Standardization of Blended Squash using Banana Pseudostem Sap with Mango, Papaya and *Aloe Vera*

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Abstract— *The present investigation entitled "Standardization of blended squash using banana pseudostem sap with mango, papaya and Aloe vera" was carried with 11 treatments along with different blending combinations of banana pseudostem sap: mango: papaya: Aloe vera (T_1-75:0:25:0, T_2-75:0:20:5, T_3-75:5:20:0, T_4-75:5:15:5, T_5-75:10:15:0, T_6-75:10:10:5, T_7-75:15:10:0, T_8-75:15:5:5, T_9-75:20:5:0, T_{10}-75:20:0:5, T_{11}-75:25:0:0,). The prepared blended squash was filled in PET bottles and stored at room temperature up to 6 months. Chemical parameters like total soluble solids (°Brix), titrable acidity (%), total sugars (%), reducing sugars (%), carbohydrates (%), proteins (%) , iron (mg/100 ml), potassium (mg/100 ml), total phenols (mg/100 ml), calorific value (Kcal/100 ml), β-carotene (mg/100 ml) and microbial parameters were recorded at initial, 2, 4 and 6 months of storage. The results were statistically analysed using completely randomized design with 3 repetitions. From the experimentation it was revealed that, the TSS, titrable acidity, total sugars, reducing sugars showed increasing trend and carbohydrates, proteins, iron, potassium, total phenols, calorific value, β-carotene showed decreasing trend up to 6 months storage of blended squash and no microbial growth was observed during 6 months storage period. Results revealed that, best quality blended squash with stable nutritional quality can be prepared using 75 per cent banana pseudostem sap, 10 per cent mango pulp, 10 per cent papaya pulp and 5 per cent Aloe vera juice. Thus, the developed technology can be commercially explored by the food processors for production of quality blended squash. Therefore, it will be helpful for profitable utilization of banana pseudostem and also helps in development of different value added products.*

Keywords— Banana, Blended, Pseudostem, Storage.

I. INTRODUCTION

Banana is one of the major fruit crop grown in India. It is a monocarpic, monocotyledonous and herbaceous plant belonging to the family Musaceae and order Zingiberales. It has been suggested that cultivated bananas are originated from the islands of South-East Asia with India as one of its origin and have been developed by the cross of *Musa accuminata* and *Musa bulbisiana* and their natural hybrids which are originally found in the rain forests of South-East Asia. At present, banana is being cultivated throughout the warm tropical regions of the world between 30^0 N and 30^0 S of the equator. Banana is basically a tropical crop, grows well in a temperature range of 15 ºC to 35 ºC with relative humidity of 75 to 85 per cent. It prefers tropical humid low lands and is grown from the sea level to an elevation of 2000 m above mean sea level. Banana is well known for its antiquity and has an ancient history as old as Indian history.

It is popularly called as '*Kalpataru*' (Tree of heaven) due to its socio-economic and multiple uses. It is consumed as staple food in many tropical and subtropical countries around the world. It provides balanced nutritional diet when compared to any other fruit. Plantain banana are the raw fruits which are consumed after cooking where as dessert bananas are consumed after ripening. 100 g of banana fruit contains 75 per cent of water, 89 Kcal of energy, 22.84 g of carbohydrates, 12.23 g of sugars, 2.6 g of dietary fibres and 8.7 mg of vitamin C with 358 mg of potassium (Sidhu and Zafar, 2018). Strongest natural fibre can be extracted from pseudostem and currency note paper was prepared from banana fibre in Japan (Meena *et al*., 2018).

Pseudostem juice is potential source of antioxidants such as gentisic acid, catechin, ferulic acid and protocatechuic acid. Thus, it is having the ability to cure urinary disorders and stone formation in gall bladder (Sharma *et al*., 2017). It helps to dissolve calcium oxalate which is responsible to cause kidney stones.

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae. India is the leading producer of mango in the world. Mango is called the king of all fruits because of its luscious, aromatic flavour and a delicious taste in which sweetness and acidity are delightfully blended. Mango has also strong antioxidant, anti-lipid peroxidation, immunomodulation, cardiotonic, hypotensive, wound healing, antidegenerative and antidileutic activities (Chaudhary *et al*., 2017).

Papaya (*Carica papaya* L.) belongs to family Caricaceace. It is a common man's fruits, which is reasonably priced and has a high nutritive value. It is low in calories and rich in natural vitamins and minerals. Papaya places first among the fruits for vitamin C, vitamin A, riboflavin, foliate, calcium, thiamine, iron, niacin, potassium and fibre. Papaya when consumed regularly will ensure a good supply of vitamin A and C, which are essential for good health especially for eyesight and can help to prevent early age blindness in children. In recent years, the consumption of carotene products have increased steadily due to their recognition as an important source of natural antioxidant besides, anticancer activity of β-carotene being a precursor of vitamin (Gowri and Sri, 2015).

Aloe vera belongs to family Lilliaceae. It is most widely used and commercially available medicinal plant because of its nutritional and therapeutic properties (Olariu, 2009). It is useful in curing various diseases like tumour, liver complaints, vomiting, asthma, jaundice and ulcer (Malhotra *et al*., 2010). *Aloe vera* gel contains a glucomannan, which is a polysaccharide similar to guar and locust bean-gums and is believed to be the active constituents. The active principle of *Aloe* is a mixture of glycosides called aloin and a complex carbohydrate called acemannan. (Hamid *et al*., 2014). *Aloe vera* contains around 98.5-99 per cent moisture, the dry matter incorporates polysaccharides (55 %), sugars (17 %), minerals (16 %), proteins (7 %), lipids (4 %) and phenolic compounds (1 %). Carbohydrates comprising of mono and polysaccharides, are derived from the mucilage layer of the plant under the rind, surrounding the inner parenchyma or gel. The Egyptians call *Aloe vera* as "The plant of immortality".

