Original Research Article

Effect of blending custard apple and banana pulp and acidity on quality of nectar

Abstract

The present investigation was aimed to study the effect of blend proportion and acidity level for the preparation of blended nectar and to evaluate nutritional as well as sensory quality of developed product during storage. During investigation, experiment was laid out using completely randomized design with factorial concepts. Experiment was conducted for preparation of custard apple and banana (var. Grand Naine) blended nectar using different levels of blends (B_1-20:0, B_2-15:5, B_3-10:10, B_4-5:15 and B_5-0:20) and acidity (A_1-0.15%, A_2-0.20%, A_3-0.25% and A_3-0.30%) by maintaining TSS of 15°Brix. The results of the present investigation indicate that custard apple and banana fruits can be utilized for processing into custard apple and banana blended nectar. Blended nectar prepared from 20% pulp (5% custard apple and 15% banana) by maintaining 15°Brix TSS and 0.30 per cent acidity was rated as the best treatment (A_4B_4) on the basis of higher sensory score as well as nutritional composition and also exhibited minimum changes in nutritional as well as sensory attributes (above 7) during six months storage at ambient temperature of 32±2°C. During storage period of six months no microbial counts (nil cfu) were observed in blended nectar. Overall findings of investigation revealed that custard apple and banana blended nectar (A_4B_4) can be stored successfully for 6 months in glass bottles (after 30 min heat processing at 96±1˚C) with minimum changes in chemical, sensory and microbial quality. The benefit cost ratio (BCR) of custard apple and banana blended nectar was observed 1.64. Thus, developed technologies can commercially be explored by food processing industry for the production of custard apple and banana blended nectar to ensure better returns to growers and processors as well.

Keywords: Banana pulp, Custard apple pulp, Nectar, Storage, Blending, Quality

1. INTRODUCTION

Banana (*Musa paradisiaca* L.) also known as “apple of the paradise”. In India, it is cultivated in Tamil Nadu, Maharashtra, Karnataka, Gujarat, Andhra Pradesh and Assam. In India it is cultivated under area of 803000 ha with 297.25 lakh MT production. It is being cultivated on commercial scale in Bharuch and Narmada districts of Gujarat over an area of 66500 ha with production of 42.25 lakh MT (Anonymous, 2014) [6]. Banana fruits are rich source of minerals like magnesium, sodium, potassium, phosphorus and calcium beside vitamin A, B_2, and C. Banana contains 70% water, 27% carbohydrates, 0.5% crude fiber, 0.3% fat, 1.2% protein, 460 mg potassium, 36 mg magnesium, 2 mg phosphorus, 7 mg calcium and 10 mg ascorbic acid per 100 g fruit, respectively. Besides banana, custard apple is a major crop of the Gujarat.

Custard apple is also known as “sugar apple” or “sweet sop” [12]. In India, it is cultivated in Andhra Pradesh, Maharashtra, Uttar Pradesh, Tamil Nadu, Assam, Karnataka, Gujarat and Orissa. In Gujarat, custard apple is mostly grown in arid zone regions viz., Sourashtra, North Gujarat and Middle Gujarat. In India, custard apple is grown under area of 22000 ha with production of about 1.65 lakh MT. Gujarat state occupies an area of 5150 ha with production of

0.52 lakh MT [5]. Custard apple is one of the most delicious and highly perishable fruit. It is mostly consumed as desert fruit. The fruits of custard apple are rich source of carbohydrates, proteins, fibers, vitamins (ascorbic acid and B-complex) and minerals like calcium and phosphorus. Approximately pulp contains 73.3% moisture, 1.6% protein, 0.3% fat, 0.7% mineral matter, 23.9% carbohydrates, 21-27% TSS and 0.19 - 0.29% acidity, calcium 0.02%, phosphorus 0.04% and iron 1.0% [10]. The fruits of the custard apples are mostly used for table purpose and rarely used for processing owing to presence of large number of seed in the fruits as well as resinous compound in the rind of custard apple resulting development of off-flavour in developed products.

Due to huge production, banana is sold at very low price (Rs. 10-15/kg) and at the same time the custard apple is sold comparatively at higher price (Rs. 40-60/kg). Despite such a huge production of banana, the processed products of banana particularly fruit drinks are not available in the market due to development of off-flavour in processed products of banana. On the other hand, heat processing of custard apple causes bitterness in the pulp as well as its processed products [19]. Therefore, value added products of banana and custard apples are not available in the market. The results of earlier studies reported that blending of different fruits in different proportion can increase the sensory as well as nutritional quality of the fruit juice beverages even if the fruit pulp possess astringent taste. Thus, blending of pulp (e.g. apple with pear) can be a best alternative for production of delicious fruit beverages with improve organoleptic quality and high nutritive value [26]. Moreover, till date custard apple and banana have not been tried for making any kind of blended beverages. Although, the pulp of banana is almost similar to that of custard apple in appearance. Therefore, the present investigation was under taken to study effect of pulp proportion and acidity level on quality of blended nectar of custard apple and banana pulp during storage.

2. MATERIALS AND METHODS

Raw Material

The ripe fruits of custard apple and banana (50 kg each) were procured from Umargam and Navsari fruit market, Navsari and brought to Department of Post-Harvest Technology, ASPEE College of Horticulture, NAU, Navsari, Gujarat. Custard apple and banana fruits were analyzed for physico-chemical characteristics and used further for extraction of pulp to be utilized for the preparation of nectar.

