

Original Research Article

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Natural Coatings on Physicochemical Properties and Shelf life of Papaya (*Carica papaya*) Slices cv. Red Lady

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ABSTRACT

The present experiment was carried out during 2018 - 2019 in Post Harvest Laboratory of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Completely Randomized Design (CRD), with thirteen treatments, replicated thrice. The treatments were T₀ (Control), T₁ (Sugar 20%), T₂ (Sugar 40%), T₃ (Sugar 60%), T₄ (Sugar 80%), T₅ (Jaggery 20%), T₆ (Jaggery 40%), T₇ (Jaggery 60%), T₈ (Jaggery 80%), T₉ (Honey 20%), T₁₀ (Honey 40%), T₁₁ (Honey 60%) and T₁₂ (Honey 80%). From the present investigation it is found that treatment T₁₁, i.e., Honey 60% edible coating was found superior in physico-chemical properties and shelf life of papaya slices, followed by treatment T₁₂ (Honey 80%) and minimum was observed in treatment T₀ (Control), in terms of economics maximum Gross return Rs. 512.00 recorded in T₈ (Jaggery 80%), maximum Net Return Rs. 255.00 and cost benefit ratio 1:2.02, was recorded in T₆ (Jaggery 40%) and minimum Gross Return Rs. 336.00, Net Return Rs. 107.00 recorded in T₀ (Control) and lowest Cost Benefit Ratio 1:1.40 recorded in T₁₂ (Honey 80%).

Keywords

Papaya, Natural coatings, Sugar, Jaggery, Honey

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Introduction

Papaya (*Carica papaya* L.) provides several vitamins, particularly of B group, several antioxidant molecules such as flavonoids, carotenes and vitamin-C as well as foliates; trace minerals, pantothenic acid, potassium, magnesium and dietary fiber. Papaya flesh is

very high in vitamin A. The overall quality and shelf-life of fruits and vegetables are reduced by several including water loss, browning, texture deterioration, and microbial growth, among others.

In the case of fresh-cut fruits, it is well known that these events are accelerated due to lesions

of tissues inflicted by peeling, slicing, and cutting (Rojas-Grau *et al.*, 2008).

There are Several techniques which have been employed to minimize the deleterious effects of minimal processing in fruits and vegetables, including refrigeration, controlled atmosphere packaging, use of additives, and Plastic (King and Bolin, 1989; Wong *et al.*, 1994). For many years, the most effective chemical preservatives for fresh produce were sulfites since they served as both inhibitors of enzymatic browning and as antimicrobials. However, the use of sulfur dioxide (SO₂) was subject to government regulation in several countries and sodium bisulfite has been linked to adverse reactions among certain consumer populations (Sapers, 1993). Therefore, there is a need of safe preservatives and preservation techniques to substitute for sulfite and other plastic treatments. As Sugar, Jaggery and Honey are among the best natural preservatives which are not only safe but also effective and easily available

The main objective of fruit processing is to supply wholesome safe, nutritious and acceptable fruit to consume throughout the year and the main objective of post harvest studies are reduction of fruit losses, import of produce and generation of Urban and Rural employment as well as sources of income to the farmers. It also helps in developing value added products so that they can be relished throughout the year. So there should be some ways that farmer can easily and rapidly save their produce. This can be only being done only if they have a processing industry nearby.

Materials and Methods

The Experimental was conducted in Completely Randomized Design (CRD) with 13 treatments of Sugar, Jaggery and Honey with three replications in the Post Harvest Laboratory of Department of Horticulture,

Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during 2018 - 2019. Total number of treatments were thirteen viz. T₀ (Control), T₁ (Sugar 20%), T₂ (Sugar 40%), T₃ (Sugar 60%), T₄ (Sugar 80%), T₅ (Jaggery 20%), T₆ (Jaggery 40%), T₇ (Jaggery 60%), T₈ (Jaggery 80%), T₉ (Honey 20%), T₁₀ (Honey 40%), T₁₁ (Honey 60%) and T₁₂ (Honey 80%).

Results and Discussion

The results of the present investigation, regarding the effect of natural coatings on physicochemical properties and shelf life of Papaya, have been discussed and interpreted in the light of previous research work done in India and abroad. The results of the experiment are summarized below.

The maximum score of TSS (8.60, 10.05, 11.46 and 12.42 °Brix) at Initial, 5, 10 and 15 days was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (8.33, 9.84, 11.01 and 12.95 °Brix), minimum score was observed in treatment T₀ (control) with (7.19, 8.22, 9.40 and 10.48 °Brix). An increase in total soluble solids content of Papaya slices during storage may possibly be due to conversion of polysaccharides starch etc, in to sugars. Total soluble solids content of Papaya slices, Singh, (1985) and Pandey, (1995), juice has also been reported to increase during storage. Shabi *et al.*, (2018) reported in Guava Cheese.

