The Asian Journal of Horticulture, **Vol. 3 No. 2 : 203-207 (December-2008)**

Standardization of recipe and storage behaviour of lime blended amla squash

A. HARSHAVARDHAN REDDY **AND** V. CHIKKASUBBANNA

Accepted : ***April, 2008***

See end of the article for authors' affiliations

Correspondence to:

A. HARSHAVARDHAN REDDY
Division of Horticulture, University of Agricultural Science, G.K.V.K., BANGALORE (KARNATAKA) INDIA

ABSTRACT

Lime blended Amla squash with 25 per cent juice containing amla pulp and lime juice in the ratio of 1:3,1:1 and 3:1 and 40, 45 and 50^{0}brix T.S.S was prepared and subjected to physico-chemical analysis at 0, 30, 60 and 90 days of storage and organoleptic rating at 90 days of storage. An increasing trend in pH, total soluble solids and total sugars, reducing sugars and decreasing trend in acidity, crude protein, fibre, tannins, non-reducing sugars and ascorbic acid was noticed during storage period of 90 days. Squash prepared with 25 per cent pulp (amla pulp and lime juice in the ratio of 1:3), 40^{0}B total soluble solids was found to be the best recipe for organoleptic qualities like appearance, aroma and flavour, taste and overall acceptability.

Key words : Recipe, Storage behaviour, Lime blended, Amla squash, Organoleptic raling.

The Amla ('Aonla') *(Phyllanthus emblica* or *Emblica officinalis* Gaertn), also known as Indian Gooseberry is a minor sub-tropical deciduous tree belonging to the family Euphorbiaceae. It is used for various ailments in the Indian system of medicine. It possesses pronounced expectorant, antiviral, cardiotonic, hypoglycemic and antioxidant activities (Kalra, 1988). Amla fruit contains 89 to 94% pulp, 0.8 to 2% fibre, 10 to 14% total soluble solids, 1.4 to 2.4% acidity, 700 to 900 mg vitamin C /100g pulp, 2.4 to 3.1% pectin and 2 to 3% phenols (Singh *et al*., 1993). Fruit of amla is not consumed in fresh form because of its astringency and fruits during their peak harvesting season go as a waste due to limited usage. However, it has the potentiality of becoming a popular fruit if suitably processed into value added products which have great importance in alleviating malnutrition among rural population in addition to several health benefits. The present study was carried out to develop value-added squash blended with lime from amla fruits to minimize losses due to improper handling and unmarketability of fruits.

MATERIALS AND METHODS

Well matured amla fruits of uniform size and free from bruises were collected from forest localities of Karnataka. The collected fruits were washed thoroughly with clean water and boiled for five minutes with equal amount of water for easy separation of seed and pulp (Singh and Kumar, 1995). The pulp is then fed into a warring blender for mashing into fine texture using the same boiled water. Thus extracted pulp was used for preparation of lime blended squash with the following ingredients.

The prepared squash was filled into the pre-sterilized bottles of 200 ml capacity and sealed air tight using crown caps with the help of crown corking machine. Then the product was processed in boiling water for 25 minutes, cooled immediately and stored at room temperature for further observations. Stored squash was analyzed for physico-chemical parameters at 0, 30, 60 and 90 days of storage.

Recipes for lime blended squash

Recipe No.	Pulp / juice content (25%)		TSS (^{0}Brix)	Acidity (%)
	Amla Pulp	Lime juice		
1.	25	75	40	1.4
2.	25	75	45	1.4
3.	25	75	50	1.4
4.	50	50	40	1.1
5.	50	50	45	1.1
6.	50	50	50	1.1
7.	75	25	40	1.0
8.	75	25	45	1.0
9.	75	25	50	1.0

The pH was measured using Toshniwal digital pH meter (Model DI 707). Total soluble solids content was recorded using Erma-hand refractometer. Titrable acidity (as citric acid) and ascorbic acid were estimated by methods suggested by Ranganna (1977). Total and reducing sugars were estimated by Shaffer-Somogyi method (Somogyi, 1945). Crude protein was calculated by multiplying per cent nitrogen content with the factor 6.25. Per cent nitrogen content was determined by Micro-

Kjeldhal method described by (A.O.A.C., 1970). Crude fibre was expressed as grams per 100 g of sample (A.O.A.C., 1970). Tannin content was calculated by comparing the absorbance to that of standard curve (Ranganna, 1977).

