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The combined effect of bio-extracts coating and packaging materials on quality of papaya fruit

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Abstract

The experiment was conducted at Post harvest laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj - 211007, (U.P.), India. During the year 2022-2023. The research entitled "The combined Effect Bio- Extract treatment and Packaging Material on Quality of Papaya (*Carica papaya* L.) fruit." consisted of experiments to study the performance of different bio-extracts and combination of first two best treatments of bio-extracts with different packaging materials on quality of papaya cv. Pusa Delicious, which were the experiments, the design followed was Completely Randomized Design (CRD) with three replications. Were found to be best improving the quality of papaya cv. Pusa Delicious fruits at ambient temperature.

Keywords: Papaya, bio-extract, packaging material, post harvest, quality

1. Introduction

Papaya (*Carica papaya* L.) a native of tropical America (Singh, 1990) [6], is an important fruit crop, belonging to family Caricaceae. *Carica* is the largest of the four genera with 48 species, among which *Carica papaya* L. is most important and cultivated all over the world (Badillo, 1971) [2]. Papaya is believed to have originated in Mexico. In India, papaya was introduced in early part of 16th century from Philippines through Malaysia. The popularity of papaya fruit has made it ubiquitous in tropical and subtropical regions of the world.

In India it is grown commercially in an area of about 138.40 lakh hectares with an annual production of 5988.83 lakh tonnes. It is commercially grown in Karnataka, Uttar Pradesh, Orissa, Bihar, West Bengal, Tamil Nadu, Gujarat Maharashtra, and Chhattisgarh. Papaya now has become popular all over the country and is the fifth most commercially important fruit of the country. Total area of papaya in Uttar Pradesh is about 2.01 thousand ha with an annual production of 96.83 thousand tonnes (Horticultural Statistics at a Glance, 2018) [4].

There are several methods for postharvest quality retention, but most of them are chemical based and thus pose health concerns owing to their residual toxicity, environmental pollution, and their side effects on human health. Healthy and eco-friendly technologies are very popular. Natural plant extracts that are non-hazardous to both human health and environment are better alternatives to chemicals. Extracts obtained from plants have recently gained popularity and scientific interest for their antibacterial and antifungal activity (Santas *et al.*, 2010) [7].

2. Materials and Methods

The methods employed during investigation and bio extract coating and wrapping materials utilized have great significance in research program. The experiment was carried out at UG Laboratory, Department of Horticulture, Naini Agricultural Institute SHUATS, Prayagraj, U.P., during 2022-23. The details of material used and techniques employed in carrying out the investigation are described.

The experiments were designed in completely randomized design (CRD) with treatments and each replicated thrice with a unit of 03 fruits per treatment per replication. Butter paper Wrap (Biodegradable) with Bio extract coating, Brown paper Wrap (Biodegradable) with Bio extract coating and Aluminium foil with Bio extract coating were constituted the treatments *viz.*: T₀ control, T₁ *Aloe vera* gel extract (100% Solution) + Butter Paper Wrap, T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap, T₃ *Aloe vera* gel extract (50% Solution) + Aluminium foil, T₄ Neem extract (100% Solution) + Butter Paper Wrap, T₅ Neem extract

(75% Solution) + Brown paper Wrap, T₆ Neem extract (50% Solution) + Aluminium foil, T₇ Garlic extract (100% Solution) + Butter Paper Wrap, T₈ Garlic extract (75% Solution) + Brown paper Wrap, T₉ Garlic extract (50% Solution) + Aluminium foil, T₁₀ Ginger extract (100% Solution) + Butter Paper Wrap, T₁₁ Ginger extract (75% Solution) + Brown paper Wrap and T₁₂ Ginger extract (50% Solution) + Aluminium foil. To study various physical and quality parameters.

2.1 Physical parameters

Physical parameters fruit weight(kg), fruit length(cm) (Govindan and Purushothaman 1984)^[3], Fruit firmness with peel (kg/m²) and Fruit firmness without peel (kg/m²) measured manually using a penetrometer (Deccan Techno Corporation, 0-20 kg) Azene *et al.* (2014)^[1].

2.2 Quality parameters

Ascorbic acid (mg/100 g of pulp) was estimated by Indophenol method Ranganna (1986)^[5], Titratable acidity (%) was determined by the method of Ranganna (1986)^[5], Reducing Sugars (%), Non- Reducing Sugars (%) and Total Sugars (%) was estimated using the colorimetric method (Somogyi, 1945)^[8].

