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Effect of blending proportion and storage on sensory parameters of blended juice using banana pseudostem sap with noni, *Aloe vera* and guava

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Abstract

The present experiment was conducted to study the effect of blending proportion on sensory quality of the blended juice during storage period of 6 months in polyethylene terephthalate bottles with 16 treatments along with different blending combinations of banana pseudostem sap, noni, *Aloe vera* and guava under ambient temperature. The prepared blended juices were evaluated for sensory qualities on the basis of colour, texture, taste, flavour and overall acceptability on a 9 point hedonic scale. The results obtained from the experiment have been concluded that best quality blended juice with higher sensory acceptability can be obtained using 80 per cent banana pseudostem sap, 5 per cent noni juice, 5 per cent *Aloe vera* juice and 10 per cent guava pulp. It can be stored successfully for 6 months in PET bottles in ambient temperature.

Keywords: Blending proportion sensory quality, blended juice, storage period, polyethylene terephthalate bottles

Introduction

Globally there is a high demand for food resources to meet the current need and to meet the future population requirements. India is the second largest producer of fruits next to China. In India, horticultural crops occupies an area of 25.4 million hectares with a production of 311 million tonnes. Fruits are grown over an area of 6.5 million hectares with a production of 97.3 million tonnes (Anon., 2019) [3]. Despite of huge production, around 1.7 million deaths worldwide are attributed to low fruit and vegetable consumption (Anon., 2018) [2]. Inadequate fruit and vegetable consumption leads to an increase in non-communicable diseases like cardiovascular diseases, stomach cancer and stroke. Waste utilization is one of the best options to meet the food and nutrition requirements of the increasing population. In India, Banana is the second largest fruit crop grown over an area of 8.74 lakh hectares with a production of 300.06 lakh MT and productivity of 34.33 MT/ha (Anon., 2019) [3]. Banana is basically a tropical crop, grows well in a temperature range of 15 °C to 35 °C 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 consumed as staple food in many countries. It provides balanced nutritional diet when compared to any other fruit. 100 g of banana fruit contains 75 g of water, 89 Kcal of energy, 22.84 g of carbohydrates, 12.23 g of sugars, 2.6 g of dietary fibers and 8.7 mg of vitamin C with 358 mg of potassium (Sidhu and Zafar, 2018) [11].

Apart from fruit, banana pseudostem juice is potential source of antioxidants such as gentisic acid, catechin, ferulic acid and protocatechuic acid and it also have ability to cure urinary disorders and stone formation in gall bladder by dissolving calcium oxalate which is responsible to cause kidney stones (Sharma *et al.*, 2017) [19]. According to the reports of CFTRI (Central Food Technological Research Institute) Mysore, there are no harmful components present in it and can be used as edible processed product. It is also advised that blending of banana pseudostem juice with fruit juice will helps to increase the sensory as well as nutritional value of the product.

Noni (*Morinda citrifolia* L.) belonging to family Rubiaceae is an important medicinal crop and its juice is used to cure varied health problems such as diabetes, high blood pressure, aches, constipation, *etc.* It is usually consumed by blending with other fruit juices due to its sour taste and foul odour. *Aloe vera* belongs to family Liliaceae.

It is most widely used and commercially available medicinal plant because of its nutritional and therapeutic properties. Guava (*Psidium guajava*) belongs to family Myrtaceae. It is one of the important commercial fruit crop of India. It is cultivated in many tropical and subtropical countries for their edible fruit. It is one of the most delicious, nutritionally valuable and remunerative crop. These fruit juice were used as a blending with banana pseudostem sap to increase the nutritional and sensory properties of blended juice.

Materials and Methods

The banana pseudostems were procured from the farm of Soil and Water Management Research Unit, Navsari Agricultural University, Navsari (Gujarat). Fully ripened fruits of noni and fully developed slips of *Aloe vera* were harvested from the farm of Navsari Agricultural University, Navsari (Gujarat) and fully ripened fruits of guava were procured from APMC,

Navsari (Gujarat).

