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Effect of post-harvest dips and packing treatments on Shelf life of papaya (*Carica papaya* L.)

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Abstract
The present study was taken up primarily with a view to evaluate the effects of dipping the fruits with different chemicals and the packing treatments on the storage behaviour of papaya cv. Co-7 under ambient condition. Among the various post harvest dips tried, the fruits treated with GA_3 recorded the lowest Post harvest loss in weight (11.9%) was observed on 9th DAS. At the end of storage, the maximum TSS (15.8 °B) was observed in Kinetin treated fruits. The untreated fruits were infected by disease on 7th DAS making it unfit for further evaluation. At the end of storage GA_3 recorded the highest ascorbic acid content (36.81 mg/100g). Among the packing treatments the lowest Post harvest loss in weight was recorded in T_1 (vacuum packing). Among the various packing materials used for assessing the storage behaviour, vacuum packed fruits (350 guage polythene bags) showed the best results with prolonged shelf life (20 days) and acceptable TSS, total sugars, titrable acidity and ascorbic acid when compared with polybags with 1% vents and unpacked fruits. There is no significant difference among the packing with regard to TSS, total sugars, titrable acidity and ascorbic acid of papaya fruits. The shelf life of papaya cv. Co-7 was significantly influenced by packing.

Keywords: Papaya, post harvest dips, packaging, shelf life, quality parameters

Introduction
In fruits like papaya, postharvest metabolic changes are of particular importance because the fruits are harvested at unripe and inedible stage and the quality of fruits ultimately depends upon the postharvest handling and storage methods. A proper understanding of the morphological, physiological and biochemical changes that occur in the fruit during ripening is essential for the development of good storage techniques (Ndubizu, 1985) [5]. Reduction of losses during post harvest handling is as good as increasing the production. Storage of papaya fruits at low temperature and controlled atmospheric storage is limited as they are susceptible to chilling injury and involvement of huge capital cost respectively. Packing is one of the factors that influence indirectly the quality of fruits. Adequate packaging protects the produce from physiological and pathological and more important from physical deterioration in the marketing channels retaining its attractiveness. The present study aims at increasing the shelf life and quality of papaya cv. Co-7 by standardizing the postharvest dip along with packing. This study would help to identify Co-7 as an export variety, which has excellent taste and flavour.

Materials and Methods
Fruits used in the study were collected from the orchard of Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. In all the experiments, uniform sized mature fruits free from bruises or blemishes were used. The selected fruits were washed in running water and shade dried after smearing with paper on the fruit surface. Washed papaya fruits were gently dipped in GA_3 40 ppm, kinetin 10 ppm, calcium nitrate 1% and calcium chloride 1% separately for five minutes, shade dried and stored in ambient conditions under room temperature. 300 guage thick polythene bags were used both for vacuum packing and packing without vents. The treated fruits were stored under ambient conditions at room temperature. The observations were recorded at regular intervals of every five days for physical and biochemical changes. The experiment was laid out in completely randomized design with five treatments in three replications. The best performing chemical or growth regulator was selected and the fruits were treated with the same and then packed in polythene covers either without vents or vacuum packed.

Results and Discussion

Among the postharvest treatments, the lowest PLW (11.9%) was observed in T_3 (GA_3) on 9th DAS which is on par with T_1, T_2, T_4 and the highest PLW (20.20) in fruits under control (Table 1). At the end of storage, the maximum TSS (15.8 °B) was observed in T_4 (Kinetin) which is on par with T_1, T_2, T_3. The untreated fruits were infected by disease on 7th DAS making it unfit for further evaluation (Table 2).

The ascorbic acid shows a positive trend with increase in storage life. The postharvest treatments significantly influenced the ascorbic acid content. At the end of storage T_3 (GA_3) recorded the highest Ascorbic acid content (36.81 mg/100g) which is on par with T_1, T_2 and T_4. The lowest PLW (0, 0, 2.3, 5.12 and 6.89%) was recorded in T_1 (vacuum packing) on 3rd, 6th, 9th, 12th and 20th DAS respectively. The shelf life of papaya cv. Co-7 was significantly influenced by packing (Table 3). Vacuum packing (T_1) recorded highest shelf life of 20 days followed by T_2 (12 days) while the unpacked fruits registered the lowest shelf life (9 days).

The observations on the effect of packing treatments on TSS, total sugars, titrable acidity and ascorbic acid of Co-7 papaya were furnished in table 4.There is no significant difference among the packing with regard to TSS, total sugars, titrable acidity and ascorbic acid of papaya fruits.