II. MATERIALS AND METHODS

The experiment was carried out at the Department of Post Harvest Technology, ASPEE College of Horticulture and Forestry as well as Banana Pseudostem Processing Unit, Soil and Water Management Research Unit, Navsari Agricultural University, Navsari, Gujarat during October 2020 to April 2021. Banana pseudostems were harvested from the fields of Soil and Water Management Research Unit, Navsari Agricultural University, Navsari immediately after harvesting of bunch in the second week of October. The banana pseudostems were washed and cleaned. These pseudostems were hygienically used for product processing in experiment. Pseudostem was split by sharp stainless steel knife and washed. From the sheaths juice was extracted with the use of sugarcane juicer. The collected juice was filtered by using muslin cloth to remove any pithy matter from juice.

Extraction of aloe vera juice: After sorting and washing, the lower 1 inch of the leaf base (the white part attached to the large rosette stem of the plant), the tapering point (2-4 inch) of the leaf top and the short sharp spines were removed to avoid presence of bitter compound *i.e*., aloin content in the gel. The gel was extensively washed with drinkable water followed by cutting into small pieces and pre-treated with soybean extract (1.5 % for 12 h) to remove aloin content (US Patent, 2007). After pre-treatment, the *Aloe vera* gel was washed with water. Then juice was extracted from gel using grinder. The juice was further boiled at 95 ºC for 30 minutes then filled in glass bottles.

Extraction of papaya pulp: Fully ripened papaya fruits were sorted and then washed. The washed fruits are peeled, cut into halves and deseeded. After deseeding, the pulp was extracted using grinder. Then the pulp was boiled at 95 ºC for 30 minutes. Pulp was filled in polyethylene bags and was cooled by keeping them in cold water, pulp was further used for blended squash preparation.

Blended squash was prepared using banana pseudostem sap along with juice/pulp of mango, papaya and *Aloe vera*. Total 11 treatments were fixed for preparation of blended squash using different blending proportions of mango, papaya and *Aloe vera*.

Banana pseudostem sap was used instead of water for preparation of squash. The TSS and acidity of blended squash was kept constant 40 ºB and 1 %, respectively in all the treatments. The blended squash was periodically observed up to 6 months. The samples were subsequently used for organoleptic evaluation for 0, 2, 4 and 6 months of storage. The squash was stored in Polyethylene Terephthalate (PET) bottles of 200 ml capacity. The bottles were kept at room temperature which is ranged from 20 to 35ºC temperatures. The experiment was carried out using 11 treatments with 3 replications. The treatment combinations were presented in Table 1.

TABLE 1
TREATMENT DETAILS WITH DIFFERENT BLENDING PROPORTION

Treatments	Banana pseudostem sap(%)	Mango pulp(%)	Papaya pulp(%)	*Aloe vera* juice(%)
T_1	75	0	25	0
T_2	75	0	20	5
T_3	75	5	20	0
T_4	75	5	15	5
T_5	75	10	15	0
T_6	75	10	10	5
T_7	75	15	10	0
T_8	75	15	5	5
T_9	75	20	5	0
T_{10}	75	20	0	5
T_{11}	75	25	0	0

2.1 Assessment of physico-chemical and microbial parameters

The prepared blended squash was analyzed periodically for physico-chemical and microbial parameters at initial, 2, 4 and 6 months interval. The TSS content of blended squash was measured using abbe's refractometer. Titrable acidity was estimated using 0.1% NaoH as per Ranganna (1986). For the estimation of total sugars and reducing sugars, Lane and Eynon method as described in Ranganna (1986) was used. The carbohydrates content was estimated by anthrone method suggested by Sadasivam and Manickam, (1991). Total phenols were estimated by measuring optical density at 660nm. The Calorific value was calculated using the Atwater factor method as described by Eneche (1991). Protein content was estimated by Lowry's method as described by Sadasivam and Manickam (1991). Iron content was estimated by Atomic Absorption Spectrophotometer and potassium content was analyzed by flame photometric method. β-carotene was determined by spectrophotometeric method as detailed by Raj et al. (2016). Microbial analysis was carried out by standard plate count method. All these methods were carried as described by Ranganna (1986).

2.2 Statistical Analysis

Experiment data were statistically analyzed using Completely Randomized Design (CRD) as described by Panse and Shukatme (1985) at the Department of Agricultural Statistics, ASPEE College of Horticulture, Navsari, Gujarat.

III. EXPERIMENTAL RESULTS AND DISCUSSION

3.1 TSS (ºBrix)

The highest TSS *i.e.*, 41.12 ºB was recorded in the treatment T_7 which was statistically at par with T_{11} (40.95 ºB) while, the lowest TSS (40.47 ºB) was recorded in the treatment T_4 have been presented in Table 2. The TSS (ºBrix) level of blended squash varied significantly with respect to different treatments. Storage period of 6 months showed significantly increased TSS content in all the treatments. Increased TSS during the storage might be due to conversion of polysaccharides like starch, cellulose and pectin substances into simple sugars. Similar results were recorded by Uddin *et al.* (2019) in blended mango and guava squash during 3 months storage period and Chaudhary *et al*. (2017) in blended mango and *Aloe vera* squash during storage period. Borane and Khan (2015) also reported in blended banana pseudostem juice with papaya during 90 days of storage period. Rani and Rao (2014) also observed in blended *Aloe vera* and sapota squash during storage period.