3. Results and Discussion

The results obtained in the present investigation have been described and discussed character wise under the following headings:

3.1 Physical Parameters

3.1.1 Fruit weight (kg)

The Fruit Weight at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material used in present study Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper (1.40), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 1.

3.1.2 Fruit length (cm)

The Fruit length at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material different levels of bio extract used in present study. Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap (21.53), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 1.

3.1.3 Fruit firmness with peel (kg/m²)

The Firmness with peel at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material used in present study.

Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap (0.98), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 2.

3.1.4 Fruit firmness without peel (kg/m²)

The Firmness without peel at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material used in present study. Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap (0.20), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 2.

3.2 Quality Parameters

3.2.1 Titratable Acidity (%)

The Titratable Acidity at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material used in present study. Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap (0.49), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 3.

3.2.2 Ascorbic Acid (mg/100gm)

The Ascorbic acid at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material used in present study. Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap (58.47), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 3.

3.2.3 Reducing Sugar (%)

The Reducing sugars at 12 DAS of packaging material of papaya were significantly influenced by different levels of bio extract and packaging material used in present study. Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap (7.98), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 4.

3.2.4 Non-Reducing Sugar (%)

The Non- Reducing sugars at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material used in present study. Treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap (2.29), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 4.

3.2.5 Total Sugar (%)

The Total sugars at 12 DAS of packaging material of papaya was significantly influenced by different levels of bio extract and packaging material used in present study. Treatment T₂ (*Aloe vera* gel extract (75% Solution) + Brown paper Wrap, (10.19), recorded significantly highest as compared to T₀: Control (0.00). Data presented in tables 4.

Physical Parameters

Table 1: Fruit Weight (kg), and Fruit Length (cm)

Treatments	Fruit Weight (kg)				Fruit Length (cm)			
	3 Days	6 Days	9 Days	12 Days	3 Days	6 Days	9 Days	12 Days
To: Control	0.77	0.85	*	*	20.99	20.81	*	*
T ₁ : Aloe vera gel extract (100% Solution) + Butter Paper Wrap	1.23	1.30	1.38	1.34	20.50	20.34	19.26	18.18
T ₂ : Aloe vera gel extract (75% Solution) + Brown paper Wrap	1.16	1.31	1.39	1.40	26.70	26.52	25.44	21.53
T ₃ : Aloe vera gel extract (50% Solution) + Aluminium foil	1.27	1.24	1.32	1.27	23.80	23.69	22.61	18.86
T ₄ : Neem extract (100% Solution) + Butter Paper Wrap	0.90	0.98	1.06	*	21.90	21.72	20.64	*
T ₅ : Neem extract (75% Solution) + Brown paper Wrap	1.18	1.26	1.34	*	21.30	21.12	20.04	*
T ₆ : Neem extract (50% Solution) + Aluminium foil	0.99	1.07	1.15	*	21.00	20.82	19.74	*
T ₇ : Garlic extract (100% Solution) + Butter Paper Wrap	1.04	1.12	1.20	*	21.70	21.52	20.44	*
T ₈ : Garlic extract (175% Solution) + Brown paper Wrap	0.93	1.01	1.09	*	22.10	21.92	20.84	*
T ₉ : Garlic extract (50% Solution) + Aluminium foil	0.99	1.07	1.15	*	22.60	22.42	21.34	*
T ₁₀ : Ginger extract (100% Solution) + Butter Paper Wrap	0.92	1.00	1.08	*	21.10	20.92	19.84	*
T ₁₁ : Ginger extract (75% Solution) + Brown paper Wrap	1.09	1.17	0.93	*	21.20	21.02	19.94	*
T ₁₂ : Ginger extract (50% Solution) + Aluminium foil	0.96	1.04	1.12	*	22.00	21.82	20.74	*
F- test	S	S	S	S	S	S	S	S
S.E(m)	0.048	0.063	0.072	0.084	0.915	0.891	0.675	0.756
C. D. (P = 0.05)	0.098	0.130	0.148	0.172	1.888	1.840	1.394	1.561
CV	0.636	0.838	0.953	1.113	12.190	11.878	8.996	10.078

End of shelf life *

Table 2: Fruit firmness with peel (kg/m²), and Fruit firmness without peel (kg/m²)

