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Storage Studies of Aonla (*Emblica officinalis* Gaertn.) Juice Cv. NA-10

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ABSTRACT

Aonla juice was stored at two different storage conditions *viz.* ambient temperature (S_1) and cold storage (S_2) for 6 months after adding different concentrations of benzoic acid (T_1- 0 ppm (control), T_2- 200 ppm, T_3- 400 ppm and T_4-600 ppm.). T.S.S., reducing sugar, total sugar and titratable acidity content of aonla juice were determined. The present findings reveals that, for storage of aonla juice 600 ppm benzoic acid and cold storage condition was good followed by 400 ppm benzoic acid and cold storage condition.

Key Words:

Aonla, Benzoic acid, Juice quality, Storage conditions.

INTRODUCTION

India ranks first in the word in area and production of aonla crop (Priya and Khatkar 2013). In India, it is grown in an area of 50, 000 ha with a total annual production 2, 00, 000 metric tonnes (Goyal et al. 2009). Among the fruits, aonla commonly known as Indian Gooseberry (*Emblica officinalis* Gaertn.) finds a special place in India as it has got tremendous medicinal value. Aonla is rich source of vitamin C. Now a days, world opinion has changed towards nutritional as well as medicinal value rather than huge horticultural crops. Improvement in the existing method of storage is an urgent need of the day. The fresh form of aonla fruit is generally not consumed due to high astringency and thus fruit during their peak harvesting season go as waste due to limited usage. But, it has great potential in processed form. The work on processed form of aonla in this region is scanty. There is great demand for pure aonla juice as it has medicinal value. Hence, to study the preservation of aonla juice, experiment entitled "Storage studies of aonla (*Emblica officinalis* Gaertn.) juice Cv. NA-10" was undertaken.

MATERIALS AND METHODS

The present investigation was carried out in the Fruit and Vegetable Processing Unit Laboratory, at Department of

Horticulture, College of Agriculture, Dapoli, Dist-Ratnagiri (M.S.). Fully riped and uniform sized fruits of aonla were procured from the Regional Fruit Research Station, Vengurle, Taluka- Vengurle, Dist.- Sindhudurg. About 100 Kg of aonla fruits were brought to the laboratory. Unripe, diseased, damaged and off type fruits were discarded. The selected fruits were thoroughly washed with clean tap water to remove dirt and dust particles adhered to the pericarp of the fruit and then washing was done with 30 ppm KMS solution (30 mg/lit water) for 5 minutes. Finally fruits were wiped dry and then juice was extracted. The extracted juice was stored at two different storage conditions *viz.* ambient temperature (S_1) and cold storage (S_2) for 6 months after adding different concentrations of benzoic acid (Fig 1 Kambale et al. 2019) *viz.* T_1- 0 ppm (control), T_2- 200 ppm, T_3- 400 ppm and T_4- 600 ppm. Thus, the experiment was comprised of eight treatment combinations replicated thrice in factorial completely randomized design.

