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**EFFECT OF 1-METHYLCYCLOPROPENE, 1- MCP ON STORABILITY
OF GUAVA FRUITS
BY**

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ABSTRACT

This investigation was carried out during two successive seasons (2002 and 2003) at the Hort. Res. Inst., Fruit handling department. Guava fruits were picked from Sabahaia. Res. Station farm at Alex Governorate- Hort. Res. Inst., at maturity stage when fruit color changed from dark green to greenish yellow. Fruits were treated with 1- MCP (1-Methylcyclopropene), 1.0ppm for 24 hours at 23°C, and then stored at 10C and R.H 90-95% for 20 days during the two seasons. Physical and chemical fruit Characteristics were determined during the two seasons

1- MCP treatments delayed changes of color, fruit firmness, total soluble solids, total acidity, respiration rate and V.C content during storage. After 20 days of storage at 10°C, total losses of 1- MCP treated fruits reached the value of 9%, compared with the value of 55 % for untreated fruits (control) during the same period. This study confirmed that, treating fruits with 1- MCP as a post-harvest treatment was necessary to keep fruit quality of guava during storage.

This result is important for fruit transportation when these periods are expected to exceed 15 days for shipping.

INTRODUCTION

Guava fruits are highly perishable fruits, and very sensitive to post - harvest decay, losses and more subject to several disorders during marketing which may be limited for only a few days.

Guava fruits are harvested when their color change from green to light green. This change in color occurs 90-180 days after flowering, depending on the cultivar, production area, and the summer or winter times ((Yusof *et al.*, (1988) Kader, A; (1992) & Nawar, A; and Ezz, T. (1994) and Mercado-Silva *et al.*, (1998))

Mode of action of 1-MCP as an inhibitor of ethylene action was demonstrated and discussed where it was highly effective in blocking the undesirable post-harvest effects of ethylene on numerous fruits and vegetables.

The ability of 1-methylcyclopropene (1-MCP) to delay ripening of mature green climacteric bananas has been widely demonstrated, (Sisler and Serek, 1997; Golding *et al.*, 1998; Jayceet *et al.*, 1999). As well as the time of adding, the concentration and storage temperature affect this response (Yueming *et al.*, 1999; Macnish *et al.*, 2000). However, the reports of the efficiency of 1-MCP in these studies were quite variable (Harris *et al.*, 2000).

It has been illustrated that, the maximum recommended and approved concentration is 1.00 ppm (Warner 2002, from El -Bassiouny, 2003)

Chahin, *et al.*, 1999 reported that the application of 1-MCP was found to delay the rate of softening of apricot fruits.

Porat, *et al.*, 1999 mentioned that post-harvest treatment with 1-mcp at 10ppm for 60 hours had no effect on green or orange shamoti fruits loss of firmness during storage.

Fan *et al.*, 2000 on apricot and 2002 on peach mentioned that post-harvest treatments with 1-MCP significantly increased total acidity content of fruits compared with control.

Chen Weihui *et al.* (2001) reported that total soluble solids content of guava fruits increased while total acidity and V.C increased for some period then decreased during storage.

El-Bassiouny, 2003 suggested that 1-mcp (1.0 ppm) had no effect on the storage life of Ewais mango. On the contrary the high concentration (5.00ppm) had inconsistent significant effects in direction of enhanced ripening.

Also she added that, 0.1ppm 1-MCP treatment for 48 hours had no effect on the loss of flesh texture, flesh firmness, the increase in T.S.S, loss in titratable acidity, and the increase in TSS/acid ratio. Also she mentioned that post-harvest treatment with MCP had no effect on 1*,a*,b* either on the peel or on the flesh.

Bassetto *et al.*, 2004 in there study on " Pedro Sato" guava fruit were treated with 0,100,300 and 900 nl l⁻¹ of 1 MCP for 3, 6, 9 and 12 h and stored at 25 C for 5 days control fruits and 9 days (treated fruits) they mentioned that the 100 and 300 nl l⁻¹ 1-MCP concentration were inefficient for the 3 hours of exposure time. However storage was improved with treatments by 6 or 12 h and at 900 nl l⁻¹ for 3 h showed the best results. Fruits treated with 900 nl l⁻¹ of MCP for 6 or 12 h did not ripen. Also they added that 1-MCP delayed green color losses in fruits and reduced respiration rate and increased total acidity content of fruits compared with control fruits at the end of storage period. On the other hand they, mentioned that 1-MCP had no effect on T.S.S and ascorbic acid content of fruits.