Experimental Detail

The experiment to prepare of blended custard apple and banana nectar was planned with different number of treatments. A total of 20 treatments were used for preparation of nectar using different proportion of custard apple and banana pulp (Factor-1) with different acidity levels (Factor-2) as detailed in the Table 1 using CRD (with factorial concept) design. Each treatment was repeated thrice times. The prepared nectar was packed in 200 ml glass bottles and kept at ambient temperature of 32±2°C for 6 months to analyse the quality parameters at 2 months' intervals.

Factor 1: Blending levels (B)

Blending level (B)	Custard apple, %	Banana, %
B_1	20	0
B_2	15	5
B_3	10	10
B_4	5	15
B_5	0	20

Factor 2: Acidity levels (A)

Acidity level (A)	
A_1	0.15%
A_2	0.20%
A_3	0.25%
A_4	0.30%

Table 1: Detail of treatments used for preparation of blended nectar

Treatments	Acidity (A),%	Blends (B),%	
		Custard apple	Banana
A_1B_1	0.15	20	0
A_1B_2	0.15	15	5
A_1B_3	0.15	10	10
A_1B_4	0.15	5	15
A_1B_5	0.15	0	20
A_2B_1	0.20	20	0
A_2B_2	0.20	15	5
A_2B_3	0.20	10	10
A_2B_4	0.20	5	15
A_2B_5	0.20	0	20
A_3B_1	0.25	20	0
A_3B_2	0.25	15	5
A_3B_3	0.25	10	10
A_3B_4	0.25	5	15
A_3B_5	0.25	0	20
A_4B_1	0.30	20	0
A_4B_2	0.30	15	5
A_4B_3	0.30	10	10
A_4B_4	0.30	5	15
A_4B_5	0.30	0	20

Methodology

Extraction of custard apple pulp: Mature and ripe fruits of custard apple were used for pulp extraction. The defective as well as undesirable fruits were removed while sorting. Then fruits were thoroughly washed to remove any adhering dust and dirt particles. After washing, the fruits were cut into two halves with stainless steel (SS) knife. Then pulp along with seed was scooped out from fruit halves with the help of SS spoon. The seeds were separated from pulp manually using strainer. After seed separation, the pulp was homogenized in lab scale blender to get fine pulp. The pulp extracted was further utilized for preparation of blended nectar. Extraction of banana pulp: Fresh, fully ripe and yellow coloured banana fruits having uniform size and shape, frees from mechanical damage, bruises, sunburns and fungal attack were selected for extraction of pulp. The fruits were washed in running water to remove adhering dirt and dust particles. After washing, the fruits were cut into small pieces and banana pulp was

extracted using crusher type pulp extractor. The pulp was further used for preparation of blended nectar.

Preparation of Custard Apple and Banana blended Nectar

Custard apple and banana nectar was prepared from the pulp of custard apple and banana. The nectar was prepared using different proportion of custard apple and banana pulp (Factor-1) acidity levels (Factor-2) as per Table 1 by maintaining 20% pulp part in blended nectar as per FSSAI guidelines. The TSS of the nectar was maintained 15˚B in all the treatments. The water was added as per treatment requirement. Prepared nectar was stored at room temperature of 32±2ºC. Fig 1. Principal Steps Used for Preparation of Blended Nectar

