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Effect of UV Light, Preservative and Heat Treatment on Quality of *Aloe Vera* Based Blended Nectar

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ABSTRACT

Effect of UV light, preservative and heat treatment on quality of *Aloe vera* based blended nectar for quality retention and to study the storage stability of blended nectar was conducted in the year 2015-16. Experiment was conducted for preservation of blended nectar (12% *Aloe vera juice*, 2% Bitter gourd juice, 2% Aonla juice and 4% Guava pulp having 15.00°Brix TSS and 0.30 per cent acidity) using different preservation methods i.e. standard heat processing, chemical preservation and UV light treatments. The results indicate that blended nectar can be preserved for long time by adding 75ppm KMS (50% recommended chemical preservative) followed by 30 minutes UV light treatment (T_{10}-$P_{75}U_{30}$) on the basis of higher sensory score as well as nutritional composition. Six month storage of blended nectar preserved by adding 75ppm KMS followed by 30 minutes UV light treatment (T_{10}-$P_{75}U_{30}$) exhibited minimum changes in nutritional as well as sensory attributes. Overall findings of investigation revealed that blended nectar can successfully be stored for 6 months in glass bottles with minimum changes in chemical, sensory and microbial quality. The Benefit cost ratio (BCR) of blended nectar was observed 1.20 at 20 per cent profit margin and 1.74 at minimum market sale price of Rs. 10.00 per bottle (200 ml). Thus, UV light treatment of blended nectar for 30 minutes containing 75 ppm KMS can be utilized more beneficially for its preservation by food processing industry for a period of six months to ensure minimum changes in nutritional as well as sensory quality.

INTRODUCTION

India is the 2nd largest producer of the fruits and vegetables in the world after China (Anon. 2014). According to recent estimate, horticultural crops occupy 10% gross cropped area (23.7 million ha) with production of 268.80 million tonnes. In India, the production of fruits is 81.29 million tonnes from an area of 6.98 million ha; while, that of vegetable production is 162.19 million tonnes from an area of 9.21 million ha. India's share in world fruit production is 12.6% and vegetable production is 14%. Despite such a huge production of fruits and vegetables, world population still has insufficient food for an active

and healthy life (USDA 2009).

It is now being realized that supportive nutritional care of the sufferers should be considered as an integral part of therapeutic regime; whatever, the treatment may be. Therefore, a preventive food is required to avoid the necessity of taking medication/ drugs (WHO 2003). However, the availability of health foods to cater the specific health problems of the society is limited in the Indian and world markets. A food highly conducive to health is called health food (Jacobson 2005).

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). The health drink (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 health drink can be stored successfully for a period of six months in glass bottles after 30 min heat processing at 96±1°C (Vaghashiya 2015).

Food drinks deteriorate in quality due to a wide range of reactions in food which may be chemical or microbiological. Thermal processes such as blanching, pasteurization or heat sterilization are being employed for food preservation. However, in most cases thermal energy induces various chemical reactions, leading to quality deterioration in certain foods causing undesirable changes in sensory and nutritional qualities. In addition, the food preservatives which are being used for preservation of the processed foods possess several health ill effects and even some time deteriorates nutritional and sensory qualities of foods. Consumers are becoming more health conscious and demanding food products having better nutritional quality with low or even no food preservative. Therefore, some alternative methods need to be evaluated for the preservation of the foods to develop the consumer's confidence towards safety. Application of UV light can become a non thermal non chemical (NTNC) preservation method by killing microbes present in the food. At present, very little literature is available on UV light assisted preservation method.

