

## **Study of storage ability and quality parameters of two prickly pear cultivars grown under south Tahrir environments**

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Key Words: Prickly pear\_ maturity stages\_ storage period\_ packing materials\_ quality parameters

### **ABSTRACT**

The study was carried out during two successive seasons 2003,2004 on two cultivars of Prickly pear at Southern Tahrir, Behera Governorate. Physical and chemical changes during fruit development for determining maturity stage were estimated and the effect of liner or individual polypropylene packaging on fruit quality during storage at 5<sup>0</sup> C and 85-90%RH also were studied. Results indicated that with age advanced there was an increase in fruit weight, flesh weight, TSS, Vitamin C, and peel and pulp color and decrease in fruit texture and acidity. Balady (green) cultivar was earlier harvest than Frawla (red) cultivar, the highest fruit weight, Flesh weight, Texture, TSS, V.C. and red color observed in Frawla cv. Fruits that stored in individual polypropylene bags showed lower values of weight loss, highest texture, higher V.C. than fruits in liner polypropylene packaging, besides, delayed the development of peel and pulp color values. Storage period were 48 days at 5<sup>0</sup> C without any symptoms of decay or chilling injury for two cultivars in the two seasons

### **INTRODUCTION**

In many countries Prickly pear fruits (*Opuntia -ficus- indica* L.,Mill) are a very important food. The nutritional, medicinal and human health properties of cactus pear are factors that could contribute to an increase in cactus pear consumption (Hegwood 1990). Recently the possibility of using seed oil from cactus pear and in producing ethanol and antioxidants from cladodes has been pointed out.

Stage of maturity or ripeness at harvest is very essential for fruit quality since sugar content and sweetness do not increase after harvest. Maturity indices include fruit size and fullness, changes in peel color, abscission of the small spines or glochids, fruit firmness. Peel color is the single most important index for commercial harvest.

Fruits of high quality need to be harvest near full- ripe to have color and flavor typical of each variety. They should have a high percentage of pulp, a low content of seeds, and have peel that is easy to remove. Fruit typically have high sugar content (SSC) 12 to 17%, low titratable acidity (0.03 to 0.12%) cactus pears contain considerable amounts of vitamin C (20- 40 mg/100 g fresh weight) if harvest at the

maturity from good varieties, fruit have a delicate sweet flavor that differs with variety (Cantweel, 1995). During postharvest handling of Prickly pear fruits there is serious problem (water loss) because it decreases saleable weight and appearance. Whereas, weight losses on fruits were less than 7% did not affect fruits appearance (Rodriguez,2002). However, techniques to reduce weight and water loss include the use of wax and polyethylene liners. Storage at lower temperatures (5°C) reduces water loss by reducing the vapor pressure deficit (Cantwell,1991). On the other hand, mechanical injuries during postharvest handling injured fruits are easily infected by microorganisms causing stem end rot (Chessa and Schirra, 1992). Late season fruits developed chilling injury after storage at 5°C for 15 days and were more susceptible to chilling injury than early season fruits (Rodriguez,2002). A slight decline in soluble solids and sugars of fruits was observed after two weeks of storage at 20°C and the highest percentage of change in the color index after two months of cold storage (Alvarado-Sosa 1978). Furthermore, mature green fruits of mango wrapped in different types of individual low density polyethylene bags. These bags were more effective than all other treatments in reducing the rate of fruit softening and physiological weight loss in the fruits during storage (Zora et al 2001). Packaging decreased weight loss, mainly at lower temperature (Jeronine and Kanesimo 2001). Therefore, individual packaging for mango fruits retarded fruit ripening (peel and pulp color) change firmness and fruit weight loss and chilling injury during cold storage (El Oraby et al 2004).

The objective of this study was to evaluate the two Prickly pear cultivars Balady (green cv.) Frawla (red cv.) for maturity stages, and studying the effect of pre-storage packaging on fruit quality and cold storage life.

