

RESEARCH PAPER

DOI: 10.15740/HAS/IJPPHT/11.2/39-45

Studies on bioactive components retention in sugar based amla products

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■ **Research chronicle** : Received : 10.08.2020; Revised : 27.09.2020; Accepted : 25.11.2020

SUMMARY :

Amla fruit is known for its antioxidant activity (Vitamin C) and medicinal properties. Value added products make the fruit available throughout the year and helps to promote the use of amla among the public. Hence an attempt was made to standardized sweet based products viz., jam, squash and jelly with different treatments. The prepared amla products were standardized on the basis of sensory evaluation. The bio active components and sensory evaluation of amla products were analysed during storage period. The shelflife studies of amla jam, squash and jelly were also done at room temperature and it has more shelflife with high organoleptic scores.

KEY WORDS : Amla products, Bio active components, Sensory evaluation and Sugars

How to cite this paper : Sivakumar, K.P. and Nallakurumban, B. (2020). Studies on bioactive components retention in sugar based amla products. *Internat. J. Proc. & Post Harvest Technol.*, **11**(2) : 39-45. DOI: 10.15740/HAS/IJPPHT/11.2/39-45. Copyright@2020: Hind Agri-Horticultural Society.

Amla also known as Indian gooseberry (*Emblica officinalis*) is one of the useful fruit. It is consumed as a fresh fruit or in the form of food products like preserves. The amla is regarded as main ingredient in many ayurvedic preparations like chyvanprash and is regarded as rejuvenating herb. Amla is a rich source of vitamin C, which rank second next to Barbados cherry which has maximum vitamin C. It is found to possess anti-aging, expectorant, purgative, antibacterial, antioxidant, hypoglycemic activity (Rastogi and Mehrotra, 1993). Many different products have been reported from amla like ready – to-serve beverage, candy, jam, powder, Amla bar (Deka *et al.*, 2011). Amla berries

can be used as a valuable ingredient for the production of an herbal fermented beverage. The Indian gooseberry is native to India and also grows in tropical and subtropical regions. In addition of being an important medicinal herbs, it has potent antioxidant, several active tannoid principles (Emblicannin A, Emblicannin B, Punigluconin and Pedunculagin) have been identified which to account for its health benefits like antioxidant activity, antiaging property (Pater and Goyal, 2012). The Amla fruit, because of its high acidity and astringent taste is not preferred for direct consumption; hence, it is consumed mainly after processing, as processed product. Present study was done to prepare preserved product utilizing bioactive rich

Sr. No.	Bioactive components	Method adopted	Reference
1.	Moisture	Hot air oven	AOAC (2015)
2.	Titration acidity	Titration against 0.01 N NaOH using phenolphthalein	Ranganna (2012)
3.	pH	pH meter	Hart and Fisher (2015)
4.	TSS	Hand refractometer	Saini <i>et al.</i> (2001)
5.	Reducing sugar and total sugars	Shaffer somogyi micro method	McDonlad and Foley (1960)
6.	Vitamin – C	2,6 dichlorophenol indophenol visual titration	Sadasivam and Manickam (1996)

underutilized fruit amla.

EXPERIMENTAL METHODS

Selection of amla fruit:

Fully matured and fresh amla fruit (Kanchan Var.) were procured from the local market of Madurai city, Tamil Nadu, India.

Standardization of amla jam:

The selected fresh amla fruits were washed in clean water, surface dried, cut into small pieces, pulped in mixer, passed through hand pulper and strained using muslin cloth and used for the preparation of amla jam. The amla jam was standardized with addition of different level (0.1, 0.2 and 0.3 %) of pectin contents and without pectin. Among the jam prepared with and without addition of pectin, the jam prepared with 0.1% of pectin was found to be best. The product was standardized on sensory evaluation in terms of acceptability with special reference to colour and appearance, flavour, texture taste and overall acceptability.

Standardization of amla squash :

Amla squash was standardized as per the FPO specification with addition of mint extract (1, 1.5 and 2%), honey (10, 15 and 20%) and date syrup (10, 15 and 20). The prepared amla squash samples were poured in to a sterilized bottle (cap.680 ml) leaving one inch head space and capped air tightly. The prepared amla squash was organoleptically evaluated using a 9 point hedonic scale by panel of 20 semi trained judges of Department of Food Science and Nutrition, Home Science College and Research Institute, Madurai.

