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Standardization of a recipe for the preparation of tutti-frutti from Apple Ber (*Ziziphus mauritiana* L.)

Shubham Bhagwan Bhand, Saket Mishra, VM Prasad, Vijay Bahadur and Sarvada Bhand

Abstract
The present experiment was carried out during December 2020 to April 2021 in Post Harvest Laboratory of Department of Horticulture, SHUATS, Prayagraj. The experiment was consisted of 10 treatments and thrice replications with 0.1% KMS (Potassium metabisulphate). In that concentrations of sugar syrup mainly 40 °B, 50 °B 60 °B and 70 °B prepared by steeping same sample for 24 hrs time duration. The treatments were T_1 (Control), T_2 (NaCl 10%), T_3 (NaCl 20%), T_4 (NaCl 30%), T_5 ($Ca(OH)_2$ 0.5%), T_6 ($Ca(OH)_2$ 1%), T_7 ($Ca(OH)_2$ 1.5%), T_8 ($CaCl_2$ 1%), T_9 ($CaCl_2$ 1.5%) and T_{10} ($CaCl_2$ 2%). Apple ber tutti-frutti was stored for 120 days at ambient temperature. From the present investigation it is found that treatment T_{10} ($CaCl_2$ 2%) was found superior in respect of the parameters Total Soluble Solids, Titratable Acidity, Reducing Sugar, Total Sugar, Ascorbic Acid, Score for Colour and Appearance, Flavour and Taste, Texture and Overall Acceptability of Apple ber tutti frutti. In terms of benefit cost ratio the highest net return, Benefit cost Ratio was also found in T_{10} (CaCl2 2%) and minimum was recorded in treatment T_4 (NaCl 30%) in all the parameters.

Keywords: Apple Ber, Tutti-Frutti, Physico-chemical, Organoleptic, Storage

Introduction
Ber (*Ziziphus mauritiana* L.) belongs to the family Rhamnaceae. It is widely distributed in tropical and subtropical climate in the world. Ber has been recognized as a useful edible fruit since antiquity in India. Ber is relished for its sweet and sour fruits. It is an ideal fruit tree for arid and semi-arid regions in tropical and subtropical climate. It is highly suitable for marginal land and hot arid region. It is mainly grown in India, as well as different countries in central Asia, China and Taiwan. It has been truly called as poor man's apple.

There are two distinct groups of ber found in India. There are two distinct groups of ber found in India *viz*. Chinese ber (*Ziziphus jujube*) which is an upright tree of 10 m height, bearing dark red fruit and Indian ber (*Ziziphus mauritiana*), a spreading tree having drooping branches with its leaves rusty on lower surface. Ber has about 50 genera and more than 600 species (Pareek, 1983). Bhansli (1975) stated that the genus *Ziziphus* consists of 135 species of which nearly 90 are found in the old world and 45 species are confined to the new world. He has described 28 species found in various regions of India.

Ber fruit is a highly nutritious fruit, rich in ascorbic acid and contains good amount of protein and amino acids. It contains good amount of vitamins A, B complex and C in comparison to other fruits. Ber fruits are also high in calorific value and ascorbic acid as compared to apple and orange (Bakshi and Singh, 1974). It is also rich source of different nutrients like calcium, phosphorus and iron. The ascorbic acid content in different ber cultivars ranged from 39-160 mg/g (Helmy *et al*, 2012). The ber fruit contains 20-28% sugar, 0.3-2.5% acid, 2.9% protein, 500 to 600 mg vitamin C/l00g pulp and very high quality of vitamin B complex (Kuliev and Guseinnova, 1974).

Apple ber (*Ziziphus mauritiana* L.) is a variety of ber cultivated in Thailand. The taste of Apple ber (*Ziziphus mauritiana* L.) fruit is very sweet. The weight of each fruit is about 50-150 g. It looks similar to green apples in taste and colour. Average yield of Apple ber fruit per plant is 50-100 kg. It is a thorn free tree, an early variety and suitable for extremely dry area in Rajasthan, Haryana, Gujarat, Madhya Pradesh, Jammu and Kashmir, Chhattisgarh, Karnataka and Maharashtra.

