



Value Addition of *Aloe vera* in Health Drinks and its Storage Stability

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ABSTRACT

Fruits, vegetable and medicinal plant act as protective foods in the era of hectic schedule by supplying all the nutrients especially minerals, vitamin & crude fiber which are beneficial for prevention of certain diseases. However, some of these commodities are not available throughout year while others are not have acceptance either due to bitter, astringent or acidic tastes causing hindrance in their consumption although beneficial for health. Thus, the present investigation was conducted at Department of Post Harvest Technology, ACHF, NAU during 2014-2015 to study changes in quality characteristics of *Aloe vera* based health drink [B₁-2:2:12:4, B₂-2:12:2:4, B₃-4:4:8:4, B₄-4:6:6:4, B₅-4:8:4:4, B₆-6:4:6:4, B₇-6:6:4:4, B₈-8:4:4:4 and B₉-12:2:2:4 (*Aloe vera*: Bitter gourd: Aonla: Guava)] during storage. The results of the present investigation indicate that drink prepared from 12% *Aloe vera* juice, 2% Bitter gourd juice, 2% Aonla juice and 4% Guava pulp having 16.00°Brix TSS and 0.30 per cent acidity (B₉) was extremely liked on the basis of 9 point Hedonic scale and found best on the basis of nutritional composition. Six month storage of drink prepared by using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp having 16°Brix total soluble sugars (TSS) and 0.30 per cent acidity (B₉) exhibited minimum changes in nutritional as well as sensory attributes. The benefit cost ratio of drink was observed 1.20 at 20 per cent profit margin and 1.75 at minimum market sale price of Rs. 10.00 per bottle (200 ml). Thus, the developed technologies can commercially be explored by food processing industry for the production of quality health drink.

Key Words:

Aloe Vera Juice, Aonla Juice, Bitter Gourd Juice, Blended Nectar, Guava Pulp, Quality, Storage

INTRODUCTION

India is the 2nd largest producer of the fruits and vegetables in the world after China (Anon

2014). Despite such a huge production of fruits and vegetables, population still has insufficient food for an active and healthy life (USDA 2009). According to the World Health Organization

reports; non-communicable diseases (NCDs) are the leading cause of mortality in the world, representing over 60% of all deaths; out of which 30% deaths are due to cardiovascular diseases. Non-communicable diseases include heart disease, stroke, cancer, asthma, diabetes, chronic kidney disease, osteoporosis, Alzheimer's disease, cataracts etc. One of the major causes of these diseases is the malnutrition resulting from food insecurity. So; health, fitness, well-being, nutrition and freshness of the foods are likely to drive the Indian food processing industry in the year ahead, as in the rest of the world. Therefore, a preventive food is required to avoid the necessity of taking medication/ drugs (WHO 2003). According to the traditional system of Indian Medicine, combinations of different foods are used to enhance the desired activity and to eliminate unwanted side effects. Food commodities like Aonla, Guava, Bitter gourd and medicinal herbs like *Aloe vera* are known from centuries for the beneficial effects and are being used to care different degenerative diseases. *Aloe vera*, is the most widely used and commercially available medicinal plant because of its nutritional and therapeutic properties (Olariu 2009). Recently, many commercial food-product manufacturers have initiated the use of *Aloe vera* in their productions. It is useful in various diseases such as type II diabetes, arthritis, eye disease, tumor, spleen enlargement, liver complaints, vomiting, bronchitis, asthma, jaundice and ulcers (Henry 1979). Bitter gourd is one of the most popular vegetables in South-East Asia. It has anti-diabetic, stimulant, stomachic, laxative and blood purifying properties (Raman and Lau 1996). Aonla is one of the minor fruit crops of commercial significance. It is used in Ayurvedic and Unani systems of Indian medicines. It possesses antibacterial, anticarcinogenic, antiemetic, antioxidative, antipyretic, antitumour, antiviral and expectorant activities (Mitra and Pathak 2008). However, the most serious and commonly occurring problem in consumption of these commodities in fresh form is due to its bitter taste (*Aloe vera*, bitter gourd) and

highly acidic as well as astringent taste (aonla). Guava fruits besides having medicinal importance also possess good flavour and acceptability (Joseph and Priya 2011); thus having positive attribute for blending purpose. Therefore, development of blended nectar by making a judicious combination of such fruits, vegetables and medicinal herbs having hypoglycemic properties appears to be one of the best alternatives to develop nectar in the form of healthy drink suitable for consumers of various age groups. Keeping these facts in view, the experiment was laid to study changes in quality characteristics of *Aloe vera* based blended nectar during storage.

