Proc. Fla. State Hort. Soc. 109:289-290. 1996.

POSTHARVEST QUALITY OF AN ASTRINGENT PERSIMMON VARIETY AFTER LONG-TERM STORAGE FOLLOWED BY ETHEPHON TREATMENT

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Additional index words. Conservation, chlorophyll, *Diospyros kaki,* fruit wrapping, low temperature storage, modified atmosphere, ripening, water loss.

Abstract. **Persimmon fruits (*Diospyros kaki* L.) cv. Taubate, an astringent variety, were either overwrapped with polyvinyl-chloride (PVC) film (4 fruits per tray) or left unwrapped, followed by storage at 0°C (32°F) and 80-85% relative humidity (RH) for 72 days. At the end of the storage period, overwrapping delayed chlorophyll breakdown and reduced water loss, however, there were no differences in soluble tannins, astringency, soluble solids content, fruit firmness, reducing sugars and titratable acidity. Following storage, the film was removed from overwrapped fruits and both treatments were sprayed with 1000 µl/l of ethephon, then held at 20°C (68°F) and 90% RH. Upon ripening, there were no differences in final fruit quality due to storage treatments. Based on these results, it is suggested that persimmon fruits be overwrapped during long-term storage followed by ethephon treatment to promote uniform ripening.**

Although originated in China, persimmon fruits (*Diospyros kaki* L.) have developed commercially in Japan, where they have been regarded as traditional fruit for hundreds of years (Collins and Tisdell, 1995). In the last two decades, there has been an expansion on persimmon production in Australia, New Zealand and South America, particularly in Brazil. In this country, 'Taubate', an astringent variety cultivated in almost 80% of Sao Paulo state, is one of the main varieties. Part of its production is exported either to closer markets, that are normally reached by air freight, or to more distant ones like Asia, Europe and Middle East that can only be economically served by sea freight. The latter scenario involves long term storage and changes in postharvest quality.

During transport, several techniques are employed to reduce fruit metabolism. Among these techniques are low temperature storage, modified atmosphere packing (MAP) and controlled atmosphere (CA). With MAP storage, low temperature is usually combined with use of plastic films like polyvinyl-chloride (PVC), creating a modified environment inside the package, which contributes to reduced water loss and increased shelf life of many commodities. Although widely used in postharvest handling, there are many aspects concerning the utilization of MAP and low temperature storage that still must be investigated, such as ripening uniformity after storage, color development, pulp firmness, astringency degree and so on.

This work was designed to investigate the effects of ethephon, modified atmosphere packaging and low temperature storage on physical and chemical characteristics of persimmon fruits, cv Taubate.

Material and Methods

Persimmon fruits were harvested on 1992 season, at Araponga Experimental Station (Minas Gerais State), 880 meters high, 20°40" south latitude and 42°31" west longitude, and transported to the postharvest laboratory of the Universidade Federal de Vicosa (UFV), 30 km away. Fruits were harvested within a commercial maturity index, which corresponds to a green sugarcane color or 7,5Y8/8 on Munsell color chart (1957). Fruits in groups of four were placed on 32 trays (14 × 14 cm) and stored at 0°C and 80-85% relative humidity (RH). Sixteen trays were overwrapped with PVC and sixteen were left unwrapped. After 72 days of storage, fruits were removed from the cold room, unwrapped and left at 90% RH and 20°C. On the following day, the fruits were sprayed with a 1000 µl/l ethephon solution in order to promote uniform ripening. Seven days after ethephon treatment, chemical and physical analysis were carried out every two days.

The experimental design consisted of 36 treatments, with a 2 × 18 arrangement (overwrapped and unwrapped fruits and 18 sampling times), in a fully randomized scheme with four replications (of four fruits each). Data were subjected to analysis of variance and regression analysis.

Chemical and physical analysis were performed as follows. Chlorophyll was analyzed by extraction of 2 g from the peel that was titrated with 0.5 g of $MgSO_4$ in acetone at 80%. The filtered solution was adjusted to 25 ml and the chlorophyll content was determined according to Arnon (1949).