Amal jelly :

The amla jelly were tried with different proportions (50: 50, 65: 35 and 75: 25) of amla and guava extract and amla and jack fruit rind at different levels (0.75, 1.0 and

1.5%) of commercial pectin and agar at 2,3 and 4 per cent level also. Among the above, the amla jelly was set at 1.5% level of pectin and 4% of agar. The prepared amla jelly was packed in air tight plastic jar and glass bottle. Amla, jelly samples were organoleptically evaluated using a 9 point hedonic scale by panel of 20 semi trained judges.

Bioactive components analysis:

The methods adopted to analysis the various bioactive components of the amla products before and during storage at regular intervals are given below.

Storage study:

The storage study of prepared products was analysis by noting the changes in the bioactive components and sensory evaluation at regular intervals before and during storage.

Statistical analysis:

The data obtained were subjected to statistical analysis to find out the impact of storage period and packaging materials on the quality of amla products during storage. Factorial Completely Randomized Design (FCRD) was applied for the analysis (Rangaswamy, 1995).

EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Shelf-life studies of amla products during storage period:

Amla jam :

Amla jam was packed in glass bottle and stored at room temperature. The storage behaviour of the jam was

recorded by noting the changes in the chemical composition at regular interval of once in 30 days.

Table 1 summaries the changes observed in the moisture content of amla jam during storage. The freshly prepared amla jam contained 24.94 g per cent which had changed to 24.00 g per cent at the end of nine months of storage period. Amla jam exhibited a gradual increase in acidity during storage. Initially, the sample had 1.05 g per cent and it was increased to 1.95 g per cent after nine months of storage. The minimum changes were observed in total soluble solids and total sugar. At the end of the storage period the TSS and total sugar were 67.62°Bx and 52.23 g per cent, respectively. Similar parameters changes were also observed by Sudhagar and Manimegalai (2001).

The notable changes were exhibited (13.43 to 13.92%) in reducing sugar content of amla jam. The conversion of total sugar to simple sugar during storage might have increased the reducing sugar level in the stored samples. The straw berry fruit jam has increase trend was noted during storage period Saravanakumar and Manimegalai (1999). The vitamin C and tannin content of amla jam is presented in Table 5. There was a gradual reduction in vitamin C and tannin during storage. Initially 388.13 mg/100g and 0.96 mg/100g in vitamin C and tannin content respectively. After nine months of storage, the amla jam contained 387.42 mg/100g in vitamin C and 0.82 mg/100g in tannin, respectively.

Amla squash :

Data on the changes in chemical composition of amla squash during the storage is given in Table 2 and 3. The freshly prepared amla squash had 1.04g / 100 ml of acidity in control (T₁), 1.06, 1.04 and 1.01 g of acidity in 100 ml of amla squash treated with 1, 1.5 and 2% of mint extract (T₂), 1.04, 1.03 and 1.01g / 100 ml of acidity treated with 10, 15 and 20% of honey (T₃) and 1.05, 1.03 and 1.02 g of acidity in 100 ml of the amla squash treated with 10, 15 and 20% of date syrup (T₄). A slight variation was observed between the treatments during storage period. A gradual increase of acid content was observed during storage. After nine month of storage, the acidity was increased to 1.24 g per cent in control (T₁) 1.20, 1.19 and 1.21 g / 100 ml of acidity in amla squash treated with 1, 1.5 and 2% of mint extract (T₂), 1.21, 1.20 and 1.19 g per cent acid content treated with honey (T₃) and 1.20, 1.20 and 1.21 g / 100 ml of acidity treated with 10, 15 and 20% of date syrup (T₄), respectively. Saravanakumar and Manimegalai (1999) reported that the strawberry squash showed an increasing trend in acid content from 1.20 to 1.43 per cent during storage period. The patharnakh pear juice had 0.44 per cent acid content after 3 month of storage (Saini and Grewal, 2000). Similar trend was noted in the present study during storage.