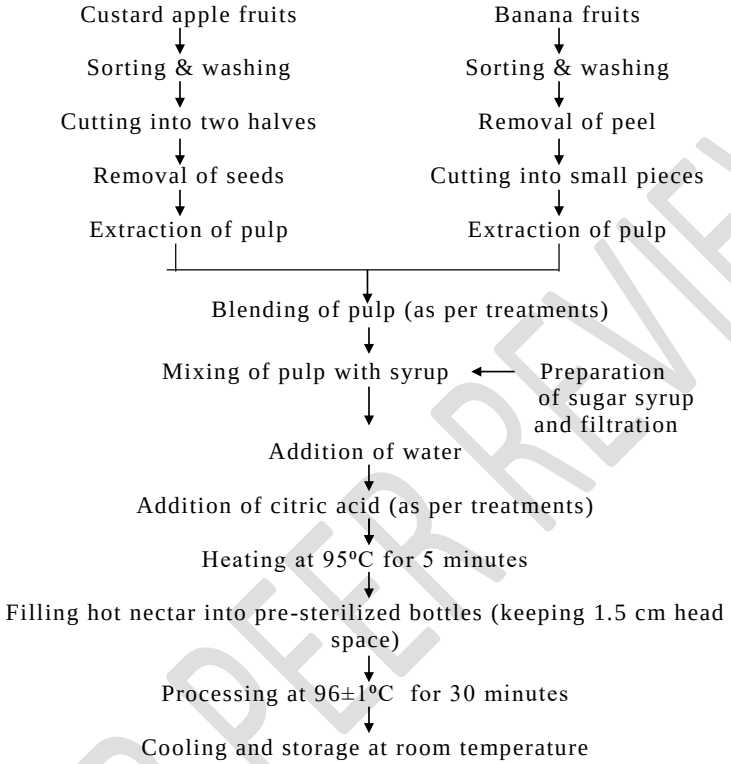

Fig 1. Principal Steps Used for Preparation of Blended Nectar

Analysis of Qualities Parameters

Physico-chemical parameters of fresh samples of each produce (n=10) were recorded. The moisture was estimated by drying the weighted samples in hot air oven at 70±2°C to a constant weight [6]. The total soluble solids (TSS) of the samples were determined with the help of hand refractometer and expressed as °Brix [22]. The titratable acidity and ascorbic acid content were determined by the method as detailed by Ranganna [22]. The nectar was evaluated for sensory qualities on the basis of overall acceptability by a panel of 7-10 judges (Professors and students of Post Harvest departments with 25- 50 years) of on a 9-point Hedonic scale [4]. Total Plate Count (TPC) of samples was estimated aseptically by inoculating 0.1 ml of serially diluted sample in petri-plates containing LB agar medium prepared according to Ranganna [22]. The data pertaining to physico-chemical characteristics of nectar was analysed statistically by following completely randomized design [17].

3. RESULTS AND DISCUSSION

Physico-chemical parameters of fresh fruits

The physico-chemical characteristics of fresh custard apple and banana fruits which were used for the preparation of nectar are given in Table 2. The data on physical parameters of custard apple revealed the mean size, fruit weight, peel weight, pulp weight and seed weight in the range of 6.55×7.28 cm, 176.66±15.50 g, 82.16±10.25 g, 73.47±12.45 g and 21.03±2.65 g, respectively. The data on physical parameters of banana revealed the mean size, fruit weight,

peel weight and pulp weight in the range of 14.77×5.3 cm, 265.25±14.35 g, 123.14±8.86 g and 142.11±11.20 g, respectively. Further, data on chemical parameters of custard apple pulp revealed mean moisture, TSS, acidity, reducing sugars, non-reducing sugars, total sugars and ascorbic acid content in the range of 73.5±1.25 per cent, 16±3.50 per cent, 0.192±0.025 per cent, 11.74±0.29 per cent, 1.77±0.13 per cent, 13.61±0.39 per cent and 35.19±0.81mg/100 g, respectively. The data on chemical parameters of banana pulp revealed mean moisture, TSS, acidity, reducing sugars, non-reducing sugars, total sugars and ascorbic acid content in the range of 77.19±1.65 per cent, 18.5±1.50 per cent, 0.25±0.015 per cent, 9.36±0.42 per cent, 8.48±0.45 per cent, 18.29±0.43 per cent and 12.62±0.75mg/100 g, respectively. The results of present investigations for physico-chemical parameters of custard apple and banana pulp are in line with the observations made by Sousa *et al.* [28] for different tropical fruits, Hashmi and Pawar [14], Bazaz et al [7] for custard apple, Akhter *et al.* [2] and Alizadeh *et al.* [3] for banana. The slight variation in weight and size might be attributed to agro-climatic variations or varietal differences.

Table 2 Proximate physico-chemical composition of fresh fruits

Sr. No.	Particulars	Mean±S.Em.	
		Custard apple	Banana
Physical parameters			
1.	Size, cm	6.55×7.28	14.77×5.3
2.	Fruit weight, g	176.66 ± 15.50	265.25 ± 14.35
3.	Peel weight, g	82.16 ± 10.25	123.14 ± 8.86
4.	Pulp weight, g	73.47 ± 12.45	142.11 ± 11.20
5.	Seeds weight, g	21.03 ± 2.65	-
Chemical parameters			
1.	Moisture, %	73.5 ± 1.25	77.19 ± 1.65
2.	TSS, ºB	16 ± 3.50	18.5 ±1.50
3.	Acidity, %	0.192 ± 0.025	0.25 ± 0.015
4.	Reducing sugars, %	11.74 ± 0.29	9.36 ± 0.42
5.	Non-reducing sugars, %	1.77 ±0.13	8.48 ± 0.45
6.	Total sugars, %	13.61 ± 0.39	18.29 ± 0.43
7.	Ascorbic acid, mg/100 g	35.19 ± 0.81	12.62 ± 0.75
8.	pH	6.5 ± 0.03	4.5 ± 0.04

Effect of treatments and storage on quality of blended nectar

Total soluble solids (TSS): The perusal of data about effect of different treatments (blending proportions and acidity levels) on TSS of blended nectar has been presented in Table 3. Data show that among different levels of blends; the grand mean (B) TSS of nectar varied from 15.27˚B to 15.33˚B, with minimum TSS in nectar prepared by blending 15% custard apple and 5% banana pulp (B_2) and maximum in blended nectar having 10% custard apple pulp and 10% banana pulp (B_3). However, changes were observed non-significant. Thakre and Jain [29] reported that the change in TSS was non-significant in nectar prepared by using blended papaya and banana pulp (50:50) with 18% TSS. Further, the grand mean (A) TSS of nectar prepared by maintaining different levels of acidity also varied non-significantly from 15.26˚B to 15.34˚B, with minimum TSS in nectar prepared by maintaining 0.20% acid (A_2) and maximum in nectar prepared by maintaining 0.25% acid (A_3). Non-significant differences were also observed in the TSS of nectar when prepared using different levels of acidity and blending proportion. Data depict that six months' storage of nectar resulted significant increase in grand mean (S) TSS from initial value of 15.00˚B to 15.64˚B. Further, data depict that six months' storage of nectars prepared using different blending proportions resulted maximum non-

