SOME EFFECTS OF TREATMENT CONDITIONS ON THE COLOR-ADDING OF TEMPLE ORANGES[1]

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Temple oranges are usually associated with fine color in the minds of consumers. However, in some seasons and some groves the natural color of Temple oranges leaves much to be desired at the time of shipment. Several years ago color-adding of Temples was allowed by special permit on an experimental basis. More recently the process has been permitted, but treatment conditions have been legally limited to 2½ minutes at 115° F. (3). However, citrus packers have shown an interest in obtaining even better color. The experiments described here were done to determine the effects of more drastic treatment conditions in color-adding upon fruit color, dye residues and keeping quality of Temple oranges.

EXPERIMENTAL METHODS

Fruit.—The Temple oranges used in these experiments were purchased and picked from a grove, located in Lake Alfred, which is managed by Haines City C.G.A. Four experiments were made at weekly intervals during January of 1962. Fruit in the successive runs was degreened for 48, 48, 24, and 18 hours respectively.

Packinghouse Treatments.—Fruit was washed with a transverse brush washer. It was then run through a flood-type color-add applicator, polisher-dryer and coated with "Flavorseal 93."

Color-add.—Emulsions of Citrus Red No. 2 were prepared from color-add concentrates (courtesy of the F.M.C. Corporation). Most applications were made at the recommendad color concentration, but one treatment was made at 1½ times the normal strength of emulsion. Treatment times of 2½ and 4 minutes were used at each of two temperatures, 115° F. and 120° F. Control samples received no color-add application. A hot water treatment of 4 minutes at 120° F. without color was included in all except the first experiment.

Packing and Storage.—Temple oranges representing the various treatments were hand-packed into 4/5 bushel fiberboard cartons. Three cartons were packed for each treatment. Samples were stored at 60° F. for 6 days and then transferred to 70° F. storage for the duration of the experiment.

Keeping Quality.—All samples were examined for stem-end rot and mold at 10 and 17 days from packing as a measurement of keeping quality.

Fruit Color.—A random spot on each of 10 fruit taken at random from each sample were read for color by determining the "a" value with the Hunter Color and Color Difference Meter. Readings were also made on a sample of Temple oranges selected as the best natural-colored fruit from a commercial packinghouse line.

Residues of Citrus Red No. 2.—Dye residues were determined by the method of Ting (1) in which the fruit was weighed and washed with two portions of chloroform. The solution was made to volume, and the light absorption at 520 $m\mu$ was determined with a Bausch and Lomb "Spectronic 20." Results are reported as ppm of Citrus Red No. 2 in the whole fruit.

RESULTS AND DISCUSSION

The fruit color expressed as average "a" values and results of analyses for residues of Citrus Red No. 2 are given in Table 1.

Fruit Color.—The average "a" values show that color-adding definitely improved the color of the fruit. No significant differences in fruit color were obtained by variation of time, temperature or concentration in the color-add process. This indicates that residual green color in the peel cannot be completely obscured by the dye. Average "a" values for color-added Temple oranges did not exceed those of natural-colored fruit selected for good color.

Dye Residues.—Results of analyses for residues of Citrus Red No. 2 indicated that residues increased with time of exposure of Temples to the color-add process but that temperature and concentration had little effect on the amount of dye deposited. Residues for all treatments were less than the official tolerance of 2 ppm for Citrus Red No. 2 (2).

Keeping Quality.—Average per cent total decay results at 10 and 17 days from packing are shown for the 2½-minute treatments in Figure 1 and for the 4-minute treatments in Figure 2.

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Table 1. Average fruit color "a" values and dye residues of color-added Temple oranges.

Color-add Treatment	Fruit Color Avg. "a" Value	Residues of Citrus Red No. 2 ppm
1. Control -- no color-add	33.6	0
2. 2½ minutes at 115° F.	38.3	0.7
3. 4 minutes at 115° F.	39.7	1.1
4. 2½ minutes at 120° F.	40.5	0.7
5. 4 minutes at 120° F.	39.9	1.1
6. 1½ X normal concentration 2½ minutes at 115° F.	40.0	0.6
7. Warm water only, 4 minutes at 120° F.	--	--
8. Selected natural-color Temple oranges	46.5	--

It should be noted that all color-add treatments resulted in a reduction in the decay of Temple oranges. At 2½ minutes neither temperature nor concentration of the color-add emulsion had any major effect on decay. At 4 minutes decay was appreciably less for fruit which was color-added at 120° F. than for that treated at 115° F. A

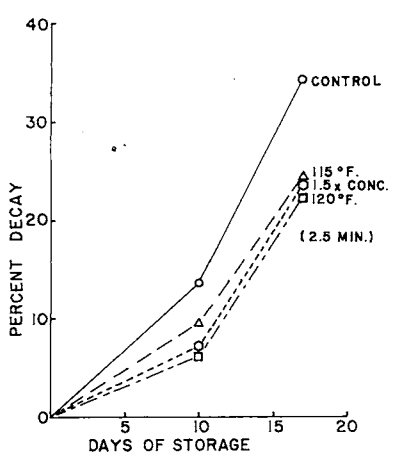

Figure 1. Effects of temperature and concentration in color-adding for 2½ minutes on average total decay of Temple oranges at 10 and 17 days from packing.

