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Physico-Chemical, Sensory and Microbial Evaluation of Ginger-Lime Ready-To-Serve (RTS) Functional Beverage, Sweetened by Palmyra Sugar Candy

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Abstract: *Production of functional beverage is an excellent method for incorporation of phyto-chemicals, anti-oxidants and beneficial components. In the present investigation, an effort has been made to prepare a Ready-To-Serve (RTS) functional beverage by exploiting the medicinal, nutritional and organoleptic properties of ginger, lime juice and palmyra sugar candy to find out the most suitable proportion of ginger and lime extracts and to assess the shelf life of the formulated beverages. The beverage combinations were prepared by blending of ginger and lime juices at different % of 20:0, 18:2, 16:4, 14:6, 12:8, and 10:10 and sweetened by 15% of plamyra sugar candy. Physico-chemical, microbial and sensory analyses were carried out immediately after preparation and storage. The declining trends in pH, TSS and ascorbic acid and an increasing trend in titratable acidity and total sugar were noted with advancement of storage period. Based on the quality evaluation, it was concluded that the formulation with 12% of ginger and 8% of lime juice extract had highest mean scores for organoleptic characteristics that could be stored at 30±1°C temperature and 70-75% of RH for a period of 12 weeks and which is safe for human consumption.*

1. Introduction

Degenerative diseases such as diabetes, hypertension, atherosclerosis and obesity are the main causes for the reduction in the consumption of synthetic beverages among health conscious people which has led to produce the functional beverages. Incorporation of natural compounds in the fruits, rhizomes, vegetables such as phyto-chemicals, flavonoids, anti-oxidants and vitamins together without harmful to human consumption is one of the new product development strategy in functional beverage industry to attract customer; the development of health beneficial beverage is a demand of time [1]. The formulation of anti-oxidant rich beverage is one of the innovations in the product development in food industry, which will increase the demand for intake of dietary anti-oxidants with the hope to be healthy and free from diseases.

Ginger (*Zingiber officinale*) is a herbaceous aromatic perennial plant which possesses medicinal properties due to its bioactive compounds [2], anti-oxidants [3] and anti-inflammatory activities [4]. Effective anti-oxidants in ginger such as gingerols, zingerone and vitamin C contents, which has been inconsistent and may have capacity to blood thinning and reduce cholesterol levels that may make it useful for treating heart disease [5]. The pungency of ginger is due primarily to the gingerols and shoagaols and the zingiberol, zingiberene, pheallndrene and linalool are the important constituents which account for the aroma of ginger [6].

Lime *(Citrus aurantifolia*) is a fruit, acidic in nature and serve as rich sources of dietary fiber, vitamin C, phenolic components, and flavonoids, citrus fruits are believed to have potential health-promoting properties [7]. Lime fruits have citric acid which acts as a natural preservative in foods. The health benefits of lime include weight loss, skin care, good digestion, relief from constipation, eye care, and treatment of scurvy, piles, peptic ulcer, respiratory disorders, gout, gums, urinary disorders, etc. [8]. Like the other palm sugars, the glycemic index of palmyra sugar candy is lesser than the cane sugar. Therefore, addition of Palmyra sugar candy in functional RTS beverage is very suitable for consumption of diabetic patient.

The fruit-ginger drinks are generally acceptable to the people; on the basis of the medicinal and anti-microbial properties of ginger the production of fruit juice blended with ginger is highly recommended [9]. Blending of different nutritional, organoleptic and medicinal properties from ginger, lime and Palmyra sugar candy may boost taste, aroma and overall acceptability. Accordingly, the objectives of the present study are to develop functional Ready-To-Serve (RTS) beverage with different ratios of ginger juice and lime juice, evaluate the physico-chemical, sensory and microbial properties of formulated juice blends of ginger during day on preparation and storage.

2. Materials and methods

2.1 Materials collection

Previous investigations revealed that Local ginger variety is superior to Rangoon and Chinese varieties for developing RTS functional beverages. Therefore, ginger rhizomes of Local variety and mature lime fruits were obtained from Commercial Horticultural Farm and Palmyra sugar candy was purchased from Palmyra Research Institute.