Apple ber (*Ziziphus mauritiana* L.) has a niche market in India at present. Prices are dependent on the demand for the fruit but as compared to other variety of ber fruit price is more. The ease of establishment and rapid growth may quickly lead to an oversupply in the market. Processed apple ber fruit products are not available in our markets and no systematic work done on

processing of apple ber fruit. Food processing industries are in developing stage in India and consumption of processed fruit products is gradually becoming popular. Number of locally processed fruit products is now available in the market. But no ber processed products are available in market or commercial. So the scope of utilizing apple ber fruit remains bright in India. If quality products from apple ber fruit are developed, it might be welcomed by the consumers.

Materials and Methods

The present study entitled ''Standardization of a recipe for the preparation of tutti-frutti from Apple ber (*Ziziphus mauritiana* L.)'' was laid out with the appropriate methodology at the post-harvest laboratory of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2020 to 2021. The Experimental was conducted in Completely Randomized Design (CRD) with 10 treatments of and 3 replications and stored for 120 days.

These treatments are T_1 (Control), T_2 (NaCl 10%), T_3 (NaCl 20%), T_4 (NaCl 30%), T_5 (Ca(OH)2 0.5%), T_6 (Ca(OH)2 1%), T_7 (Ca(OH)2 1.5%), T_8 ($CaCl_2$ 1%), T9 ($CaCl_2$ 1.5%), T10 (CaCl2 2%).

Procedure of preparation Apple ber tutti-frutti

Uniform, unripe ber fruits Cv. Apple ber were washed, peeled and destoned. The peeled and destoned fruits were cut into small cubes of uniform size with cube maker. Cubes were then blanched with hot water in 0.1 per cent potassium metabisulphate for 3 minutes. Later on the cubes were steeped for 1hr in different chemicals as per the treatment. After pretreatment, the cubes were washed continuously steeped in sugar syrup having each concentration of 40 B°, 50 B°, 60 B°, 70 B° for 24hr and then dried in sun dryer for 6 hr. Then the tutti frutti was stored in a plastic container at ambient temperature. This was then subsequently used for periodical evaluation at Initial, 30, 60, 90 and 120 days interval for a period.

Sensory analysis of Apple ber tutti-frutti

For statistical analysis samples were evaluated for TSS, Acidity, Reducing sugar, Total suagr, Ascorbic acid and sensory evaluation for colour and appearance, flavour and taste, texture and overall acceptability was performed by panel of 9 members. The samples were presented to 9 members. The members were asked to rate the different composition presented to them on a 9-point hedonic scale with the ratings of: 9 = Like extremely; 8 = Like very much; 7 = Like moderately; 6 = Like slightly; 5 = Neither like nor dislike; 4 = Dislike slightly; 3 = Dislike moderately; 2 = Dislike very much; and 1 = Dislike extremely. The result was analyzed by statistical software (statistics).

Results and Discussion

1. Physico-Chemical Parameters

Total Soluble Solid (B°), Acidity, Reducing Sugar, Total Sugar, Ascorbic acid

2. Organoleptic Parameters

Colour and Appearance, Flavour and Taste, Texture, and Overall Acceptability.

3. Economics

Net income and Benefit Cost ratio.

Total Soluble Solids (^{0}Brix)

In terms of TSS, maximum score (71.24, 72.07, 72.71, 73.83 and 75.12 °Brix) at Initial, 30, 60, 90 and 120 days after storage was observed in treatment T_{10} ($CaCl_2$ 2%), at Initial, 30, 60, 90 and 120 days after storage, whereas the minimum score was observed in treatment T_4 (NaCl 30%) with (66.82, 67.63, 68.46, 69.42 and 69.94 ^{0}Brix) during 120 days storage. The total soluble solids content of Apple ber tutti frutti was showed increasing trend in all treatments during storage. This might be due to the conversion of polysaccharides into sugars during hydrolysis process. Increase in TSS might also be attributed to the reduction in moisture content of the product with storage. Manivsagan *et al*. (2006) [9] in Karonda candy has also been reported to increase during storage and Tripathi *et al*. (1988) [18] in Aonla Candy.

