



Studies on Syrup Preparation from Mango (*Mangifera indica* L.), Citrus (*Citrus aurantifolia* Swingle.), Aloe Vera (*Aloe barbadensis* Miller.) and Ginger (*Zingiber officinale* Rosc.) Blends

Harendra^{a*} and Bhagwan Deen^{b#}

^a ITM University Gwalior- 474001, M.P., India.

^b Department of Fruit Science, College of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya -224229, U.P., India.

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 of Department of Fruit Science, College of Horticulture and Forestry, A.N.D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during the year 2019-2020. The blend beverages of fruits, medicinal plants and spices are rich source of nutrients, medicinal properties and flavors to meet the consumers demand in National and International markets. 25 per cent of blend comprising 55 per cent mango pulp, 25 per cent kagzi lime juice, 10 per cent Aloe vera gel and 10 per cent ginger juice was found best on 9- point hedonic scale for the preparation of syrup with 70 per cent TSS and 1.20 per cent acidity than other blend combinations viz., 100, 0, 0 and 0 percent (T₁); 0, 100, 0 and 0 percent (T₂); 0, 0, 100 and 0 percent (T₃); 0, 0, 0 and 100 percent (T₄); 25, 25, 25 and 25 percent (T₅); 40, 20, 20 and 20 percent (T₆); 70, 10, 10 and 10 percent (T₇); 20, 40, 20 and 20 percent (T₈) and 50, 20, 15 and 15 percent (T₁₀), mango pulp, kagzi lime juice, Aloe vera gel and ginger juice, respectively. The TSS, acidity, reducing sugars and total sugars increased whereas, vitamin-A, vitamin-C, non-reducing sugar and organoleptic score decreased continuously up to the end of the storage period under ambient temperature (20.1-29.4°C). Moreover, it had been found that syrup organoleptically acceptable up to 5 months of storage in case of both glass and polypet

[‡]Assistant Professor;

[#]Professor and Head (Post Harvest Technology) [Ex. ARS, PCS (A) & PC-KVK];

^{*}Corresponding author: E-mail: a7906837701@gmail.com;

bottles. This study indicates that mango, kagzi lime, Aloe vera and ginger can be utilized for palatable syrup making beneficial for the consumers in terms of taste, color, flavor, medicinal and therapeutic properties.

Keywords: Syrup; mango pulp (*Mangifera indica* L.); kagzi lime juice (*Citrus aurantifolia* Swingle.); aloe vera gel (*Aloe barbadensis* Miller.); ginger juice (*Zingiber officinale* Rosc.); blend combination; glass and polypet bottles; storage; organoleptic quality.

1. INTRODUCTION

A beverage is a liquid intended for human consumption, in addition to their basic function of satisfying thirst, beverages play an important role in human culture [1]. Beverages are of two types-unfermented (non-alcoholic) and fermented (alcoholic). Blended beverages with using different fruits, vegetables, spices extract and plants of medicinal values as new food products definitely attract the consumers in the interpretation of sensory and nutritional characteristics.

Mango is the king among tropical fruits which is botanically known as *Mangifera indica* L. and belongs to the family Anacardiaceae. It is also known as Aam, National fruit of India, Bathroom fruit and Symbol of love. It is originated in South-East-Asia, particularly in Indo-Burma region. On the basis of analysis of different varieties of mango, it is reported that mango fruit contains moisture 73.0 – 86.7%, carbohydrate 11.6 – 24.3%, protein 0.3 – 1.0%, fat 0.1 – 0.8%, fibers 0.8%, minerals 0.3 – 0.7%, Vitamin A 650 – 25940 I.U., Vitamin C 3 – 83 mg/100g, calcium 0.01%, phosphorous 0.02% and iron 4.5 mg/100 g [2]. Young and unripe mango fruits are utilized for culinary purposes as well as for preparing pickles, chutney and amchur, because of their acidic taste. Ripe mango fruits are utilized in preparation of pulp, juice, syrup, squash, jam, jelly, preserve, nectar, canned slices, dried powder, RTS, baby food, mango leather (Aam Papar), toffee, candy and many other products. These conventional type of mango products have been developed to a considerable level and a significant demand has been built up by the processing industry, both for domestic and export market [3-6].

