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Standardization and Evaluation of Quality Attributes and Bioactive Components of Ginger (*Zingiber officinale* Roscoe) and Kokum (*Garcinia indica* Choisy) Based Herbal Tea

Modugu Likhitha [a++*], K. Venkata Laxmi [b#], G. Jyothi [c†], M. Sreenivas [d‡] and K. Aparna [e^]

[a] Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Telangana-502279, India.
[b] College of Horticulture Malyal, Mahabubabad Telangana, India.
[c] Horticultural Research Station, Konda Mallepally, Nalgonda, Telangana, India.
[d] College of Horticulture, Rajendranagar, Hyderabad, Telangana, India.
[e] MFPI Quality Control Laboratory, PJTSAU, Rajendranagar, Hyderabad, Telangana, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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[++] PG Scholar;
[#] Associate Professor;
[†] Scientist (Horti.);
[‡] Assistant Professor (Horti.),
^ principal scientist and head;
**Corresponding author: E-mail: modugulikhitha@gmail.com;*

ABSTRACT

The present investigation entitled “Standardization and evaluation of quality attributes and bioactive components of Ginger (*Zingiber officinale* Roscoe) and Kokum (*Garcinia indica* Choisy) based herbal tea” was carried out in the Central Instrumentation Laboratory, College of Horticulture, Rajendranagar, Hyderabad. The experiment was carried out with Completely Randomized Design (CRD) with two experiments, experiment-I consists of 7 treatments and three replications. and experiment -II consists of 8 treatments and 3 replications. Tea bags of 3.5grams will be prepared as per the treatments and Standard cup volume of 100 ml is considered for study. The results revealed that the treatment combination of ginger -kokum mix (first best T_7 Dry ginger powder 90 % + Dry Kokum powder 10 %), second best -T_3 (Dry ginger powder 50 % + Dry kokum powder 50 %) based on organoleptic evaluation were selected from experiment one and proceeded to experiment two for evaluation of ginger kokum based herbal tea. The results related to physico-chemical parameters and organoleptic evaluation indicated that, among the different herbal teas, the treatment T_3 (First best -90 %+ Cardamom -10 %) recorded best with pH (4.54) of 0th day, T_2 (Second Best -100 % - Control) recorded highest titratable acidity (4.02 %) of 60th day, T_2 (Second Best -100 %) recorded best with Ascorbic acid (1.32 mg/100 g) of 0th day. T_4 (First best 90 % +Turmeric -10 %) at 0th day found to be best with total Phenol content (88.95 mg GAE/g). The maximum organoleptic score for overall acceptability (8.47) was in “Like very much range” on nine-point hedonic scale which is recorded in treatment T_4: (First best-90 % +Tulasi-10 %) at the end of storage period. it can be concluded that T_4-(First best -90 % + Tulasi - 10%) and T_8 (Second best 90 % + Turmeric -10%) are best two standardized herbal teas from this research work.

Keywords: pH; tritable acidity (%); ascorbic acid content (mg /100 g); total phenols; organoleptic evaluation.

1. INTRODUCTION

Herbal tea one of the most traditional and calming herbal medicines. Herbal tea is an infusion created from herbs rather than tea bush leaves; it is an extract made from a variety of dried seeds, leaves, barks, flowers, fruits, nuts, and roots that have varied medicinal characteristics. Herbal teas are inherently caffeine-free, which is why they are more popular than other varieties of tea because they do not even have a trace of caffeine. Many different herbs or components are used to make herbal tea, and each one has a distinct meaning Chandrasekara and Shahidi. [1].

The Zingiberaceae family includes the therapeutic plant ginger (*Zingiber officinale* R. Ginger rhizomes are used as a spice and folk remedy for a number of illnesses. Ginger is unique in having wide range of natural components with great nutritional value. Ginger constitutes 5-6% of all spices eaten worldwide. Due to its ethnic medical properties and nutritional value, *Zingiber officinale*'s rhizome is widely utilised for both culinary and medicinal reasons worldwide Dissanayake et al. [2].

One of the significant indigenous tree spices and a member of the Clusiaceae family is kokum (*Garcinia indica* Choisy.). The kokum fruit is either dark purple or scarlet with golden undertones when it is fully mature. Kokum fruit rind, and seeds have a variety of uses in the food and beverage industry as well as in manufacturing medicines. Kokum has palatable flavour with a sweet acidic (sour) taste, making it a well-liked culinary addition Swami et al. [3].