Banana pseudostems were washed and juice was extracted from sheaths with the use of sugarcane juice extractor. Noni juice was extracted using hydraulic press then boiled and filled in glass bottles. After sorting and washing of *Aloe vera* slips, they were pre-treated with soybean extract (1.5% for 12 h) to remove aloin content (US Patent, 2007) [14] then juice was extracted using screw type juice extractor and filled in glass bottles. Guava pulp was extracted using fruit pulper, then the pulp was boiled at 95 °C for 30 minutes filled in polyethylene bags and cooled.

Methodology for preparation of blended juice

The methodology adopted for blended juice preparation is given in Fig. 1 as a technical flowchart. The experiment was carried out using 16 treatments with 3 repetitions. The different treatment combinations were recorded in Table 1.

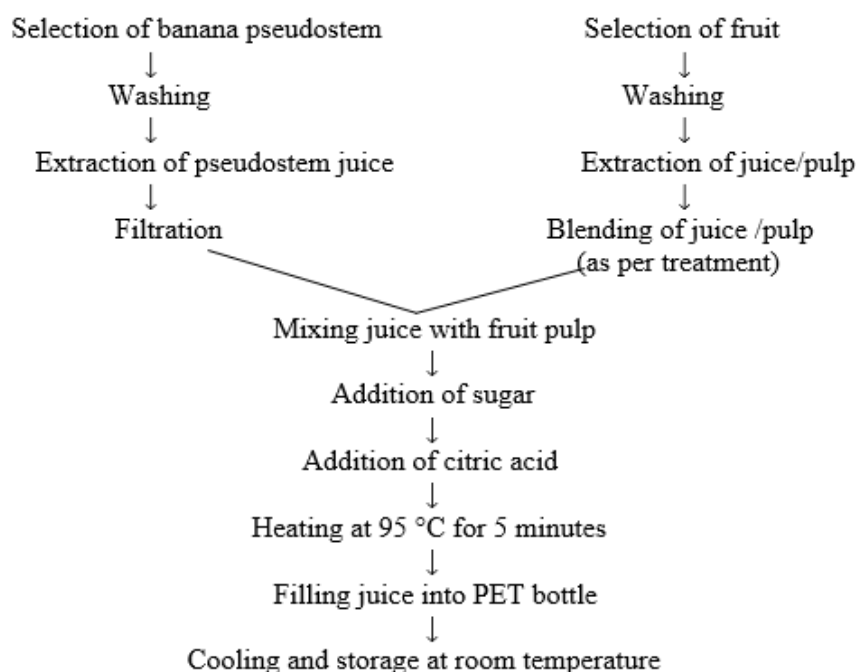


Fig 1: Principle steps used for preparation o blended juice

Table 1: Treatment details with different blending proportions

Treatments	Banana pseudostem sap (%)	Noni juice (%)	<i>Aloe vera</i> Juice (%)	Guava pulp (%)
T ₁	100	0	0	0
T ₂	80	0	0	20
T ₃	80	0	5	15
T ₄	80	0	10	10
T ₅	80	0	15	5
T ₆	80	0	20	0
T ₇	80	5	5	10
T ₈	80	5	10	5
T ₉	80	5	15	0
T ₁₀	80	5	0	15
T ₁₁	80	10	0	10
T ₁₂	80	10	10	0
T ₁₃	80	10	5	5
T ₁₄	80	15	5	0
T ₁₅	80	15	0	5
T ₁₆	80	20	0	0

Methodology adopted for recording the changes in sensory attributes of blended juice during storage

Sensory evaluation of blended juice was conducted during

storage to assess the consumers acceptance for the product. The prepared samples were evaluated for sensory qualities on the basis of colour, texture, taste, flavour and overall acceptability on a 9 point hedonic scale. For the accurate results, a panel of faculty members and PG students of Department of Post-Harvest Technology, NAU, Navsari were used for sensory analysis throughout the storage period interval. A taste breaker like chips with normal water was provided to the panelists for mouth rinsing in between the sensory test.