Citrus (*Citrus spp.*) is a genus of flowering trees and shrubs, belonging to the family Rutaceae. Citrus fruits are used extensively in food processing industry to prepare a wide varieties of products such as RTS, juice, squash, syrup, chutney, slices, pickles and cordial. Kagzi lime (*Citrus aurantifolia* Swingle) is said to be originated in India. Vitamin C content is the

maximum in acid lime (15-65 mg/100 g). The fruit is very sour because of high quantity of acid; hence fresh fruits are not consumed whereas, fresh juice mixed with water and sugar makes a delicious drink during summer season. Lime fruits are also consumed as pickles in India. Lime juice reduces the body heat and increases the appetite. Drinking lime juice with salt reduces the stomach pain. It helps in digestion of foods. They are refreshing and delicious to eat.

Aloe vera (*Aloe barbadensis* Miller) is perennial, drought resistant succulent plant commonly known as 'Ghrit-kumari' and 'Gheegwar' belongs to the Asphodelaceae or Liliaceae family, which historically has been used for a variety of medicinal purpose. There are 275 species of aloe vera grown all over the world. The most widely used species of aloe vera are *Aloe barbadensis* Miller and *Aloe aborescens* [7,8]. Aloe vera gel is colorless, transparent and slippery mucilage containing water and bioactive polysaccharides mainly acemannan and glucomannan. Aloe vera gel is used to treat constipation, coughs, ulcers, diabetes, headaches, arthritis, and immune-system deficiencies [9]. In food industry, it has been used as an ingredient for preparation of functional foods and production of gel-containing health drinks, energy drinks and different type of beverages like RTS, squash, syrup, tea, milk, ice-cream and confectionary.

Ginger is an ancient medicinal as well as spicy plant belonging to Zingiberaceae family and botanically known as *Zingiber officinale* Rosc. It is indigenous to South-Eastern-Asia. Since a very long time ginger is known for its medicinal values as a digestive aid, spiritual beverage, aphrodisiac, antiemetic, anticancer, anti-oxidant, anti-inflammatory and immune stimulating properties [10]. The fresh ginger is widely used in pickles and candies making whereas fresh ginger juice is used in RTS, squash, syrup and nectar beverages preparation while ginger powder, oleoresin, essence, soft drink, non-alcoholic beverages and ginger oil are manufactured from dry ginger. Ginger ale and the ginger beer are

two most popular ginger drinks which are carbonated ginger, flavored with soft drinks.

The demands of natural beverages rich in nutrients and having therapeutic as well as medicinal values, are increasing because of changing life style, health consciousness and increasing purchasing capacity of the consumers. The present studies were carried out because the blend beverages of fruits, medicinal plants and spices are rich source of nutrients, medicinal properties and flavors to meet the consumers demand in National and International markets.

2. MATERIALS AND METHODS

2.1 Raw Materials

Mango (var. Dashehari), kagzi lime purchased from local market, Aloe vera (var. Samsheetal)

purchased from National Botanical Research Institute, Lucknow and ginger (Local variety) purchased from local market were used for the syrup preparation.

2.2 Extraction of Mango Pulp, Kagzi Lime Juice, Aloe Vera Gel and Ginger Juice

The process adopted for the extraction of mango pulp, kagzi lime juice, Aloe vera gel and ginger juice is given in Fig. 1, Fig. 2, Fig. 3 and Fig. 4, respectively.

2.3 Standardization of Blends for Syrup

The following combinations of mango pulp, kagzi lime juice, Aloe vera gel and ginger juice were evaluated to standardize the blend for the development of palatable and quality syrup (Table 1).

Table 1.