TABLE 2

EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON TSS (°BRIX) DURING STORAGE

Treatments	Storage Period (P)				Mean (T)
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	
T_1 (75:0:25:0)	40	40.51	40.79	40.87	**40.54**
T_2 (75:0:20:5)	40	40.59	40.81	40.94	**40.58**
T_3 (75:5:20:0)	40	40.58	40.77	40.93	**40.57**
T_4 (75:5:15:5)	40	40.48	40.62	40.79	**40.47**
T_5 (75:10:15:0)	40	40.75	40.88	40.97	**40.65**
T_6 (75:10:10:5)	40	40.89	40.94	41.1	**40.73**
T_7 (75:15:10:0)	40	41.19	41.44	41.84	**41.12**
T_8 (75:15:5:5)	40	40.89	40.94	41.1	**40.73**
T_9 (75:20:5:0)	40	40.8	40.89	40.94	**40.66**
T_{10} (75:20:0:5)	40	40.73	40.83	41.1	**40.66**
T_{11} (75:25:0:0)	40	40.7	41.67	41.43	**40.95**
Mean (P)	**40**	**40.74**	**40.96**	**41.09**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.12	0.09	0.28		
C.D. at 5 %	0.34	0.24	NS		
C.V. %	0.99	1.21			

TABLE 3

EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON TITRABLE ACIDITY (%) DURING STORAGE

Treatments	Storage Period (P)				Mean
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	(T)
T_1 (75:0:25:0)	1	1.12	1.33	1.44	**1.23**
T_2 (75:0:20:5)	1	1.18	1.35	1.44	**1.24**
T_3 (75:5:20:0)	1	1.22	1.35	1.45	**1.25**
T_4 (75:5:15:5)	1	1.27	1.37	1.47	**1.28**
T_5 (75:10:15:0)	1	1.26	1.36	1.46	**1.27**
T_6 (75:10:10:5)	1	1.29	1.33	1.46	**1.27**
T_7 (75:15:10:0)	1	1.25	1.39	1.47	**1.28**
T_8 (75:15:5:5)	1	1.22	1.39	1.42	**1.26**
T_9 (75:20:5:0)	1	1.28	1.35	1.43	**1.26**
T_{10} (75:20:0:5)	1	1.27	1.4	1.5	**1.29**
T_{11} (75:25:0:0)	1	1.24	1.4	1.5	**1.28**
Mean (P)	**1**	**1.24**	**1.37**	**1.46**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.006	0.004	0.01		
C.D. at 5 %	0.02	0.01	0.04		
C.V. %	1.5	1.74			

3.2 Titrable acidity (%)

It was found that treatment mean (T) titrable acidity of blended squash varied from 1.23 to 1.29 per cent. The highest titrable acidity *i.e.,* 1.29 % was recorded in the treatment T_{10} which was statistically at par with T_4 (1.28 %), T_7 (1.28 %), T_{11} (1.28 %), T_5 (1.27 %) and T_6 (1.27 %). The lowest titrable acidity (1.23 %) was recorded in the treatment T_1 have been presented in Table 3. The titrable acidity of blended squash varied based on the different blending ratio of fruits. During 6 months of storage titrable acidity of blended squash increased significantly and standard methodology was followed to maintain 1.0 per cent titrable acidity while preparation of blended squash. The increased titrable acidity during storage might be due to the blending effect of fruits used for blending and also due to the accelerated degradation of pectin substances, sugars and formation of organic acid during storage. Similar results were also observed by Thirukkumar *et al*. (2018) in noni fruit juice blended squash with amla juice during 180 days of storage. Borane and Khan Sumaiya (2015) also reported in blended banana pseudostem juice with papaya during 90 days of storage period. Priyanka *et al*. (2015) also reported similar results in jamun blended squash with mango, grapes and pineapple juice during storage period.

3.3 Total sugars (%)

Data showed that the treatment mean (T) total sugars content of blended squash prepared using different combinations of banana pseudostem sap, mango, papaya and *Aloe vera* juice/pulp varied significantly from 36.29 to 39.98 per cent have been presented in Table 4. The maximum total sugars content was reported in treatment T_6 (39.98 %), it might be due to the equal concentration of papaya and mango pulp and the minimum total sugars was found in treatment T_{10} (36.29 %). Total sugars content in blended squash varied based on the blending ratio of different treatments. The total sugars level of blended squash showed increasing trend during 6 months of storage. This might be due to hydrolysis of starch into sugars as well as conversion of complex polysaccharides into simple sugars. Similar findings were reported by Chaudhary *et al*. (2017) in mango and *Aloe vera* blended squash during the storage period. Dhiman *et al.* (2017) also noted similar findings in ripe pumpkin based squash during 6 months of storage. Similar results were also reported by Saleem *et al.* (2011) in peach squash during 6 months of storage.

