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Evaluation of quality attributes of phalsa blended squash during storage

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ABSTRACT

A study was aimed to standardize the protocol for preparation of phalsa blended squash. The investigation was conducted at Rainfed Research Sub-Station for Sub-Tropical Fruits (RRSS), SKUAST-J, Raya, Samba, J&K, UT. Phalsa and guava pulp were blended in the ratio of 100:0, 90:10, 80:20, 70:30, 60:40 and 50:50, respectively. The processed products were stored at room temperature and subjected to chemical, microbial and sensory evaluation at an interval of one month for a period of three months. With the advancement of storage period, an increasing trend was observed in TSS, reducing and total sugar content; however; a decreasing trend was observed in titratable acidity, ascorbic acid and anthocyanin content during the three months of storage period. In blended phalsa-guava squash, no microbial count was observed in all the treatment combinations during the three months of storage period. However, the blended squash prepared from treatment T_4(Phalsa:Guava::70:30) was adjudged the best on the basis of overall acceptability.

Keywords: Phalsa, guava, blended, sensory evaluation and squash

Commonly known as star apple, phalsa (*Grewia subinaequalis* L.) is a nutritious fruit of sub-tropical areas under Indian conditions.The fruit belongs to family 'Tiliaceae' and has about 41 genera and 400 species. The profitable market of phalsa fruit mainly exits in the states namely Punjab, Haryana, Rajasthan, UP and MP. In the states like Maharashtra, Gujarat, AP, Bihar and WB phalsa fruit is grown on a very limited scale (Kumar *et al.*, 2014). In J&K UT, it is not a commercial fruit crop and grown only in rainfed and dry land areas of districts Kathua, Samba, Jammu, Udhampur, Rajouri and Reasi. From these locations, it could find ready market for disposal. Phalsa fruit is ready for picking in S. India from March to April; whereas in N. India it is harvested in the months of May-June. The fruits are highly perishable in nature and it cannot be exported but its processedproducts are quite appreciable. Ripe fruits are consumed fresh in desserts, or processed intorefreshing soft drinks like squash, RTS, sharbet *etc*. which areenjoyed during hot summer months in India (Tiwari *et al*., 2014; Pangotra *et al*., 2018).

Guava (*Psidium guajava* L.) is a champion fruit belonging to family Myrtaceae and originated in tropical South America. It is one of the leading fruit crops in India due to wide adaptability to varying soil and climatic conditions.Guava has earned the popularity of 'poor man's apple' due to low fetching price available in plenty to all almost thrice in a year. It is no inferior to apple for its nutritive values. It is pleasant, sweet and refreshingly, acidic in flavour and emits sweet aroma. It is an excellent source of vitamin C and pectin. The major growing areas of guava fruit in India are in the states like UP, Bihar, MP, Gujarat and Maharashtra. However, in J&K UTit is grown mainly in the areas of Jammu, Kathua, Samba, Reasi, Udhampur, Rajouri, Poonch and Ramban districts (Gupta *et al.*, 2016). It is the fourth most important fruit in area and production after mango, banana and citrus (Sharma *et al*., 2019). The phalsa guava squash would give consumer a new product with high nutritive value.

MATERIALS AND METHODS

The investigation was conductedat RRSS, Raya, SKUAST-J, Samba, J&K UT. under adhoc Research Project entitled, "Exploitation of under-utilized fruits of *kandi* areas of Jammu region through value addition for human resource development"funded by SERB-DST, New Delhi, GOI during the year 2014-2015.The Phalsa and guava fruits were procured from RRSS, Raya. For the development of blended squash, pulp of phalsa and guava were mixed together in different ratios as per the treatment combinations. The various treatment combinations were T_1: 100:0, T_2: 90:10, T_3: 80:20, T_4: 70:30, T_5: 60:40 and T_6: 50:50, on mixing of phalsa and guava pulp, respectively. After evaluating the blends for TSS and acidity, a required amount of sugar and citric acid was added to the mixture to maintain 45^{0}Brix TSS and 0.1% acidity of the blended squash. The mixture was then heated to dissolve the sugar completely. Before hot filling, the sodium benzoate @ 600 ppm was added to the blended squash. The product was filled hot in pre-sterilized glass bottles. The bottles were then sealed air tight, pasteurized, labelled and stored at a cool and dry