Treatments	Mango pulp (%)	Kagzi lime juice (%)	Ginger juice (%)	Aloe vera jel (%)
T ₁	100	0	0	0
T ₂	0	100	0	0
T ₃	0	0	100	0
T ₄	0	0	0	100
T ₅	25	25	25	25
T ₆	40	20	20	20
T ₇	70	10	10	10
T ₈	20	40	20	20
T ₉	55	25	10	10
T ₁₀	50	20	15	15

25% blended fruit juice, 70% TSS and 1.20% acidity for syrup (Recommended by Food Products Order)

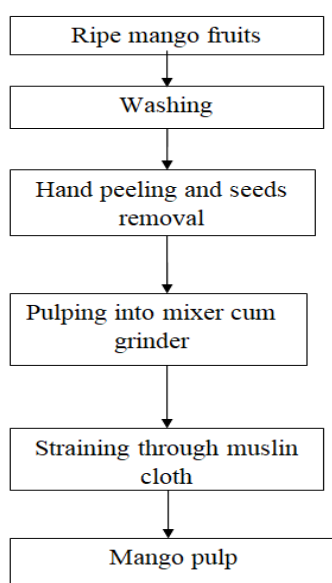


Fig. 1. Flow chart for extraction of pulp from mango fruits

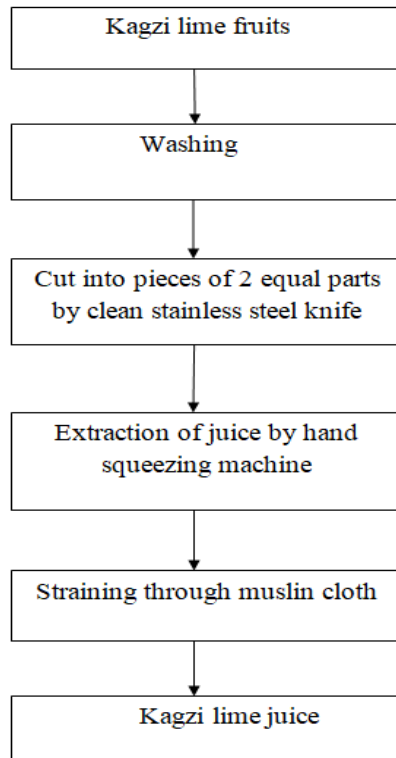


Fig. 2. Flow chart for extraction of juice from kagzi lime fruits

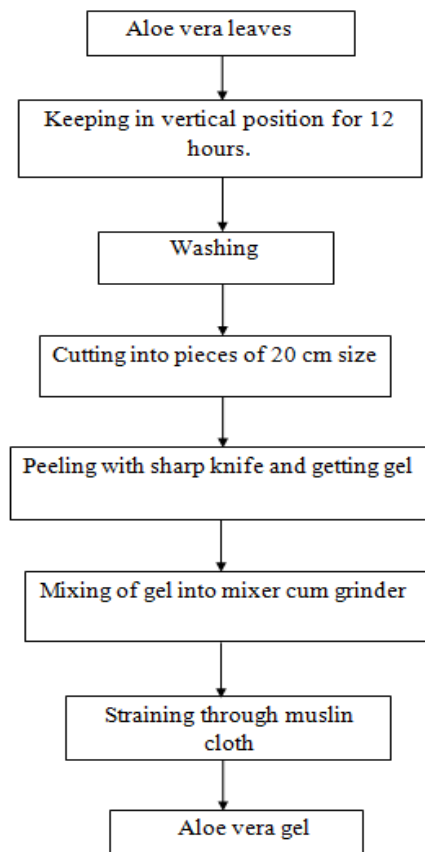


Fig. 3. Flow chart for extraction of Aloe vera gel

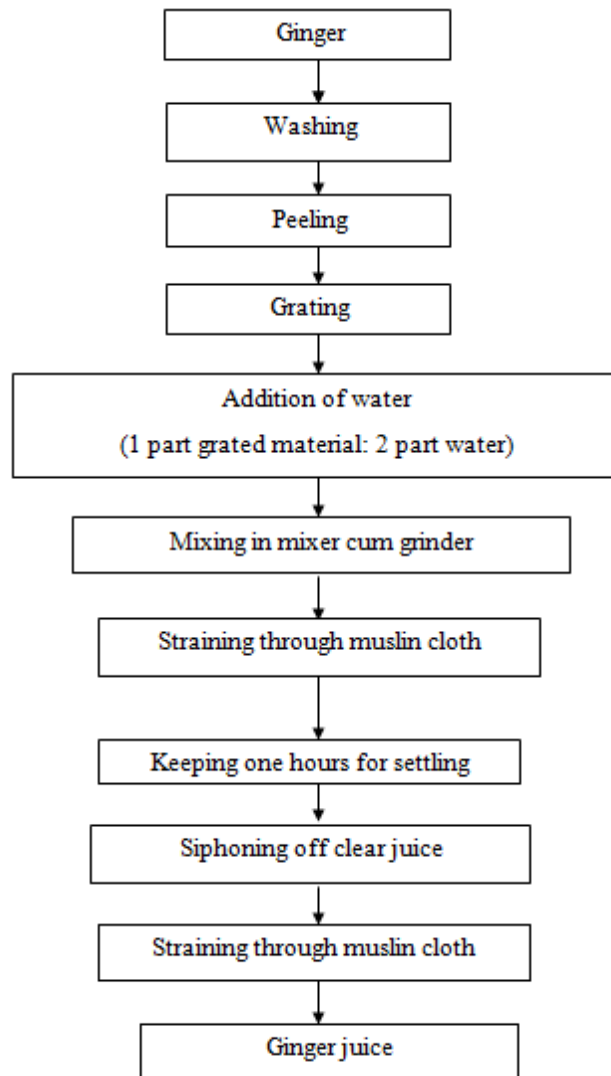


Fig. 4. Flow chart for extraction of ginger juice

2.4 Preparation of Syrup

Syrup comprising 25% blend, 70% TSS and 1.20% acidity were prepared from different treatments. The prepared syrup was organoleptically evaluated on 9-point Hedonic scale to find out the best combination of blend for large scale preparation. The technique used for syrup making is shown in Fig. 5.

2.5 Storage Studies

About 5 litres of syrup was prepared with best combination of blend, and filled into 750 ml glass bottles and polypet bottles of 750 ml capacity leaving 2 cm head space, capped and put for storage studies under ambient condition (20.1-29.4°C). During storage observation on changes in TSS, acidity, vitamin-A, vitamin-C, reducing

sugars, non-reducing sugar, total sugars and organoleptic quality were recorded at monthly interval. Observations were recorded for changes in TSS, acidity and vitamin-C [11], vitamin-A [12], sugars [13] and organoleptic quality [14] at monthly intervals during 5 months of storage period and are described as follows.

The TSS of the sample of determined by using hand refractometer (Model: ERMA INC. TOKYO JAPAN) having the range of 58- 92 percent. The values of TSS recorded at ambient temperature were corrected at 20°C with the help of reference table and the mean value was expressed as per cent. 'TSS content of the sample (Ranganna, 2010) whereas the acidity was determined by titrating known quantity of sample against 0.1 N sodium hydroxide solution using phenolphthalein indicator and expressed in per cent anhydrous