#### **MATERIAL AND METHODS**

This study was carried out during two successive seasons 2003-2004 on two cultivars of Prickly pear grown at Southern Tahrir orchard, Behera Governorate.

##### **A-Determination of maturity:**

At full bloom, flowers were labeled, harvesting take place on labeled fruits, three samples from each cultivar were picked at 5 days intervals start from 70 days after full bloom to determine fruit properties and maturity stage. Some physical and chemical characteristics were studied. Physical properties were days after full bloom, flesh fruit weight (g), flesh fruit percentage, fruit texture (g/cm<sup>2</sup>), peel and pulp color. While, chemical properties were TSS%, pH, and Vitamin C.

##### **B-Storage studies:**

Fruits were picked at maturity stage according to (70-75) and (80) days after full bloom for Balady cv. And Frawla cv. respectively. Fruits were transferred to the fruit handling laboratory at Giza where they sorted, sound and healthy fruits were chosen

Fruits from each cultivar were divided into two groups: one was packed in one layer inside foam plates (20 x 10 x 2.5 cm), tightly over wrapped line with 20  $\mu$  thick), and both of them stored at 5<sup>o</sup> C and 85-90% RH. Fifteen replicates were prepared for each type treatment in the two cultivars. Each replicate contain eight fruits. There replicate from each treatment were taken and examined every 7 days during storage period for quality parameters.

The following data were recorded:

2-1 Weight loss percentage: was estimated according to the following equation:

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

2-2 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 5 millimeters inside fruit flesh and firmness is expressed in gram units.

2-3 Color determination: intensity of color was estimated by Hunter colorimeter (DP9000) for each fruit. "a", value- green+ red" b" value blue- yellow according to (McGuire,1992).

2-4 pH value: This value was estimated by a pH meter instrument(schott gerate).

2-5 Total soluble solids (T.S.S.) percentage: was determined using an Abbe refractometer (AOAC 1990).

2-6 Ascorbic acid: was determined by using 2,6-Dichlorophenolindophenoldye and oxalic acid as a substrate and calculated per 100 ml of juice (AOAC 1990).

2-7 Statistical analysis: Means were compared by the L.S.D. value at 5% level (Snedecor and Cochran 1990).

## RESULTS AND DISCUSSION

### Determination of maturity in Prickly pear fruits:

#### 3-1 Physical characteristics:

##### 3-1-1 Fruit weight:

Observing the development changes in prickly pear cultivars for determining the proper maturity stage, data in Table (1) indicated that fruit weight gradually increased until the age of 70-75 days for Balady cv. (176, 158.7 g for first and second seasons respectively) after full bloom. The increase of fruit weigh may be attributed to cell enlargement. Significant increased was observed between the age of 70 days and 80 days. Frawla (red cultivar) fruits were heavier than Balady (green cultivar) fruits. The same trend was observed in the second season.

Cantwell,(1995) reported that fruits of Cactus pear typically weights 100 g to 200 g.

### **3-1-2-Flesh weight:**

Data in Table (1) indicated that flesh fruit weight increased as maturity advanced. There were significant differences between cultivars in this concern. The heaviest flesh weight had recorded by Frawla red cultivar (83, 75.7 g for first and second seasons respectively).

### **3-1-3- Flesh weight percentage:**

It is evident from Table (1) that flesh weight percentage increased with the continuous increase in flesh fruit weight. This results was noticed during the two seasons. Cantwell (1995) observed that Prickly pear fruits consists of a thick fleshy skin or rind surrounding a juicy pulp 60% from total weight.

### **3-1-4- Texture:**

Regarding fruit texture, it is clear from Table (1) that fruit texture decreased at maturity period advanced. Frawla (red) cultivar was higher in texture than Balady (green) cultivar in the two seasons.