Lime blended amla squash was evaluated at 90 days of storage for sensory attributes such as appearance, aroma and flavour, taste and overall acceptability by a panel of 10 judges by numerical scoring method (Amerine *et al.*, 1965).

In this experiment, factorial completely randomized design (factorial CRD) was adopted. Observations on various parameters were recorded with three replications. The data was analyzed and main interaction effects were presented (Sundararaj *et al.*, 1972).

RESULTS AND DISCUSSION

The pH of squash indicated an increasing trend during three months storage period (Table 1). A corresponding decrease in acidity due to chemical reactions taking place between organic acids and pigments could be responsible for change in pH (Kannan and Thirumaran, 2001). Analogous observations were recorded by Gajanana (2002) in amla juice and Thakur and Barwal (1998) in squash from kiwi fruit.

A slight increase in total soluble solids content of stored amla squash was noticed. This might be due to increase in soluble solids content and total soluble sugars caused by hydrolysis of polysaccharides like starch, cellulose and pectin substances into simpler substances. This indicates that during storage there was change in pulp composition. Similar results were observed in squash prepared from lemon, jack, bael and orange (Bhatia *et al*., 1956 and Jain *et al*., 1984).

Acidity of amla squash witnessed a decreasing trend during storage period. This might be attributed to hydrolysis of polysaccharides and non-reducing sugars where acid is utilized for converting them to hexose sugars (reducing sugars) or complexing in the presence of metal ions. The declining trend might also be due to chemical

Table 1 : Changes in pH, TSS, acidity and ascorbic acid content of lime blended amla squash during storage

Factors	pH				TSS (^{0}Brix)				Acidity (%)				Ascorbic acid (mg/100g)			
	Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days
Pulp (25%)																
Amla : Lime																
25:75 (AL_1)	2.64	2.71	2.79	2.84	45.00	45.53	46.31	47.07	1.47	1.42	1.35	1.29	41.70	32.34	29.00	26.96
50:50 (AL_2)	2.53	2.63	2.70	2.76	45.00	45.58	46.40	47.14	1.17	1.12	1.06	1.02	51.90	43.31	38.66	33.30
75:25 (AL_3)	2.41	2.49	2.56	2.64	45.00	45.55	46.33	47.22	1.01	0.97	0.95	0.94	63.41	49.65	46.69	42.00
F test	*	*	*	*	-	NS	NS	NS	*	*	*	*	*	*	*	*
S.E.±	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	0.00	0.54	0.61	0.56	0.59
C.D. (P=0.05)	0.02	0.02	0.01	0.01	-	-	-	-	0.00	0.01	0.00	0.00	1.62	1.80	1.68	1.76
TSS (^{0}Brix)																
40(T_1)	2.54	2.62	2.69	2.74	40.00	40.53	41.36	42.23	1.21	1.17	1.23	1.09	52.46	40.29	37.16	32.34
45 (T_2)	2.53	2.62	2.69	2.75	45.00	45.47	46.22	46.97	1.21	1.17	1.23	1.08	51.90	42.42	38.11	33.78
50(T_3)	2.52	2.60	2.68	2.75	50.00	50.66	51.45	52.23	1.22	1.17	1.23	1.08	52.64	42.60	39.09	36.14
F test	NS	NS	NS	NS	-	*	*	*	NS	NS	NS	NS	NS	*	*	*
S.E.±	-	-	-	-	-	0.04	0.04	0.04	-	-	-	-	-	0.61	0.56	0.59
C.D. (P=0.05)	-	-	-	-	-	0.12	0.14	0.12	-	-	-	-	-	1.83	1.68	1.76
Interaction																
AL_1T_1	2.66	2.75	2.81	2.86	40.00	40.50	41.20	42.16	1.46	1.41	1.34	1.28	42.81	30.86	28.63	25.29
AL_1T_2	2.64	2.72	2.78	2.84	45.00	45.43	46.26	46.86	1.47	1.43	1.35	1.29	40.58	34.75	29.19	26.40
AL_1T_3	2.64	2.71	2.77	2.85	50.00	50.36	51.36	52.04	1.48	1.42	1.36	1.29	41.70	31.41	29.19	29.19
AL_2T_1	2.54	2.64	2.70	2.76	40.00	40.36	41.54	42.23	1.17	1.12	1.07	1.04	52.27	41.90	36.81	31.24
AL_2T_2	2.54	2.64	2.71	2.76	45.00	45.30	46.43	46.96	1.17	1.11	1.06	1.02	51.16	44.58	40.15	32.91
AL_2T_3	2.53	2.63	2.71	2.77	50.00	50.70	51.46	52.23	1.16	1.12	1.06	1.01	52.27	43.47	39.04	35.75
AL_3T_1	2.42	2.50	2.57	2.64	40.00	40.43	41.30	42.03	1.01	0.96	0.95	0.94	62.29	48.10	46.05	40.48
AL_3T_2	2.43	2.50	2.58	2.65	45.00	45.50	46.16	47.90	1.01	0.97	0.95	0.94	63.16	47.93	44.99	42.03
AL_3T_3	2.39	2.46	2.55	2.65	50.00	50.63	51.53	52.26	1.00	0.97	0.94	0.93	63.96	52.94	49.04	43.49
F test	*	*	*	*	-	*	*	*	*	*	*	*	*	*	*	*
S.E.±	0.01	0.01	0.00	0.00	-	0.07	0.08	0.07	0.00	0.00	0.00	0.00	0.94	1.07	0.98	1.02
C.D. (P=0.05)	0.03	0.03	0.02	0.02	-	0.23	0.25	0.21	0.01	0.01	0.01	0.01	0.81	3.18	2.91	3.05