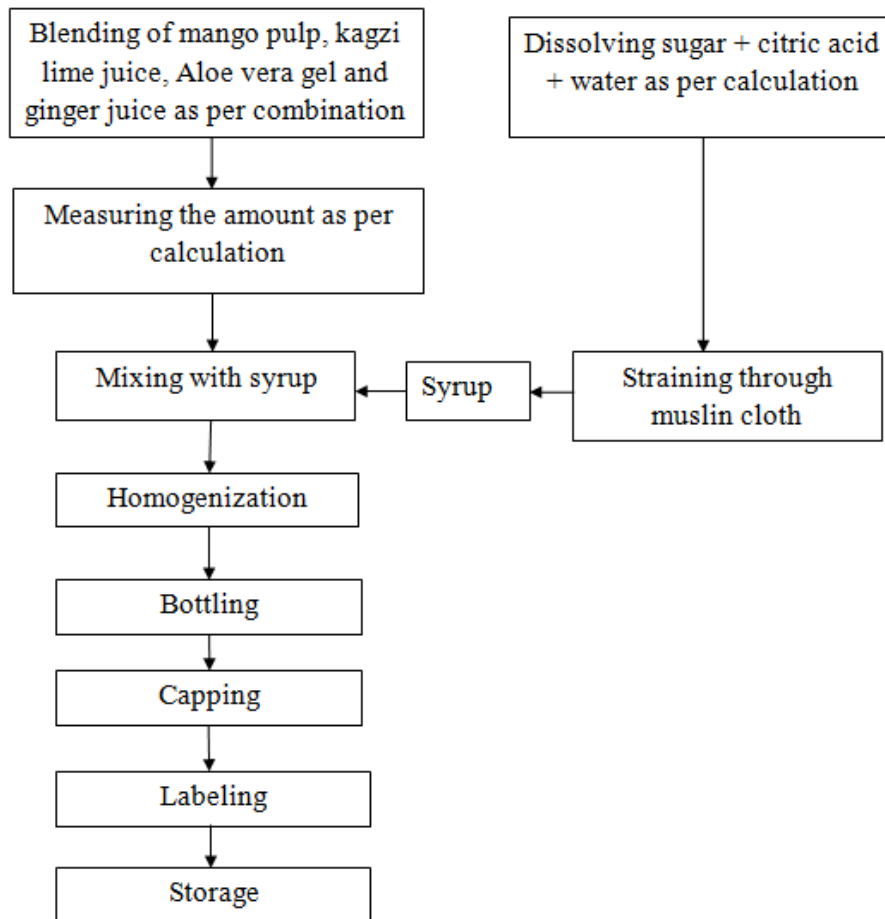


Fig. 5. Flow sheet for preparation of mango + kagzi lime + Aloe vera + ginger blended syrup

citric acid. Vitamin-A was determined by preparing sample in acetone, then in petroleum ether and thereafter in sodium sulphate till the appearance of dark yellowish green colour and the optical density was measure at 452 nm and 503 nm using spectrophotometer. Vitamin-C content was estimated by preparing sample in 3 per cent metaphosphoric acid solution and titrating against 2, 6 dichlorophenol indophenols dye solution till the appearance of light pink colour. The reducing, non-reducing and total sugars were analysed by using Fehling's solution A and B and methylene blue indicator. A panel of 9 semi trained judges evaluated syrup for its colour, flavour, taste, appearance and overall acceptability on 9-point Hedonic scale.

2.6 Statistical Analysis

The experiments were conducted in 3 replications and the statistical analysis of the data was done by computer software "SPSS" on excel as the method described by Panse and Sukhatme [15] for CRD experiment.

3. RESULTS AND DISCUSSION

3.1 Chemical Attributes of Fresh Mango Pulp, Kagzi Lime Juice, Aloe Vera Gel and Ginger Juice

The data pertaining to chemical attributes of fresh mango pulp, kagzi lime juice, Aloe vera gel and ginger juice is presented in Table 2 which revealed that the mango pulp used in syrup making contained 19.00 percent TSS, 1.36 per cent acidity, 2650.17 I.U. vitamin-A, 17.33 mg/100g vitamin-C, 4.24 per cent reducing sugars, 12.66 per cent non-reducing sugar and 16.90 percent total sugars. Similarly Chaudhary et al. [16] reported 23.10 percent total soluble solids, 0.31 per cent acidity, 16.00 mg/100 g vitamin-C, 7.08 per cent reducing sugars, 12.24 per cent non-reducing sugar, 19.32 per cent total sugars and 14.30236 mg/100 g total carotene in mango pulp. Kagzi lime juice contained 5.00 per cent TSS, 7.68 percent acidity, 2.78 I.U. vitamin-A, 59.80 mg/100ml vitamin-C, 1.43 per cent reducing sugars, 1.08 per cent non-reducing