The lowest score of Acidity (0.606, 0.578, 0.561 and 0.534 %) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (0.633, 0.607, 0.590 and 0.567 %), whereas the maximum score was observed in treatment T₀ (control) with (0.826, 0.788, 0.769 and 0.754 %). A decrease in acidity (%) of Papaya slices during storage might be attributed to the chemical interaction

between constituents of Papaya slices induced by temperature and action of enzymes. Deka, (2000) and Deka *et al.*, (2004) reported similar finding with lime-aonla blended RTS and Nath and Yadav, (2005b) with ginger-kinnow squash. Shabi *et. al.*, (2018) in Guava Cheese.

In terms of pH the lowest score of pH (4.41, 4.35, 4.25 and 4.16) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (4.44, 4.39, 4.29 and 4.20), whereas the maximum score was observed in treatment T₀ (control) with (5.10, 4.89, 4.64 and 4.62). The pH content of Papaya slices was showed decreasing trend in all edible coatings during storage. There was a negligible change in pH content decreased of the papaya slices during storage may possibly be due to increase in time interval, temperature and action of enzymes. Similar results were reported by Shanker *et al.*, (1967b) in case of guava juice. Shabi *et. al.*, (2018) in Guava Cheese.

The highest score of Vitamin C (99.80, 96.46, 94.02 and 90.59 mg/100g) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (93.66, 91.95, 90.24 and 87.95 mg/100 g) whereas the minimum score was observed in treatment T₀ (Control) with (70.31, 67.66, 65.65 and 62.95 mg/100 g). Results indicated that vitamin c content of papaya slices reduced continuously during entire period of storage. This reduction may be due to oxidation of Vitamin c in to dehydro ascorbic acid by oxygen. Several authors have also recoded the loss of vitamin c in fruit juice during storage Ghosh *et al.*, (1982) and Shabi *et. al.*, (2018) reported in Guava Cheese.

The highest score of Reducing Sugar (3.03, 3.16, 3.31 and 3.43 %) at Initial, 5, 10 and 15 days respectively was observed in treatment

T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (2.94, 3.05, 3.17 and 3.29 %) whereas the minimum score was observed in treatment T₀ (Control) with (2.58, 2.70, 2.79 and 2.91 %).

The increase in reducing sugar was slightly higher in storage condition that could be attributed to more rapid hydrolysis of polysaccharides and their subsequent conversion into sugars. Deka, (2000) and Deka *et al.*, (2004) reported similar finding with lime-aonla blended RTS and Nath and Yadav, (2005b) with ginger-kinnow squash. Shabi *et. al.*, (2018) in Guava Cheese.

The highest score of non-reducing sugar (5.90, 6.06, 6.18 and 6.29 %) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (5.75, 5.90, 6.03 and 6.19 %) whereas the minimum score was observed in treatment T₀ (Control) with (4.35, 4.50, 4.66 and 4.80 %). The non-reducing sugar content of Papaya slices was showed increasing trend in all edible coatings during storage due to increase in time interval and temperature. Kumar *et al.*, (2012) and Shabi *et. al.*, (2018) reported similar finding with Guava Cheese.

The highest score of total sugar (8.94, 9.22, 9.49 and 9.72 %) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (8.69, 8.95, 9.20 and 9.48 %) whereas the minimum score was observed in treatment T₀ (control) with (6.94, 7.20, 7.46 and 7.72 %).

The result showed a progressive and increase in total sugar content through the storage period increase in total sugar might be due to hydrolysis of polysaccharides like starch, pectin etc, and there conversion into sample sugars.

Table.1 Effects of Natural coatings on Total Soluble Solids (^oBrix), Acidity (%), p^H, Vitamin C (mg/100 g), Reducing Sugar (%) and Non Reducing Sugar (%) of Papaya Slices.

