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Evaluation of Quality Assessment during Storage of Ready-to-Serve (RTS) Blended from Papaya, Ginger and Honey

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Authors' contributions

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

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ABSTRACT

The current investigation took place at P.G. Laboratory of Department of Horticulture, School of Agriculture, ITM University, Gwalior (M.P.) during the year 2021. To satisfy customer demand in both national and international markets, blended beverages made from fruits, medicinal herbs, and spices are a rich source of nutrients, medical characteristics, and flavours. 10 % of blend consisting 80 % papaya pulp, 10 % ginger juice and 10 % honey (T_6) was found best on 9- point hedonic scale by semi-trained judges including males and females for the preparation of RTS with 13% TSS, 0.20% acidity and 70 ppm SO_2 than other blend combinations. Result revealed that the TSS,

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acidity, reducing sugars and total sugars increased whereas, pH, vitamin-A, vitamin-C, non-reducing sugar and organoleptic score decreased continuously up to the termination period of the storage under room conditions (23.1-28.7^{0}C). Furthermore, it had been noticed that RTS beverage could be stored for 4 months with acceptable sensory quality into polypet bottles.

Keywords: Papaya; ginger; honey; RTS; Polypet bottles; organoleptic quality; storage.

1. INTRODUCTION

Blending is one of the most efficient ways to enhance the nutritional quality of a juice.Depending on the variety and quality of the fruits and vegetables used, it might increase the vitamin and mineral levels [1]. Ready-to-serve (RTS) beverages are gaining popularity across the country due to their health and nutritional benefits, as well as their pleasing flavour and taste. Fruit-based RTS beverages and juices are not only high in essential minerals, vitamins, and other nutrients, but they are also delicious and universally appealing [2]. By using blending technology in beverage processing, it is possible to combine the sensory, nutritional, and therapeutic qualities of two or more plant species into a beverage. Papaya (*Carica papaya* Linn.) is a member of the Caricaceae family and is known as papaya in English, Papita in Hindi, and Erandakarkati in Sanskrit. The plant is indigenous to Tropical America and was presented to India in the sixteenth century. The plant is distinguished by its weak and usually unbranched soft stem that yields copious white latex and is crowded by a terminal cluster of large and long stalked leaves. It grows fast and can reach a height of 20 m. Papaya leaves are widely used for the treatments of malaria, dengue, jaundice, immunomodulatory and antiviral activity. Compared to mature leaves, papaya leaf and fruit contain β-carotene, lycopene, and anthraquinones glycoside, which gives them medicinal properties like anti-inflammatory, hypoglycaemic, anti-fertility, abortifacient, hepatoprotective, wound healing, and most recently, antihypertensive and antitumor activities. Since leaves are a significant component of many traditional formulations, efforts are made to standardise them for things like moisture content, extractive values, ash values, swelling index, etc [3]. Now-a-days papaya is widely used in processing industry due to having low shelf life e.i. candy, sweet and other processed products.

Every country in the world consumes honey in some form since it is a natural biological product that developed from nectar and is extremely beneficial to humans both as a food and a medicine. Honey has minor amounts of proteins, minerals, organic acids, and vitamins in addition to glucose, fructose, and water. The distinctive flavour, sweetness, and texture are what make it popular. Ginger scientifically known as *Zingiber officinale* Rosc. belongs to the family of Zingiberaceae. Fresh ginger is frequently used to make pickles and candies. Fresh ginger juice is used to make beverages, whereas dry ginger is used to make ginger powder, oleoresin, essence, soft drinks, non-alcoholic beverages, and ginger oil. The richest component of ginger is starch, which makes up 40–60% of the dry rhizome as a whole. The beverage has health-promoting properties as a result of the fine ginger grains' fermentation with yeasts. It is also very useful for treating heart disease [4]. It is widely used for preparation of various type of beverages.