Different bioactive chemicals found in kokum fruit have anti-inflammatory, antibacterial, and antioxidant activities. Furthermore, kokum demonstrates anti-inflammatory effects. Anthocyanins, hydroxycitric acid, and garcinol are the three main bioactive substances found in kokum, and each of them has nutraceutical characteristics. Kokum rinds contain all of these substances and have anti-cancer and anti-obesity qualities, hence useful to human health Ranveer et al. [4].

2. MATERIALS AND METHODS

The plant material utilized for conducting the experiment viz., Dry ginger powder (*Zingiber officinal* Roscoe), Kokum (*Garcinia indica* Choisy), Turmeric powder (*Curcuma longa*), Cardamom (*Elettaria cardamomum*) was procured from local market. Tulsi leaves (*Ocimum sps*) were collected from MAPRS, SKLTSHU.

2.1 Preparation of Herbal Tea

Tea bags were prepared by taking (3.5 g) of tea powder mix in each bag as per the treatments. Standard cup volume of 100 ml is considered for study.

EXPERIMENT: 1 "Standardization of ginger-kokum mix for herbal tea formulation".

TREATMENT COMBINATIONS

T_1 -Dry ginger powder – 100%
T_2 -Dry kokum powder -100 %
T_3 -Dry ginger powder -50 % +Dry kokum powder -50 %
T_4 -Dry ginger powder -60 % + Dry kokum powder - 40 %
T_5 -Dry ginger powder -70 % + Dry kokum powder - 30 %
T_6 -Dry ginger powder -80 %+ Dry kokum powder - 20 %
T_7 -Dry ginger powder -90 % + Dry kokum powder -10 %

EXPERIMENT:2 "Evaluation of ginger-kokum based herbal tea for quality and bioactive composition"

TREATMENT COMBINATIONS

T_1 - First best -100% (control)
T_2 - Second best -100% (control)
T_3 - First best - 90%+ cardamom powder - 10%
T_4 - First best - 90% + tulsi powder -10%
T_5 - First best - 90 % + turmeric powder-10%
T_6 - Second best - 90% + cardamom powder-10%
T_7 - Second best - 90% + tulsi powder-10%
T_8 - Second best - 90%+ turmeric powder - 10%

2.2 pH

The measurement of the herbal teas, pH values was made at 25^0C through a pH electrode connected to an ion analyser. 50 ml of the herbal tea was taken and the pH measured using pH meter. The readings were performed in duplicate for each sample. Lunkes and Hashizume [5].

2.3 Titratable Acidity

In the sequence of pH measurements, the samples which showed a pH value below 7.0 were submitted to titratable acidity analysis. Increments of 0.5 ml of 0.1N NaOH solution was added, in a tea volume of 50 ml, until pH 7 was reached. The volume of 0.1N NaOH solution (in millilitres) necessary to achieve a neutral solution was recorded and it corresponded to titratable acidity of each sample. The procedure was also conducted in duplicate for each sample. Lunkes and Hashizume [5].

$$\text{Amount of 0.1N NaoH used/100 ml tea} = \frac{x}{Amount\ of\ tea} \times 100$$

Where x = Amount of NaoH x Amount of tea ×100

2.4 Ascorbic Acid (mg /100g) estimation

The ascorbic acid content was determined by 2, 6-dichlorophenol indophenol visual titration method as given by Ranganna [6] and expressed in mg/100g.

2.4.1 Procedure

Ten grams of sample was blended with 3 per cent metaphosphoric acid and made up to 50 ml with 3 per cent HPO_3. The contents are filtered through Whatman No.1 filter paper. Ten milliliters of the HPO_3 extract were taken and titrated against standard 2, 6-Dichloro phenol indophenol dye to a pink end point given by Ranganna [6].

Ascorbic acid mg/100g = (Tritre value × Dye factor× Volume make up)/(Volume taken ×Weight of the sample)×100

2.5 Total Phenolic Content

The total phenol content was estimated based on Folin–Ciocalteau (FC) method (Singleton and Rossi, 1965) with some slight modifications. 0.1 ml of the aliquot was diluted with 1.4 ml of Distilled water to which 0.5 ml of Folin Ciocalteau (FC) was added and test tubes were shaken well. Then 10 ml of sodium carbonate (20 %, w/v) was added. Similarly, this process was done for 0.2,0.3,0.4 ml aliquots and sample. These solutions were mixed well and incubated at room temperature for 60 minutes. After incubation, the absorbance was measured at 760 nm. A suitable calibration curve was prepared using Gallic acid and the results are expressed in milligram per gram (mg/ g) Gallic acid equivalent. 2 g each sample was crushed in pestle and mortar with 20 ml 80 % methanol. The extract was then centrifuged at 10000 rpm at 40C for 20

minutes. The supernatant was taken for determination of total phenolic content.