TABLE 4
EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON TOTAL SUGARS (%) DURING STORAGE

Treatments	Storage Period (P)				Mean (T)
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	
T_1 (75:0:25:0)	37.65	37.77	37.97	38.2	**37.9**
T_2 (75:0:20:5)	36.5	36.78	36.92	37.16	**36.84**
T_3 (75:5:20:0)	37.72	37.95	38.06	38.27	**38**
T_4 (75:5:15:5)	36.21	36.37	36.81	37.16	**36.64**
T_5 (75:10:15:0)	38.53	38.45	38.79	39.24	**38.75**
T_6 (75:10:10:5)	39.41	39.92	40.27	40.35	**39.98**
T_7 (75:15:10:0)	37.43	37.4	37.87	38.06	**37.69**
T_8 (75:15:5:5)	35.98	36.28	36.69	36.69	**36.41**
T_9 (75:20:5:0)	37.13	37.25	37.58	37.85	**37.45**
T_{10} (75:20:0:5)	35.93	36.16	36.39	36.67	**36.29**
T_{11} (75:25:0:0)	36.65	36.84	37.01	37.35	**36.96**
Mean (P)	**37.2**	**37.38**	**37.67**	**37.91**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.12	0.08	0.25		
C.D. at 5 %	0.36	0.21	NS		
C.V. %	1.14	1.16			

3.4 Reducing sugars (%)

Data revealed the treatment mean (T) reducing sugars of blended squash varied significantly from 18.35 to 20.66 per cent have been presented in Table 5. Maximum reducing sugars (20.66 %) were reported in treatment T_6 followed by T_5 (19.83 %). Minimum reducing sugars (18.35 %) content was observed with treatment T_2. Reducing sugars content of blended squash showed significantly increasing trend during 6 months of storage period. This might be due to partial acid hydrolysis of starch and disaccharides of blended squash converted into invert sugar and also inversion of part of non-reducing sugars into glucose and fructose and gradual degradation of polysaccharides in sqaush through acid hydrolysis. The results were supported by the findings of Chaudhary *et al.* (2017) in mango and *Aloe vera* blended squash during the storage period. Dhiman *et al.* (2017) also noted similar findings in ripe pumpkin based squash during 6 months of storage. Similar results were also reported by Saleem *et al.* (2011) in peach squash during 6 months of storage.

TABLE 5

EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON REDUCING SUGARS (%) DURING STORAGE

Treatments	Storage Period (P)				
	P_1	P_2	P_3	P_4	Mean
	(Initial)	(2 month)	(4 month)	(6 month)	(T)
T_1 (75:0:25:0)	18.61	18.88	19.4	19.95	**19.21**
T_2 (75:0:20:5)	17.94	18.23	18.41	18.81	**18.35**
T_3 (75:5:20:0)	18.9	19.01	19.81	20.12	**19.46**
T_4 (75:5:15:5)	17.73	18.1	18.67	19.16	**18.42**
T_5 (75:10:15:0)	19.32	19.52	19.93	20.55	**19.83**
T_6 (75:10:10:5)	19.96	20.36	20.9	21.43	**20.66**
T_7 (75:15:10:0)	19.07	19.72	19.8	20.38	**19.74**
T_8 (75:15:5:5)	17.82	18.27	18.72	19.3	**18.53**
T_9 (75:20:5:0)	19.02	19.62	20.05	20.63	**19.83**
T_{10} (75:20:0:5)	17.89	18.38	18.8	19.34	**18.6**
T_{11} (75:25:0:0)	18.57	19.15	19.63	19.97	**19.33**
Mean (P)	**18.62**	**19.02**	**19.47**	**19.97**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.08	0.05	0.16		
C.D. at 5 %	0.23	0.14	NS		
C.V. %	1.41	1.46			

3.5 Carbohydrates (%)

Data revealed that the treatment mean (T) carbohydrates content of blended squash varied significantly from 16.94 to 19.91 per cent have been presented in Table 6. The highest carbohydrates content (19.91 %) was found in treatment T_6 and significantly lowest carbohydrates content (16.94 %) was observed in treatment T_2, it was might be due to higher carbohydrates content in mango, papaya and lower carbohydrates content in banana pseudostem juice and *Aloe vera*. Carbohydrates content of squash varied accordingly with the different blending ratio of juice. It showed significantly decreasing trend during 6 months of storage period. The decreasing trend was might be due to the hydrolysis of polysaccharides like pectin, starch *etc.* into simple sugars. Similar finding were reported by Shiva *et al.* (2018) in banana pseudostem based novel functional blended ready to drink beverages with ginger rhizome and nannari root extracts during 6 months of storage. Patel (2016) also reported similar results in blended nectar using banana pseudostem sap and mango pulp during storage period of 6 months.

TABLE 6

EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON CARBOHYDRATES (%) SCORE DURING STORAGE

Treatments	Storage Period (P)				Mean (T)
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	
T_1 (75:0:25:0)	17.41	17.17	16.94	16.7	**17.06**
T_2 (75:0:20:5)	17.17	17.12	16.84	16.63	**16.94**
T_3 (75:5:20:0)	17.34	17.23	17.1	16.94	**17.15**
T_4 (75:5:15:5)	18.53	18.2	18.02	17.84	**18.15**
T_5 (75:10:15:0)	18.15	17.9	17.56	17.22	**17.71**
T_6 (75:10:10:5)	20.21	20.03	19.88	19.52	**19.91**
T_7 (75:15:10:0)	19.42	19.2	18.95	18.55	**19.03**
T_8 (75:15:5:5)	18.21	18.11	17.82	17.43	**17.89**
T_9 (75:20:5:0)	18.16	18.01	17.75	17.35	**17.82**
T_{10} (75:20:0:5)	17.38	17.15	17.09	16.94	**17.14**
T_{11} (75:25:0:0)	17.73	17.67	17.57	17.22	**17.55**
Mean (P)	**18.16**	**17.98**	**17.77**	**17.49**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.1	0.06	0.21		
C.D. at 5 %	0.29	0.18	NS		
C.V. %	1.05	1.09			