2. MATERIALS AND METHODS

2.1 Raw Materials

Papaya (Local variety), ginger (Local variety) and honey purchased from local market near ITM University were used for the RTS preparation.

2.2 Extraction of Papaya, Honey and Ginger Juice

The process adopted for the extraction of papaya pulp and ginger juice is given in Fig. 1 and Fig. 2, respectively.

2.3 Standardization of Blends for RTS

The following combinations of papaya pulp, ginger juice and honey were evaluated to standardize the blend for the development of palatable and quality RTS.

T1 10% blend comprising 100 % papaya pulp + 0 % ginger juice + 0 % honey and adjusted to 13 % TSS, 0.20 % acidity and 70 ppm SO2.

T2 10% blend comprising 0 % papaya pulp + 100 % ginger juice + 0 % honey and adjusted to 13 % TSS, 0.20 % acidity and 70 ppm SO2.

T3 10% blend comprising 0 % papaya pulp + 0 % ginger juice + 100 % honey and adjusted to 13 % TSS, 0.20 % acidity and 70 ppm SO2.

T4 10% blend comprising 33.33 % papaya pulp + 33.33 % ginger juice +33.33 % honey and adjusted to 13 % TSS, 0.20 % acidity and 70 ppm SO2.

T5 10% blend comprising 70 % papaya pulp + 15 % ginger juice + 15 % honey and adjusted to 13 % TSS, 0.20 % acidity and 70 ppm SO2.

T6 10 % blend comprising 80 % papaya pulp + 10 % ginger juice + 10 % honey and adjusted to 13 % TSS, 0.20 % acidity and 70 ppm SO2.

T7 10% blend comprising 90 % papaya pulp + 5 % ginger juice + 5 % honey and adjusted to 13 % TSS, 0.20 % acidity and 70 ppm SO2.

2.4 Preparation of RTS

From several treatments, RTS containing 10% blend, 13% TSS, and 0.20% acidity was created. To determine the ideal blend for large-scale production, the prepared RTS was organoleptically assessed on a 9-point hedonic scale. In Fig. 3, the method for RTS production is depicted.

