

**EFFECT OF POST-HARVEST TREATMENTS ON PHYSIO-CHEMICAL  
CHARACTERS OF MANGO FRUITS (CV. BULLOCK'S HEART)  
DURING STORAGE  
BY**

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**ABSTRACT**

This work aimed at increasing the storage period, maintaining fruit quality and increasing the shelf life of mango fruits (cv. Bullock's heart) (*Mangifera indica* L.), mature fruits were harvested at Barrage Horticulture Research Station farm in (2003 & 2004). Seven post-harvest treatments were applied on uniform fruits (calcium chloride 1 & 2 %, waxing emulsions 4, 6 & 8 %, wrapping and control) and all fruits were stored at 8 °C with 85-90 % R.H. Results in both seasons showed that waxing 8 % and calcium chloride 2 % were the most effective in maintaining fruit quality, storability, superior in prolonging shelf life and reducing decayed fruits.

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**Key words:** Mango fruits – cold storage – waxing – wrapping – calcium chloride  
– fruit quality – storage life – shelf life.

**INTRODUCTION**

Mango is one of the most popular fruits in Egypt, preferred for its high nutritional value. It is considered as the third main fruit crop. The fruiting area is approximately 73028 feddans producing about 318791 metric tons per year (Ministry of Agriculture 2003). Unfortunately only 1 % of that production is exported.

Mango fruits are very sensitive and more subjected to several post-harvest problems such as pathological and physiological disorders, as well as many biochemical changes leading to a short storage and marketing life.

Calcium has widely been reported to play an important structural role in providing firmness and mechanical strength to cell walls, (Povaiah *et al.*, 1988). Hisaw (1991) observed that apple fruits having adequate tissue calcium concentrations were firmer and could be stored for longer periods than those of low calcium contents.

Nawar and Ezz (1994) revealed that 3 % CaCl<sub>2</sub> reduced fruit browning and improved fruit quality of guava fruits.

The rate of mango fruit weight loss was lower in Ca treated fruits (Zambrano and Manzano 1995).

When mango fruits were dipped in calcium chloride (0.5, 1.0 and 1.5 %) for 2 minutes then packed in perforated polyethylene bags before storage under ambient or cool temperatures, TSS increased during storage, but the increase was faster in the control and CaCl<sub>2</sub> 1 % treated fruits (Dahaka *et al.* 2001).

Storage at room temperature will be sufficient for short storage period, but for long storage period, using low temperature will be necessary.

Waxing and wrapping maintained fruit quality parameters to higher levels compared with untreated fruits.

This work was an attempt to extend the storage life of mango fruits (cv. Bullock's heart) by using low temperature (8 °C), supplemented by some other treatments, such as dipping in calcium chloride solutions (1 & 2 %), waxing emulsion (4, 6, 8 %), individual wrapping to compare with untreated fruits, in order to protect fruits from decay incidence, maintain quality, storability and extending the shelf life.

#### MATERIALS AND METHODS

This work was carried out during two successive seasons (2003 & 2004) at fruit Handling Department Hort. Res. Inst. Giza, Egypt. In both seasons mature mango fruits (cv. Bullock's heart) were harvested (according to maturity indices of Pantastico, (1975) from the farm of Barrage Research Station (Hort. Res. Inst. ARC). The fruits were sound and uniform in size and colour. Fruits were washed with tap water and air dried, then divided into seven groups subjected to the following treatments:

1. Dipping in CaCl<sub>2</sub> solution (1 %) for 5 minutes.
2. Dipping in CaCl<sub>2</sub> solution (2 %) for 5 minutes.
3. Wax emulsion (4 %).
4. Wax emulsion (6 %).
5. Wax emulsion (8 %).
6. Individual fruit wrapping with low density polyethylene film.
7. Control (fruits without any treatments).

All fruits were packed in one layer inside carton boxes (9 fruits in each box). Each treatment as well as the control was represented by 5 boxes and then stored at 8 °C and 85-90 % RH.

Fruits were examined at 8 days intervals until the end of the storage period. After 8, 16, 24, 32 days from cold storage, fruits were transferred to ambient temperature (23 ± 2 °C) and 55-65 % RH for five days as a marketing period.

Post-harvest disorders (decay and discoloration of fruits) were calculated, fruit weight loss was recorded fruit firmness was determined by using a hand Magness Taylor pressure tester with 5/16" end plunger on the two opposite sides of the peeled fruit and the average flesh firmness of each side was measured in lb/inch<sup>2</sup>.

## ***Effect Of Post-Harvest Treatments On Physio-Chemical.....707***

Total soluble solids were determined by A'bbe refractometer in fruit juice and total acidity was recorded according to A.O.A.C. (1980).

Total sugars were determined as mg/100 gm of pulp of fruit flesh according to the method adapted by Dubais *et al.*, (1956).