TABLE 7

EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON PROTEINS (%) SCORE DURING STORAGE

Treatments	Storage Period (P)				Mean (T)
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	
T_1 (75:0:25:0)	0.93	0.91	0.9	0.88	**0.9**
T_2 (75:0:20:5)	0.89	0.86	0.85	0.83	**0.86**
T_3 (75:5:20:0)	1.03	0.99	0.98	0.92	**0.98**
T_4 (75:5:15:5)	0.95	0.93	0.93	0.9	**0.93**
T_5 (75:10:15:0)	1.33	1.31	1.3	1.28	**1.3**
T_6 (75:10:10:5)	1.25	1.21	1.16	1.05	**1.17**
T_7 (75:15:10:0)	1.39	1.36	1.34	1.32	**1.35**
T_8 (75:15:5:5)	0.88	0.85	0.83	0.82	**0.84**
T_9 (75:20:5:0)	1.04	1.02	1	0.97	**1.01**
T_{10} (75:20:0:5)	0.88	0.86	0.83	0.82	**0.85**
T_{11} (75:25:0:0)	1	0.99	0.96	0.95	**0.98**
Mean (P)	**1.05**	**1.03**	**1.01**	**0.98**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.01	0.01	0.02		
C.D. at 5 %	0.03	0.02	NS		
C.V. %	3.55	3.18			

3.6 Proteins (%)

It was found that treatment mean (T) proteins content of blended squash varied significantly from 0.84 to 1.35 per cent have been presented in Table 7. Significantly maximum proteins content (1.35 %) was observed with treatment T_7, followed by treatment T_5 (1.30 %) and significantly lowest proteins content (0.84 %) was recorded in treatment T_8, this might be due to the lower proteins content in banana pseudostem juice and higher proteins content in mango and papaya pulp. Proteins level in blended squash decreased significantly during 6 months storage period. This might be due to the physical changes in proteins due to denaturation and oxidation during storage. Similar findings were reported by Deshmukh *et al*. (2019) in blended aonla and *Aloe vera* nectar with stevia as a sugar substitute. Patel (2016) also reported in blended nectar using banana pseudostem sap and mango pulp.

3.7 Iron (mg/100 ml)

Data pertaining to the treatment mean (T) iron content of blended squash varied significantly from 2.54 to 3.68 mg/100 ml have been presented in Table 8. The maximum iron content (3.68 mg/100 ml) was reported with treatment T_6 and the lowest iron content (2.54 mg/100 ml) was reported with the treatment T_1. Iron content in all the treatments varied according to the iron content present in the fruits used for blending and their blending ratio in preparation of blended squash. During storage iron content of blended squash showed slightly decreasing trend, this might be due to the interaction between chemical organic constituents of squash induced by high temperature actions and presence of catalyst as reported by Kumar *et al*. (2012). Similar finding were reported by Deshmukh *et al*. (2019) in blended aonla and *Aloe vera* nectar with stevia as a sugar substitute and Patel (2016) in blended nectar using banana pseudostem sap and mango pulp. Kumar *et al.* (2012) also reported similar results in value added nutraceutical beverages of guava blended with *Aloe vera* and roselle.

TABLE 8
EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND ALOE VERA ON IRON (MG/100 ML) DURING STORAGE

Treatments	Storage Period (P)				
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	Mean (T)
T_1 (75:0:25:0)	2.68	2.59	2.45	2.43	**2.54**
T_2 (75:0:20:5)	2.73	2.64	2.58	2.63	**2.64**
T_3 (75:5:20:0)	2.93	2.86	2.78	2.65	**2.81**
T_4 (75:5:15:5)	3	2.94	2.86	2.73	**2.88**
T_5 (75:10:15:0)	3.14	3.05	2.94	2.74	**2.97**
T_6 (75:10:10:5)	3.84	3.72	3.66	3.49	**3.68**
T_7 (75:15:10:0)	3.53	3.4	3.37	3.36	**3.41**
T_8 (75:15:5:5)	3	2.93	2.81	2.61	**2.84**
T_9 (75:20:5:0)	2.93	2.76	2.66	2.57	**2.73**
T_{10} (75:20:0:5)	2.85	2.71	2.67	2.42	**2.66**
T_{11} (75:25:0:0)	2.9	2.83	2.73	2.67	**2.78**
Mean (P)	**3.05**	**2.95**	**2.86**	**2.76**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.04	0.02	0.06		
C.D. at 5 %	0.11	0.05	NS		
C.V. %	4.22	3.69			

3.8 Potassium (mg/100 ml)

It was found that the treatment mean (T) potassium content of blended squash varied significantly from 41.94 to 46.42 mg/100 ml have been presented in Table 9. Maximum potassium content 46.42 mg/100 ml was observed with treatment T_8 followed by treatment T_5 (45.88 mg/100 ml) while, the minimum potassium content was recorded in treatment T_{10} (41.94 mg/100 ml), this might be due to higher potassium content in pseudostem sap, mango pulp and lower potassium content in papaya. During

storage slightly decreased potassium content was observed, this results were in accordance with the results of Patel (2016) in blended nectar using banana pseudostem sap and mango pulp. Anonymous (2015) also noted slightly decreased potassium content in ready to serve beverage from banana pseudostem sap during 6 months storage period.