MATERIALS AND METHODS

This investigation was carried out during two successive seasons (2002 & 2003) at Hort. Res. Inst. Fruit handling department Giza, Egypt. Guava fruits were picked from Hort. Res. Inst., Sabahaia Res Station farm at Alex Governorate. In the morning, at maturity, when the fruit color changed from dark green to greenish yellow (According to Yusof *et al.* (1988) and Kader (1992) Guava fruits were picked, and directly transported to the laboratory. Fruits were washed thoroughly and left to dry and divided into the following treatments for the two seasons of this investigation.

- 1- Control fruit (Untreated) only washed by distilled water.
- 2- Fruit treated with one part per million of 1- MCP for 24 hours at 23°C.

Fruits were stored for 20 days at 10°C and 85-90% RH. 9 cartons (20 fruits per/carton) for all used treatments. Three cartons were used for weight loss % calculation, three cartons were used for decay percentage calculation, and the other three cartons were used for physical and chemical analysis. Samples were taken at 10 day intervals and physical, chemical characteristics were studied as following:-

Weight loss %:

Weight loss % was calculated according to the following equation. Fruits weight at the beginning –fruits weight at the sampling time x 100/fruit weight at the beginning of the storage.

Decay percentage:

Unmarketable fruits were considered as decayed. Decay percentage was calculated according to the following equation. Decayed fruits weight x 100/fruit weight at the beginning of the storage.

Color Evaluation:

Fruit color was estimated in 15 fruits per treatment after 0, 10 and 20 days using a Minolta colorimeter type C-R-400 which gives L, a, b values (L) for lightness, (a) for redness to greenness and (b) for yellowness to blueness. Hue angle(h°)was calculated as described by Mc Guire, 1992 and Voss, 1992

Fruit firmness: kg/cm²

Using fruit pressure tester (Mod.FT327, Italy)

Flesh texture:

This factor is estimated by measuring resistance of fruit flesh (at a middle position) to a penetrating needle (1mm diameter) of a texture analyzer instrument (Lera texture analyzer), for a fixed distance of 3, 5 millimeters inside fruit flesh, and firmness is expressed in gram units.

Respiration activity:-

The respiration activity expressed as CO₂ or O₂ concentration per air was determined by incubating 2 equals mass and volume samples from all

treatments in 6000 ml glass flask for 24 hours and then CO₂ and O₂ concentration in the flask were determined by using a Dual Trak model 902D Gas analyzer (Quantek Instruments USA)

Fruit Chemical analysis:-

Total soluble solids (TSS %): This property was determined by Carl-Zeiss hand refractometer

Total acidity%:

This property was determined according to A.O.A.C method (1990); the results were expressed as a percent mg of citric acid per 100 ml juice.

TSS/acid ratio:

This property was determined by dividing total soluble solids (TSS %) on total acidity%

Ascorbic acid (V.C):-

Ascorbic acid was calculated as mg/100m juice according to A.O.A.C. (1990).

Statistical analysis:

A completely randomized design was employed for this experiment. The treatment means were compared using the method of L.S.D at 5% level of significance (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Weight loss and decay percentage:-

Data presented in Tables (1, 2) clearly indicate that, weight loss percentage and decay percentage significantly increased with the prolonging of storage period in both of seasons under the investigation.

Concerning the effect of 1-MCP, it is clear that post-harvest treatment with 1-MCP significantly decreased weight loss, and decay incidence of guava fruits during storage compared with control fruits.

Weight loss of fruits treated with 1-MCP reached the values of 2.63, 3.8 % after 20 days of storage at 10°C compared with 3.53 and 9.15 % for untreated fruit in the first and the second season, respectively.

Decay percentage of fruits treated 1-MCP after the same period reached the values of 0.00 and 15.33 % compared with 56.99 and 41.0 for untreated fruits in the first and the second seasons respectively.