2.2 Preparation of RTS beverages

Ginger rhizomes were peeled and thoroughly washed in clean water. The cleaned ginger rhizomes were cut into small pieces by using a clean stainless steel knife and ground by electric grinder (Model Smeeth-620). The ginger juice (GJ) was filtered through muslin cloth according to the method expressed by [10]. Lime was cut into two halves with a clean stainless steel knife and lime juice (LJ) was extracted by squeezing the lime by hand. Extracted LJ was filtered using muslin cloth to remove the seeds. For the preparation of 100 ml of RTS functional beverage blends, 15 g of palmyra sugar candy was dissolved in 65 ml of portable water, mild heated, filtered using muslin cloth to remove impurities to get Palmyra Sugar Candy Solution (PSCS). Then, GJ and LJ were added according to the experimental formulations with PSCS, and it was heated at 85°C for 20 minutes for pasteurization and hot filling was done into previously sterilized glass bottles.

2.3 Experimental Formulations

Control **(C)**: 20% of GJ only
Treatment 1 **(T_1)**: 18% of GJ and 02% of LJ
Treatment 2 **(T_2)**: 16% of GJ and 04% of LJ
Treatment 3 **(T_3)**: 14% of GJ and 06% of LJ
Treatment 4 **(T_4)**: 12% of GJ and 08% of LJ
Treatment 5 **(T_5)**: 10% of GJ and 10% of LJ

2.4 Physico-chemical analysis

Physico-chemical qualities of the freshly prepared and stored Ginger-Lime RTS functional beverages were analyzed using recommended standard AOAC methods [11]. The Total Soluble Solids (TSS) was measured using the hand held refractrometer (Model ATAGO-S-28E). The pH was measured by using Digital pH meter (Model HANNA HI 98130). The titratable acidity was determined by titrating the juices with standard NaOH and the results were expressed as % of citric acid. The Vitamin C content was titrimetrically estimated by indophenol dye method and Total sugar of RTS beverages were done by Lane-Eynon method. Each parameter was triplicated during analysis.

2.5 Microbial analysis

The total plate count method was performed to the formulations that selected for storage studies and the counts were taken from day on preparation at monthly interval up to the end of storage period. The RTS beverage formulations were used to prepare the dilutions of 10^0, 10^{-1} and 10^{-2} and microbial counts were triplicated.

2.6 Sensory evaluation

Sensory evaluation was conducted using a panel consisting of 30 trained members. The colour, pungency, taste, and overall acceptability were evaluated using 7-point hedonic scale. A structured questionnaire was used for the sensory evaluation. Among the different blends the best three formulations and control were selected for storage studies and the Ginger-Lime RTS beverages were stored at the temperature of 30±1°C and the RH 70-75% for a period of 12 weeks. The sensory evaluation was performed for the freshly made Ginger-Lime RTS beverages and at the end of storage period.

2.7 Statistical Analysis

Each formulation was triplicated in experiments and they were in Complete Randomized Design. Data of the physico-chemical parameters were analyzed by Analysis of Variance (ANOVA) (α = 0.05) and mean separation was done with Ducan's Multiple Range Test (DMRT). Data related to sensory evaluation were analyzed using the Friedman Test at 95% significant level. Both physico-chemical and organoleptic analysis was done through Statistical Analysis System (SAS) software statistical package.

3. Results and Discussions

Ginger and its constituents create optimism towards the novel ingredients in the production of functional beverages. The lime juice consist of several beneficial components that have potential to develop Ready- To- Serve functional beverages in the industry. The initial chemical composition of ginger and lime are given below in Table 1.

Table 1. Chemical composition of ginger and lime

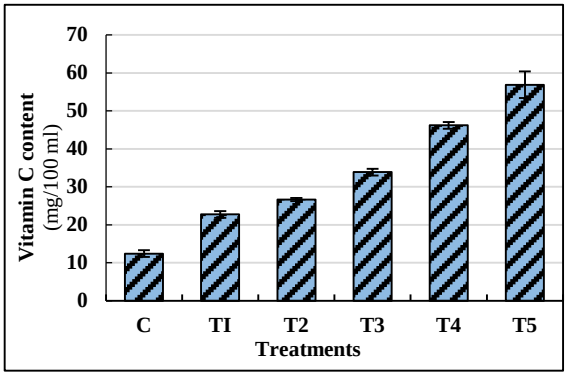
Chemical composition	Ginger	Lime
pH	4.72 ±0.22	2.46 ±0.16
TSS (°Brix)	2.82 ±0.32	6.21 ±0.41
Titratable Acidity (as % citric acid)	0.17 ±0.05	5.88 ±0.17
Ascorbic acid (mg/100 g)	3.12 ±0.42	38.91 ±0.59
Total sugar (%)	15.61 ±0.12	1.43 ±0.25