Table 3 summarizes the changes noted in the vitamin C content of the amla squashes during the study period. A slight variation was observed between the squashes throughout the storage period. The initial vitamin C

Table 1 : Changes in bioactive components of amla jam during storage period

Storage period (in months)	Chemical characteristics					
	Moisture (%)	Acidity (%)	TSS (°Bx)	Total sugar (%)	Reducing sugar (%)	Vitamin C (mg/100g)
Initial	24.94	1.05	68.10	52.76	13.43	388.13
1	24.94	1.06	68.10	52.71	13.51	388.13
2	24.81	1.06	68.10	52.54	13.63	388.13
3	24.70	1.19	68.02	52.47	13.64	388.04
4	24.54	1.32	67.94	52.41	13.67	387.93
5	24.39	1.53	67.94	52.33	13.73	387.88
6	24.26	1.70	67.88	52.30	13.80	387.81
7	24.12	1.82	67.80	52.30	13.82	387.68
8	24.03	1.88	67.70	52.25	13.85	387.50
9	24.00	1.95	67.62	52.23	13.92	387.42
	Moisture	Acidity	TSS	Total sugar	Reducing sugar	Vitamin C
S.E.±	0.0077	0.0081	0.0322	0.0100	0.0161	0.0351
C.D. (P=0.01)	0.0246 **	0.0256**	0.1022 **	0.0317 **	0.0511 **	0.1112**

content of amla squashes were 535.16 mg /100 ml in control (T₁) which had decreased to 528.08 mg/100ml after nine month of storage. Amla squash treated with mint extract samples (T₂) initially had 537.12, 537.20 and 537.21 mg/100 ml which had changed to 533.18, 532.94 and 532.68 mg per cent in 1, 1.5 and 2%, respectively

after nine month of storage at room temperature. Similarly the vitamin C content was 534.72, 534.86 and 535.13 mg/100ml in 10, 15 and 20% at initially. After nine month of storage, it was (honey treated amla squash) decreased to 532.15, 532.89 and 531.44 mg/100 ml in 10, 15 and 20%, respectively. Likewise date syrup treated amla

Table 2 : Changes in bioactive components of Amla squash during storage period

Treatments	Percentage levels	Acidity (g/100ml)					pH					Tannin (mg/100ml)				
		Storage period (in month)					Storage period (in month)					Storage period (in month)				
		Initial	1	3	6	9	Initial	1	3	6	9	Initial	1	3	6	9
Control (T ₁)	-	1.04	1.05	1.10	1.17	1.24	3.38	3.37	3.34	3.29	3.20	3.85	3.82	3.75	3.65	3.40
Amla +	1%	1.06	1.08	1.12	1.17	1.20	3.41	3.40	3.37	3.33	3.25	3.69	3.68	3.60	3.51	3.29
Mint extract (T ₂)	1.5%	1.04	1.06	1.10	1.15	1.19	3.46	3.44	3.43	3.36	3.27	3.68	3.66	3.55	3.46	3.23
	2%	1.01	1.05	1.09	1.14	1.21	3.47	3.46	3.44	3.37	3.24	3.69	3.66	3.59	3.45	3.23
Amla +	10%	1.04	1.08	1.10	1.16	1.21	3.50	3.48	3.46	3.41	3.27	3.72	3.70	3.61	3.47	3.25
Honey (T ₃)	15%	1.03	1.05	1.10	1.17	1.20	3.52	3.52	3.49	3.40	3.26	3.71	3.68	3.61	3.48	3.26
	20%	1.01	1.03	1.06	1.12	1.19	3.55	3.54	3.51	3.40	3.25	3.74	3.70	3.65	3.51	3.24
Amla +	10%	1.05	1.05	1.10	1.16	1.20	3.51	3.50	3.47	3.37	3.25	3.61	3.59	3.53	3.45	3.28
Date syrup (T ₄)	15%	1.03	1.08	1.10	1.15	1.20	3.52	3.50	3.47	3.40	3.24	3.65	3.62	3.53	3.41	3.23
	20%	1.02	1.03	1.09	1.14	1.21	3.57	3.55	3.53	3.40	3.25	3.69	3.64	3.55	3.40	3.18
		Acidity			pH			Tannin								
		S.E.±	C.D. (P=0.01)			S.E.±	C.D.(P=0.01)			S.E.±	C.D.(P=0.01)					
t		0.01451	0.03887 **			t	0.00767			t	0.00477			0.01280 **		
s		0.01026	0.02748 **			s	0.00542			s	0.00338			0.00905 **		
ts		0.03243	0.08691 NS			ts	0.01715			ts	0.01068			0.02861 **		