significant increases in TSS of nectar prepared by 20% banana pulp (B_5-0:20) while minimum increase in TSS of nectar prepared by 15% custard apple and 5% banana pulp (B_2-15:5). Yadav *et al.* [30] reported that there was more increase in TSS during three months of storage in pomelo and orange blended nectar. The increase in TSS during storage might be attributed to hydrolysis of polysaccharides into simple soluble sugars. Similar observations were reported by Bhardwaj and Mukherjee (2011)[8]. They reported a minimum increase is TSS from 12.0ºB to 14.13ºB in blended juice of kinnow, pomegranate and ginger (87:10:3) during 6 months' storage. Raj *et al.* [21] reported that TSS of different sand pear juice-apple juice (SPJ-AJ) blends ranged from 8.3˚B to 10.8˚B. They reported that maximum TSS was observed in blended beverage containing 10% SPJ and 90% AJ and minimum in 90% SPJ and 10% AJ. The variation in TSS of blended nectar was due to variation in the level of AJ and SPJ. Further, six months' storage of nectar prepared using different acidity levels also resulted non-significant increase in TSS, with minimum increase in TSS from 15.00˚B to 15.60˚B in nectar prepared by maintaining 0.20% acid (A_2), whereas maximum increase from 15.00˚B to 15.66˚B in nectar prepared by maintaining 0.25% as well as 0.30 % acid (A_3 and A_4). Jakhar *et al.* [16] also reported that blended beverage prepared by using different concentration of citric acid resulted minimum increase in TSS of blended beverage (50% guava: 50% barbados cherry) during storage period of 6 months when prepared by using 0.20% acidity. During six months' storage, maximum increase in TSS (15.00˚B to 15.78˚B) was observed in nectar prepared using 20% banana pulp with 0.25% acidity (A_3B_5) while minimum increase (15.00˚B to 15.54˚B) was observed in nectar prepared using 15% custard apple and 5% banana with 0.20% acidity (A_2B_2). The data under present investigations are in corroboration with the reported observations of Raj *et al.* [20], Patil *et al.* [18], Raj *et al.* [21] and Gaudani *et al.* [13]. They also reported variations in increase of TSS among different blending treatments. Generally, the TSS of products increases with gradual passage of storage time which might be due to hydrolysis of polysaccharides into monosaccharide and oligosaccharides [28, 26]. However, non-significant differences were observed in TSS of nectar prepared using different levels of blends and acidity.

Table 3: Effect of different treatments on TSS (ºB) of nectar during storage

Treatments		**TSS, ºB**					**Grand mean (B)**
Acidity (A), %	**Blends* (B), %**	**Storage (S)**				**Grand mean (A)**	
		0 Month (S_1)	**2 Month (S_2)**	**4 Month (S_3)**	**6 Month (S_4)**		
A_1-0.15	B_1 -20:0	15.00	15.26	15.36	15.68	15.33	15.30
	B_2 -15:5	15.00	15.20	15.40	15.57	15.29	15.27
	B_3 -10:10	15.00	15.18	15.48	15.70	15.34	15.33
	B_4 -5:15	15.00	15.10	15.32	15.56	15.25	15.29
	B_5 - 0:20	15.00	15.22	15.42	15.70	15.34	15.32
	Mean	**15.00**	**15.19**	**15.40**	**15.64**	**15.31**	
A_2-0.20	B_1 -20:0	15.00	15.14	15.32	15.62	15.27	
	B_2 -15:5	15.00	15.08	15.26	15.54	15.22	
	B_3 -10:10	15.00	15.24	15.46	15.62	15.33	
	B_4 -5:15	15.00	15.06	15.20	15.62	15.22	
	B_5 - 0:20	15.00	15.22	15.28	15.62	15.28	
	Mean	**15.00**	**15.15**	**15.30**	**15.60**	**15.26**	
A_3-0.25	B_1 -20:0	15.00	15.20	15.31	15.66	15.29	
	B_2 -15:5	15.00	15.26	15.34	15.58	15.30	
	B_3 -10:10	15.00	15.20	15.48	15.68	15.34	

	B_4 -5:15	15.00	15.60	15.32	15.62	15.39	
	B_5 - 0:20	15.00	15.24	15.51	15.78	15.38	
	Mean	**15.00**	**15.30**	**15.39**	**15.66**	**15.34**	
A_4-0.30	B_1 -20:0	15.00	15.18	15.38	15.70	15.32	
	B_2 -15:5	15.00	15.12	15.30	15.64	15.27	
	B_3 -10:10	15.00	15.20	15.42	15.66	15.32	
	B_4 -5:15	15.00	15.24	15.32	15.61	15.29	
	B_5 - 0:20	15.00	15.10	15.40	15.69	15.30	
	Mean	**15.00**	**15.17**	**15.36**	**15.66**	**15.30**	
Grand mean (S)		**15.00**	**15.20**	**15.36**	**15.64**		**15.30**
$C.D._{0.05}$							
Blends (B) :		NS	SxB :	NS	SxAxB : NS		
Acidity (A) :		NS	AxB :	NS			
Storage (S) :		0.058	SxA :	NS			
*Custard apple: Banana							

