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Development of Blend Beverages from Guava (*Psidium guajava* L.), Strawberry (*Fragaria ananassa* Duch.) and Ginger (*Zingiber officinale* Roscoe)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out at Post Graduate Laboratory, Department of Post Harvest Management, College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229, U.P. India during 2023. The results show that, palatable RTS blend beverages can be developed from 10% blend comprising 50% guava pulp + 25% strawberry pulp + 25% ginger juice adjusted to 13% Total soluble solids, 0.30% acidity and incorporated with 120 ppm Benzoic Acid. During the storage period TSS, acidity, reducing sugars and total sugars increased whereas, ascorbic acid (vitamin-C), non-reducing sugar and organoleptic quality decreased with the advancement of storage period. The developed RTS can be stored for 3 months with acceptable quality at room temperature.

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Keywords: RTS; guava; strawberry; ginger; beverage.

1. INTRODUCTION

A beverage is a liquid intended for human consumption. Beverages are an essential component of the human diet and serve the basic purpose of quenching thirst, but they also have a significant cultural impact. Beverages have a variety of unique medical and health advantages, such as enhancing digestion and immunity, promoting heart health, and boosting energy. Ready-To-Serve is a non-fermented drink made by dissolving sugar and the edible portion of the fruit in water. "The extraction of juice from fruits differs depending on the structure and composition of fruits" [1].

Guava (*Psidium guajava* L.), which is native to Tropical America and belong to the Myrtaceae family, is successfully cultivated across India's tropical and subtropical areas. The fruit consists of 20% peel, 50% flesh and seed core [2]. Guava is a fair source of ascorbic acid (299 mg/100 g) and pectin (1.15%) and contains 74–84% moisture, 13-26% dry matter, 0.8–1.5% protein, 0.4-0.7% fat, and 0.5–1.0% ash. The fruit contains a sizable amount of vitamins including niacin, thiamine, riboflavin, and vitamin A and minerals like phosphorus (23-37 mg/100 g), calcium (14-30 mg/100 g), iron (0.6-1.4 mg/100 g), and more [3]. The primary sugars in green mature fruits and completely mature fruits, are fructose (about 59%) and sucrose, respectively [4].

Strawberry (*Fragaria ananassa* Duch.), is a fruit crop which can be successfully cultivated from subtropical to temperate climate. It is part of the Rosaceae family and a good source of fructose, glucose, sucrose, and organic acids, iron, phosphorus, anthocyanin, vitamin C, and other minerals. "Attribute of strawberry fruits depends mainly on their appearance, firmness, and chemical composition" [5]. The whole strawberry fruit has an energy value of 37 Kcal/100 gram and comprises 89.9% moisture, 0.7% protein, 0.5% fat, 5% total carbohydrates, and 1.3% crude fibre. It includes 0.5% of total minerals and ranges in acidity from 0.52 to 2.26 % citric acid [6]. A fruit sold commercially with an abundance of processing potential and are used to make purees, preserves, juice, pureed squash, jams, jelly and alcoholic beverages [7].

Ginger (*Zingiber officinale* Roscoe) is a herbaceous aromatic perennial plant member of the family Zingiberaceae. Which possesses medicinal properties and has anti-inflammatory, antioxidant, and bioactive chemical qualities that make it useful in medicine. "Nutrient composition like protein (2.3%), fat (0.9%), carbohydrates (12.3%), mineral (1.2%), fiber (2.4%) and moisture (80.9%) are the key ingredients in fresh ginger" [8]. The main components that give ginger its pungency and scent are gingerols and shoagaols. Zingiberol, zingiberene, pheallndrene, and linalool are other significant components [9]. The bioactive components of ginger, give it therapeutic benefits [10]. Effective anti- oxidants found in ginger, including gingerols, zingerone, and keep vitamin C, may have the capacity to thin the blood and keep minimum cholesterol levels, which can make it helpful for treating heart disease [11].

"The blend beverages can be made from combination of different fruits and medicinal plants with therapeutic, nutritional, and medical benefits and acceptable flavour" [12]. The development of beverages using combinations of guava, strawberry and ginger would offer options for the optimum utilization of these raw ingredients while also making palatable drinks with therapeutic benefits available to customers. The market is seeing a rise in demand for natural beverages over synthetic ones because consumers are more aware of health and attentive to their fitness. The present investigation, therefore, conducted to develop blend beverages carrying the quality of guava, strawberry and ginger.