MATERIALS AND METHODS

Fully developed slips of *Aloe vera* were procured from Bhavnagar (Gujarat) while mature fruits of aonla, fully ripe fruits of guava and tender fruits of bitter gourd were procured from APMC, Navsari (Gujarat) and brought to the laboratory at Navsari (Gujarat). Juice/ pulp from *Aloe vera*, bitter gourd, aonla and guava were extracted by grating the slips/ fruits following extraction by using crusher & screw type juice extractor and pulper. Produce juice/ pulp after extraction and filtration were blended in ratio of 2:2:12:4, 2:12:2:4, 4:4:8:4, 4:6:6:4, 4:8:4:4, 6:4:6:4, 6:6:4:4, 8:4:4:4 and 12:2:2:4 (*Aloe vera*: Bitter gourd: Aonla: Guava) with TSS level of 16°B and maintained with 0.30% acidity followed by heat pasteurization at 95°C for 5 min. Immediately after pasteurization, the nectar was packed in 200 ml pre-sterilized glass bottles followed by processing in boiling water for 30 min at 96±1°C. The sample followed by labeling were stored for 6 months and analyzed at regular intervals for physico-chemical as well as sensory attributes. The experiment was carried out by using completely randomized design with factorial concepts including 27 treatments each with three replications.

Morphological parameters of fifteen sample of each produce were recorded with the help of electronic Vernier calipers. Average weight of produce was determined gravimetrically. The

moisture was estimated by drying the weighted samples in hot air oven at $70 \pm 2^\circ\text{C}$ to a constant weight (AOAC 1984). The yield of the juice was calculated after extraction of the juice and expressed in percentage. The total soluble solids (TSS) was determined with the help of hand refractometer and expressed as °Brix (Ranganna 1997). The titratable acidity, sugars and ascorbic acid content were determined by the method as detailed by Ranganna (1997). Brix acid ratio was calculated by the ratio of TSS and titratable acidity. The pH was measured by a Cambridge pH meter using glass electrode as described by Raj et al. (2011). Total phenols were determined by the method described by Sadasivam and Manickam (1996). The sodium (Na) and potassium (K) contents were estimated by flame photometric

method as detailed by Ranganna (1997). The blended *Aloe vera*, bitter gourd, aonla and guava nectar was evaluated for sensory qualities on the basis of colour, taste, flavour and overall acceptability by a panel of 15 judges on a 9-point Hedonic scale Amerine et al. (1965). The data pertaining to physico-chemical characteristics of nectar were analyzed statistically by following completely randomized design with factorial concepts (Panse and Shukhatme 1967). The expenditures incurred in preparation of nectar were calculated by taking into consideration costs of *Aloe vera*, Bitter gourd, Aonla, Guava, sugar, citric acid etc. Processing and packaging charges were also included in the total cost of production. The sale price of product was calculated after adding 20 per cent profit margin.