MATERIALS AND METHODS

Fully developed slips of *Aloe vera* were procured from Anand (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 was blended in ratio of 12:2:2:4 (*Aloe vera:* Bitter gourd: Aonla: Guava) with TSS level of 15°B and maintained with 0.30% acidity. Prepared blend was mixed thoroughly in freshly prepared syrup on weight basis and the mixture was boiled by adding required quantity of citric acid to get consistent product. The prepared nectar was filled into pre-sterilized glass bottles of 200 ml and sealed air tight with crown caps. The product was then processed as per treatments followed by cooling and storage for six months at room temperature and analyzed at regular intervals for physico-chemical as well as sensory attributes. The experiment was carried out by using completely randomized design including 11 treatments each with three replications.

Morphological parameters of fifteen sample of each produce were recorded with the help of electronic Vernier callipers. Average weight of produce was determined gravimetrically. The moisture was estimated by drying the weighted samples in hot air oven at 70±2°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). 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). Total Plate Count (TPC) was determined by the method described by Ranganna (1997). The data pertaining to physico - chemical characteristics of nectar were analyzed statistically by following completely randomized design (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.

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 Vaghashiya (2015) and Vaghashiya et al. (2016), 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 parameters of *Aloe vera,* Bitter gourd, Aonla and Guava fruits/ slips

Sr. No.	Parameters	Mean ± SE			
		Aloe vera	Bitter gourd	Aonla	Guava
1	Fruit/ Slip Length (cm)	**40.2 ± 8.95**	14.5 ± 1.08	3.2 ± 0.20	5.3 ± 0.55
2	Fruit/ Slip Breadth (cm)	15.1 ± 1.39	3.31 ± 0.32	3.0 ± 0.10	5.5± 0.23
3	Fruit/Slip weight (g)	92.66 ± 2.68	34.52 ± 1.84	19.11 ± 0.42	130 ± 2.29
4	Juice yield (%)	36.24 ± 1.06	70.00 ± 1.59	72.00 ± 3.16	88.20 ± 3.38
5	Moisture (%)	97.00 ± 1.00	90.00 ± 0.96	82.00 ± 0.75	80.20 ± 0.70
6	TSS (°B)	2.00 ± 0.07	3.20 ± 0.07	4.00 ± 0.14	10.00 ± 0.11
7	Acidity (%)	0.02 ± 0.003	0.03 ± 0.003	2.30 ± 0.03	0.38 ± 0.02
8	pH	4.00 ± 0.07	5.00±0.09	3.20 ± 0.07	4.40 ± 0.07
9	Reducing Sugars (%)	0.31 ± 0.03	2.40 ± 0.07	2.30 ± 0.06	4.60 ± 0.07
10	Total Sugars (%)	0.63 ± 0.04	2.80 ± 0.06	4.20 ± 0.07	9.60 ± 0.08
11	Non -reducing Sugars (%)	0.30 ± 0.014	0.38 ± 0.02	1.81 ± 0.01	4.75 ± 0.02
12	Ascorbic acid (mg/100g)	2.2 ± 0.37	16.20 ± 0.11	464 ± 2.83	285 ± 1.14
13	Total phenols (mg/100 g)	12.5 ± 0.71	60 ± 0.85	290 ± 0.90	2.50 ± 0.05

Quality of Blended nectar and its storage stability

Total Soluble Solids (TSS): Minimum TSS was in blended nectar preserved by UV light treatment for 15 minutes (T_3-U_{15}) and maximum in blended nectar preserved with the addition of 75ppm KMS followed by 45 minute UV light treatment (T_{11}- $P_{75}U_{45}$) (Table 2). Total Soluble Solids were significantly affected due to UV light