Acidity: The perusal of data pertaining to effect of different treatments (blending proportions and acidity levels) on acidity of nectar has been presented in Table 4. Data show that among different levels of blends; the grand mean (B) acidity of nectar varied significantly from 0.254% to 0.266%, with minimum acidity in nectar prepared by blending 5% custard apple and 15% banana pulp (B_4) and maximum in nectar having 20% banana pulp (B_5). Bhardwaj and Mukharjee [8] also reported variations in acidity of blended beverages when prepared using different blending proportions. Further, the grand mean (A) acidity of nectar prepared by maintaining different levels of acidity varied from 0.181% to 0.331%, with minimum acidity in nectar prepared by 0.15 % acid (A_1) and maximum in nectar prepared by maintaining 0.30% acid (A_4). The variation in acidity of nectar is due to variations in levels of acidity in the prepared nectar. Similar findings were also reported by Jakher *et al.* [16]. The acidity of nectar prepared using different blending levels and acidity levels varied significantly, with minimum acidity (0.174%) in nectar prepared by using treatment combination A_1B_4 and maximum (0.346%) in nectar prepared by using treatment combination A_4B_1. Data depict that six months' storage of nectar resulted significant increase in grand mean (S) acidity from initial value of 0.225% to 0.298%. Patil *et al.* [19] reported significant variations for decrease of acidity in blended nectar prepared using different proportions of rose apple and jamun (75:25, 50:50 and 25:75). The minimum decrease in acidity might be due to better compatibility of the best blended proportion. Further, data depict that six months' storage of nectars prepared using different blending proportion resulted maximum increase in acidity of nectar prepared using 20% banana pulp (B_5-0:20) while minimum increase in acidity of nectar prepared by 5% custard apple and 15% banana pulp (B_4-20:0). The variation in increase of acidity in blended nectar might be due to variation in blending portion of pulp in the nectar. This might be due to variation in formation of organic acid by degradation of ascorbic acid among different blending proportion during storage [25]. Similar findings were also reported by Sarvankumar and Manimegalai [24] for blended RTS drink. Further, six months storage of nectar prepared by maintaining different acidity levels resulted minimum increase in acidity from 0.150% to 0.213% in nectar prepared by using 0.15% acid (A_1) closely followed by A_4, whereas maximum increase from 0.200% to 0.287% in nectar prepared using 0.20% (A_2). Ahmed [1] reported that banana based RTS beverage prepared by maintain 0.15% acidity was more shelf stable without any change in acidity during 9 months as compared to RTS maintained with acidity of 0.10% and 0.20%. During six-month storage, maximum increase in acidity (0.200% to 0.310%) was observed in nectar prepared using 20% banana pulp with 0.20% acidity (A_2B_5) while minimum

increase (0.300% to 0.340%) was observed in nectar prepared using 5% custard apple and 15% banana pulp with 0.30% acidity (A_4B_4). Jakhar *et al.* [16] reported minimum increase in acidity (0.20 to 0.25 per cent) in beverage prepared using 50:50 proportion of guava and barbados cherry with 0.20% acidity during six months' storage at ambient temperature. The interaction of blends, acidity and storage possess significant effects on the acidity content of nectar.

Table 4: Effect of different treatments on acidity of nectar during storage

Treatments		**Acidity, %**					**Grand mean (B)**
Acidity (A), %	**Blends* (B), %**	**Storage (S)**				**Grand mean (A)**	
		0 Month (S_1)	**2 Month (S_2)**	**4 Month (S_3)**	**6 Month (S_4)**		
A_1-0.15	B_1 -20:0	0.150	0.170	0.200	0.230	0.188	0.264
	B_2 -15:5	0.150	0.160	0.200	0.200	0.178	0.259
	B_3 -10:10	0.150	0.160	0.190	0.207	0.177	0.260
	B_4 -5:15	0.150	0.163	0.180	0.203	0.174	0.254
	B_5 - 0:20	0.150	0.173	0.210	0.227	0.190	0.266
	Mean	**0.150**	**0.165**	**0.196**	**0.213**	**0.181**	
A_2-0.20	B_1 -20:0	0.200	0.220	0.250	0.260	0.233	
	B_2 -15:5	0.200	0.227	0.257	0.287	0.243	
	B_3 -10:10	0.200	0.220	0.273	0.297	0.248	
	B_4 -5:15	0.200	0.230	0.250	0.280	0.240	
	B_5 - 0:20	0.200	0.230	0.260	0.310	0.250	
	Mean	**0.200**	**0.225**	**0.258**	**0.287**	**0.243**	
A_3-0.25	B_1 -20:0	0.250	0.270	0.290	0.347	0.289	
	B_2 -15:5	0.250	0.283	0.307	0.310	0.288	
	B_3 -10:10	0.250	0.280	0.300	0.300	0.283	
	B_4 -5:15	0.250	0.273	0.290	0.330	0.286	
	B_5 - 0:20	0.250	0.270	0.310	0.340	0.293	
	Mean	**0.250**	**0.275**	**0.299**	**0.325**	**0.288**	
A_4-0.30	B_1 -20:0	0.300	0.330	0.353	0.400	0.346	
	B_2 -15:5	0.300	0.320	0.337	0.360	0.329	
	B_3 -10:10	0.300	0.330	0.350	0.350	0.333	
	B_4 -5:15	0.300	0.310	0.310	0.340	0.315	
	B_5 - 0:20	0.300	0.320	0.330	0.380	0.333	
	Mean	**0.300**	**0.322**	**0.336**	**0.366**	**0.331**	
Grand mean (S)		**0.225**	**0.247**	**0.272**	**0.298**		**0.261**
C.D. $_{0.05}$							
Blends (B) :		0.0041	SxB :	0.0084	SxAxB : 0.017		
Acidity (A) :		0.0038	AxB :	0.0084			
Storage (S) :		0.0038	SxA :	0.0075			
*Custard apple: Banana							