TABLE 9

EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON POTASSIUM (MG/100 ML) DURING STORAGE

Treatments	Storage Period (P)				Mean (T)
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	
T_1 (75:0:25:0)	43.35	43.08	42.82	42.72	**42.99**
T_2 (75:0:20:5)	42.7	42.4	42.2	41.78	**42.27**
T_3 (75:5:20:0)	44.42	44.13	44.07	43.9	**44.13**
T_4 (75:5:15:5)	45.62	45.37	45.08	44.99	**45.26**
T_5 (75:10:15:0)	46.3	46.15	45.7	45.38	**45.88**
T_6 (75:10:10:5)	45.23	45.19	45.17	44.76	**45.09**
T_7 (75:15:10:0)	44.94	44.45	44.17	44	**44.39**
T_8 (75:15:5:5)	46.43	46.6	46.43	46.21	**46.42**
T_9 (75:20:5:0)	43.29	43.12	42.8	42.46	**42.92**
T_{10} (75:20:0:5)	42.46	42.09	41.8	41.43	**41.94**
T_{11} (75:25:0:0)	42.26	42.08	41.99	41.48	**41.95**
Mean (P)	**44.27**	**44.06**	**43.84**	**43.55**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.14	0.09	0.28		
C.D. at 5 %	0.4	0.24	NS		
C.V. %	1.09	1.11			

TABLE 10

EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND *ALOE VERA* ON TOTAL PHENOLS (MG/100 ML) DURING STORAGE

Treatments	Storage Period (P)				Mean (T)
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	
T_1 (75:0:25:0)	29.81	27.09	25.95	23.79	**26.66**
T_2 (75:0:20:5)	30.08	28.5	26.83	24.65	**27.51**
T_3 (75:5:20:0)	34.96	32.35	31.2	29.71	**32.06**
T_4 (75:5:15:5)	37.69	35.74	33.4	31.2	**34.51**
T_5 (75:10:15:0)	44.89	42.85	42.05	40.95	**42.68**
T_6 (75:10:10:5)	49.05	47.67	46.1	44.67	**46.87**
T_7 (75:15:10:0)	47.96	45.31	43.39	42.26	**44.73**
T_8 (75:15:5:5)	41.63	40.01	38.87	35.63	**39.04**
T_9 (75:20:5:0)	38.24	36.9	35.17	33.25	**35.89**
T_{10} (75:20:0:5)	31.43	29.56	28.23	26.39	**28.91**
T_{11} (75:25:0:0)	28.16	26.42	23.51	21.33	**24.85**
Mean (P)	**37.63**	**35.67**	**34.06**	**32.17**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.18	0.14	0.47		
C.D. at 5 %	0.53	0.4	NS		
C.V. %	1.81	2.35			

3.9 Total phenols (mg/100 ml)

Data regarding the treatment mean (T) total phenols content of blended squash varied significantly from 24.85 to 46.87 mg/100 ml have been presented in Table 10. Significantly highest total phenols content (46.87 mg/100 ml) was observed with treatment T_6 followed by treatment T_7 (44.73 mg/100 ml) and significantly lowest total phenols content (24.85 mg/100 ml) was recorded with treatment T_{11}. The variation in total phenol content in different blends might be due to variation in initial total phenol content of produce. Decreasing trend of total phenols were reported during storage period of 6 months. This might be due to their oxidation during storage period reported by Sridhar *et al*. (2017). Thakur *et al.* (2018) also noted similar results in wild pomegranate squash. Tahasildar (2016) also reported similar findings in preparation of blended nectar using *Aloe vera*, guava and jamun.

3.10 Calorific value (Kcal/100 ml)

It was found that the treatment mean (T) calorific value of blended squash varied significantly from 71.18 to 84.32 Kcal/100 ml have been presented in Table 11. Maximum calorific value (84.32 Kcal/100 ml) was recorded with the treatment T_6 and significantly minimum calorific value (71.18 Kcal/100 ml) was observed in treatment T_2. It showed decreasing trend during storage. Calorific value of blended squash varied according to the proteins, fat and carbohydrates content in blended squash. These findings were also supported by Patel (2016) and Anonymous (2015) ready to serve beverage from banana pseudostem sap during 6 months storage period.

TABLE 11
EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND ALOE VERA ON CALORIFIC VALUE (KCAL/100 ML) DURING STORAGE

Treatments	Storage Period (P)				Mean (T)
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	
T_1 (75:0:25:0)	73.37	72.39	71.36	70.29	**71.85**
T_2 (75:0:20:5)	72.21	71.92	70.73	69.84	**71.18**
T_3 (75:5:20:0)	73.47	72.88	72.31	71.41	**72.52**
T_4 (75:5:15:5)	77.92	76.52	75.79	73.81	**76.01**
T_5 (75:10:15:0)	77.91	76.85	75.41	73.97	**76.04**
T_6 (75:10:10:5)	85.85	84.96	84.17	82.28	**84.32**
T_7 (75:15:10:0)	83.24	82.25	81.17	79.49	**81.54**
T_8 (75:15:5:5)	75.21	75.84	74.63	72.99	**74.67**
T_9 (75:20:5:0)	76.79	76.13	74.99	73.28	**75.3**
T_{10} (75:20:0:5)	73.04	72.04	71.68	71.05	**71.95**
T_{11} (75:25:0:0)	74.89	74.63	74.12	72.71	**74.09**
Mean (P)	**76.72**	**76.04**	**75.12**	**73.74**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.5	0.37	1.22		
C.D. at 5 %	1.46	1.04	NS		
C.V. %	2.28	2.81			

3.11 β-carotene (mg/100 ml)