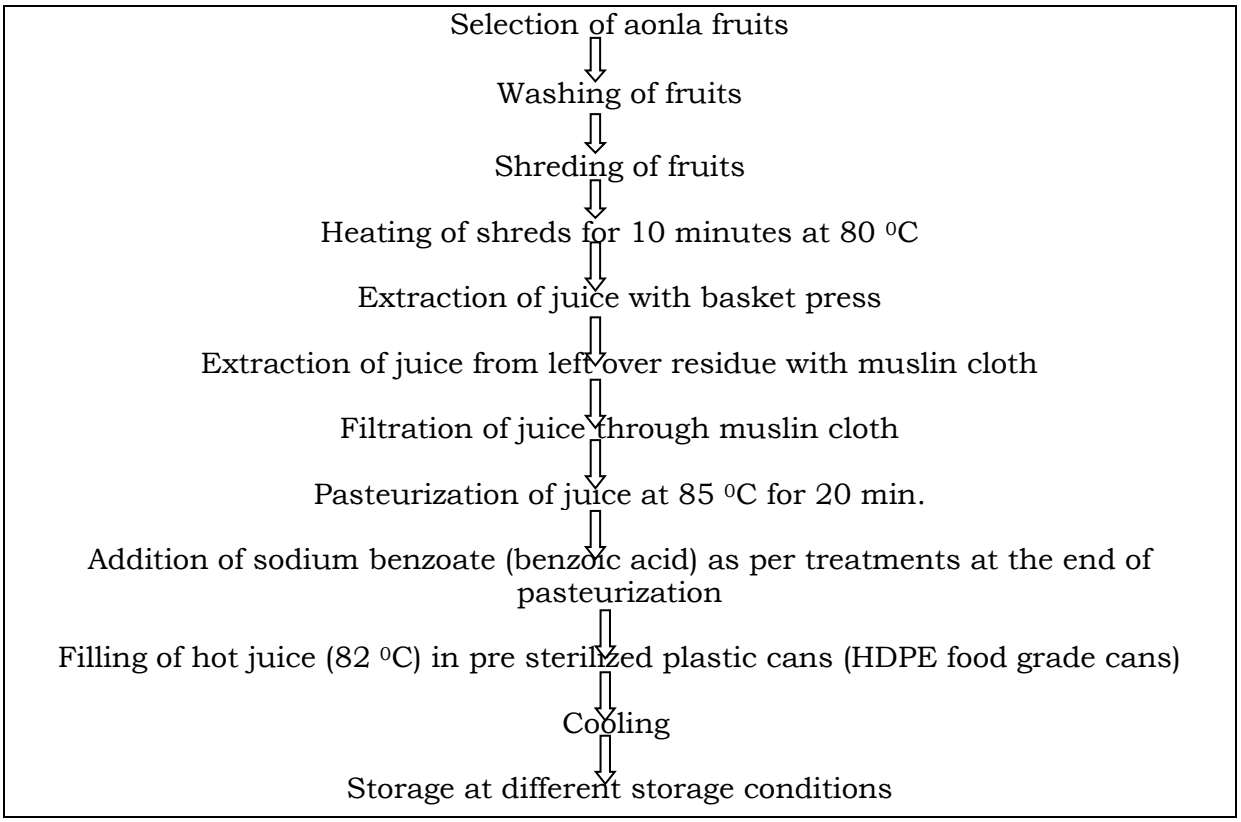

Fig. 1. Flow chart for extraction of juice from aonla fruits

The T.S.S. content of aonla juice was determined by using Hand Refractometer and was recorded as °Brix (AOAC. 1975). The reducing sugar, total sugar and titratable acidity content of aonla juice were determined as per the procedures described by Ranganna (1979). The pH was determined with the help of pH meter (Model Systronics µ pH system 361).

RESULTS AND DISCUSSIONS

Results of the chemical composition of aonla juice are presented in Table 1 to 5. The storage conditions, benzoic acid concentrations and their interactions showed significant results at 4 and 6 months storage with respect to all chemical parameters studied.

In different benzoic acid concentrations, the T.S.S, reducing sugar, total sugar and pH content of aonla juice was found to be increased and acidity decreased with increase in benzoic acid concentrations, at the end of storage (6 months). This indicates that control and low concentrations (200 ppm) failed to stop fermentation of juice during storage. However, higher concentrations of benzoic acid (400 and 600 ppm) were effective still 6 months for controlling microbial fermentation. Similar findings have been reported by Ayub (2010) in strawberry juice and Bagkar (2013) in jamun juice. Among different benzoic acid concentrations under study, treatment T_4 (600 ppm benzoic acid) recorded highest T.S.S, reducing sugar,

Table 1. Effect of benzoic acid concentrations and storage conditions on total soluble solids (°Brix) content of aonla juice

BA* concentrations (T)	Storage Period (Months)											
	Initial (0 months) Storage conditions (S)			2 months Storage conditions (S)			4 months Storage conditions (S)			6 months Storage conditions (S)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	10.40	10.40	10.40	10.60	10.80	10.70	8.50	9.80	9.15	7.80	9.50	8.65
T_2	10.40	10.40	10.40	10.70	10.80	10.75	8.90	10.90	9.90	8.30	11.00	9.65
T_3	10.40	10.40	10.40	10.60	10.50	10.55	10.50	11.00	10.75	10.70	11.20	10.95
T_4	10.40	10.40	10.40	10.70	10.50	10.60	10.70	11.30	11.00	10.90	11.70	11.30
Mean	10.40	10.40	10.40	10.65	10.65	10.65	9.65	10.75	10.20	9.43	10.85	10.14
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
BA concentrations (T)	0.096		NS	0.015		0.062	0.087		0.364	0.087		0.367
Storage conditions (S)	0.204		NS	0.031		NS	0.184		0.773	0.185		0.779
Interactions (T×S)	0.136		NS	0.020		0.088	0.122		0.516	0.123		0.520