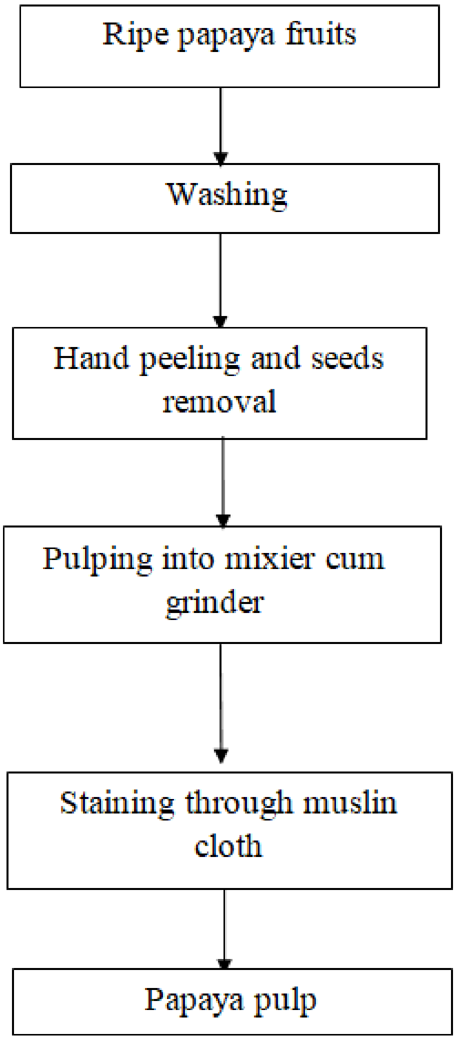

Fig. 1. Flow chart for extraction of pulp from papaya fruits

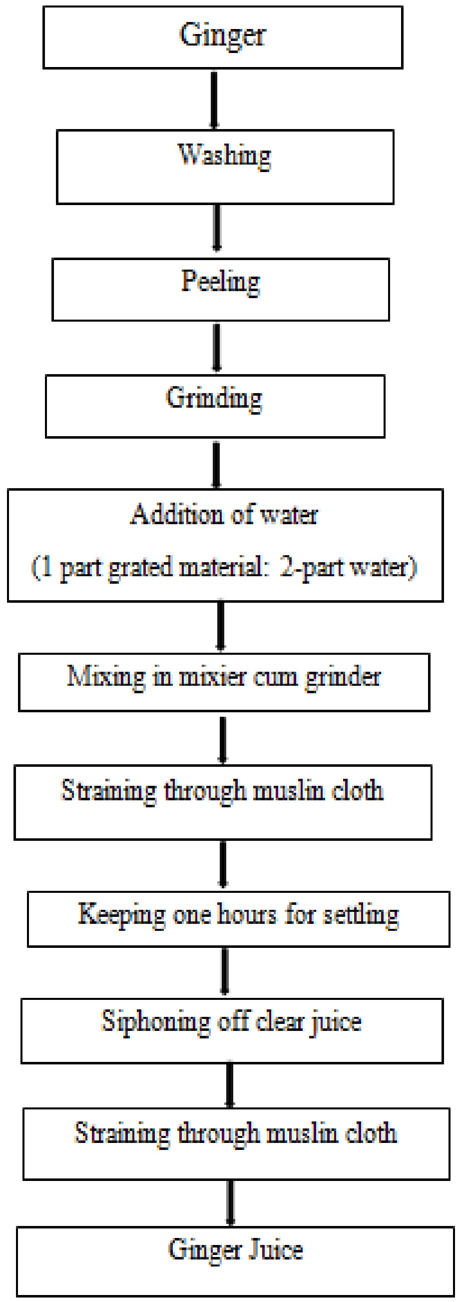

Fig. 2. Flow chart for extraction of ginger juice

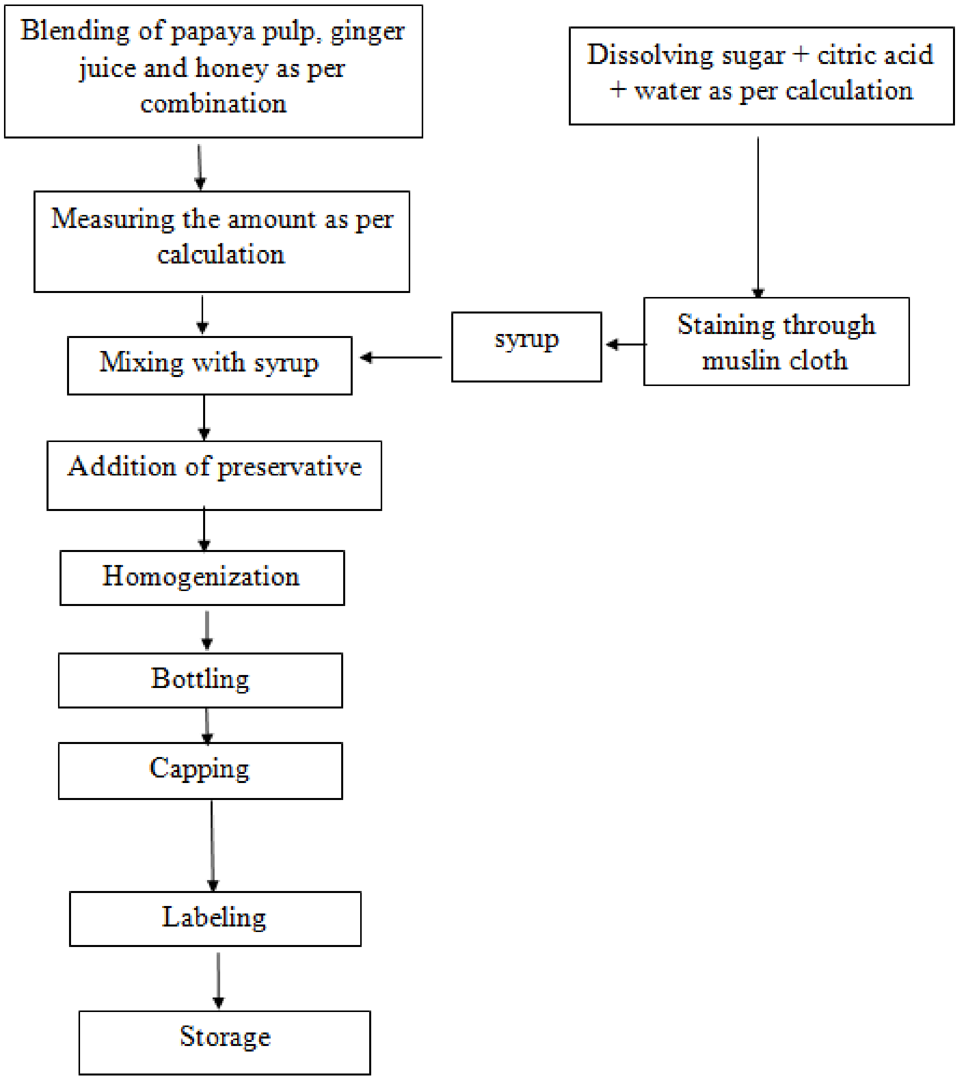

Fig. 3. Flow sheet for preparation of papaya + ginger + honey blended RTS

2.5 Storage Studies

In order to conduct storage tests under ambient conditions, about 5 litres of RTS were made using the optimal mix combination and placed into polypet bottles with a 200 ml capacity, leaving 1.6 cm of headspace (23.1- 28.70C). TSS, acidity, pH, vitamin A, ascorbic acid, sugars, and organoleptic quality changes during storage were monitored and recorded on a monthly basis (30 days). Observations were recorded for changes in TSS, pH, acidity and Ascorbic-acid, vitamin-A, sugars and organoleptic quality at monthly intervals (30 days). These observations are detailed below.

The TSS of the sample of determined by using hand refractometer (Model: ERMA INC. TOKYO JAPAN) having the range of 0-32%. With the aid of a reference table, the TSS measurements taken at ambient temperature were adjusted to 20°C, and the mean value was represented as a percent. TSS concentration of the sample was evaluated by titrating a known quantity of it against 0.1 N sodium hydroxide solution using phenolphthalein indicator, and the acidity was represented as a percent of anhydrous citric acid [5]. "pH is determined by a digital pH meter using buffer solutions (4, 7 and 9.2) while, vitamin-C content was estimated by preparing sample in 3 % metaphosphoric acid solution and titrating against 2, 6 dichlorophenol indophenols (dye solution) till the appearance of light pink colour" [6]. Using fehling's solutions A and B and methylene blue as an indicator, the sugars were analysed. RTS was assessed on a 9-point hedonic scale for colour, flavour, taste, appearance, and general acceptability by a panel of 9 semi-trained judges, including both men and women.

2.6 Statistical Analysis

Three replications of the experiments were carried out, and the statistical analysis of the data was completed on Excel using the "SPSS" programme, following the procedure outlined by Panse and Sukhatme in [7] for the CRD experiment.