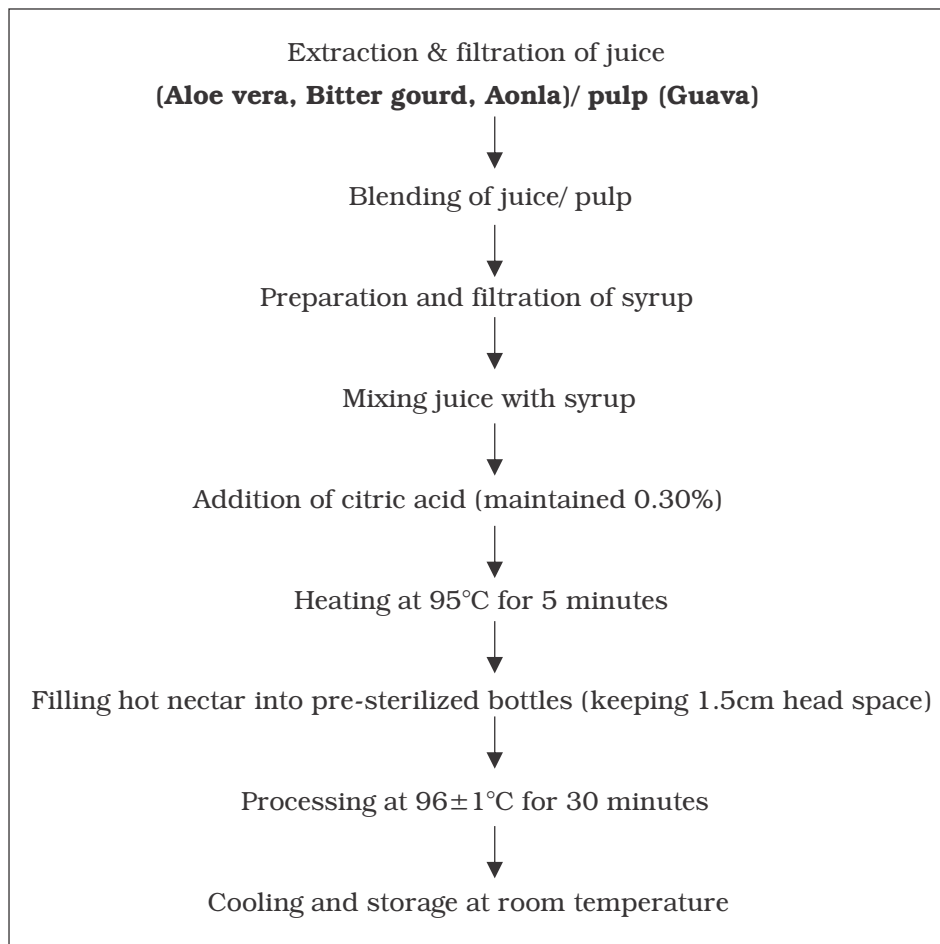


Fig. 1. Principal steps used for preparation of nectar

RESULTS AND DISCUSSION

The physico-chemical characteristics of fresh *Aloe vera*, bitter gourd, aonla and guava slips/ fruits are presented in Table 1. Results for physico-chemical parameters are in line with the observations made by Hamid et al. (2014),

Ramachandran and Nagarajan (2014) for fresh *Aloe vera* slips; Satkar et al. (2013), and Kaur and Aggarwal (2014) for bitter gourd; Jain and Khurdiya (2004), and Kumar and Singh (2013) for aonla; Mahour et al. (2012) and Sudhindra et al. (2012) for guava.

Table 1. Physico-chemical characteristics of fresh *Aloe vera*, bitter gourd, aonla and guava slips/ fruits

Parameters	<i>Aloe vera</i>	Bitter gourd	Aonla	Guava
Fruit/ Slip Length, cm	40.2 ± 8.95*	14.5 ± 1.08	3.2 ± 0.20	4.1 ± 0.55
Fruit/ Slip Breadth, cm	15.1 ± 1.39	3.31 ± 0.32	3.0 ± 0.10	3.9 ± 0.23
Fruit/ Slip weight, g	92.66 ± 2.68	34.52 ± 1.84	19.11 ± 0.42	17.1 ± 2.29
Juice yield, %	36.24 ± 1.06	70 ± 1.59	72 ± 3.16	88.2 ± 3.38
Moisture, %	97.5 ± 1.00	90 ± 0.96	82 ± 0.75	80.2 ± 0.70
TSS, °B	2.10 ± 0.07	3.20 ± 0.07	4 ± 0.14	10 ± 0.11
Acidity, %	0.02 ± 0.003	0.03 ± 0.003	2.30 ± 0.03	0.38 ± 0.02
pH	4 ± 0.07	5 ± 0.09	3.2 ± 0.07	4.40 ± 0.07
Reducing Sugars, %	0.31 ± 0.03	2.40 ± 0.07	2.30 ± 0.06	4.60 ± 0.07
Total Sugars, %	0.63 ± 0.04	2.80 ± 0.06	4.20 ± 0.07	9.60 ± 0.08
Non-reducing Sugars, %	0.30 ± 0.014	0.38 ± 0.02	1.81 ± 0.01	4.75 ± 0.02
Ascorbic acid, mg/100g	2 ± 0.37	16.20 ± 0.11	464 ± 2.83	285 ± 1.14
Total phenols, mg/100g	12.5 ± 0.71	60 ± 0.85	290 ± 0.90	2.50 ± 0.05

n=15

*Mean ± SE

Quality of blended nectar and its storage stability

Total Soluble Solids (TSS)