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place at ambient temperature conditions. The storage behaviour of the product was evaluated with respect to the changes in chemical, microbial and sensory qualities immediately after preparation and then at an interval of one month up to three months of storage. Total soluble solids (TSS) were measured by hand refractrometer, titratable acidity, sugars (Ranganna, 1986), ascorbic acid (AOAC, 2002) and anthocyanin (Srivastava and Kumar, 1994)were determined as per the standard procedures.Total plate count of micro-organism was taken according to the method given by Harrigan and Mccance (1966). A semi-trained taste panels of 6-7 judges evaluated the prepared product on the basis of sensory evaluation by using 9 point hedonic scale. A score of 5.5 and above was considered acceptable (Amerine *et al.,* 1965). The lab experiment was carried out in Completely Randomized Design with factorial concept for the interpretation of results through analysis of variance with three numbers of replications (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The fresh phalsa and guava fruits were analysed for various chemical characteristics and are presented in the table 1. In fresh phalsa fruit the values were found to be 16^0Brix, 1.65%, 12%, 13%, 8.96 mg $100g^{-1}$ and 75 mg $100g^{-1}$ for TSS, acidity, reducing sugar, total sugar, ascorbic acid and anthocyanin, respectively. These findings are in conformity with study in phalsa fruit (Pangotra *et al*., 2018). The values were observed as10.5 ^{0}Brix, 0.50%, 2.60%, 3.29%, 155 mg $100g^{-1}$value for TSS, acidity, reducing sugar, total sugar and ascorbic acid, respectively in freshguava fruit. Similar findings have been reported by Gupta *et al*., 2016.

Table 1: Chemical characteristics of phalsa and guava fruit

S.No.	Particulars	Phalsa	Guava
1.	TSS	16.0	10.5
2.	Acidity	1.65	0.50
3.	Reducing sugar	12.0	2.60
4.	Total Sugar	13.0	3.29
5.	Ascorbic acid	8.96	155
6.	Anthocyanin	75.0	

A significant increasing trend observed in total soluble solids (TSS) of phalsa blended squash from initial to end of storage period (Table 2). On completion of 1 month storage period, treatment T_1 (100:00:: phalsa: guava) recorded statistically higher TSS (45.65^0Brix) which was followed by T_2 (90:10::phalsa:guava) having value to the tune of 45.50^0Brix. After three months of storage, treatment T_1 (100:00::phalsa:guava) recorded statistically higher TSS (46.84^0Brix) and the lowest value (46.24^0 Brix) was observed in T_6 (50:50::phalsa:guava). The mean TSS varied between 45.63 and 46.07%. It was evident from the results that treatment T_1 (46.07^0Brix) recorded maximum TSS as compared to other treatments mean values. Treatment and storage interaction was also found to be significant.This increase in TSS content might be due to the hydrolysis of polysaccharides like starch and pectic substances into simpler substances. Similar observations were also recordedby Archana and Laxman(2015) in tamarind squash,Gupta (2019) in karonda-beetroot RTS and Mahnoori *et al*.(2020) in litchi-beetroot RTS.

Titratable acidity content data presented in the table 2 depicted a decreasing trendof phalsa blended squash. After 2 months of storage, the highest acidity content to the tune of 0.88% was recorded in treatment T_1 (100:00::phalsa:guava) and the lowest value (0.70%) in T_6 (50:50::phalsa:guava). After 3 months of storage, value of acidity decreased to 0.82% in T_1(100:00:: phalsa:guava) and 0.62% in T_6 (50:50::phalsa:guava). A non-significant difference was recorded in interaction between treatments and storage period. It might be due to the conversion of acids into salts and sugars by enzymes particularly invertase (Kumar *et al.,*1992). Similar results were also reported by Sogi and Singh, 2001 in kinnow squash.