Mg gallic acid Dilution equivalent per gram = (O.D x Standard curve factor x volume made up)/(Aliquot taken x wt.Of sample)

2.6 Organolepic Evaluation (9-point hedonic scale)

The tea infusions were subjected to sensory evaluation for their acceptability using 9-point hedonic scale for colour, flavour, taste, consistency, overall acceptability. Each attribute was given a separate score of 9 points. From the quality point of view, higher product scoring was treated as more acceptable. Sensory evaluation panel consisted of 10 panelists and the panelists were instructed to evaluate the sample as per hedonic scale procedure as described by Ranganna [6] in a format prepared for rating the teas as per the 9-point Hedonic scale.

List 1. 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

3. RESULTS AND DISCUSSION

The Present Investigation On “Standardization and evaluation of quality attributes and bioactive components of Ginger (*Zingiber officinale* Roscoe) and Kokum (*Garcinia indica* Choisy) based herbal tea” are discussed and presented below.

3.1 pH

Among all of the treatments T_1: (Dry ginger powder 100 %) (5.72) recorded a significantly higher value followed by T_7: (Dry ginger powder - 90 % + Dry Kokum powder - 10 %) (4.04) Whereas, a significantly lower value recorded in T_2: (Dry Kokum powder - 100 %) (2.11). A similar range of pH was reported by Ali and Rani [7]. in dried ginger paste (Table 1).

3.2 Titratable Acidity (%)

Titratable acidity of ginger-kokum mix formulations shows a significant maximum value in T_2: (Dry Kokum powder -100 %) (10.84 %) followed by T_3 (Dry ginger powder -50 % + Dry Kokum powder -50 %) (5.70 %) Whereas, significant lower value was recorded in T_7: (Dry ginger powder -90 % + Dry Kokum powder -10 %) (1.02%) (Table 1).

The maximum value was recorded in T_2 because the percentage of kokum powder composition is maximum in it. These results are in accordance with Raju [8].

3.3 Ascorbic Acid Content (mg /100 g)

Among all the treatments T_2: (Dry Kokum powder -100 %) (9.55 mg /100 g) recorded a significant maximum value followed by T_3: (Dry ginger powder -50 % + Dry Kokum powder -50 % (8.23 mg /100 g) and minimum value is recorded in T_7: (Dry ginger powder -90 % + Dry Kokum powder - 10 %) (1.08) (Table 1).

The amount of ascorbic acid is maximum in T_2 as it contains 100 % of kokum powder. These results are supported by Raju [8].

3.4 Total Phenols (mg GAE /g)

Total phenols (mg GAE/g) of ginger - kokum mix formulations show significantly maximum value recorded in T_5: (Dry ginger powder - 70 % + Dry Kokum Powder - 30 % (127.73 mg GAE /g) followed by T_4: (Dry ginger powder - 60 % + Dry Kokum powder -40 %) (119.25 mg GAE /g) and minimum value recorded in T_3: (Dry ginger powder -50 % + Dry Kokum powder -50 %) (68.84 mg GAE /g) (Table 2). A similar range of total phenols is found in ginger extracts by Stoilova et al. [9].

3.5 Organoleptic Evaluation (9-point hedonic scale)

3.5.1 Colour

Significant maximum score for colour was recorded in T_2: (Dry Kokum powder - 100 %) (8.24) followed by T_3: (Dry ginger powder -50 % + Dry Kokum powder - 50 % (7.80) and minimum score was recorded in T_1: (Dry ginger powder - 100 %) (4.75).

Experiment-1

Table 1. pH, titratable acidity, ascorbic acid content of ginger - kokum mix formulation.

Treatments	pH	Titratable acidity %	Ascorbic acid content mg/100g
T_1 Dry ginger powder -100%	5.72	0.60	1.37
T_2 Dry Kokum powder -100%	2.11	10.84	9.55
T_3 Dry ginger powder -50% + Dry Kokum powder -50%	2.92	5.70	8.23
T_4 Dry ginger powder -60% + Dry Kokum powder - 40%	3.19	4.45	5.27
T_5 Dry ginger powder -70% + Dry Kokum Powder -30%	3.47	3.17	5.72
T_6 Dry ginger powder -80% + Dry Kokum powder -20%	3.10	1.23	4.92
T_7 Dry ginger powder -90% + Dry Kokum powder -10%	4.04	1.02	1.08
S.E(m)	0.08	0.07	0.18
CD at 5%	0.26	0.22	0.56

Table 2. Total phenols of ginger - kokum mix formulation

Treatments	Phenols (mg GAE/g)
T_1 Dry ginger powder -100%	72.47
T_2 Dry Kokum powder -100%	89.18
T_3 Dry ginger powder -50% + Dry Kokum powder -50%	68.84
T_4 Dry ginger powder -60% + Dry Kokum powder - 40%	119.25
T_5 Dry ginger powder -70% + Dry Kokum Powder -30%	127.73
T_6 Dry ginger powder -80% + Dry Kokum powder -20%	83.13
T_7 Dry ginger powder -90% + Dry Kokum powder -10%	74.58
S.E(m)	0.98
CD at 5%	2.98

As the T_2: (Dry Kokum powder - 100 %) solely consists of kokum, the tea might have got brighter colour (Table 3).