### **3-1-5-Color development:**

It is obvious from Table (2,3) that "a" value (red color) were increased till the end of maturity stage while "b" values were decreased during maturity stage. The highest "a" values and the lowest "b" values were observed in Frawla (red) cultivar in peel and pulp color. Peel color is the single most important index for commercial harvest (Canwell 1995).

## **3-2 Chemical characteristics:**

**3-2-1- Total Soluble Solids:**It is clear from Table (4) that, total soluble solids percentage gradually increased. Frawla red cultivars had a higher percentage of total soluble solids than Balady cv. in both seasons. Tucker,(1993) found that there is no significant increase in sugar content of non climacteric fruits after harvest. Moreover, fruits typically have high sugar content 12 to 17% SCC. (Cantwell.1995)

**3-2-2-pH value determination:** It was noticed also in Table (4) that, pH of both cultivars decreased gradually and significantly with advanced time. The differences among cultivars were slight. These results are in agreement with the finding of (Kader,1992)

**3-2-3- Ascorbic acid percentage:** It increased significantly and gradually during maturation period for both cultivars in both seasons.

Results presented in Table (4) revealed that Frawla red cultivar fruit had the highest values of Vitamin C% Barbera et al (1992), recommended that Cactus pear contain considerable amounts of Vitamin C(25-30% mg/100g) also, Kuti,1992. reported that Cactus pear contain (10-40% mg/100g). the fruit contains significant amounts of Vitamin C, one fruit containing about one – half the amount of an orange (Cantwell,1995).

Generally, according to days after full bloom, fruit weight and a value of peel and pulp color, it can be concluded that Balady (green) cultivar reached maturity from (70-75) days after full bloom. Fruit weight was (120-127g) and peel color turned from dark green (-10.2) to yellowish green (0.51). while pulp color tuned from light yellowish (5.6) to dark yellow (9.2). However, Frawla red cultivar reached maturity after 80 days from full bloom. Fruit weight was (158-176g) and peel color turned from green (-6.6) to red (8.0). while pulp color turned from light red (18.8) to dark red (21.3) and the same trend was observed in the second season.

#### **Physical and chemical changes in fruits during cold storage:**

##### **Physical changes:**

##### **Weight loss:**

It is evident from Table (5) that weight loss percentage fruits at 5<sup>0</sup>C was increased gradually as storage period advanced (48 days).

The increase in weight loss percentage may be due to the loss in moisture through transpiration at loss in dry matter content through respiration (Cantwell,1995). Also, (Kader,2000) reported that fruit can be kept for 2 to 5 weeks at 5 to 8<sup>0</sup>C (41 to 46<sup>0</sup> F) with 90 to 95% RH. Weight losses on fruits were less than 7% did not affect fruit appearance. However, it was seen that different wrapping film showed significant differences in their weight loss percentage. In this respect, individual packaging in polypropylene showed the least significant percentage of weight loss. These results are in agreement with (Zora et al 2001).

Moreover, there was a significant difference in weight loss percentage between cultivars. Frawla (red) cultivar had the lowest values of weight loss in both seasons. (Piga et al. 1996) reported some beneficial effects of cold stored fruits were also achieved by fruit packaging.

##### **Texture:**

Cold storage allows the fruits to maintain firmness from data shown Table (6). It is clear that fruit texture was decreased gradually during the storage period. Individual polypropylene packaging kept fruit texture higher than packaging in one layer.

results agree with (Tucker,1993) who reported that, there was slight changes in texture after fruit harvest compared with another fruits, also (Joel,1997) who reported that all cultivars showed a reduction of pulp firmness with prolongation of storage period.

#### **Peel and pulp color:**

The effect of prolonged storage on the pulp color of the fruits can be noticed from Table (7,8) as the "a" and "b" values showed gradual increased with the storage period of the fruit in two seasons. Individual packaging in polypropylene packaging. It can be noticed that there was strongly significant differenced between the two cultivars in both seasons.