2. MATERIALS AND METHODS

2.1 Raw Materials Used for Beverages Preparation

Raw materials for blend RTS made from guava, strawberry, and ginger, were purchased from different places. Guava (Local variety) purchased from local market Kumarganj, Strawberry purchased from sabjee mandi at Ayodhya district headquarter and ginger (Local Variety) purchased from local market Kumarganj.

Extraction of guava pulp, strawberry pulp and ginger juice: The methods which are used for the extraction of guava pulp, strawberry pulp and ginger juice are shown in Fig. 1, Fig. 2, and Fig. 3, respectively.

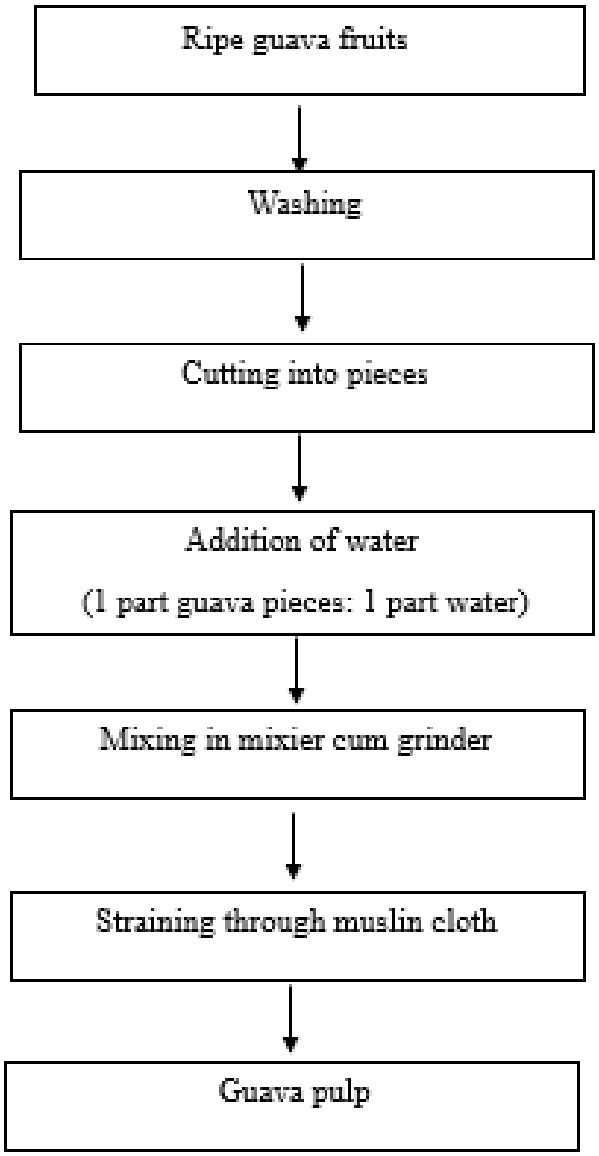

Fig. 1. Flow chart of pulp extraction from guava fruits

2.2 Standardization of Blends for RTS

The RTS was prepared from following each combination (Treatment) of guava pulp, strawberry pulp, and ginger juice to obtain best combination for palatable RTS beverage:

T_1 -10 % blend comprising 100% Guava pulp + 0% strawberry pulp + 0 % ginger juice with 13% TSS, 0.3% acidity and 120ppm Benzoic Acid.

T_2 -10 % blend comprising 0% Guava pulp + 100% strawberry pulp + 0% ginger juice with 13 % TSS, 0.3 % acidity and 120ppm Benzoic Acid.

T_3 -10 % blend comprising 0 % Guava pulp + 0% strawberry pulp + 100 % ginger juice with 13% TSS, 0.3% acidity and 120ppm Benzoic Acid.

T_4 -10 % blend comprising 33.33 % Guava pulp + 33.33 % strawberry pulp + 33.33% ginger juice with 13% TSS,0.3 % acidity and 120ppm Benzoic Acid.

T_5 -10 % blend comprising 40 % Guava pulp + 30 % strawberry pulp + 30 % ginger juice with 13 % TSS, 0.3 % acidity and 120ppm Benzoic Acid.