Treatments	Fruit firmness with peel (kg/m ²)				Fruit firmness without peel (kg/m ²)			
	3 Days	6 Days	9 Days	12 Days	3 Days	6 Days	9 Days	12 Days
To: Control	2.57	0.93	*	*	3.13	1.43	*	*
T ₁ : Aloe vera gel extract (100% Solution) + Butter Paper Wrap	4.75	2.79	1.85	0.26	5.35	3.35	2.32	0.20
T ₂ : Aloe vera gel extract (75% Solution) + Brown paper Wrap	5.05	3.09	2.09	0.98	5.52	3.49	2.49	0.81
T ₃ : Aloe vera gel extract (50% Solution) + Aluminium foil	4.35	2.69	1.45	0.17	4.75	3.09	1.75	0.11
T ₄ : Neem extract (100% Solution) + Butter Paper Wrap	4.09	2.55	1.19	*	3.85	2.31	0.98	*
T ₅ : Neem extract (75% Solution) + Brown paper Wrap	4.05	2.65	1.35	*	3.31	1.75	0.55	*
T ₆ : Neem extract (50% Solution) + Aluminium foil	3.89	2.29	1.29	*	3.15	1.51	0.41	*
T ₇ : Garlic extract (100% Solution) + Butter Paper Wrap	4.52	2.86	1.62	*	4.92	3.26	1.92	*
T ₈ : Garlic extract (175% Solution) + Brown paper Wrap	4.26	2.72	1.36	*	4.02	2.48	1.15	*
T ₉ : Garlic extract (50% Solution) + Aluminium foil	4.22	2.82	1.52	*	3.48	1.92	0.72	*
T ₁₀ : Ginger extract (100% Solution) + Butter Paper Wrap	4.06	2.46	1.46	*	3.32	1.68	0.58	*
T ₁₁ : Ginger extract (75% Solution) + Brown paper Wrap	4.69	3.03	1.79	*	5.09	3.43	2.09	*
T ₁₂ : Ginger extract (50% Solution) + Aluminium foil	4.43	2.89	1.53	*	4.19	2.65	1.32	*
F- test	S	S	S	S	S	S	S	S
S.E(m)	0.329	0.265	0.297	0.058	0.408	0.288	0.412	0.106
C. D. (P = 0.05)	0.679	0.546	0.612	0.119	0.841	0.595	0.850	0.218
CV	4.380	3.524	3.953	0.768	5.431	3.842	5.489	1.408

End of shelf life *

Quality Parameters

Table 3: Titrable Acidity (%), and Ascorbic Acid (mg/100gm)

Treatments	Titrable Acidity (%)				Ascorbic Acid (mg/100gm)			
	3 Days	6 Days	9 Days	12 Days	3 Days	6 Days	9 Days	12 Days
To: Control	0.55	0.45	*	*	26.60	35.54	*	*
T ₁ : Aloe vera gel extract (100% Solution) + Butter Paper Wrap	0.70	0.63	0.52	0.44	31.82	41.86	56.58	34.86
T ₂ : Aloe vera gel extract (75% Solution) + Brown paper Wrap	1.30	1.23	1.15	0.49	32.74	43.58	58.47	35.47
T ₃ : Aloe vera gel extract (50% Solution) + Aluminium foil	1.13	1.06	0.52	0.47	32.16	42.20	56.92	35.10
T ₄ : Neem extract (100% Solution) + Butter Paper Wrap	0.96	0.89	0.81	*	30.17	40.42	48.51	*
T ₅ : Neem extract (75% Solution) + Brown paper Wrap	0.96	0.89	0.81	*	29.36	39.71	47.50	*
T ₆ : Neem extract (50% Solution) + Aluminium foil	0.93	0.87	0.80	*	28.89	38.78	46.76	*
T ₇ : Garlic extract (100% Solution) + Butter Paper Wrap	0.87	0.80	0.69	*	31.99	42.03	56.75	*
T ₈ : Garlic extract (175% Solution) + Brown paper Wrap	1.12	1.05	0.98	*	30.34	40.59	48.68	*
T ₉ : Garlic extract (50% Solution) + Aluminium foil	0.70	0.63	0.98	*	29.53	39.88	47.67	*
T ₁₀ : Ginger extract (100% Solution) + Butter Paper Wrap	1.10	1.04	0.97	*	29.06	38.95	46.93	*
T ₁₁ : Ginger extract (75% Solution) + Brown paper Wrap	1.04	0.97	0.86	*	31.82	41.86	56.58	*
T ₁₂ : Ginger extract (50% Solution) + Aluminium foil	0.73	0.64	0.53	*	30.51	40.76	48.85	*
F- test	S	S	S	NS	S	S	S	S
S.E(m)	0.121	0.072	0.099	0.088	0.915	0.891	0.675	0.756
C. D. (P = 0.05)	0.251	0.148	0.204	0.182	1.888	1.840	1.394	1.561
CV	1.618	0.953	1.317	1.173	12.190	11.878	8.996	10.078