The data depicted in the table 3 showed a constant increase in reducing sugar content of blended squash during the storage periods. At initial day of storage, maximum increase in reducing sugar content was observed in treatment T_1 and the minimum content found in T_6 having the values 32.50 and 31.72%, respectively. After three months of storage period, reducing sugar increased to 33.54 and 32.40% in treatments T_1 and T_6, respectively. During the various storage periods, there was a significant increase in the mean score from32.14% at initial day to 32.74% during 90 days of storage period. The statistical analysis showed significant effect on the interaction of treatments and storage periods.The reason behind this might be the partial acid hydrolysis of starch and disaccharide of squash converted into invert sugar and also inversion of part of non-reducing sugars into glucose and fructose and gradual degradation of polysaccharides in pulp through acid hydrolysis. Similar findings were also reported by Sahu *et al.*(2006) in mango lemon grass beverage.

The statistical analysis showed that the treatments and storage time had a substantial influence on total sugars of phalsa and guava squash throughout storage at ambient temperature (Table 3). At the initial day of storage, total sugar of the samples were 40.50, 40.29, 40.14, 40.02, 39.43 and 39.16% which were gradually increased to 41.92, 41.80, 41.72, 41.64, 40.92 and 40.80%, respectively during 90 days of storage period at room temperature. Mean values of reducing sugar

Table 2: Effect of treatment and storage period on total soluble solids and titratable acidity of phalsa blended squash

Treatments	Total soluble solids (^{0}Brix)					Titratable acidity (%)				
	Storage period (months)					Storage period (months)				
	0	1	2	3	Mean	0	1	2	3	Mean
T_1:Phalsa:Guava::100:00	45.00	45.65	46.80	46.84	46.07	1.00	0.94	0.88	0.82	0.91
T_2: Phalsa:Guava::90:10	45.00	45.50	46.72	46.86	46.02	1.00	0.92	0.86	0.80	0.89
T_3: Phalsa:Guava::80:20	45.00	45.46	46.64	46.79	45.97	1.00	0.86	0.80	0.76	0.85
T_4: Phalsa:Guava::70:30	45.00	45.40	45.70	46.73	45.71	1.00	0.84	0.78	0.70	0.83
T_5: Phalsa:Guava::60:40	45.00	45.36	45.84	46.50	45.67	1.00	0.78	0.72	0.68	0.79
T_6: Phalsa:Guava::50:50	45.00	45.32	45.98	46.24	45.63	1.00	0.72	0.70	0.62	0.76
Mean	**45.00**	**45.45**	**46.28**	**46.66**		**1.00**	**0.84**	**0.79**	**0.73**	
LSD (0.05)										
Treatments			**0.02**					**0.08**		
Storage			**0.01**					**0.07**		
Treatments x Storage			**0.03**					**NS**		

Table 3: Effect of treatment and storage period on reducing and total sugar of phalsa blended squash

Treatments	Reducing sugar (%)					Total sugar (%)				
	Storage period (months)					Storage period (months)				
	0	1	2	3	Mean	0	1	2	3	Mean
T_1:Phalsa:Guava::100:00	32.50	32.64	33.12	33.54	32.95	40.50	40.62	41.80	41.92	41.21
T_2: Phalsa: Guava::90:10	32.44	32.60	32.76	32.80	32.65	40.29	40.46	41.72	41.80	41.07
T_3: Phalsa: Guava::80:20	32.32	32.40	32.54	32.65	32.48	40.14	40.28	41.60	41.72	40.93
T_4: Phalsa: Guava::70:30	32.01	32.30	32.48	32.56	32.34	40.02	40.20	41.42	41.64	40.82
T_5: Phalsa: Guava::60:40	31.84	31.95	32.18	32.48	32.12	39.43	39.74	40.64	40.92	40.18
T_6: Phalsa: Guava::50:50	31.72	31.90	32.33	32.40	32.09	39.16	39.50	40.59	40.80	40.01
Mean	**32.14**	**32.30**	**32.57**	**32.74**		**39.92**	**40.13**	**41.29**	**41.47**	
LSD (0.05)										
Treatments			**0.02**					**0.02**		
Storage			**0.01**					**0.01**		
Treatments × Storage			**0.03**					**0.03**		