Total carotenoids were determined according to the method described by Wettstein (1957).

All obtained data were subjected to analysis of variance according to Snedecor and Cochran (1980). Differences among means were compared using Duncan Multiple Range Test (Duncan, 1955) at 5 % level.

### **RESULTS AND DISCUSSION**

#### **1- Fruit physical composition:**

##### **1.1. The percentage of weight loss:**

Data presented in Table (1) showed that the weight loss percentage significantly increased by prolonging the storage periods during storage at 8 °C for 32 days in both seasons. Mango fruits treated with citrus wax emulsion at 8 % showed a remarkable reduction in fruit weight loss (2.6 %) followed by calcium chloride solution at 2 % (3.2 %) as compared with other treatments in both seasons.

Similar results were observed by Shivarama *et al.* (1989) who found that coating mango fruits with wax emulsion (2, 4, 6 or 8 %) reduced weight loss. Castrillo and Bermudez (1992) reported that wax emulsion (10 %, 5 %) reduced the rate of fruit weight loss during ripening. The obtained results are also in accordance with those obtained by Yuniarti (1992), Manzano *et al.* (1997) Oosthuysse, Baldwin *et al.* (1999) on mango.

##### **1-2- Decayed fruit percentage:**

Data presented in Table (2) showed that the decay percentage of mango fruits significantly increased as th storage period increased during storage at 8°C. Treated fruits with CaCl<sub>2</sub> 2 % or wax 8 % showed no decay incidence. Other treatments (wax 6 %, CaCl<sub>2</sub> 1%, wrapping and wax 4 %) showed lower values of decayed fruits percentage (0.61, 1.29, 2.19, 3.82) respectively than control ones (6.34) at the end of storage in both seasons. The interaction effect of storage period and post-harvest treatments was significant in both seasons.

These observations disagree with those obtained by Dhak *et al.*, (2001), as they reported that mango fruits were dipped in wax emulsion (4, 6, 8 %) had the lower spoilage incidence especially at the high concentration (8 %). Similar results were obtained by Oosthuysse (1997). Nawar and Ezz, (1994) revealed that 3 % CaCl<sub>2</sub> dipping treatment reduced fruit browning and improved fruit quality of guava fruits.

##### **1-3- Fruit firmness:**

Data in Table (3) cleared that, flesh firmness of mango fruits significantly decreased when extending the storage period with all treatments during storage at 8°C.

Table (1): Effect of postharvest treatments on weight loss (%) of Bullock's heart mango fruits held at 8°C.

Season Storage period in days	First season					Mean
	0	8	16	24	32	
Treatments						
CaCl <sub>2</sub> (1%)	0.0	3.41	5.02	6.30	7.81	4.51 D
CaCl <sub>2</sub> (2%)	0.0	1.64	3.20	4.71	6.51	3.21 F
Wax emulsion (4%)	0.0	5.10	6.15	8.23	9.81	5.86 B
Wax emulsion (6%)	0.0	2.25	4.02	5.61	7.21	3.82 E
Wax emulsion (8%)	0.0	1.04	2.08	4.11	5.71	2.59 G
Individual wrapping	0.0	4.54	5.89	7.03	8.52	5.20 C
Control	0.0	5.53	8.21	9.51	11.21	6.89 A
Mean	0.0 E	3.36 D	4.94 C	6.5 B	8.11 A	*
L.S.D. 5%	T = 0.04608		P = 0.03895		T X P = 0.1030	
	Second season					
CaCl <sub>2</sub> (1%)	0.0	3.4	5.09	6.27	7.76	4.51 D
CaCl <sub>2</sub> (2%)	0.0	1.68	3.23	4.61	6.45	3.20 F
Wax emulsion (4%)	0.0	5.01	6.11	8.29	9.92	5.87 B
Wax emulsion (6%)	0.0	2.20	4.36	5.69	7.21	3.89 E
Wax emulsion (8%)	0.0	1.14	2.07	4.09	5.68	2.60 G
Individual wrapping	0.0	4.60	5.90	7.03	8.42	5.19 C
Control	0.0	5.5	8.19	9.61	11.13	6.89 A
Mean	0.0 E	3.36 D	5.0 C	6.51 B	8.08 A	*
L.S.D. 5%	-		-		-	

Means followed by the letter(s) are not significantly at 5% level.

T = Treatments P = Storage periods TxP = The interaction between T and P

Post-harvest treatments increased fruit firmness especially when fruits were dipped in CaCl<sub>2</sub> (2 & 1 %) and wax 8 % as they were firmer (17.28, 16.68 & 16.05 respectively) than control ones (13.44), at the end of storage in both seasons.

The interaction between storage periods and post-harvest treatments was significant.

