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Development of smoothies from selected fruit pulps/juices

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Abstract

Smoothies with improved sensory characteristics were developed by blending selected tropical Indian fruit pulps/juices. Fruit pulps from mango, papaya, sapota, banana; juices from green grapes and pineapple were blended at various proportions (10-60%) by considering their individual properties such as pulpy, juicy, sweetness, sourness and colour to yield palatable smoothies without addition of external sugar and acidulant. The selected smoothies with optimized quantities of fruit pulp/grape juice were prepared in bulk and preserved in glass bottles by thermal processing. They were analysed for physico-chemical and organoleptic properties during the storage period of six months. Significant increase in reducing sugars and total polyphenols was observed whereas, acidity and total carotenoids decreased significantly ($P < 0.05$) in smoothies after six months of storage. Smoothies containing sapota, pineapple and pomegranate showed the highest polyphenol content of 158 mg/100 g on the day of preparation, which increased to 164 mg/100 g after six months storage period. The palatability of smoothies not only depended on the brix:acid ratio but also the fruits selected. Smoothies containing papaya, mango and phalsa tasted acidic whereas sapota and grape yielded sweeter products. The overall sensory score for smoothies containing i) papaya, mango and pineapple pulps/juice and ii) grape juice and mango pulp was very good (8.1) during six month storage period.

Introduction

Fruits are excellent sources of phytochemicals which are essential for human health and relished by consumers in all seasons. Though India is the second largest producer of fruits next only to China in the world with 71.5 million tonnes production in 2009-2010, 2% produce is only being processed. The perishable nature of fruits leads to higher pre- and post- harvest losses during distribution and processing. Fruits high in acidity content and astringency have a limited scope for table consumption though they are rich in functional ingredients. Combination of two or more fruits will develop novel flavour and taste, which help in consumer acceptance. Presently, blended beverages are available in different flavours such as strawberry, chocolate, banana, vanilla, mango, raspberry, orange, pineapple etc.

Various blended beverages were prepared using mango, guava and papaya and their storage stability was reported (Kalra and Tandon, 1984; Kalra *et al*., 1991). Ready-to-serve (RTS) beverages prepared using fruit blends such as mango-papaya and papaya-passion fruit were studied earlier (Fernando *et al*., 2004; El-Mansy *et al*., 2005). RTS beverages were prepared using 15% juice blend of guava and papaya (80:20) maintaining 15 °brix and 0.35% acidity (Indu *et al*., 2008). 'Thompson seedless' sour green grapes were used to produce highly acceptable carbonated RTS beverages by blending purple grape juice and phalsa juice at 2:1 and 1:1 ratios, respectively (Balaswamy *et al*., 2011).

Smoothies are thick in consistency and are normally consumed fresh or preserved for short periods (1-3 weeks) by storing in the refrigerator after pasteurisation or freezing. Walking *et al.* (2010) suggested a mild thermal pasteurisation for preservation of smoothies type beverages when compared to processing by pulsed electric field. Keenan *et al.* (2011) utilised thermal and high hydrostatic pressure processing for preserving fruit smoothies consisting of apples, strawberries, banana and oranges for better retention of colour, polyphenols and other quality attributes. Literature available on juice blends indicated the possibility to use common and under-utilized fruits, vegetables, and medicinal plants in the preparation of RTS beverages or health drinks by blending spice extracts (Bhardwaj and

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Pandey, 2011).

India is one of the largest producers of tropical fruits and a major quantity is lost due to inadequate processing facilities and lack of knowledge on preservation methodologies. Hence, an attempt was made to preserve the fruit pulps/juices in the form of smoothies in glass bottles using thermal processing. Blending different fruit pulps and juices not only help maximum utilisation of fruit pulps and juices but also help the nutritional status of the population. The study was aimed to blend optimal quantities of different fruit pulps viz., mango, papaya, banana, sapota and juices namely grapes, pineapple, phalsa, pomegranate, and watermelon not only for obtaining the required consistency but to facilitate the smoothies amenable for thermal preservation in glass bottles. Blending of fruit pulps and juices also helps to obtain palatable sugar:acid ratio along with enhanced sensory attributes such as colour and flavour without any external additives.