Acidity (%)

In terms of Acidity lowest score (0.27, 0.32, 0.37, 0.43 and 0.49%) at Initial, 30, 60, 90 and 120 days respectively after storage was observed in treatment T_4 (NaCl 30%), whereas the maximum score was observed in treatment T_7 (Ca(OH)2 1.5%) with (0.58, 0.69, 0.76, 0.85 and 0.96%) during 120 days storage. The acidity (%) of Apple ber tutti frutti was showed increasing trend in all treatments during storage. An increase in acidity (%) of Apple ber tutti frutti during storage might be attributed to the pectic acid has been reported to increase in the acidity in fruit products. hence, degradation of pectic substances into acid might have contributed towards an increased in acidity of apple ber candy during storage. Rani and Bhatia (1985) [14] recorded a continuous decrease in titratable acidity of pear candy and Manivasagan *et al.* (2006) [9] observed that the acidity of karonda candy decrease.

Reducing Sugar (%)

In terms of Reducing Sugar content at different periods of storage. The highest score of reducing sugar (25.14, 25.97, 27.15, 28.96 and 29.97) at Initial, 30 60, 90 and 120 days respectively was observed in treatment T_1 (Control), at initial, 30, 60, 90 and 120 days respectively, whereas the minimum score was observed in treatment T_7 (Ca(OH)2 1.5%) with (22.83, 23.35, 23.95, 24.67 and 25.58) during 120 days storage. The Reducing Sugar content of Apple ber tutti frutti was showed increasing trend in all treatments during storage. The increase in reducing sugars was probably due to acid hydrolysis of sucrose during storage. The increase in reducing sugar with storage might be because of increased degree of inversion of sugars Tripathi *et al*. (1988) [18]; Kaikadi *et al*. (2006) [7]; Srivastava *et al*. (2006) [16] and Nayak *et al.* (2012) [12] also reported an increase in reducing sugars of aonla preserve, ber candy, ash gourd candy and aonla candy, respectively during storage.

Total Sugar (%)

In terms of Total sugar content at different periods of storage. The maximum score of Total sugar content (58.77, 59.86, 60.68, 61.41 and 62.13%) at Initial, 30, 60, 90 and 120 days respectively was observed in treatment T_{10} ($CaCl_2$ 2%), whereas the minimum score was observed in treatment T_4 (NaCl 30%) with (57.13, 57.54, 58.11, 58.59 and 59.05%) during 120 days storage. The Total sugar content of Apple ber tutti frutti was showed increasing trend in all treatments during storage. Results indicated that Total sugar content of tutti frutti increased continuously during entire period of storage might be due to increased degree of conversion of

polysaccharides in to soluble sugars. These results were in conformity with the results obtained by Singh and Pathak (2016) [15] in ber candy, Rani and Bhatia (1985) [14] in pear candy.

Ascorbic acid (%)

In terms of Ascorbic acid content at different periods of storage. The maximum score of Ascorbic acid content (82.53, 81.18, 79.95, 79.29 and 78.63%) at Initial, 30, 60, 90 and 120 days respectively was observed in treatment T_1 (Control), Whereas the minimum score was observed in treatment T_4 (NaCl 30%) with (81.08, 79.12, 77.65, 76.66 and 75.86%) during 120 days storage. The Ascorbic acid content of Apple ber tutti frutti was showed decreasing trend in all treatments during storage. Reduction in ascorbic acid was due to oxidation by transfer of oxygen through packaging material which results in formation of dehydro ascorbic acid. Similar findings previously also reported by Manivasagan *et al.* (2006) [9] in karonda candy and Rani and Bhatia (1985) [14] in Pear Candy.