The perusal of data pertaining to TSS of blended nectar has been presented in Table 2. Data revealed that mean TSS (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla and guava juice/ pulp varied significantly from 16.10°B to 16.35°B, with minimum TSS in blended nectar prepared by blending 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp (B₉) and maximum in blend using 4% *Aloe vera* juice, 8%

bitter gourd juice, 4% aonla juice & 4% guava pulp (B₅) & 8% *Aloe vera* juice, 4% bitter gourd juice, 4% aonla juice & 4% guava pulp (B₈). Total soluble solids were significantly affected due to blending ratio during storage (Bhardwaj and Mukherjee 2012). Similar results have been reported in mixed fruit juice due to gradual inversion of sugars by hydrolysis (Vaidya et al. 1998). Data depict that storage of blended nectar resulted significant increase in mean TSS (S) from initial value of 16.00°B to 16.61°B after six month of storage. The increase in TSS might be due to inversion of polysaccharides like starch and cellulose into simpler soluble molecules in the presence of organic acid (Sudhindra et al. 2012). Similar

results were reported by Jakhar and Pathak (2012). The hydrolysis of polysaccharides into monosaccharides and oligosaccharides causes gradual increase in TSS during storage (Singh and Gaikwad 2012). Further, six month storage of blended nectar prepared using different blending levels observed minimum increase in TSS from 16.00°B to 16.20°B in blended nectar prepared by blend using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₆), whereas maximum increase in TSS from 16.00°B to 16.70°B in blended nectar prepared by blend using 4% *Aloe vera* juice, 8% bitter gourd juice, 4% aonla juice & 4% guava pulp (B₅) and 8% *Aloe vera* juice, 4% bitter gourd juice, 4% aonla juice & 4% guava pulp (B₈). Changes in TSS in RTS prepared by using different blend of bael: aonla during storage period of 45 days were also reported by Rathod et al. (2014) and Deka and Sethi (2001) in aonla: lime spiced beverage. The increase in TSS might be due to inversion of polysaccharides like starch and cellulose into simpler soluble molecules in the presence of organic acid (Sudhindra et al. 2012). Similar results were reported by Jakhar and Pathak (2012). The hydrolysis of polysaccharides into monosaccharides and oligosaccharides causes gradual increase in TSS during storage (Singh and Gaikwad 2012).

Reducing sugars

The perusal of data pertaining to reducing sugars of blended nectar has been presented in

Table 2. Data revealed that mean reducing sugars (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla & guava juice/ pulp varied significantly from 7.50 per cent to 7.72 per cent, with minimum reducing sugars in blended nectar prepared by blending 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁), whereas maximum in blend using 6% *Aloe vera* juice, 4% bitter gourd juice, 6% aonla juice & 4% guava pulp (B₆) and 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₉). The variation in reducing sugars due to blending was also reported by Kumar et al. (2009) and Tripathi et al. (1988). This could be due to hydrolysis of polysaccharides and inversion of non-reducing sugars during processing and storage (Roy and Singh 1979). Data depict that storage of blended nectar resulted significant increase in mean reducing sugars (S) from initial value of 4.50 per cent to 10.03 per cent after six month of storage. Similar results were reported in bitter gourd: mosambi as well as bitter gourd: lemon blends by Sheela and Sruthi (2014). Further, six month storage of blended nectar prepared using different blending levels resulted minimum increase in reducing sugars of blended nectar prepared by blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁), whereas maximum increase in reducing sugars of blended nectar prepared by blend using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₉).

Table 2: Effect of blending formulation of *Aloe vera*, Bitter gourd, Aonla & Guava on TSS and sugars content of blended nectar during storage

AV: AO: BG and GV Blends (B)	TSS (°Brix)				Reducing sugars (%)				Total sugars (%)			
	Storage (Month)			Mean (B)	Storage (Month)			Mean (B)	Storage (Month)			Mean (B)
	0	3	6		0	3	6		0	3	6	
B ₁ - 2:2:12:4	16.0	16.1	16.6	16.27	4.42	8.20	9.86	7.50	14.73	14.91	15.17	14.94
B ₂ - 2:12:2:4	16.0	16.4	16.6		4.51	8.37	10.06		7.65	15.04	15.21	
B ₃ - 4:4:8:4	16.0	16.2	16.7	16.30	4.54	8.41	10.10	7.68	15.14	15.29	15.53	15.32
B ₄ - 4:6:6:4	16.0	16.2	16.6		4.45	8.24	9.91		7.54	14.83	14.99	