These results recorded during the two seasons are in accordance with those obtained by (Suntharalingam 1996) who noticed that mango fruit softening was retarded by calcium chloride treatments. Calcium has widely been reported to play an important structural role in providing firmness and mechanical strength to cell walls, (Povaiah *et al.*, 1988). Parmar & Chundawat (1989) reported that using wax emulsion was the most effective treatment in delaying ripening in Kesar mango fruits. Hisaw (1991) observed that apple fruits having adequate tissue calcium concentrations were firmer and could be stored for longer periods than those of low calcium contents.

## Effect Of Post-Harvest Treatments On Physio-Chemical.....709

**Table (2): Effect of postharvest treatments on decay (%) of Bullock's heart mango fruits held at 8°C.**

Season Storage period in days	First season					Mean
	0	8	16	24	32	
<b>Treatments</b>						
CaCl <sub>2</sub> (1%)	0.0	0.0	1.42	1.71	3.19	1.27 D
CaCl <sub>2</sub> (2%)	0.0	0.0	0.0	0.0	0.0	0.0 F
Wax emulsion (4%)	0.0	2.20	4.41	5.42	6.75	3.76 B
Wax emulsion (6%)	0.0	0.0	0.0	1.02	2.02	0.61 E
Wax emulsion (8%)	0.0	0.0	0.0	0.0	0.0	0.0 F
Individual wrapping	0.0	0.0	2.69	3.61	4.82	2.23 C
Control	0.0	4.13	6.13	9.44	11.54	6.25 A
Mean	0.0 E	0.90 D	2.09 C	3.03 B	4.05 A	
L.S.D. 5%	T = 0.0073		P = 0.0062		T X P = 0.0162	
	Second season					
CaCl <sub>2</sub> (1%)	0.0	0.0	1.32	1.83	3.41	1.31 D
CaCl <sub>2</sub> (2%)	0.0	0.0	0.0	0.0	0.0	0.00 F
Wax emulsion (4%)	0.0	2.14	4.52	5.62	7.11	3.88 B
Wax emulsion (6%)	0.0	0.0	0.0	1.14	1.85	0.60 E
Wax emulsion (8%)	0.0	0.0	0.0	0.0	0.0	0.0 F
Individual wrapping	0.0	0.0	2.55	3.41	4.75	2.14 C
Control	0.0	4.03	6.33	9.95	11.85	6.43 A
Mean	0.0 E	0.88 D	2.10 C	3.14 B	4.14 A	
L.S.D. 5%	T = 0.0073		P = 0.0062		T X P = 0.0162	

Means followed by the letter(s) are not significantly at 5% level.

T = Treatments P = Storage periods TxP=The interaction between T and P

### 2- Fruit chemical changes during storage periods.

Data presented in Table (4) showed a gradual increase in T.S.S. values with prolonging the storage period. Post-harvest treatments decreased the T.S.S. contents compared with control in both seasons. On the other hand data in Table (5) cleared that, total acidity decreased significantly by extending the storage period, with an increase in treated fruits than control ones. Post-harvest treatments had the same trend in both seasons.

Data in Table (6) showed that total sugars significantly increased by extending the storage period with all treatments during storage at 8°C in both seasons. Calcium chloride 2 % showed a lower values of total sugars followed by wax 8 % in maintaining ripening.

These results are in line with those obtained by Yuniarti (1992), who found that the wax emulsion at 6 or 7 % treatment resulted in the lowest T.S.S. contents compared with control. Jain *et al.*, (2001) at the end of the storage period, found that the minimum total soluble solids, total sugars, reducing sugar contents and maximum acidity were recorded for wax emulsion 8 % in cool chamber storage and this trend was supported by some investigators Dhaka *et al.*, (2001) and El-Oraby *et al.* (2001 & 2004).

Table (3): Effect of postharvest treatments on flesh firmness (lb / in<sup>2</sup>) of Bullock's heart mango fruits held at 8°C.

Season Storage period in days	First season					Mean
	0	8	16	24	32	
Treatments						
CaCl <sub>2</sub> (1%)	22.64	18.74	16.24	14.03	11.80	16.69 B
CaCl <sub>2</sub> (2%)	22.32	19.61	17.25	14.31	12.53	17.21 A
Wax emulsion (4%)	22.51	15.64	12.12	10.31	8.77	13.87 F
Wax emulsion (6%)	22.51	18.11	15.12	12.52	10.18	15.69 B
Wax emulsion (8%)	22.49	18.42	15.69	12.79	10.73	16.03 C
Individual wrapping	22.40	16.31	14.73	12.11	9.92	15.09 E
Control	22.62	15.02	11.04	9.92	7.93	13.60 G
Mean	22.50 A	17.41 B	14.60 C	12.18 D	10.27 E	
L.S.D. 5%	T = 0.0527		P = 0.0062		T X P = 0.1324	
	Second season					
CaCl <sub>2</sub> (1%)	22.46	18.75	16.33	14.12	11.70	16.67 B
CaCl <sub>2</sub> (2%)	22.64	19.73	17.41	14.21	12.72	17.34 A
Wax emulsion (4%)	22.62	15.80	12.32	10.34	8.63	13.94 F
Wax emulsion (6%)	22.32	18.32	15.14	12.42	10.21	15.68 D
Wax emulsion (8%)	22.51	18.64	15.82	12.72	10.64	16.07 C
Individual wrapping	22.48	16.51	14.61	12.03	16.03	15.13 E
Control	22.61	15.21	11.20	9.31	8.01	13.27 G
Mean	22.52 A	17.56 B	14.69 C	12.16 D	10.28 E	
L.S.D. 5%	T = 0.0073		P = 0.044		T X P = 0.1175	