during storage when apple cider was pasteurized & treated with UV-light (Tandon et al. 2003). Similar results have been reported in UV-irradiated pineapple juice (Chia et al. 2012). However, non-significant change in TSS content of fresh tiger nuts' milk beverage treated with UV-C light reported by Margarita et al. (2011). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for TSS of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1°C for 30 minutes. The storage of blended nectar irrespective of UV light treatment (S) shown slight significant increase in TSS after storage period of 2nd months (15.00 to 15.17°B) followed by immediate decline (15.17 to 14.77°B) in TSS after storage period of 4th & 6th months. The changes in TSS during 6 months storage period were significant. 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). The increase in TSS was also reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage. During six months of storage, the TSS of blended nectar preserved by different UV light treatments possessed significant variation, with minimum increase in TSS (15.00 to 15.25°B) in nectar preserved by 15 minutes heat processing followed by 30 minutes UV light treatment (T_7-$H_{15}U_{30}$) & 15 minutes heat processing followed by 45 minutes UV light treatment (T_8-$H_{15}U_{45}$) and maximum increase (15.00 to 15.65°B) in nectar preserved by addition of 75ppm KMS followed by 45 minute UV light treatment (T11-P75U45). Significant increase and decrease in TSS were observed in treatments which were preserved by only UV light treatments (T_3-U_{15}, T_4-U_{30}, and T_5-U_{45}). It might be due to start of fermentation after two months storage.

Acidity: Minimum acidity in blended nectar preserved by 75ppm KMS followed by 30 minute UV light treatment (T_{10}- $P_{75}U_{30}$) was at par with 75ppm KMS followed by 45 minute UV light treatment (T_{11}- $P_{75}U_{45}$) (Table 2) and maximum in blended nectar preserved with UV light treatment for 15 minutes (T_3-U_{15}). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for acidity of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1°C for 30 minutes. The storage of blended nectar irrespective of UV light treatment (S) shown significant increase in acidity after storage period of 6 months (0.300 to 0.397%). Chia et al. (2012) reported lower acidity content of the UV-irradiated pineapple juice than the thermally pasteurized juice during storage. Caminiti et al. (2012) reported non-significant changes in acidity of apple juice exposed to UV light during 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). The increase in acidity was also reported earlier by Vaghashiya (2015) in blended health drink during 6 months storage. During six months of storage, the acidity of blended nectar preserved by different UV light treatments possessed significant increased, with minimum increase in acidity (0.300 to 0.369%) in nectar preserved by 75ppm KMS followed by 45 minute UV light treatment (T_{11}-$P_{75}U_{45}$) at par with 75ppm KMS followed by 30 minute UV light treatment (T_{10}-$P_{75}U_{30}$) and maximum increase (0.300 to 0.498%) in nectar preserved by 15 minute UV light treatment (T_3-U_{15}).

Table 2: Effect of different UV light treatments on TSS, acidity (%) of blended nectar during storage.

Treatments (T)	TSS (°Brix) Storage (S)				Mean (T)	Acidity (%) Storage (S)				Mean (T)
	Initial	2 month	4 month	6 month		Initial	2 month	4 month	6 month	
T_1 - H_{30}	15.00	15.20	15.32	15.45	15.24	0.300	0.322	0.352	0.378	0.338
T_2 - P_{150}	15.00	15.20	15.25	15.27	15.18	0.300	0.315	0.350	0.380	0.336
T_3 - U_{15}	15.00	15.05	12.85	10.75	13.41	0.300	0.330	0.410	0.498	0.385
T_4 - U_{30}	15.00	15.10	14.35	14.08	14.63	0.300	0.318	0.372	0.436	0.357
T_5 - U_{45}	15.00	15.10	14.72	14.50	14.83	0.300	0.323	0.365	0.422	0.353
T_6 - $H_{15}U_{15}$	15.00	15.15	15.25	15.30	15.18	0.300	0.328	0.363	0.382	0.343
T_7 - $H_{15}U_{30}$	15.00	15.10	15.20	15.25	15.14	0.300	0.325	0.361	0.380	0.342
T_8 - $H_{15}U_{45}$	15.00	15.10	15.18	15.25	15.13	0.300	0.327	0.360	0.382	0.342
T_9 - P_{75} U_{15}	15.00	15.30	15.35	15.50	15.29	0.300	0.306	0.351	0.369	0.332
T_{10} -P_{75} U_{30}	15.00	15.28	15.40	15.50	15.30	0.300	0.305	0.347	0.370	0.331
T_{11}-P_{75} U_{45}	15.00	15.25	15.45	15.65	15.34	0.300	0.310	0.344	0.369	0.331
Mean (S)	15.00	15.17	14.94	14.77		0.300	0.319	0.361	0.397	
$CD_{0.05}$	T = 0.306 S = 0.184 T×S =0.612					T = 0.008 S = 0.0048 T×S = 0.016				

