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Studies on Chemical Constituents of Stored Bael Squash Prepared from Different Recipes

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Abstract: *An experiment on "Studies on chemical constituents of stored bael squash prepared from different recipes" was carried out during the year 2015-16 in Post Harvest Technology Laboratory, Section of Horticulture, College of Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola. An experiment was conducted in FCRDwith two factors. Factor A consists of six recipes viz. 35% Bael pulp + 1.0% Acidity, 35% Bael pulp + 1.5% Acidity, 40% Bael pulp + 1.0% Acidity, 40% Bael pulp + 1.5% Acidity, 45% Bael pulp + 1.0% Acidity and 45% Bael pulp + 1.5 % Acidity with common TSS is 50 °B and factor B consists of storage conditions viz. refrigerated and ambient conditions and replicated thrice.From the results, it was observed that,significantly minimum changes during storage in acidity, reducing sugars, non reducing sugars and total sugars found in bael squash prepared from 45% pulp + 1.5 % acidity and stored at refrigerated condition as compared to ambient storage conditionsupto 120 days of storage.*

Keywords: *Bael, squash, chemical constituent, storage.*

INTRODUCTION

Bael (*Aegle marmelos* L. Correa) belongs to the family Rutaceae, It is an important indigenous fruit of India. The bael fruit is one of the most nutritious and medicinal fruits.According to Gopalan *et. al* (1971), it contains 61.5 g water, 1.8 g protein, 0.39 mg fat, 1.7 g minerals, 31.8 gcarbohydrates, 55 mg carotene, 0.13 mg thiamine, 1.19 mg riboflavin, 1.1 mg niacin and 8 mg vitamin C per 100 g of edible portion. No other fruit has such a high content of riboflavin. A fair amount of pectin is found in bael. Thepercent age of pectin on fresh fruit weight basis is 2.66 (Roy and Mujumdar, 1989). Marmelosin is most probably the therapeutically active principal of bael fruit. It has been isolated as a colourless crystalline compound (Dixit and Dutta, 1932).

Although, ripe bael fruit is sweet, aromatic, nutritious, aromatic, laxative and palatable but it cannot be consumed as such due to its hard shell, mucilaginous texture, high astringency and numerous seeds in its pulp. Obviously, rich flavour of bael fruit is not destroyed even during processing it into different fruit products. 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 bael in this region is scanty. Thus, scientific approach in preparation and preservation of bael processed products like bael squash, syrup, ready toserve beverages, etc. is required. Earlier, workers have explored the possibilities of utilizing bael fruit beverages for the preparation juice and syrup. Keeping all these views into consideration, the experiment was undertaken on "Studies on chemical constituents of stored bael squash prepared from different recipes". This would result in emerging suitable technology for utilization by the processing industries.

MATERIALS AND METHOD

The present investigationwas conducted in Post Harvest Technology Laboratory Section of

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Horticulture, College of Agriculture, Dr. P.D.K.V. Akola during the year 2015-16 with Factorial Completely Randomized Design with three replications. For the experimentation, fully ripe, uniform size bael fruits were selected and selected riped bael fruits were sorted out. Unripe, diseased, damaged and off type fruits were strictly discarded. The collected fruits were washed thoroughly with clean water. Pulp was extracted from fruits by scooping.

Water was added to the pulp equal to the weight of the pulp followed by mixing, heating at 80°C for 1 minute and then passing through muslin cloth to separate seeds and fiber. Thus extracted pulp was used for preparation of bael squash with as per different six treatments *viz.* 35% Bael pulp + 1.0% Acidity, 35% Bael pulp + 1.5% Acidity, 40% Bael pulp + 1.0% Acidity, 40% Bael pulp + 1.5% Acidity, 45% Bael pulp + 1.0% Acidity and 45% Bael pulp + 1.5 % Acidity with common TSS is 50°B and stored under two different conditions *viz.* refrigerated and ambient conditions. Thus extracted pulp will be used for preparation of bael squash with following recipe.

