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Studies on the storage behaviour of amla jam

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ABSTRACT

Amla jam with 45 and 50 per cent pulp,68 and 70^{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. Jam prepared with 45 per cent pulp, 70^{0}B total soluble solids and 1per cent acidity was found to be the best recipe for organoleptic qualities like appearance, aroma and flavour, taste and overall acceptability.

Key words : Brix, Amla, Crude protein, Total soluble solids.

INTRODUCTION

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 said to be native of tropical Asia and found growing wild in tropical forests of India as well as on the hill slopes up to an elevation of 1300 m from mean sea level. It is a hardy plant which grows without much care and thus an ideal tree for dry regions.

The fruits are light green at first, but when they mature become dull greenish yellow. Fruits have nearly spherical and globular shape, smooth surface with six obscure vertical furrows (Tewari *et al*., 2001).

Amla is used for various ailments in the Indian system of medicine. It possesses pronounced expectorant, antiviral, cardiotonic, hypoglycemic and antioxidant activities (Kalra, 1988).

Amla has been highly extolled for its medicinal and nutritional properties. Fruits during their peak harvesting season go as a waste due to limited usage. Therefore, development of value added products could find national and international markets and have great importance in alleviating malnutrition among rural population in addition to several health benefits.

Hence, it is proposed to standardize recipes for development of commonly used products such as jam. This would result in emerging suitable technology for utilization by the processing industries.

MATERIALS AND METHODS

The amla fruits were collected from forest localities of Karnataka. Well matured fruits of uniform size and free from bruises were used for the experiment. Selected 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 jam with the following ingredients.

Recipes for jam:

Recipe No.	Pulp (%)	TSS(^{0}B)	Acidity (%)
1	45	68	1.0
2.	45	70	1.0
3.	50	68	1.1
4.	50	70	1.1

The prepared jam was analyzed for physico-chemical characteristics and assessed for its acceptability by organoleptic evaluation at 90 days of storage.

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

Amla jam 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 following numerical scoring method (Amerine *et al.*, 1965).

In this experiment, factorial completely randomized design (FCRD) was adopted. Observations on various

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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 jam 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 jam 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 nectar and jam of muskmelon (Katiyar *et al*., 1967) and in papaya jam (Saravanan *et al*., 2004).

Acidity of amla jam 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 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.

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 jam 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 papaya jam was noticed by Saravanan *et al*. (2004).

Total sugar content of amla jam increased slightly

Table 1: Changes in pH, TSS, acidity and ascorbic acid content of amla jam 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 (%)																
45 (J_1)	2.92	2.98	3.08	3.15	69.00	69.60	70.36	71.13	1.00	0.96	0.93	0.88	152.14	133.82	119.24	104.20
50 (J_2)	2.94	3.03	3.12	3.18	69.00	69.68	70.41	71.23	1.16	1.12	1.06	1.03	167.22	144.48	126.41	114.91
F test	*	*	*	*	-	NS	NS	NS	*	*	*	*	*	*	*	*
S.E. ±	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	0.00	0.48	0.39	0.52	0.59
C.D. (P=0.05)	0.01	0.01	0.01	0.02	-	-	-	-	0.01	0.01	0.01	0.01	1.56	1.28	1.69	1.92
TSS (^{0}Brix)																
68(T_1)	2.93	3.00	3.10	3.16	68.00	68.56	69.30	70.08	1.08	1.04	1.00	0.96	160.66	140.96	123.94	111.36
70 (T_2)	2.92	3.01	3.10	3.17	70.00	70.71	71.48	72.28	1.08	1.04	1.00	0.95	158.71	137.34	121.71	107.75
F test	NS	NS	NS	NS	-	*	*	*	NS	NS	NS	NS	*	*	*	*
S.E. ±	-	-	-	-	-	0.06	0.03	0.03	-	-	-	-	0.48	0.39	0.52	0.59
C.D. (P=0.05)	-	-	-	-	-	0.01	0.11	0.11	-	-	-	-	1.56	1.28	1.69	1.92
Interaction																
J_1T_1	2.93	2.99	3.08	3.14	68.00	68.53	69.33	70.03	1.01	0.96	0.93	0.87	153.81	135.49	120.63	106.43
J_1T_2	2.91	2.97	3.07	3.16	70.00	70.66	71.40	72.23	1.00	0.96	0.93	0.88	150.47	132.15	117.85	101.98
J_2T_1	2.95	3.01	3.11	3.18	68.00	68.60	69.26	70.13	1.15	1.11	1.06	1.03	167.50	146.43	127.24	116.30
J_2T_2	2.94	3.05	3.14	3.18	70.00	70.76	71.56	72.33	1.16	1.12	1.05	1.02	166.95	142.53	125.57	113.52
F test	NS	*	NS	NS	-	NS	*	NS	*	*	*	*	*	*	*	*
S.E. ±	-	0.00	-	-	-	-	0.04	-	0.00	0.00	0.00	0.00	0.68	0.55	0.73	0.83
C.D. (P=0.05)	-	0.02	-	-	-	-	0.16	-	0.01	0.01	0.01	0.01	2.21	1.81	1.04	2.72

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

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 jam were dependent on the total soluble solids as