AV: AO: BG and GV Blends (B)	TSS (°Brix)			Mean (B)	Reducing sugars (%)				Mean (B)	Total sugars (%)			
	Storage (Month)				Storage (Month)					Storage (Month)			
	0	3	6		0	3	6	0		3	6	0	3
B ₅ - 4:8:4:4	16.0	16.3	16.7	16.35	4.51	8.37	10.06	7.65	15.05	15.22	15.48	15.25	
	0	5	0										
B ₆ - 6:4:6:4	16.0	16.2	16.6	16.28	4.56	8.45	10.15	7.72	15.20	15.36	15.61	15.39	
	0	5	0										
B ₇ - 6:6:4:4	16.0	16.3	16.6	16.32	4.44	8.23	9.90	7.52	14.79	14.96	15.23	15.00	
	0	0	5										
B ₈ - 8:4:4:4	16.0	16.3	16.7	16.35	4.51	8.36	10.06	7.65	15.03	15.20	15.47	15.24	
	0	5	0										
B ₉ - 12:2:2:4	16.0	16.1	16.2	16.10	4.55	8.45	10.15	7.72	15.19	15.36	15.64	15.40	
	0	0	0										
Mean (S)	16.0	16.2	16.6	16.29	4.50	8.34	10.03	7.62	15.00	15.17	15.43	15.20	
	0	6	1										
CD _{0.05}	B=0.029 S= 0.017 B×S =0.050			B=0.019 S=0.011 B×S =0.033				B=0.012 S=0.007 B×S =0.021					

Total Sugars

The perusal of data pertaining to total sugars of blended nectar has been presented in Table 2. Data revealed that mean total sugars (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla & guava juice/pulp varied significantly from 14.94 per cent to 15.40 per cent, with minimum total sugars in blended nectar prepared by blending 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁), whereas maximum in blend prepared by using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₉). Sharma et al. (2013) reported that there was a gradual increase in total sugars of guava-jamun blends RTS and squash during three month storage, which might be due to hydrolysis of polysaccharides like pectin, starch, etc. into simple sugars. Similar observations were recorded by Kenghe and Zambare (2009) in blended bael RTS drink while Nagpal and Rajyalakshmi (2009) recorded similar observations in RTS beverage prepared from bael and citrus fruit blends. Data depict that storage of blended nectar resulted significant increase in mean total sugars (S) from initial value of 15.00 per cent to 15.43 per cent after six month of

storage. This slight increase in total sugars during storage might be due to acid hydrolysis of polysaccharides as reported by Sudhindra et al. (2012). Attri et al. (1991) reported similar findings in blended juice prepared from pear and apricot juice. Further, six month storage of blended nectar prepared by different blending levels resulted minimum increase in total sugars of blended nectar prepared by blend using 4% *Aloe vera* juice, 4% bitter gourd juice, 8% aonla juice and 4% guava pulp (B₃), whereas maximum increase in total sugars of blended nectar prepared by blend using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₉).

Acidity

The perusal of data pertaining to acidity of blended nectar has been presented in Table 3. Data revealed that mean acidity (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla and guava juice/pulp varied significantly from 0.320 per cent to 0.373 per cent, with minimum acidity in blended nectar prepared by blending 2% *Aloe vera* juice, 12% bitter gourd juice, 2% aonla juice and 4% guava pulp (B₂) and maximum in blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice &

4% guava pulp (B₁). This might be due to increase in the level of aonla juice as acidity of aonla juice increased during storage (Rathod et al. 2014). Data depict that storage of blended nectar resulted significant increase in mean acidity (S) from initial value of 0.300 per cent to 0.373 per cent after six month of storage. The acidity of blended nectar increased during storage period of six month which might be due to ascorbic acid degradation or hydrolysis of pectin (Chauhan et al. 1997). Similar results were observed by Karanjalker et al. (2013). Further, six month storage of blended nectar prepared using different blending levels resulted minimum increase in acidity of blended nectar prepared by blend using 2% *Aloe vera* juice, 12% bitter gourd juice, 2% aonla juice and 4% guava pulp (B₂), whereas maximum increase in acidity of blended nectar prepared by blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁). Increase in acidity during storage of *Aloe vera*, aonla and ginger blended RTS beverage was revealed by Sasi et al. (2013). The increase in acidity might be due to formation of organic acid by degradation of ascorbic acid during storage of guava-jamun blended beverage as predicted by Sharma et al. (2009).

Ascorbic acid

The perusal of data pertaining to ascorbic acid of blended nectar has been presented in Table 3. Data revealed that mean ascorbic acid (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla and guava juice/ pulp varied significantly from 5.13 mg/100g to 15.09 mg/100g, with minimum ascorbic acid in blended nectar prepared by blending 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp (B₉) and maximum in blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁). The variation in ascorbic acid content in different blends might be due to variation in initial ascorbic acid content of produce. Higher proportion of aonla was responsible for higher ascorbic acid content of blends (B₁). The blended nectar prepared with higher aonla juice was found

