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QUALITY MAINTENANCE OF CACTUS PEAR FRUITS AS FRESH CUT PRODUCTS

H. Allam and Gihan Ali
Horticulture Research Institute, A.R.C

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ABSTRACT: *This experiment was carried out on peeled cactus pear fruits as fresh cut product during 2002 and 2003 seasons. The aim of this research is to evaluate the effect of wrapping film with polypropylene (liner and individual) to improve the keeping quality of two cultivars (Farawla and Balady) during cold storage at 0°C and 90 % RH. The Farawla cultivar had the lowest weight loss, decay, texture of flesh fruits, T.S.S and good visual quality, when compared with Balady cv. under long-term storage conditions. Wrapping fruits individually with polypropylene film was the most effective in reducing weight loss and decay percentages, than the liner wrapping with polypropylene film. In addition, wrapping fruits individually with polypropylene film maintained fruit's quality (texture, T.S.S, ascorbic acid and visual quality) during cold storage. While, weight loss and decay percentages were greater in the unwrapped fruits (control). Concerning the storage period, weight loss and decay percentages of peeled cactus pear fruits increased with the prolongation of storage period, while T.S.S. %, ascorbic acid content, texture flesh fruits and visual quality were decreased during storage periods. Therefore, individual wrapping of peeled cactus pear fruits (Farawla cv.) can be useful in extending its shelf life.*

Key words: *Cactus pear – fresh cut – wrapping film – quality parameters – storage period.*

INTRODUCTION

Cactus pear (*Opuntia ficus – indica* (L.) Mill) fruits represent a very important food source in satisfying the nutritional needs of populations of various countries (Pimienta, 1993). However, the nutritional, medicinal and human health properties of cactus pears are factors that could contribute to an increase in cactus pear consumption (Hegwood, 1990). In particular, they are rich in vitamin C, calcium, magnesium and diabetic fiber (Shapiro and Gong, 2002). Marketing cactus as ready to eat (fresh – cut) products may significantly expand their consumption; on condition that their quality, safety and longevity would satisfy the market demands (Goldman *et al*, 2005). Fresh cut of cactus pear is more perishable than the unprocessed row materials from which they are made, because internal tissues are exposed and generally lack skin or cuticle as a protective covering. In addition, the fresh cut processing accelerates the metabolism of the tissue. The combination of the exposed and injured internal tissues and accelerated metabolism places

severe stress on the fresh cut product, which subsequently affects the shelf life and quality of the product (Piga *et al*, 2000; Saenz, *et al*, 2001and Corbo, *et al*, 2004). Furthermore, peeled cactus pears maintained satisfactory visual, organoleptic and microbiological quality for at least 14 days when stored in micro perforated packages at 4°C. At 8 °C storage for more than 10 days it was accompanied by a sharp increase of yeast population. They also found that peeling did not accelerate fruit deterioration (Goldman *et al*, 2005). High quality can be maintained by selecting produce at proper maturity and controlling deterioration with low temperature and modified atmosphere packages.

During post-harvest life of cactus fruits there are a serious problem expressed as weight and water loss because it decreases salable weight and appearance. However, cooling to 0 °C is the primary mean of maintaining good salable conditions, fresh fruit and good appearance .When cactus pear fruits were stored at 0 °C, quality could be maintained for two months and the fruits were tolerant to low temperature (Berger *et al*, 1978). Storage at lower temperature (5°C) reduces water loss by reducing the vapor pressure deficit (Cantwell, 1986) and (Chessa and Barbera, 1984). Whereas, cold storage (10°C) of peeled cactus allows the fruits to maintain firmness and to reduce water losses and fungus incidence (Ochoa *et al*, 2002). On the other hand, storing peeled cactus pears at less favorable conditions will accelerate quality deterioration (Cantwell, 1995). When peeled fruits were held at 20 °C, their life was shortened to 3 – 5 days (Goldman *et al*, 2005). However, the shelf life of fresh cut cactus pears (peeled intact or in halves), packed in bi-directional polypropylene bags 25 µm thick, sealed and stored at 4°C, can be extended up to 20 days without affecting their quality (Garcia, *et al*, 2006).

Utilization of permeable polymeric films to achieve modification of package atmospheric gases concentration offer ample potential to extend peeled cactus pear shelf life (Cantwell, 1992). Therefore, atmospheric modification within a package develops as a result of the respiration rate of the tissue and gas diffusion characteristics of the film (Kader, 2002).

Wrapping peeled cactus pear fruits in polymeric films retards water loss which enhances maintenance of visual quality and minimizes the loss of firmness and vitamin C content (Piga *et al*, 1996). Micro perforated packages slightly delayed quality change in peeled cactus pears as compared to non – peeled fruits (Goldman *et al*, 2005).

With respect to cactus pears cultivars, it was found that large differences among cactus pear cultivars were evident in total soluble solids (12 – 17 %), titratable acidity (0.03 – 0.12 %), pH (6.0 – 6.6) and ascorbic acid contents (20 – 40 mg / 100 g fresh weight). Furthermore, cactus pear varieties differed in weight loss and decay percentages during cold storage. (Kader, 2000).