Result and Discussion

Physical parameters of fresh produce

Juice/Pulp recovery (%)

The juice recovery percentage of fresh fruits are presented in the Table 2 and showed the juice recovery percentage of banana pseudostem juice, noni, *Aloe vera* and guava as 77.7, 51, 54 and 82 per cent, respectively. The average weight of banana pseudostem was 720 g (per feet) where as the outer sheaths weight was 160 g the obtained psuedostem juice was 560 g. The 490 g of noni juice recovered from noni fruits with an average weight of 1000 g and 510 g as seed and pomace

weight. The average weight of *Aloe vera* was 1000 g whereas peel weight was 460 g and recovered juice was 540 g. The

820 g of guava pulp and 180 g of peel obtained from average guava fruits with weight of 1000 g.

Table 2: Juice/Pulp recovery (%) of fresh fruits/banana pseudostem

	Parameters	Banana pseudostem (per feet)	Noni (per 1 kg)	<i>Aloe vera</i> (per 1 kg)	Guava (per 1 kg)
1.	Average weight of raw materials (g)	720.00	1000.00	1000.00	1000.00
2.	Weight of wastage (g)	160.00	490.00	460.00	180.00
3.	Juice/Pulp recovered (g)	560.00	510.00	540.00	820
4.	Juice/Pulp recovery (%)	77.7	51	54	82

Analysis of chemical properties of blended juice

Standard methodology was followed during preparation of blended juice, TSS and titrable acidity were maintained to 15 °Brix and 0.3%, respectively.

Sensory changes of blended juice during storage

Colour

Data regarding the colour score (based on 9 point Hedonic rating) of blended juice during 6 months of storage have been presented in the Table 3. Based on the score given by the panelists the maximum score (8.27) was found in treatment T₇ (banana pseudostem juice: noni: *Aloe vera*: guava 80:5:5:10) and the lowest colour score (6.69) was recorded in the treatment T₁ (banana pseudostem juice: noni: *Aloe vera*: guava (100:0:0:0)). The Maximum colour score in treatment T₇ was might be due to light brown of juice preferred by the panelists and minimum score in treatment T₁ was might be

due to colourless nature of banana pseudostem juice. The colour score of product decreased during 6 months storage. It might be due to non enzymatic browning and oxidation of phenolic compounds in the juice leads to decreased colour value of blended juice storage. After 6 months of storage highest colour mean value observed in T₇ and lowest mean colour value was recorded in treatment T₁. However, the colour value found acceptable above 7 *i.e.* all the treatments found acceptable except T₁ and T₁₆. Similar results were recorded by Shiva *et al.* (2018) ^[10] in banana pseudostem based novel functional blended ready to drink beverages with ginger rhizome and nannari root extracts during 6 months of storage. The findings were also supported by the results of Anonymous (2016) ^[11] in standardization of methods for noni juice preparation. Tahasildar (2016) ^[13] also reported similar findings in preparation of blended nectar using *Aloe vera*, guava and jamun.

Table 3: Effect of blending of banana pseudostem sap with noni, *Aloe vera* and guava juice on colour 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 (100:0:0:0)	6.80	6.72	6.65	6.60	6.69
T ₂ (80:0:0:20)	8.12	8.06	8.00	7.96	8.04
T ₃ (80:0:5:15)	7.96	7.91	7.84	7.80	7.88
T ₄ (80:0:10:10)	7.80	7.73	7.64	7.60	7.69
T ₅ (80:0:15:5)	7.88	7.82	7.77	7.71	7.80
T ₆ (80:0:20:0)	8.04	7.97	7.90	7.85	7.94
T ₇ (80:5:5:10)	8.35	8.30	8.22	8.20	8.27
T ₈ (80:5:10:5)	8.26	8.23	8.16	8.11	8.19
T ₉ (80:5:15:0)	7.74	7.68	7.59	7.53	7.64
T ₁₀ (80:5:0:15)	7.62	7.57	7.48	7.42	7.52
T ₁₁ (80:10:0:10)	7.56	7.49	7.37	7.30	7.43
T ₁₂ (80:10:10:0)	7.40	7.32	7.26	7.22	7.30
T ₁₃ (80:10:5:5)	7.32	7.27	7.21	7.16	7.24
T ₁₄ (80:15:5:0)	7.24	7.17	7.09	7.01	7.13
T ₁₅ (80:15:0:5)	7.19	7.11	7.03	6.97	7.08
T ₁₆ (80:20:0:0)	7.06	6.95	6.88	6.80	6.92
Mean (P)	7.65	7.58	7.51	7.45	