Treatment Symbol	Treatment Details	Total Soluble Solids (^o Brix)				Acidity (%)				pH (%)				Vitamin C(mg/100 g)				Reducing Sugar (%)				Non - Reducing Sugar (%)			
		Initial	5 DA C	10 DA C	15 DA C	Initial	5 DA C	10 DA C	15 DA C	Initial	5 DA C	10 DA C	15 DA C	Initial	5 DA C	10 DA C	15 DA C	Initial	5 DAC	10 DA C	15 DAC	Initial	5 DAC	10 DAC	15 DAC
T ₀	Control	7.19	8.22	9.40	10.48	0.826	0.788	0.769	0.754	5.10	4.89	4.64	4.62	70.31	67.66	65.65	62.95	2.58	2.70	2.79	2.91	4.35	4.50	4.66	4.80
T ₁	Sugar 20%	7.55	8.81	10.10	11.22	0.766	0.735	0.719	0.702	4.70	4.82	4.82	4.51	78.16	75.88	73.78	70.98	2.76	2.97	3.03	3.16	4.87	5.00	5.17	5.30
T ₂	Sugar 40%	7.68	8.85	10.15	11.28	0.753	0.731	0.714	0.699	4.58	4.20	4.81	4.22	85.21	82.77	80.84	77.87	2.79	2.85	2.90	3.01	5.00	5.16	5.32	5.45
T ₃	Sugar 60%	7.72	8.84	10.06	11.24	0.733	0.720	0.708	0.685	4.56	4.36	4.27	4.31	88.62	85.91	83.66	80.88	2.80	2.86	2.94	3.06	5.08	5.19	5.33	5.47
T ₄	Sugar 80%	7.73	8.86	10.08	11.27	0.727	0.709	0.689	0.672	4.73	4.62	4.54	4.44	90.32	88.13	85.68	82.99	2.87	2.90	2.94	3.03	5.10	5.23	5.35	5.47
T ₅	Jaggery 20%	7.70	8.82	10.14	11.43	0.785	0.762	0.746	0.726	4.59	4.59	4.42	4.36	77.23	74.83	72.80	70.31	2.88	2.96	3.07	3.19	5.09	5.24	5.37	5.50
T ₆	Jaggery 40%	7.85	9.01	10.23	11.33	0.763	0.743	0.727	0.708	4.78	4.59	4.42	4.61	78.60	75.75	73.65	71.23	2.86	2.96	2.99	3.11	5.15	5.28	5.43	5.59
T ₇	Jaggery 60%	7.83	8.96	10.19	11.38	0.749	0.729	0.713	0.698	4.84	4.86	4.04	4.62	81.02	78.60	76.67	73.68	2.89	2.95	3.03	3.14	5.26	5.42	5.55	5.66
T ₈	Jaggery 80%	7.88	9.04	10.42	11.41	0.737	0.723	0.711	0.691	4.89	4.53	4.12	4.75	84.05	81.81	79.79	76.58	2.92	2.98	3.05	3.16	5.35	5.49	5.62	5.74
T ₉	Honey 20%	8.06	9.39	10.53	11.63	0.729	0.706	0.691	0.670	4.87	4.83	4.51	4.69	75.48	72.98	70.94	68.59	2.84	2.97	3.07	3.17	5.10	5.26	5.42	5.60
T ₁₀	Honey 40%	8.08	9.50	10.67	11.77	0.680	0.658	0.639	0.617	4.56	4.47	4.36	4.27	84.02	81.93	79.84	77.72	2.88	2.97	3.13	3.25	5.25	5.39	5.55	5.73
T ₁₁	Honey 60%	8.60	10.05	11.46	12.42	0.606	0.578	0.561	0.534	4.41	4.35	4.25	4.16	99.80	96.46	94.02	90.59	3.03	3.16	3.31	3.43	5.90	6.06	6.18	6.29
T ₁₂	Honey 80%	8.33	9.84	11.01	11.95	0.633	0.607	0.590	0.567	4.44	4.39	4.29	4.20	93.66	91.95	90.24	87.95	2.94	3.05	3.17	3.29	5.75	5.90	6.03	6.19
F-test		S	S	S	S	S	S	S	S	NS	S	S	S	NS	NS	NS	NS	NS	S	S	S	S	S	S	S
SE(d)		0.201	0.229	0.228	0.234	0.020	0.019	0.019	0.020	0.285	0.032	0.034	0.033	8.427	8.340	8.381	8.252	0.128	0.079	0.075	0.082	0.246	0.257	0.259	0.261
C.V.		3.135	3.086	2.702	2.498	3.335	3.283	3.390	3.584	7.424	0.861	0.955	0.915	12.349	12.590	12.986	13.240	5.511	3.296	3.007	3.175	5.821	5.915	5.802	5.709
C.D. at 5%		0.416	0.474	0.472	0.483	0.041	0.039	0.039	0.041	N/A	0.067	0.071	0.069	N/A	N/A	N/A	N/A	N/A	0.164	0.154	0.169	0.509	0.531	0.535	0.540

Table.2 Effects of Natural coatings on Total Sugar (%), Score for Colour and Appearance, Score for Flavour and Taste, Score for Texture, Score for Overall acceptability, Shelf Life and Benefit Cost Ratio of Papaya Slices.