Data revealed that treatment mean (T) β-carotene content of blended squash varied Significantly from 0.22 to 0.39 mg/100 ml have been presented in Table 12. Significantly maximum β-carotene (0.39 mg/100 ml) was found with the treatment T_5 which was statistically at par with T_6 (0.36 mg/100 ml) and significantly minimum β-carotene content (0.22 mg/100 ml) was found in the treatment T_2, it might be due to higher β-carotene content in mango and papaya pulp where as lower β-carotene content in pseudostem sap and *Aloe vera* juice. β-carotene content varied according to the blending ratio of fruits. Storage studies showed significantly decreasing trend in β-carotene content of blended squash. The decrease in the β-carotene with the storage period might have been due to the reason that the β-carotene gets oxidized with storage and also by the biochemical degradation

of the pigment. Similar findings were reported by Prabha *et al*. (2019) in papaya and mango blended squash during 6 months of storage period. Dhiman *et al.* (2017) also observed that decreased β-carotene content in ripe pumpkin based squash during the storage period.

TABLE 12
EFFECT OF BLENDED SQUASH USING BANANA PSEUDOSTEM SAP WITH MANGO, PAPAYA AND ALOE VERA ON B-CAROTENE (MG/100 ML) DURING STORAGE

Treatments	Storage Period (P)				Mean
	P_1 (Initial)	P_2 (2 month)	P_3 (4 month)	P_4 (6 month)	(T)
T_1 (75:0:25:0)	0.25	0.24	0.22	0.19	**0.23**
T_2 (75:0:20:5)	0.23	0.21	0.21	0.21	**0.22**
T_3 (75:5:20:0)	0.34	0.32	0.31	0.29	**0.31**
T_4 (75:5:15:5)	0.37	0.34	0.33	0.31	**0.34**
T_5 (75:10:15:0)	0.41	0.39	0.39	0.36	**0.39**
T_6 (75:10:10:5)	0.4	0.39	0.34	0.3	**0.36**
T_7 (75:15:10:0)	0.38	0.36	0.34	0.32	**0.35**
T_8 (75:15:5:5)	0.29	0.28	0.25	0.21	**0.26**
T_9 (75:20:5:0)	0.36	0.34	0.33	0.31	**0.34**
T_{10} (75:20:0:5)	0.37	0.35	0.32	0.28	**0.33**
T_{11} (75:25:0:0)	0.3	0.28	0.27	0.25	**0.27**
Mean (P)	**0.33**	**0.32**	**0.3**	**0.28**	
	Treatment (T)	**Period (P)**	**TXP**		
S.Em. ±	0.008	0.004	0.015		
C.D. at 5 %	0.022	0.012	NS		
C.V. %	10.26	8.17			

3.12 Total plate count (cfu/ml)

There was no microbial growth observed in the blended squash up to 6 months of storage at ambient temperature. Microbial parameter of blended squash revealed that no microbial growth was observed up to 6 months of storage at room temperature, it indicates that blended squash can be used up to 6 months without any microbial deterioration.

IV. CONCLUSION

Based on the above findings, best quality blended squash with stable nutritional quality can be prepared using 75 per cent banana pseudostem sap, 10 per cent mango pulp, 10 per cent papaya pulp and 5 per cent *Aloe vera* juice. It can be stored successfully for 6 months in PET bottles at ambient temperature when preserved by 350 ppm of KMS and citric acid. Utilization of banana pseudostem sap/juice helps to reduce the cost of production as well as it helps to increase nutritional status of product. Blending of fruit juice/pulp resulted in good sensory as well as nutritional quality in blended squash. Thus, the developed technology can be commercially explored by the food processors for production quality blended squash. Therefore, it will be helpful for profitable utilization of banana pseudostem and also for development of different value added products.

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REFERENCES

[1] Anonymous (2015). "Preparation of Ready to serve (RTS) beverage from banana pseudostem sap". 11th *AGRESCO Report* 2015, N. A. U., Navsari, pp. 127-132.

[2] Borane, D. T. and Khan Sumaiya (2015). "Physiochemical and sensory evaluation of RTS beverage by incorporating banana pseudostem juice in papaya." *Int. J. Eng. Res. Tech.,* vol. **4**(8): pp. 403-406.

[3] Chaudhary, M.; Deen, B.; Gautam, D. K. and Mishra, K. K. (2017). "Studies on development of squash from mango pulp and *Aloe vera* gel blend." *Int. J. Curr. Microbiol. App. Sci*., vol. **6**(7): pp.1962-1969.

[4] Deshmukh, N. M.; Sawate, A. R.; Kshirsagar, R. B.; Desai, G. B. and Patil, B. M. (2019). "Studies on preparation and proximate composition of aonla and *Aloe vera* nectar with stevia (*Stevia rebaudiana*) as a sugar substitute." *J. Pharmacognosy Phytochem.*, vol. **8**(2): pp.26-32.

[5] Dhiman, A. K.; G. Babu, G. N.; Surekha, A. and Preethi, R. (2017). "Development and standardization of ripe pumpkin based squash and its stability during storage." *Int. J. Curr. Microbiol. App. Sci.,* vol.**6**(10): pp. 821-831.

[6] Eneche, E. H. (1991). "Biscuit making potential of millet/pigeon pea flour blends." *Plant Fd. Human Nutri*., vol. **54**: pp. 21-27.

[7] Gowri, M. and Sri, R. (2017). "Formulation and analysis of papaya and carrot based squash". *Int. J. Sci. Res.*, vol. **6**(11): pp. 642-644.