better in ascorbic acid content. These findings are in conformity with the studies of Jain and Khurdiya (2004) and reported that the Indian gooseberry juice contained the highest vitamin C (478.56 mg/100ml). Hence, blending of gooseberry juice with other fruit juices for the preparation of blended ready-to-serve beverages resulted increase in vitamin C content (Mall and Tandon 2005; Garg et al. 2008). Similar results were found by Jain and Meena (2013). Data depict that storage of blended nectar resulted significant decrease in mean ascorbic acid (S) from initial value of 9.35 mg/100g to 7.76 mg/100g after six month of 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 (Mapson 1970). 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 (De Sousa et al. 2010). Further, six month storage of blended nectar prepared by different blending levels resulted minimum decrease in ascorbic acid of blended nectar prepared by blend using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₉), whereas maximum decrease in ascorbic acid of blended nectar prepared by blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁). Similar results were found by Hu et al. (2003). It might be due to good antioxidant activity of *Aloe vera*. The polyphenols along with bioactive polysaccharides like acemannan and glucomannan could protect vitamins from oxidation and loss (Zheng and Wang 2001).

Total phenols

The perusal of data pertaining to total phenols of blended nectar has been presented in Table 3. Data revealed that mean total phenols (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla and guava juice/ pulp varied significantly from 7.16

mg/100g to 29.92 mg/100g, with minimum total phenols in blended nectar prepared by blending 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp (B₉) and maximum in blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁). Similar results were observed by Jain and Meena (2013) in blended aonla-kinnow RTS beverages. This could be attributed to the higher total phenols content in the aonla juice (Barthakur and Arnold, 1991; Kalra 1988). Data depict that storage of blended nectar resulted significant decrease in mean total phenols (S) from initial value of 19.47 mg/100g to 12.06 mg/100g after six month of storage. Similar results were observed in blends of apple, jamun and vegetable juice during storage period by Mishra and Sharma (2012) as well as Gliszczynska and Tyrakowska (2003) in apple juice stored under ambient conditions up to 11 months. The six month storage of spiced squash

resulted 50% loss of total phenols as reported by Selvamuthukumaran and Khanum (2013). The loss of total phenols during storage might be due to the sensitivity of the phenolic components to oxidation. Further, six month storage of blended nectar prepared by different blending levels resulted minimum decrease in total phenols of blended nectar prepared by blend using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₉), whereas maximum decrease in total phenols of blended nectar prepared by blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁). The content of polyphenols decreased gradually in aonla juice throughout the storage period at ambient condition (Bhattacharjee et al. 2011). They mentioned that some individual polyphenols like caffeic acid and kaempferol decreased continuously throughout the storage of juice resulting loss of total polyphenols.

Table 3: Effect of blending formulation of Aloe vera, Bitter gourd, Aonla & Guava on acidity, ascorbic acid and total phenols of blended nectar during storage

AV: AO: BG and GV Blends (B)	Acidity (%)				Ascorbic acid (mg/100g)				Total phenols (mg/100g)			
	Storage (Month)			Mean (B)	Storage (Month)			Mean (B)	Storage (Month)			Mean (B)
	0	3	6		0	3	6		0	3	6	
B ₁ - 2:2:12:4	0.30	0.38	0.44		16.9	14.8	13.4		36.4	30.8	22.5	
	0	0	0	0.373	9	7	2	15.09	1	6	0	29.92
B ₂ - 2:12:2:4	0.30	0.32	0.34		5.66	5.30	5.05		13.3	11.3		
	0	0	0	0.320	5.66	5.30	5.05	5.34	7	4	8.30	11.00
B ₃ - 4:4:8:4	0.30	0.34	0.41		12.4	11.0	10.0		26.2	22.3	16.2	
	0	7	0	0.352	9	4	5	11.19	4	0	6	21.60
B ₄ - 4:6:6:4	0.30	0.34	0.34		10.1				21.6	18.3	13.3	
	0	0	7	0.329	8	9.11	8.37	9.22	2	5	8	17.78
B ₅ - 4:8:4:4	0.30	0.32	0.35		7.83	7.13	6.64		17.0	14.4	10.5	
	0	0	3	0.324	7.83	7.13	6.64	7.20	3	6	0	14.00
B ₆ - 6:4:6:4	0.30	0.36	0.40		10.1				20.7	17.5	12.8	
	0	0	0	0.353	7	9.05	8.28	9.16	0	5	3	17.03
B ₇ - 6:6:4:4	0.30	0.33	0.34		7.76	7.11	6.59		16.0	13.6		
	0	0	7	0.326	7.76	7.11	6.59	7.15	9	6	9.98	13.24
B ₈ - 8:4:4:4	0.30	0.35	0.36		7.72	6.90	6.52		15.1	12.8		
	0	3	7	0.340	7.72	6.90	6.52	7.05	4	7	9.40	12.47
B ₉ - 12:2:2:4	0.30	0.34	0.35		5.35	5.10	4.95		8.65	7.38	5.44	
	0	0	3	0.331	5.35	5.10	4.95	5.13	8.65	7.38	5.44	7.16
Mean (S)	0.30	0.34	0.37		9.35	8.40	7.76		19.4	16.5	12.0	
	0	3	3	0.339	9.35	8.40	7.76	8.50	7	3	6	16.02
CD _{0.05}	B=0.003 S=0.002 B×S=0.005				B= 0.012 S=0.07 B×S=0.021				B=0.016 S=0.009 B×S=0.028			