3.5.2 Flavour

Maximum score for flavour was found to be in T_7: (Dry ginger powder -90 % + Dry Kokum powder - 10 %) (8.72) followed T_3: (Dry ginger powder - 50 % + Dry Kokum powder - 50 %) (8.02) and minimum was recorded in T_6: (Dry ginger powder - 80% + Dry Kokum powder -20 %) (4.09) (Table 3).

3.5.3 Taste

Significant maximum score for taste was recorded T_7: (Dry ginger powder -90 % + Dry Kokum powder -10 %) (8.59) followed T_3: (Dry ginger powder -50 % + Dry Kokum powder - 50%) (8.57) and minimum value is recorded in T_2: (Dry Kokum powder -100 %) (3.52) (Table 3).

3.5.4 Texture

Among all the treatments the T_7: (Dry ginger powder - 90 % + Dry Kokum powder -10 %) (7.73) followed by T_3: (Dry ginger powder – 50 % + Dry Kokum powder -50%) (7.56) and minimum value is recorded in T_5: (Dry ginger powder -70 % + Dry Kokum Powder -30 %) (5.27) (Table 3).

3.5.5 Overall acceptability

Among all the treatments the maximum score was recorded in T_7: (Dry ginger powder -90 % + Dry Kokum powder -10 %) (8.66) followed by T_3: (Dry ginger powder - 50 % + Dry Kokum powder -50 %) (8.17) and minimum score was seen in T_2: (Dry Kokum powder -100 %) (5.76) (Table 3).

Experiment-II “Evaluation of ginger-kokum based herbal tea for quality and bioactive composition"

Based on the physico-chemical parameters, bio-chemical parameters and organoleptic

evaluation, two best ginger-kokum mix formulations were selected for proceeding to experiment II. Observations were recorded on pH, Titrable acidity, Ascorbic acid content, total Phenols and organoleptic evaluation (9-point Hedonic scale).

3.6 pH

pH, titrable acidity and ascorbic acid content found to decrease in all the treatments during the storage period of sixty days on the 60th day of storage, pH was observed highest in T_3: (First best - 90 % + Cardamom -10 %) (4.49) and minimum was observed in T_2: (Second best - 100 % -(control) (2.83).

The pH values of herbal tea prepared from ginger and kokum decreased significantly as storage time increase. Fig. 1 and Fig. 2 will help in understanding the range of pH, titrable acidity. The decrease in pH values with storage duration might be attributed to phenolic chemicals being transformed into monomeric phenolic acid, resulting in increased ionization in an acidic environment and a lowering of pH (Table 5). A similar, decreasing range of pH was also observed by Sawale et al. [10].in Terminalia Arjuna herbal drink and Amol et al. [11]. in Hibiscus and Rose tea.

3.7 Titrable Acidity and Ascorbic Acid Content

Among all the treatments at 60th day of storage T_2: (Second best -100 %-(control) recorded maximum titrable acidity and ascorbic acid (4.02%,1.30mg/100g respectively) while minimum titrable acidity was observed in T_5: (First best - 90 % + Turmeric -10 % (1.75 %) and minimum ascorbic acid content was obtained in T_4: (First best -90 % + Tulasi -10 %) (0.30 mg /100g).