sugar and 2.51 per cent total sugars whereas, Hariharan and Mahendran [17] reported that 6.21⁰B TSS, 5.88 per cent acidity, 38.91 mg/100ml vitamin-C and 1.43 per cent total sugars in kagzi lime juice. Aloe vera gel contained 1.88 per cent TSS, 0.24 per cent acidity, 0.00 I.U. vitamin-A, 2.53 mg/100g vitamin-C, 0.53 per cent reducing sugars, 1.18 per cent non-reducing sugar and 1.71 per cent total sugars whereas, Sudhendra et al. [18] reported that Aloe vera gel contains 0.80-0.86⁰B TSS, 4.50-4.52 pH, 0.23-0.26 per cent acidity, 3.76-3.86 mg/100g vitamin-C, 97.8-99.0 per cent moisture, 0.026 per cent reducing sugars, 1.894 per cent non-reducing sugar, 1.92 per cent total sugars, 8.86-9.00 mg/100g calcium and 0.92-0.94 mg/100 g iron. Ginger contained 2.20 per cent TSS, 0.26 per cent acidity, 0.00 I.U. vitamin-A, 1.90 mg/100 g vitamin-C, 0.63 per cent reducing sugars, 1.12 per cent non-reducing sugar and 1.75 per cent total sugars similarly Hegde et al. [19] observed 1.50⁰B TSS, 5.20 pH, 0.24 per cent acidity, 2.70 mg/100 g vitamin-C, 0.64 per cent reducing sugars and 1.60 per cent total sugars in ginger. The subtle difference in chemical attributes of raw materials might be due to variety, agroclimatic and cultural practices.

3.2 Standardization of Blends for Syrup

A quality blended syrup with 25 per cent blend comprising 55 per cent mango pulp, 25 per cent kagzi lime juice, 10 per cent Aloe vera gel and 10 per cent ginger juice with 70 per cent TSS and 1.20 per cent acidity was organoleptically found best for preparation of blend syrup (Table 3). Similarly Tiwari and Deen [20] observed that syrup containing 50% bael pulp and 50% Aloe vera gel has secured highest organoleptic score. Chaudhary et al. [16] reported that the syrup containing 75 per cent mango pulp and 25 per cent aloe vera gel has secured maximum organoleptic score which indicates that component of raw materials influenced the acceptability of the blend beverages.

3.3 Biochemical Changes during Storage

Data pertaining to biochemical changes during storage of syrup into glass and polypet bottles are presented in Table 4 and Table 5, respectively which indicates that the TSS of syrup increased gradually after 5 months of storage from 70.00 per cent to 71.42 per cent and from 70.00 per cent to 73.30 per cent into glass and polypet bottles, respectively. This change might be due to the conversion or

hydrolysis of polysaccharides into simple sugars (monosaccharides and oligosaccharides). The conversion rate was comparatively higher in polypet container than glass bottles which might be due to container effects. Similarly an increasing trend in TSS during storage was reported in pummelo based blended syrup [21], mango-aloe vera blended syrup [22], bael and aloe vera blended syrup [20], mango squash [23], mango, orange and pineapple mixed juice [24], wood apple squash [25] and phalsa-pear blended juice [26], which are in agreement of present observations. The acidity of syrup increased gradually during storage period. Total acidity was increased from 1.20 per cent at initial day to 1.81 per cent at final day of storage into glass bottles while, from 1.20 per cent at initial day to 1.87 per cent into polypet bottles. Degradation of pectic substances and formation of organic acid have been reported to increase the acidity of fruit products [27]. Similarly an increasing trend in acidity during storage was observed by Chaudhary, [22] in mango-aloe vera blended syrup, Biswas et al. [28] in Aloe vera and pineapple blended beverage, Tiwari and Deen [20] in bael and aloe vera blended syrup, Begum et al. [24] in mango, orange and pineapple mixed juice and Kumar and Deen [25] in wood apple squash. Vitamin-A content was continuously decreased from the first day (664.50 I.U.) to the end of storage (661.74 I.U.) throughout the storage period into glass bottles and (664.50 I.U.) to (661.11 I.U.) into polypet bottles. This decrease in vitamin-A content might be due to the auto-oxidative degradation during storage and/or due to oxidative breakdown, isomerization or enzymatic destruction of the pigments. The loss of vitamin-A in syrup of different fruits based beverages during storage at ambient temperature was also reported in other studies [29,30,31,32,33]. Vitamin-C content was continuously decreased from the first day (23.41 mg/100 ml) to the end of storage (21.87 mg/100 ml) into glass bottles and (23.41 mg/100 ml) to (21.77 mg/100 ml) into polypet bottles throughout the storage period. This decrease in vitamin-C content might be due to the oxidation of ascorbic acid into dehydro-ascorbic acid by oxygen. The loss of vitamin C in syrup of different fruits based beverages during storage at ambient temperature was also reported in previous studies [21,22,20,29,24,25,30,26,34]. The reducing sugars and total sugars of blended syrup increased gradually and it was increased from 1.65 per cent to 3.93 per cent and 69.75 per cent to 70.91 per cent respectively in case of glass bottles whereas from 1.65 per cent to 4.10