Table 4: Effect of treatment and storage period on ascorbic acid and anthocyanin of phalsa blended squash

Treatments	Ascorbic acid (mg 100 g^{-1})					Anthocyanin (mg 100 g^{-1})				
	Storage period (months)					Storage period (months)				
	0	1	2	3	Mean	0	1	2	3	Mean
T_1:Phalsa:Guava::100:00	7.50	7.44	7.30	7.22	7.36	18.80	18.72	18.60	17.84	18.49
T_2: Phalsa:Guava::90:10	7.90	7.84	7.50	7.36	7.65	18.72	18.60	18.52	17.62	18.36
T_3: Phalsa:Guava::80:20	8.24	8.16	8.10	7.90	8.10	18.60	18.48	18.34	17.51	18.23
T_4: Phalsa:Guava::70:30	8.48	8.40	8.32	8.20	8.35	18.51	18.36	18.26	17.32	18.11
T_5: Phalsa:Guava::60:40	8.60	8.52	8.48	8.40	8.50	17.92	17.64	17.46	16.92	17.48
T_6: Phalsa:Guava::50:50	8.74	8.70	8.64	8.52	8.65	17.46	17.26	17.12	16.74	17.14
Mean	**8.24**	**8.18**	**8.06**	**7.93**		**18.33**	**18.18**	**18.05**	**17.32**	
LSD (0.05)										
Treatments			**0.02**					**0.02**		
Storage			**0.01**					**0.01**		
Treatments x Storage			**0.03**					**0.03**		

Table 5: Effect of treatment and storage period on microbial count of phalsa blended squash

Treatments	Total number of colonies (cfu ml^{-1})			
	Storage period (months)			
	0	1	2	3
T_1: Phalsa:Guava::100:00	ND	ND	ND	ND
T_2: Phalsa:Guava::90:10	ND	ND	ND	ND
T_3: Phalsa:Guava::80:20	ND	ND	ND	ND
T_4: Phalsa:Guava::70:30	ND	ND	ND	ND
T_5: Phalsa:Guava::60:40	ND	ND	ND	ND
T_6: Phalsa:Guava::50:50	ND	ND	ND	ND

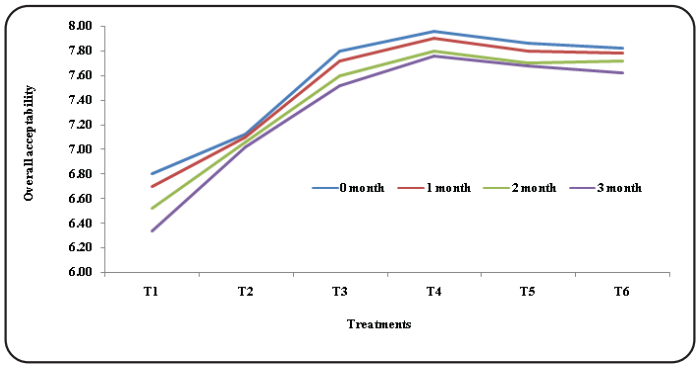

Fig. 1: Effect of treatment and storage period on overall acceptability of phalsa blended squash

significantly increased from 39.92 to 41.47% from beginning to end of storage. For treatments, maximum value for mean was noted in T_1 (41.21%), which was followed by T_2 (41.07%), while minimum value for total sugar noted in T_6 (40.01%), followed T_5(40.18%). Treatments, storage and their interaction were found significant. It might be due to conversion of starch and pectin into simple sugar. Comparable finding was observed in phalsa crush (Pangotra *et al*., 2019).