The values are means of triplicates ± standard error

3.1 Physico-chemical analysis of freshly prepared beverages

3.1.1 Vitamin C content

Vitamin C is an essential component in the functional beverage. The changes of Vitamin C content during blending of ginger-lime juice is shown in Figure 1. The Vitamin C content increased significantly ($p<0.05$) from 12.4 to 56.8 mg/100 ml with an increase in the concentration of lime juice from 0 to 10% in the RTS beverage because high vitamin C content in lime juice than ginger juice. This increasing trend while blending of two different fruit juices is in agreement with [12] who also observed this same trend in their study on bael-guava blended beverage.



The values are means of triplicates
Vertical bars indicate the standard errors.

Figure 1. Vitamin C content of Freshly Made RTS Beverages

3.1.2 Titratable acidity

The titratable acidity measures the ionic power of a solution which determines the rate of chemical reactions. The tritratable acidity of the Ginger-Lime RTS beverage samples varied significantly ($p<0.05$) and increased from 0.22 to 0.52% (as % of anhydrous citric acid) with the proportion of lime juice extract added to the blends increased from 0 to 10% as shown in the Table 2. The reason may be due to the inherent acidity present in the lime juice. Similar trend was reported by [13] in the experiment on preparation, physico-chemical and sensory assessment of pawpaw-red ginger food drink. Titratable acidity is a directly proportional measure of shelf life of the product and guard against the attack of microorganisms [14]. According to the Sri Lanka Standard Institute Specifications, the limits of acidity for RTS preparation are 0.3-1% as anhydrous citric acid [15].

Table 2. The Titratable acidity, TSS and pH of the Formulated Functional RTS Beverages

Formulations	Titratable acidity	TSS (°Brix)	pH
C	0.22 ±0.01^{d}	12.60 ±0.21^{e}	6.63 ±0.01^{a}
T_1	0.31 ±0.04^{c}	13.20 ±0.12^{d}	4.63 ±0.04^{b}
T_2	0.35 ±0.01^{c}	13.47 ±0.07^{cd}	3.76 ±0.01^{c}
T_3	0.41 ±0.01^{b}	13.77 ±0.03^{bc}	3.45 ±0.01^{d}
T_4	0.47 ±0.01^{ab}	13.88 ±0.07^{b}	3.26 ±0.07^{e}
T_5	0.52 ±0.05^{a}	16.80 ±0.12^{a}	3.10 ±0.02^{f}

The values are means of triplicates ± standard error
Scores of the different superscripts in the same column are significantly different at $p<0.05$.
C: 20% of GJ only, **T_1**: 18% of GJ and 02% of LJ, **T_2**: 16% of GJ and 04% of LJ, **T_3**: 14% of GJ and 06% of LJ, **T_4**: 12% of GJ and 08% of LJ and **T_5**: 10% of GJ and 10% of LJ.

3.1.3 Total Soluble Solids (TSS)

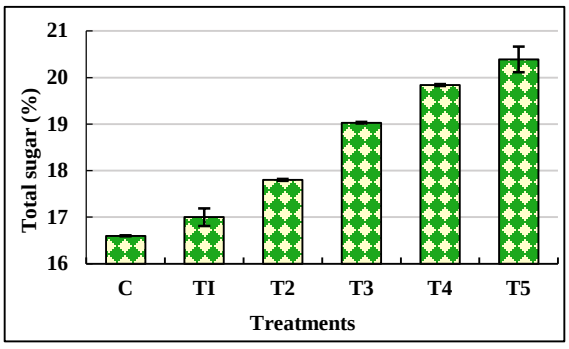
The TSS: Acid ratio is often better related to palatability of the fruits than either sugar or acid alone. The recommended TSS for commercial RTS production is 15° Brix [15]. The TSS of ginger juice blended with lime juice extracts RTS functional beverage formulation adjusted initially. The TSS increased significantly ($p<0.05$) with the increasing concentration of lime juice in RTS beverages (Table 2). The highest TSS value of 16.8°Brix was obtained in the treatment T_5 (RTS beverage with 10% of ginger juice and 10% of lime juice). The Control (C) (RTS beverage with 20% ginger juice only) had the least mean value of 12.6°Brix due to low TSS content in ginger juice extract than lime juice extract in Ginger-Lime RTS beverages.