per cent and 69.75 per cent to 71.00 per cent respectively in case of polypet bottles. The increase in reducing and total sugars of processed fruit products could be due to inversion of non-reducing sugar into reducing sugars. These finding were supported by Bohra et al. [21] in pummelo based blended syrup, Smitha et al. [35] in avocado based squash blended with sapota and Aloe vera, Chaudhary [22] in blended syrup of mango and aloe vera, Shahid et al. [36] in mango-mandarin squash, Tiwari and Deen [20] in bael and aloe vera blended syrup, Sherzed et al. [37] in strawberry based blended squash and Kumar et al. [30] in mango squash. The non-reducing sugar of blended syrup decreased continuously throughout the entire period of storage and it was decreased from 68.10 per cent to 66.98 per cent and from 68.10 per cent to 66.90 per cent into glass and polypet bottles respectively. The decrease in non-reducing sugar of processed fruit products might be due to inversion of non-reducing sugar. This finding was supported by published works of Tiwari and Deen [20] in bael

and aloe vera blended syrup, Mishra et al. [38] in mango-Aloe vera blend squash, Kumar and Deen [25] in wood apple squash and Noor uddin et al. [39] in blended mango-guava squash. Organoleptic score of blended syrup decreased gradually with the storage period at room temperature (20.1-29.4°C) but the acceptability of syrup was maintained up to five months. The score was significantly decreased from 8.10 at first day to 7.08 at final day of storage into glass bottles and from 8.10 to 7.01 into polypet bottles. The loss in organoleptic quality of beverages after certain period is obvious because of undesirable changes in the products. Temperature plays an important role in biochemical changes that leads to development of off flavour as well as discolouration in the beverages. Reduction in organoleptic quality are also reported in pummelo based blended syrup [21], lime squash [40], bael and Aloe vera blended syrup [20], concentrated orange juice [41] and guava-papaya blended bar [31]. These reported observations are in the support of the present findings.

Table 2. Chemical characteristics of mango pulp, kagzi lime juice, Aloe vera gel and ginger juice [42]

S. No.	Chemical attributes	Mean value			
		Mango pulp	Kagzi lime juice	Aloe vera gel	Ginger juice
1.	Total soluble solids (%)	19.00	5.00	1.88	2.20
2.	Acidity (%)	1.36	7.68	0.24	0.26
3.	Vitamin-A ((I.U.))	2650.17	2.78	0.00	0.00
4.	Vitamin-C (mg/100 g)	17.33	59.80	2.53	1.90
5.	Reducing sugars (%)	4.24	1.43	0.53	0.63
6.	Non-reducing sugar (%)	12.66	1.08	1.18	1.12
7.	Total sugars (%)	16.90	2.51	1.71	1.75

