

DEGREENING, COLOR-ADD AND STORAGE OF 'AMBERSWEET' ORANGE FRUIT

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Additional index words. decay, postharvest, hybrid

Abstract. The optimum storage temperature for 'Ambersweet' fruit (*Citrus reticulata*) Blanco X (*C. paradisi* Macf. X *C. reticulata*) X midseason orange, *C. senensis* (L.) Osb.), based on rind breakdown and extent of decay, was 34°F for 2 weeks prior to holding at a higher temperature (70°F) during 3 successive seasons. This is similar to the optimum conditions for Florida oranges. At the end of 2 weeks at 70°F, fruit decay was 1% or less and the fruit retained its good flavor characteristics. The major decay was green-mold rot. Fruit stored well after 43 to 57 hours of degreening with ethylene. Rootstocks did not influence storage characteristics. Color-add treatment following degreening had no adverse effects on fruit quality during storage or subsequent holding, and improved the rind color.

'Ambersweet' is a hybrid of (*Citrus reticulata* Blanco X (*C. paradisi* Macf. X *C. reticulata*) X midseason orange, *C. sinensis* (L.) Osb.) that was released as a new variety in 1989 (2) and has been extensively planted by Florida growers. In October 1990, the Florida Citrus Commission ruled that the 'Ambersweet' be marketed fresh as an orange because its characteristics closely resemble those of orange varieties.

The purpose of this paper is to report on tests in 1987, 1988, and 1989 to determine the fruit storage characteristics as well as the effects of storage temperature, ethylene degreening, and color-add on subsequent storage and shelf life.

Materials and Methods

Test 1, comparison of 2 storage temperatures. Fruit were snapped from 13-year-old 'Ambersweet' trees at Leesburg December 1, 1987. They were randomly selected, washed, treated (drenched) with benomyl at 600 ppm, and waxed. Samples for 3 replicates at each temperature were separated into lots of 160 fruit each and placed in storage at 34 and 40°F at relative humidity (RH) of 88 to 92%. After storage for 2 weeks, fruit were removed and evaluated for extent of decay, rind breakdown, and cold injury (CI). Fruit were then held at 70°F and RH of 80 to 92% for 3 weeks of further evaluations on a weekly basis. Analysis of variance was used to compare fruit decay at each weekly evaluation following storage at the 2 temperatures.

Test 2, evaluation of degreening effects on postharvest fruit decay. Fruit were snapped from 14-year-old 'Ambersweet' trees at Leesburg October 24, 1988. They were exposed to

The author gratefully acknowledges the assistance of Dr. Roy McDonald and Ms. Roxanne Wiseman in sample preparation and treatment and Conoly Fruit Packers, Inc., Winter Garden, FL, for color-add treatment of samples.

5 ppm ethylene in a chamber regulated at 85°F and at 90 to 95% RH until the fruit were completely degreened (57 hr). During degreening, the heater thermostat failed and the temperature in the chamber increased to well above 100°F for an unknown period. Fruit were removed from the degreening chamber, washed, treated (drenched) with thiabendazole (TBZ) at 1,000 ppm, and waxed. Two randomly selected lots of 100 fruit each from trees on Cleopatra mandarin (*C. reticulata*) and sour orange (*C. aurantium* L.) rootstocks were used (total 400 fruit). Fruit were stored at 34°F and 88 to 92% RH for 2 weeks then held for an additional 2 weeks at 70°F and 80 to 92% RH. Fruit were examined when taken from 34° storage and after holding for 7 and 14 days.

Test 3, evaluation of fruit decay following degreening and color-add prior to storage. Fruit were snapped from 15-year-old 'Ambersweet' trees near Lake Wales on November 13, 1989, and degreened for 43 hr. Fruit were divided into 2 lots. One lot (check) was washed, treated (drenched) with TBZ at 1,000 ppm, and waxed. The other lot was taken to a nearby packinghouse where it was washed, treated with sodium orthophenylphenate (SOPP) at 2%, color-added for 2 min in a solution at 116°F, and waxed with a wax containing 1,000 ppm TBZ. The check fruit had been washed, treated, and waxed before it was known that SOPP was included in the packing line following the color-add treatment, resulting in another possible variable. Samples of 80 fruit each, 4 replications, were selected from each of the 2 lots and placed in storage at 34°F for 2 weeks. They were then placed in a holding room at 70°F and 80 to 92% RH for 4 weeks and were evaluated at weekly intervals. The data were not statistically analyzed because of the unexpected SOPP variable.