Score for Colour and appearance

In terms of score for colour and appearance (8.24, 8.19, 8.04, 7.96 and (7.82) at Initial, 30, 60, 90 and 120 days respectively was observed in treatment T_{10} ($CaCl_2$ 2%), followed by treatment T_9 ($CaCl_2$ 1.5%) with (7.35, 7.16, 7.05, 7.16 and 7.00) whereas the minimum score was observed in treatment T_6 (6.86, 6.56, 6.26, 6.16, and 6.07) during 120 days storage. The colour and appearance of Apple ber tutti frutti was showed decreasing trend in all value added Ber candy during storage due to increase in time interval, temperature and action of enzymes. Similar findings previously also reported by Babalola (2002) [2] in Guava leather, Navitha and Mishra (2018) [11] in Ber Candy.

Score for Flavour and Taste

In terms of Flavour and Taste there were significant differences among all the treatments during storage. There was subsequent decrease in score for flavor and Taste at different periods of storage. The highest score of flavour and taste (8.55, 8.18, 8.15, 7.68 and 7.53) at Initial, 30, 60, 90 and 120 days respectively was observed in treatment T_{10} ($CaCl_2$ 2%), followed by treatment T_1 (Control) with (7.42, 7.23, 7.27, 7.21 and 7.13) and whereas the minimum score was observed in treatment T_4 (NaCl 30%) with (5.53, 5.17, 5.10, 5.12 and 4.98) during 120 days storage. The score for Flavour and Taste showed in decreasing trend in all value added Apple ber tutti frutti during storage due to increase in time interval, temperature and action of enzymes. Similar results previously also reported by Navitha and Mishra (2018) [11] in Ber Candy.

Score for Texture

In terms of score for Texture (8.52, 8.16, 7.96, 7.37 and 7.47) at Initial, 30, 60, 90 and 120 days respectively was observed in treatment T_{10} ($CaCl_2$ 2%), followed by treatment T_9 ($CaCl_2$ 1.5%) with (7.35, 7.16, 7.05, 7.16 and 7.00) whereas the minimum score was observed in treatment T_4 (NaCl 30%) with (5.54, 5.48, 5.11, 5.10 and 5.00) during 120 days storage. The Texture of Apple ber tutti frutti was showed decreasing trend in all value added tutti frutti during storage due to increase in time interval, temperature and action of enzymes. Similar findings previously also reported by Babalola (2002) [2] in Guava leather and Chavan (2010) [4] in jackfruit product, Navitha and Mishra (2018) [11] in Ber Candy.

Score for Overall acceptability

In terms of score for Overall acceptability at different periods of storage, The highest score of overall acceptability (8.55, 8.13, 7.98, 7.56 and 7.35) at Initial, 30, 60, 90 and 120 days respectively was observed in treatment T_{10} ($CaCl_2$ 2%), followed by treatment T_5 (Ca(OH)2 0.5%) with (7.36, 7.07, 6.79, 7.13 and 6.94) whereas the minimum score was observed in treatment T_4 (NaCl 30%) with (5.75, 5.12, 5.08, 5.07 and 4.97) during 120 days storage. However, the organoleptic characters showed a gradual decreasing during storage due to increase in time interval, temperature and action of enzymes at room temperature. This finding was in conformity with Navitha and Mishra (2018) [11] in Ber Candy.

Economics

In terms of Economics the maximum Gross return, Net Return and Benefit cost ratio (Rs. 300.00), (Rs. 151.50) and (2.02) respectively was recorded in treatments T_{10} ($CaCl_2$ 2%) and minimum Gross return, Net return and Benefit cost ratio (Rs. 220.00), (Rs. 70.50) and (1.47) was recorded in treatment T_4 (NaCl 30%).