**BA: Benzoic Acid; T_1- control, T_2- benzoic acid 200 ppm, T_3- benzoic acid 400 ppm, T_4- benzoic acid 600 Ppm, S_1- ambient temperature, S_2- cold storage*

total sugar and pH and lowest titratable acidity content at the end of storage (6 months), which was at par with T_3 (400 ppm benzoic acid) in case of total sugars and titratable acidity at the end of storage. Hence, for storage of aonla juice treatment T_4 (600 ppm benzoic acid) was found to be good followed by T_3 (400 ppm benzoic acid).

During storage it was noticed that, at ambient temperature (S_1) the T.S.S, reducing sugars, total sugars and pH content of aonla juice was increased up to 2 months storage and then it was decreased at 4 and 6 months storage. However, acidity decreased up to 2 months storage and then it was increased at 4 and 6 months storage.

The decrease in T.S.S, reducing sugars, total sugars and pH in ambient storage may be due to higher rate of microbial fermentation as high temperature favourable for microbial growth was available at ambient temperature. This might have converted sugar into alcohol.While at cold storage, the T.S.S, reducing sugar, total sugar and pH content of aonla juice was increased and acidity decreased.

Table 2. Effect of benzoic acid concentrations and storage conditions on reducing sugar (%) content of aonla juice

Benzoic acid concentrations (T)	Storage Period (Months)											
	Initial (0 months)			2 months			4 months			6 months		
	Storage conditions (S)			Storage conditions (S)			Storage conditions (S)			Storage conditions (S)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	1.62	1.62	1.62	1.86	1.80	1.83	1.24	1.57	1.41	0.43	1.20	0.82
T_2	1.62	1.66	1.62	1.70	1.68	1.69	1.68	1.75	1.72	1.11	1.90	1.51
T_3	1.62	1.62	1.62	1.68	1.65	1.67	1.77	1.82	1.80	1.91	2.21	2.06
T_4	1.62	1.62	1.62	1.65	1.64	1.65	1.67	1.70	1.69	1.95	2.37	2.16
Mean	1.62	1.62	1.62	1.72	1.69	1.71	1.59	1.71	1.66	1.35	1.92	1.64
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Benzoic acid concentrations (T)	0.018		NS	0.017		0.071	0.013		0.053	0.020		0.086
Storage conditions (S)	0.038		NS	0.036		NS	0.027		0.112	0.043		0.182
Interactions (T×S)	0.026		NS	0.024		NS	0.018		0.075	0.029		0.121

T_1- control, T_2- benzoic acid 200 ppm, T_3- benzoic acid 400 ppm, T_4- benzoic acid 600 Ppm, S_1- ambient temperature, S_2- cold storage

Table 3. Effect of benzoic acid concentrations and storage conditions on total sugar (%) content of aonla juice

Benzoic acid concentrations (T)	Storage Period (Months)											
	Initial (0 months)			2 months			4 months			6 months		
	Storage conditions (S)			Storage conditions (S)			Storage conditions (S)			Storage conditions (S)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	1.95	1.95	1.95	2.10	2.05	2.08	1.35	1.67	1.51	0.58	1.28	0.93
T_2	1.95	1.95	1.95	2.04	2.02	2.03	2.02	2.13	2.08	1.19	2.22	1.71
T_3	1.95	1.95	1.95	2.04	2.00	2.02	2.07	2.18	2.13	2.14	2.39	2.27
T_4	1.95	1.95	1.95	2.03	1.97	2.00	2.04	2.12	2.08	2.18	2.46	2.32
Mean	1.95	1.95	1.95	2.05	2.01	2.03	1.87	2.03	1.95	1.52	2.09	1.81
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Benzoic acid concentrations (T)	0.049		NS	0.019		NS	0.019		0.081	0.015		0.063
Storage conditions (S)	0.104		NS	0.039		NS	0.041		0.171	0.031		0.134
Interactions (T×S)	0.070		NS	0.026		NS	0.027		0.144	0.021		0.089