T_6 - 10 % blend comprising 50 % Guava pulp + 25 % strawberry pulp + 25 % ginger juice with 13 % TSS, 0.3 % acidity and 120ppm Benzoic Acid.

T7 - 10 % blend comprising 60 % Guava pulp + 20 % strawberry pulp + 20 % ginger juice with 13 % TSS, 0.3 % acidity and 120ppm Benzoic Acid.

T_8 - 10 % blend comprising 70 % Guava pulp + 15 % strawberry pulp + 15 % ginger juice with 13 % TSS, 0.3 % acidity and 120ppm Benzoic Acid.

T_9 -10 % blend comprising 80 % Guava pulp + 10 % strawberry pulp + 10 % ginger juice with 13 % TSS, 0.3 % acidity and 120ppm Benzoic Acid.

T_{10} - 10 % blend comprising 90 % Guava pulp + 05 % strawberry pulp + 05 % ginger juice with 13 % TSS, 0.3 % acidity and 120ppm Benzoic Acid

2.3 Preparation of RTS

The RTS prepared from each combination and were organoleptically evaluated on 9-point Hedonic scale to find out the best combination of blend for large scale preparation. The technique used for RTS making is shown in Fig. 4.

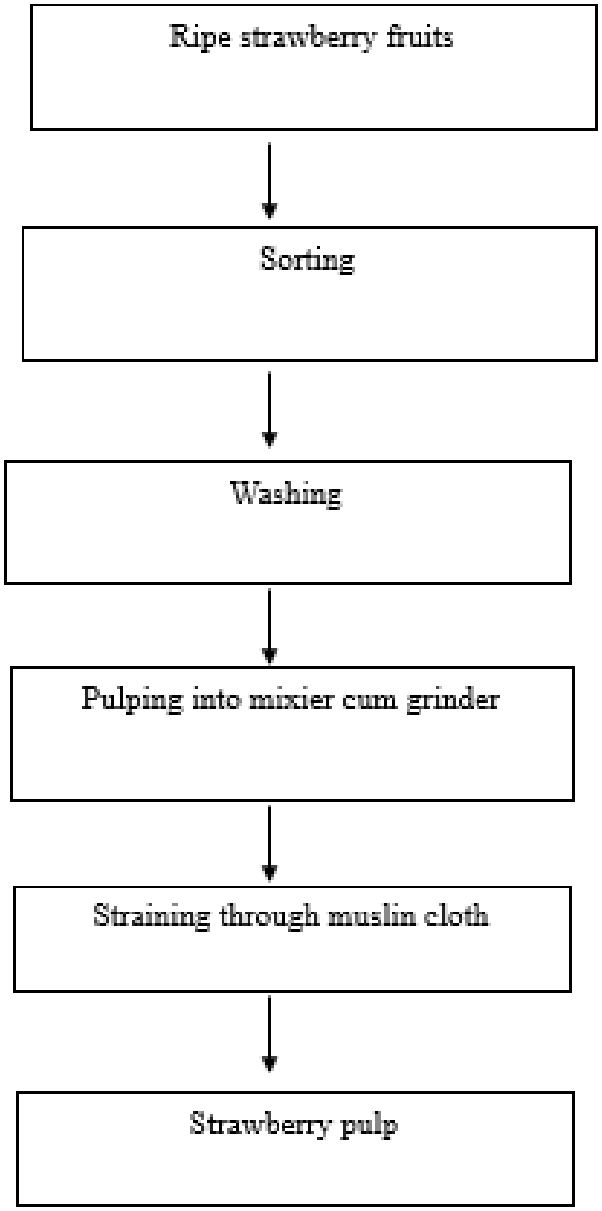

Fig. 2. Flow chart of pulp extraction from strawberry fruits

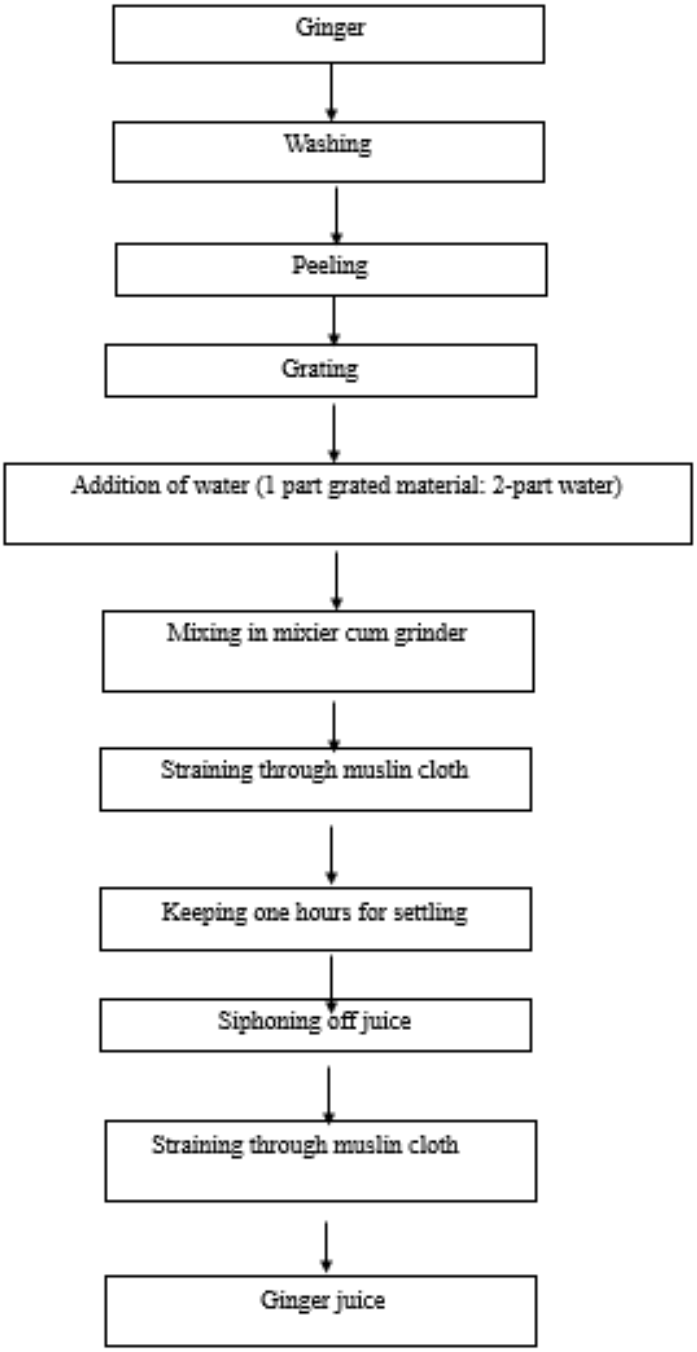

Fig. 3. Flow chart of ginger juice extract

2.4 Methods of Storage Studies

The best combination was used to prepare 10 liters of RTS drink, which were then filled into 200 mL capacity bottles with 2.5 cm headspace, and sealed with a crown cap and put for storage. During storage observation on changes in TSS, acidity, ascorbic acid (vitamin C), reducing sugars, non-reducing sugar, total sugars, and organoleptic quality were recorded at monthly intervals till the product was fit for consumption.

