

this experiment. Wiant and Bratley (10) reported that decay per carlot of tomatoes shipped by rail and inspected at New York City from 1935 to 1942 ranged from 2.3 to 3.4 % yearly and averaged 2.9% for the entire period. In this work, tomatoes were produced and consumed within the State of Florida. Thus the distance of shipping and methods of handling might have accounted for part of the difference in the rates of decay between these 2 studies.

Although there does not appear to be a grade-price differential at retail, this differential does exist at the production area. The average prices of mature-green tomatoes of size 6 x 6 at the shipping points in Florida during this experiment from week ending May 4 to week ending June 1, 1974 were 8.00, 7.95, 7.58, 7.12, and 5.38 dollars per 30-pound equivalent for grades U.S. no.1, 85% U.S. no.1, U.S. Combination, U.S. no.2, and U.S. no.3, respectively.³

In view of the fact that the consumer did not discriminate among present U.S. Standards' grades of Florida mature-green tomatoes, and that the rates of decay did not correlate with the grades, it is, therefore, questionable whether or not there is a need for separating tomatoes into the exist-

ing grades at the shipping points. Since the consumer studies were limited to only one constant price, one season, and a single city in Florida only a short distance from the producing area, other economic effects including marketing costs, seasonal supply and demand, and others, were not fully investigated. Further studies would be needed to encompass the economic effects of grade stratification as now practiced. Consumer studies would include additional distant markets, seasonal effects, size or price influences on sales, and additional measurements of physical losses as affected by grades.

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³From weekly analyses of shipments and sales by the Florida Tomato Committee from week ending May 4 to week ending June 1, 1974.

ASCORBIC ACID AND CAROTENE CONTENTS OF PEPPERS

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Abstract. Peppers (*Capsicum annuum* L.) were harvested at the mature green and red ripe stage for ascorbic acid and carotene determinations. Green fruit analyzed for ascorbic acid at

harvest contained 105 mg/100 g 'Yolo Wonder L' fruit, 108 mg/100 g 'Early Calwonder', 113 mg/100 g 'Resistant Florida Giant', and 117 mg/100 g 'Florida 136'. 'Yolo Wonder L' fruit harvested at the red stage contained significantly greater ascorbic acid levels (153 mg/100 g) than green fruit. Storage of green peppers for 7 days resulted in a significant reduction (10-16 percent) in ascorbic acid; fruit stored at 70°F were lower in ascorbic acid than fruit stored at 45°F. The ascorbic acid content of red peppers decreased 10 percent during 14 days storage.

Carotene content of green bell peppers was reduced following 14 days storage at 45°F and after 7 days at 70°F.

Regulations enacted by the Food and Drug Administration permit the labeling of fresh or processed foods for nutritional composition. If nu-

tritional claims are made for the food product, prescribed nutritional labeling information is required.

Data on the nutritional composition of Florida-grown peppers is very limited, and no published data was located on the effect of storage on the nutrient composition of bell pepper fruit (*Capsicum annuum* L.).

French and Abbott (4) reported the composition of Florida-grown green peppers to be 0.33 mg carotene/100 g fruit and 172 mg ascorbic acid/100 g fruit. Howard, et al. (5) reported green bell peppers to contain 0.32 mg/100 g carotene and 160 mg/100 g ascorbic acid. Red bell peppers contained 3.4 mg/100 g carotene and 220 mg/100 g ascorbic acid. Carotene content of green sweet peppers has been reported (4,5,6,7,8,10,11) to range from 0.01 to 0.35 mg/100 g of green fruit. Curl (2) found that beta-carotene accounted for approximately 13.4 percent and alpha-carotene for approximately 0.4 percent of the total carotenoids of green bell peppers.

This study evaluated the effects of cultivar, storage period, and storage temperature on the ascorbic acid and carotene contents of bell peppers.

Methods and Materials

Bell peppers were grown on a Kanapaha fine sandy soil during the spring of 1975 near Gainesville. Fertilizer was broadcast at the rate of 2,000 lb/acre 6-8-8, mixed into the soil, and beds were prepared 6 feet apart. Black polyethylene mulch was applied. Pepper plants of four cultivars (Table 1) were transplanted in rows 12 inches apart and 12 inches within the rows on March 14, 1975.

Fruit were harvested in the mature green and full red stages. Three harvests were made at approximately one-week intervals starting on June 10, 1975. Harvest dates served as replications. At each harvest, samples were placed in polyethylene bags and stored at 45° and 70° F. Sub-samples were removed after 7 and 14 days storage for ascorbic acid and carotene analysis.