Bael pulp : As per treatment

Sugar : 1.8 kg per kg of pulp

Sodium Benzoate : 300 ppm

Bael squash was filled into the pre-sterilized bottles of 300 ml capacity and sealed air tight using crown corks and were stored as per treatment for further observations. Titrable acidity was determined by the procedure as reported by Sadasivam and Manickam (1997). Total soluble solids were determined with the help of digital refractrometer and values were corrected to 20 pC with the help of temperature correction chart (AOAC, 1995)

RESULT AND DISCUSSION

Effect of Recipes and Storage Conditions

TSS (°Brix):

The data presented in Table 1 shows non significant differences in total soluble solids of bael squash among the different treatments at initial stage; however it was significant at 120th day of observation. In general, the total soluble solids of bael squash were gradually increased in all the recipes. Significantly minimum increase (from 50.00 to 51.57°B) in total soluble solids at 120th dayof storage was observed in treatment T_6 (45% Bael pulp + 1.5% Acidity). However, the change in total soluble solids was more (from 50.00 to 51.81°B) in treatment T_1 (35% Bael pulp + 1.0% Acidity) and regarding storage condition minimum increase in TSS found upto 120th day in refrigerated condition as compared to ambient storage condition.

Titrable acidity (%)

The data presented in Table 1 shows non significant differences in titrable acidity of bael squash among the different treatments at initial stage, however it was significant at 120th day of observation. In general, titrable acidity of bael squash were gradually decreased in all the recipes. Minimum decrease (from 1.53 to 1.35%) in titrable acidity at 120 days of storage was observed in treatment T6 (45% Bael pulp +1.5% Acidity). However, the change in titrable acidity was more (from 1.01 to 0.70%) in treatment T1 (35% Bael pulp + 1.0% Acidity) and regarding storage condition minimum decrease in titrable acidity found upto 120th day in refrigerated condition as compared to ambient storage condition.

Reducing sugars (%)

The data presented in Table 1 shows non significant differences in reducing sugars of bael squash among the different treatments at initial, however it was significant at 120th day of observation. In general, the reducing sugars of bael squash were gradually increased in all the recipes. Significantly minimum increase (from 8.59 to 11.60 %) in reducing sugars at 120 days of storage was observed in treatment T6 (45% Bael pulp + 1.5% Acidity). However, the change in reducing sugars was more (from 6.01 to 9.67 %) in treatment T1 (35% Bael pulp + 1.0% Acidity)and regarding storage conditions, significantly minimum increase in reducing sugars upto 120th day of storage was found in refrigerated condition as compared to ambient storage condition.

Total sugars (%)

The data presented in Table 1 shows non significant differences in total sugars of bael squash among the different treatments at initial, however it was

Table 1
Changes in TSS, acidity, reducing sugars and total sugars of bael squash as influenced by different recipes and storage conditions

	TSS (0 Brix)			*Titrable Acidity (%)*			*Reducing sugars (%)*			*Total sugars(%)*		
	Storage period (Days)			*Storage period (Days)*			*Storage period (Days)*			*Storage period (Days)*		
Treatments	*Initial*	*120th day*	*Increase in TSS (° Brix)*	*Initial*	*120th day*	*Decrease in titrable acidity (%)*	*Initial*	*120th day*	*Increase in reducing sugars (%)*	*Initial*	*120th day*	*Increase in total sugars (%)*
Recipe												
T1- 35% bael pulp + 1.0% acidity	50.00	51.81	1.81	1.01(1.00)	0.70(0.84)	0.32	6.01(2.45)	9.67(3.11)	3.66	40.50	42.85	2.35
T2- 35% bael pulp+ 1.5 % acidity	50.00	51.67	1.67	1.51(1.23)	1.22(1.10)	0.29	6.01(2.45)	9.33(3.05)	3.32	40.50	42.61	2.11
T3- 40% bael pulp+ 1.0 % acidity	50.00	51.76	1.76	1.02(1.01)	0.71(0.84)	0.31	7.50(2.74)	11.04(3.32)	3.55	44.00	46.27	2.27
T4- 40% bael pulp+ 1.5 %acidity	50.00	51.62	1.63	1.52(1.23)	1.25(1.12)	0.27	7.50(2.74)	10.66(3.26)	3.17	44.00	45.99	2.00
T5- 45% bael pulp+ 1.0 % acidity	50.00	51.72	1.72	1.04(1.02)	0.74(0.86)	0.30	8.59(2.93)	12.04(3.47)	3.45	45.50	47.71	2.21
T6- 45% bael pulp+ 1.5 % acidity	50.00	51.57	1.58	1.53(1.24)	1.35(1.16)	0.18	8.59(2.93)	11.60(3.41)	3.01	45.50	47.37	1.87
'F' test	NS	Sig	Sig	NS	Sig	Sig	NS	Sig	Sig	NS	Sig	Sig
SE(m)±	0.12	0.003	0.003	0.005	0.006	0.004	0.003	0.002	0.002	0.001	0.002	0.002
CD at 5%	–	0.009	0.011	–	0.018	0.011	–	0.006	0.006	–	0.006	0.007
Storage Conditions												
S1- Refrigerated storage	50.00	51.55	1.55	1.47(1.21)	1.37(1.17)	0.10	7.31(2.70)	7.68(3.11)	2.27	43.00	45.01	2.01
S2 – Ambient storage	50.00	51.83	1.83	1.27(1.13)	0.73(0.85)	0.53	7.36(2.71)	11.34(3.38)	3.98	43.00	45.92	2.92
'F' test	NS	Sig	Sig	NS	Sig	Sig	NS	Sig	Sig	NS	Sig	Sig
SE(m)±	0.008	0.005	0.005	0.009	0.010	0.007	0.003	0.004	0.003	0.002	0.004	0.003
CD at 5%	–	0.016	0.014	–	0.031	0.020	–	0.012	0.009	–	0.011	0.012