Ascorbic acid: The perusal of data pertaining to effect of different treatments (blending proportions and acidity levels) on ascorbic acid of nectar has been presented in Table 5. Data show that among different levels of blends; the grand mean (B) ascorbic acid of nectar varied significantly from 1.36 mg/100 g to 3.32 mg/100 g, with minimum ascorbic acid in nectar prepared by blending 20% banana pulp (B_5) and maximum in blended nectar having 20% custard apple pulp (B_1). Ascorbic acid content of the products is dependent on level of pulp

used [8] besides other processing parameters. Patil *et al.* [18] reported significant variation in ascorbic acid of blended nectar when prepared using different proportions of rose apple and jamun (75:25, 50:50 and 25:75). Further, the grand mean (A) ascorbic acid of nectar prepared by maintaining different levels of acidity varied significantly from 2.24 mg/100 g to 2.35 mg/100 g, with minimum ascorbic acid in nectar prepared by maintaining 0.20% acid (A_2) and maximum in nectar prepared by maintaining 0.30% acid (A_4). The ascorbic acid of nectar prepdare using different blending levels and acidity levels varied significantly, with minimum ascorbic acid (1.29 mg/100g) in nectar prepared by using treatment combination A_2B_5 and maximum (3.44 mg/100g) in nectar prepared by using treatment combination A_4B_1. Ascorbic acid content was found to increase when blended nectar contain higher proportion of custard apple pulp. Data depict that six months' storage of nectar resulted decrease in grand mean (S) ascorbic acid from initial value of 3.02 mg/100 g to 1.52 mg/100 g. Further, data depict that six months' storage of nectars prepared using different blending proportion resulted minimum decrease in ascorbic acid of nectar prepared by 20% custard apple pulp (B_1-20:0) while maximum decrease in ascorbic acid of nectar prepared by 20% banana pulp (B_5-0:20). Custard apple blending with banana prevented oxidation of ascorbic acid and thus causes less decrease in ascorbic acid of blended nectar having custard apple compared to 100% banana nectar. Patil *et al.* [18] reported decrease in ascorbic acid content of blended nectar from 22.20 mg/100 g to 14.89 mg/100 g during 3 months' storage. Further, six months' storage of nectar prepared by maintaining different acidity levels resulted minimum decrease in ascorbic acid from 3.06 mg/100 g to 1.57 mg/100 g in nectar prepared by maintaining 0.30% acid (A_4), whereas maximum decrease in ascorbic acid from 2.97 mg/100 g to 1.45 mg/100 g in nectar prepared by maintaining 0.20% acid (A_2) due oxidation of ascorbic acid . During six months' storage, maximum decrease in ascorbic acid (2.59 mg/100 g to 0.97 mg/100 g) was observed in nectar prepared using 5% custard apple and 15% banana pulp with 0.25% acidity (A_3B_4) while minimum decrease (4.11 mg/100 g to 2.72 mg/100 g) was observed in nectar prepared using 20% custard apple pulp with 0.30% acidity (A_4B_1). The minimum decrease in ascorbic acid in A_4B_1 might be attributed to custard apple because nectar prepared using 20% custard apple has also shown minimum decrease in ascorbic acid content during storage. The ascorbic acid content of the juice decreased during storage, which was probably due to the fact that ascorbic acid being sensitive to oxygen, light and heat was easily oxidized in presence of oxygen [17]. Because of the high vitamin C content of acerola, cashew apple and guava fruits, which were present in the nectar, despite high loss during processing and storage, the beverages can still be considered a good source of vitamin C [11]. However, non-significant differences were observed in ascorbic acid of nectar prepared using different levels of blends and acidity. The reduction of ascorbic acid during storage might be attributed due to oxidation by trapped residual oxygen in glass bottles. Sharma *et al.* [25] reported that ascorbic acid content of blended nectar prepared from 20% guava and jamun pulp (50:50) with 14˚B TSS and 0.25% acidity decreased from 14.28 mg/100 g to 10.88 mg/100 g during three months storage. A similar result was observed by Thakre and Jain (2009) in papaya and banana blended nectar. Jakhar *et al.* [16] reported that minimum decrease in ascorbic acid content (68 mg/100 g to 50 mg/100 g) in beverage prepared using 50:50 proportion of guava and barbados cherry with 0.20% acidity during six months' storage at ambient temperature.

Table 5: Effect of different treatments on ascorbic acid of nectar during storage.