These results are in harmony with those obtained by Hardenberg *et al.*, 1986; Thompson *et al.*, 2002, they mentioned that 1-MCP significantly reduced weight loss and decay incidence of fruit during storage.

Table (1): Effect of 1-methylcyclopropene on weight loss% of Guava fruits stored at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	0.00	0.00	0.00	0.00	0.00	0.00
10 days	3.20	1.90	2.55	5.06	3.16	4.43
20 day	3.53	2.63	3.08	9.15	3.80	6.15
Means	2.24	1.51	1.87	4.91	2.32	3.61
L.S.D at 5% for:-						
Storage period:	0.3017			1.067		
Treatments:	0.2537			0.871		
Interaction:	0.4394			1.51		

Table (2): Effect of 1-methylcyclopropene on decay % of Guava fruits Stored at 10°C during 2002 and 2003 seasons

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	0.00	0.00	0.00	0.00	0.00	0.00
10 days	28.90	0.00	14.45	6.50	0.00	3.25
20 day	56.99	0.00	23.05	41.00	15.33	28.17
Means	28.63	0.00	14.32	15.83	5.11	10.47
L.S.D at 5% for:-						
Storage period:	2.205			2.316		
Treatments:	1.850			1.891		
Interaction	3.118			3.275		

Fruit firmness and fruit texture:-

Values of fruit firmness and texture of Guava fruits during storage were recorded in tables (3, 4, and 5). It is clear that fruit firmness and fruit texture significantly decreased during storage in the two seasons under this investigation. Post-harvest treatment with 1-MCP significantly inhibited the decreasing rate of fruit firmness and texture during storage in the two seasons of this work. According to the data in the same tables, fruit firmness and texture at 3mm, fruit texture at 5mm, after 20 days of storage at 10°C in fruits treated with 1-MCP reached the values of (8.5,38.94 and 74.96) and(8.4,51.83 and 118.83) in the first and second seasons, respectively. On contrast these parameters reached the values of (6.4, 0.00 and 0.00) and (4.93, 20.08 and 32.60) for untreated fruit after the same period.

These results are in harmony with those obtained by Chahin, *et al.*, 1999. On contrary these results disagree with those obtained by Porat, *et al.*, 1999.

Table (3): Effect of 1-methylcyclopropene on firmness of Guava fruit stored at 10°C during 2002 and 2003 seasons (kg.cm²).

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	10.90	10.90	10.90	11.93	11.93	11.93
10 days	9.23	9.73	9.48	7.66	9.83	8.74
20 day	6.40	8.50	7.45	4.93	8.40	6.67
Means	8.84	9.71	9.28	8.17	10.05	9.11
L.S.D at 5% for:-						
Storage period:	1.317			0.5274		
Treatments:	1.106			0.4284		
Interaction:	1.914			0.7421		

Table (4): Effect of 1-methylcyclopropene on texture of Guava fruits stored at 10°C during 2002 and 2003 seasons (at 3 mm).

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	80.27	80.27	80.27	122.38	122.38	122.83
10 days	24.91	41.47	33.19	45.48	82.36	64.10
20 day	0.00	38.94	19.47	20.08	51.83	35.96
Means	35.06	53.56	44.31	62.64	85.52	74.08
L.S.D at 5% for:-						
Storage period:	3.607			17.73		
Treatments:	2.945			14.48		
Interaction:	5.101			25.08		

Table (5): Effect of 1-methylcyclopropene on texture of Guava fruits stored at 10°C during 2002 and 2003 seasons (at 5 mm).

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	148.42	148.42	148.42	194.36	194.36	194.36
10 days	55.24	86.37	70.80	48.82	157.41	103.11
20 day	0.00	74.96	37.48	32.66	118.83	75.74
Means	67.88	103.25	85.57	91.82	156.74	124.28
L.S.D at 5% for:-						
Storage period:	11.94			22.98		
Treatments:	9.745			18.76		
Interaction:	16.88			32.49		

Peel color I*, a*b* and hue angle (h°)

Data presented in Tables (6, 7) clearly indicated that, color directly changed from green yellow (hue angle >90 °C) to yellow (hue angle < 90°C) with prolonging of the storage period.