Table 3 : Changes in bioactive components of Amla squash during storage period

Treatments	Percentage levels	Total sugar (g/100ml)					Reducing sugar (g/100ml)					Vitamin C (mg/100ml)				
		Storage period (in month)					Storage period (in month)					Storage period (in month)				
		Initial	1	3	6	9	Initial	1	3	6	9	Initial	1	3	6	9
Control (T ₁)	-	41.04	41.00	40.88	40.35	40.02	2.93	2.99	3.27	3.66	3.96	535.16	535.10	534.82	533.45	528.08
Amla +	1%	40.95	40.93	40.80	40.52	40.30	2.80	2.85	2.99	3.42	3.81	537.12	537.03	536.81	535.64	533.18
Mint extract (T ₂)	1.5%	40.91	40.87	40.71	40.56	40.28	2.76	2.81	2.97	3.32	3.79	537.20	537.15	536.88	535.11	532.94
	2%	40.90	40.87	40.75	40.58	40.26	2.71	2.80	2.94	3.27	3.77	537.21	537.11	536.84	535.05	532.68
Amla +	10%	40.70	40.64	40.58	40.38	40.22	2.92	2.97	3.19	3.54	3.92	534.72	534.58	534.31	533.79	532.15
Honey (T ₃)	15%	40.74	40.66	40.41	40.22	40.10	2.95	3.01	3.22	3.58	3.95	534.86	534.80	534.54	533.22	532.89
	20%	40.80	40.70	40.52	40.31	40.12	2.97	3.05	3.23	3.60	3.95	535.13	535.08	534.85	533.85	531.44
Amla +	10%	40.72	40.70	40.53	40.30	40.10	3.05	3.10	3.25	3.64	3.99	534.33	534.25	533.99	532.66	530.69
Date syrup (T ₄)	15%	40.75	40.66	40.54	40.32	40.13	3.09	3.19	3.38	3.72	4.05	534.55	534.43	534.17	533.33	531.48
	20%	40.85	40.80	40.62	40.34	40.12	3.15	3.21	3.50	3.81	4.18	535.20	535.09	534.79	533.59	531.77
		Total sugar			Reducing sugar			Vitamin C								
		S.E.±	C.D. (P=0.01)			S.E.±	C.D.(P=0.01)			S.E.±	C.D. (P=0.01)					
t		0.00687	0.1841 **			t	0.80706			t	32.91136			88.19215 NS		
s		0.00486	0.1302 **			s	0.57068			s	23.27184			62.36127 NS		
ts		0.01536	0.04117 **			ts	1.80465			ts	73.59203			197.20364 NS		

NS= Non-significant

squash contained 534.33, 534.55 and 535.20 mg/ 100 ml in 10, 15 and 20% in freshly prepared samples at room temperature. After nine month of storage, it was decreased to 530.69, 531.48 and 531.77 mg of vitamin C per 100 ml in 10, 15 and 20% of date syrup treated samples. The vitamin C content of the stored sample showed a very slight difference between treatments throughout the study period. The vitamin C content of the mango squash was 2.10, 2.08 and 2.05mg/100ml in

T₁, T₂ and T₃ during storage (Sivakumar and Malathi, 2004).

Total sugar and tannin content of amla squashes were decreased during storage period. Total sugar was 40.02 g per cent in control (T₁) 40.30, 40.28 and 40.26 in amla squash treated with 1, 1.5 and 2% mint extract (T₂), 40.22, 40.10 and 40.12 g per cent in amla squash treated with 10, 15 and 20% honey (T₃) and 40.10, 40.13 and 40.12 g per cent in amla squash treated with 10, 15 and