The data presented in the table 4 showed a decreasing trendin ascorbic acid contentof phalsa-guava blended squash. The data revealed a significant influence due to different treatments on ascorbic acid content of blended squash. At initial day of storage, the maximum ascorbic acid content of (8.74 mg 100 ml^{-1}) was recorded in T_6 and minimum (7.50 mg 100ml^{-1}) in treatment T_1 (100:0::phalsa:guava). The values of ascorbic acid decreased to 8.52mg 100ml^{-1} in T_6(50:50::phalsa:guava) and (7.22 mg 100g^{-1}) in T_1 after 90 days of storage. Overall mean highest ascorbic acid content (8.65 mg 100 ml^{-1})recorded in $T_6$and lowest (7.36 mg 100ml^{-1}) in treatment T_1. The mean values of storage period showed a decreasing trend from initial value of 8.24 to 7.93 mg 100ml^{-1} after 90 days of storage.It was probably due to the fact that ascorbic acid being sensitive to oxygen, light and heat was easily oxidized in presence of oxygen by both enzymatic and non-enzymatic catalyst. Comparable details for diminish in vitamin C content was observed by Ga janana (2002) in aonla juice and Basavaraja (2005)in rose apple aonla squash.

Data in table 4 showed that among the various treatments, T_1had maximum anthocyanin content of18.80mg 100 ml^{-1}; however, the lowest anthocyanin content of 17.46 mg 100 ml^{-1} was noticed in treatment T_6at initial month of storage (Table 4). After 3 months of storage, maximum mean anthocyanin content (17.84 mg 100 ml^{-1}) observed in T_1 (100:00::phalsa:guava) and minimum mean anthocyanin content of 16.74 mg 100 ml^{-1}in T_6 (50:50::phalsa:guava).

Anthocyanin content was significantly affected by storage period which followed the decreasing trend. The mean values of storage period showed a decreasing trend from initial value of 18.33 to 17.32 mg 100 ml^{-1} after 90 days of storage period. Loss of anthocyanins in squash might be due to their high susceptibility to auto oxidative degradation (hydrolysis) during storage. These findings are in agreement with the study in wild pomegranate squash by Thakur *et al*. (2018).

No sign of microbial count were observed in blended squash from initial to 3 months of storage were evaluated by total plate count method (Table 5). Pangotra *et al*.(2019) reported that phalsa crush did not observe any microbial growth during three months of storage. Mahnoori *et al*. (2020) also reported no microbial growth upto 2 months of storage in RTS beverage.

Overall acceptability score showed a decreasing trend during storage of blended squash (Fig. 1). At initial month of storage, blended squash treatment T_4

(70:30::phalsa:guava) found the maximum score of 7.90 which declined to 7.80 after two months of storage and 7.76 after three months of storage and was adjudged to have the best overall acceptability score. Whereas, T_1 (100:0::phalsa:guava) have the minimum score of 6.70 which further decreased to 6.52 and 6.34 after 2 and 3 months of storage, respectively. The overall acceptability scores of different treatments decreased during storage from the initial mean levels of 7.56-7.32. Treatments, storage and their interaction were found to be significant. There was a decrease in overall acceptability scores of squash during storage, which might be due to the loss in appearance, flavour compounds and uniformity of the product. The results were in conformity with the finding of Thakur *et al*. (2018) in pomegranate squash and Gupta and Kaul (2013) in ber chuhara.

On basis of the results revealed in the present study, it may be concluded that the evaluation of blended squash is possible to satisfy consumers' taste and preferences. The product was microbiologically safe during three months of storage with good acceptability. Among the various treatments, treatment T_4 (phalsa::guava::70:30) was found to be acceptable on the basis of overall acceptability. So this blended squash could be stored for three months.

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