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Effect of post-harvest treatments on shelf life and quality of mango (*Mangifera indica* L.) cv. Banglora

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Abstract
An experiment was conducted at Department of Horticulture, Faculty of Agriculture, Annamalai University during 2013 to investigate the effect of post-harvest treatments on shelf-life and quality of Mango cv. Banglora. Immediately harvested Banglora Mango fruits were collected from Department Orchard. The fruits were stored at ambient conditions (25 ± 5°C; 65 ± 5% RH). Mango were sprayed with 0.5 and 1.5 % $CaCl_2$ and 200 and 300 ppm GA_3 and wrapping with News paper and perforated polyethylene bags. The objective of this experiment extending the shelf-life of fruits and delay the ripening process. Fruits sprayed with T_2- GA3 200 ppm + wrapping with Newspaper + stored in wooden box took more number of days for ripening, physiological loss, firmness, shelf life, spoilage, TSS, Sugar content, Titrable acidity, Ascorbic acid content. While it was least in control. Fruits sprayed with GA_3 @ 200 ppm + wrapping with News paper showed shelf life up to 18.24 days followed by 0.5 % $CaCl_2$ at (14.48 days) as against 8.03 days of control. The physico-chemical parameters evaluation of mango fruits were compared to control.

Keywords: post-harvest, shelf-life, Mango

Introduction
Mango (*Mangifera indica* L.) is one of the most important commercial fruit crops, being referred to as the 'King of fruits'. Mango is cultivated in an area of 2.5 million hectares with a production of 18.3 million tones and a productivity of 7.3 MTh^{-1}. As per NHB 2012 data base, mango occupies 34.9% of total fruit area, 20.7% of total fruit production. Mango has rich diversity with many cultivated varieties and hybrids. Among them, Banglora is a well known as a regular bearing variety. The fruit is oblong in shape. It is excellent in taste and is regarded as a good table variety. The fruit quality of Banglora is favorably superior over its parent. The flesh is deep orange red colour content indicating higher vitamin A content. Besides, being attractive flesh colour, this variety is more suitable for export and processing industry for postparing colored mango nectar and juice. Due to dwarf nature the cultivar is recommended for high density planting. (Ray, 1999) Gibberellins as a post-harvest spray was reported as an efficient growth regulator in enhancing fruit storability and marketability through its action on cell juvenility and retardation of senescence, fruit coloration and softness (Macleod and Millar, 1962). Post harvest spray of calcium increases the productivity of mango due to reduction of abscission and it enhances the fruit quality by increasing the fruit firmness and by maintaining the turgidity of middle lamella cells (Ranjan, *et al*., 2005) [4] Fruits storability was also improved by $CaCl_2$ under cold storage (Ahmed *et al*., 2000) [2] Low fruit calcium levels have been associated with reduced post harvest life and physiological disorders. Hence the postharvest study was taken to investigate the effect of post-harvest spray of 0.5, and 1.5 % $CaCl_2$+ and 200 and 300 ppm GA_3 + wrapping with Newspaper in mango cv. Banglora with the objective of extending the shelf-life of fruits and delay the ripening process.

Materials and Methods
The present experiment was carried out on 10 year old mango cv. Banglora at Department of Horticulture, Faculty of Agriculture, Annamalai University. During the year 2013. randomized block design was used with thirteen treatments and three replications, the treatment combinations of T_1- GA_3@ 200 ppm storage in perforated polythene bags, T_2- GA_3@ 200 ppm wrapping with newspaper and storage in wooden box, T_3- GA_3@ 200ppm wrapping with newspaper and stored in room temperature, T_4- GA_3@ 300ppm storage in perforated polythene bags,T5- GA_3@ 300ppm wrapping with newspaper and storage in room temperature T6- $CaCl_2$@ 0.5% storage in perforated polythene bags T_7- $CaCl_2$@ 0.5% wrapping with newspaper and storage in room temperature T_8- $CaCl_2$@ 1.5% storage in perforated polythene bags T_9- $CaCl_2$@ 1.5% wrapping with newspaper and stored in woodenbox T_{10}- $CaCl_2$@ 1.5%

wrapping with newspaper and storage in room temperature, T_{11}- Control. The Harvested fruits were sorted for uniformity in size, maturity and free from defects and washed with sterile water. An average of 15 fruits per treatment was considered for calculating the fruit weight, pulp weight, stone weight in grams Mango fruits with more than 50 percent yellowing of skin colour were counted at specific intervals of storage was considered ripening. Such ripened fruits out of total fruits stored in each replication was computed fruits and Shelf life (in days) The shelf-life of fruits was accounted from the date of shelf- life expiration date. The shelf life was determined by recording the number of days the fruits remained in good condition during storage without spoilage. When the spoilage of fruits exceeded 50% it was considered as the end of shelf (Singh *et al.* 2000) [8]. The average of all the score for above characters was calculated and as overall acceptance or palatability rating. Higher scoring was treated as more acceptable from the attraction point of view. Total sugars, reducing, non reducing sugars, total soluble solids and acidity Total sugars and reducing sugars post harvest in the mango pulp samples were determined by the method of Lane and Eynon (AOAC, 1990) [1] Statistical analysis The data were subjected to Analysis of Variance (ANOVA) for a Randomized Block Design as per the procedure outlined by Panse and Sukhatme (1985).