* indicates significance of value at P=0.05 NS : Non significant

interaction between the chemical constituents of juice induced by temperature influencing enzymatic action (Palaniswamy and Muthukrishnan, 1974). Bhatia *et al.* (1956) reported that degree of reduction in acidity is depending on concentration of sugar and is a general phenomenon during storage of beverages in the presence of sugars. Reduction in acidity during storage was noticed by Awan *et al*. (1980) in lemon squash and Jasim Ahmed (1996) in watermelon squash.

Ascorbic acid content reduced considerably during storage period. The decline in ascorbic acid concentration could be due to thermal degradation during processing and subsequent oxidation in storage as it is very sensitive to heat and pressure treatment, oxidation and light (Brock *et al*., 1998). Both ascorbic acid and dehydroascorbic acid are highly volatile and unstable forms of vitamin-C. Ascorbic acid content of the squash was dependent on level of pulp used. Hence, throughout the storage period in spite of degradation of ascorbic acid, higher concentration of ascorbic acid was found in the recipes with maximum pulp content. Similar trend of declining in ascorbic acid content of stored products was noticed by Roy and Singh (1979a) in bael fruit squash.

Total sugar content of amla squash increased slightly during storage period (Table 2). This could be attributed to the fact that, the hydrolysis of polysaccharides during storage resulted in increase of soluble sugars. Total sugars of squash were dependent on the total soluble solids as anticipated. There was considerable rise in reducing sugars and corresponding decline in non-reducing sugars. This could be due to inversion of non-reducing sugars to reducing sugars caused by acids present in squash. Enzymes (invertases) could also contribute to this inversion to a little extent. The rate of inversion was rapid initially, which may be due to availability of more substrate for inversion at initial stages.

Increase in reducing and total sugars and decrease in non-reducing sugars during storage is a general phenomenon as noticed by Roy and Singh (1979a) in bael squash and Awan *et al.* (1980) in orange, lemon and bael

Table 2 : Changes in sugars and crude protein content of lime blended amla squash during storage

