg GAE g^{-1}) was observed in T_5 (50% guava leaf powder + 30% lemon grass + 10% mint powder + 5% basil leaf powder + 5% curry leaf powder). Significant difference in the phenolic content between interactions was observed during all the days of storage. On the initial day of storage T_9 (50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder) recorded the highest phenolic content with value of (117.79 mg GAE g^{-1}). The lowest phenolic content (73.17 mg GAE g^{-1}) was recorded in T_5 (50% guava leaf powder + 30% lemon grass + 10% mint powder + 5% basil leaf powder + 5% curry leaf powder). Similar trend was observed during rest of the days i.e. 30, 60 days of storage. On the 90th day of storage highest phenolic content (105.72 mg GAE g^{-1}) was observed in T_9 (50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder). The lowest phenolic content (67.44) was observed in T_5 (50% guava leaf powder + 30% lemon grass + 10% mint powder + 5% basil leaf powder + 5% curry leaf powder).

The highest phenolic content was recorded in T_9 (50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder) which may be due to high phenol content in the curry leaf powder. There was decrease in the phenolic content during the storage period. This may be caused by the phenols being deglycosylated, polymerized or photooxidized. It may also be caused by the immobile reactants in a glassy state, at low moisture content and water activity during the storage, and those conditions increased during the storage, the mobility of reactants also increased, causing them to react with the phenols and breakdown them. The findings showed that phenolic content of the green tea (control) was lower when compared to the combination of herbal tea. Where as in other tea combination, the presence of moringa leaves, curry leaves, guava leaves, basil leaves, lemon grass and mint which cause the tannins to breakdown into basic phenolic compounds. The antioxidant activity is brought about by the total phenol concentration. Similar results were shown by Ubashana *et al.* (2020) [7].

Table 1: Effect of different blends on phenols (mg GAE g^{-1}) of guava leaf based herbal tea powder

Treatments	Days				Means for Treatments
	0	30	60	90	
T_1 (50% GLP + 10% LG + 25% MP + 5% MLP + 5% BLP + 5% CLP)	87.58	82.09	79.15	77.08	81.48
T_2 (50% GLP + 15% LG + 20% MP + 5% MLP + 5% BLP + 5% CLP)	85.20	81.26	79.48	76.46	80.60
T_3 (50% GLP + 20% LG + 15% MP + 5% MLP + 5% BLP + 5% CLP)	80.13	77.87	79.02	72.70	77.43
T_4 (50% GLP + 25% LG + 10% MP + 5% MLP + 5% BLP + 5% CLP)	79.78	77.30	75.16	72.25	76.12
T_5 (50% GLP + 30% LG + 10% MP + 5% BLP + 5% CLP)	73.17	70.96	68.13	67.44	69.92
T_6 (50% GLP + 10% LG + 30% MP + 5% MLP + 5% CLP)	85.46	81.52	79.76	77.02	80.94
T_7 (50% GLP + 20% LG + 20% MP + 10% CLP)	87.00	84.36	81.98	77.61	82.74
T_8 (50% GLP + 15% LG + 15% MP + 5% MLP + 15% CLP)	101.43	96.87	95.25	85.69	94.81
T_9 (50% GLP + 10% LG + 10% MP + 5% MLP + 5% BLP + 20% CLP)	117.79	114.28	109.80	105.72	111.90
T_{10} (100% GLP)	88.08	85.26	84.40	80.09	84.46
T_{11} (100% GT)	93.52	91.30	85.76	82.48	88.27
Means for Days	89.01	85.73	83.44	79.50	
Factors	SEM±		C.D.@5%		
Days	0.347		0.974		
Treatments	0.575		1.615		
Days Vs. Treatments	1.150		3.231		

GLP: Guava leaf powder LG: Lemongrass MP: Mint powder CLF: Curry leaf powder BLP: Basil leaf powder MLP: Moringa leaf powder GT: Green tea

Antioxidants (% DPPH activity)

The data pertaining to the antioxidant content of the guava leaf based herbal tea powder at 0, 30, 60, 90 days of storage under ambient conditions are represented in the table 2.