Reducing sugars: Minimum reducing sugars in blended nectar preserved by UV light treatment for 15 minutes (T_3-U_{15}) and maximum in blended nectar preserved with the addition of 150ppm KMS treatment (T_2-P_{150}) (Table 2). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for reducing sugars of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1°C for 30 minutes. The storage of blended nectar irrespective of UV light treatments (S) shown significant increase in reducing sugars after storage period of 6 months (4.38 to 7.26%). This change is attributed to acid hydrolysis of the non-reducing sugars (sucrose) added during preparation of blended nectar, because presence of citric acid easily hydrolyze sucrose. Similar results were reported in mixed fruit nectar by De-Sousa et al. (2010). The increase in reducing sugars were also reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage. Further, significant differences were observed in reducing sugars of blended nectar preserved by different UV light treatments during six months storage (T×S). During six months of storage, the reducing sugars of blended nectar preserved by different UV light treatments possessed significant increase, with minimum increase in reducing sugar (4.30 to 7.15%) in nectar preserved by 30 minutes UV light treatment (T_4-U_{30}) and maximum increase (4.82 to 8.02) in nectar preserved by addition of 150ppm KMS treatment (T_2-P_{150}). Significant increase and decrease in reducing sugars were observed in a treatment which was preserved by only UV light treatment (T_3-U_{15}). It might be due to start of fermentation after storage period of two months.

Total sugars: Minimum total sugars in blended nectar preserved by UV 44 light treatment for 15 minutes (T_3-U_{15}) and maximum in blended nectar preserved with heat processing treatment (T1- H_{30}) (Table 3). However, non-significant variations in sugars content were reported earlier by Víctor et al. (2010). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for total sugarsof the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1°C for

30 minutes. The storage of blended nectar irrespective of UV light treatment (S) shown non-significant differences in total sugars after storage period of 6 months (14.25 to 14.10%). 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. The increase in total sugars was also reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage. During six months of storage, the total sugars of blended nectar preserved by different UV light treatments possessed significant variation, with minimum increase in total sugars (14.18 to 14.48%) in nectar preserved by 75ppm KMS followed by 15 minute UV light treatment (T_9-$P_{75}U_{15}$) and 75ppm KMS followed by 30 minute UV light treatment (T_{10}-$P_{75}U_{30}$) and maximum increase (14.22 to 14.77%) in nectar preserved by addition of 150ppm KMS treatment (T_2-P_{150}). Significant increase followed by decrease in TSS were observed in treatments which were preserved by only UV light treatments (T_3-U_{15}, T_4-U_{30}, and T_5-U_{45}). It might be due to start of fermentation after two months storage.

Table 3: Effect of different UV light treatments on Reducing sugars (%) and Total sugars (%) of blended nectar during storage.