Table 1: Total Soluble Solids (°Brix), Acidity (%) and Reducing sugar of Apple ber tutti frutti during storage in ambient condition

Treatment Symbol	Treatment Combination	Total Soluble Solids (°Brix)					Acidity (%)					Reducing Sugar				
		Initial	30 DAS	60 DAS	90 DAS	120 DAS	Initial	30 DAS	60 DAS	90 DAS	120 DAS	Initial	30 DAS	60 DAS	90 DAS	120 DAS
T_1	Control	70.26	71.13	71.91	72.73	73.69	0.60	0.67	0.72	0.77	0.84	25.14	25.97	27.15	28.96	29.97
T_2	NaCl 10%	68.22	68.94	69.75	70.51	71.39	0.57	0.64	0.69	0.76	0.82	24.09	24.63	25.20	25.95	26.99
T_3	NaCl 20%	68.30	69.15	69.85	70.49	71.24	0.57	0.63	0.69	0.72	0.76	24.32	24.83	25.39	26.12	26.92
T_4	NaCl 30%	66.82	67.63	68.46	69.42	69.94	0.27	0.32	0.37	0.43	0.49	24.06	24.46	25.07	25.90	26.81
T_5	Ca(OH)2 0.5%	70.04	70.94	71.73	72.74	74.11	0.35	0.39	0.43	0.48	0.53	25.64	26.61	27.44	28.37	29.33
T_6	Ca(OH)2 1%	69.58	70.47	71.21	72.11	72.74	0.49	0.55	0.60	0.66	0.71	23.70	24.10	24.72	25.68	26.89
T_7	Ca(OH)2 1.5%	69.28	70.20	70.84	71.43	72.09	0.58	0.69	0.76	0.85	0.96	22.83	23.35	23.95	24.67	25.58
T_8	CaCl2 1%	69.24	69.84	70.42	70.87	71.51	0.47	0.54	0.59	0.64	0.73	24.44	25.01	25.81	26.72	27.75
T_9	CaCl2 1.5%	69.54	70.36	71.08	71.94	72.30	0.41	0.44	0.47	0.57	0.67	24.92	25.54	26.08	27.18	28.30
T10	CaCl2 2%	71.24	72.07	72.71	73.83	75.12	0.32	0.39	0.46	0.53	0.58	25.50	26.38	27.23	28.10	28.93
F-Test		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SE(d)		0.095	0.088	0.105	0.073	0.080	0.027	0.026	0.024	0.023	0.027	0.024	0.025	0.023	0.025	0.025
C.D. at 5%		0.199	0.186	0.221	0.153	0.168	0.057	0.055	0.051	0.048	0.057	0.051	0.052	0.048	0.053	0.052

Table 2: Total Sugar (%), Ascorbic acid (%) and Colour and appearance of Apple Ber Tutti Frutti during storage in ambient condition

Treatment Symbol	Treatment Combination	Total Sugar					Ascorbic Acid (%)					Colour and Appearance				
		Initial	30 DAS	60 DAS	90 DAS	120 DAS	Initial	30 DAS	60 DAS	90 DAS	120 DAS	Initial	30 DAS	60 DAS	90 DAS	120 DAS
T_1	Control	58.67	59.17	59.89	60.92	61.51	82.53	81.18	79.95	79.29	78.63	7.66	7.38	7.25	7.15	7.05
T_2	NaCl 10%	57.32	58.13	58.89	59.54	60.04	81.26	79.38	77.84	76.97	76.19	7.22	7.14	6.88	6.65	6.35
T_3	NaCl 20%	57.62	58.21	58.83	59.47	60.02	81.04	79.22	77.74	76.91	76.13	7.35	7.15	7.04	6.94	6.76
T_4	NaCl 30%	57.13	57.54	58.11	58.59	59.05	81.08	79.12	77.65	76.66	75.86	7.27	6.99	6.92	6.80	6.64
T_5	Ca(OH)2 0.5%	57.82	58.53	59.24	59.86	60.55	81.48	79.69	78.38	77.57	76.84	6.93	6.76	6.49	6.34	6.21
T_6	Ca(OH)2 1%	57.38	58.14	58.90	59.54	59.93	81.32	79.34	78.03	77.09	76.42	6.86	6.56	6.26	6.16	6.07
T_7	Ca(OH)2 1.5%	57.49	58.11	58.79	59.45	59.96	81.18	79.40	78.11	77.30	76.63	6.94	6.85	6.73	6.56	6.31
T_8	CaCl2 1%	58.73	59.34	60.19	60.84	61.46	82.09	80.26	78.83	77.91	77.18	7.55	7.46	7.35	7.22	7.11
T_9	CaCl2 1.5%	58.92	59.55	60.25	61.27	61.25	82.37	80.78	79.53	78.77	78.07	8.01	7.84	7.65	7.56	7.44
T10	CaCl2 2%	58.77	59.86	60.68	61.41	62.13	82.45	81.35	80.03	79.14	78.43	8.24	8.19	8.04	7.96	7.82
F-Test		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SE(d)		0.020	0.024	0.026	0.021	0.021	0.037	0.011	0.022	0.021	0.026	0.016	0.030	0.030	0.021	0.023
C.D. at 5%		0.043	0.050	0.054	0.045	0.043	0.078	0.023	0.045	0.043	0.054	0.033	0.063	0.064	0.043	0.047