Results noticed that the mean antioxidant content decreased gradually from the initial day of storage (92.77%) to (82.61%) on the 90 days after storage. Significant difference among different treatment combinations in the antioxidant content

was observed. Significantly higher antioxidant content (90.33%) was noticed in T_9 (50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder). Lowest antioxidant content (85.23%) was recorded in T_5 (50% guava leaf powder + 30% lemon grass + 10% mint powder + 5% basil leaf powder + 5% curry leaf powder). Among the interactions significant difference in the antioxidant content was noticed during all the days of storage. On the initial day of storage, highest antioxidant content (95.72%) was noticed in T_9 (50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder). Least antioxidant content (90.61%) was recorded in T_5 (50% guava leaf powder + 30% lemon grass + 10% mint powder + 5% basil leaf powder + 5% curry leaf powder). Similar trend was observed during the remaining days of storage i.e. 30, 60, 90 days of storage.

Irrespective of the treatments, there was a significant decrease in antioxidant activity during the storage period Naithani *et al.* (2006) [5]. This may be as a result of oxygen being absorbed into package through the packing material and oxidizing the antioxidants. According to research hebal tea combination have greater antioxidant content than green tea due to the presence of different leaves which possed high antioxidant activity. Similar results shown by ubashana *et al.* (2020) [7].

Table 2: Effect of different blends on antioxidants (% DPPH activity) of guava leaf based herbal tea powder

Treatments	Days				Means for Treatments
	0	30	60	90	
T_1 (50% GLP + 10% LG + 25% MP + 5% MLP + 5% BLP + 5% CLP)	93.43 (9.71)	89.31 (9.50)	85.97 (9.32)	83.30 (9.18)	88.00 (9.43)
T_2 (50% GLP + 15% LG + 20% MP + 5% MLP + 5% BLP + 5% CLP)	93.35 (9.71)	89.22 (9.49)	86.08 (9.33)	83.20 (9.17)	87.96 (9.43)
T_3 (50% GLP + 20% LG + 15% MP + 5% MLP + 5% BLP + 5% CLP)	91.10 (9.59)	87.92 (9.43)	83.29 (9.18)	80.93 (9.05)	85.81 (9.31)
T_4 (50% GLP + 25% LG + 10% MP + 5% MLP + 5% BLP + 5% CLP)	91.14 (9.59)	87.02 (9.38)	83.88 (9.21)	81.00 (9.05)	85.76 (9.31)
T_5 (50% GLP + 30% LG + 10% MP + 5% BLP + 5% CLP)	90.61 (9.57)	86.50 (9.35)	83.35 (9.18)	80.48 (9.02)	85.23 (9.28)
T_6 (50% GLP + 10% LG + 30% MP + 5% MLP + 5% CLP)	92.59 (9.67)	88.47 (9.45)	85.31 (9.29)	82.45 (9.13)	87.21 (9.39)
T_7 (50% GLP + 20% LG + 20% MP + 10% CLP)	92.51 (9.67)	88.36 (9.45)	85.24 (9.28)	82.39 (9.13)	87.13 (9.38)
T_8 (50% GLP + 15% LG + 15% MP + 5% MLP + 15% CLP)	94.45 (9.77)	90.32 (9.55)	87.17 (9.39)	84.29 (9.23)	89.06 (9.48)
T_9 (50% GLP + 10% LG + 10% MP + 5% MLP + 5% BLP + 20% CLP)	95.72 (9.83)	91.55 (9.62)	88.48 (9.45)	85.56 (9.30)	90.33 (9.55)
T_{10} (100% GLP)	91.85 (9.63)	87.66 (9.41)	84.52 (9.24)	81.69 (9.09)	86.43 (9.34)
T_{11} (100% GT)	93.69 (9.73)	89.46 (9.51)	86.34 (9.34)	83.47 (9.19)	88.24 (9.44)
Means for Days	92.77 (9.68)	88.71 (9.47)	85.42 (9.29)	82.61 (9.14)	
Factors	SEM±				C.D.@5%
Days	0.0003				0.001
Treatments	0.001				0.002
Days Vs. Treatments	0.001				0.004

GLP: Guava leaf powder LG: Lemongrass MP: Mint powder CLF: Curry leaf powder BLP: Basil leaf powder MLP: Moringa leaf powder GT: Green tea

Note: Values in parenthesis are square root transformed values

Ascorbic acid (mg 100 g^{-1})

The data related to the ascorbic acid (mg 100 g^{-1}) of guava leaf based herbal tea powder at 0, 30, 60, 90 days of storage under ambient conditions are presented in table 3.