Table 4 : Changes in bioactive components of Amla jelly during storage period

Storage period (in month)	Moisture (%)				Acidity (g/100g)				Tannin (mg/100g)			
	Pectin		Agar		Pectin		Agar		Pectin		Agar	
	Glass bottle (PC ₁)	Plastic jar (PC ₂)	Glass bottle (AC ₁)	Plastic jar (AC ₂)	Glass bottle (PC ₁)	Plastic jar (PC ₂)	Glass bottle (AC ₁)	Plastic jar (AC ₂)	Glass bottle (PC ₁)	Plastic jar (PC ₂)	Glass bottle (AC ₁)	Plastic jar (AC ₂)
Initial	20.10	20.10	20.92	20.92	1.02	1.02	1.03	1.03	0.92	0.92	0.94	0.94
1	20.09	20.10	20.90	20.92	1.03	1.04	1.05	1.06	0.91	0.91	0.93	0.92
2	19.98	20.00	20.82	20.85	1.05	1.07	1.07	1.09	0.89	0.89	0.91	0.90
3	19.90	19.96	20.68	20.73	1.08	1.09	1.10	1.11	0.89	0.88	0.90	0.89
4	19.77	19.81	20.56	20.64	1.12	1.13	1.12	1.14	0.87	0.86	0.90	0.88
5	19.55	19.66	20.39	20.29	1.12	1.14	1.13	1.16	0.85	0.84	0.88	0.87
6	19.27	19.40	20.22	20.15	1.14	1.17	1.14	1.18	0.85	0.82	0.86	0.84
	Moisture				Acidity				Tannin			
	S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)				
t	1.20000	3.31641	NS	t	0.00598	0.01652	**	t	0.00443	0.01225	**	
s	0.90712	2.50697	NS	s	0.00452	0.01248	**	s	0.00335	0.00926	**	
ts	2.40001	6.63283	NS	ts	0.01195	0.03303	NS	ts	0.00886	0.02450	NS	

NS= Non-significance

Table 5 : Changes in bioactive components of Amla jelly during storage period

Storage period (in month)	Total sugar(g/100g)				Reducing sugar (g/100g)				Vitamin C (mg/100g)			
	Pectin		Agar		Pectin		Agar		Pectin		Agar	
	Glass bottle (PC ₁)	Plastic jar (PC ₂)	Glass bottle (AC ₁)	Plastic jar (AC ₂)	Glass bottle (PC ₁)	Plastic jar (PC ₂)	Glass bottle (AC ₁)	Plastic jar (AC ₂)	Glass bottle (PC ₁)	Plastic jar (PC ₂)	Glass bottle (AC ₁)	Plastic jar (AC ₂)
Initial	51.75	51.75	51.84	51.84	9.42	9.42	9.48	9.48	302.12	302.12	310.44	310.44
1	51.64	51.68	51.76	51.79	9.57	9.60	9.55	9.58	302.05	302.00	310.31	310.28
2	51.57	51.60	51.68	51.71	9.72	9.77	9.62	9.71	301.22	301.08	309.87	309.33
3	51.45	51.49	51.55	51.60	9.72	9.81	9.70	9.80	300.86	300.73	308.82	308.43
4	51.30	51.33	51.43	51.50	9.79	9.86	9.84	9.88	300.05	299.44	307.98	307.27
5	51.20	51.16	51.37	51.31	9.88	9.90	9.86	9.90	291.43	283.61	300.11	297.36
6	51.08	51.00	51.22	51.17	9.98	10.02	9.96	9.99	280.17	268.84	292.24	273.53
	Total sugar				Reducing sugar				Vitamin C			
	S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)				
t	341.84851	944.75711	NS	t	62.31062	172.20612	NS	t	1997.97489	5521.74702	NS	
s	258.41318	714.16925	NS	s	47.10240	130.17559	NS	s	1510.32706	4174.04840	NS	
ts	683.69702	1889.51422	NS	ts	124.62125	344.41223	NS	ts	3995.94979	11043.49404	NS	

NS=Non-significant

20% of date syrup (T_4) at end of the storage. The same result was observed from Sudhagar and Manimegalai (2001) reported that the total sugar content was decreased in pear squash (35.05 to 34.52%) and pear and pineapple blended squash (35.19 to 34.06%) during the storage period (6 months). Likewise the tannin content of amla squash was 3.40 mg/100 ml in T_1 , 3.29, 3.23 and 3.23 mg/100 ml in amla squash treated with 1, 1.5 and 2% of mint extract (T_2), 3.25, 3.26 and 3.24 mg/100 ml in amla squash treated with 10, 15 and 20% honey (T_3) and 3.28, 3.23 and 3.18 mg/100 ml in amla squash treated with 10, 15 and 20% of date syrup (T_4) at end of the storage. Seshadri *et al.* (1994) revealed that tannin content decreased after storing for 60 days. The statistical examination of the data concluded that there was a significant difference in the bio active components between treatments and storage period.