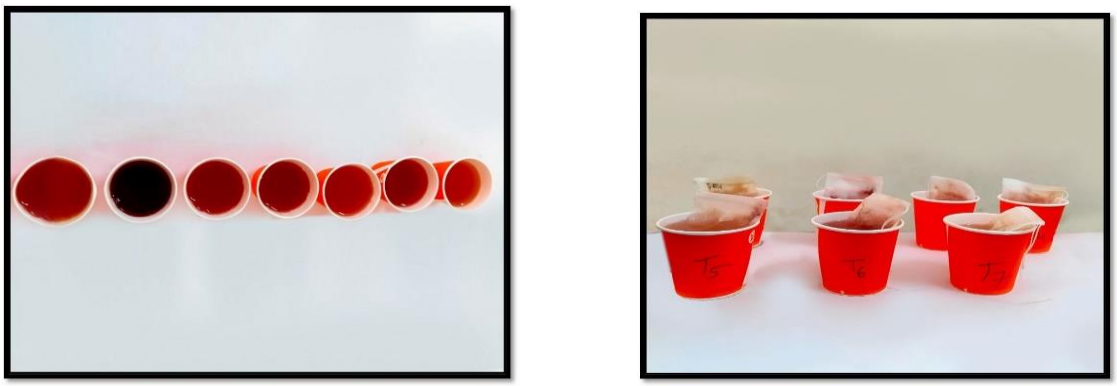
There was a considerable rise in titratable acidity values of ginger and kokum-based herbal tea with storage time. The reduction in pH and rise in acidity during storage might be the formation of acid by degradation of polysaccharides and oxidation of reducing sugars or by breakdown of pectic substances. Similar increasing trends were found in guava-lime-ginger RTS beverages during storage of 12 weeks by Hariharan et al. [12].

Ascorbic acid content decreases during the storage period of 0,30, 60 days. Fig. 3 shows the decreasing trend of ascorbic acid. The decreasing trend of ascorbic acid was found mostly due to its oxidation and a substrate in non-enzymatic browning during the storage period (Table 6). Similar readings are reported by Tayade et al. [13]. in dehydrated kasuri methi (*Trigonella corniculate* L.).

3.8 Total Phenolic Content

Total phenolic content showed decreasing trend during storage. Fig. 4 will help in studying range of phenols. Out of all treatments, T_4: (First best -90 % + Tulasi -10 %) recorded highest total phenols (87.30 mg GAE/g) and lowest was observed in T_7: (Second best 90 %+ Tulasi -10 %) (67.12 mg GAE/g) on 60th day of storage.

The storage loss of phenolic compounds is mainly because of oxidative degradation due to external environmental conditions during the storage period. Similar results were obtained by Mandez and Flaque [14].



Picture 1. Tea infusions of ginger and kokum

Picture 2. Tea infusions of ginger, kokum, cardamom, tulsi and turmeric

Table 3. Organoleptic evaluation (9-point Hedonic Scale) of ginger - kokum mix formulation

Treatments	Colour	Flavour	Taste	Consistency	Overall acceptability
T_1 Dry ginger powder -100%	6.62	6.89	6.71	7.11	6.28
T_2 Dry Kokum powder -100%	8.24	6.40	3.52	6.95	5.76
T_3 Dry ginger powder -50% + Dry Kokum powder -50%	8.15	8.02	8.57	7.56	8.17
T_4 Dry ginger powder -60% + Dry Kokum powder - 40%	7.16	5.56	5.26	5.48	6.42
T_5 Dry ginger powder -70% + Dry Kokum Powder -30%	4.75	5.31	6.81	5.27	6.38
T_6 Dry ginger powder -80% + Dry Kokum powder -20%	6.12	4.09	4.75	6.34	6.39
T_7 Dry ginger powder -90% + Dry Kokum powder -10%	6.75	8.72	8.59	7.73	8.66
S.E(m)	0.13	0.06	0.11	0.11	0.12
CD at 5%	0.41	0.20	0.36	0.33	0.38

Experiment-2

Table 4. pH and titratable acidity of ginger and kokum based herbal tea

Treatments	Duration of Storage					
	pH			Titratable acidity (%)		
	0th day	30th day	60th day	0th day	30th day	60th day
T_1 First best -100% -(control)	4.04	3.96	3.94	1.65	1.63	1.69
T_2 Second best - 100% -(control)	2.92	2.92	2.83	3.85	3.92	4.02
T_3 First best -90% + Cardamom - 10%	4.54	4.51	4.49	1.61	1.71	1.78
T_4 First best -90 % + Tulasi - 10%	4.27	4.23	4.10	1.68	1.73	1.90
T_5 First best -90% + Turmeric -10%	4.13	3.13	3.12	1.71	1.75	1.75
T_6 Second best 90% + Cardamom -10%	3.21	3.20	3.08	3.70	3.73	3.77
T_7 Second best 90%+ Tulasi -10%	3.24	3.18	3.16	3.26	3.26	3.59
T_8 Second best 90 % + Turmeric -10%	3.20	3.14	3.13	3.13	3.13	3.15
S.E(m)	0.11	0.08	0.08	0.07	0.07	0.07
CD at 5%	0.34	0.24	0.24	0.21	0.21	0.21

Table 5. Ascorbic acid content of ginger and kokum based herbal tea.