Treatments (T)	Reducing sugars (%) Storage (S)				Mean (T)	Total sugars (%) Storage (S)				Mean (T)
	Initial	2 month	4 month	6 month		Initial	2 month	4 month	6 month	
T_1 - H_{30}	3.85	5.18	6.45	7.30	5.70	14.40	14.48	14.7	14.88	14.62
T_2 - P_{150}	4.82	6.20	7.56	8.02	6.65	14.22	14.40	14.59	14.77	14.50
T_3 - U_{15}	4.35	5.68	5.22	4.15	4.85	14.20	14.30	12.10	10.51	12.78
T_4 - U_{30}	4.30	5.63	7.12	7.15	6.05	14.21	14.27	13.92	13.36	13.94
T_5 - U_{45}	4.25	5.55	7.02	7.48	6.08	14.19	14.29	13.96	13.74	14.05
T_6 - $H_{15}U_{15}$	4.18	5.51	6.80	7.64	6.03	14.32	14.43	14.62	14.80	14.54
T_7 - $H_{15}U_{30}$	4.10	5.42	6.72	7.56	5.95	14.28	14.36	14.56	14.75	14.49
T_8 - $H_{15}U_{45}$	4.05	5.38	6.67	7.51	5.90	14.30	14.37	14.6	14.82	14.52
T_9 - P_{75} U_{15}	4.72	5.96	7.19	7.74	6.40	14.18	14.37	14.43	14.48	14.37
T_{10} -P_{75} U_{30}	4.76	6.01	7.23	7.71	6.43	14.23	14.32	14.45	14.53	14.38
T_{11}-P_{75} U_{45}	4.79	6.08	7.21	7.65	6.43	14.18	14.25	14.40	14.50	14.33
Mean (S)	4.38	5.69	6.84	7.26		14.25	14.35	14.21	14.10	
$CD_{0.05}$		T = 0.159	S = 0.096	T×S =0.318			T = 0.328	S = NS	T×S = 0.657	

Ascorbic acid: Mean ascorbic acid of blended nectar preserved by different UV light treatments (T) varied significantly from 5.14 to 7.58 mg/100g , with minimum ascorbic acid in blended nectar preserved by 15 minutes heat processing followed by 45 minutes UV light treatment (T8-H15U45) and maximum in blended nectar preserved with 150ppm KMS treatment (T2- P150) (Table 4). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for ascorbic of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1°C for 30 minutes. Significant decrease in ascorbic acid content was observed in UV-C treated star fruit juice, where the least reduction was 10% (Bhat et al. 2011). Similarly, Tran and Farid (2004) also reported loss of ascorbic acid (12%) in orange juice after UV-C treatment. The depletion of ascorbic acid could be explained by the formation of free hydroxyl radicals by photochemical reaction, related to oxidative processes (Koutchma et al. 2009). In addition, oxidative degradation as a result of enzyme activities such as ascorbate oxidase and per-oxidase, and the presence of oxygen and light, mainly contribute to detrimental effects on ascorbic acid. The storage of blended nectar irrespective of UV light treatments (S) shown significant decrease in ascorbic acid after storage

period of 6 months (6.68 to 6.03 mg/100g). 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 (DeSousa et al. 2010).

Phenols:. Data revealed that mean phenols of blended nectar preserved by different UV light treatments (T) varied significantly from 7.06 to 8.23 mg/100g (Table 4), with minimum phenol in blended nectar preserved by heat processing treatment (T1-H30) and maximum in blended nectar preserved with 15 minutes UV light treatment (T3-U15). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for phenols of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1oC for 30 minutes. The storage of blended nectar irrespective of UV light treatment (S) showed significant decrease in phenols after storage period of 6 months (9.01 to 6.65mg/100g). Similar results were observed in blends of apple, jamun and vegetable juice during storage period by Mishra and Sharma (2012). 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. The decrease in phenols were also reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage.

Table 4: Effect of different UV light treatments on ascorbic acid (mg/100g) and Total phenols (mg/100g) of blended nectar during storage