In the present study application of GA_3 possibly had retarded the production of ethylene in the tissue having a direct effect with the biochemical changes involved in the process of ripening. This corroborates with the findings of Gautam amd Chundawat (1990) [3], Butani and Joshi (1993) [2], Arparia (1994) [1] and Patel *et al*. (1995) [6]. The PLW was minimum in GA_3 treatment because it slows down the diffusion of free water from the tissue there by decreased metabolism. Fruits treated with GA_3 recorded extended shelf life. This was thought to be the consequence of slow ripening changes by GA_3 treatment because of its anti senescent property of GA_3. GA_3 treated fruits showed maximum TSS and ascorbic acid. This might be due to GA_3 slowed down the activity of oxidizing enzymes like ascorbic acid oxidase, peroxidase and catalase during storage. Similar findings were reported by Singh (1988) [7] with GA_3 spray in mango.

O_2 acts as co-substrate in ethylene biosynthesis pathway. In vacuum packing no O_2 will be left inside the pack and also there won't be any diffusion or exchange of gas between the fruit and atmosphere. Hence the ethylene synthesis, respiration and transpiration get slowed down. This in turn slows down the ripening and there by enhance the shelf life of papaya fruits. Thus the vacuum packaging slowed down the metabolic activity of a produce and of the micro organisms present (both spoilage and pathogenic), by limiting the O_2 supply and applying an elevated level of CO_2 (Gorris and Peppelenbos, 1992) [4].

Owing to lack of planning and climatic factors a huge accumulation of papaya takes place in a particular area resulting in market glut and therefore distress sale and a substantial reduction in quality of the produce leads to waste. To overcome the problem, extended storage life can be achieved even under room temperature by treating the fruits with GA_3 along with vacuum packing. This could be of economic significance in a developing country like India, where sophisticated refrigeration or cold storage facilities are not adequate and are expensive. The results obtained from the study amply illustrate that this low cost technique can be an added advantage for marketing Co-7 papaya to distant markets and as well as for export relatively at a cheaper cost.

Table 1: Effect of postharvest treatments on Physiological loss in Weight (%) and TSS of papaya under ambient condition

Treatments	PLW (%)			TSS (°B)	
	3rd DAS	6th DAS	End of storage	6th DAS	End of storage
T_1 – 1% Cacl2	6.50	8.20	12.80	12.30	15.70
T_2 - 1% Ca(No3)2	6.90	8.50	12.50	12.50	15.50
T_3 - GA_3 (40 ppm)	5.80	7.60	11.90	12.20	15.30
T_4 – Kinetin (10 ppm)	6.70	8.20	12.50	12.70	15.80
T_5 - Control	8.20	13.50	20.21	15.00	0.00
C.D (0.05)	NS	1.1663	1.8245	0.99	0.86
S.Ed	NS	0.5234	0.8188	0.45	0.38

Table 2: Effect of postharvest treatments on shelf life (days), disease incidence (%) and titrable acidity (%) of papaya under ambient condition

Treatments	Shelf life (days)	Disease incidence (%)	Titrable acidity (%)
T_1 – 1% Cacl2	8.00	8.00	0.091
T_2 - 1% Ca(No3)2	8.00	10.00	0.100
T_3 - GA_3 (40 ppm)	9.00	5.00	0.096
T_4 – Kinetin (10 ppm)	7.00	9.00	0.092
T_5 - Control	6.00	20.00	0.090
C.D (0.05)	1.0422	0.9124	NS
S.Ed	0.4678	0.4095	NS

Table 3: Effect of packing on Physiological loss in Weight (%) and shelf life of papaya under ambient condition

Treatments	PLW (%)						Shelf life (days)
	3rd DAS	6th DAS	9th DAS	12th DAS	20th DAS	Mean	
T_1 - GA_3+ vacuum packaging	0.00	0.00	2.30	5.12	6.89	4.77	20.00
T_2 - GA_3+ packs with 1% vent	3.20	6.80	8.25	13.50	*	7.94	12.00
T_3 - GA_3 dip alone	6.20	8.50	12.80	*	*	9.17	9.00
C.D (0.05)	4.26	2.57	3.28				2.08
S.Ed	1.74	1.05	1.34				0.85

* - fruits were unfit for further evaluation due to decay

Table 4: Effect of packing on Titrable acidity (%), ascorbic acid (mg/100g), TSS (°B) and total sugars (%) of papaya under ambient condition

Treatments	Titrable acidity (%)	Ascorbic acid (mg/100g)	TSS (°B)	Total sugars (%)
T_1 - GA_3+ vacuum packaging	0.091	37.21	15.20	10.10
T_2 - GA_3+ packs with 1% vent	0.089	37.50	15.50	9.90
T_3 - GA_3 dip alone	0.092	36.98	15.80	10.30
C.D	NS	NS	NS	NS
S.Ed	NS	NS	NS	NS

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