Means followed by the letter(s) are not significantly at 5% level.

T = Treatments P = Storage periods TxP= The interaction between T and P

### 3- Fruit total carotenoid contents.

Data in Table (7) showed that a gradual increase in the carotenoid values by prolonging the storage period and indicated that individual wrapping of fruits had more effect on slowing down colour formation. This may be due to the fact that wrapping the fruits and waxing helped in more accumulation of CO<sub>2</sub> and reduction of O<sub>2</sub> which in turn reduced and slowed down the oxidizing enzymes activity resulting in delaying of pulp colour development. Data in Table (7) cleared that individual wrapping, waxing 4% and CaCl<sub>2</sub> 1% improved fruit ripening than control during storage in both seasons. Similar results were noticed by Suntharalingam (1996) and El-Oraby (2004).

### 4- Characters of fruits during the marketing period (23 ±2°C) after cold storage at 8°C

Data in Fig. (1) showed that fruit weight loss, after cold storage periods (8, 16, 24 and 32 days) then transferred to ambient temperature (23 ±2°C) for five days as a marketing period, increased by advanced storage period and with using wax (8 %) and CaCl<sub>2</sub> 2 % treatments had more effect in reducing weight loss of mango fruits than control which had high values as compared with other treatments. The same trend was noticed in total sugars percentage as indicated in Fig. (2). Similar results were obtained by Castrillo & Bermudez (1992), Oosthuysen (1994 a, b) & (1997) and El-Oraby *et al.*, (2001) & (2004).

**Effect Of Post-Harvest Treatments On Physio-Chemical.....711**

**Table (4): Effect of postharvest treatments on total soluble solids (%) of Bullock's heart mango fruits held at 8°C.**

Season Storage period in days	First season					Mean
	0	8	16	24	32	
Treatments						
CaCl <sub>2</sub> (1%)	8.4	10.25	11.44	12.61	14.31	11.41 D
CaCl <sub>2</sub> (2%)	8.30	9.12	9.74	10.61	13.11	10.18 F
Wax emulsion (4%)	8.45	11.40	12.42	13.91	15.57	12.35 B
Wax emulsion (6%)	8.13	9.48	10.61	11.51	14.02	10.75 E
Wax emulsion (8%)	8.34	8.77	9.23	9.7	12.10	9.63 G
Individual wrapping	8.24	11.15	12.23	13.41	14.77	11.96 C
Control	8.20	11.57	12.67	14.42	16.32	12.64 A
Mean	8.30 E	10.25 D	11.19 C	12.31 B	14.31 A	
L.S.D. 5%	T = 0.0494		P = 0.0418		T X P = 0.1105	
	Second season					
CaCl <sub>2</sub> (1%)	8.34	10.24	11.75	12.72	14.61	11.51 D
CaCl <sub>2</sub> (2%)	8.49	9.23	9.72	10.65	13.22	10.26 F
Wax emulsion (4%)	8.43	11.30	12.12	14.03	15.71	12.37 B
Wax emulsion (6%)	8.17	9.39	10.72	12.02	14.43	10.95 E
Wax emulsion (8%)	8.21	8.62	9.13	9.62	12.01	9.52 G
Individual wrapping	8.32	11.01	11.63	13.50	15.12	12.02 C
Control	8.36	11.80	12.37	14.52	16.61	12.81 A
Mean	8.33 E	10.23 D	11.21 C	12.44 B	14.53 A	
L.S.D. 5%	T = 0.0052		P = 0.0440		T X P = 0.1164	