3.1.4 pH

The presence of free hydrogen ions and buffering capacity of the juices influence the pH value of the beverage [16]. The results generally showed that the higher acidity, lower pH of ginger blend with lime RTS beverages as shown in Table 2. According to DMRT, the pH decreased significantly ($p<0.05$) with the increasing concentration of lime juice in all RTS beverage formulations and the formulation with 20% of ginger juice only (C) had highest mean value (6.63) and the formulation with 10% ginger juice and 10% lime juice (T_5) had the least mean value (3.11) for pH on day of preparation. The reduction of pH during blending of ginger juice with the increasing percentage of lime juice may due to the higher acidic content in lime juice. Similarly, [17] found that there is a corresponding reduction in pH as the acidity increased in Pineapple Juice Blend with Carrot and Orange juice drink.

3.1.5 Total Sugar

Sugars, acids and their interaction are important to sweetness, sourness and overall acceptability in RTS beverages. The minimum total sugar content (as sucrose) for RTS preparation is 5% [15]. The Figure 2 shows the total sugar content of the freshly made RTS beverage formulations. The total sugar significantly ($p<0.05$) differed among each formulations.



The values are means of triplicates
Vertical bars indicate the standard errors.

Figure 2. Total Sugar content of Freshly Made RTS Beverages

The formulation T_5 had highest mean value (20.4%) and the formulation C had a least mean value (16.6%). The total sugar content showed an increasing trend with the added proportion of the lime juice increased from 0 to 10%.

3.2 Microbial analysis

The results of microbial analysis revealed that there were no microbial growth observed in freshly made and stored functional beverage preparations throughout the storage period. This may be due to no microbial level of initial samples, pasteurization process and the anti-microbial properties of ginger and lime. Our findings are supported by [18]. Similar observations were reported by [10] in processing and preservation of ginger Juice.

3.3 Sensory analysis of freshly made Ginger-Lime RTS beverages

The sensory evaluation scores (Table 3) of freshly made ginger-lime RTS functional beverages revealed that there were significant differences between the formulations for colour, pungency, taste and overall acceptability at 5% level of significance as the concentration of lime extract was increased from 2% to 10%. Scores of overall acceptability of freshly made formulations were showed that, formulation T_4 appeared to be most superior while the T_3 and T_2 are sub superior than other tested formulations. Therefore, formulations T_2, T_3, T_4 were selected with Control treatment for storage studies and to evaluate shelf life of the beverages.

Table 3. Sensory scores of Freshly Made Ginger-Lime RTS Beverages

Treatments	Colour	Pungency	Taste	Overall acceptability
C	4.4 $\pm0.23^{b}$	2.5 $\pm0.11^{d}$	3.5 $\pm0.16^{c}$	4.3 $\pm0.14^{d}$
T_1	4.7 $\pm0.18^{b}$	4.7 $\pm0.12^{c}$	5.7 $\pm0.12^{c}$	5.1 $\pm0.19^{bc}$
T_2	5.5 $\pm0.10^{a}$	5.3 $\pm0.14^{ab}$	6.2 $\pm0.10^{b}$	5.9 $\pm0.13^{b}$
T_3	5.5 $\pm0.12^{a}$	5.8 $\pm0.10^{a}$	6.5 $\pm0.09^{ab}$	6.5 $\pm0.16^{a}$
T_4	5.7 $\pm0.11^{a}$	5.7 $\pm0.13^{a}$	6.9 $\pm0.10^{a}$	6.9 $\pm0.08^{a}$
T_5	4.9 $\pm0.12^{ab}$	5.1 $\pm0.15^{bc}$	5.7 $\pm0.12^{c}$	4.7 $\pm0.14^{b}$

The values are means of 30 replicates ±standard error.
Sensory parameters were measured using a 7-point hedonic scale.
The means with same letters in same column are not significantly differed from each other at 5% of level based on Fried man Test.
C: 20% of GJ only, **T_1**: 18% of GJ and 02% of LJ, **T_2**: 16% of GJ and 04% of LJ, **T_3**: 14% of GJ and 06% of LJ, **T_4**: 12% of GJ and 08% of LJ and **T_5**: 10% of GJ and 10% of LJ.