3. RESULTS AND DISCUSSION

3.1 Chemical Attributes of Papaya Pulp, Ginger Juice and Honey

The data pertaining to chemical attributes of fresh papaya pulp, ginger juice and honey is presented in Table 1 which revealed that the papaya pulp used in RTS making contained 10.00 % TSS, 0.13 % acidity, 5.53 pH, 60.85 mg/100g vitamin-C, 4.91 % reducing sugars, 4.25 % non-reducing sugar and 9.16 % total sugars. Similarly, Kumari et al. [8] showed 14.50% TSS, 0.18% acidity, 4.52% reducing sugar, 6.10% non-reducing sugar, 10.62% total sugars in papaya. Ginger juice contained 2.13 % TSS, 0.22 % acidity, 6.5 pH, 1.9 mg/100g vitamin-C, 0.61 % reducing sugars, 1.14 % non-reducing sugar and 1.75 % total sugars. Similarly, Hedge et al. [9] reported 1.50 % TSS, 0.24 % acidity, 5.20 % pH, 2.70 mg/100g vitamin-C, 0.64 % reducing sugars and 1.60 % total sugars in ginger. Honey contained 80.00 % TSS, 0.70 % acidity, 4.23 pH , 0.5 mg/100g vitamin-C, 46.77 % reducing sugars, 32.23 % non-reducing sugar and 79.00 % total sugars. The subtle difference in chemical attributes of raw materials might be due to variety, season and lab facilities.

3.2 Standardization of blends for RTS

A quality blended RTS with 10 % blend comprising 80 % papaya pulp, 10 % ginger juice and 10 % honey with 13 % TSS and 0.20 % acidity and 70 ppm SO_2 was organoleptically found best for preparation of blend RTS (Table 2). Similarly, Sindumathi et al. [10] reported that 10% of blended juices incorporated 50% papaya juice + 50% mango juice with 15% TSS and 0.3% acidity was reached the highest sensory scores for overall acceptability. which indicates that component of raw materials influenced the acceptability of the blend beverages.

3.3 Biochemical changes during storage

The biochemical changes that occurred when RTS was being stored in polypet bottles are depicted in Table 3, which shows that after 4 months of storage, the TSS of RTS steadily increased from 13.00% to 13.79%. The hydrolysis or conversion of polysaccharides into simple sugars (monosaccharides and oligosaccharides) may be the cause of this shift. These results are also in conformity with the findings of Sawant et al. [11] in papaya and aloe vera blended RTS, Kumari et al. [8] in RTS prepared from papaya and aloe vera, Harendra and Deen [6] in mango based RTS and Deen and Harendra [12] in rangpur lime based RTS. The acidity of RTS increased gradually from 0.20 % at initial day to 1.05 % at final day of storage. This alteration could be attributed to the degradation of pectic substances and the formation of organic acid, which has been shown to boost the acidity (citric acid) of fruit products [13]. Similarly, an increasing trend in acidity during storage was observed by Bornare and Khan [14] in papaya and banana blended RTS, Hirdyani [15] in kinnow-basil-ginger blended RTS, Hariharan and Mahendran [16] in ginger-lime blended RTS, Sindumathi et al. [10] in papaya and mango based RTS and Harendra and Deen [6] in mango based RTS. The pH decreases from 2.76 to 2.17 during 4 months of storage. This might be due to increase in titrable acidity, as acidity and pH are inversely proportional to each other. Similarly finding was observed by Sindumathi and Premalatha [17] in the papaya and pineapple based RTS and Sawant et al. [11] in the papaya and aloe vera based RTS. Vitamin-A content was continuously decreased from the first day (93.87 I.U.) to the end of storage (92.95 I.U.) entire the storage period. This finding was supported by Sindumathi and Premalatha (2013); Sindumathi et al. [10] and Harendra and Deen [18]. Ascorbic acid content was continuously decreased from the first day (8.35 mg/100ml) to the end of storage (7.77 mg/100ml) entire the storage period. This drop in vitamin C level may be caused by the

Table 1. Chemical attributes of papaya pulp, ginger juice and honey

Chemical attributes	Papaya pulp	Ginger juice	Honey
TSS (%)	10	2.13	80.00
Acidity (%)	0.13	0.223	0.70
pH	5.53	6.50	4.23
Vitamin A (I.U.)	950	0.00	0.00
Vitamin C (mg/100g)	60.85	1.90	0.5
Reducing sugars (%)	4.91	0.61	46.77
Non-reducing sugar (%)	4.25	1.14	32.23
Total sugars (%)	9.16	1.75	79.00