**Table (5): Effect of postharvest treatments on acidity (%) of Bullock's heart mango fruits held at 8°C.**

Season Storage period in days	First season					Mean
	0	8	16	24	32	
Treatments						
CaCl <sub>2</sub> (1%)	1.90	1.48	1.31	1.10	0.66	1.29 D
CaCl <sub>2</sub> (2%)	1.89	1.64	1.53	1.35	0.84	1.45 B
Wax emulsion (4%)	1.91	1.35	1.14	0.91	0.43	1.15 F
Wax emulsion (6%)	1.90	1.55	1.42	1.18	0.71	1.35 C
Wax emulsion (8%)	1.91	1.70	1.66	1.50	0.92	1.54 A
Individual wrapping	1.89	1.42	1.22	1.03	0.51	1.22 E
Control	1.89	1.30	0.96	0.75	0.31	1.04 G
Mean	1.90 A	1.49 B	1.32 C	1.12 D	0.63 E	
L.S.D. 5%	T = 0.0126		P = 0.01067		T X P = 0.0282	
	Second season					
CaCl <sub>2</sub> (1%)	1.91	1.54	1.36	1.15	0.65	1.32 D
CaCl <sub>2</sub> (2%)	1.92	1.71	1.58	1.41	0.78	1.48 B
Wax emulsion (4%)	1.90	1.41	1.22	0.96	0.48	1.20 F
Wax emulsion (6%)	1.93	1.64	1.49	1.26	0.71	1.40 C
Wax emulsion (8%)	1.93	1.83	1.72	1.57	0.85	1.58 A
Individual wrapping	1.90	1.47	1.30	1.06	0.58	1.26 E
Control	1.92	1.35	0.98	0.87	0.33	1.09 G
Mean	1.92 A	1.57 B	1.38 C	1.18 E	0.63 E	
L.S.D. 5%	T = 0.0103		P = 0.0082		T X P = 0.02304	

Means followed by the letter(s) are not significantly at 5% level.

T = Treatments P = Storage periods TxP= The interaction between T and P

Table (6): Effect of postharvest treatments on total sugars (%) of Bullock's heart mango fruits held at 8°C.

Season Storage period in days	First season					Mean
	0	8	16	24	32	
Treatments						
CaCl <sub>2</sub> (1%)	8.62	9.90	10.10	10.40	10.06	9.93 D
CaCl <sub>2</sub> (2%)	8.47	9.03	9.30	9.55	9.65	9.20 F
Wax emulsion (4%)	8.56	10.66	10.80	11.60	11.90	10.71 B
Wax emulsion (6%)	8.57	9.40	9.60	9.74	9.94	9.45 E
Wax emulsion (8%)	8.53	8.70	8.88	8.95	9.20	8.82 G
Individual wrapping	8.62	10.53	10.70	11.10	11.30	10.45 C
Control	8.46	10.81	10.90	11.91	12.21	10.86 A
Mean	8.55 E	9.86 D	10.04 C	10.46 B	10.69 A	
L.S.D. 5%	T = 0.0505		P = 0.0427		T X P = 0.113	
	Second season					
CaCl <sub>2</sub> (1%)	8.48	0.04	10.20	10.53	10.62	9.97 D
CaCl <sub>2</sub> (2%)	8.53	9.10	9.22	9.40	9.65	9.18 F
Wax emulsion (4%)	8.59	10.77	11.10	11.55	12.02	10.81 B
Wax emulsion (6%)	8.47	9.42	9.51	9.66	10.04	9.42 E
Wax emulsion (8%)	8.47	8.52	8.90	9.02	9.35	8.85 G
Individual wrapping	8.55	10.70	10.91	11.02	11.43	10.52 C
Control	8.45	10.85	11.20	11.53	12.43	10.89 A
Mean	8.51 E	9.91 D	10.15 C	10.39 B	10.79 A	
L.S.D. 5%	T = 0.0033		P = 0.0275		T X P = 0.0729	

Table (7): Effect of postharvest treatments on carotenoids (%) of Bullock's heart mango fruits held at 8°C.

Season Storage period in days	First season					Mean
	0	8	16	24	32	
Treatments						
CaCl <sub>2</sub> (1%)	0.28	0.78	1.37	1.91	2.83	1.44 C
CaCl <sub>2</sub> (2%)	0.28	0.57	0.93	1.44	2.33	1.11 F
Wax emulsion (4%)	0.28	0.95	1.45	1.80	3.05	1.51 B
Wax emulsion (6%)	0.27	0.68	1.22	1.86	2.58	1.32 E
Wax emulsion (8%)	0.28	0.49	0.67	0.87	2.05	0.87 G
Individual wrapping	0.29	1.12	1.56	1.98	3.22	1.63 A
Control	0.28	0.89	1.33	1.66	2.82	1.40 D
Mean	0.28 E	0.78 D	1.22 C	1.65 B	2.70 A	
L.S.D. 5%	T = 0.007		P = 0.006		T X P = 0.02	
	Second season					
CaCl <sub>2</sub> (1%)	0.28	0.74	1.22	1.81	2.96	1.40 C
CaCl <sub>2</sub> (2%)	0.27	0.56	0.88	1.53	2.34	1.12 F
Wax emulsion (4%)	0.28	0.96	1.35	1.73	3.13	1.49 B
Wax emulsion (6%)	0.27	0.60	1.05	1.79	2.51	1.24 E
Wax emulsion (8%)	0.29	0.47	0.68	0.86	2.01	0.90 G
Individual wrapping	0.28	1.07	1.44	1.95	3.34	1.62 A
Control	0.29	0.90	1.28	1.56	2.73	1.35 D
Mean	0.28 E	0.76 D	1.13 C	1.60 B	2.75 A	
L.S.D. 5%	T = 0.0242		P = 0.0204		T X P = 0.054	

Means followed by the letter(s) are not significantly at 5% level.