The same trend was observed with (Sa'ena et al.,1992) and (Joel,1997).

#### **Decay percentage:**

No signs of decay appeared till the end of storage period, this was due to gentle handling of fruits which protect fruits from mechanical injuries and microorganisms

(Chessa and Schirra,1992) and the best effect of polypropylene packaging. This result was also observed in the second season for two cultivars. Our finding are in line with those of (Schirra,1997)to reduce damage during harvesting and limit postharvest decay caused by wound pathogens, it is advisable to a small piece of cladode at the fruit edge cut .

#### **Chilling injury:**

Chilling injury symptoms were not evident during cold storage. This result may be due to cultivars resistance, suitable low storage temperature, packaging material and packing methods.

The susceptibility of fruits to chilling injury depends on cultivar (Schirra.et al.1997). Moreover, Chilling occurred in arid-fruit variety after only 2 weeks at 6°C(43°F), but fruit from other varieties were held for several weeks without signs of chilling (Cantwll,1995), while tuna fruit is more tolerant of CI. Similar results were noticed by Gorinai et al.(1993) when established storage condition for Cactus 5-8°C and 90-95%RH, to be the best compromise in limiting. Also, these results are in harmony with (Eloraby et al,2004), it confirmed that, individual packaging for mango fruits retarded ripening peel and pulp color, change firmness, fruit weight loss and chilling Injury.

#### **Chemical changes:**

**Total soluble solids:**

It could be concluded that total soluble solids percentage of fruits were fluctuated in narrow range and did not follow a special pattern during storage period (Table9).

In general, there is no significant increase in sugar content of non climacteric fruits after harvest. (Tucker,1993 and Cantwell 1995). While (Joel,1997) reported that TSS declined with time of cold storage.

However, there were slightly significant differences among liner packaging and individual packaging. Besides, Frawla (red) cultivar fruits had the highest percentage of TSS till the end of the storage period in two seasons.

**Ascorbic acid content:**

Concerning the content of fruits of vitamin C, it is clear that vitamin C decreased with prolonged storage (Table 10). There was significant difference between cultivars, the highest values were noticed with Frawla (red) cultivar in both seasons, either packing in liner or individual polypropylene packaging. Individual polypropylene bags were recorded the highest values in the first season.

**pH determination:**

Data presented in Table (11) declared that was gradually decreased by increasing the storage period. Individual polypropylene packaging significant difference between cultivars packing in the second seasons. These results are in agreement with those of (Barera, et al.1992) who stated that no significant differences were found between both types of packages by end of storage.

**CONCLUSIONS**

Generally, it could be concluded that Frawla cultivar fruits had the highest fruit weight, flesh weight, texture, TSS and a values (red color. Moreover this cultivar fruits packaging individual with polypropylene film were the most effective in reducing weight loss percentage at maintained the fruit quality during storage at 5<sup>0</sup> C and 85-90%RH for 48 days.

**Table (1): Physical characteristics for maturity determination of Balady and Frawla**

	First season				Second season			
	a- Fruit weight (g)							
	Days from full bloom				Days from full bloom			
	70	75	80	M	70	75	80	M
<b>B</b>	108.2	127.9	147.6	127.9 b	108.1	120.1	132.1	120.1 b
<b>F</b>	119.2	147.6	176.0	147.6 a	123.9	114.3	158.7	132.3 a
<b>M</b>	113.7 c	137.8 b	161.8 a	137.3	116.0 b	117.2 b	145.4 a	126.2
b- Flesh fruit weight (g)								
<b>B</b>	48.4	58.5	68.5	58.5 b	50.6	60.5	70.4	60.5 b
<b>F</b>	58.3	70.5	83.0	70.6 a	64.1	69.9	75.6	69.8 a
<b>M</b>	53.3 c	64.5 b	75.8 a	64.5	57.3 c	65.2 b	73.0 a	65.2
c- Fresh weight %								
<b>B</b>	45.0	45.7	46.7	45.8 b	46.7	50.7	53.3	50.2 b
<b>F</b>	49.0	47.7	47.0	47.9 a	52.0	67.3	47.7	55.7 a
<b>M</b>	47.0 a	46.7 b	46.8 b	46.8	49.3 c	59.0 a	50.5 b	52.9
g- Texture g/cm <sup>2</sup>								
<b>B</b>	92.3	94.7	78.3	88.4 b	110.7	106.7	87.7	101.7 b
<b>F</b>	116.0	101.3	90.3	102.6 a	121.3	115.0	98.7	111.7 a
<b>M</b>	104.2 a	98.0 b	84.3 c	95.5	116.0 a	110.8 b	93.2 c	106.7