[8] Hamid, G. H.; Ei-Kholany, E. A. and Nahla, E. A. (2014). "Evaluation of aloe vera gel as antioxidant and antimicrobial ingredients in orange-carrot blend nectars". *Middle East J. Agri. Res*., vol. **3**(4): pp.1122-1134.

[9] Kumar, S. N.; Sreenivas, K. N.; Shankerarappa, T. H. and Ravindra, V. (2012). "Standardization of recipe for value added nutraceutical beverages of guava blends with *Aloe vera* and roselle". *J. Environ. Eco.,* vol. **30**(3B): pp. 995-1001.

[10] Malhotra, R.; Tyagi, S. M. and Saini, P. (2010). "Studies on *aloe vera* a component of functional foods." *Beverage Fd. World*, vol. **37**(7): pp. 36-39

[11] Meena, S. K.; Deeshmukh, R. V. and Giri, V. V. (2018). "Efficacy of consequent, alternate and mix spraying of protectant and systemic fungicides against sigatoka leaf spot disease of banana." *Int. J. Chem. Studies*, vol. **6**(5): pp.129-132.

[12] Olariu, R. (2009). Aloe vera – natures silent healer. *J. Hygiene Public Health*, vol. **59**(4): pp.79-88.

[13] Panse, V. G. and Sukhatme, P. V. (1985). "*Statistical methods for agricultural workers*". ICAR publications, New Delhi. pp. 151.

[14] Patel, S. (2017). "Standardization of blended nectar using banana pseudostem sap and mango pulp". *M.Sc. thesis* submitted to Navsari Agricultural University, Navsari. (Unpub.)

[15] Prabha, A.; Modgil, R. and Sandal, A. (2019). "Effect of blending and storage on the physic-chemical composition of the papaya and mango squash." *Asian J. Dairy Fd. Res.,* vol. **38**(2): pp.150-154.

[16] Priyanka, N.; Dorajeerao, A. V. D.; Sudhavani, V. and Umakrishna, K. (2015). "Physico-chemical characters and sensory evaluation of jamun based blended squash beverages during storage." *Plant archives*, **15**(2): 939-946.

[17] Raj, D.; Sharma, R. and Patel, N. L. (2016). "*Handbook of Food Sci. and Technol. Vol. 1, Chemistry and Safety*", pp. 452.

[18] Ranganna, S. (1986). *Handbook of analysis and quality control for fruit and vegetable products*. Tata McGraw Hill Publishing Co. Ltd., New Delhi, India.

[19] Rani, T. B. and Rao, K. D. (2014). "Acceptability and storage studies of *Aloe vera* based squash blends of sapota". *Asian. J. Dairy & Food Res.,vol.* **33**(3): pp. 230-233.

[20] Rashid, R.; Bhat, A.; Dayal, A.; Sood, M. and Sharma, S. (2018). "Studies on storage stability of guava RTS." *Pharma Innovation*, vol. **7**(5D): pp. 230.

[21] Sadasivam, S. and Manickam, A. (1996). Biochemical methods. New Age International Publishers, Chennai, India. pp. 1-256.

[22] Saleem, N.; Kamran, M.; Shaikh, S. A.; Tarar, O. M. and Jamil, K. (2011). "Studies on processing and preparation of peach squash." *Pakistan J. Biochem. Mol. Bio*., vol. **44**(1): pp. 12-23. Sharma, M.; Patel, S. N.; Sangwan, R. S. and Singh, S. P. (2017). "Biotransformation of banana pseudostem extract into a functional juice containing value added biomolecules of potential health benefits." *Indian J. Experimental Biol*. vol. **55**: pp. 453-462.

[23] Shiva, K. N.; Adiyaman, P.; Ravindra Naik and Marimuthu, N. (2018). "Development and standardization of banana pseudostem based novel functional blended ready to drink (RTD) beverages and studies nutritional changes during storage." *Int. J. Life Sci*., vol. **7**(3): pp. 151-158.

[24] Sidhu, J. S. and Zafar, T. A. (2018). "Bioactive compounds in banana fruits and their health benefits". *Food Quality Safety*, vol. **2**(4): pp. 183-188.

[25] Sridhar, D.; Prashanth, P.; Kumar, M. R. and Jyothi, G. (2017). "Studies on the effect of blending of jamun juice and guava juice on sensory quality and storage". *Int. J. Pure App. Biosci*., vol. **5**(4): pp. 1089-1096.

[26] Tahasildhar, L. (2016). Optimization of blend for the preparation of nectar using *Aloe vera,* guava and jamun. *M.Sc. thesis* submitted to Navsari Agricultural University, Navsari. (Unpublished).

[27] Thakur, N. S.; Dhaygude, G.S.; Thakur, A.; Kumar, P. and Hamid (2018). "Studies on preparation and preservation of squash from wild pomegranate (*Punica granatum* L.) fruits and its quality evaluation during storage". *Int. J. Bio-resource and Stress* Mgt., vol. **9**(1): pp. 07-012.

[28] 29. Thirukkumar, P.; Vennila, P. and Kanchana, S. (2018). "Physico- chemical characteristics of noni fruit juice blended squashes during storage". *Int. J. Chem. Studies*, vol. **6**(1): pp. 449-455. 30. Uddin, M. N.; Wahab, S.; Muhammad, A.; Bilal, H.; Din, M. U.; Nawaz, H.; Khan, S. A. and Sultan, Q. A. (2019). "Development and quality evaluation of mango and guava blended squash during storage." *Pure Appl. Biol*., vol. **8**(2): pp.1182-1190.