T = Treatments P = Storage periods T x P = The interaction between T and P



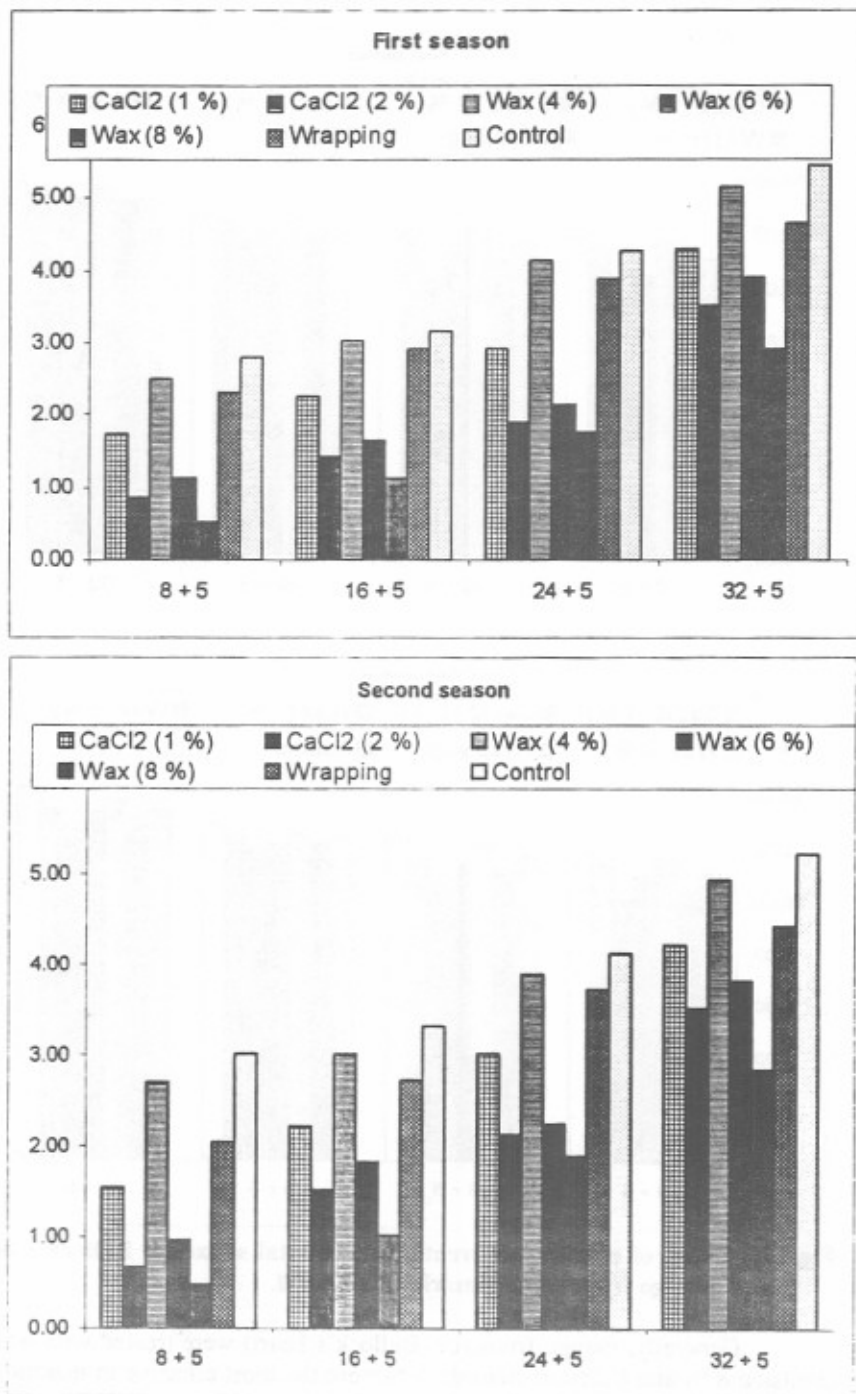


Fig. (1): Effect of postharvest treatments on weight loss of Bullock's heart mango fruits during marketing period.