Factors	Total sugars (%)				Reducing sugars (%)				Non-reducing sugars (%)				Crude protein (%)			
	Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days
Pulp (25%)																
Amla : Lime																
25:75 (AL_1)	37.70	37.80	37.94	38.02	8.52	21.16	27.61	32.12	29.17	16.63	10.30	5.90	0.20	0.20	0.20	0.19
50:50 (AL_2)	37.68	37.85	37.95	38.04	8.61	21.89	28.41	32.37	29.06	15.93	9.42	5.67	0.26	0.25	0.25	0.25
75:25 (AL_3)	38.06	38.13	38.24	38.37	8.79	22.55	29.19	32.86	29.26	15.57	9.05	5.50	0.31	0.31	0.31	0.31
F test	NS	NS	NS	NS	NS	*	*	*	NS	*	*	NS	*	*	*	*
S.E. ±	-	-	-	-	-	0.12	0.10	0.13	-	0.13	0.13	-	0.00	0.00	0.00	0.00
C.D. (P=0.05)	-	-	-	-	-	0.37	0.30	0.39	-	0.38	0.40	-	0.00	0.00	0.00	0.00
TSS (^{0}Brix)																
40(T_1)	33.05	33.11	33.32	33.46	6.97	20.14	26.37	29.23	26.07	12.97	6.86	4.23	0.25	0.25	0.25	0.25
45 (T_2)	38.26	38.44	38.52	38.56	9.12	22.15	28.49	33.18	29.14	16.28	9.97	5.38	0.26	0.25	0.25	0.25
50(T_3)	42.13	42.23	42.30	42.41	9.84	23.31	30.35	34.95	32.29	18.89	11.95	7.46	0.25	0.25	0.25	0.25
F test	*	*	*	*	*	*	*	*	*	*	*	*	NS	NS	NS	NS
S.E. ±	0.15	0.11	0.12	0.12	0.15	0.12	0.10	0.13	0.10	0.13	0.13	0.13	-	-	-	-
C.D. (P=0.05)	0.47	0.34	0.36	0.26	0.45	0.37	0.30	0.39	0.32	0.38	0.40	0.39	-	-	-	-
Interaction																
AL_1T_1	32.42	32.53	32.86	32.93	6.29	19.32	25.17	28.94	26.13	13.21	7.89	3.98	0.20	0.20	0.19	0.19
AL_1T_2	38.41	38.54	38.63	38.74	8.18	21.56	27.90	32.55	30.23	16.98	10.72	6.19	0.20	0.20	0.20	0.19
AL_1T_3	42.28	42.33	42.34	42.40	9.71	22.61	29.78	34.68	32.57	19.71	12.55	7.72	0.19	0.19	0.19	0.18
AL_2T_1	33.58	33.59	33.71	33.82	6.90	20.16	26.89	29.13	26.68	13.43	6.64	4.69	0.25	0.25	0.24	0.24
AL_2T_2	37.57	37.94	38.04	38.05	9.12	22.02	28.24	33.07	28.45	15.92	9.64	4.98	0.26	0.25	0.25	0.25
AL_2T_3	41.89	42.02	42.11	42.25	9.82	23.49	30.12	34.90	32.06	18.46	11.99	7.35	0.26	0.25	0.25	0.25
AL_3T_1	33.15	33.21	33.38	33.62	7.13	20.94	27.07	29.60	26.05	12.27	6.31	4.01	0.30	0.30	0.30	0.29
AL_3T_2	38.79	38.84	38.89	38.90	9.25	22.89	29.34	33.91	29.54	15.95	9.54	4.98	0.31	0.31	0.30	0.30
AL_3T_3	42.13	42.34	42.47	42.58	9.98	23.84	31.16	35.38	32.24	18.50	11.31	7.20	0.30	0.29	0.29	0.29
F test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
S.E. ±	0.27	0.20	0.21	0.21	0.26	0.21	0.17	0.23	0.18	0.22	0.23	0.23	0.00	0.00	0.00	0.00
C.D. (P=0.05)	0.81	0.59	0.63	0.63	0.79	0.65	0.53	0.68	0.56	0.67	0.78	0.68	0.00	0.00	0.00	0.00