Table 2. Organoleptic quality of RTS prepared from different blends of papaya pulp, ginger juice and honey

Treatments	Different combination of blends			Organoleptic quality	
	Papaya pulp	Ginger juice	Honey	Score	Rating
T1	100	0	0	7.69	Like moderately
T2	0	100	0	7.00	Like moderately
T3	0	0	100	7.50	Like moderately
T4	33.33	33.33	33.33	7.90	Like moderately
T5	60	20	20	8.04	Like very much
T6	**80**	**10**	**10**	**8.31**	**Like very much**
T7	90	5	5	8.20	Like very much
SE (m)				**0.23**	
C.D. at 5%				**0.70**	

Table 3. Biochemical and organoleptic changes of RTS during storage into polypet bottles

Storage period in months	TSS (%)	Acidity (%)	pH	Vitamin-A (I.U.)	Vitamin-C (mg/100ml.)	Reducing sugars (%)	Non-reducing sugar (%)	Total sugars (%)	Organoleptic	
									Score	Rating
0	13.00	0.20	2.76	93.87	8.35	6.00	3.93	9.93	8.31	LVM
1	13.11	0.33	2.70	93.62	8.22	6.15	3.84	9.99	8.08	LVM
2	13.34	0.51	2.59	93.44	8.08	6.34	3.70	10.04	7.81	LM
3	13.50	0.79	2.40	93.17	7.92	6.57	3.52	10.09	7.44	LM
4	13.79	1.05	2.17	92.95	7.77	6.76	3.39	10.15	7.06	LM
SE (m)	0.01	0.04	0.10	0.03	0.02	0.02	0.04	0.03	0.05	
C.D. at 5%	0.04	0.11	0.32	0.09	0.07	0.06	0.11	0.08	0.17	

LVM: Like very much, LM: Like moderately oxygen-induced oxidation of ascorbic acid into dehydro-ascorbic acid. Similar observation was also observed by Kumari et al. [8] and Deen and Harendra [18]. The reducing sugars and total sugars of blended RTS increased and it was increased from 6.00 % to 6.76% and 9.93% to 10.15 %, respectively. This change might be due to the inversion of non-reducing sugar into reducing sugars. This was also shown by Malav et al. [19] in orange based blended RTS and Sindumathi et al. [10] in papaya based RTS. The non-reducing sugar (Sucrose) of formulated RTS was decreased during storage and it was decreased from 3.93 % to 3.39 %. This might be due to also inversion of reducing sugars. Singh et al. [20] provided support for this conclusion in mango and aloe vera blended RTS and Kumari et al. [8] in papaya and aloe Vera blended RTS. The blended RTS organoleptic score gradually decreased with increasing the storage period at room temperature (23.1-28.7^{0}C). RTS continued to be acceptable for four months. The score was significantly decreased from 8.31 to 7.06. This change could be due to temperature, as temperature plays a crucial role in biochemical changes that lead to the development of off flavours and discoloration in beverages. Previous research by Kumari et al. [8] on papaya and aloe vera blended RTS and by Harendra and Deen [6] on mango-based RTS beverages both revealed a decrease in organoleptic quality.

4. CONCLUSION

The study concluded that RTS prepared from 10 % blend pulp comprising 80% papaya pulp, 10% ginger juice and 10% honey containing 13% TSS, 0.20% acidity and 70 ppm SO_2 (T6) was found superior among all the treatments during organoleptic evaluation. While the pH, vitamin A, vitamin C, non-reducing sugars, and organoleptic quality were reduced following storage into polypet bottles, the Total Soluble Solids, acidity, reducing sugars, and total sugars were enhanced. At ambient temperature (23.1-28.7^{0}C), the RTS can be kept in acceptable-quality polypet bottles for up to 4 months.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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