Table 3. Organoleptic quality of syrup prepared from different blends of mango pulp, kagzi lime juice, Aloe vera gel and ginger juice

Treatments (Recipe No.)	Different combination of blends				Organoleptic quality	
	Mango pulp (%)	Kagzi lime juice (%)	Aloe vera gel (%)	Ginger juice (%)	Score	Rating
T ₁	100	Nil	Nil	Nil	7.56	Like moderately
T ₂	Nil	100	Nil	Nil	6.56	Like slightly
T ₃	Nil	Nil	100	Nil	6.45	Like slightly
T ₄	Nil	Nil	Nil	100	6.05	Like slightly
T ₅	25	25	25	25	7.10	Like moderately
T ₆	40	20	20	20	7.25	Like moderately
T ₇	70	10	10	10	7.95	Like moderately
T ₈	20	40	20	20	6.87	Like slightly
T ₉	55	25	10	10	8.10	Like very much
T ₁₀	50	20	15	15	7.44	Like moderately
SE.m±					0.03	
CD at 5%					0.08	

Table 4. Biochemical and organoleptic changes of syrup during storage into glass bottles

Storage period (in months)	TSS (%)	Acidity (%)	Vitamin-A (I.U.)	Vitamin-C (mg/100ml)	Reducing sugars (%)	Non- reducing sugars (%)	Total sugars (%)	Organoleptic	
								Score	Rating
0	70.00	1.20	664.50	23.41	1.65	68.10	69.75	8.10	LVM
1	70.24	1.28	663.95	23.16	1.99	67.99	69.98	8.00	LVM
2	70.46	1.39	663.04	22.93	2.45	67.69	70.14	7.85	LM
3	70.73	1.53	662.72	22.64	2.82	67.50	70.32	7.62	LM
4	71.00	1.70	661.94	22.15	3.20	67.29	70.49	7.33	LM
5	71.42	1.81	661.74	21.87	3.93	66.98	70.91	7.08	LM
SE.m±	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.02	
CD at 5%	0.12	0.09	0.10	0.08	0.08	0.13	0.10	0.07	

LVM: Like very much, LM: Like moderately

Table 5. Biochemical and organoleptic changes of syrup during storage into polypet bottles

Storage period (in months)	TSS (%)	Acidity (%)	Vitamin-A (I.U.)	Vitamin-C (mg/100ml)	Reducing sugars (%)	Non- reducing sugars (%)	Total sugars (%)	Organoleptic	
								Score	Rating
0	70.00	1.20	664.50	23.41	1.65	68.10	69.75	8.10	LVM
1	71.50	1.32	663.65	23.22	2.04	67.91	69.95	7.87	LM
2	72.46	1.43	663.00	22.92	2.52	67.74	70.26	7.60	LM
3	72.83	1.57	662.48	22.60	2.94	67.44	70.36	7.45	LM
4	73.00	1.72	661.74	22.07	3.40	67.15	70.55	7.25	LM
5	73.30	1.87	661.11	21.77	4.10	66.90	71.00	7.01	LM
SE.m±	0.02	0.04	0.06	0.03	0.04	0.03	0.05	0.03	
CD at 5%	0.07	0.11	0.17	0.10	0.11	0.08	0.16	0.08	

LVM: Like very much, LM: Like moderately



Syrup at the time of storage into glass bottles



Syrup after five months of storage into glass bottles



Syrup at the time of storage into polypet bottles



Syrup after five months of storage into polypet bottles

4. CONCLUSION

It may be concluded from above findings that syrup prepared from 25 per cent blend comprising 55% mango pulp, 25% kagzi lime juice, 10% Aloe vera gel and 10% ginger juice containing 70% TSS and 1.20% acidity was best during organoleptic evaluation. The TSS, acidity, reducing sugars, total sugars was increased, whereas vitamin-A, vitamin-C, non-reducing and organoleptic quality was decreased during storage into both glass and polypet bottles. The syrup can be stored up to 5 months at ambient storage temperature (20.1-29.4⁰C) into both glass and polypet bottles with acceptable quality.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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