The cultivars Burrona and Cristalina had the lowest loss of pulp firmness, weight loss, and respiratory rate and chilling injury levels when compared with the cultivars Copena – Torreoja and Copena (Garcia *et al*, 1997).

Moreover, the firmness of cactus pear fruits decreased during storage at 20 °C for one month. Weight loss and decay percentage increased gradually with prolongation of storage period (Rodriguez, *et al,* 1992).

The purpose of this experiment was to evaluate using the wrapping film with polypropylene (liner and individual) on improving the keeping quality of two cultivars (Farawla and Balady) during cold storage (0°Cand 90 % RH).

MATERIALS AND METHODS

This study was carried out in a private orchard during two successive seasons 2002 and 2003 at South Tahrir district, Behera Governorat. Cactus pear (*Opuntie ficus* – indice (L.) Miller) Balady (B) and Farawla (F) cultivars were used in this study. Agricultural practices took place whenever it was necessary according to the recommendations of Ministry of Agriculture. Cactus pear fruits were picked at yellow – green stage for Balady cv. and pink for Farawla cv. in the mid season and transported immediately to the laboratory of fruit handling department, Horticulture Research Institute (HRI), where sound and healthy fruits were chosen for storage experiment.

The fruits of each cultivar were peeled and divided into three groups: the first group was the peeled fruits of each cultivar were packed in foam tray (20 x 10 x 2.5 cm) and tightly over wrapped (liner (L)) with 20 µ thick polypropylene .The second group was wrapped individually (I) in 20 µ thick polypropylene .The last group was the unwrapped fruits (control). Twelve replicates were prepared for each treatment type for both cultivars. Each replicate contained eight fruits. All treatments were stored at 0°C and 90 % RH. Three replicates from each treatment were taken and examined every 7 days for quality parameters.

The following data were recorded:

- Weight loss percentage was estimated according to the following equation:

$$\text{Weight loss \%} = \frac{\text{Initial weight of fruits} - \text{weight of fruits at sampling date}}{\text{Initial weight of fruits}} \times 100$$

- Decay percentage was estimated according to the following equation:

$$\text{Decay percentage} = \frac{\text{Weight of decayed fruits}}{\text{Original weight of the sample}} \times 100$$

- Visual quality was evaluated using a 1 – 5 scale with 9 = Excellent, 7 = good, 5 = Fair, 3 = poor, 1 = unusable fruit evaluated at less than 3 and considered unmarketable (Kasmire *et al.*, 1974 and Able *et al.*, 2002).
- Texture: this factor is estimated by measuring resistance of fruit flesh (at a middle position) to a penetrating needle of a texture analyzer instrument

(Lfra texture analyzer) for a fixed distance of 3 millimeters inside fruit flesh and firmness is expressed in gram units.

- Color Hue angle: Intensity of color was estimated by Hunter colorimeter (DP9000) for each fruit, and color Hue angle was calculated as "$\tan^{-1}$ b/a". Color was represented by a (green – red) and b (blue – yellow) .The hue° was estimated as 0° = red –purple, 90° = yellow, 180° = blush – green, 270° = blue. (McGuire, 1992).
- Total soluble solids (T.S.S.) percentage was determined using an Abbe refractometer.
- Ascorbic acid: was determined by using 2,6-Dichlorophenolindophenol dye and 2% Oxalic acid as a substrate and calculated per 100 ml of juice (A.O.A.C, 1990).
- pH values: This value was estimated by a pH meter instrument (Schott Gerate).
- Statistical analysis: Means were compared by the L. S. D. value at 5% level. (Snedecor and Cochran, 1990).

RESULTS AND DISCUSSION

• Physical characteristics

1- Weight loss:

The results in Table (1) indicated that weight loss at cold storage was significantly affected by cultivar, wrapping and storage period.

Concerning the effect of cultivar on weight loss percentage during storage, data indicated that there were significant varietals differences. Cultivar (F) exhibited the lowest weight loss compared with cv. (B). These results are in harmony with the results obtained by Cantwell, (1986) and Rodriguez, *et al*, (1992), on cactus pears.

This result could be due to the genetic reactions of different cultivars and also to the fruits chemical constituents, which needed some work to clarify these arguments. However, it was noticed that wrapping fruits showed significant differences in their fruit weight loss percentage. In this respect, wrapping peeled cactus pear fruits slowed the rate of weight loss comparatively to the highest ones obtained from unwrapped fruits (control). Wrapping fruits individually surpassed the liner wrapping with polypropylene in minimizing fruit weight loss percentage during storage in both cultivars.

Wrapping provides excellent protection from weight loss as it minimizes air movement in a microclimate with a very high humidity around the fruits. Moreover, modification of the atmosphere around the cactus pear fruits as a result of respiration may relatively reduce water loss due to its inhibiting effect on senescence. Goldman, *et al.*, (2005) and Garcia, *et al*, (2006).