Materials and Methods

Materials

Fresh fruits viz., banana (*Musa paradisiaca*), grapes (*Vitis vinifera*) green (Thompson seedless) and purple varieties, mango (*Mangifera indica*, Var. Banginipally), muskmelon (*Cucumis melo*), papaya (*Carica papaya*), pineapple (*Ananas comosus*), pomegranate (*Punica granatum*), sapota (*Achras sapota*) and watermelon (*Citrullus vulgaris*) were procured from local fruit market, Kothapet, Hyderabad, India. Fresh phalsa (*Grewia asiatica*) fruits were procured from orchards situated at Acharya N. G. Ranga Agricultural University, Hyderabad, India. Pectin (150 grade) was procured from M/s Ruby Food Specialties Ltd., Hyderabad, India. Analytical grade chemicals were procured from S.d. Fine Chemicals, Mumbai, India.

Extraction of fruit pulps / juices

Fruits were thoroughly washed under tap water. Fruit pulps from mango, papaya, sapota, banana and muskmelon were extracted using a fruit pulper (Sanitary type, Engineers Overseas Corporation, Kolkata, India). Grapes (green and purple varieties), watermelon, pineapple and pomegranate were passed through a motorised juice extractor for recovery of juice (Jassica, Techno Instruments, Bangalore, India). The juices were strained through double layered muslin cloth to remove bigger pulp particles and seed. The phalsa fruit juice was extracted using a basket press (Gardner Corporation, New Delhi, India).

Preparation of smoothies

Preliminary trials were conducted to prepare smoothies (500 g each) using either fruit pulp or grape juice as the major constituent. Smoothies based on fruit pulps were prepared using banana (25-40%), mango (30-50%), papaya (20-30%) and sapota (20-40%). Similarly, smoothies based on grape juice as the main constituent (50-60%) was prepared by the addition of other ingredients namely papaya, banana, mango, sapota and muskmelon. All smoothies were prepared without addition of water, sugar and citric acid. The smoothies were analysed for brix:acid ratio and evaluated for their acceptability by a panel of 10 judges. The smoothies preferred by the panelists (12 No.) were prepared in bulk (2500 g each) for physico-chemical, sensory and storage analysis. Fruit pectin (0.1%) was added to the smoothies and homogenised to maintain the cloud and prevent settling of pulp particles. The smoothies were subjected to heat processing by boiling for 5 min, filled hot in pre-sterilized glass bottles (275 ml), hermetically sealed by crown corking and stored at room temperature (28 ± 4°C) under dark conditions for a period of six months.

Physico-chemical analysis

Fruit pulps and juices were analyzed initially for total soluble solids (°brix) by using a hand refractometer (Erma, Japan), acidity as percent citric acid by titration with standard alkali, pH (Control Dynamics, Bangalore, India), reducing sugars (%) and total sugars (%) using Lane and Eynon's method as described by Ranganna (1986). The bottled smoothies were drawn at bi-monthly intervals for a period of six months and analysed for the above parameters. Polyphenols (mg/100 g) were determined by measuring the colour developed by Folin-Ciocalteu reagent at 675 nm and total carotenoids (mg/100 g) were analysed by measuring the optical density of the suitably diluted aliquots of hexane extracts at 452 nm. Non-enzymatic browning (NEB) during storage was assessed by determining absorbance of alcoholic extract at 440 nm during storage.

Sensory analysis

The products were subjected to sensory evaluation using a 9-point Hedonic scale where, score 1 is for 'dislike extremely' and 9 for 'like extremely' by a panel of 10 judges (Amerine *et al*., 1965) during storage period.

Statistical analysis

All physico-chemical analyses were conducted in triplicate and mean values ± SD were computed and reported. The data on physico-chemical analysis and

the scores of each sensory attribute for 0 days and 6 months were analysed statistically by 'paired T test' for significance at $P < 0.05$ using SPSS 15.0.

Results and Discussion

Data on physico-chemical analysis of fruit pulps/juices are presented in Table 1. It was observed that among the fruit pulps/juices, sapota pulp possessed higher brix (26°) and muskmelon juice has 6°. Similarly highest total sugar content (20.87%) was observed in sapota pulp while lower content (5.07%) was noted in muskmelon. High acidity in phalsa juice (2.8%) and low acidity (0.03%) in muskmelon were observed. Fruit pulp and grape juice based smoothies were given to panelists for sensory analysis and asked for comments for preliminary screening. Smoothies with uneven colour, high acidity and incompatible flavours were rejected. A total number of 12 smoothies were selected, out of which six smoothies were based on different fruit pulps and the others were based on grape juice as major ingredient. The selected blends (Table 2) were prepared in bulk (2500 g) and preserved in glass bottles by heat processing for further storage studies.