Treatments		**Ascorbic acid, mg/100 g**					**Grand mean (B)**
Acidity (A), %	**Blends* (B), %**	**Storage (S)**				**Grandmean (A)**	
		0 Month (S_1)	**2 Month (S_2)**	**4 Month (S_3)**	**6 Month (S_4)**		
	B_1 -20:0	3.85	3.45	2.75	2.45	3.13	3.32

A_1-0.15	B_2 -15:5	3.52	3.02	2.42	2.03	2.75	2.71
	B_3 -10:10	3.11	2.71	2.21	1.60	2.41	2.35
	B_4 -5:15	2.41	1.81	1.31	0.85	1.60	1.71
	B_5 - 0:20	2.08	1.68	1.18	0.50	1.36	1.36
	Mean	**2.99**	**2.53**	**1.97**	**1.49**	**2.25**	
A_2-0.20	B_1 -20:0	4.01	3.71	3.11	2.56	3.35	
	B_2 -15:5	3.40	2.90	2.40	1.90	2.65	
	B_3 -10:10	2.85	2.45	1.85	1.33	2.12	
	B_4 -5:15	2.59	1.99	1.49	1.03	1.78	
	B_5 - 0:20	2.01	1.61	1.11	0.43	1.29	
	Mean	**2.97**	**2.53**	**1.99**	**1.45**	**2.24**	
A_3-0.25	B_1 -20:0	4.03	3.63	3.13	2.63	3.36	
	B_2 -15:5	3.55	3.05	2.45	2.05	2.78	
	B_3 -10:10	3.07	2.67	2.17	1.72	2.41	
	B_4 -5:15	2.59	1.99	1.39	0.97	1.74	
	B_5 - 0:20	2.10	1.72	1.22	0.50	1.39	
	Mean	**3.07**	**2.61**	**2.07**	**1.57**	**2.33**	
A_4-0.30	B_1 -20:0	4.11	3.71	3.21	2.72	3.44	
	B_2 -15:5	3.39	2.99	2.39	1.96	2.68	
	B_3 -10:10	3.24	2.74	2.14	1.75	2.47	
	B_4 -5:15	2.44	2.04	1.54	0.90	1.73	
	B_5 - 0:20	2.10	1.90	1.10	0.53	1.41	
	Mean	**3.06**	**2.68**	**2.08**	**1.57**	**2.35**	
Grand mean (S)		**3.02**	**2.59**	**2.03**	**1.52**		**2.29**

C.D. $_{0.05}$

Blends (B) :	0.0415	SxB :	0.0831	SxAxB : NS
Acidity (A) :	0.0317	AxB :	0.0831	
Storage (S) :	0.0371	SxA :	NS	

*Custard apple: Banana

Overall acceptability: The perusal of data pertaining to effect of different treatments (blending proportions and acidity levels) on sensory score for overall acceptability of nectar has been presented in Table 6. Data show that among different levels of blends; the grand mean (B) overall acceptability of nectar varied significantly from 6.39 to 6.93, with minimum overall acceptability score in nectar prepared by blending 15% custard apple and 5% banana pulp (B_2) and maximum in blended nectar having 5% custard apple pulp and 15% banana pulp (B_4). Results revealed that nectar prepared using higher proportion of custard apple obtained lower sensory score for overall acceptability except nectar with 20% banana. It might be due to development of more bitterness in nectar containing higher proportion of custard apple. Nectar prepared using 20% banana pulp had lower sensory score for overall acceptability than B_4. It might be due to development of off-flavour in nectar containing 20% banana pulp. Banana pulp having lower ascorbic acid might be responsible for development of more off-flavour due to enzymatic reactions. The overall acceptability of blended beverage in whey and custard apple slightly decreased with the increase in pulp level of custard apple [14]. Similar observation was also reported earlier by Sangani et al. [23]. Raj *et al.* [20] reported maximum sensory score for blended beverage containing SPJ-AJ in the proportion of 50:50 to 60:40. Patil *et al.* [18] reported significant variation in overall acceptability of blended nectar when prepared using different proportions of rose apple and jamun (75:25, 50:50 and 25:75). Further, the grand mean (A) sensory score for overall acceptability of nectar prepared by maintaining different