Treatment Symbol	Treatment Details	Total Sugar (%)				Score for Colour and Appearance				Score for Flavour and Taste				Score for Texture				Score for Overall Acceptability				Shelf Life (days)	Benefit cost ratio
		Initial	5 DAC	10 DAC	15 DAC	Initial	5 DAC	10 DAC	15 DAC	Initial	5 DAC	10 DAC	15 DAC	Initial	5 DAC	10 DAC	15 DAC	Initial	5 DAC	10 DAC	15 DAC		
T ₀	Control	6.94	7.20	7.46	7.72	6.66	7.03	6.50	6.00	6.10	6.51	6.31	6.11	6.80	7.03	6.50	6.00	7.16	7.25	6.86	6.41	15.16	1:1.47
T ₁	Sugar 20%	7.64	7.98	8.21	8.46	7.23	7.23	7.20	7.00	7.06	7.61	7.75	7.55	7.16	7.20	7.01	7.00	7.49	7.27	7.43	7.03	18.33	1:1.86
T ₂	Sugar 40%	7.80	8.02	8.23	8.46	7.26	7.46	7.56	7.80	7.76	7.71	7.88	7.56	7.66	7.76	7.80	7.75	7.88	7.75	7.76	7.46	18.75	1:1.89
T ₃	Sugar 60%	7.88	8.06	8.27	8.53	7.86	7.95	7.93	7.93	7.60	7.80	7.90	7.25	7.75	7.78	7.26	7.21	7.63	7.80	7.50	7.30	20.00	1:1.90
T ₄	Sugar 80%	7.97	8.13	8.29	8.51	7.06	7.46	7.00	7.23	7.43	7.45	7.55	7.03	7.56	7.15	7.16	7.28	7.71	7.46	7.51	7.18	19.83	1:1.90
T ₅	Jaggery 20%	7.97	8.21	8.44	8.69	7.78	7.20	7.55	7.75	7.83	7.86	7.25	7.58	7.78	7.55	7.13	7.21	7.78	7.71	7.25	7.46	18.58	1:2.01
T ₆	Jaggery 40%	8.01	8.24	8.42	8.70	7.55	7.65	7.20	7.25	7.23	7.55	7.20	7.08	7.30	7.01	7.46	7.25	7.86	7.50	7.20	7.11	18.66	1:2.02
T ₇	Jaggery 60%	8.15	8.37	8.59	8.81	7.63	7.05	7.80	7.50	7.50	7.50	7.10	7.50	7.50	7.91	7.50	7.50	7.23	7.25	7.00	7.43	18.91	1:1.95
T ₈	Jaggery 80%	8.27	8.47	8.67	8.91	7.20	7.01	7.50	7.16	6.83	7.08	7.06	7.81	7.38	7.95	7.93	7.66	7.78	7.75	7.85	7.55	19.83	1:1.90
T ₉	Honey 20%	7.95	8.24	8.49	8.77	7.41	7.68	8.00	8.00	7.23	7.40	7.46	7.56	7.81	7.86	7.90	7.95	7.83	7.90	8.00	7.96	21.33	1:1.76
T ₁₀	Honey 40%	8.13	8.36	8.68	8.98	7.95	8.10	8.31	8.26	7.90	8.01	8.13	8.25	8.00	8.10	8.16	8.00	7.91	8.08	8.25	8.26	22.75	1:1.58
T ₁₁	Honey 60%	8.94	9.22	9.49	9.72	8.43	8.50	8.68	8.93	8.38	8.48	8.60	8.76	8.38	8.51	8.60	8.63	8.41	8.50	8.63	8.75	26.00	1:1.50
T ₁₂	Honey 80%	8.69	8.95	9.20	9.48	8.28	8.43	8.54	8.55	8.05	8.18	8.28	8.41	8.16	8.25	8.33	8.45	8.08	8.21	8.36	8.51	23.91	1:1.40
F-test		S	S	S	S	NS	S	S	S	NS	S	S	S	NS	S	S	S	NS	S	S	S	S	
SE(d)		0.299	0.276	0.279	0.290	0.619	0.261	0.185	0.089	0.736	0.171	0.167	0.101	0.566	0.185	0.153	0.163	0.426	0.233	0.138	0.105	1.244	
C.V.		4.566	4.084	4.017	4.063	10.020	4.215	2.956	1.421	12.094	2.749	2.702	1.627	9.082	2.939	2.460	2.647	6.729	3.693	2.201	1.691	7.559	
C.D. at 5%		0.619	0.570	0.576	0.600	N/A	0.540	0.383	0.183	N/A	0.354	0.346	0.208	N/A	0.382	0.315	0.336	N/A	0.482	0.285	0.216	2.572	

The similar findings reported by Deka, (2000) and Deka *et al.*, (2004) for lime-aonla blended RTS and Tiwari, (2000) for RTS beverages prepared from guava-papaya. Shabi *et al.*, (2018) reported in Guava Cheese.