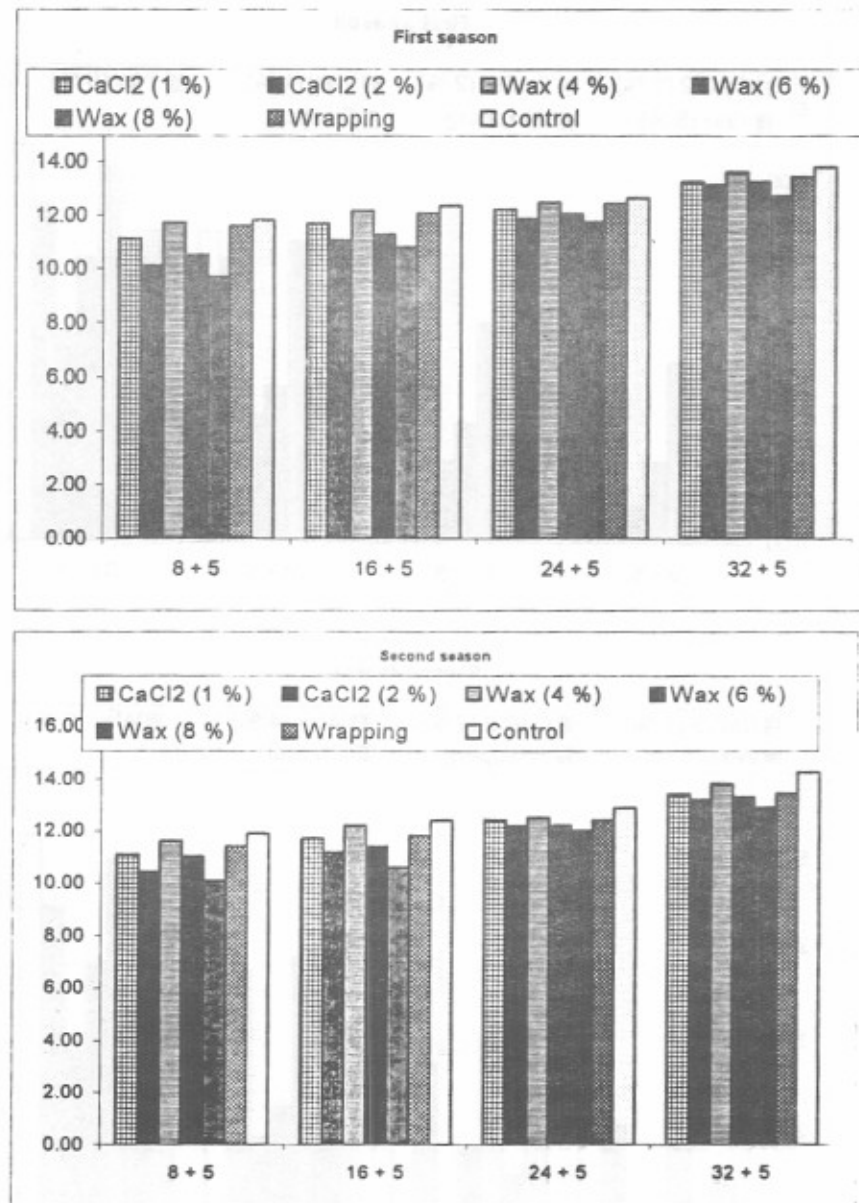


Fig. (2): Effect of postharvest treatments on total sugars of Bullock's heart mango fruits during marketing period.

Generally, mango fruits (cv Bullock's heart) were treated with waxing emulsion 8 % and Calcium chloride 2 % were the most effective in maintaining fruit quality, storability, superior in prolonging shelf life and reducing decayed fruits.