Table 1. Physico-chemical analysis of fruit pulps/juices

Fruit	°Brix	Acidity (as % citric acid)	pH	Reducing sugars (%)	Total sugars (%)
Banana	20.0 ± 0.0	0.42 ± 0.01	4.52 ± 0.03	6.52 ± 0.08	18.2 ± 0.16
Green grape	16.23 ± 0.05	0.73 ± 0.01	3.24 ± 0.07	13.17 ± 0.21	14.3 ± 0.14
Mango (Banginipally)	18.03 ± 0.05	0.38 ± 0.01	3.87 ± 0.12	4.57 ± 0.06	13.77 ± 0.12
Muskmelon	5.93 ± 0.05	0.03 ±0.01	6.75 ± 0.15	5.03 ± 0.06	5.07 ± 0.09
Papaya	13.07 ± 0.05	0.16 ± 0.01	4.98 ± 0.14	10.03 ± 0.15	10.23 ± 0.12
Phalsa	10.0 ± 0.0	2.81 ± 0.08	2.79 ± 0.01	5.67 ± 0.15	6.03 ± 0.05
Pineapple	12.7 ± 0.09	0.46 ± 0.03	3.92 ± 0.02	8.4 ± 0.35	10.6 ± 0.14
Pomegranate	14.0 ± 0.0	0.22 ± 0.01	3.61 ± 0.02	11.07 ± 0.29	11.4 ± 0.42
Purple grape	12.53 ± 0.09	0.48 ± 0.03	2.75 ± 0.09	5.13 ± 0.06	11.2 ± 0.16
Sapota	26.03 ± 0.09	0.11 ± 0.01	4.23 ± 0.05	10.2 ± 0.35	20.87 ± 0.38
Watermelon	7.0 ± 0.0	0.08 ± 0.0	6.23 ± 0.20	5.13 ± 0.06	5.75 ± 0.04

Values are mean of 3 replicates ± SD

Results on physico-chemical analysis of smoothies on the day of preparation and after 6 months of storage are presented in Tables 3 and 4. Smoothies possessed °brix content of 12.92 - 25.50 and acidity of 0.26 - 0.57%. Significant decrease in acidity in all smoothies and brix in smoothies III, VI, VII and VIII was observed after storage of six months. The brix to acid ratio of the smoothies were in the range of 40.0 to 66.6. Smoothies containing 10% phalsa, 50% grape and 50% pineapple juice (II, VI and VII), respectively were found to be highly acidic. The higher brix:acid ratio containing smoothie X was found to be sweeter. Though the smoothies VIII, IX, XI and XII contained similar quantity of grape juice, the changes in brix to acid ratio observed is mainly due to the variation in quantity of different fruit pulps. Salomon *et al.* (1977) also used higher pulp to lower fruit juice ratio (87.5:12.5) in preparation of papaya/passion fruit nectar to optimise the brix:acid ratio. The increase in reducing sugars and total sugars was observed in smoothies may be due to the release of monomers by hydrolysis of polysaccharides in the presence of citric acid. Ahmed *et al*. (2008) also observed a gradual increase in reducing sugar level in

Table 2. Standardized fruit pulps and grape juice based smoothies

Fruit pulp/juice	Per cent pulp or juice used in the smoothies											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Fruit pulps												
Papaya	30	30	-	-	-	20	20	40	30	-	-	-
Sapota	-	-	40	40	40	-	-	-	-	-	40	-
Banana	-	-	-	-	-	30	30	-	10	-		-
Mango	30	30	-	-	-	-	-	-	-	50	-	-
Muskmelon	-	-	-	-	-	-	-	-	-	-	-	40
Fruit juices												
Green grape	-	-	-	-	-	-	50	60	60	50	60	60
Pineapple	40	-	40	-	40	50	-	-	-	-	-	-
Phalsa	-	10	-	-	-	-	-	-	-	-	-	-
Purple grape	-	-	-	10	-	-	-	-	-	-	-	-
Pomegranate	-	-	-	50	20	-	-	-	-	-	-	-
Watermelon	-	30	20	-	-	-	-	-	-	-	-	-

Table 3. Physico-chemical changes in smoothies based on fruit pulps during storage