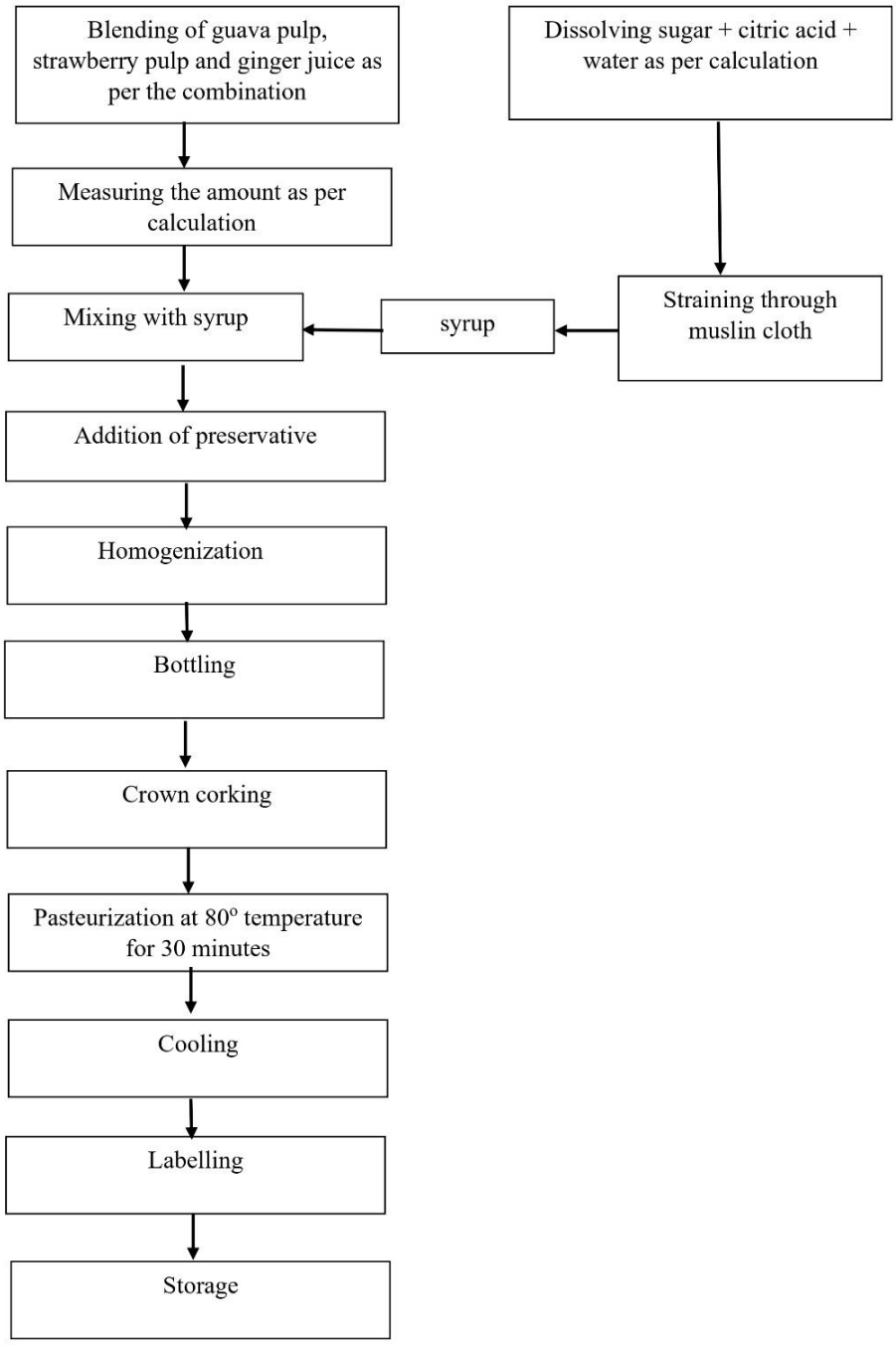

Fig. 4. Flow chart of guava, strawberry, and ginger blend RTS preparation

"The TSS of the sample was determined by using hand refractometer (Erma Inc. Tokyo Japan, 0-32% and 28-62%) and the TSS recorded at ambient temperature were corrected to 20° C with the help of reference table and the mean value of the sample was expressed as per cent TSS content [13]. The acidity was estimated by titrating known quantity of sample against standard N/10 NaOH solution using 2-3 drops of phenolphthalein indicator and expressed in per cent anhydrous citric acid. Ascorbic acid (vitamin-C) content was determined by preparing sample in 3% HPO_3 (metaphosphoric Acid) solution then titrated against 2, 6-dichlorophenol indophenol dye solution till the appearance of light pink colour [13]. The reducing, non-reducing

and total sugars were estimated by using Fehling's solution A and B and methyl blue as an indicator in boiling stage" [13]. "For the evaluation of organoleptic quality of RTS a semi trained panel of 9 judges was conducted organoleptic test who scored on the 9.0point Hedonic Rating Scale to assess the colour, flavour and texture of the beverages" (Amerine et al.,1965).

2.5 Statistical Analysis

The experiments were conducted in 3 replications and the observations were recorded at monthly intervals. The statistical analysis of the data was done by computer software in completely randomized design (CRD) that described by Panse and Sukhatme [14].