Weight loss percentage of peeled cactus pear fruits increased by the prolongation of the storage periods. This continuous loss in weight during

storage results from the loss of water by transpiration and dry mater due to respiration.

Regarding the effect of interaction between cultivars and wrapping obviously it had positive effect on loss in weight. It is clear that cv. (F) wrapped individually with polypropylene had the lowest weight loss percentage.

Table (1): Effect of variety, modified atmosphere packaging (MAP) and storage periods on Weight loss percentage of fresh cut cactus pear fruits stored at 0 °C during 2002 and 2003 seasons.

Varieties	MAP	2002 season					2003 season				
		Storage period in days				Mean	Storage period in days				Mean
		0	7	14	21		0	7	14	21	
B	L		1.33	2.18	2.52	2.01		1.65	2.54	4.81	1.32
	I		0.35	1.17	1.82	1.11		0.26	0.85	0.92	0.68
	Control		2.86	6.25	9.42	6.18		2.64	5.93	8.14	5.57
Mean			1.51	3.20	4.59	---		1.32	3.11	4.62	---
F	L		0.30	0.87	1.43	0.87		0.84	1.03	1.47	1.11
	I		0.27	0.49	0.66	0.47		0.45	0.83	1.00	0.76
	Control		2.15	5.04	8.21	5.13		1.94	4.82	7.62	4.79
Mean			0.91	2.13	3.43	---		1.08	2.22	3.36	---
MAP	L		0.82	1.53	1.98	1.44		0.95	1.79	3.14	1.96
	I		0.31	0.83	1.24	0.79		0.36	0.84	0.96	0.72
	Control		2.51	5.65	8.82	5.66		2.29	5.38	7.88	5.18
Mean			1.21	2.67	4.01	---		1.20	2.67	3.99	---
L.S.D at 5 %											
Variety A:		0.12					0.09				
MAP B:		0.09					0.06				
Storage period C:		0.09					0.06				
A x B:		0.20					0.12				
A x C:		0.21					0.12				
B x C:		0.16					0.11				
A x B x C:		0.35					0.25				

2- Color determination:

From data displayed in fig. (1), it is evident that fresh color did not change noticeably during the cold storage and till its termination. Cactus pear fruits of cv. (B) were less yellowish than cv. (F), which had more yellowish with orange - red tint. Hue angle of (B) fruit at the start was (85.5) at the first season and (82.3) at the second season and after 21 days in cold storage, package type had no effect on the color which was relatively stable, for (F) cv. Fruits of the second season tended to be less developed in color with hue values moving slowly backwards (after 21 days), all values exceeded slightly the start value of (37.1) but that could be due to fruit natural randomness only. This conclusion agrees with those of Merin *et al* (1987) who stated that pigments of cactus are stable at a temperature range wide and also it is almost similar to results of Morga *et al*, (2006).

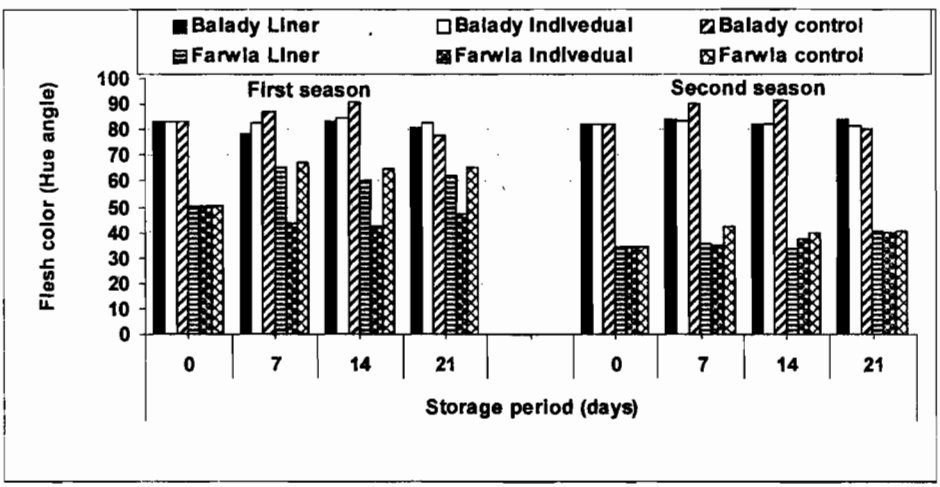

Fig. (1): Effect of variety, modified atmosphere packaging (MAP) and storage periods on color (h°) of fresh cut Cactus pears fruits stored at 0 °C during 2002 and 2003 seasons.

3- Decay percentage:

Results presented in Table (2) revealed that the tested cultivars showed significant differences in their fruit decay. In this respect, cv. (F) showed the lowest decay percent, and cv. (B) gave the highest decay value.