Table 2: Changes in sugars and crude protein content of amla jam 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 (%)																
45 (J_1)	61.76	61.87	61.89	61.93	11.57	21.66	29.18	33.23	50.19	40.20	32.70	28.69	0.26	0.26	0.25	0.25
50 (J_2)	61.79	61.88	61.97	61.94	12.06	23.17	30.40	33.89	49.72	38.70	31.50	28.05	0.29	0.28	0.28	0.28
F test	NS	NS	NS	NS	*	*	*	NS	NS	*	*	*	*	*	*	*
S.E. ±	-	-	-	-	0.06	0.22	0.24	-	-	0.15	0.15	0.19	0.00	0.00	0.00	0.00
C.D. (P=0.05)	-	-	-	-	0.21	0.73	0.80	-	-	0.49	0.51	0.63	0.00	0.00	0.00	0.00
TSS (^{0}Brix)																
68(T_1)	61.32	61.47	61.48	61.43	11.05	21.53	29.21	33.24	50.27	39.93	32.27	28.18	0.27	0.27	0.27	0.27
70 (T_2)	62.23	62.28	62.38	62.44	12.05	23.30	30.37	33.88	49.64	38.97	32.01	28.55	0.27	0.27	0.27	0.27
F test	*	*	*	*	*	*	*	NS	*	*	NS	NS	*	*	NS	NS
S.E. ±	0.01	0.00	0.02	0.01	0.06	0.22	0.24	-	0.04	0.15	-	-	0.00	0.00	-	-
C.D. (P=0.05)	0.05	0.02	0.08	0.05	0.21	0.73	0.80	-	0.13	0.49	-	-	0.00	0.00	-	-
Interaction																
J_1T_1	61.35	61.38	61.42	61.46	10.85	20.26	28.47	32.98	50.50	41.12	32.94	28.48	0.26	0.25	0.25	0.25
J_1T_2	62.18	62.27	62.36	62.39	12.29	23.06	29.89	33.49	49.88	39.20	32.47	28.90	0.26	0.26	0.25	0.25
J_2T_1	61.30	61.45	61.55	61.40	11.25	22.80	29.95	33.51	50.04	38.65	31.60	27.88	0.29	0.28	0.28	0.28
J_2T_2	62.28	62.30	62.39	62.49	12.88	23.54	30.85	34.28	49.40	38.75	31.54	28.21	0.29	0.29	0.28	0.28
F test	*	*	*	*	*	*	*	NS	*	*	NS	NS	NS	NS	NS	NS
S.E. ±	0.02	0.01	0.04	0.03	0.09	0.32	0.35	-	0.07	0.21	-	-	-	-	-	-
C.D. (P=0.05)	0.08	0.04	0.12	0.09	0.29	1.04	1.14	-	0.22	0.69	-	-	-	-	-	-

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

Table 3 : Changes in crude fibre and tannins of amla jam during storage

Factors	Crude fibre(%)				Tannins(%)			
	Fresh	30 days	60 days	90 days	Fresh	30 days	60 days	90 days
Pulp (%)								
45 (J_1)	1.41	1.41	1.40	1.40	1.16	1.02	0.86	0.71
50 (J_2)	1.57	1.57	1.56	1.56	1.30	1.14	0.98	0.80
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)								
68(T_1)	1.49	1.49	1.49	1.48	1.23	1.08	0.92	0.76
70 (T_2)	1.49	1.49	1.48	1.48	1.23	1.08	0.92	0.75
F test	NS	NS	NS	NS	NS	NS	NS	NS
S.E. ±	-	-	-	-	-	-	-	-
C.D. (P=0.05)	-	-	-	-	-	-	-	-
Interaction								
J_1T_1	1.41	1.41	1.41	1.40	1.17	1.02	0.86	0.71
J_1T_2	1.41	1.41	1.40	1.40	1.16	1.02	0.87	0.73
J_2T_1	1.57	1.57	1.56	1.56	1.28	1.15	0.98	0.81
J_2T_2	1.57	1.57	1.56	1.56	1.30	1.13	0.97	0.79
F test	NS	NS	NS	NS	*	*	*	*
S.E. ±	-	-	-	-	0.00	0.00	0.00	0.00
C.D. (P=0.05)	-	-	-	-	0.00	0.00	0.00	0.00

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

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 jam. 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 Saravanan *et al*. (2004) in papaya fruit jam**.**

Crude protein content of jam was not altered much during storage indicating the stability of nitrogenous substances. As expected, jam with higher pulp 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 jam (Table 3). Jam 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 jam 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 jam decreased slightly during storage period. jam with higher pulp retained more tannins. Initial content of tannins in the jam 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 results on storage of amla fruit.

Overall acceptability of amla jam was influenced by the interaction effect of pulp and total soluble solids. Jam prepared with 45 per cent pulp, 70^0B total soluble solids and 1 per cent acidity was adjudged better over other recipes which might be due to better combination of pulp and total soluble solids that assisted to retain better taste, aroma and flavour at the end of storage period.(Table 4).

Jam was free from microbial spoilage during storage. High sugar concentration might have decreased the water activity due to osmosis, thereby preventing availability of free water for growth and multiplication of microorganisms. There were no defective remarks regarding the fermentation of jam by the organoleptic evaluation panel.

Table 4 : Organoleptic scores of Amla jam at 90 days of storage

Interaction	Appearance	Aroma and flavour	Taste	Overall acceptability
J_1T_1	3.87	3.41	3.66	3.62
J_1T_2	3.75	3.87	4.12	4.25
J_2T_1	3.62	3.37	3.75	3.50
J_2T_2	3.75	3.26	3.87	3.75
F test	NS	*	*	*
S.E. ±	0.07	0.07	0.14	0.14
C.D. (=0.05)	0.21	0.21	0.42	0.42

* indicates significance of value at P=0.05

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