* indicates significance of value at P=0.05 NS : Non significant

Table 3: Changes in crude fibre and tannins content of lime blended amla squash

Factors		Crude fibre(%)				Tannins(%)			
		Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days
Pulp (25%)									
Amla : Lime									
25:75	(AL_1)	0.43	0.43	0.43	0.43	0.35	0.30	0.26	0.21
50:50	(AL_2)	0.55	0.55	0.54	0.54	0.44	0.38	0.32	0.26
75:25	(AL_3)	0.67	0.67	0.66	0.66	0.54	0.47	0.40	0.33
F test		*	*	*	*	*	*	*	*
S.E. ±		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C.D. (P=0.05)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TSS (^{0}Brix)									
40(T_1)		0.55	0.55	0.54	0.54	0.44	0.38	0.33	0.27
45 (T_2)		0.55	0.55	0.55	0.54	0.44	0.38	0.33	0.27
50(T_3)		0.55	0.55	0.55	0.55	0.44	0.38	0.33	0.27
F test		NS	NS	NS	NS	NS	NS	NS	NS
S.E. ±		-	-	-	-	-	-	-	-
C.D. (P=0.05)		-	-	-	-	-	-	-	-
Interaction									
AL_1T_1		0.43	0.43	0.43	0.43	0.35	0.30	0.26	0.21
AL_1T_2		0.43	0.43	0.43	0.43	0.35	0.31	0.26	0.22
AL_1T_3		0.44	0.44	0.43	0.43	0.35	0.30	0.26	0.21
AL_2T_1		0.55	0.55	0.54	0.54	0.45	0.38	0.33	0.27
AL_2T_2		0.55	0.55	0.54	0.54	0.44	0.38	0.32	0.26
AL_2T_3		0.54	0.55	0.55	0.55	0.44	0.38	0.32	0.26
AL_3T_1		0.67	0.66	0.66	0.66	0.54	0.47	0.40	0.33
AL_3T_2		0.68	0.67	0.67	0.67	0.53	0.47	0.40	0.32
AL_3T_3		0.67	0.67	0.66	0.66	0.51	0.48	0.40	0.33
F test		*	*	*	*	*	*	*	*
S.E. ±		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C.D. (P=0.05)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* indicates significance of value at P=0.05 NS : Non significant

fruit squash.

Crude protein content of squash was not altered much during storage indicating the stability of nitrogenous substances. As expected, squash with higher pulp or juice content retained more crude protein throughout storage period. Palaniswamy and Muthukrishnan (1974) noticed similar trend in lemon squash.

There was a little decrease in crude fibre content of stored amla squash (Table 3). squash prepared with more of pulp content retained better crude fibre content throughout storage period. The dietary fibre is composed of mainly complex polysaccharides like cellulose, hemi-cellulose, gums, mucilages and pectins. A meagre decrease in crude fibre concentration of stored squash might be due to heat treatment during sterilization and hydrolysis of polysaccharides by enzymes and acids. Palaniswamy and Muthukrishnan (1974) obtained analogous results in lemon squash.

Tannins content of squash decreased slightly during storage period. Squash with higher pulp retained more tannins. Initial content of tannins in the squash compared to fresh pulp was less, which may be due to thermal degradation during pasteurization and processing. The decrease in tannins content might also be due to the increased activity of polyphenol oxidase (PPO) enzyme activity. Ghorai and Vijay Sethi (1996) obtained similar

Table 4 : Organoleptic scores of lime blended amla squash at 90 days of storage

Interaction	Appearance	Aroma and flavour	Taste	Overall acceptability
AL_1T_1	4.45	4.58	4.40	4.66
AL_1T_2	4.16	3.91	3.87	4.18
AL_1T_3	3.91	3.75	3.58	3.87
AL_2T_1	3.91	4.00	3.50	3.75
AL_2T_2	4.08	3.50	3.75	3.75
AL_2T_3	3.87	3.40	3.33	3.50
AL_3T_1	3.75	3.58	3.87	3.37
AL_3T_2	3.50	3.47	3.47	3.62
AL_3T_3	3.58	3.40	3.75	3.75
F test	*	*	*	*
S.E. ±	0.09	0.08	0.08	0.14
C.D. (P=0.05)	0.26	0.23	0.23	0.40

* indicates significance of value at P=0.05

results on storage of amla fruit.