Table 3: Flavour and Taste, Texture and Overall acceptability of Apple ber tutti frutti during storage in ambient condition

Treatment Symbol	Treatment Combination	Flavour and Taste					Texture					Overall acceptability					Cost: Benefit Ratio
		Initial	30 DAS	60 DAS	90 DAS	120 DAS	Initial	30 DAS	60 DAS	90 DAS	120 DAS	Initial	30 DAS	60 DAS	90 DAS	120 DAS	
T_1	Control	7.42	7.23	7.27	7.21	7.13	5.54	5.48	5.11	5.10	5.00	7.48	7.18	7.16	6.92	6.60	1.93
T_2	NaCl 10%	6.64	6.28	6.23	6.18	5.86	5.79	5.59	5.40	5.19	5.12	6.69	6.21	6.16	6.17	5.74	1.67
T_3	NaCl 20%	5.80	5.48	5.44	5.19	5.12	7.41	7.24	7.05	7.00	6.47	5.77	5.44	5.31	5.11	5.10	1.53
T_4	NaCl 30%	5.53	5.17	5.10	5.12	4.98	7.55	7.26	7.17	7.04	6.68	5.75	5.12	5.08	5.07	4.97	1.47
T_5	Ca(OH)2 0.5%	7.40	7.30	7.21	7.09	6.78	7.40	7.21	7.02	6.99	6.33	7.36	7.07	6.79	7.13	6.94	1.99
T_6	Ca(OH)2 1%	7.42	7.26	7.10	7.02	6.48	7.33	6.44	6.29	6.20	6.06	7.43	7.16	6.87	6.97	6.45	1.82
T_7	Ca(OH)2 1.5%	7.46	6.51	6.34	6.24	6.14	6.65	6.25	6.20	6.16	5.83	7.42	7.15	6.86	6.81	6.33	1.75
T_8	CaCl2 1%	6.71	6.40	6.28	6.23	6.08	6.80	6.58	6.26	6.19	6.06	6.66	6.94	6.21	6.15	6.03	1.73
T_9	CaCl2 1.5%	7.35	7.23	7.07	7.09	6.35	7.35	7.16	7.05	7.16	7.00	7.15	7.21	6.75	6.81	6.44	1.78
T10	CaCl2 2%	8.55	8.18	8.15	7.68	7.53	8.52	8.16	7.96	7.37	7.47	8.55	8.13	7.98	7.56	7.35	2.02
F-Test		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
SE(d)		0.172	0.113	0.084	0.060	0.132	0.162	0.224	0.133	0.119	0.136	0.268	0.330	0.295	0.152	0.156	
C.D. at 5%		0.362	0.237	0.176	0.127	0.278	0.340	0.470	0.279	0.251	0.286	0.563	0.693	0.620	0.320	0.327	

Conclusion

In this present investigation that treatment T_{10} (CaCl2 2%) was found most suitable treatment in terms of physico-chemical parameters like Total soluble solid (^{0}Brix), Acidity (%), Reducing Sugar (%), Total Sugar, and Ascorbic Acid. With respectively sensory attributes like Colour & appearance, Flavor & taste, Texture and Overall acceptability also T_{10} (CaCl2 2%) was found best. In terms of cost benefit ratio the highest net return, Cost Benefit Ratio was found in T_{10} (CaCl2 2%).

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