Sodium

The perusal of data pertaining to sodium content of blended nectar has been presented in Table 4. Data revealed that mean sodium content (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla and guava juice/ pulp varied significantly from 45.32 mg/100g to 64.49 mg/100g, with minimum sodium content in blended nectar prepared by blending 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp (B₉) and maximum in blend using 2% *Aloe vera* juice, 12% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₂). The variation in sodium content might be attributed to variation in the sodium content of different produce. Data depict that storage of blended nectar resulted non-significant decrease in mean sodium content (S) from initial value of 50.05 mg/100g to 49.99 mg/100g after six month of storage. Further, decrease in sodium content during six months storage was observed non-significant in blended nectar prepared by using different levels of blending.

Potassium

The perusal of data pertaining to potassium content of blended nectar has been presented in Table 4. Data revealed that mean potassium content (B) of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla and guava juice/ pulp varied significantly from 17.56 mg/100g to 33.49 mg/100g, with minimum potassium content in blended nectar prepared by blending 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp (B₉) and maximum in blend using 2% *Aloe vera* juice, 12% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₂). The variation in potassium content might be attributed to variation in the potassium content of different produce. Data depict that storage of blended nectar resulted non-significant decrease in mean potassium content (S) from initial value of 26.73 mg/100g to 26.69 mg/100g after six month of storage. Further, decrease in potassium content during six months storage was observed non-significant in blended nectar prepared by using different levels of blending.

Table 4: Effect of blending formulation of *Aloe vera*, Bitter gourd, Aonla & Guava on sodium, potassium and overall acceptability of blended nectar during storage

AV: AO: BG and GV Blends (B)	Sodium (mg/100g)			Mean (B)	Potassium (mg/100g)			Mean (B)	Overall acceptability			Mean (B)
	Storage (Month)				Storage (Month)				Storage (Month)			
	0	3	6		0	3	6		0	3	6	
B ₁ - 2:2:12:4	48.3	48.3	48.2		26.8	26.8	26.7		7.45	6.81	6.48	6.92
B ₂ - 2:12:2:4	64.5	64.5	64.4	48.29	33.5	33.4	33.4	26.79	7.17	7.15	6.99	7.10
B ₃ - 4:4:8:4	48.2	48.2	48.1	64.49	28.8	28.8	28.8	33.49	7.37	7.20	6.85	7.14
B ₄ - 4:6:6:4	48.6	48.6	48.6	48.21	22.1	22.0	22.0	28.86	7.74	7.64	7.58	7.65
B ₅ - 4:8:4:4	52.1	52.1	52.0	48.62	30.4	30.4	30.4	22.08	7.57	7.60	7.35	7.51
B ₆ - 6:4:6:4	47.7	47.6	47.6	52.07	30.3	30.3	30.3	30.45	7.75	7.45	7.27	7.49
B ₇ - 6:6:4:4	48.2	48.2	48.2	47.66	25.1	25.1	25.1	25.14	7.85	8.01	7.80	7.88
B ₈ - 8:4:4:4	47.3	47.2	47.2	48.25	25.7	25.7	25.7	25.14	8.32	8.32	8.13	8.25
B ₉ - 12:2:2:4	45.3	45.3	45.2	45.32	17.5	17.5	17.5	25.72	8.32	8.32	8.13	8.25
Mean (T)	50.0	50.0	49.9		26.7	26.7	26.6		7.78	7.64	7.42	7.61
CD _{0.05}	5	3	9	50.02	3	1	9	26.71	B=0.057	S=0.033	B×S	
	=NS				=NS				=0.098			