Treatments (T)	Ascorbic acid (mg/100g) Storage (S)				Mean (T)	Total phenols (mg/100g) Storage (S)				Mean (T)
	Initial	2 month	4 month	6 month		Initial	2 month	4 month	6 month	
T_1 - H_{30}	5.54	5.14	5.03	4.89	5.15	8.65	7.95	6.53	5.10	7.06
T_2 - P_{150}	7.97	7.61	7.45	7.30	7.58	9.27	8.12	7.65	7.12	8.04
T_3 - U_{15}	7.38	6.93	6.92	6.75	7.00	9.20	8.00	7.93	7.80	8.23
T_4 - U_{30}	7.13	6.76	6.68	6.50	6.77	9.17	7.96	7.77	7.57	8.12
T_5 - U_{45}	6.87	6.52	6.30	6.20	6.47	9.13	7.93	7.69	7.43	8.05
T_6 - $H_{15}U_{15}$	5.68	5.33	5.18	5.05	5.31	8.73	7.98	6.67	5.36	7.19
T_7 - $H_{15}U_{30}$	5.64	5.30	5.16	5.00	5.28	8.69	7.92	6.65	5.28	7.14
T_8 - $H_{15}U_{45}$	5.49	5.20	5.01	4.85	5.14	8.66	7.90	6.6	5.21	7.09
T_9 - P_{75} U_{15}	7.37	7.00	6.85	6.70	6.98	9.25	8.07	7.83	7.47	8.16
T_{10} -P_{75} U_{30}	7.30	6.95	6.80	6.65	6.93	9.21	8.05	7.75	7.42	8.11
T_{11}-P_{75} U_{45}	7.06	6.93	6.53	6.40	6.73	9.18	8.00	7.69	7.39	8.07
Mean (S)	6.68	6.33	6.17	6.03		9.01	7.99	7.34	6.65	
$CD_{0.05}$		T = 0.119	S = 0. 072	T×S = NS			T = 0.139	S = 0.084	T×S = 0.278	

Sodium: Mean sodium of blended nectar preserved by different UV light treatments (T) varied non-significantly from 45.09 to 46.21 mg/100g (Table 5), with minimum sodium in blended nectar preserved by 15 minutes heat processing followed by 30 minute UV light treatment (T7-H15U30) and maximum in blended nectar preserved with the addition of 75ppm KMS followed by 30 minute UV light treatment (T10-P75U30). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for sodium of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1oC for 30 minutes. The storage of blended nectar

irrespective of UV light treatment (S) shown non-significant decrease in sodium after storage period of 6 months (45.77 to 45.72 mg/100g). Similar non-significant changes in sodium content were also reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage.

Potassium: Mean potassium of blended nectar preserved by different UV light treatments (T) varied non-significantly from 18.08 to 18.89 mg/100g (Table 5), with minimum potassium in blended nectar preserved by 15 minute UV light treatment (T3-U15) and maximum in blended nectar preserved with the addition of 75ppm KMS followed by 45 minute UV light treatment (T11-P75U45). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for potassium of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1oC for 30 minutes. The storage of blended nectar irrespective of UV light treatment (S) shown non-significant in potassium after storage period of 6 months (18.51 to 18.47 mg/100g). Similar non-significant changes in sodium content were also reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage.

Table 5: Effect of different UV light treatments on Na (sodium) and K (potassium) of blended nectar during storage.

Treatments **(T)**	Na (mg/100g) Storage (S)				Mean **(T)**	K (mg/100g) Storage (S)				Mean **(T)**
	Initial	2 month	4 month	6 month		Initial	2 month	4 month	6 month	
T_1 - H_{30}	45.52	45.52	45.51	45.50	45.51	18.10	18.08	18.08	18.07	18.08
T_2 - P_{150}	45.63	45.63	45.62	45.61	45.62	18.82	18.79	18.76	18.74	18.78
T_3 - U_{15}	45.95	45.93	45.90	45.88	45.92	18.34	18.31	18.30	18.27	18.31
T_4 - U_{30}	45.35	45.31	45.30	45.28	45.31	18.15	18.12	18.09	18.07	18.11
T_5 - U_{45}	45.93	45.91	45.90	45.88	45.91	18.12	18.11	18.11	18.10	18.11
T_6 - $H_{15}U_{15}$	46.00	46.03	46.04	46.05	46.03	18.70	18.69	18.67	18.67	18.68
T_7 - $H_{15}U_{30}$	45.10	45.10	45.09	45.08	45.09	18.62	18.62	18.63	18.63	18.63
T_8 - $H_{15}U_{45}$	45.38	45.36	45.63	45.35	45.43	18.32	18.32	18.31	18.30	18.31
T_9 - P_{75} U_{15}	46.15	46.13	46.11	46.10	46.12	18.77	18.75	18.73	18.73	18.75
T_{10} -P_{75} U_{30}	46.28	46.22	46.19	46.16	46.21	18.76	18.76	18.73	18.72	18.74
T_{11}-P_{75} U_{45}	46.15	46.11	46.09	46.08	46.11	18.89	18.89	18.89	18.90	18.89
Mean (S)	45.77	45.75	45.76	45.72		18.51	18.49	18.48	18.47	
$CD_{0.05}$	T = NS S = NS T×S =NS					T = NS S=NS T×S = NS				