Texture

Data obtained during sensory evaluation of blended juice with respect to texture value have been presented in the Table 4. Texture score of blended juice (based on 9 point Hedonic rating) given by the panelist recorded maximum (8.18) in treatment T₇ and the minimum texture value (6.98) was recorded in the treatment T₁ (banana pseudostem juice: noni: *Aloe vera*: guava 100:0:0:0). The highest texture score was might be due to the consistency preferred by the panelists in the blended juice and lower texture score was might be due to juicy nature of banana pseudostem juice. Texture value of

blended juice showed decreasing trend during 6 months storage period. But, the mean texture score remain same as highest in treatment T₇ and lowest in treatment T₁. However, texture score above 7 was found acceptable *i.e.*, all the treatments are acceptable except T₁. Similar results were recorded by Shiva *et al.* (2018) ^[10] in banana pseudostem based novel functional blended ready to drink beverages with ginger rhizome and nannari root extracts and their nutritional changes during 6 months of storage. Kumar and Reddy (2015) ^[6] also noted similar results in utilization of plantain banana pseudostem stem juice by sweetening with jaggery.

Table 4: Effect of blending of banana pseudostem sap with noni, *Aloe vera* and guava juice on texture 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 (100:0:0:0)	7.10	7.03	6.92	6.87	6.98
T ₂ (80:0:0:20)	8.12	8.04	7.98	7.91	8.01
T ₃ (80:0:5:15)	7.97	7.91	7.86	7.80	7.88
T ₄ (80:0:10:10)	7.87	7.79	7.67	7.62	7.74
T ₅ (80:0:15:5)	7.90	7.84	7.73	7.70	7.79
T ₆ (80:0:20:0)	8.07	7.96	7.90	7.85	7.95
T ₇ (80:5:5:10)	8.28	8.21	8.15	8.08	8.18
T ₈ (80:5:10:5)	8.20	8.14	8.06	8.00	8.10
T ₉ (80:5:15:0)	7.80	7.72	7.68	7.60	7.70
T ₁₀ (80:5:0:15)	7.74	7.64	7.59	7.53	7.63
T ₁₁ (80:10:0:10)	7.65	7.57	7.51	7.47	7.55
T ₁₂ (80:10:10:0)	7.58	7.43	7.37	7.30	7.42
T ₁₃ (80:10:5:5)	7.44	7.33	7.28	7.21	7.32
T ₁₄ (80:15:5:0)	7.14	7.06	6.97	6.91	7.02
T ₁₅ (80:15:0:5)	7.21	7.11	7.07	7.01	7.10
T ₁₆ (80:20:0:0)	7.14	7.03	6.95	6.91	7.01
Mean (P)	7.70	7.61	7.54	7.49	

3.3.3 Flavour

Data pertaining to flavor score of blended juice have been presented in the table 5. According to the flavour score of blended juice (based on 9 point Hedonic rating) the maximum flavor value (8.21) was recorded in treatment T₇ (banana pseudostem juice: noni: *Aloe vera*: guava 80:5:5:10) and minimum flavour score was recorded in the treatment T₁ (6.77) (banana pseudostem juice: noni: *Aloe vera*: guava 100:0:0:0). These results were due to blended flavour of fruits in treatment T₇ which was preferred more by the panelists and lower flavour score in treatment T₁ was due to less flavour in

banana pseudostem juice. During 6 months storage the flavour value of blended juice resulted decreasing trend this might be due to loss of flavour compounds during storage of blended juice. At the end of 6 months of storage higher mean flavour score was reported in treatment T₇ and lower mean flavour score was recorded in treatment T₁. Similar results were reported by Desai *et al.* (2016) [5] in preparation of flavoured candy from central core of banana pseudostem. Ladda *et al.* (2016) [7] also reported similar results in formulation of noni based syrup along with *Aloe vera* and aonla juice for blending.