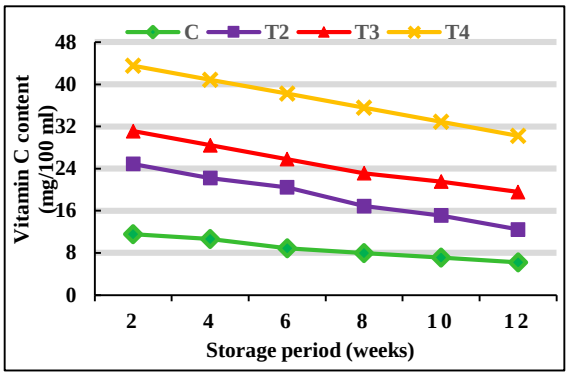
3.4 Changes in quality characteristics during storage

The samples with high sensory scores in organoleptic evaluation such as T_2, T_3 and T_4 were selected for storage studies and they were kept under ambient conditions for 12 weeks. The physico-chemical parameters such as vitamin C content, titratable acidity, total soluble solids and pH were assessed at 2 weeks interval. The results of sensory parameters such as colour, pungency, taste and overall acceptability were assessed after 12 weeks of storage.

3.5 Physico-chemical analysis of formulated beverages during storage

3.5.1 Vitamin C content

The vitamin C content of the ginger blend with lime RTS functional beverages was significantly ($p<0.05$) decreased with the advancement of storage period which stored at 30±1°C temperature and 70-75% of RH (Figure 3). The reason for vitamin C (Ascorbic acid) reduction during storage period was probably due to the fact that ascorbic acid is very sensitive to oxidative deterioration and being sensitive to oxygen, light and heat is easily oxidized in presence of oxygen by both enzymatic and non-enzymatic catalyst from ascorbic acid to dehydro-ascorbic acid.



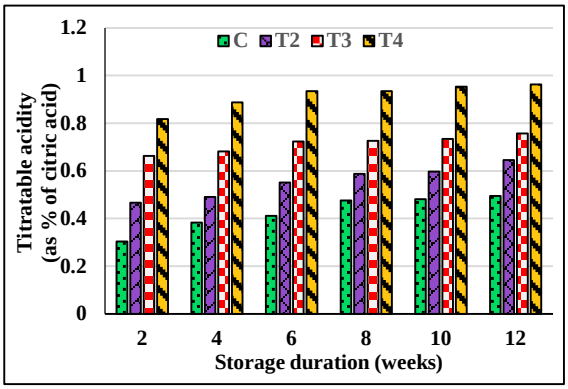
Values are means of triplicates

Figure 3. Changes in Vitamin C content during storage

According to [19] there was a gradual reduction in the ascorbic acid content in all the samples of guava-lime-ginger RTS therapeutic beverage which stored at room and refrigerated temperatures separately for 180 days. Our findings are in consonance with the previous studies reported in value added RTS drinks prepared from blend of carrot, mandarin and ginger during storage [20] and in syrup of pumello (*Citrus gradin* Linn) juice blend with mango ginger (*Curcuma amada*) and kokum (*Garcinia indica*) during storage period of 120 days [21].

3.5.2 Titratable acidity

Data pertaining to the changes in acidity during storage of RTS is illustrated in Figure 4, which indicates that acidity contents were significantly increased ($p<0.05$) throughout storage period reaching a maximum value of 0.96% (observed in T_4) with the minimum value of 0.30% (observed in Control) and the limits were within the Sri Lanka Standard Institute Specifications. The significant increment might be due to conversion of acids into salts and sugars by enzymatic reactions. During conversion of acids into salts the increase in titratable acidity in juices may be attributed to releases of hydrogen ions (H^+) during storage. Another explanation for the acidity increase due to formation of acid by degradation of polysaccharides and oxidation of reducing sugars or by breakdown of pectic substances.



Values are means of triplicates

Figure 4. Changes in Titratable acidity during storage

Similar observations were expressed by [22] who reported that gradual increase in acidity, which may be due to degradation of pectic substances and formation of uronic acid. An increasing trend observed in the titratable acidity content of the guava-lime-ginger RTS beverage during storage in at room and refrigerated temperature [19]. Similar pattern in increasing of titratable acidity content in all blend rations of Orange-Carrot Juice blends during storage in ambient temperature also observed by [23].

3.5.3 Total Soluble Solids (TSS)

The changes in TSS of different treatments along with the storage period are given in the Table 4.