Parameter	Storage period (months)											
	I		II		III		IV		V		VI	
	0	6	0	6	0	6	0	6	0	6	0	6
°Brix	15.03 ± 0.06	15.03 ± 0.06	12.93 ± 0.06	13.00 ± 0.0	17.53 ± 0.12	15.50 ± 0.10	17.93 ± 0.12	17.5 ± 0.0	18.53 ± 0.23	17.87 ± 0.12	16.97 ± 0.06	15.50 ± 0.10
pH	4.29 ± 0.01	4.64 ± 0.07	3.88 ± 0.02	4.13 ± 0.01	4.57 ± 0.06	4.71 ± 0.12	4.02 ± 0.03	3.97 ± 0.06	4.33 ± 0.12	4.47 ± 0.06	4.18 ± 0.05	4.20 ± 0.00
Acidity (% citric acid)	0.33 ± 0.01	0.31 ± 0.01	0.46 ± 0.02	0.43 ± 0.01	0.30 ± 0.03	0.26 ± 0.03	0.33 ± 0.03	0.29 ± 0.01	0.31 ± 0.02	0.29 ± 0.04	0.52 ± 0.03	0.48 ± 0.05
Reducing sugars (%)	7.93 ± 0.12	8.28 ± 0.12	7.44 ± 0.17	8.13 ± 0.06	8.97 ± 0.29	9.54 ± 0.23	13.67 ± 0.12	14.3 ± 0.17	10.45 ± 0.15	12.56 ± 0.28	12.42 ± 0.19	12.53 ± 0.12
Total sugars (%)	13.60 ± 0.53	13.43 ± 0.51	11.17 ± 0.06	11.10 ± 0.10	14.65 ± 0.23	15.45 ± 0.47	14.41 ± 0.36	14.57 ± 0.06	15.80 ± 0.69	15.16 ± 0.07	13.30 ± 0.44	13.13 ± 0.31
Total polyphenols (mg /100 g)	63.33 ± 1.15	98.40 ± 0.60	54.00 ± 1.00	83.87 ± 1.50	88.67 ± 1.15	134.67 ± 8.33	123.63 ± 3.96	143.33 ± 3.06	158.33 ± 8.02	164.00 ± 8.54	78.00 ± 2.00	95.33 ± 3.79
Total carotenoids (mg /100 g)	1.29 ± 0.08	0.57 ± 0.04	1.17 ± 0.15	0.52 ± 0.03	0.73 ± 0.08	0.26 ± 0.04	0.14 ± 0.03	0.06 ± 0.02	0.16 ± 0.02	0.08 ± 0.05	0.87 ± 0.05	0.78 ± 0.07
NEB	0.02 ± 0.01	0.09 ± 0.01	0.06 ± 0.01	0.07 ± 0.01	0.13 ± 0.02	0.13 ± 0.02	0.02 ± 0.01	0.09 ± 0.01	0.22 ± 0.07	0.23 ± 0.06	0.00	0.08 ± 0.02

Values are mean of 3 replicates ± SD, I - VI indicates smoothies based on fruit pulps, NEB: Non enzymatic browning

Table 4. Physico-chemical changes in smoothies based on grape juice during storage