Table 5: Effect of blending of banana pseudostem sap with noni, *Aloe vera* and guava juice on flavour 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 (100:0:0:0)	6.85	6.80	6.72	6.70	6.77
T ₂ (80:0:0:20)	8.24	8.16	8.09	8.03	8.13
T ₃ (80:0:5:15)	8.22	8.15	8.08	8.03	8.12
T ₄ (80:0:10:10)	8.18	8.13	8.05	8.01	8.09
T ₅ (80:0:15:5)	8.17	8.11	8.00	7.98	8.07
T ₆ (80:0:20:0)	8.12	8.04	7.95	7.89	8.00
T ₇ (80:5:5:10)	8.34	8.26	8.14	8.10	8.21
T ₈ (80:5:10:5)	8.12	8.04	7.95	7.89	8.00
T ₉ (80:5:15:0)	8.00	7.91	7.80	7.77	7.87
T ₁₀ (80:5:0:15)	8.05	7.98	7.86	7.80	7.92
T ₁₁ (80:10:0:10)	7.80	7.73	7.62	7.58	7.68
T ₁₂ (80:10:10:0)	7.55	7.48	7.35	7.31	7.42
T ₁₃ (80:10:5:5)	7.71	7.65	7.57	7.50	7.61
T ₁₄ (80:15:5:0)	7.27	7.22	7.11	7.05	7.16
T ₁₅ (80:15:0:5)	7.40	7.36	7.27	7.21	7.31
T ₁₆ (80:20:0:0)	7.12	7.05	6.91	6.87	6.99
Mean (P)	7.82	7.75	7.65	7.61	

Taste: Data regarding the taste value of blended juice have been recorded in Table 5. Looking at taste score of blended juice (based on 9 point Hedonic rating) showed maximum taste score (8.30) in treatment T₇ (banana pseudostem juice: noni: *Aloe vera*: guava 80:5:5:10) and minimum taste score (6.71) was recorded in the treatment T₁ (banana pseudostem juice: noni: *Aloe vera*: guava 100:0:0:0). Higher taste score was might be due to blended taste of pseudostem sap, noni, *Aloe vera* and guava also due to sweeter taste of juice due to higher ratio of guava, the lowest score was might be due to the tasteless nature of banana pseudostem juice. During

storage taste score of blended juice showed decreasing trend, this might be due to effect of temperature on juice leads to biochemical changes that leads to loss of volatile compounds in the blended juice. However, taste score of above 7 was found acceptable *i.e.*, in terms of taste score all the treatments found acceptable except T₁ and T₁₆. Similarly, the findings were supported Anonymous (2016) [1] in standardization of methods for noni juice preparation. Bhavya Sree and Vanajalata (2015) [4] also recorded similar results on blended RTS beverage with different proportions of sweet orange and pomegranate juice during 3 months storage period.