Table 4. Changes in TSS of Ginger-Lime RTS Functional Beverages during storage period

Storage Duration (weeks)	C	T_2	T_3	T_4
2	12.47 ±0.24^b	13.53 ±0.07^a	13.4 ±0.12^a	13.33 ±0.03^a
4	12.43 ±0.03^b	12.73 ±0.07^a	12.27 ±0.13^b	12.00 ±0.00^c
6	12.17 ±0.03^a	11.8 ±0.20^{ab}	12.00 ±0.12^a	11.6 ±0.00^b
8	11.97 ±0.09^a	11.2 ±0.12^b	11.27 ±0.07^b	11.47 ±0.07^b
10	11.87 ±0.07^a	11.30 ±0.06^b	11.13 ±0.13^b	11.2 ±0.00^b
12	11.83 ±0.09^a	10.95 ±0.25^b	10.93 ±0.13^b	11.07 ±0.07^b

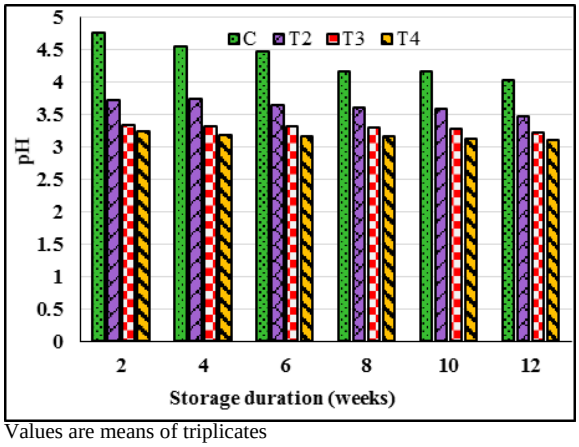
The values are means of triplicates ± standard error.
The means with the same letters in the same column are not significantly different from each other at 5% level based on DMRT.

According to the DMRT, the formulations were significantly differed ($p<0.05$) from each other in TSS during storage period. The maximum mean value (13.53° Brix) for TSS was observed in formulation (T_2) which had 16% of ginger juice and 4% of lime juice in 2nd week of storage period. The minimum mean value of 10.93° Brix was observed in formulation which had 14% of ginger juice and 6% of lime juice in 12th week of storage period.

The reason for reduction might be due to the chemical interactions taking place among the organic constituents of the beverage [24]. The reason of reduction of TSS during storage period is may due to phenolic compounds in ginger juice such as gingerole, shagoal and etc. may trap sucrose, hexoses and other components and prevent it to contribute soluble components. The findings of present study are in accordance with the findings of [25] in low calorie herbal aonla-ginger RTS beverage.

3.5.4 pH

The pH has got importance to preserve shelf stability and it can also influence the flavour of ready to serve beverage. The changes of the pH with advancement of storage duration are presented in Figure 5. The results indicated that the pH of ginger-lime RTS beverages decreased with increased period of storage in all the formulations.



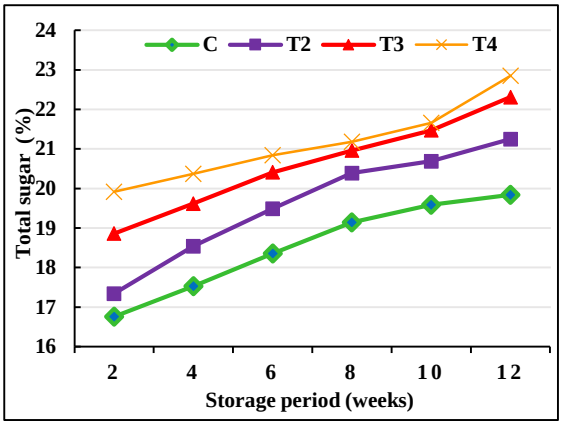
Values are means of triplicates

Figure 5. Changes in pH of Ginger-Lime RTS Beverage Formulations during storage

There was a significant ($p<0.05$) decrease in pH during storage in all formulations in ambient temperature. It was observed that the maximum pH (4.75) was recorded in the control (C) and the least pH 3.11 was recorded in the formulation T_4. The reason for decrease in pH might be due to increase in titratable acidity, as acidity and pH are inversely proportional to each other [26]. High acid and low pH may due to the production of acetic acid and lactic acid during storage. Similarly, trends indicated by [27] in that the pH of orange based (Orange-aonla-ginger, Orange-pomegranate-ginger) blended RTS beverages decreased with increased period of storage in all the treatments for 90 days. On the other hand, [12] also found the slight decrease in pH of the Ready-To-Serve bael-guava blended beverage during 60 days of storage.