Concerning the effect of the wrapping film, the presented data showed that all wrapping treatments effectively controlled decay percentage as compared with control. The lowest decay percentage was noted in peeled cactus pear fruits wrapped individually in polypropylene in the two seasons. The decay percentage of fruits was significantly increased with prolongation

of the storage periods. The decay started slowly and successively increased till the end of storage. This was a result of the changes, which occurred in fruits during storage, which caused an increase of moisture condensation on external surface of fruits. This consequently decreases fruit firmness, as well as, the transformation of complex compounds to simple forms with more liability to fungus infection. These results are in agreement with those obtained by Garcia *et al.,* (1997), on peeled cactus pear fruits. With respect to the effect of the interaction between cultivars and wrapping film on the decay percentage, it was clear that the cv (F) wrapped individually with polypropylene had the lowest value of decay.

Table (2): Effect of variety, modified atmosphere packaging (MAP) and storage periods on decay percentage of fresh cut cactus pear fruits stored at 0 °C during 2002 and 2003 seasons.

Varieties	MAP	2002 season					2003 season				
		Storage period in days				Mean	Storage period in days				Mean
		0	7	14	21		0	7	14	21	
B	L		0.00	3.21	28.18	10.46		0.00	4.23	25.34	9.86
	I		0.00	0.00	10.23	3.41		0.00	0.00	11.25	3.75
	Control		13.26	30.21	65.14	36.20		11.24	34.62	71.24	39.03
Mean			4.42	11.14	34.52	---		3.75	12.95	35.94	---
F	L		0.00	0.00	8.17	2.72		0.00	2.13	49.23	17.12
	I		0.00	0.00	4.93	1.64		0.00	0.00	3.14	1.05
	Control		10.17	23.68	52.17	28.67		9.32	30.12	67.25	35.56
Mean			3.39	7.89	21.76	---		3.11	10.75	39.87	---
MAP	L		0.00	1.61	18.18	6.60		0.00	3.18	37.29	13.49
	I		0.00	0.00	7.58	2.53		0.00	0.00	7.19	2.4
	Control		11.72	26.95	58.66	32.44		10.23	32.37	69.25	37.30
Mean			3.91	9.52	28.14	---		3.41	11.85	37.91	---
L.S.D at 5%											
Variety A:		0.13					0.12				
MAP B:		0.10					0.11				
Storage period C:		0.10					0.10				
A x B:		0.18					0.16				
A x C:		0.18					0.16				
B x C:		0.16					0.14				
A x B x C:		0.30					0.28				

4- Visual quality:

Data in Table (3) involve the effect of cultivar on fruit visual quality during storage; as it indicated that there were significant varietals differences in their character of cactus fruits. Fruits of cv. (F) surpassed cv. (B) in visual quality during storage.

Table (3): Effect of variety, modified atmosphere packaging (MAP) and storage periods on visual quality of fresh cut cactus pear fruits stored at 0 °C during 2002 and 2003 seasons.

Varieties	MAP	2002 season					2003 season				
		Storage period in days				Mean	Storage period in days				Mean
		0	7	14	21		0	7	14	21	
B	L	9	7	5	3	6.0	9	7	5	3	6.00
	I	9	9	7	5	7.5	9	9	7	5	7.50
	Control	9	5	3	1	4.5	9	5	3	1	4.5
Mean		9	7	5	3	---	9	7	5	3	---
F	L	9	9	7	5	7.5	9	9	7	3	7.00
	I	9	9	9	7	8.5	9	9	9	7	8.50
	Control	9	5	3	1	4.5	9	5	3	1	4.50
Mean		9	7.66	6.33	4.33	---	9	7.67	6.33	3.67	---
MAP	L	9	8	6	4	6.75	9	8	6	3	6.00
	I	9	9	8	6	8.00	9	9	8	6	8.00
	Control	9	5	3	1	4.5	9	5	3	1	4.50
Mean		9	7.33	5.67	3.67	---	9	7.33	5.67	3.33	---
L.S.D at 5 %											
Variety A:		0.25					0.26				
MAP B:		0.19					0.20				
Storage period C:		0.21					0.21				
A x B:		3.6					0.32				
A x C:		3.0					0.36				
B x C:		2.6					0.28				
A x B x C:		0.49					0.39				

Table (3) shows that there were significant differences in visual quality due to wrapping film. Application of the wrapping film effectively maintained a high visual quality as compared with control treatment. Furthermore, visual

quality was relatively better for samples wrapped individually with polypropylene than samples with liner wrapping. These results are in agreement with those reported by Goldman (2005) who pointed that peeled cactus fruit stored in micro-perforated packages at 4°C maintained satisfactory visual and inhibited quality deterioration of metabolic activity.

As to storage period, visual quality of peeled cactus pear declined with the prolongation of the storage period, and this may be due to the physical injuries of fruits tissue inflicted upon processing and accelerate the metabolism and hence, caused changes in nutritional and sensory properties leading to quick decrease of quality at shelf life. (Amal, 2006). The interaction between cultivars and wrapping film were not significant. The results indicated that by the end of storage period, peeled cactus pears fruits cultivar (F) wrapped individually maintained the highest visual quality score.