Reducing sugars were measured according to Teles (1977). After extraction in alcohol (50% v/v), a 1 ml sample was mixed with Teles solution and the color development was evaluated using a spectrophotometer at 520 nm. A standard glucose solution (lg/kg) was used as a reference for each treatment.

The extraction methodology used for soluble tannins was the same as for reducing sugars. Determination of tannin content was done according to AOAC (1975) procedures, using a Follin-Dennis solution. A 2 ml sample was separated, the volume was completed to 50 ml and the final solution was analyzed in a spectrophotometer at 750 nm. A standard solution of tannic acid (0.1 g/l) was used as a reference.

Astringency was evaluated according to Awad and Amenomory (1972) using an arbitrary table, ranging from 0 (low astringency) to 3 (high astringency). Pulp firmness and soluble solids content were determined with a penetrometer with a 11 mm tip and a hand refractometer, respectively. Water loss was quantified every four days on eight trays, which had been separated for that purpose. Titratable acidity was determined according to AOAC (1975) procedures. The values found were transformed to the corresponding values of malic acid (Instituto Adolfo Lutz, 1985).

Table 1. Mean values of chemical and physical characteristics of persimmon, cv. Taubate, stored at 0°C for 72 days, with (+) and without (-) plastic film.

Characteristics	Plastic film +	Plastic film -
Total chlorophyll (mg/kg)	21.29 b[z]	19.69 a
Soluble tannins (g/kg)	2.65 a	2.67 a
Astringency degree	3.00 a	3.00 a
Reducing sugars (g/kg)	150.30 a	143.6 a
Titr. acidity (% malic acid)	0.0365 a	0.054 a
Pulp firmness (kg f/cm^2)	9.53 a	9.74 a
Water loss (%)	0.51 b	3.17 a

[z]Chemical and physical means with the same letter are not different at the 5% level of significance (F test).

Table 2. Mean values of chemical and physical characteristics of persimmon, cv. Taubate, after storage at 0°C for 72 days, with (+) and without (-) plastic film and subsequent treatment with ethephon. Fruit analyzed after 7 days at 20°C and 90% RH.

Characteristics	Plastic film +	Plastic film -
Total chlorophyll (mg/kg)	8.74 a[z]	9.08 a
Soluble tannins (g/kg)	0.97 a	1.13 a
Astringency degree	1.77 a	1.87 a
Reducing sugars (g/kg)	129.30 a	124.40 a
Titr. acidity (% malic acid)	0.0365 a	0.0353 a
Pulp firmness (kg f/cm^2)	2.79 a	3.52 a
Water loss (%)	1.41 a	1.45 a

[z]Chemical and physical means with the same letter are not different at the 5% level of significance (F test).

Results and Discussion

After the 72 day storage period, modified atmosphere packing (MAP) and low temperature storage contributed to a delay in chlorophyll breakdown and reduced water loss (Table 1), while ethephon application induced a desirable ripening uniformity (Table 2). Fruits that were left unwrapped during storage had a cumulative weight loss (loss during storage plus loss after ethephon application) of 10.8%. On the other hand, overwrapped fruits showed a cumulative weight loss of 4.31%, which is clearly a desirable effect of MAP (data not shown). Belotto et al. (1989) working on mandarins observed similar results.

Under low temperature storage associated with MAP, fruit metabolism and respiration rate are decreased. This usually happens because MAP leads to an accumulation of CO_2 inside the package, which leads to a decrease in respiration rate. Another effect of CO_2 accumulation is that, even in low concentrations, CO_2 is able to compete with ethylene (C_2H_4) for the binding sites, promoting a reduction of C_2H_4 action. Thus, there is a delay in normal ripening, which is reflected in the higher contents of chlorophyll in overwrapped fruits. After ethephon application, statistical differences on total chlorophyll content and water loss disappeared, indicating the desirable effect of ethephon on ripening uniformity (Table 2).

Based on these results, it is suggested that persimmon fruits, cv. Taubate, be overwrapped during long-term storage followed by ethephon treatment to promote uniform ripening.

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