Parameter	Storage period (months)											
	VII		VIII		IX		X		XI		XII	
	0	6	0	6	0	6	0	6	0	6	0	6
°Brix	19.00 ± 0.20	17.00 ± 0.15	23.00 ± 0.25	22.20 ± 0.15	22.00 ± 0.20	22.60 ± 0.10	25.50 ± 0.25	24.50 ± 0.20	24.00 ± 0.10	24.20 ± 0.20	19.50 ± 0.15	20.00 ± 0.20
pH	3.94 ± 0.04	3.99 ± 0.06	3.55 ± 0.01	3.94 ± 0.03	3.38 ± 0.01	3.82 ± 0.10	4.23 ± 0.06	3.92 ± 0.10	4.40 ± 0.08	4.12 ± 0.08	3.90 ± 0.07	4.17 ± 0.10
Acidity (% citric acid)	0.57 ± 0.01	0.55 ± 0.06	0.50 ± 0.02	0.42 ± 0.08	0.55 ± 0.10	0.51 ± 0.07	0.45 ± 0.02	0.35 ± 0.07	0.36 ± 0.02	0.26 ± 0.04	0.34 ± 0.02	0.32 ± 0.01
Reducing sugars (%)	13.04 ± 0.15	13.89 ± 0.21	20.18 ± 0.21	17.72 ± 0.15	18.78 ± 0.17	19.05 ± 0.07	16.60 ± 1.16	20.97 ± 0.56	18.39 ± 0.23	18.95 ± 0.15	15.40 ± 0.19	16.84 ± 0.03
Total sugars (%)	15.40 ± 0.18	14.67 ± 0.16	20.84 ± 0.78	20.25 ± 0.23	18.89 ± 0.17	20.82 ± 0.31	21.52 ± 0.72	21.81 ± 0.11	20.09 ± 0.72	20.62 ± 0.43	15.60 ± 0.19	17.86 ± 0.55
Total polyphenols (mg / 100 g)	65.60 ± 2.10	115.50 ± 8.22	33.00 ± 1.06	57.40 ± 0.34	58.00 ± 1.11	63.30 ± 1.22	44.79 ± 0.56	59.20 ± 1.78	63.20 ± 5.23	69.90 ± 8.96	46.80 ± 4.32	68.10 ± 3.16
Total carotenoids (mg / 100 g)	0.89 ± 0.05	0.48 ± 0.02	0.97 ± 0.01	0.76 ± 0.04	0.64 ± 0.03	0.55 ± 0.07	1.54 ± 0.07	0.86 ± 0.01	ND	ND	ND	ND
NEB	0.00	0.20 ± 0.0	0.038 ± 0.02	0.091 ± 0.0	0.023 ± 0.02	0.066 ± 0.01	0.046 ± 0.01	0.092 ± 0.02	0.020 ± 0.01	0.037 ± 0.01	0.058 ± 0.02	0.063 ± 0.02

Values are mean of 3 replicates ± SD, VII-XII indicates smoothies based on grape juice, NEB: Non enzymatic browning, ND: not determined

all RTS mandarin diet drink as a function of storage.

Total polyphenol content in smoothies increased significantly ($P < 0.05$) after 6 months storage period. The increasing trend in polyphenol content was observed to be more in pulp based smoothies compared to grape juice based smoothies. Smoothie sample V containing sapota, pineapple and pomegranate showed the highest polyphenol content of 158 mg/100 g on the day of preparation and increased to 164 mg/100 g after storage for six months. Similarly, smoothie sample IV containing sapota, purple grape and pomegranate showed the polyphenol content of 123 mg/100 g and increased to 143 mg/100 g during storage for 6 months. It was observed that polyphenol content almost doubled in sample VII from 65 to 116 mg/100 g during six months of storage. Such a rise in polyphenols might be due to the release of bound phenols from cell wall and dissociation of dimers into monomers during storage. Higher carotenoid content was observed in smoothies containing mango and papaya (I-II, VI-X). Highest value for carotenoids was observed in smoothie sample X (1.54 mg/100 g) which is due to the presence of 50% mango and lower values were noted in smoothie IV (0.14 mg/100 g). Total carotenoid content decreased significantly ($P < 0.05$) during 6 months storage. Deka (2000) reported initial carotenoid content of 1.12 mg/100 g in mango-pineapple (85:15) blended RTS beverage, which decreased during storage. Non-enzymatic browning (NEB) showed an increase up to 0.2 in smoothie samples V and VII, which might be due to reactions of organic acid with sugars and oxidation of polyphenols. Sharma *et al*. (2004) observed increase in NEB of lemon juice concentrate (45 °brix) from 0.07 to 0.87 during 9 months storage at ambient temperature.

Changes in overall organoleptic quality of smoothies on the day of preparation and after storage for six months are shown in Tables 5 and 6. All smoothies scored good (>7) in sensory evaluation after four months storage period (data not shown). Smoothies based on papaya pulp including mango pulp (I and II) were found to be very good in terms of sensory quality. It was in agreement with the studies made by Kalra *et al*. (1984) in the preparation of RTS beverages from mango-papaya blends and suggested 25-33% papaya pulp to yield acceptable beverages. Smoothies III, IV and V containing sapota possessed characteristic flavour, even though panelists observed gritty texture. Smoothie sample III containing watermelon juice showed significant decrease score for appearance, colour and overall sensory quality during six month storage period.