T_1- control, T_2- benzoic acid 200 ppm, T_3- benzoic acid 400 ppm, T_4- benzoic acid 600 Ppm, S_1- ambient temperature, S_2- cold storage

Table 4. Effect of benzoic acid conc. and storage on titratable acidity (%) of aonla juice

Benzoic acid concentrations (T)	Storage Period (Months)											
	Initial (0 months) Storage conditions (S)			2 months Storage conditions (S)			4 months Storage conditions (S)			6 months Storage conditions (S)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	2.35	2.35	2.35	2.32	2.30	2.31	2.64	2.42	2.53	3.28	2.53	2.91
T_2	2.35	2.35	2.35	2.29	2.26	2.28	2.61	2.18	2.40	2.86	2.16	2.51
T_3	2.35	2.35	2.35	2.28	2.22	2.25	2.22	2.15	2.19	2.20	2.08	2.14
T_4	2.35	2.35	2.35	2.26	2.18	2.22	2.18	2.14	2.16	2.15	2.00	2.08
Mean	2.35	2.35	2.35	2.29	2.24	2.27	2.41	2.22	2.32	2.62	2.19	2.41
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Benzoic acid concentrations (T)	0.047		NS	0.013		0.053	0.013		0.054	0.013		0.056
Storage conditions (S)	0.100		NS	0.027		0.112	0.027		0.155	0.028		0.118
Interactions (T×S)	0.067		NS	0.018		NS	0.018		0.077	0.019		0.079

T_1- control, T_2- benzoic acid 200 ppm, T_3- benzoic acid 400 ppm, T_4- benzoic acid 600 Ppm, S_1- ambient temperature, S_2-cold storage

Table 5. Effect of benzoic acid conc. and storage conditions on pH content of aonla juice

Benzoic acid concentrations (T)	Storage Period (Months)											
	Initial (0 months) Storage conditions (S)			2 months Storage conditions (S)			4 months Storage conditions (S)			6 months Storage conditions (S)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	2.73	2.73	2.73	2.79	2.85	2.82	2.59	2.83	2.71	2.32	2.65	2.49
T_2	2.70	2.70	2.70	2.82	2.88	2.85	2.66	2.91	2.79	2.41	2.93	2.67
T_3	2.72	2.72	2.72	2.84	2.88	2.86	2.88	2.94	2.91	2.93	3.05	2.99
T_4	2.74	2.74	2.74	2.87	2.93	2.90	2.90	2.97	2.94	2.94	3.25	3.10
Mean	2.72	2.72	2.72	2.83	2.89	2.86	2.76	2.91	2.84	2.65	2.97	2.81
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Benzoic acid concentrations (T)	0.022		NS	0.019		NS	0.016		0.067	0.016		0.069
Storage conditions (S)	0.046		NS	0.400		NS	0.034		0.141	0.035		0.146
Interactions (T×S)	0.030		NS	0.027		NS	0.022		0.094	0.023		0.098

T_1- control, T_2- benzoic acid 200 ppm, T_3- benzoic acid 400 ppm, T_4- benzoic acid 600 Ppm, S_1- ambient temperature, S_2-cold storage

up to 6 months storage. This may be due to hydrolysis of complex carbohydrates into simple sugars. Even low temperature (12±1 ^{0}C) available at cold storage might have restricted the growth and activity of microbes and hence no fermentation. Similar findings were also reported by Bhandari (2004), Bagkar (2013) in jamun juice at ambient storage and Bahadur *et al.* (2008) in aonla juice at cold storage condition. Among the two storage conditions, the cold storage (S_2) condition recorded highest T.S.S, reducing sugars, total sugars and pH and lowest acidity content during storage. Hence, the cold storage condition was found to be good for storage of aonla juice.

CONCLUSIONS

Among different interactions tried, the interaction T_4S_2 recorded highest T.S.S, reducing sugars, total sugars, pH and lowest acidity at the end of storage (6 months) and it was at par with T_3S_2 in case of T.S.S., total sugars and titratable acidity. Hence, interaction T_4S_2 was found to be good for storage of aonla juice. From the present findings it can be concluded that, for storage of aonla juice interaction T_4S_2 (600 ppm benzoic acid and cold storage condition) was found to be good followed by T_3S_2 (400 ppm benzoic acid and cold storage condition).

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