5- Texture:

Results in Table (4) revealed that fruit texture was significantly affected by cultivars where cv. (F) gave the highest fruit texture values compared with (B) cv. during storage. These results were true in the two seasons. Garcia *et al.*, (1997) found that cultivars Cristalina, Picochulo and Amarillo Montesa registered initial values of firmness higher than the other cultivars of cactus fruits, and found also that cv. Cristalina showed the highest firmness value compared to other cultivars after three months of cold storage. With respect to wrapping film, data indicated that wrapping cactus fruits individually with polypropylene film led to significant reduction in the rate of fruit softening followed by liner wrapping with the same film. Whereas, unwrapped ones (control) had the highest softening value. Data in Table (4) revealed that cactus fruits before storage were firmer than by the end of storage period. There was significant reduction in fruit texture values with prolongation of investigation. These results are in agreement with those obtained by Cantwell (1986) and Rodriguez *et al*, (1992) on cactus pear fruits. The decrease in fruit texture values may be due to the gradual breakdown of prospecting to lower molecular weight fractions, which are more soluble in water, and this was directly correlated with the rate of softening of the fruits (Wills *et al.*, 1981). The interaction between cultivars and wrapping film was significant in both seasons.

• Chemical characteristics:

1. T.S.S and Ascorbic acid:

Concerning the effect of cultivars on fruit T.S.S. and ascorbic acid content during storage, data indicated that there was a significant difference in these characters of cactus fruits. Fruits of cultivar (F) had the highest values of T.S.S. and ascorbic acid content compared with (B) cultivar. This was obvious in both seasons. These results are in harmony with those obtained

by Garcia *et al.*, (1997). There were significant differences in T.S.S. and ascorbic acid content due to wrapping film. Wrapping significantly reduced the degradation of T.S.S. and ascorbic acid. Peroxidases play an important role in enzymatic degradation of T.S.S. and ascorbic acid (Wang. 1990). Reduction in O_2 within the wrapped sample can protect these characters, presumably through prevention of oxidation.

Table (4): Effect of variety, modified atmosphere packaging (MAP) and storage periods on texture (gm) of fresh cut cactus pear fruits stored at 0 °C during 2002 and 2003 seasons.

Varieties	MAP	2002 season					2003 season				
		Storage period in days				Mean	Storage period in days				Mean
		0	7	14	21		0	7	14	21	
B	L	30.67	24.33	19.33	15.00	22.33	28.33	23.33	20.00	16.67	22.08
	I	30.67	27.33	25.00	21.33	26.08	28.33	25.33	24.00	21.33	24.75
	Control	30.67	21.67	18.33	11.67	20.59	28.33	23.67	20.33	13.00	21.33
Mean		30.67	24.51	20.88	16.00	–	28.33	24.11	21.44	17.00	---
F	L	33.33	27.33	21.67	18.33	25.17	30.67	24.33	21.00	17.67	23.42
	I	33.33	30.33	27.67	23.00	28.58	30.67	27.33	25.00	22.33	26.33
	Control	33.33	23.67	20.00	15.67	23.17	30.67	23.00	20.67	14.33	22.17
Mean		33.33	27.11	23.11	19.00	---	30.67	24.88	22.22	18.11	---
MAP	L	32.00	25.83	20.50	16.67	23.75	29.50	23.83	20.50	17.17	22.75
	I	32.00	28.83	26.34	22.17	27.34	29.50	26.33	24.50	21.83	25.54
	Control	32.00	22.77	19.17	13.67	21.90	29.50	23.34	20.50	13.67	21.75
Mean		32.00	25.81	22.00	17.50	---	29.50	24.50	21.83	17.55	---
L.S.D at 5%											
Variety A:		0.96					0.87				
MAP B:		1.20					0.96				
Storage period C:		1.25					0.97				
A x B:		1.30					0.99				
A x C:		1.33					1.04				
B x C:		1.36					1.13				
A x B x C:		1.40					1.23				

Data in Tables (5 and 6) demonstrated that T.S.S and ascorbic acid content of cactus pear fruits were significantly higher at the beginning of storage and then decreased with the prolongation of the storage period. The reduction in these characters during storage might be due to the higher rate of sugar loss through respiration than water loss through transpiration.

These results are true in both seasons. These results are in agreement with those obtained by Alvarado. Sosa (1978) who reported that T.S.S and ascorbic acid and sugar contents were declined with time in cold storage. Regarding the interaction effect of cultivars and wrapping film during storage, the highest value of fruits T.S.S. and ascorbic acid content were recorded in fruits of cv.(F) wrapped individually with polypropylene. On the other hand, the lowest values were obtained from untreated fruits of cv. (B)

Table (5): Effect of variety, modified atmosphere packaging (MAP) and storage periods on T.S.S percentage of fresh cut cactus pear fruits stored at 0 °C during 2002 and 2003 seasons.