Table 5: Effect of blending of banana pseudostem sap with noni, *Aloe vera* and guava juice on taste 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 (100:0:0:0)	6.80	6.80	6.64	6.58	6.71
T ₂ (80:0:0:20)	8.32	8.30	8.18	8.05	8.21
T ₃ (80:0:5:15)	8.11	8.06	8.00	7.95	8.03
T ₄ (80:0:10:10)	8.01	7.96	7.90	7.84	7.93
T ₅ (80:0:15:5)	7.90	7.82	7.75	7.62	7.77
T ₆ (80:0:20:0)	7.78	7.70	7.59	7.52	7.65
T ₇ (80:5:5:10)	8.38	8.35	8.25	8.20	8.30
T ₈ (80:5:10:5)	8.25	8.22	8.12	8.00	8.15
T ₉ (80:5:15:0)	7.33	7.28	7.22	7.16	7.25
T ₁₀ (80:5:0:15)	7.42	7.36	7.30	7.25	7.33
T ₁₁ (80:10:0:10)	7.30	7.26	7.22	7.15	7.23
T ₁₂ (80:10:10:0)	7.23	7.18	7.13	7.07	7.15
T ₁₃ (80:10:5:5)	7.26	7.20	7.16	7.11	7.18
T ₁₄ (80:15:5:0)	7.12	7.08	7.01	6.96	7.04
T ₁₅ (80:15:0:5)	7.18	7.12	7.05	7.00	7.09
T ₁₆ (80:20:0:0)	7.09	7.01	6.96	6.87	6.98
Mean (P)	7.59	7.54	7.47	7.40	

3.3.5 Overall acceptability

Data regarding the overall acceptability of blended juice have been presented in Table 6. Overall acceptability is one of the important sensory attribute that determine the product preference by the consumer. Based on the previous results of colour, texture, flavour and taste of blended juice the maximum overall acceptability (8.24) was recorded in treatment T₇ (banana pseudostem juice: noni: *Aloe vera*: guava 80:5:5:10) and the minimum overall acceptability value (6.79) was recorded in the treatment T₁ (banana pseudostem

juice: noni: *Aloe vera*: guava 100:0:0:0). During storage overall acceptability of blended juice recorded decreasing trend, this was due to decreased colour, texture, flavour and taste scores of blended juice. However, the product found acceptable above score 7 *i.e.*, all the treatments are acceptable except T₁ and T₁₆. Similar results were reported by Marimuthu and Narayanan (2019) ^[8] in preparation of noni RTS beverages and Sridhar *et al.* (2017) ^[12] in effect blending of jamun juice and guava juice on sensory quality and storage.

Table 6: Effect of blending of banana pseudostem sap with noni, *Aloe vera* and guava juice on overall acceptability 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 (100:0:0:0)	6.89	6.84	6.73	6.69	6.79
T ₂ (80:0:0:20)	8.20	8.14	8.06	7.99	8.10
T ₃ (80:0:5:15)	8.07	8.01	7.95	7.90	7.98
T ₄ (80:0:10:10)	7.97	7.90	7.82	7.77	7.86
T ₅ (80:0:15:5)	7.96	7.90	7.82	7.75	7.86
T ₆ (80:0:20:0)	8.00	7.92	7.84	7.78	7.88
T ₇ (80:5:5:10)	8.34	8.28	8.19	8.14	8.24
T ₈ (80:5:10:5)	8.21	8.16	8.07	8.00	8.11
T ₉ (80:5:15:0)	7.72	7.65	7.57	7.51	7.61
T ₁₀ (80:5:0:15)	7.71	7.64	7.56	7.50	7.60
T ₁₁ (80:10:0:10)	7.58	7.51	7.43	7.38	7.47
T ₁₂ (80:10:10:0)	7.44	7.35	7.28	7.23	7.33
T ₁₃ (80:10:5:5)	7.43	7.36	7.31	7.25	7.34
T ₁₄ (80:15:5:0)	7.19	7.13	7.04	6.98	7.09
T ₁₅ (80:15:0:5)	7.24	7.17	7.10	7.05	7.15
T ₁₆ (80:20:0:0)	7.10	7.01	6.93	6.86	6.98
Mean (P)	7.69	7.62	7.54	7.49	

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Conclusion

Based on the above findings, best quality blended juice with higher sensory acceptability can be obtained using 80 per cent banana pseudostem sap, 5 per cent noni juice, 5 per cent *Aloe vera* juice and 10 per cent guava pulp. It can be stored successfully for 6 months in PET bottles in ambient

temperature. Utilization of banana pseudostem 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 quality in blended juice.

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