Overall acceptability: The perusal of data pertaining to sensory overall acceptability score (9 point Hedonic scale) of blended nectar (12% Aloe vera, 2% bitter gourd, 2% aonla and 4% guava) preserved by different UV light treatment and their effect during 6 months storage has been presented in Table 6. Data revealed that mean overall acceptability of blended nectar preserved by different UV light treatments (T) varied significantly from 5.60 to 7.72 with minimum sensory body score in blended nectar preserved 15 minutes UV light treatment (T3-U15) and maximum in blended nectar preserved with 150ppm KMS treatment followed by 30 minutes UV light treatment (T11- P75U45) at par with T10-P75U30 . Similar result was shown by Zehra et al. (2014). Almost similar observations with slight variations were reported earlier by Vaghashiya (2015) and Vaghashiya et al. (2016) for overall acceptability of the health drink prepared using Aloe vera, bitter gourd, aonla and guava when health drink was preserves by processing at 96±1oC for 30 minutes. The storage of blended nectar irrespective of UV light treatments (S)

shown significant decreases in sensory overall acceptability score after storage period of 6 months (7.52 to 6.01). The storage study of aonla-ginger beverage revealed 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). The decrease in overall acceptability were also reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage.

Total plate count (TPC): The perusal of data pertaining to total plate count of blended nectar (12% Aloe vera, 2% bitter gourd, 2% aonla and 4% guava) preserved by different UV light treatments and their effect during 6 months storage has been presented in Table 6. Blended nectar preserved by using only UV light has shown microbial contamination after 2 months of storage. Highest TPC (cfu/g) were observed in blended nectar preserved by 15 minutes UV light (T3-U15) during six month storage. Nectar preserved by 15 minutes heat processing followed by 30 to 45 minute UV light treatment were observed free from TPC during storage. Further, nectar preserved by addition of 75ppm KMS followed by 15 to 45 minutes UV light treatment were observed free from TPC during six months storage. No microbial counts were reported earlier by Vaghashiya (2015) in blended health drink prepared using 12% Aloe vera, 2% bitter gourd, 2% Aonla and 4% guava during 6 months storage.

Table 6: Effect of different UV light treatments on Overall acceptability and TPC of blended nectar during storage.