levels of acidity varied significantly from 6.51 to 6.68, with minimum overall acceptability in nectar prepared by maintaining 0.15% acidity (A_1) and maximum in nectar prepared by maintaining 0.30% acidity (A_4) (Table 5). Ahmed [1] reported that banana beverage prepared by using different concentration of citric acid resulted significant variation in overall acceptability, with higher overall acceptability score in banana beverage containing 0.15 per cent acidity with TSS of 10ºBrix. The overall acceptability score of nectar prepare using different blending levels and acidity levels varied significantly, with minimum overall acceptability score (6.32) in nectar prepared by using treatment combination A_2B_2 and maximum (7.23) in nectar prepared by using treatment combination A_4B_4. Patil *et al.* (2011) reported that nectar containing 20 per cent blended juice of rose and jamun (50:50) with 20 percent TSS and 0.5 percent acidity was more acceptable with good organoleptic scores. The significant variations in overall acceptability were also observed in blended RTS when prepared using different proportions of guava and Barbados cherry by maintaining different concentrations of acidity [16]. Data depict that six months' storage of nectar resulted significant decrease in grand mean (S) sensory score for overall acceptability score from initial value of 7.14 to 6.10. Data depict that six months' storage of nectars prepared using different blending proportion resulted maximum decrease in sensory overall acceptability score of nectar prepared by using 20% banana pulp (B_5-0:20) while minimum decrease in nectar prepared by using 10% custard apple and 10% banana pulp (B_3-10:10). Further, six months' storage of nectar prepared by maintaining different acidity levels resulted minimum decrease in overall acceptability from 7.05 to 6.11 in nectar prepared by using 0.20% acidity (A_2), whereas maximum decrease in overall acceptability from 7.17 to 6.04 in nectar prepared by maintaining 0.25% acidity (A_3). The interaction of blends, acidity and storage possess significant effects in the sensory overall acceptability score of nectar. During six months' storage, maximum decrease in overall acceptability (7.25 to 5.88) was observed in nectar prepared using only 20% banana pulp with 0.15% acidity (A_1B_5) while minimum decrease (6.70 to 6.00) was observed in nectar prepared using 15% custard apple and 5% banana pulp with 0.20% acidity (A_2B_2). However, despite minimum decrease in A_2B_2, the nectar prepared using A_4B_4 (5% custard apple and 15% banana with 0.30% acidity) still possess higher sensory score for overall acceptability during six months' storage. The decrease in score of overall acceptability during storage could be correlated to change in colour, taste, body and flavour of nectar. However, under room condition the quality was maintained to more than six months of storage. Sharma *et al.* (2009) reported that preparation of blended guava and jamun RTS drinks with 20% pulp (50 guava: 50 jamun), 14% TSS and 0.25% acidity resulted maximum sensory score for overall acceptability.

Table 6: Effect of different treatments on overall acceptability of nectar during storage.

Treatments		**Overall acceptability (9 Point of Hedonic scale)**					**Grand mean (B)**
Acidity (A), %	**Blends* (B), %**	**Storage (S)**				**Grand mean (A)**	
		0 Month (S_1)	**2 Month (S_2)**	**4 Month (S_3)**	**6 Month (S_4)**		
A_1-0.15	B_1 -20:0	6.89	6.48	6.30	6.05	6.43	6.44
	B_2 -15:5	6.97	6.60	6.29	5.88	6.44	6.39
	B_3 -10:10	7.02	6.49	6.26	6.15	6.48	6.50
	B_4 -5:15	7.39	6.75	6.33	6.10	6.64	6.93
	B_5 - 0:20	7.25	6.91	6.26	5.88	6.57	6.66
	Mean	**7.10**	**6.65**	**6.29**	**6.01**	**6.51**	
A_2-0.20	B_1 -20:0	6.73	6.59	6.32	5.97	6.41	

	B_2 -15:5	6.70	6.38	6.21	6.00	6.32	
	B_3 -10:10	6.83	6.65	6.34	6.05	6.47	
	B_4 -5:15	7.42	6.91	6.63	6.32	6.82	
	B_5 - 0:20	7.56	6.58	6.46	6.20	6.70	
	Mean	**7.05**	**6.62**	**6.39**	**6.11**	**6.54**	
A_3-0.25	B_1 -20:0	6.90	6.70	6.15	5.78	6.38	
	B_2 -15:5	7.03	6.58	6.13	5.86	6.40	
	B_3 -10:10	6.95	6.58	6.36	5.98	6.47	
	B_4 -5:15	7.57	7.20	6.88	6.46	7.03	
	B_5 - 0:20	7.42	6.92	6.42	6.12	6.72	
	Mean	**7.17**	**6.80**	**6.39**	**6.04**	**6.60**	
A_4-0.30	B_1 -20:0	7.12	6.62	6.33	6.15	6.55	
	B_2 -15:5	7.00	6.58	6.25	5.84	6.42	
	B_3 -10:10	7.13	6.65	6.34	6.13	6.56	
	B_4 -5:15	7.73	7.21	7.00	6.98	7.23	
	B_5 - 0:20	7.26	6.74	6.36	6.15	6.63	
	Mean	**7.25**	**6.76**	**6.46**	**6.25**	**6.68**	
Grand mean (S)		**7.14**	**6.71**	**6.38**	**6.10**		**6.58**

C.D. $_{0.05}$

Blends (B) : 0.0317 SxB : 0.0635 SxAxB : 0.127

Acidity (A) : 0.0284 AxB : 0.0635

Storage (S) : 0.0284 SxA : 0.056

*Custard apple: Banana

Total plate count (TPC): The nectar prepared using different blending level and different acidity level were free from microbial contamination and even not detected any TPC (cfu/g) during six-month storage. Thus, all nectar samples were safe for consumption during six-month storage.

4. CONCLUSION

Overall, it can be concluded that six month of storage of custard apple and banana nectar prepared by different blending proportion and acidity levels showed remarkable changes in nutritional and sensory quality. The TSS, acidity increased gradually during storage period while ascorbic acid decreased during storage. The organoleptic characteristics for overall acceptability decreased slightly during six months of storage period. Likewise, throughout the storage period, all treatments of nectar were completely free from microbial spoilage. The nectar prepared by using 20 per cent pulp (5% custard apple and 15% banana) by maintaining 15°Brix TSS and 0.30% acid (A_4B_4) found shelf stable up to six months based on nutritional as well as sensory quality.

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 this manuscript.

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