(Figure in parenthesis are square root values)

significant at 120th day of observation. In general, the total sugars of bael squash were gradually increased in all the recipes. Significantly minimum increase (from 45.50 to 47.37 %) in total sugars at 120 days of storage was observed in treatment T6 (45% Bael pulp + 1.5% Acidity). However, the change in total sugars was more (from 40.50 to 42.61 %) in treatment T1 (35% Bael pulp + 1.0% Acidity) and regarding storage conditions, significantly minimum increase in TSS upto 120th day of storage was found in refrigerated condition as compared to ambient storage condition.

Interaction Effects

TSS (°Brix)

The data presented in Table 2 shows that, at initial stage, all the treatment combinations shows non significant differences while significant differences was noticed at 120th day of observation. Significantly minimum increase (from 50.00 to 51.46°B) in total soluble solids at 120 days of storage was observed in treatment combination T_6S_1 (45% Bael pulp + 1.5% Acidity stored in refrigerated condition). However, increase in total soluble solids was found to be maximum (from 50.00 to 51.97 °B) in treatment combination T_1S_2 (35% Bael pulp + 1.0% Acidity stored in ambient condition).

Titrable acidity(%)

The data presented in Table 2 exhibited that, at initial stage, all the treatment combinations shows non significant differences while, significant differences was noticed at 120th day of observation. Significantly minimum decrease (from 1.52to 1.40%) in titrable acidity at 120 days of storage was observed in treatment combination T_6S_1 (45% Bael pulp + 1.5% Acidity stored in refrigerated condition). However, decrease in titrable acidity was found to be significantly maximum (from 1.01 to 0.40%) in treatment combination T_1S_2 (35% Bael pulp + 1.0% Acidity stored in ambient condition).

Reducing sugars(%)

The data presented in Table 2 showsthat at initial stage, all the treatment combinations shows non significant differences while significant differences was noticed at 120th day of observation. Minimum increase (from 8.59 to 10.65%) in reducing sugars at 120 days of storage was observed in treatment combination T_6S_1 (45% Bael pulp + 1.5% Acidity stored in refrigerated condition). However, increase in reducing sugars was found to be maximum (from 6.01 to 10.77%) in treatment combination T_1S_2 (35% Bael pulp + 1.0% Acidity stored in ambient condition).

Total sugars(%)

The data presented in Table 2 shows that, , all the treatment combinations shows non significant differences at initial stage while, significant differences was noticed at 120th day of observation. Minimum increase (from 45.50 to 46.95 %) in total sugars at 120 days of storage was observed in treatment combination T_6S_1 (45% Bael pulp + 1.5% Acidity stored in refrigerated condition). However, increase in total sugars was found to be maximum (from 40.50 to 43.31%) in treatment combination T_1S_2 (35% Bael pulp + 1.0% Acidity stored in ambient condition).

From the above result it is observed in general that, there was progressive increase in TSS of bael squash during storage. The increase in TSS of bael during storage was probably due to partial hydrolysis of complex carbohydrates into simple sugar. Sujana (2006) found that, the total soluble solids of custard apple pulp increased throughout the storage period. There was slight decrease in titrable acidity percentage of bael squash prepared by different six recipes during storage is due to chemical interaction between organic constituents of the bael pulp fruit pulp induced by temperature and action of enzymes during storage. Similar trend was noticed by Kaushik *et al.* (2002) in Jamun products and Srinivas *et al.* (2007). Reducing sugars was increased during storage period might be due to gradual loss of moisture, hydrolysis of polysaccharides into sugars. Similar observation recorded by the Palaniswamy and Muthukrishanan (1974) andWaskar and Khurdiya (1987).The decreased in non reducing sugars is due to inversion of non reducing sugars. Similar observation recorded by Reddy and Chikkasubbanna (2008).Total sugars also increased during storage