**REFERENCES**

- A.O.A.C. (1980): Official Methods of Analysis. Association of Official Analytical Chemists 13<sup>th</sup> Ed., Published by A.O.A.C. Washington D.C., U.S.A.
- Baldwin, E.A.; Burns, J.K., Kazokas, W.; Brecht, J.K.; Hagenmaier, R.D.; Bender, R.J. and Pesis, E. (1999): Effect of two edible coatings with different permeability characteristics on mango ripening during storage. *Post-harvest Biology and Technology* 171 (3): 215-226.
- Castrillo, M. and Bermudez, A. (1992): Post-harvest ripening in wax-coated Bacado mango. *International Journal of food Science and Technology*. 27: (4): 457-473.
- Dhaka, R.S.; Verma, M.K. and Agrwal, M.K. (2001): Effect of post-harvest treatments on physio-chemical characters during storage of mango (cv. Totapuri). *Haryana Journal of Horticultural Sciences*. 30: (1-2) 36-38.
- Dubais, M.; Gilles, K.A.; Hamilton, J.K.; Rebres, P.A. and Smith, F. (1956): Colormetric, methods for determination of sugars on related to substance. *Analytical chemistry*, 28: 3p 350-356.
- Duncan, D.B. (1955): Multiple range and multiple "F." tests. *Biometric*, 11: 1-42.
- El-Oraby, S.; El-Zayat, H. and Allam, H. (2001): Effect of storage temperature on mango fruits. The proceeding of the Fifth Hort. Conference, Ismailia Egypt. 24-28 March: 65-68.
- El-Oraby, S.; Amal, S.; Hassan, M. and Somaia A. Fawaz (2004): Effect of low Temperature and some supplemental treatments on the potential storage life of Fagriklan mango fruits. *Egypt. J. Appl. Sci.*, 19: (8) 343-361.
- Hisaw, L. (1991): Calcium sprays influence on apple fruit quality and storage shelf life. *Compact fruit tree*, 24: 75-79.
- Jain, S.K.; Mukherjee, S. and Gupta, M.K. (2001): Effect of post-harvest treatments and storage condition on the quality of mango during storage. *Haryana Jour. of Horticulture Sciences*. 30: (3-4) 183-187.
- Manzano, J.E.; Perez, Y.; Rojas, E., Lavi, V. (ed.); Degani, C. (ed.); S.S. Gazit (ed.); E. Lahav (ed.); E. Pesis (ed.); D. Prusky (ed.); E. Tomer (ed.) and Wysoki, M. (1997): Coating waxes on Haden mango fruits (*Mangifera indica* L.). cv. for export. *Acta Horticulture*. 455, 738-746.
- Nawar, A. and Ezz, TH. (1994): The control of enzymatic browning in Balady guava fruits. *Alex. J. Agric. Res.* 39 (1): 315-329.
- Oosthuysen, S.A. (1997): Effect of waxing and of a number of waxes on weight loss, shelf life and fruit quality of mangoes after four weeks of cool storage. Year book South African Mango Growers Association. 17: 105-110.
- Oosthuysen, S.A. (1994 a): Quality of mature Zill mango after long term refrigerated storage as determined by pre-storage ripeness and cold storage regime. South African Mango Growers Association, Yearbook 14: 37-42.
- Oosthuysen, S.A. (1994 b): Evaluation of (11 & 13 °C.) for sea export of Tommy Atkins and Sensation mangoes respectively. South African Mangoes Association Symposium Abstracts.

- Pantastico, E. R. B. (1975): Harvest indices maturity. Post-harvest, physiology, handling and utilization of tropical and subtropical fruits and vegetables. U.S.A., 57-63.
- Parmar, P.B. and Chundawat, B.S. (1989): Effect of various post-harvest treatments on the physiology of Kesar mango. Acta Horticulture 231: 679-684.
- Povaiah, B.W.; Glenn, G.M. and Reddy, A.S.N. (1988): Calcium and fruit softening. Physiology and Biochemistry. Hort. Rev. 10: 107-143.
- Shivarama; Reddy, L. Thimmarajv, K.R. and Reddy, L.S. (1989): Effect pre-packaging and post-harvest on the storage behaviour Acta Horticulture.231: 670-674.
- Snedecor, G.W. and Cochran, W.G. (1980): Statistical Methods. 7<sup>th</sup> Ed the Iowa State Univ. Press. Iowa. U.S.A.
- Suntharalingam, S. (1996): Post-harvest treatments of mango with calcium. Tropical Science 36, (1): 14-17.
- Wettestin (1957): Chlorophyll, letal and der submikro sropische frommech sell der plastiden exptl, cell, Res., 2-427433.
- Yuniarti; Suhardi (1992): Ripening retardation of Arumanis mango. Asean Food Journal 7: (4) 207-208.
- Zambrano, J. and Manzano, J. (1995): Effect of post-harvest calcium application on mango ripening and storage. Fruits-Pairs, 50: 145-152.

### تأثير معاملات ما بعد القطف على الصفات الطبيعية والكيميائية أثناء تخزين ثمار المانجو صنف قلب الثور

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قسم بحوث تداول الفاكهة - معهد بحوث البساتين - مركز البحوث الزراعية

أجرى هذا البحث خلال موسمى (٢٠٠٣، ٢٠٠٤) فى محطة بحوث البساتين بالقناطر الخيرية، بهدف إطالة الفترة التخزينية والعمر التسويقي وتحسين صفات الجودة لثمار المانجو صنف قلب الثور، حيث تم قطف الثمار عند مرحلة اكتمال النمو وأجريت عليها المعاملات التالية:

- الغمر فى محلول كلوريد الكالسيوم ١، ٢ %.
- تسميع الثمار بمستحلب الشمع بتركيز ٤، ٦، ٨ %.
- التغليف الفردى بالبولى إيثيلين منخفض الكثافة.
- بالإضافة إلى الثمار الغير معاملة كمقارنة.

وتم تخزين كل المعاملات على درجة حرارة ٨ °م ورطوبة نسبية ٨٥-٩٠ %.

أظهرت النتائج أن المعاملة بالتسميع ٨ %، كلوريد الكالسيوم ٢ %، كانت أفضل النتائج فى الحفاظ على صفات الجودة والقدرة التخزينية وإطالة العمر التسويقي للثمار وتقليل نسبة التلف.