Value followed by the same letters in each column are not significantly different at 5% level.

B= Balady cv.

F= Frawla



**Table (2): Changes in a, b values of peel color in two prickly pear cultivars in relation to maturity period.**

	First season			Second season		
	a* value					
	Days from full bloom			Days from full bloom		
Date	B	F	M	B	F	M
<b>1</b>	-10.2	-6.6	--8.4 c	-5.2	-3.5	-4.4 c
<b>2</b>	-5.6	1.4	-3.5 b	-2.9	-0.43	1.6 b
<b>3</b>	0.51	8.0	4.2 a	-0.6	5.16	2.2 a
<b>M</b>	-5.0 b	0.0 a	-2.5	-2.9 b	0.37 a	-1.2
b* value						
<b>1</b>	25.7	16.4	21.6 a	23.3	20.2	21.7 b
<b>2</b>	26.8	14.2	20.5 c	24.1	18.8	21.4 c
<b>3</b>	31.3	16.6	20.9 b	25.4	18.8	22.1 a
<b>M</b>	27.9 a	13.7 b	20.8	24.2 a	19.2 b	21.7

**Table (3): Changes in a, b values of Pulp (flesh) color in relation to maturity period.**

	First season			Second season		
	a* value					
	Days from full bloom			Days from full bloom		
Date	B	F	M	B	F	M
<b>1</b>	5.6	18.1	11.8 c	1.6	18.6	10.1 c
<b>2</b>	7.6	19.5	13.5 b	2.5	21.9	12.2 b
<b>3</b>	9.2	21.3	15.2 a	2.6	23.1	12.8a
<b>M</b>	7.4 b	19.6 a	13.5	2.2 b	21.2 a	11.7
b* value						
<b>1</b>	43.1	24.7	33.9 a	39.9	18.8	29.3 a
<b>2</b>	42.7	24.3	33.5 b	37.6	15.6	26.6 b
<b>3</b>	42.1	23.9	33.0 c	35.3	12.8	24.0 c
<b>M</b>	42.6 a	24.3 b	33.4	37.6 a	15.7 b	26.6

B= Balady cv.

F= Frawla

**Table (6): Some physical changes (Texture g/cm<sup>2</sup>) for Balady and Frawla cvs. during cold storage at 5°C in seasons 2003- 2004.**

	First season				Second season			
	Weight loss %							
	Balady		Frawla		Balady		Frawla	
Days of storage	Liner	Indi.	Liner	Indi.	Liner	Indi.	Liner	Indi.
Start	89.7	105.3	97.7	95.3	75.7	84.7	94.7	91.3
8	89.0	89.7	95.7	89.3	73.7	81.0	93.3	88.3
16	79.3	89.3	80.7	84.3	79.7	75.3	89.3	90.3
24	76.7	86.7	87.3	104.3	80.7	97.7	84.7	87.7
32	87.7	87.2	88.3	80.0	70.3	80.0	80.0	89.7
40	82.3	85.0	98.7	96.7	68.3	76.7	83.7	88.7
48	76.7	82.3	83.3	86.7	60.0	61.0	88.6	89.9
M	84.2b	9.2 a	92.3a	92.7a	72.6b	79.4a	87.7	89.3a
C.M	87.2 b		92.5 a		76.0 b		88.5	