Treatments	Duration of Storage Ascorbic acid content (mg/100 g)		
	0th day	30th day	60th day
T_1 First best -100% -(control)	0.58	0.53	0.52
T_2 Second best - 100% -(control)	1.32	1.31	1.30
T_3 First best -90% + Cardamom - 10%	0.41	0.41	0.40
T_4 First best -90 % + Tulasi - 10%	0.31	0.30	0.30
T_5 First best -90% + Turmeric -10%	0.36	0.36	0.35
T_6 Second best 90% + Cardamom -10%	0.34	0.33	0.31
T_7 Second best 90%+ Tulasi -10%	0.41	0.40	0.40
T_8 Second best 90 % + Turmeric -10%	0.41	0.41	0.40
S.E(m)	0.01	0.01	0.01
CD at 5%	0.04	0.03	0.04

Table 6. Total phenols of ginger and kokum based herbal tea

Treatments	Total phenols (mg GAE/g)		
Duration of Storage	0th day	30th day	60th day
T_1 First best -100% -(control)	74.58	74.38	74.11
T_2 Second best - 100% -(control)	68.84	68.60	68.41
T_3 First best -90% + Cardamom - 10%	73.30	73.17	73.05
T_4 First best -90 % + Tulasi - 10%	88.95	87.61	87.30
T_5 First best -90% + Turmeric -10%	72.32	72.22	72.04
T_6 Second best 90% + Cardamom -10%	68.11	68.07	67.87
T_7 Second best 90%+ Tulasi -10%	67.61	67.43	67.12
T_8 Second best 90 % + Turmeric -10%	67.89	67.41	67.37
S.E(m)	0.43	0.27	0.30
CD at 5%	1.30	0.83	0.91