It was noticed that both smoothie samples VI and VII containing high quantity of banana pulp (30%) received low scores, possibly the panelists did not accept the taste of banana together with high acid juices from pineapple and grape. Changes were not significant ($P < 0.05$) in individual sensory parameters for all smoothies when the initial and six month scores were compared. Non-enzymatic browning might be one of the main reasons for decrease in scores for colour. Though fruit based smoothies possessed pH >4.0, they showed good storage stability without any off-flavour. Grape juice based smoothies (VII-XII) had high sensory score on the day of preparation. Grape juice with papaya, banana (IX) and mango (X) have maintained good score during storage. In contrast, grape juice blended with sapota (XI) and muskmelon (XII) have shown decrease in scores for all sensory parameters after 6 months storage period and overall sensory attributes reduced to below 7. The overall quality of smoothies (I) containing papaya pulp, mango pulp and pineapple juice was maximum (8.1) on the day of preparation and maintained the maximum score 7.8 even after six month storage period. The smoothies sample X prepared by blending green grape (Thompson seedless) juice with mango pulp has scored high (8.1) and maintained the score throughout the storage period. The results were in agreement with the data reported by Saxena *et al.* (1996), who developed carbonated RTS beverages using 10% grape-mango and grape-pineapple blends

Table 5. Overall sensory score of smoothies based on fruit pulps during storage

Parameter	Storage period (months)											
	I		II		III		IV		V		VI	
	0	6	0	6	0	6	0	6	0	6	0	6
Appearance	8.4±0.5	8.1±0.6	8.3±0.8	7.9±0.3	7.6±0.5	7.1±0.6	7.4±0.5	6.9±0.6	7.6±0.5	6.8±0.8	8.0±1.0	7.4±0.7
Colour	8.4±0.5	8.3±0.7	8.4±0.7	7.6±0.5	7.9±0.3	7.0±0.9	7.3±0.7	6.9±0.6	7.4±0.7	6.6±0.9	7.6±1.1	7.4±0.9
Flavour	7.9±0.6	7.9±0.6	7.4±1.1	7.1±1.1	7.4±0.5	7.3±1.0	7.1±0.6	6.6±0.7	7.3±0.4	7.0±0.9	7.1±0.8	7.1±0.6
Taste	8.3±0.7	7.3±0.8	7.0±1.0	6.8±1.2	7.6±0.9	7.3±0.8	7.0±1.1	6.9±1.1	7.4±079	7.4±0.9	7.1±0.3	7.2±0.6
Overall quality	8.1±0.8	7.8±0.8	7.5±1.1	7.1±1.1	7.6±0.5	6.9±0.6	7.0±1.0	6.8±0.6	7.4±0.9	7.0±0.9	7.0±0.5	7.1±0.7

I-VI indicates smoothies based on fruit pulps

Table 6. Overall sensory scores of smoothies based on grape juice during storage

Parameter	Storage period (months)											
	VII		VIII		IX		X		XI		XII	
	0	6	0	6	0	6	0	6	0	6	0	6
Appearance	7.8±1.1	7.5±0.9	7.7±0.9	7.4±0.9	7.2±1.1	7.0±0.8	8.3±0.5	8.1±0.3	7.9±0.6	6.9±0.8	7.7±0.5	7.0±0.8
Colour	7.6±1.0	7.6±1.0	7.8±1.1	7.6±0.7	6.8±0.1	6.7±0.7	8.3±0.5	8.0±0.5	7.6±0.9	6.9±0.8	7.3±0.5	6.7±0.5
Flavour	6.9±0.6	7.2±0.9	7.3±1.1	7.0±0.8	7.2±1.1	6.9±0.6	8.0±0.5	7.8±0.4	7.4±0.5	7.1±0.8	8.1±0.4	6.6±0.5
Taste	6.6±0.5	6.9±1.0	7.7±0.5	6.6±0.7	7.1±0.6	6.6±0.7	8.4±0.5	8.1±0.6	7.6±1.0	6.9±0.7	7.8±0.7	6.4±0.5
Overall quality	6.8±1.0	6.9±0.8	7.7±0.5	7.1±0.8	7.2±0.6	7.0±0.8	8.1±0.6	8.1±0.6	7.9±0.9	6.8±0.7	7.9±0.6	6.4±0.7

VII-XII indicates smoothies based on grape juice

with good (7.5) overall quality during storage period of six months. Blending of fruit juices help in improving nutritional and sensory quality and reduce cost of production by using seasonal low cost fruits leading to new product development (Kalra and Revathi, 1981).