End of shelf life *

Table 4: Reducing Sugar (%), Non-Reducing Sugar (%), and Total Sugar (%)

Treatments	Reducing Sugar (%)				Non-Reducing Sugar (%)				Total Sugar (%)			
	3 Days	6 Days	9 Days	12 Days	3 Days	6 Days	9 Days	12 Days	3 Days	6 Days	9 Days	12 Days
T ₀ : Control	5.69	6.66	*	*	1.36	2.21	*	*	6.73	8.56	*	*
T ₁ : <i>Aloe vera</i> gel extract (100% Solution) + Butter Paper Wrap	6.05	7.07	9.43	7.83	1.40	2.29	2.63	2.10	7.13	9.04	11.74	9.93
T ₂ : <i>Aloe vera</i> gel extract (75% Solution) + Brown paper Wrap	7.66	10.33	9.85	7.98	2.25	3.10	2.95	2.29	9.11	12.64	12.08	10.27
T ₃ : <i>Aloe vera</i> gel extract (50% Solution) + Aluminium foil	7.42	10.24	9.43	7.95	2.16	3.07	3.05	2.24	8.72	12.51	11.70	10.19
T ₄ : Neem extract (100% Solution) + Butter Paper Wrap	7.06	9.84	8.84	*	1.82	2.73	2.71	*	8.26	11.95	10.93	*
T ₅ : Neem extract (75% Solution) + Brown paper Wrap	7.25	10.07	9.04	*	1.93	2.88	2.76	*	8.55	12.34	11.19	*
T ₆ : Neem extract (50% Solution) + Aluminium foil	7.49	10.16	9.07	*	2.08	2.93	2.78	*	8.94	12.47	11.23	*
T ₇ : Garlic extract (100% Solution) + Butter Paper Wrap	6.22	7.24	9.60	*	1.57	2.46	2.80	*	7.30	9.21	11.91	*
T ₈ : Garlic extract (175% Solution) + Brown paper Wrap	7.23	10.01	9.01	*	1.99	2.90	2.88	*	8.43	12.12	11.10	*
T ₉ : Garlic extract (50% Solution) + Aluminium foil	6.05	7.07	9.21	*	2.10	3.05	2.93	*	7.13	9.04	11.36	*
T ₁₀ : Ginger extract (100% Solution) + Butter Paper Wrap	7.51	9.93	9.24	*	1.94	2.62	2.73	*	9.15	12.24	11.40	*
T ₁₁ : Ginger extract (75% Solution) + Brown paper Wrap	6.39	7.41	9.77	*	1.74	2.63	2.97	*	7.47	9.38	11.26	*
T ₁₂ : Ginger extract (50% Solution) + Aluminium foil	7.40	10.18	9.18	*	1.40	2.29	2.60	*	8.60	12.29	11.27	*
F- test	S	S	S	S	NS	S	S	S	S	S	S	S
S.E(m)	0.288	0.379	0.385	0.143	0.247	0.123	0.257	0.264	0.531	0.650	0.529	0.392
C. D. (P = 0.05)	0.595	0.783	0.795	0.295	0.510	0.254	0.531	0.544	1.096	1.342	1.091	0.810
CV	3.842	5.055	5.134	1.907	3.290	1.637	3.428	3.514	7.077	8.665	7.044	5.227

End of shelf life *

4. Conclusions

From the present findings, it is concluded that treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap has performed best in terms parameters: - highest Fruit weight (1.40), Fruit Length (21.53), Firmness with peel (0.98 kg/cm²), Firmness without peel (0.81 kg/cm²), Titrable Acidity (0.49), Ascorbic acid (58.47 mg/ml), Total sugar (10.19%) Reducing sugar (7.98%) and non-Reducing sugar (2.29%). Among the different packaging materials, when compared to other treatment. Therefore, from this experiment it is recommended to treatment T₂ *Aloe vera* gel extract (75% Solution) + Brown paper Wrap for enhanced quality of papaya fruit.

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