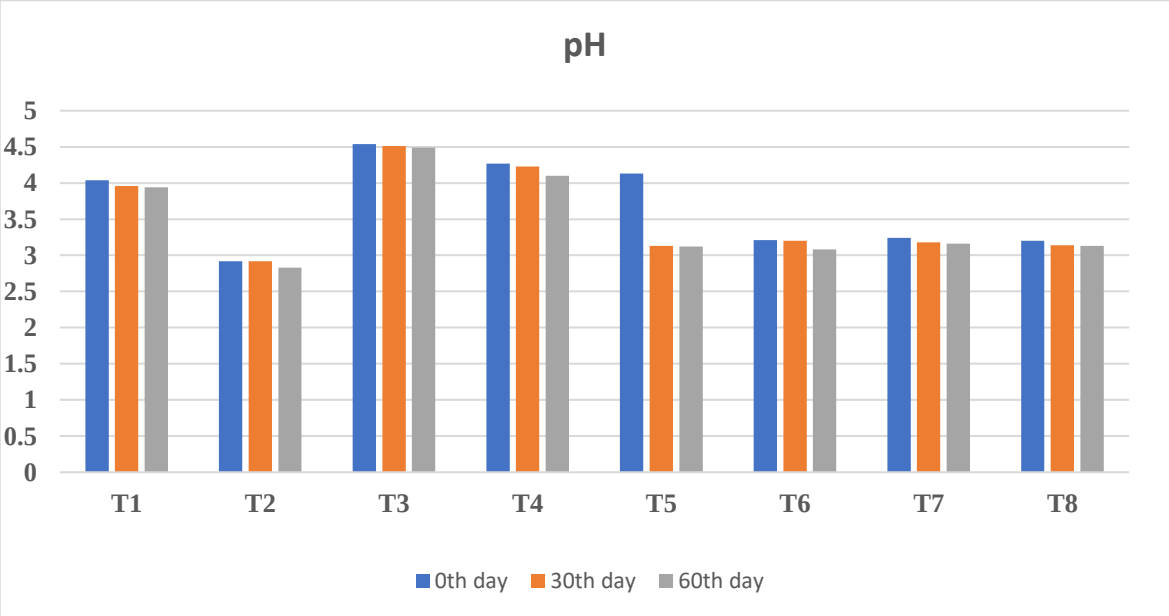


Fig. 1. pH of ginger and kokum based herbal tea

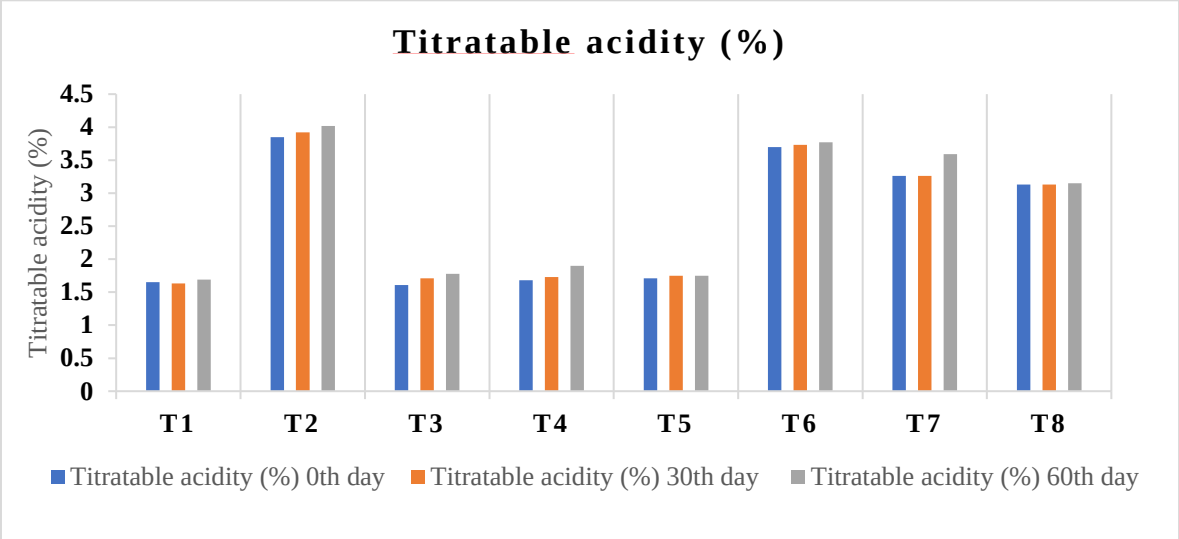


Fig. 2. Titratable acidity of ginger and kokum based herbal tea

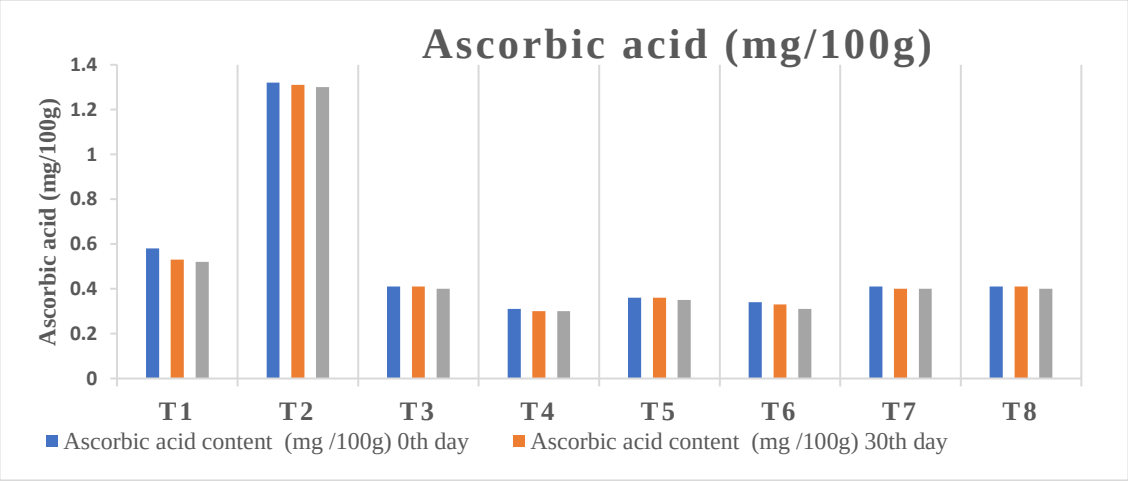


Fig. 3. Ascorbic acid of ginger and kokum based herbal tea

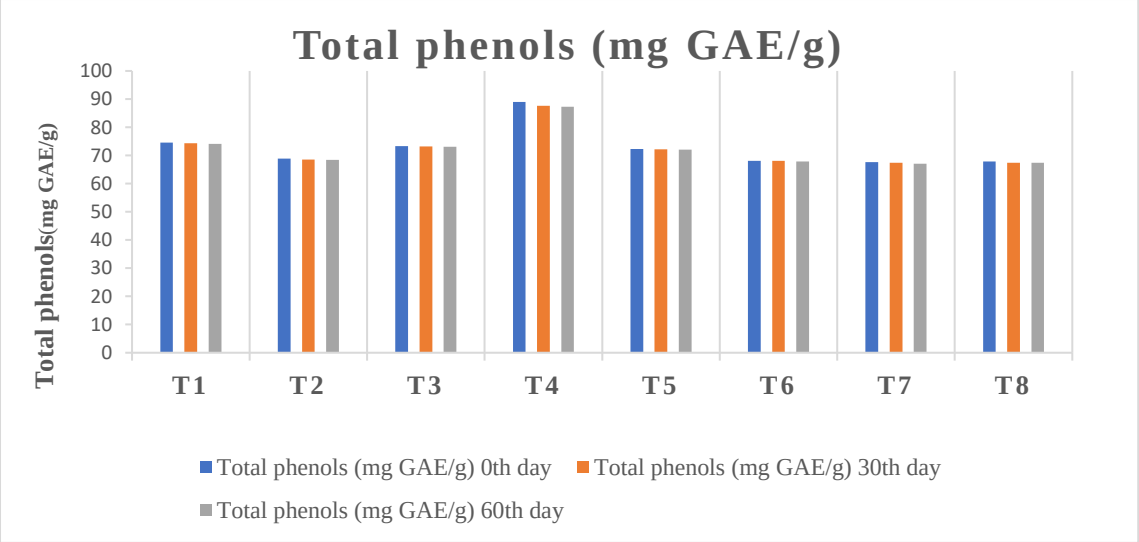


Fig. 4. Total phenols of ginger and kokum based herbal tea

Table 7. Organoleptic evaluation (9-point Hedonic scale) of ginger and kokum based herbal tea

Treatments	Duration of Storage														
	Colour			Flavour			Taste			Consistency			Overall acceptability		
	0th day	30th day	60th day	0th day	30th day	60th day	0th day	30th day	60th day	0th day	30th day	60th day	0th day	30th day	60th day
T_1 First best -100% -(control)	6.75	6.47	6.33	8.72	8.47	8.35	8.59	8.42	8.23	7.73	7.45	7.32	8.66	8.35	8.27
T_2 Second best - 100% -(control)	8.15	8.12	8.11	8.02	7.88	7.75	8.57	8.42	8.31	7.56	7.51	7.42	8.17	8.17	8.10
T_3 First best -90% + Cardamom - 10%	6.90	6.63	6.10	8.67	7.47	7.40	6.53	6.43	6.42	7.73	7.43	7.30	7.27	6.87	6.37
T_4 First best -90 % + Tulasi - 10%	7.96	7.23	7.20	8.73	8.53	8.23	8.90	8.93	8.80	8.53	8.40	8.27	8.90	8.87	8.47
T_5 First best -90% + Turmeric -10%	7.90	7.85	7.83	6.67	6.43	6.20	6.50	6.57	6.47	7.20	7.17	7.13	7.37	7.27	7.07
T_6 Second best 90% + Cardamom -10%	8.06	8.04	8.01	8.27	8.13	7.90	7.43	7.33	6.97	7.23	7.23	7.23	6.96	6.87	6.40
T_7 Second best 90%+ Tulasi -10%	8.04	8.01	8.00	7.47	7.20	7.13	7.69	7.08	6.57	7.10	6.97	6.83	7.20	7.17	7.07
T_8 Second best 90 % + Turmeric -10%	8.23	8.20	8.17	7.63	7.38	7.30	8.63	8.63	8.63	8.13	8.13	8.03	8.77	8.47	8.33
S.E(m)	0.10	0.15	0.08	0.11	0.07	0.12	0.15	0.17	0.14	0.13	0.11	0.13	0.08	0.08	0.09