**Table (7): changes in a\* and b values of peel color for Balady and Frawla cvs. during cold storage at 5 °C in seasons 2003 – 2004.**

Days of storage	First season				Second season			
	a* values							
	Balady		Frawla		Balady		Frawla	
	Liner	Indi.	Liner	Indi.	Liner	Indi.	Liner	Indi.
Start	1.93	-0.04	7.44	3.41	-0.98	-1.00	5.19	2.86
8	-8.32	4.45	-0.59	2.34	-7.62	2.11	9.03	5.41
16	-6.89	6.89	4.19	9.62	2.14	5.01	12.04	9.21
24	5.64	5.13	19.51	14.72	5.80	3.78	18.97	11.61
32	8.18	5.80	18.04	13.66	6.33	4.35	9.55	14.58
40	6.64	4.46	15.39	17.66	7.20	5.64	12.70	19.71
48	7.60	5.88	16.75	18.46	7.54	6.83	16.29	16.84
M	1.55b	4.65a	11.53a	11.41a	2.91b	3.81a	11.96a	11.48a
C.M	3.10 b		11.47 a		3.36 b		11.72 a	
* values								
Start	29.58	29.17	14.13	15.09	25.45	24.35	118.89	18.86
8	37.55	29.09	17.82	28.99	27.07	27.12	16.53	17.88
16	41.06	49.43	23.89	28.25	27.69	28.35	16.81	20.28
24	37.94	41.03	26.50	21.21	29.53	26.56	12.07	13.07
32	36.18	42.63	16.46	23.50	30.46	31.16	15.28	17.76
40	42.05	39.45	27.58	29.28	30.54	28.57	15.52	21.72
48	39.20	37.01	21.69	25.12	29.34	30.14	17.18	20.41
M	37.65b	38.25a	21.22b	24.49a	28.58	37.75a	16.03	18.56a
C.M	37.95a		22.85 b		33.16		17.29 b	

**Table (8): changes in a\* and b values of pulp color for Balady and Frawla cvs. during cold storage at 5 °C in seasons 2003 – 2004.**

Days of storage	First season				Second season			
	a* values							
	Balady		Frawla		Balady		Frawla	
	Liner	Indi.	Liner	Indi.	Liner	Indi.	Liner	Indi.
Start	3.45	2.59	23.05	22.21	1.86	2.66	20.22	23.38
8	-0.20	6.50	26.11	20.48	0.16	4.41	20.41	21.55
16	7.72	5.38	29.71	27.69	5.33	6.76	22.45	20.14
24	8.81	9.12	29.21	26.66	7.11	9.77	29.47	28.90
32	9.86	9.92	17.61	30.42	7.38	9.44	17.35	28.80
40	10.51	11.17	18.54	34.52	9.50	8.11	29.47	30.19
48	11.92	10.14	27.14	32.15	9.31	9.00	33.16	29.45
M	7.43a	7.83	24.48b	27.67a	5.80b	7.16a	24.64b	26.05a
C.M	7.63 b		26.07 a		6.48 b		25.34 a	
b* values								
	Liner	Indi.	Liner	Indi.	Liner	Indi.	Liner	Indi.
Start	43.63	45.78	23.98	21.58	35.39	34.94	12.86	12.01
8	50.39	47.65	24.43	21.55	38.09	39.94	15.76	17.32
16	80.10	76.71	31.05	31.35	40.26	38.97	16.62	20.44
24	50.24	56.76	29.40	28.03	43.34	42.31	19.02	21.99
32	49.55	55.65	27.03	22.77	44.81	41.89	18.10	20.48
40	54.40	57.53	26.03	26.17	46.72	42.98	18.06	18.99
48	57.53	55.31	18.98	23.15	45.18	42.12	20.13	18.50
M	55.12b	56.48a	25.84b	24.94a	41.97a	40.45	17.13b	18.53a
C.M	55.80 a		25.39 b		41.12		17.83 b	