Conclusion

Smoothies could be prepared and preserved by blending various tropical fruit pulps/juices without any addition of external sweetener, acidulant and preservatives. Smoothies based on fruit pulps viz., mango, papaya, sapota, muskmelon, and juices viz., grapes and pineapple was organoleptically acceptable during six months of storage. Smoothies containing i) papaya pulp 30%, mango pulp 30% and pineapple juice 40%, and ii) grape juice 50% and mango pulp 50% were found to be best combinations in terms of sensory score (>8.0) during storage. A variety of smoothies can be prepared depending on availability of seasonal fruits and the taste of the local population. Commercialisation of these products helps in utilising various perishable seasonal fruits into nutrient rich value added products, which in turn balances the economic aspects.

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References

Ahmed, M., Ahmad, A., Chatha, Z. A. and Dilshad, S. M. R. 2008. Studies on preparation of ready to serve mandarin (*Citrus reticulata*) diet drink. Pakistan Journal of Agricultural Science 45: 470-476.

Amerine, M. A., Pongborn, R. M. and Roessler, E. B. 1965. Principles of sensory evaluation of food. New York: Academic Press.

Balaswamy, K., Prabhakara Rao, P. G., Nagender, A. and Satyanarayana, A. 2011. Preparation of sour grape (*Vitis vinifera*) beverages and evaluation of their storage stability. Journal of Food Processing and Technology 2:3 *http://dx.doi.org/10.4172/2157-7110.1000116.*

Bhardwaj, R. L. and Pandey, S. 2011. Juice blends - A way of utilization of under-utilized fruits, vegetables, and spices: a review. Critical Reviews in Food Science and Nutrition 51: 563-570.

Deka, B. C. 2000. Preparation and storage of mixed fruit juice spiced beverages. New Delhi. Indian Agricultural Research Institute, PhD Thesis.

El-Mansy, H. A., Sharoba, A. M., Bahlol, H. E. L. M. and El-Desouky, A. I. 2005. Rheological properties of mango and papaya nectar blends. Annals of Agricultural Sciences, Moshtohor 43: 665-686.

Fernando, C. A. U. M., Marilia, L. S. F., Ricardo, L. C. and Daniel, C. F. 2004. Sensory acceptance of mixed nectar of papaya, passion fruit and acerola. Scientia Agricola (Piracicaba, Braz.) 61: 604-608.

Indu, S., Kumari, K. R. and Anju, B. 2008. Effect of different treatment combinations of guava and papaya on quality and storability of ready-to-serve beverages. Journal of Research SKUAST J, 7: 68-78.

Kalra, S. K. and Revathi, G. 1981. Storage of guava pulp. Indian Food Packer 35: 29-30.

Kalra, S. K. and Tandon, D. K. 1984. Guava nectars from sulphited pulp and their blends with mango nectar. Indian Food Packer 38: 74-77.

Kalra, S. K., Tandon, D. K. and Singh, B. P. 1991. Evaluation of mango-papaya blended beverage. Indian Food Packer 45(1): 33-35.

Keenan, D. F., Brunton, N., Gormley, R. and Butler, F. 2011. Effects of thermal and high hydrostatic pressure processing and storage content of polyphenol and some quality attributes of fruit smoothies. Journal of Agricultural and Food Chemistry 59: 601-607.

Ranganna, S. 1986. Handbook of analysis and quality control for fruit and vegetable products. 2nd edn. New Delhi: Tata McGraw-Hill Publishing Co Ltd.

Salomon, E. A., Kato, K., Martin, Z. J. D. E., Silva, S. D. D. A. and Mori, E. E. M. 1977. Blending of papaya/ passion fruit nectar. Boletim-do-Instituto-Tecnologia-de-Alimentos-Brazil 51: 165-179.

Saxena, A. K., Teotia, M. S. and Berry, S. K. 1996. Studies on the development of grape-mango and grape-pineapple beverage blends. Indian Food Packer 50(4): 26-29.

Sharma, S. K., Lal Kaushal, B. B. and Sharma, P. C. 2004. Effect of temperature and amino acids on non-enzymatic browning of lemon juice concentrates during storage. Journal of Scientific and Industrial Research 63: 444-451.

Walking, R. M., Noci, F., Cronin, D. A., Lyng, J. G. and Morgan, D. J. 2010. Shelf life and sensory attributes of a fruit smoothie – type beverage processed with moderate heat and pulsed electric fields. LWT Food Science and Technology 43: 1067-1073.