3.5.5 Total sugar

The results revealed that the total sugar content was significantly affected as a result of blending of ginger juice with lime juice in all formulations during storage. Figure 6 shows the changes in Total sugar during storage period of 12 weeks.



Values are means of triplicates

Figure 6. Changes in Total sugar content during storage

The total sugar content in the ginger blend with lime juice increased apparently during storage, which might be due to hydrolysis of polysaccharides like pectin, cellulose, starch, etc. and its conversion into monosaccharide and oligosaccharides. Similarly, progressive and marked increase in total sugars content was reported by [27] in the studies of bio-chemical composition of orange based (orange-aonla-ginger, orange-pomegranate-ginger) blended RTS beverages throughout the storage period of 90 days in all treatments. Similar observations on changes in total sugar content were reported in blended RTS of mango and ginger [28]. Our findings are also in consonance with [29] who conducted the study in guava-aonla blended RTS beverage and [30] in bael RTS.

3.6 Sensory characteristics of functional beverages following storage

Sensory qualities determine the storage stability and the consumer preference of the prepared beverage products. Sensory scores for colour,

pungency, taste and overall acceptability are presented below in Table 5. The sensory scores for colour of all formulations were decreased after 12 weeks of storage period due to increasing browning which may be due to millard reaction between sugars and amino acids. Similarly, colour reduction was reported by [31] in therapeutic Ready-To-Serve (RTS) beverage using ginger extract and honey.

Table 5. Sensory scores of Ginger-Lime RTS Beverages Following Storage

Treatments	Colour	Pungency	Taste	Overall acceptability
C	3.2 ±0.23^{b}	2 .4 ±0.14^{b}	3.4 ±0.06^{c}	3.7 ±0.28^{c}
T_2	4.4 ±0.10^{a}	5.1 ±0.27^{a}	4.7 ±0.30^{ab}	5.1 ±0.43^{b}
T_3	4.5 ±0.12^{a}	5.4 ±0.09^{a}	5.2 ±0.04^{a}	5.5 ±0.08^{a}
T_4	4.6 ±0.11^{a}	5.2 ±0.22^{a}	5.6 ±0.20^{a}	6.1 ±0.04^{a}

The values are means of 30 replicates ±standard error.
Sensory parameters were measured using a 7-point hedonic scale.
The means with same letters in same column are not significantly differed from each other at 5% of level based on Fried man Test.
C: 20% of GJ only, **T_2**: 16% of GJ and 04% of LJ, **T_3**: 14% of GJ and 06% of LJ and **T_4**: 12% of GJ and 08% of LJ.

The means scores for pungency of freshly made and stored formulations were not considerably varied. This is may be due to the storage stability of pungent compounds in the ginger juice since the formulations are acidic and stored under ambient temperature of 30±1°C. Our results are in accordance with the findings of [32]. Reduction in scores for taste in all formulations also was observed with the advancement of storage period. This may be due to the degradation of ascorbic acid and increase in acidity of the formulations which contributed to develop a sourness. There was a slight but significant ($p<0.05$) reduction in the overall acceptability scores of RTS beverages from the freshly made beverages with increase in storage duration. There were significant differences ($p<0.05$) in overall acceptability among the formulations during storage. The formulation T_4 had the highest mean value (5.7) followed by the formulation T_3 (5.2) and these formulations were rated superior to others in terms of overall acceptability ratings of sensory panel judgment.

4. Conclusions

The ginger juice extract of 12% blended with 8% of lime juice is the best combination to develop ginger-lime RTS functional beverage sweetened by 15% of palmyra sugar candy which based on microbial, physico-chemical and organoleptic quality characteristics. The blending of ginger and lime found to be one of the best methods to improve the nutritional, organoleptic and medicinal properties *in* functional beverage preparation and one of the way in the new product development. The nutritious beverages formulated with ginger, lime and palmyra sugar candy should be stored at the temperature of 30±1°C and the RH of 70-75% of RH for a period of 12 weeks without any significant effect on consumer acceptability and safety.

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