3. RESULTS AND DISCUSSION

Chemical attributes of guava pulp, strawberry pulp and ginger juice: The data recorded on the chemical attributes of guava pulp, strawberry pulp and ginger juice are presented in Table 1**.** The Total Soluble Solids of guava pulp, strawberry pulp and ginger juice were recorded 11.02 percent, 7.02 percent and 2.18 percent, respectively. The acidity of guava pulp, strawberry pulp and ginger juice were recorded 0.52 percent, 1.26 percent, and 0.32 percent, respectively. The vitamin C content of guava pulp, strawberry pulp and ginger juice were recorded 189.5 mg/100g, 57.20 mg/100g, and 1.94 mg/100g, respectively. The reducing, non-reducing and total sugars content in guava pulp were recorded 3.38 percent, 1.97 percent, and 5.35 percent, respectively. Whereas strawberry pulp contained 3.14 percent reducing sugars, 2.65 percent non-reducing sugar and 5.79 percent total sugar and ginger juice contained 0.62 percent reducing sugars, 1.16 percent non-reducing sugar and 1.78 percent total sugars. Overall guava pulp contains a higher amount of vitamin C and TSS, whereas strawberry pulp contains a higher amount of acidity and sugars. The quality and chemical attributes of raw materials influences the sensory attributes of processed products.

Standardization of the blends: The RTS was prepared using various combinations (treatments) of guava pulp, strawberry pulp, and ginger juice blends. The data recorded on the organoleptic quality of RTS prepared from different combination are furnished in Table 2. Results show that the treatment no. 06 comprising 50 % guava pulp + 25 % strawberry pulp + 25 % ginger juice was found to be best over other treatments for development of palatable quality RTS blend beverage and the organoleptic score secured significantly varied with other treatments. Therefore 10% blend comprising 50 % guava pulp + 25 % strawberry pulp + 25 % ginger juice adjusted to 13% Total soluble solids, 0.30% acidity and incorporated with 120 ppm Benzoic Acid used to develop quality palatable RTS beverage for storage study.

Changes during storage of RTS: "Data recorded on changes in RTS during storage is tabulated in Table 3, which observes that TSS of RTS increased from 13.00% to 13.51%. An increase in TSS content in RTS, product prepared from guava, strawberry and ginger blend might be due to the conversion or hydrolysis of polysaccharides into simple sugars. Similar results that an increase in total soluble solids (TSS) content during storage of products were reported in sweet orange RTS" [15], in strawberry ginger and aloe vera RTS [16], in mango, kagzi lime, aloe vera and ginger based blended RTS [17] and in aloe vera, ginger, sweet lime and amla RTS drinks [18]. These reports are in support of findings a change in TSS during storage of RTS in present investigation. Acidity content in RTS increased from 0.30% to 0.83%. An increase in the acidity content might be due to degradation of pectic substances and formation of organic acid. Similar results that an increase in acidity content during storage of products were reported by Kumar et al. [19] in RTS, Shagiwal and Deen [16] in RTS from strawberry, ginger and aloe vera, Harendra and Deen [17] in mango, kagzi lime, aloe vera and ginger based blended RTS and Khalid et al. [20] in strawberry and dates blend ready to serve drink. Vitamin-C content of RTS prepared from guava, strawberry and ginger blends gradually decreased up to the end of storage and content was found to be significantly reduced from 10.76 mg/100ml to 9.84 mg/100ml. "The depletion in ascorbic acid (vitamin- C) content might be due to oxidation of ascorbic acid into dehydro-ascorbic acid by oxygen (O_2) trapped into containers and intramolecular space of the product. The present results on changes in vitamin-C content during storage of beverage" are also supported by the findings of Bharati et al. [15] in sweet orange and guava RTS, Shagiwal and Deen [16] in strawberry, ginger and aloe vera and Harendra and Deen [16] in mango, kagzi lime, aloe vera and ginger based blended RTS. The reducing