Varieties	MAP	2002 season					2003 season				
		Storage period in days				Mean	Storage period in days				Mean
		0	7	14	21		0	7	14	21	
B	L	11.41	11.15	10.95	10.61	11.03	11.92	11.73	11.60	11.24	11.62
	I	11.41	11.13	10.90	10.66	11.03	11.92	11.75	11.63	11.36	11.66
	Control	11.41	11.25	11.69	10.52	11.29	11.92	11.77	11.50	11.02	11.55
Mean		11.41	11.18	11.27	10.59	--	11.92	11.75	11.57	11.21	--
F	L	12.62	12.54	12.23	12.06	12.36	12.71	12.62	12.41	12.16	12.48
	I	12.62	12.58	12.19	12.09	12.37	12.71	12.67	12.56	12.20	12.53
	Control	12.62	12.57	12.26	11.84	12.32	12.71	12.66	12.24	11.91	12.36
Mean		12.62	12.56	12.23	11.99	--	12.71	12.63	12.40	12.09	--
MAP	L	12.02	11.28	11.59	11.34	11.55	12.31	12.18	12.00	11.70	12.05
	I	12.02	11.86	11.59	11.38	11.71	12.31	12.21	12.09	11.78	12.09
	Control	12.02	11.91	12.11	11.18	11.81	12.31	12.19	11.87	11.47	11.96
Mean		12.02	11.68	11.76	11.30	--	12.31	12.19	11.98	11.65	--
L.S.D at 5%											
Variety A:		0.13					0.11				
MAP B:		0.10					0.09				
Storage period C:		0.10					0.08				
A x B:		0.14					0.11				
A x C:		0.14					0.12				
B x C:		0.13					0.12				
A x B x C:		0.25					0.21				

Table (6): Effect of variety, modified atmosphere packaging (MAP) and storage periods on ascorbic acid (mg / 100g fresh weight) of fresh cut cactus pear fruits stored at 0 °C during 2002 and 2003 seasons.

Varieties	MAP	2002 season					2003 season				
		Storage period in days				Mean	Storage period in days				Mean
		0	7	14	21		0	7	14	21	
B	L	37.77	35.30	30.67	25.20	32.24	38.13	36.33	32.15	27.26	33.47
	I	37.77	36.00	30.24	24.10	32.03	38.13	36.34	31.28	28.24	33.50
	Control	37.77	36.10	30.12	22.41	31.60	38.13	36.71	30.74	21.28	31.72
Mean		37.77	35.8	30.34	23.90	--	38.13	36.46	31.39	25.59	--
F	L	44.83	41.77	38.83	35.27	40.18	42.90	40.62	36.17	31.16	37.71
	I	44.83	41.83	38.31	35.41	40.10	42.90	40.67	36.28	31.19	37.77
	Control	44.83	41.91	37.15	31.17	38.77	42.90	40.92	35.17	29.19	37.05
Mean		44.83	41.83	38.09	33.95	---	42.90	40.73	35.87	30.51	--
MAP	L	41.30	38.54	34.75	30.24	36.21	40.52	38.48	34.16	29.21	35.59
	I	41.30	38.92	34.28	29.76	36.07	40.52	38.51	33.78	29.70	35.63
	Control	41.30	39.01	33.64	26.79	35.19	40.52	38.82	32.96	25.24	34.39
Mean		41.30	38.82	34.22	28.93	--	40.52	38.60	33.63	28.05	--
L.S.D at 5%											
Variety A:		0.14					0.15				
MAP B:		0.14					0.13				
Storage period C:		0.12					0.13				
A x B:		0.12					0.11				
A x C:		0.13					0.11				
B x C:		0.17					0.12				
A x B x C:		0.36					0.31				

2- pH value:

Results in Table (7) showed that cv.(F) had relatively lower pH values at the start than cv.(B). (5.93) For cv.(F) in the first season and (6.1) for cv.(B) which may be due to natural variability among cultivars. A slow increase in pH was detected during storage and at the end of storage for all treatments in both seasons. Control fruits recorded the highest values by the end of storage {6.50 for cv.(B) and 6.32 for cv.(F)} at first season and 6.38 for cv.(B) and 6.50 for cv.(F) at second season. These results are in agreement with those of Barbera *et al*,(1992) who stated that no significant difference were found between both type of packages by the end of storage for cv.(B) and cv.(F) while pH values rose slightly for all varieties and treatments

accentuated by a slight increase in acidity. This indicates that packaging had limited no influence upon the evaluation of acidity for fruits.

Table (7): Effect of variety, modified atmosphere packaging (MAP) and storage periods on pH of fresh cut cactus pear fruits stored at 0 °C during 2002 and 2003 seasons.