In terms of flavour and taste the highest score (8.38, 8.48, 8.60 and 8.76) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (8.05, 8.18, 8.28 and 8.41) whereas the minimum score was observed in treatment T₀ (Control) with (6.10, 6.51, 6.31 and 6.11). The taste and flavour of Papaya slices was showed decreasing trend in all edible coatings during storage due to increase in time interval, temperature and action of enzymes. Similar results previously also reported by Shabi *et al.*, (2018) in Guava Cheese.

In Case of colour and appearance the maximum score (8.43, 8.50, 8.68 and 8.93) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (8.28, 8.43, 8.54 and 8.55) whereas the minimum score was observed in treatment T₀ (control) with (6.66, 7.03, 6.50 and 6.00). The colour and appearance of Papaya slices was showed in increasing and decreasing trend in all Papaya slices during storage due to increase in time interval, temperature and action of enzymes. Similar findings previously also reported by Shabi *et al.*, (2018) in Guava Cheese.

The highest score in the case of texture are 8.38, 8.51, 8.60 and 8.63 at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (8.16, 8.25, 8.33 and 8.45) whereas the minimum score was observed in treatment T₀ (Control) with (6.80, 7.03, 6.50 and 6.00). The texture is directly related to the setting of product and

setting is a result of good pectin content Honey 60% was judged best for consistency of Papaya slices from it. There results coincide with the Studies conducted by Ishu *et al.*, (1989); Lal *et al.*, (1967), Vail *et al.*, (1978) and Shabiet. *al.*, (2018).

According to overall acceptability the highest score (8.41, 8.50, 8.63 and 8.75) at Initial, 5, 10 and 15 days respectively was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (8.08, 8.21, 8.36 and 8.51) whereas the minimum score was observed in treatment T₀ (Control) with (7.16, 7.25, 6.86 and 6.41). The organoleptic characters showed a gradual increase in all coated slices and decreasing in uncoated slices during storage due to increase in time interval, temperature and action of enzymes at low temperature. This finding was in conformity with Singh *et al.*, (1983), Vinod *et al.*, (2007) and Shabi *et al.*, (2018) in guava cheese storage and decrease there after Ranganna (2001) in food selection Ahmad *et al.*, (2004) in Apple cheese.

The maximum shelf life (26.00 days) was observed in treatment T₁₁ (Honey 60%), followed by treatment T₁₂ (Honey 80%) with (23.91 days), minimum shelf life was observed in treatment T₀ (control) with (15.16 days) during storage. The Shelf life of Papaya slices was showed increasing trend in all edible coatings during storage as compare to uncoated ones. There was increase in shelf life of the papaya slices during storage may possibly be due to increase in time interval, temperature and action of enzymes. Similar results were reported by Shanker *et al.*, (1967b) in case of guava juice. Shabi *et al.*, (2018) in Guava Cheese.

According to the economics of different treatments, maximum Gross return Rs. 512.00 is recorded in T₈ (Jaggery 80%) followed by T₆ and T₇ with Rs. 504.00, Highest Net Return

Rs. 255.00, was recorded in T₆ (Jaggery 40%) followed by T₇ with Rs. 245.00, and highest Cost Benefit Ratio 1:2.02 was recorded in T₆ (Jaggery 40%) closely followed by T₅ (Jaggery 20%) with 1:2.01, lowest Gross Return Rs. 336.00, Net Return Rs. 107.00 recorded in T₀ (Control) and lowest Cost Benefit Ratio 1:1.40 recorded in T₁₂(Honey 80%).

It is concluded that treatment T₁₁Honey 60% edible coating was found superior in physico-chemical properties and shelf life of papaya slices, followed by treatment T₁₂ (Honey 80%) and minimum was observed in treatment T₀ (Control), in terms of economics maximum Gross return Rs. 512.00 recorded in T₈ (Jaggery 80%), maximum Net Return Rs. 255.00 and cost benefit ratio 1:2.02, was recorded in T₆ (Jaggery 40%) and minimum Gross Return Rs. 336.00, Net Return Rs. 107.00 recorded in T₀ (Control) and lowest Cost Benefit Ratio 1:1.40 recorded in T₁₂ (Honey 80%).

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