sugars content of RTS increased continuously from 0.90% to 1.47%. The increase in reducing sugars of products might be due to conversion of non-reducing sugar into reducing sugars. The published works of Kumar et al. [19] in RTS, Bharati et al. (2023) in sweet orange and guava RTS, Shagiwal and Deen (2022) in strawberry, ginger and aloe vera and Harendra and Deen (2021) in mango, kagzi lime, aloe vera and ginger based blended RTS are also in support of present results. The non-reducing sugar content of RTS showed gradual decreasing from 12.22% to 11.90%. The reduction in non-reducing sugar might be due to conversion of non-reducing sugar. The results are similar with the prior results of Shagiwal and Deen [16] in strawberry, ginger and aloe vera, Harendra and Deen [17] in mango, citrus, aloe vera and ginger RTS, Khalid et al. [20] in strawberry and dates blended RTS and Mehta et al. [21] in RTS. The total sugars content of RTS increased gradually from 13.09% to 13.37%. A rise in total sugars of product might be due to inversion of non-reducing sugar into reducing sugars. The trend is similar to findings of different fruits-based beverages Kumar et al. [19] in RTS, Bharati et al. [15] in sweet orange and guava RTS, Shagiwal and Deen [16] in strawberry, ginger and aloe vera, Harendra and Deen [17] in mango, kagzi lime, aloe vera and ginger based blended RTS, Khalid et al. [20] in strawberry and dates blended RTS and Mehta et al. [21] in RTS. RTS's organoleptic quality steadily declined during the course of storage. It dropped from 8.23 to 7.18, which may be related to the impact of temperature on biochemical alterations that cause beverages to get discolored and acquire an off flavor. The reduction in organoleptic quality are also reported in previous studies performed by Kumar et al. [19] in RTS, Bharati et al. [15] in sweet orange and guava RTS, Shagiwal and Deen [16] in strawberry, ginger and aloe vera, Harendra and Deen [17] in mango, kagzi lime, aloe vera and ginger based blended RTS, Khalid et al. [20] in strawberry and dates blended RTS and Mehta et al. [21] in blended RTS [22,23].

Table 1. Chemical attributes of raw materials

S. No.	Chemical attributes	Mean values		
		Guava pulp	Strawberry pulp	Ginger Juice
1	Total soluble solids (%)	11.02	7.02	2.18
2	Acidity (%)	0.52	1.26	0.32
3	Vitamin-C (mg/100 g)	189.5	57.20	1.94
4	Reducing sugars (%)	3.38	3.14	0.62
5	Non-reducing sugar (%)	1.97	2.65	1.16
6	Total sugars (%)	5.35	5.79	1.78

Table 2. Organoleptic quality of RTS prepared from different blends of guava Pulp, strawberry pulp and ginger juice

Treatments	Different combination of blends			Organoleptic quality	
	Guava pulp (%)	Strawberry pulp (%)	Ginger juice (%)	Score	Rating
T1	100	Nil	Nil	7.71	Like moderately
T2	Nil	100	Nil	8.11	Like very much
T3	Nil	Nil	100	7.17	Like moderately
T4	33.33	33.33	33.33	7.41	Like moderately
T5	40	30	30	7.11	Like moderately
T6	50	25	25	8.23	Like very much
T7	60	20	20	7.82	Like moderately
T8	70	15	15	7.75	Like moderately
T9	80	10	10	7.64	Like moderately
T10	90	5	5	7.00	Like moderately
S.Em±				0.03	
CD at 5%				0.08	

Table 3. Changes during storage of RTS

Storage period (Months)	TSS (%)	Acidity (%)	Vitamin-C (mg/100ml)	Reducing Sugars (%)	Non-reducing sugar (%)	Total sugars (%)	Organoleptic	
							Score	Rating
0	13.00	0.30	10.76	0.90	12.22	13.09	8.23	LVM
1	13.11	0.56	10.15	1.20	12.05	13.25	8.00	LVM
2	13.23	0.68	9.96	1.38	11.98	13.36	7.60	LM
3	13.51	0.83	9.84	1.47	11.90	13.37	7.18	LM
S.Em±	0.03	0.01	0.03	0.01	0.04	0.02	0.02	
CD at 5%	0.10	0.03	0.09	0.02	0.13	0.09	0.09	

LVM: Like very much, LM: Like moderately

4. CONCLUSION

It is concluded that the above findings that RTS prepared from 10 % blend comprising 50 % guava pulp +25% strawberry pulp + 25 % ginger juice and adjusted to 13 % TSS and 0.30% acidity was found to be best during organoleptic quality and can be stored up to 3 months with acceptable quality. The TSS, acidity, reducing sugars and total sugars was increased, whereas ascorbic acid, non-reducing sugar, and organoleptic quality was decreased during storage.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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