Data also indicated that post-harvest treatment with 1-MCP significantly reduced fruit color transition fruits treated with 1-MCP .hue angle (h°) higher than associated with control fruit.

These results are in line with those reported by Bassetto *et al.*, 2004 they mentioned that 1-MCP a post-harvest treatments significantly reduced the transmission of Guava fruit color during storage period. On contrary these results disagree with those reported by El-Bassiouny, 2003 who mentioned that 1- MCP as post-harvest treatments had no effect on Mango fruits color transmission during storage.

Table (6): Effect of 1-methylcyclopropene on peel color lightness (L*) of Guava fruits stored at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	66.77	66.77	66.77	65.69	65.69	65.69
10 days	68.74	65.35	67.04	70.95	68.91	69.93
20 day	66.88	66.64	66.76	70.65	67.49	69.07
Means	67.46	66.25	66.86	69.09	67.36	68.23
L.S.D at 5% for:-						
Storage period:	3.427			N		
Treatments:	N			N		
Interaction:	N			N		

Table (7): Effect of 1-methylcyclopropene on hue angle (h°) of Guava fruits stored at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	106.58	106.58	106.58	104.16	104.16	104.16
10 days	88.12	94.85	91.48	88.07	96.42	92.24
20 day	86.9	94.18	90.54	87.09	96.11	91.16
Means	93.85	98.53	96.20	93.10	98.89	95.99
L.S.D at 5% for:-						
Storage period:	0.44			1.09		
Treatments:	0.36			1.86		
Interaction:	0.62			1.49		

Total soluble solids, total acidity, total soluble solids total acidity ratio and vitamin C contents:-

Data obtained in Tables (8, 9, 10 and 11) clearly indicated that total soluble solids contents and total soluble solids total acidity ratio gradually and significantly increased during storage while total acidity and vitamin C gradually and significantly decreased in the two seasons of this investigation. These results are in line with those obtained by Fan *et al.*, 2000-2002 and Bassetto *et al.*, 2005,

they reported that plowshares treatments with 1-MCP significantly increased fruit contents of total acidity.

Concerning the effect of 1-MCP on total soluble solids, total acidity, total soluble solids total acidity ratio and vitamin C content, it is obvious from the same tables that, post-harvest treatment with 1-MCP significantly reduced the deterioration rate of all these characteristics. On the other side these results disagree with those obtained by El .Bassiouny, 2003 and Bassetto *et al.*, 2005 they mention that 1-MCP had no effect on fruits contents of T.S.S and V.C during storage.

Respiration activity

According to data presented in Tables (12, 13) CO₂ concentration was increased gradually and significantly while O₂ decreased as fruits changed directly to repining.

Table (8): Effect of 1-methylcyclopropene on TSS % of Guava fruits stored at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	8.10	8.10	8.10	6.66	6.66	6.66
10 days	9.83	8.33	9.08	7.90	7.70	7.80
20 day	9.98	9.13	9.56	9.43	7.83	8.63
Means	9.30	8.52	8.91	7.99	7.39	7.69
L.S.D at 5% for:-						
Storage period:	0.736			1.282		
Treatments:	0.618			1.047		
Interaction:	1.041			1.813		

Table (9): Effect of 1-methylcyclopropene on titratable acidity % of Guava fruits stored at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	1.13	1.13	1.13	1.06	1.06	1.06
10 days	1.03	1.05	1.01	0.76	0.93	0.84
20 day	0.76	0.93	0.74	0.53	0.80	0.66
Means	0.97	1.04	1.01	0.78	0.93	0.86
L.S.D at 5% for:-						
Storage period:	0.195			0.7956		
Treatments:	0.159			0.0649		
Interaction:	0.276			0.1125		

Table (10): Effect of 1-methylcyclopropene on TSS/acid ratio of Guava fruits stored at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	7.17	7.17	7.17	6.28	6.28	6.28
10 days	9.54	7.93	8.74	10.39	8.28	9.34
20 day	13.13	9.82	11.47	17.79	9.79	13.79
Means	9.95	8.31	9.13	11.49	8.12	9.80
L.S.D at 5% for:-						
Storage period:	2.200			2.052		
Treatments:	1.796			1.675		
Interaction:	3.110			2.901		