Results and Discussion

Test 1, storage at 2 temperatures. Fruit stored at 34 and 40°F were evaluated immediately after 14 days' storage, and all fruit were sound. All fruit were still sound after being held at 70°F for 7 days. Following 14 days at 70°, 2.8% and 0.9% fruit decay had occurred at 40° and 34°F storage, respectively (Table 1). Commercially, it is unlikely that fruit would be held more than 14 days. However, 5.4 and 3.4% cumulative fruit decay had occurred after 21 days at 70°F. There was no statistical difference in fruit decay rates after 14 or 21 days at 70°, but 34° storage may

Table 1. Cumulative average percentage decay of 'Ambersweet' fruit following 14 days' storage at 2 temperatures before movement to a holding room in 1987^a

Initial Storage Temp.	Days Held at 70°F		
	7	14	21
40°F	0	2.8	5.4
34°F	0	0.9	3.4
Significant level	NS	NS	NS

^aFruit harvested December 1, 1987, and no degreening was needed.

be preferred as has been previously reported for Florida oranges (1).

Most of the fruit decay was caused by green mold (*Penicillium digitatum* Sacc.). Several fruit had a small rind tear (plugging) at the stem end but did not decay during the test period. There was no evidence of pitting to the rind during the test. Fruit flavor was still good 5 weeks after harvest.

Test 2, degreening and storage. Following 57 hr of degreening and 2 weeks' storage at 34°F, all fruit were sound. Then, after 7 days at 70°F, there was no decay, but 2% of the fruit showed rind pitting. After 14 days at 70°F, 1.0% decay had occurred from stem-end rot (*Diplodia natalensis* P. Evans). Rind scald was evident on 5.5% of the fruit and may have resulted from the high-temperature problem during degreening. The test was terminated after 14 days at 70°F. Rootstocks had no influence on postharvest characteristics of 'Ambersweet'.

Test 3, degreening, color-add, and storage. The purpose of this test was to determine if color-add treatment following degreening would have detrimental effects on the storage life of 'Ambersweet' fruit. The commercial packinghouse that color-added the fruit routinely used SOPP as a step in the packinghouse operation. Therefore, the color-added fruit also received an additional fungicide that may have aided in fruit decay control. Although this added variable prevented statistical comparisons, it is interesting to note that the percentage of fruit decay after holding 7 days was zero and less than 1% after 14 days (Table 2). These are very similar to data from Test 1 and Test 2 where 34°F

Table 2. Cumulative average percentage decay of 'Ambersweet' fruit following degreening, color-add, and SOPP treatment prior to storage at 34°F for 14 days and holding at 70°F in 1989²

Treatment	Days Held at 70°F			
	7	14	21	28
Check	0	0.3	8.4	11.6
Color-add	0	0.3	0.6	3.8

²Fruit were harvested November 13, 1989, and were degreened 43 hours before treatment. Check and color-add fruit were treated with TBZ. Only color-add fruit received SOPP treatment.

storage was used prior to holding at 70°F. After holding 14 days, there was no evidence of rind pitting of fruit receiving either treatment. The above results suggest that the color-add treatment did not cause detrimental effects on storage and holding of 'Ambersweet' fruit. In fact, the color-add improved the orange peel color. Further work is needed to give a more reliable comparison. Commercially, fruit would not be held more than 14 days, but decay was evaluated after 21 and 28 days at 70°F. The fruit still had a good flavor at the end of that test.

Literature Cited

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FLORIDA'S CITRUS JUICE STANDARDS FOR GRADES AND THEIR DIFFERENCES FROM UNITED STATES STANDARDS FOR GRADES AND UNITED STATES FOOD AND DRUG ADMINISTRATION STANDARDS OF IDENTITY

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Abstract. Standards for grades of the eleven major processed and fresh citrus juice products (seven orange, four grapefruit) produced in Florida are discussed. Tables are presented for ten products listing the Florida state grade requirements for the 100-point grading system, which includes the quality factors of flavor, color and defects; requirements for the quality factors of appearance, separation, coagulation and reconstitution; and finally, the analytical requirements for the quality factors for °Brix, °Brix to percent acid ratio, pulp, and recoverable oil. Differences between Florida requirements for Standards of Grades and those of U.S. Standards of Grades and U.S. Food and Drug Administration Standards of Identity are noted. Major U.S. federal and Florida special situations for each product are discussed.

Florida as a major world producer and processor of citrus has developed a host of regulations necessary to market high quality juice and provide a reasonable return on investment.

All fruit whether destined for the fresh fruit or processed juice markets must meet minimum quality or maturity standards. These standards are complicated, depending mainly on cultivar and time of year. Details of citrus fruit maturity standards appear in the volumes "Florida Citrus Fruit Laws, Chapter 601, Florida Statutes" (1989; overseen by the Florida Legislature and requiring legislative action for amendment) and "Official Rules Affecting the Florida Citrus Industry" (1975; overseen by the State of Florida, Department of Citrus and amended by the Florida Citrus Commission as necessary). Maturity standards are based on several factors including peel color break, juice content, total soluble solids or °Brix, percent acid and the ratio of °Brix to percent acid. Florida Department of Agriculture inspection personnel are responsible for the enforcement of rules and regulations involved in Florida's maturity standards.

Any Florida regulations, however, must be tempered by the absolute federal authority provided by the U.S.