Varieties	MAP	Season 2002					Season 2003				
		Storage period in days				Mean	Storage period in days				Mean
		0	7	14	21		0	7	14	21	
B	L	6.10	6.13	6.22	6.40	6.21	5.83	5.95	6.23	6.25	6.07
	I	6.10	6.21	6.30	6.47	6.27	5.83	5.91	6.23	6.23	6.06
	Control	6.10	6.23	6.38	6.50	6.31	5.83	5.92	6.29	6.38	6.11
Mean		6.10	6.19	6.31	6.46	--	5.83	5.93	6.25	6.30	---
F	L	5.93	5.96	6.14	6.20	6.06	5.69	6.15	6.20	6.21	6.06
	I	5.93	5.95	5.97	6.00	5.96	5.69	6.25	6.28	6.33	6.14
	Control	5.93	6.14	6.22	6.32	6.15	5.69	6.20	6.32	6.50	6.18
Mean		5.93	6.02	6.11	6.17	---	5.69	6.20	6.27	6.35	--
MAP	L	6.02	6.04	6.18	6.30	6.14	5.76	6.05	6.22	6.23	6.07
	I	6.02	6.80	6.14	6.25	6.12	5.76	6.08	6.26	6.31	6.10
	Control	6.02	6.19	6.32	6.41	6.24	5.76	6.06	6.31	6.44	6.30
Mean		6.02	6.10	6.23	6.32	---	5.76	6.07	6.26	6.33	---

L.S.D at 5% level		
Variety A	0.10	0.11
MAP B	0.11	0.12
Storage period C	0.11	0.12
A x B	N.S	N.S
A x C	N.S	N.S
B x C	N.S	N.S
A x B x C	N.S	N.S

Conclusion

Overall, it is concluded that Cactus Pear Farawla cv. was better than Balady cv. as it had kept a good quality at harvest and after cold storage period at 0°C of 21 days, maintained attractive appearance with the lower weight loss and minimized the rate of deterioration compared to (B) cv. also, it is clear that, the individual wrapping of peeled Cactus Pear fruits with Polypropylene can extend the shelf life of Farawla cv.

REFERENCES

A.O.A.C, (1990). Association Of Official Analytical Chemists, Washington DC., USA.

Able, A. J., L. S. Wong, A. Prasad and T. J. O'Hare (2002). 1 – MCP is more effective on a floral brassica (*Brassica oleracea* var. *italica* L.) than a leafy brassica (*Brassica rapa* var. *chinensis*). Postharvest Biology.

Alvarado Sosa, L. (1978). Fisiologia y bioquimica del desarrollo del fruto fel nopal tunero (Opuntia amyclaea Tenore). Tesis de Maestria. Colegio de Postgraduados, Chapingo, Mexico. 73pp.

Amal, S. H. A. (2006). Physiological studies on Lettuce production in sandy soil and storage ability of its fresh cut heads. Ph. D. Thesis, Vegetable crops dept. Fac. of Agri., Cairo Univ.

Barbera, G., F. Carimi, P. Inglese and M. Panno (1992). Physical, morphological and chemical changes during fruit development and ripening in three cultivars of prickly pear. J. Hort. Sci. 67:307- 312 pp.

Berger, S., H. Z. Ortuzar, R. C. Auda, M. L. A. Lizana and A. Reszcynski, (1978). Conservacion de tuna (Opuntia Ficus – indica) en almacenaje refrigerado – Invest Agricola. 4(1):21 – 24pp.

Cantwell, M. (1986). Postharvest aspects of prickly pear fruits and vegetable cladodes. Perishable Handling (Univ. California, Davis) No. 59:6 – 9 pp.

Cantwell – de – Trejo, Marita, (1992). Cooperative extension vegetable postharvest specialist, vegetable crops development, University of California, Davis, CA 95616.

Cantwell, M. (1995). Postharvest management of fruits and vegetable stems. In: Agro Ecology. Cultivation and uses of Cactus Pear. (G. Barbera, Inglese, P. and Pimienta Barrios E. eds). FAO Plant Production and Protection. Paper 132. pp 120 – 136.

Chessa, I. and G. Barbera (1984). Indagine Sulla frigoconservazione dei frutti dell acv. Gialla di ficodindia Rivista di frutticoltura e di Ortofloricoltura. 46 (8): 57 – 61 pp.

Corbo, M. R., C. Alticri, D. D. Amato, D. Campaniello, M. A .del Nobile and M. Sinigaglia (2004). Effect of temperature on shelf life and microbial population of lightly processed cactus pear fruit. Postharvest Biol. Technol. 31: 93 – 104.

Garcia. J. C., J. R. Andrade and E. C. Berabe (1997). Response of six cultivars of Tuna fruits to cold storage. Programs Nopal y Alimentos CIESTAAM – DTA – Chapingo Ede Cle Mexico CP 56230.

Garcia, J. C, G. A. Valencia, A. M. F. Espinosa and P. G. Olivares (2006). Minimal processing of cactus pear and tender cactus cladodes. ISHS Acta Horticulturae 728: V International Congress on Cactus Pear and Cochineal, No 42,Vol 1.

Goldman, G., Y. Vinokur, B. Horev, S. Lurie and V. Rodov (2005). Fresh-cut products from Cactus species Acta Hort. 682,pp 1961 - 1963.

Hegwood, D. A. (1990). Human health discoveries with Opuntia sp. (Prickly pear) HortScience 25: 1315 – 1316.

Kader, A. A. (2000). Cactus Pear. Produce Facts. Recommendations for Maintaining Postharvest Quality. Department of Pomology, university of California, Davis

Kader, A. A. (2002). Postharvest biology and technology: An overview. In A. A. Kadder (Ed) Postharvest Technology of Horticultural Crops. Univ. Calif. Agricultural and Natural Resources. Publication. 3311: pp 39 – 47.