Overall acceptability

The perusal of data pertaining to overall acceptability score (9 point Hedonic Scale) of blended nectar has been presented in Table 4. Data revealed that mean overall acceptability (B) score of blended nectar prepared by blending different proportion of *Aloe vera*, bitter gourd, aonla and guava juice/ pulp varied significantly from 6.92 to 8.58, with minimum overall acceptability score in blended nectar prepared by blending 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice and 4% guava pulp (B₁) and maximum in blend using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice & 4% guava pulp (B₉). The increase in the level of bitter gourd and aonla resulted lower sensory score for overall acceptability while higher level of *Aloe vera* resulted higher sensory score for overall acceptability in B₉. Similar results were reported by Boghani et al. (2012). They observed that sample containing 10% *Aloe vera* juice was preferred by the judges with highest overall acceptability. Data depict that storage of blended nectar resulted significant decrease in mean overall acceptability (S) score from initial value of 7.78 to 7.42 after six month of storage. The storage study of aonla-ginger beverage revealed that decrease in sensory score of overall acceptability during storage. This might be due to several nutritional changes that occurred during storage of beverage (Gomez and Khurdiya 2005). Further, six month storage of blended nectar prepared by

different blending levels resulted minimum decrease in overall acceptability score of blended nectar prepared by blend using 6% *Aloe vera* juice, 6% bitter gourd juice, 4% aonla juice & 4% guava pulp (B₇), whereas maximum decrease in overall acceptability score of blended nectar prepared by blend using 2% *Aloe vera* juice, 2% bitter gourd juice, 12% aonla juice & 4% guava pulp (B₁). Sasi et al. (2013) reported that overall sensorial quality profile of blended (*Aloe vera*, aonla and ginger) therapeutic RTS slightly decreased during storage period of 4 months even though remained under the consideration of "Like very much" by panel members.

Economics

The data in Table 5 indicated that total cost of production for 100 liter blended nectar was worked out to be Rs. 2849 (included packaging and processing charge). As per best treatment combination B₉ (12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp with TSS level of 16°B), 33 kg of *Aloe vera* slips, 3 kg Bitter gourd fruit, 2.75 kg Aonla fruit and 16 kg Guava fruit are required for preparation of 100 liter of blended nectar. The cost of production and sale price per 200 ml of nectar including 20% profit for best treatment was worked out to be Rs. 5.70 and Rs. 6.84, respectively. Further, BCR ratio per bottle (200 ml) for best treatment at 20% profit margin and at minimum market sale price of Rs. 10.00 per bottle (200 ml) was worked out to be 1.20 and 1.75, respectively.

Table 5. Economics of 100 litre nectar for treatment B₉

Sr.No.	Particulars	Quantity (kg)	Rate (Rs./ kg)	Amount (Rs.)
1	Aloe vera	33	4	132
2	Bitter gourd	3	16	48
3	Aonla	2.75	20	55
4	Guava	4.5	16	72
5	Sugar	14.75	34	502
6	Citric acid	0.162	400	65
7	Glass bottles	500 Bottle	3/Bottle	1500
8	Total of raw material cost (Sr. No 1-7)			2374
9	Processing charge @ 20% of raw material cost			475
10	Total production cost per 100 L (500 bottle) (Sr. No 8 + 9)			2849
11	Total production cost/ bottle [A]			5.70

Sr.No.	Particulars	Quantity (kg)	Rate (Rs./ kg)	Amount (Rs.)
12	Sale price per bottle including 20 % profit [B]			6.84
13	Net profit per bottle [B-A] @ 20 % profit			1.14
14	Benefit: Cost ratio @ 20 % profit			1.20
15	Minimum market sale price per bottle [C]			10
16	Net profit per bottle [C-A] (at minimum market price)			4.30
17	Benefit: Cost ratio (at minimum market price)			1.75
18	Per cent net profit [(C-A)/A*100] (at minimum market price)			75.44

CONCLUSION

The findings summarized above indicate that *Aloe vera* slips, Bitter gourd fruits, Aonla fruits and Guava fruits available in the market during glut season can be utilized more beneficially for preparation of blended nectar. The blended nectar can be prepared by using 12% *Aloe vera* juice, 2% Bitter gourd juice, 2% Aonla juice and 4% Guava pulp having 16°Brix TSS and 0.30% acidity. The prepared blended nectar can be stored successfully for a period of six months in glass bottles after 30 min heat processing at 96±1°C. Thus, the developed technologies can commercially be explored by food processing industry for the production of quality health oriented blended nectar. Therefore, profitable utilization of *Aloe vera* slips, Bitter gourd fruits, Aonla fruits and Guava fruits grown in India by processing can ensure better returns to the growers and processors and consumer.

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