CD at 5%	0.30	0.46	0.25	0.35	0.23	0.36	0.47	0.53	0.42	0.39	0.35	0.39	0.24	0.26	0.37

Policegoudra et al. [15]. also reported a similar trend of decreasing phenolic compounds in mango ginger (*Curcuma amada*).

Out of all the treatments on 60th day, organoleptic score for colour was reported highest score in T_8: (Second best 90 % + Turmeric -10 %) (8.17) and minimum score was recorded in T_3:(First best -90 % + Cardamom -10 %) (6.10) on 60th day of storage (Table 7).

3.9 Organoleptic Evaluation (9-point hedonic scale)

The maximum organoleptic score for flavour is recorded in T_1: (First best -100 % -(control) (8.35) and minimum score was recorded in T_5: (First best -90 % + Turmeric -10 %) (6.67) on 60th day of storage. The maximum organoleptic score for taste and consistency was recorded in T_4: (First best -90 % +Tulasi -10 %) (8.80, 8.27 respectively). and minimum score is recorded in T_5: (First best - 90 % + Turmeric -10 %) (6.42, 6.83 respectively). on 60th day of storage. On the 60th day of the storage period among all the treatments, the maximum organoleptic score for overall acceptability.

4. CONCLUSION

On the present research work it can be concluded that T_4-(First best -90 % + Tulasi -10%) and T_8 (Second best 90 % + Turmeric -10%) developed herbal teas showed highest phenolics and best sensorial attributes. Furthermore, the treatments also performed well in physico-chemical analysis.

Storability of the herbal teas was well within the acceptable limit up to 2 months storage at an ambient temperature.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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