Amla jelly :

The changes observed in the chemical composition of amla jelly packed in glass bottles (PC_1) and plastic container (PC_2) is given in Table 4 and 5.

Initially moisture content of pectin and agar added samples had 20.10 and 20.92/100g. A very slight variation was observed between the samples in both packaging materials throughout the storage period. After six month of storage the samples in PC_1 , PC_2 , AC_1 and AC_2 contained 19.27, 19.40, 20.22 and 20.15 per cent, respectively. The moisture content of the mango jelly was decreased in T_1 , T_2 and T_3 during storage (Sivakumar and Malathi, 2004).

A gradual increase in acidity was noted was in the acid content of the amla jelly packed in both materials. The freshly prepared amla jelly was 1.03 g per cent acidity in pectin and agar added samples which had changed 1.14 in PC_1 , 1.17 in PC_2 , 1.14 in AC_1 and 1.18 in AC_2 after six month of storage. A decreasing trend may observed in tannin and vitamin C content of amla jelly was seen during the storage period. After six month of

storage, the tannin content was 0.85 and 0.82 mg/100mg in PC_1 and PC_2 , 0.86 mg/100mg and 0.84 mg/100mg in AC_1 and AC_2 , respectively. Similarly the vitamin C was 280.17 mg/100g in PC_1 , 268.84 mg/100g in PC_2 , 292.24 mg/100g in AC_1 and 273.53 mg/100g in AC_2 at the end of the storage period. Seshadri *et al.* (1994) revealed that similar result after storing for 60 days in pineapple fruit jelly. The freshly prepared amla jelly had 65°brix TSS, which had been maintained upto four months in the samples packed in both packaging materials. There was an increasing in the TSS, after fourth month to sixth month storage and the final values noted were 65.30°brix, 66.00°brix, 65.20°brix and 65.80°brix in PC_1 , PC_2 , AC_1 and AC_2 , respectively.

Organoleptic characteristics of amla products:

The amla products were stored at room temperature (nine months) and their organoleptic characteristics *viz.*, colour, appearance, texture, taste and overall acceptability were also evaluated using a 9 point hedonic scale as per the procedure given by watts *et al.* (2009).

Neither the storage period nor the packaging materials had influenced the organoleptic evaluation score of the amla jam. Initially the amla jam had strong organoleptic scores at the end of the storage period, slight changes were observed. The score value were 8.4 (colour), 8.3 (appearance), 8.4 (texture), 8.3 (taste and overall acceptability), at the end of the storage (Table 6). Similarly The amla jelly and squashes were evaluated using a nine point hedonic scale to assess the colour and appearance, flavour, taste, texture overall acceptability with a panel of twenty semi (trained judges) and it was highly acceptable at the end of the storage period.

Conclusion:

It can be concluded that sweet based amla products such as jam, squash and jelly are highly nutritious and medicinal properties because of the amla squash can be prepared with substitute of date syrup and mint extract.

Table 6 : Organoleptic evaluation of amla jam during storage

Storage period (in days)	Organoleptic characteristics				
	Colour	Appearance	Texture	Taste	Overall acceptable
Initial	8.7	8.5	8.6	8.5	8.5
90	8.6	8.5	8.5	8.5	8.5
180	8.5	8.4	8.4	8.4	8.4
270	8.4	8.3	8.4	8.3	8.3

The shelf-life of amla products were found to be highly acceptable at ambient conditions.

Acknowledgment:

We acknowledge the National Medicinal Plants Board (NMPB), Ministry of Health and Family Welfare, Government of India, New Delhi for technical and financial support of this study.

LITERATURE CITED

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