

## **EFFECT OF CURING AND SEAL PACKAGING ON PEEL AND PULP WEIGHT LOSS PERCENTAGE OF SCUFFING DAMAGED AND UNDAMAGED CITRUS FRUIT.**

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### **Abstract**

These studies were carried out to determine the effect of damage and sealed packaging on peel and pulp weight loss in damaged, cured and non-cured fruit. The effect of scuffing damage on peel and pulp weight loss percentage was that all the damaged fruit lost more weight and had lower peel and pulp percentage than the undamaged fruit. The sealed fruits had reduced weight, peel and pulp losses in contrast to non-sealed fruits. The difference in peel and pulp loss percentage shows that the peel loss percentage was slightly higher than in pulp. The peel of those fruits which were damaged and stored without polyethylene film lost significantly more weight than undamaged fruit but the damaged and undamaged sealed fruits did not show any significant difference between them. The fruits which were stored without polyethylene film in those fruits the damage was shown to affect the quality of both peel and pulp.

**Key Words:** Citrus fruit, Curing, Damage, Packaging, Shelf life, Deformation, Firmness and Quality,

### **Introduction**

The peel plays an important role in keeping quality of citrus fruit. The weight loss of peel during storage was investigated by Harvey and Rygg, 1936. The deterioration involves primarily in the peel. The first detectable signs of deterioration were softening of fruit and drying of the button. Shriveling of the peel was the main reason for declining commercial values of the orange (Ben-Yehoshua, 1969). The peel changes its water status much more rapidly than pulp; indeed; the diurnal fruit moisture loss while fruits are still on the tree comes primarily from the peel (Kaufmann, 1970).

This project was conducted to determine the effect of damage and sealed packaging on peel and pulp weight loss percentage in damaged and undamaged cured and non-cured Clementine mandarin fruit.

### **Materials and Methods**

These studies were carried out on mandarin fruit in Silsoe College, Silsoe Cranfield University Bedford M K 45 4DT U.K during 1998-1999. Clementine mandarins produced in Spain and obtained from a U.K commercial source were used. Some fruits were damaged by scraping the surface with abrasive paper and then washed with distilled water. The initial weight of each fruit was taken

after allocating the treatments before they were sealed-packed and stored. The fruits were sealed-packed with polyethylene film (120 gauges) and some were cured at 35°C with 95-98% RH for 48 hours, and then stored at 5°C with 95% RH for 28 days, while others were stored directly at 5°C with 95% RH for 30 days.

The fruits were analyzed after 30 days of storage. The following parameters i.e. weight, pulp, peel loss percentage, deformation, firmness (damaged and undamaged and damaged + undamaged part), TSS, acidity and TSS/acid ratio were measured. The experiment was a completely randomized factorial design (2 damage x 2 sealing x 2 curing) replicated four times.

## **RESULTS AND DISCUSSION**

### **Weight, peel and pulp loss percentage.**

The effect of damage on weight, peel and pulp loss percentage (see in table) was that all the damaged fruit lost more weight and had lower peel and pulp percentage than the undamaged fruit. In sealed fruits there were no significant differences between damaged and undamaged fruits but for fruits which were not sealed those which had been damaged had higher weight, peel and pulp losses than those which had not been damaged.

The differences in peel and pulp loss percentage showed that the peel loss percentage was slightly higher than that of the pulp. The peel of damaged non-sealed fruits lost significantly more weight than undamaged fruit but the damaged and undamaged sealed fruits did not show any significant differences between them. Most of the water lost from citrus fruit during storage is lost from the peel tissues rather than from the

pulp (Ben-Yehoshua *et al.*, 1979). The peel lost more water than pulp. It is possible that this was due to the greater exposure of the peel or to its smaller water holding capacity (Harvey and Rygg, 1936). The peel of damaged fruits stored without polyethylene film showed more weight loss than in sealed fruits where there was no significant difference in weight loss between damaged and undamaged fruits. The peel changes its water status much more rapidly than pulp; indeed; the diurnal fruit moisture loss while fruits are still on the tree comes primarily from the peel (Kaufmann, 1970).

Moisture loss through transpiration is the major process leading to weight loss of both peel and pulp, which correlated with damage to the fruit. In non-sealed (without polyethylene film) damaged and undamaged fruit weight loss, and peel and pulp losses were higher than in sealed damaged and undamaged fruit. This happened because the fruits that were stored without polyethylene film or fruit that were damaged resulted in high transpirational losses. Weight loss was also observed in sealed damaged and undamaged fruit but this was not so high due to sealing, which reduced the loss of moisture from fruit surface and produced the water-saturated atmosphere and reduced the respiration rate. It is possible that the major requirement for extending the postharvest life of citrus fruit is to slow down transpiration (Ben-Yehoshua, 1985). Weight loss after 15 days storage at 20°C with 70% RH was lower in sealed packaged fruit than in those stored without polyethylene film (Martinez-Javega *et al.*, 1991). Curing of non-sealed fruits was less effective than curing of sealed fruit and caused prohibitive weight loss (Ben-Yehoshua *et al.*, 1987).