**Table (9): Some chemical changes (T.S.S) for Balady and Frawla cvs. during cold storage at 5 °C in seasons 2003 – 2004.**

Days of storage	First season				Second season			
	T.S.S. %							
	Balady		Frawla		Balady		Frawla	
	Liner	Indi.	Liner	Indi.	Liner	Indi.	Liner	Indi.
Start	12.4	11.2	13.7	12.3	15.0	14.3	13.5	15.2
8	12.5	12.4	13.1	13.4	14.6	13.8	13.2	13.1
16	11.6	13.2	13.1	12.6	13.7	13.4	12.8	12.2
24	13.3	12.4	13.3	13.4	12.6	11.3	11.3	11.7
32	14.7	13.4	13.0	12.5	13.3	13.3	13.3	12.1
40	12.6	13.3	13.	12.8	13.0	12.9	13.0	13.8
48	11.7	13.1	12.2	13.2	12.6	12.4	13.8	14.2
M	12.8a	12.6b	13.2b	12.9b	13.6a	11.1b	12.9a	13.1a
C.M	12.7 b		13.1 a		12.3 b		13.0 a	

**Table (10): Some chemical changes (vitamin C) for Balady and Frawla cvs. during cold storage at 5 °C in seasons 2003 – 2004.**

	First season				Second season			
	Weight loss %							
	Balady		Frawla		Balady		Frawla	
Days of storage	Liner	Indi.	Liner	Indi.	Liner	Indi.	Liner	Indi.
<b>Start</b>	36.50	37.33	43.07	44.63	38.13	38.13	44.73	44.00
<b>8</b>	35.00	36.63	41.57	44.13	38.87	38.13	45.47	44.73
<b>16</b>	32.00	33.33	39.67	41.67	31.33	30.67	34.67	33.33
<b>24</b>	28.83	30.00	36.87	40.13	31.00	30.33	33.33	34.33
<b>32</b>	22.33	32.00	33.23	37.87	27.00	25.69	30.00	30.67
<b>40</b>	20.13	20.67	28.87	33.53	23.00	25.67	29.00	29.67
<b>48</b>	24.20	25.01	30.31	33.20	24.41	26.20	32.70	32.65
<b>M</b>	28.42b	29.28a	36.22b	39.30a	30.53a	30.68a	35.70a	35.62a
<b>C.M</b>	28.85 b		37.70 a		30.60 b		35.66 a	

**Table (11): Some chemical changes (pH) for Balady and Frawla cvs. during cold storage at 5 °C in seasons 2003 – 2004.**

	First season				Second season			
	Weight loss %							
	Balady		Frawla		Balady		Frawla	
Days of storage	Liner	Indi.	Liner	Indi.	Liner	Indi.	Liner	Indi.
<b>Start</b>	6.22	6.04	5.98	5.92	5.95	5.91	5.52	5.54
<b>8</b>	6.19	6.08	5.92	5.94	6.23	6.31	6.11	6.32
<b>16</b>	6.19	6.13	5.90	5.96	6.48	6.50	6.63	6.45
<b>24</b>	6.19	6.32	5.92	6.00	6.42	6.53	6.42	6.71
<b>32</b>	6.10	6.34	5.98	5.95	6.47	6.48	6.45	6.44
<b>40</b>	5.42	6.07	5.53	5.93	6.47	6.39	6.44	6.22
<b>48</b>	5.66	6.00	5.61	5.90	6.21	6.30	6.00	5.52
<b>M</b>	6.02b	6.14a	5.85b	5.94a	6.31a	6.34a	6.22a	6.17a
<b>C.M</b>	6.08 a		5.89 b		6.32 a		6.19 b	

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