Table (11): Effect of 1-methylcyclopropene on V.C of Guava fruits stored at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	2.66	2.66	2.66	4.76	4.76	4.76
10 days	4.20	3.90	4.05	6.46	5.46	5.96
20 day	3.46	4.06	3.76	6.30	5.50	5.90
Means	3.44	3.54	3.49	5.84	5.24	5.54
L.S.D at 5% for:-						
Storage period:	0.4605			0.3256		
Treatments:	N			0.2569		
Interaction:	N			0.4805		

Table (12): Effect of 1-methylcyclopropene on CO₂ concentration of air around Guava fruits incubated for 24 h inside flask after 0,10,20 days of Storage at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	11.90	11.90	11.90	10.70	10.70	10.70
10 days	14.30	12.10	13.20	13.80	10.90	12.35
20 day	18.60	13.95	15.75	17.50	13.10	15.30
Means	14.93	12.65	13.61	14.00	11.56	12.78
L.S.D at 5% for:-						
Storage period:	1.36			1.25		
Treatments:	1.11			1.03		
Interaction:	1.92			1.77		

Table (13): Effect of 1-methylcyclopropene on O₂ concentration of air around Guava fruits incubated for 24 h inside flask after 0,10,20 days of Storage at 10°C during 2002 and 2003 seasons.

Treatments	2002			2003		
Storage period	Control	MCP	Means	Control	MCP	Means
Initial	6.25	6.25	6.25	5.50	5.50	5.50
10 days	7.75	7.99	7.87	6.23	8.23	7.23
20 day	8.9	12.55	10.62	7.90	11.43	9.66
Means	7.63	8.93	8.24	7.21	7.72	7.46
L.S.D at 5% for:-						
Storage period:	0.76			0.50		
Treatments:	0.62			0.41		
Interaction:	1.07			0.71		

1-MCP significantly reduced the respiration activity which diverted from the low CO₂ and the high O₂ concentration around treated fruits inside flask.

These results agree with those obtained by Bassetto, *et al.*, 2004 they mention that post-harvest Guava fruits treated with 1-MCP had respiration rate significantly less than control fruits.

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تأثير مادة ١- ميثيل سيكلوبروبان على القدرة التخزينية لثمار الجوافة

جمال فتحي عبد العزيز حسن

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

اجري هذا البحث خلال موسمي ٢٠٠٢ و ٢٠٠٣ بمعهد بحوث البساتين قسم بحوث تداول الفاكهة. تم الحصول على الثمار من مزرعة محطة بحوث الصباحية بالإسكندرية- معهد بحوث البساتين . قطف الثمار عند مرحلة اكتمال النمو للثمار (لون الثمار أخضر مصفرا). تم دراسة تأثير معاملة الثمار بمادة ١- ميثيل سيكلوبروبان بتركيز ١ جزء في المليون لمدة ٢٤ ساعة عند درجة حرارة ٢٣°م. تم تخزين الثمار على درجة حرارة ١٠°م ورطوبة نسبية ٩٠-٩٥% لمدة ٢٠ يوما للموسمين على التوالي. قدرت بعض الصفات الطبيعية والكيميائية.

أدت المعاملة بمادة ١- ميثيل سيكلوبروبان إلى تأخير معدل تغير اللون والاحتفاظ بجودة الثمار وصلابتها وتأخير الزيادة في نسبة المواد الصلبة الذاتية ومعدل التغير في كل من الحموضة وفيتامين C.

بينت الدراسة أنه يمكن باستخدام مادة ١- ميثيل سيكلوبروبان تخزين ثمار الجوافة على درجة ١٠°م لمدة ٢٠ يوما حيث وصل إجمالي الفاقد سواء مرضى أو فقدي الوزن إلى ٩% في المتوسط مقارنة بالثمار الغير المعاملة حيث وصلت نسبة الفاقد فيها إلى ٥٥% خلال هذه الفترة.

وقد تبين من الدراسة ان معاملة الثمار بمادة ١- ميثيل سيكلوبروبان بتركيز ١ جزء في المليون ضرورية للمحافظة على حيوية الثمار أثناء الشحن أو التخزين بحيث لا تتعدى فترة الشحن ١٥ يوما.