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Table: Effect of damage and sealing of Clementine mandarin in 120 gauge polyethylene film bags on their fruit quality after curing for 48 hours at 35°C with 95-98% RH and subsequent storage at 5°C with 95% RH for 28 days or storage for 30 days at 5°C with 95% RH. The figures are the mean of two curing (curing + no curing) treatments since the main effect of curing was not significant.

Treatments	Sealed in polyethylene film		Without polyethylene film		
	Undamaged	Damaged	Undamaged	Damaged	LSD ( $p=0.05$ )
Weight loss % (g)	0.65	0.80	2.43	3.93	0.30
Peel loss %	0.38	0.46	1.46	2.34	0.18
Pulp loss %	0.28	0.34	0.97	1.59	0.11
Peel loss % (Undamaged +damaged part)	0.21	0.25	1.02	1.33	0.08
Difference in peel-pulp loss%	0.10	0.12	0.49	0.75	0.05
Deformation (mm) at 5 N.	0.86	1.00	1.55	1.95	0.15
Deformation (mm) at 5 N from undamaged part	0.86	0.95	1.55	1.85	N.S
Deformation (mm) at 5 N from damaged part	0.86	1.05	1.55	2.05	0.21
Deformation (mm) at skin failure	3.91	4.06	4.66	5.25	0.28
Deformation (mm) at skin failure from undamaged part	3.91	3.96	4.66	5.15	N.S
Deformation (mm) at skin failure from damaged part	3.91	4.16	4.66	5.35	0.31
Firmness (Nmm <sup>-1</sup> ) at skin failure.	5.70	5.64	5.11	4.80	0.13
Firmness (Nmm <sup>-1</sup> ) at skin failure from undamaged part	5.70	5.66	5.11	4.91	N.S
Firmness (Nmm <sup>-1</sup> ) at skin failure from damaged part	5.70	5.61	5.11	4.71	0.20
TSS%	12.82	12.73	12.64	12.54	N.S
Acidity%	0.90	0.89	0.88	0.86	0.02
TSS/acid ratio	14.32	14.38	14.44	14.67	0.20

The results regarding deformation and firmness (see in table) show that all the damaged fruit had higher deformation and lower firmness than

undamaged fruit. The significant ( $p=0.01$ ) interaction between damage and seal packaging was that the lowest deformation and highest firmness were

recorded in undamaged sealed fruits and there was no significant difference between undamaged and damaged sealed fruits. The damaged fruits which were stored without polyethylene film had higher deformation and lower firmness than those which had not been damaged. In sealed packaging the evaporation/transpiration decreased and the moisture of the fruit was preserved which is a prerequisite for fruit firmness. On the other hand the respiration and moisture loss of non-sealed fruits increased and fruits became softer and firmness reduced.

Carefully handled grapefruit during storage were more resistant to deformation than roughly handled fruit (Rivero *et al.*, 1979). The control fruits (oranges) were the softest, while sealed packaged fruit exhibited the best firmness (Martinez-Javega *et al.*, 1991). Firmness of unwrapped mandarins was lower than film wrapped fruits (Saucedo V. C., *et al.*, 1997).

The result of TSS (see in table) were not affected by all treatments but sealed and fruits without polyethylene film showed significant results for acidity and TSS/acid ratio. Sealed fruits had higher acidity, which lowered the TSS/acid ratio, but in fruits which were stored without polyethylene film had higher TSS/acid ratio because they had less acidity and TSS/acid ratio increased with the reduction in acidity. The sealed fruits did not lose more water by evaporation because sealing provided humid environment and reduced respiration rate so the fruits exhibited higher TSS and acidity. On the other hand the damaged and undamaged fruit which were stored without polyethylene film had less acidity because the fruits lost more acidity due to higher loss of moisture through transpiration. The acidity may

be reduced due to the higher respiration rate where organic acids may be utilized as respiratory substrates/ for energy production. The reduction in acidity was mainly due to a decrease in citric acid content (Kawada and Kitagawa, 1986). Seal packaging had no effect on TSS/acid ratio (Martinez-Javega *et al.*, 1991). Acidity and ascorbic acid content of sweet oranges were shown to decrease during storage (Chattopadhyay *et al.*, 1992). Internal quality (TSS, acidity and TSS/acid ratio) remained unaffected for film wrapping treatment (Saucedo *et al.*, 1997).

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