Ascorbic acid analyses were made by the 2,6 dichloro-indophenol method (9) on a 100 g sample. Ten pepper fruit were sliced into wedges to prepare a composite sample for the ascorbic acid and the carotene analyses, which were determined in duplicate. Carotene analyses were made using an AOAC method (1) modified by increasing sample size to 20 g and solvent volumes 1.5 fold.

Results and Discussion

The ascorbic acid contents of peppers harvested and analyzed at the mature green fruit stage were not significantly influenced by cultivar (Table 1). Ascorbic acid contents varied from 105 mg/100 g 'Yolo Wonder L' fruit to 117 mg/100 g 'Florida 136' fruit (breeding line). Storage of green peppers for 7 days at temperatures of 45° F and 70° F resulted in significant reductions in ascorbic acid levels as compared with fruit at harvest. Also, ascorbic acid reductions were significantly greater when fruit were stored at 70° F than at 45° F. Mean ascorbic acid content per 100 g of fruit for the 4 cultivars at harvest was 111 mg; after 7 days storage it was 102 mg with 45° F storage and 92 mg with 70° F storage.

Ascorbic acid content of 'Yolo Wonder L' fruit harvested at the red ripe stage was significantly greater than when harvested at the green stage (Table 2). Ascorbic acid values were 152 mg and 105 mg/100 g of fruit harvested at the two respective stages. After 7 and 14 days storage, ascorbic acid content of fruit harvested in the green stage was not significantly reduced as compared with fruit at harvest. Fruit harvested at the red stage, however, were 11 percent lower after 14 days storage than red fruit analyzed at harvest.

These ascorbic acid levels are considerably lower than those reported by French and Abbott (4) (172 mg/100 g) and Howard et al. (5) (160 mg/100 g). Neither author identified the cultivar analyzed. In a previously unreported study, green fruit grown in the Ft. Pierce area were found to contain ascorbic acid levels from

Table 1. Effect of cultivar and storage on the ascorbic acid content (mg/100 g) of green bell peppers.²

Cultivar	Storage, days		
	0	7	
		45°	70°
Res. Fla. Giant	113	100	93
Yolo Wonder L	105	106	96
Early Calwonder	108	97	94
Florida 136	117	103	85
Mean	111a	102b	92c

²Mean separation within rows by Duncan's multiple range test, 5% level.

Table 2. Effect of stage of maturity at harvest and storage on the ascorbic acid content (mg/100 g) of 'Yolo Wonder L' bell peppers.^z

Harvest maturity	Storage temp(°F)	Storage, days		
		0	7	14
Green		105b		
	45		106b	98b
	70		94b	102b
Red		152ar		
	45		148ar	136as
	70		147ar	134as

^zMean separation within columns (a,b) and within rows (r,s) by Duncan's multiple range test, 5% level.

109 to 135 mg/100 g. The mean ascorbic acid value for the 5 cultivars evaluated was 118 mg/100 g.

The U.S. Recommended Daily Allowance (RDA) for ascorbic acid is 60 mg. A one cup (240 g) serving of green peppers (105 mg/100 g) would furnish 4.2 times the RDA. A 57 g serving would furnish the 60 mg RDA. A one cup serving of the fully red bell peppers would furnish 6.1 times the RDA and a 39 g serving would furnish the 60 mg RDA.

Carotene content of the green pepper, 'Yolo Wonder L,' was 0.18 mg/100 g at harvest (Table 3). Storage for 14 days resulted in a 22 percent reduction of carotene. Green peppers stored at 74° F for 7 days contained 10 percent less carotene than those stored at 45° F for 7 days. Decay of the samples stored at 70° F was severe and satisfactory samples were not available for analysis at 14 days storage. Previous storage studies (3) on leafy green vegetables has shown significant losses of carotene when storage was at 70° F.

Carotene content of the three additional varieties harvested mature green were as follows: 'Re-

Table 3. Effect of storage on the carotene content (mg/100 g) of Yolo Wonder L bell peppers^z

Harvest	Storage, days			
	0	7	14	
		45°	70°	45°
1	0.19	0.17	0.15	0.11
2	0.19	0.16	0.15	0.14
3	0.17	0.18	0.16	0.16
Mean	0.18a	0.17a	0.15b	0.14b

^zMean separation by Duncan's multiple range test, 5% level.

sistant Florida Giant,' 0.22; 'Florida 136,' 0.27; and 'Early Calwonder,' 0.24 mg/100 g.

These values are somewhat lower than reported by French and Abbott (4) and Howard, et al. (5), however, neither author indicated the variety analyzed and French and Abbott used a different method of analysis.

A one cup (240 g) serving of green pepper (0.18 mg/100 g) would provide 14 percent of the RDA for Vitamin A.

These results indicate that bell peppers, either green or red, are excellent sources of Vitamin C even after two weeks storage at 70° C. The dietary contribution of provitamin A is considerably lower.

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