Table 2
Interaction of recipes and storage conditions on TSS, acidity, reducing sugars and total sugars of bael squash

	TSS (0 Brix)			*Titrable Acidity (%)*			*Reducing sugars (%)*			*Total sugars(%)*		
	Storage period (Days)			*Storage period (Days)*			*Storage period (Days)*			*Storage period (Days)*		
Treatments	*Initial*	*120th day*	*Increase in TSS (° Brix)*	*Initial*	*120th day*	*Decrease in titrable acidity (%)*	*Initial*	*120th day*	*Increase in reducing sugars (%)*	*Initial*	*120th day*	*Increase in total sugars (%)*
T_1S1- 35% pulp+ 1.0 % acidity + Refrigerated	50.00	51.64	1.64	1.01(1.00)	0.75(0.86)	0.26	6.01(2.45)	8.58(2.93)	2.57	40.50	42.40	1.90
T_2S1- 35% pulp+ 1.5 % acidity + Refrigerated	50.00	51.53	1.53	1.51(1.23)	1.29(1.14)	0.21	6.01(2.45)	8.30(2.80)	2.29	40.50	42.15	1.65
T_3S1- 40% pulp+ 1.0 % acidity + Refrigerated	50.00	51.60	1.60	1.01(1.00)	0.77(0.87)	0.24	7.50(2.74)	9.95(3.15)	2.46	44.00	45.79	1.80
T_4S1-405% pulp+ 1.5 % acidity + Refrigerated	50.00	51.50	1.50	1.52(1.23)	1.35(1.16)	0.17	7.50(2.74)	9.67(3.11)	2.19	44.00	45.55	1.57
T_5S1- 45% pulp+ 1.0 % acidity + Refrigerated	50.00	51.57	1.57	1.04(1.02)	0.81(0.90)	0.23	8.59(2.93)	10.98(3.31)	2.39	45.50	47.24	1.74
T_6S1- 45% pulp+ 1.5 % acidity + Refrigerated	50.00	51.46	1.46	1.52(1.23)	1.40(1.18)	0.12	8.59(2.93)	10.65(3.26)	2.06	45.50	46.95	1.45
T_1S2- 35% pulp+ 1.0 % acidity + Ambient	50.00	51.97	1.97	1.01(1.00)	0.40(0.63)	0.61	6.01(2.45)	10.77(3.28)	4.76	40.50	43.31	2.81
T_2S2- 35% pulp+ 1.5 % acidity + Ambient	50.00	51.81	1.81	1.51(1.23)	0.96(0.97)	0.55	6.01(2.45)	10.36(3.22)	4.35	40.50	43.07	2.57
T_3S2- 40% pulp+ 1.0 % acidity + Ambient	50.00	51.92	1.92	1.01(1.00)	0.42(0.65)	0.59	7.50(2.75)	12.14(3.48)	4.64	44.00	46.75	2.75
T_4S2- 40% pulp+ 1.5 % acidity + Ambient	50.00	51.75	1.75	1.52(1.23)	1.02(1.01)	0.50	7.50(2.75)	11.66(3.41)	4.16	44.00	46.43	2.43
T_5S2- 45% pulp+ 1.0 % acidity + Ambient	50.00	51.86	1.86	1.04(1.02)	0.47(0.69)	0.57	8.59(2.93)	13.10(3.62)	4.51	45.50	48.18	2.68
T_6S2- 45% pulp+ 1.5 % acidity + Ambient	50.00	51.69	1.69	1.52(1.23)	1.05(1.02)	0.47	8.59(2.93)	12.55(3.54)	3.96	45.50	47.79	2.29
'F' test	NS	Sig	Sig	NS	Sig	Sig	NS	Sig	Sig	NS	Sig	Sig
SE(m)±	0.009	0.008	0.008	0.013	0.015	0.005	0.004	0.005	0.005	0.003	0.005	0.006
CD at 5%	–	0.024	0.024	–	0.044	0.015	–	0.015	0.015	–	0.016	0.017

(Figure in parenthesis are square root value)

period might be due to hydrolysis polysaccharides like pectin, starch, etc. . Similar observation recorded Roy and Sigh.

CONCLUSION

For the investigation following conclusions could be drawn.

1. Bael squash prepared from different recipes stored under refrigerated condition was found superior upto 120th days as compared to ambient storage.
2. The changes in TSS, acidity, sugars of bael squash were minimum in 45% Bael pulp + 1.5 % Acidity when stored under refrigerated condition as compared to ambient storage.

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