Kasmire, R. F., A. A. Kader and J. A. Klaustermeyer (1974). Influence of aeration rate and atmospheric composition during simulated transit on visual quality and of odor production by broccoli. Hort. Science. 9:pp 228 – 229.

McGuire, (1992). Reporting of objective color measurements. Hortscience. Vol 27 (12): 1254-1255.

Merin, U.S.G, G. Popel, S. Bernstein and I. Rosenthal, (1987). Thermal degradation kinetics of prickly pear fruits red pigment. J. Food. Sci. 52: 485 – 486 pp.

Morga, J. A., E. N. Bolanos and E. M. Siliva (2006). Effect of storage temperature on quality of minimally processed cactus pear. Acta horticulture 728: V International congress on cactus pear and cochineal. No. 42 vol. 1

Ochoa, M. J., G. Leguizaman and S. A. Uhart (2002). Effect of nitrogen availability on Cactus pear (*Opunta ficus* – indical. Mill) Postharvest quality. Acta Horticultural 581: IV international congress on Cactus pear and cochineal. No. 41. vol. 1.

Piga, A., S. D. Aquino, M. Agabbio, M. Emonti and G. A. Farris (2000). Influence of storage temperature on shelf life of minimally processed cactus pear fruits. Lebens. Wiss. Technol. 33: 15 – 20.

Piga. A., S. D. Aquino, M. Agabbio and M. Schirra (1996). Storage life and quality attributes of cactus pears cv Gialla as affected by packaging. Agriculture Mediterranean 126: 423 – 427.

Pimienta, B. E. (1993). El nopal (Opuntia spp.): una alternative Ecológica productive par alas zonas áridas y semiáridas. Ciencia 44: 339 – 350.

Rodriguez-Felix., A., M. I. Gonzalez-Salas, H. Soto-Valdez and M. I. Silveira, (1992). Effects of postharvest treatments on the quality of tuna during storage. Proc. 3rd Annual Texas Prickly pear conference, Texas Prickly pear council. Mc Allen. Texas. 9 – 21 pp.

Saenz, C., Berger, H. Galletti, L. and F. Coronado (2001). Sensory and microbiological changes in minimally processed cactus pear (*Opuntia ficus indica*). Acta Hort. 553: 709 – 710.

Shapiro, K. and W. C. Gong (2002). Natural products used for diabetes.J. Am. Pharm. Assoc. (Wash). 42: 217 – 226.

Snedecor, G. W. and W. G. Cochran (1990). statistical methods. Iowa State Univ. Press, U. S. A

Wang, C. Y. (1990). Physiological and biochemical effects of controlled atmospheres on fruits and vegetables. In: M. Calderon and R. Barkai-

Wills. R. H. H., T. H. Lee. D. Gerham., W. B. Mc Glasson and E. G. Hall (1981). postharvest an interaction to physiology and handling of fruits and handling of fruits and vegetables. The AVF publishing comp. Inc. Westport. Conn. PP. 35

المحافظة على جودة ثمار التين الشوكى المنزوعة القشرة

هشام علام – جيهان على

معهد بحوث البساتين – مركز البحوث الزراعية

الملخص العربى

اجريت هذة التجربة على ثمار التين الشوكى المنزوعة القشرة اثناء موسمى ٢٠٠٢-٢٠٠٣ . والهدف من البحث هو تقييم تاثير التغليف بالبولى بروبالين سواء تغليف فردى او بالتغطية وذلك للمحافظة على جودة ثمار صنفى فراولة وبلدى اثناء التخزين المبرد على درجة صفر مئوى ورطوبة نسبية ٩٠ % وكان صنف الفراولة اقل فى الفقد فى الوزن و العفن والصلابة ونسبة المواد الصلبة الذائبة وذات مظهر جيد عند مقارنتة بالصنف البلدى خلال مدة التخزين . التغليف الفردى للثمار بالبولى بروبالين كان اكثر تاثيرا فى تقليل نسبة الفقد فى الوزن ونسبة العفن عن الثمار المغطاة بالبولى بروبالين وبالاضافة الى ذلك فأن الثمار المغلفة فردياً بالبولى بروبالين حافظت على جودة الثمار (الصلابة- نسبة المواد الصلبة الذائبة - حامض الاسكوربيك وكذلك المظهر العام) بينما الثمار الغير معاملة اعطت نسبة عالية فى الفقد فى الوزن و العفن. أثناء فترة التخزين تزداد نسبة الفقد فى الوزن و العفن للثمار المنزوعة القشرة بزيادة فترة تخزينها بينما تقل نسبة المواد الصلبة الذائبة ونسبة حامض الاسكوربيك والصلابة والمظهر العام اثناء فترة التخزين وعلى ذلك فأن تغليف ثمار صنف فراولة المنزوعة القشرة تغليف فردى يؤدى الى زيادة فترة تسويقها بالمحافظة على جودتها و سلامتها .