Results and Discussion

There was significant difference between the treatments for number of days taken for ripening of fruits. Significant delay of ripening of fruits was found when sprayed with GA_3 200 + wrapping with Newspaper ppm (18.24 days) and 1.5 % $CaCl_2$ at (17.48 days). The reason might be that post harvest applications of gibberellic acid decreasing the tissue permeability there by reducing the rate of water loss leading to delayed fruit ripening (Wills *et al.*, 1998) [9] and it showed the inhibitory effect on ethylene biosynthesis and retarded the activity of enzymes responsible for ripening and through creation of resistance to pathogen entry, hence cell degradation was post vented which in turn facilitated the reduced moisture loss and lesser respiratory gas exchange, results in delay of ripening. The delay of ripening by $CaCl_2$ may be attributed to higher fruit calcium levels that lead to the reduction of respiration and ethylene production rates (Singh *et al*., 2003) [7]. The current study demonstrates that application of$_{GA3}$ has merit in extending the shelf life might be due to delay in conversion of starch to sugars there by reducing the peroxidase activity and ethylene. The extended shelf life in $CaCl_2$ treatment may be due to the fact that calcium enhances fruit firmness relative to control which leads to slower hastening and extends the shelf-life.

Significantly higher TSS of fruit (23.47^0Brix), significantly higher percentage of total sugars (21.99 %), and minimum percentage of titratable acidity (0.37 %) was observed when sprayed with GA_3 200 + wrapping with Newspaper and storage in woodenbox. The increase of TSS during storage periods might be the due to transformation of organic matter of fruits to soluble solids under enzymatic activities. The general increase of TSS of fruits has been recorded by Wahdan *et al*. (2011) among the different treatments minimum acidity recorded in GA_3 200 ppm + wrapping with Newspaper. This reduction of acidity content might be due to sprayed with 200 + wrapping with Newspaper ppm GA3 at 20 days before harvest to the change of acid into sugars under enzyme invertase influence during storage period. GA_3 induced reduction in acidity, may be linked with hormonal stimulation of assimilates translocation. Similar changes have been reported by Pal., (1998) [3] in litchi cv. Dehradun. The increase in sugars content of mango fruits could be due to normal ripening process that leads to senescence and to the transformation of some carbohydrates components as starch to sugars by the enzymatic activities. $CaCl_2$ and GA_3 treatments significantly increased total sugars during storage of mango fruits. The increase in the sugars of fruits has been recorded by Wahdan *et al*. (2011) Reduction of acidity content may be due to the change of acid into sugars under enzyme invertase influence during storage period. The observed decreasing in the fruit acidity could be due to that acids partially are a respiratory substrate and its consumption in respiratory increase with the progresses of storage periods.

The Results pertaining to the spoilage of fruits are post harvested in Table.1. Spoilage qualities of mango fruits Cv. Banglora when were sprayed with different concentrations of 200 + wrapping with Newspaper and storage in wooden box at (45.12 %) and 1.5% CaCl2 at (65.17 %) showed a good quality of fruit when compared to control (88.72 %). Singh *et al.* (1993) [6] also studied the changes in post-harvest quality of mangoes affected by post-harvest application of calcium chloride and they observed that this may be responsible for the observed decreasing in spoilage during the storage. The findings obtained in the post harvest investigation can be compared to those obtained by Shahjahan *et al*. (1994) [5]

They were no significant changes on skin green colour when fruits were ripened. Partially green colour of peel in treated fruits by calcium components treatment showed that there is a relationship of its components with physiological phenomenon occurred in colour development 200 + wrapping with Newspaper showed maximum score of pulp colour and pulp texture of fruits. However, the score was minimum in fruits from water sprayed (control).

Table 1: Effect of various treatments on certain post harvest shelf life charecters in Mango cv. Banglora

Treatments	Physiological loss in weight (%)	Firmness	Self life	Spoilage (%)	Total soluble solids (^{O}Brix)	Titrable acidity (%)	Total sugars (%)	Sugar acid ratio	Ascorbic acid (mg/100g pulp)
T_1- GA_3@ 200ppm storage in perforated polythene bags	44.53	3.92	10.64	83.93	19.32	0.27	11.8	44.03	14.41
T_2- GA_3@ 200ppm wrapping with newspaper and storage in wooden box	7.35	6.72	18.24	45.12	23.47	0.37	21.99	59.43	21.31
T_3- GA_3@ 200ppm wrapping with newspaper and stored in room temperature	36.95	4.48	12.16	74.55	21.35	0.29	13.91	47.96	15.79
T_4- GA_3@ 300ppm storage in perforated polythene bags	48.05	3.64	9.88	88.62	18.17	0.26	10.88	41.84	15.79

T_5- GA_3@ 300ppm wrapping with newspaper and stored in room temperature	33.25	4.76	12.92	66.86	20.29	0.30	14.92	49.73	17.17
T_6- $CaCl_2$@ 0.5% storage in perforated polythene bags	29.55	5.04	13.68	65.17	1.76	0.31	15.93	51.38	17.86
T_7- $CaCl_2$@ 0.5% wrapping with newspaper and stored in room temperature	25.85	5.32	14.44	60.48	18.70	0.32	16.94	52.93	20.62
T_8- $CaCl_2$@ 1.5% storage in perforated polythene bags	11.05	6.44	17.48	68.91	22.41	0.36	17.12	55.76	19.24
T_9- $CaCl_2$@ 1.5% wrapping with newspaper and storage in wooden box	14.75	6.16	16.72	46.41	17.11	0.35	19.7	46.07	15.1
T_{10}- $CaCl_2$@ 1.5% wrapping with newspaper and stored in room temperature	18.45	5.88	15.96	58.79	17.64	0.34	18.6	54.39	18.55
T_{11}- Control	40.65	4.2	11.4	88.72	21.88	0.28	12.90	39.24	13.03
SE.d	0.87	0.09	0.28	1.55	2.39	0.005	0.41	0.53	0.25
CD at 5%	**1.75**	**0.18**	**0.56**	**3.09**	**4.79**	**0.01**	**0.83**	**1.06**	**0.51**

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