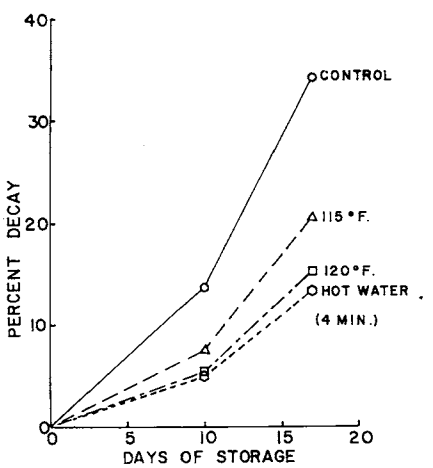

Figure 2. Effects of temperature in color-adding for 4 minutes and of a hot water treatment on average total decay of Temple oranges at 10 and 17 days from packing.

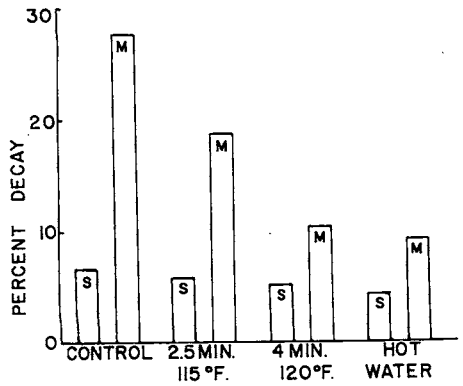

Figure 3. Effects of color-adding and hot water treatments on decay of Temple oranges by stem-end rot and mold at 17 days from packing.

similar reduction of decay by the hot water treatment indicated that a temperature effect was responsible rather than fungicidal action by any chemical in the emulsion.

Figure 3 shows the average decay due to stem-end rot and mold at 17 days from packing for control samples without color-add, for samples color-added for 2½ minutes at 115° F. and for 4 minutes at 120° F. The results of treatment with hot water for 4 minutes at 120° F. are also shown. No significant differences in stem-end rot are shown by the various treatments. Decay due to mold was appreciably reduced by color-adding for 2½ minutes at 115° F., the legal limits for Temple oranges and tangelos. Further reduction in decay by mold was shown for samples color-added at the legal limits for oranges of 4 minutes at 120° F. Hot water treatment for 4 minutes at 120° F. gave similar results. Reduction of decay by mold thus accounts for the improved keeping quality shown by color-added Temple oranges.

SUMMARY

1. The color of Temple oranges is improved by color-adding but does not exceed that of natural-color fruit selected for best color.

2. Residues of Citrus Red No. 2 increase with time of exposure to the color-add emulsion but are well within the legal tolerance of 2 ppm.

3. Exposure of Temple oranges to the elevated temperature of the color-add emulsion results in appreciable reduction in decay due to mold.

LITERATURE CITED

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HARVESTING CITRUS FRUIT WITH AN INERTIA SHAKER

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For many years the concept of shaking trees to remove their fruit has been practiced in the commercial harvesting of nut crops such as walnuts, pecans, etc. Recently this concept has been adapted to commercial harvesting of prunes (6) and red tart cherries (5). At present, it is also being tried experimentally in peaches harvested for processing (3).

The commercial machines available may be classified as fixed stroke and inertia shakers, depending on the principle at work in releasing fruit from a tree. Usually a catching frame is employed in combination with the shaker to collect the fruit as it drops from the tree.

The authors (4) evaluated a fixed stroke shaker in 1958, and found it unsuited for citrus because of low fruit removal and poor maneuverability. Coppock (2) discussed the concept of a tree shaker and catch frame for fruit harvesting using an inertia shaker. The objective of the experiments reported in this paper was to provide additional information on the merits of this concept for harvesting citrus. Emphasis was placed primarily on fruit removal without much regard to the catching and collecting of fruit.

EXPERIMENTAL EQUIPMENT

The inertia shaker shown in Figure 1 was used in the tests. It employs the same inertia principle developed by Adrian and Fridley (1)

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