Overall acceptability of squash was influenced by the interaction effect of pulp and total soluble solids. Squash prepared with 25 per cent pulp (amla pulp and lime juice in the ratio of 1:3), 40^0B total soluble solids was found to be the best recipe. Organoleptic qualities like appearance, aroma and flavour, taste and overall acceptability were best in the recipe which might be due to influence of amla pulp and lime juice, better consistency and acceptable sugar acid ratio (Table 4).

Squash was free from microbial spoilage during storage. There were no defective remarks regarding the fermentation of squash by the organoleptic evaluation panel.

Authors' affiliations:
V. CHIKKASUBBANNA, Division of Horticulture, University of Agricultural Science, G.K.V.K., BANGALORE (KARNATAKA) INDIA

REFERENCES

A.O.A.C. (1970). *Official methods of Analysis*. Association of Official Agricultural Chemists, 10th Ed., Washington, D.C.

Amerine, M.D., Pangborn, R.M. and Roesster, E.B. (1965). *Principles of sensory evaluation of foods*, Academic press, London.

Awan, J.A., Falaye, Q.A. and Okaya, T.C. (1980). Effect of bottle colour and storage condition on the quality of sour sop (*Annona muricata*) drink. *J. Food Sci. Technol.*, **17**(6) : 251-253.

Bhatia, B.S., Siddappa, G.S. and Lal, G.S. (1956). Physico-chemical changes in jackfruit squash during storage. *Indian J. Agric. Sci*., **26** (4) : 403-414.

Brock, V.D., Ludikhuyze, L., Weemaes, C., Van, L.A. and Hendrickx, M. (1998). Kinetics for isobaric isothermal degradation of L-Ascorbic acid. *J. Agric. Food Chem.*, **46** (5) : 2001-2006.

Gajanana, K. (2002). Processing of Aonla (*Emblica officinalis* Gaertn.) fruits, M.Sc. (Ag.) Hort. Thesis submitted to UAS, GKVK, Bangalore.

Ghorai, K. and Vijay Sethi (1996). Varietal suitability of aonla ('Desi' and 'Banarasi) fruits for storage and preservation. *Indian Food Packer*, **50** (1): 11-18.

Jain, S.P., Tripathi, V.K., Ram, H.B. and Singh, S. (1984). Effect of storage condition on the keeping quality of fruit squashes. Part-I studies on storage behaviour of orange, lemon and bel squashes. *Indian Food Packer*, **38** (5) : 33-39.

Jasim Ahamed (1996). Extraction of juice from banana by enzymes. *Indian Food Packer*, **50** (4) : 51-54.

Kalra, C.L. (1988). The chemistry and technology of amla a resume. *Indian Food Packer*, **42** (4) : 67-82.

Kannan, S. and Thirumaran,A.S. (2001). Studies on storage life of jamun products. *Indian Food Packer,* **55** (6) : 125-127.

Palaniswamy, K.P. and Muthukrishnan, C.R. (1974). Studies on physico-chemical characters of lemon juice and squash during storage. *Indian Food Packer*, **28** (4) : 37-41.

Ranganna (1977). *Manual of Analysis of fruit and vegetable products*, 2nd Edn. Tata Mc Graw-Hill publishing company Ltd., New Delhi, India.

Roy, S.K. and Singh, R.N. (1979a). Bael fruit (*Aegle marmelus*). A potential fruit for processing. *Economic Botany*, **33** (2) : 203-212.

Singh, I.S. and Kumar, Sanjeev (1995). Studies on processing of Aonla fruits II. Aonla products, *Prog. Hort.*, **27** (1-2) : 39-47.

Singh, I.S., Pathak, R.K., Dwivedi, R. and Singh, H.K. (1993). Aonla production and post harvest technology. Research bulletin NDUAT, Faizabad, pp. 19-30.

Somogyi, M. (1945). Estimation of reducing sugars. *J. Biol. Chem.*, pp. 160-161.

Sundararaj, N., Nagaraju, S., Venkataramana, M.N. and Jagannath, M.K. (1972). *Design and analysis of field experiments*, UAS, Bangalore.

Thakur, K.S. and Barwal, V.S. (1998). Studies on preparation and evaluation of squash from unmarketable kiwi fruit. *Indian Food Packer*, **52** (1) : 26-29.

****