Statistics showed that mean ascorbic acid content decreased steadily from initial day of storage (100.19 mg 100 g^{-1}) to 90 days after storage (87.45 mg 100 g^{-1}). Significant difference in the ascorbic acid content among different treatment combinations was observed. Among the different treatment combinations, significantly higher ascorbic acid (121.37 mg 100 g^{-1}) content was observed in T_{10} (100% guava leaf powder). The lowest ascorbic acid content (13.71 mg 100 g^{-1}) was recorded in control T_{11} (100% green tea). Significant differences in the ascorbic acid content between interactions was observed during all the days of storage. On the initial day of storage, highest ascorbic acid (126.25 mg 100 g^{-1}) content was recorded in T_{10} (100% guava leaf powder). The lowest ascorbic acid (15.58 mg 100 g^{-1}) content was observed in control T_{11} (100% green tea). Similar trend was observed during remaining days i.e. 30 days, 60 days, 90 days after storage.

Irrespective of the treatments ascorbic acid decreased during the storage period. Similar results are reported by Klu *et al.* (2016) [3] and Adejumo *et al.* (2018) [1]. In general ascorbic acid is lost during storage as a result of residual air trapped in the packaging material oxidizing it, or it might be attributed to non enzymatic anaerobic process. The irreversible conversion of L-ascorbic acid into dehydro ascorbic acid is another potential cause for ascorbic acid content decrease during storage. Brocle *et al.* (1998) [2]. Highest amount of ascorbic acid content (121.37) was found in 100% guava leaf powder (T_{10}) which may be due to the high ascorbic acid content in

fresh leaves and dehydrated leaves.

Table 3: Effect of different blends on Ascorbic acid (mg 100 g^{-1}) of guava leaf based herbal tea powder

Treatments	Days				Means for Treatments
	0	30	60	90	
T_1 (50% GLP + 10% LG + 25% MP + 5% MLP + 5% BLP + 5% CLP)	116.22	112.04	106.80	105.22	110.07
T_2 (50% GLP + 15% LG + 20% MP + 5% MLP + 5% BLP + 5% CLP)	112.68	105.34	102.00	97.63	104.41
T_3 (50% GLP + 20% LG + 15% MP + 5% MLP + 5% BLP + 5% CLP)	105.00	97.52	93.74	91.61	96.97
T_4 (50% GLP + 25% LG + 10% MP + 5% MLP + 5% BLP + 5% CLP)	98.00	92.84	85.65	81.41	89.48
T_5 (50% GLP + 30% LG + 10% MP + 5% BLP + 5% CLP)	98.99	93.54	86.85	82.67	90.51
T_6 (50% GLP + 10% LG + 30% MP + 5% MLP + 5% CLP)	119.07	115.97	110.22	106.03	112.82
T_7 (50% GLP + 20% LG + 20% MP + 10% CLP)	107.75	100.47	96.54	95.10	99.97
T_8 (50% GLP + 15% LG + 15% MP + 5% MLP + 15% CLP)	99.70	93.01	88.98	85.30	91.75
T_9 (50% GLP + 10% LG + 10% MP + 5% MLP + 5% BLP + 20% CLP)	102.93	95.55	91.74	90.14	95.09
T_{10} (100% GLP)	126.25	124.04	119.93	115.28	121.37
T_{11} (100% GT)	15.58	14.52	13.15	11.57	13.71
Means for Days	100.19	94.98	90.51	87.45	
Factors	SEM±		C.D.@5%		
Days	0.268		0.193		
Treatments	0.113		0.319		
Days Vs. Treatments	0.227		0.639		

GLP: Guava leaf powder LG: Lemongrass MP: Mint powder CLF: Curry leaf powder BLP: Basil leaf powder MLP: Moringa leaf powder GT: Green tea

Conclusion

Results revealed that the phenol content (mg GAE g^{-1}) antioxidants (% DPPH) and ascorbic acid (mg 100 g^{-1}) followed a decreasing trend from the day of storage to 90 days after storage. Highest phenol content and antioxidants was observed in treatment combination (T_9) 50% guava leaf powder + 10% lemon grass + 10% mint powder + 5% moringa leaf powder + 5% basil leaf powder + 20% curry leaf powder where as highest ascorbic acid content was observed in (T_{10}) 100% guava leaf powder.

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