Treatments (T)	Na (mg/100g) Storage (S)				Mean (T)	K (mg/100g) Storage (S)				Mean (T)
	Initial	2 month	4 month	6 month		Initial	2 month	4 month	6 month	
T_1 - H_{30}	45.52	45.52	45.51	45.50	45.51	18.10	18.08	18.08	18.07	18.08
T_2 - P_{150}	45.63	45.63	45.62	45.61	45.62	18.82	18.79	18.76	18.74	18.78
T_3 - U_{15}	45.95	45.93	45.90	45.88	45.92	18.34	18.31	18.30	18.27	18.31
T_4 - U_{30}	45.35	45.31	45.30	45.28	45.31	18.15	18.12	18.09	18.07	18.11
T_5 - U_{45}	45.93	45.91	45.90	45.88	45.91	18.12	18.11	18.11	18.10	18.11
T_6 - $H_{15}U_{15}$	46.00	46.03	46.04	46.05	46.03	18.70	18.69	18.67	18.67	18.68
T_7 - $H_{15}U_{30}$	45.10	45.10	45.09	45.08	45.09	18.62	18.62	18.63	18.63	18.63
T_8 - $H_{15}U_{45}$	45.38	45.36	45.63	45.35	45.43	18.32	18.32	18.31	18.30	18.31
T_9 - P_{75} U_{15}	46.15	46.13	46.11	46.10	46.12	18.77	18.75	18.73	18.73	18.75
T_{10} -P_{75} U_{30}	46.28	46.22	46.19	46.16	46.21	18.76	18.76	18.73	18.72	18.74
T_{11}-P_{75} U_{45}	46.15	46.11	46.09	46.08	46.11	18.89	18.89	18.89	18.90	18.89
Mean (S)	45.77	45.75	45.76	45.72		18.51	18.49	18.48	18.47	
$CD_{0.05}$	T = NS S = NS T×S =NS					T = NS S=NS T×S = NS				

Economics of blended nectar: The expenditures incurred in preparation of blended nectar preserved by different UV light treatments were calculated by taking into consideration costs of Aloe vera, Bitter gourd, Aonla, Guava, sugar, citric acid, KMS, UV light and LPG 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. Data presented in Table 6 indicated that the total cost of production, sale price and net profit per bottle (200 ml) for 100 liter of blended nectar prepared by different UV light treatments varied from Rs. 5.72 to 5.79, 6.86 to 6.95 and 1.14 to 1.16, respectively. The data in Table 7 indicated that total cost of production for 100 liter blended nectar was worked out to be Rs. 2874 (included packaging and processing charge). As per best treatment T10-P75U30 (12% Aloe vera juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp), 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 blended nectar including 20% profit for best treatment was worked out to be Rs. 5.75 and Rs.6.90, 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 1.74, respectively.

Table 7: Detailed economics for treatment

Sr. No.	Particulars	Quantity (kg)	Rate (Rs./ kg)	Amount (Rs.)
1	Aloe vera	32	3	96
2	Bitter gourd	3	16	48
3	Aonla	3	40	120
4	Guava	4.5	16	72
5	Sugar	14.20	34	482.8
6	Citric acid	0.162	400	65
7	Glass bottles	500 Bottle	3/Bottle	1500
8	KMS (g)	7.5	1512	11.34
9	UV -light (hr.)	5	0.28	1.4
10	Total of raw material cost (Sr. No 1-8)			2396.5
11	Processing charge @ 20% of raw material cost			476.76
12	Total production cost per 100 L (500 bottle) (Sr. No 8 + 9)			2873.30
13	Total production cost/ bottle [A]			5.75
14	Sale price per bottle including 20 % profit [B]			6.90
15	Net profit per bottle [B-A]@ 20 % profit			1.15
16	Benefit: Cost ratio @ 20 % profit			1.20
17	Minimum market sale price per bottle [C]			10
18	Net profit per bottle [C-A] (at minimum market price)			4.25
19	Benefit: Cost ratio (at minimum market price)			1.74
20	Per cent net profit [C-A)/A*100] (at minimum market price)			73.91

CONCLUSION

The findings summarized above indicate that UV light treatment of blended nectar for 30 minutes containing 75ppm KMS can be utilized more beneficially for its preservation by food processing industry for a period of six months to ensure minimum changes in nutritional as well as sensory quality. The prepared blended nectar can be stored successfully for a period of six months in glass bottles after UV light treatment of blended nectar for 30 minutes containing 75ppm KMS. Thus, the developed technologies can commercially be explored by food processing industry for the production of quality health oriented blended nectar.

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