

Early-season navel oranges may be too sour for consumers

Ernestine Ivans □ Marie Ferree

Most people eat oranges because they taste good and have what is considered a "typical orange" flavor. This flavor is determined largely by the sugar and acid content of the fruit. If too low in sugar and high in acid, the fruit tastes sour.

The California navel orange season begins in mid to late October and lasts until early spring. Some members of the citrus industry worry that consumers may be dissatisfied with the eating quality of low-maturity navel oranges shipped early in the season and that potential repeat customers will be lost. Consumer rejection of later purchases can slow the momentum of the navel orange market, significantly affecting overall fruit sales.

We conducted a two-year study on the sensory quality of navel oranges. We had consumers taste-test oranges in a series of panels from early picking to mid-season and correlated the results of acceptance to the sugar/acid content of the fruit. Our objective was to provide background information for recommending changes, if needed, to improve the quality of fruit reaching the consumer. We found that acceptance was related to the sugar/acid ratio, with consumers preferring oranges at the higher maturity levels.

Methods

Selected consumers from seven California counties and from Texas, New York, and Nevada participated in the



Consumer panels in California, Texas, Nevada, and New York found early-season navel oranges too sour, even though they met legal maturity standards.

study. The California counties were Sacramento, San Bernardino, Santa Clara, Santa Cruz, San Joaquin, Tulare, and Tuolumne. Testing periods covered six weeks during November and December in 1983 and 1984. Consumer panelists rated the early oranges for external quality and for flavor, sweetness, and sourness. Sugar and acid levels were then checked by laboratory analysis, and results of the subjective and objective tests were correlated.

Home economists from the University of California Cooperative Extension and the other states conducted the taste panels in each area, following detailed instructions regarding procedures and data collection. Panel member responsibilities were outlined concerning testing procedures and activity schedules. A different test date was assigned each county to ensure that a smooth, coordinated flow of taste-tested fruit would arrive for laboratory testing at the Tulare County Agricultural Commissioner's office.

Before each designated test day, home economists in each county purchased and coded oranges from three separate markets. Enough were purchased for each panelist to taste three oranges and for the chemical analysis to be conducted. Home economists recorded the date of purchase, price, store name and address, brand of oranges, fruit size, lot number, and shipper or packer's name.

Consumer panelists completed questionnaires giving background information on income, factors influencing their orange purchases, satisfaction in eating quality of oranges, whether oranges had been purchased before testing earlier in the season, and who purchased oranges in the household.

Orientation of panel members was limited to brief instruction on procedures of taste-testing and completing consumer rating sheets.

Each panelist rated orange samples for external quality (appearance and color) before slicing them in half longitudinally from stem to blossom end. If the orange was sunburned, panelists were instructed to slice it so that equal amounts of burn would appear on both halves. Sliced fruit was appropriately coded.

One-half of each orange was sealed in a plastic bag, and the halves were shipped in an ice container, reaching the laboratory within 24 hours for sugar and acid

analysis. In addition to rating the corresponding halves for internal sweetness, sourness, and typical orange flavor, consumer panelists also answered the question, "If the oranges you just tasted were representative of those currently on the market, would you buy them now?"

All orange halves received by the commissioner's office underwent uniform analysis by one lab technician. Juice was squeezed by reamer. Soluble solids were measured by refractometer, and acidity was titrated; ratios of the two were then calculated for each individual orange half. Juice extracted by reamer from whole oranges of each lot from each county formed a composite sample, which was tested by hydrometer and calculated for sugar/acid ratios. Scores for the sugar and acid content of each fruit were sent directly to the University of California, Davis. Consumer response rating sheets for taste-tested oranges were also forwarded from test counties for statistical (multiple regression) analysis.

Results

Over the two-year period, 115 consumer panelists participating in the study rated a total of 840 orange halves. Laboratory tests were performed on 737 orange halves.

Sugar/acid ratios of individual orange samples in the fall of 1983 show maturity increasing with time from the first test in mid-November to the final test in mid-December. The panelists' responses indicated that they would not buy navel oranges if the sugar/acid ratio were much below 9.1. All orange composite samples tested by hydrometer met the California minimum maturity standard, which specifies a ratio of 8.1 (table 1).

In the first test period (November 14-18, 1983), 114 samples were rated by con-

TABLE 1. Sugar/acid ratios of composite navel orange samples tested in fall of 1983

County	Sugar/acid ratios in three test periods		
	Mid-Nov	Late Nov	Mid-Dec
Tulare	8.7	8.2	10.1
Santa Clara	—	—	11.2
Santa Cruz	9.0	9.7	9.8
San Bernardino	9.4	9.0	10.7
Tuolumne	8.4	—	9.3
San Joaquin	10.2	9.8	9.1
Sacramento	12.6	9.1	9.2

TABLE 2. Relationship between sugar/acid ratio and panelists' response to the question about willingness to buy navel oranges, 1983

Sugar/acid ratio range	Response	
	No	Yes
7.5 - 7.9	17	10
8.0 - 8.4	11	14
8.5 - 8.9	7	18

Chi - square: 6.44
Significance: .05

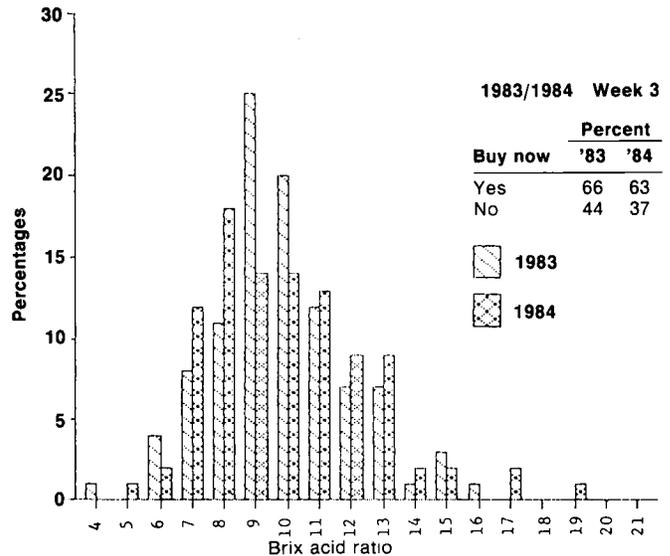
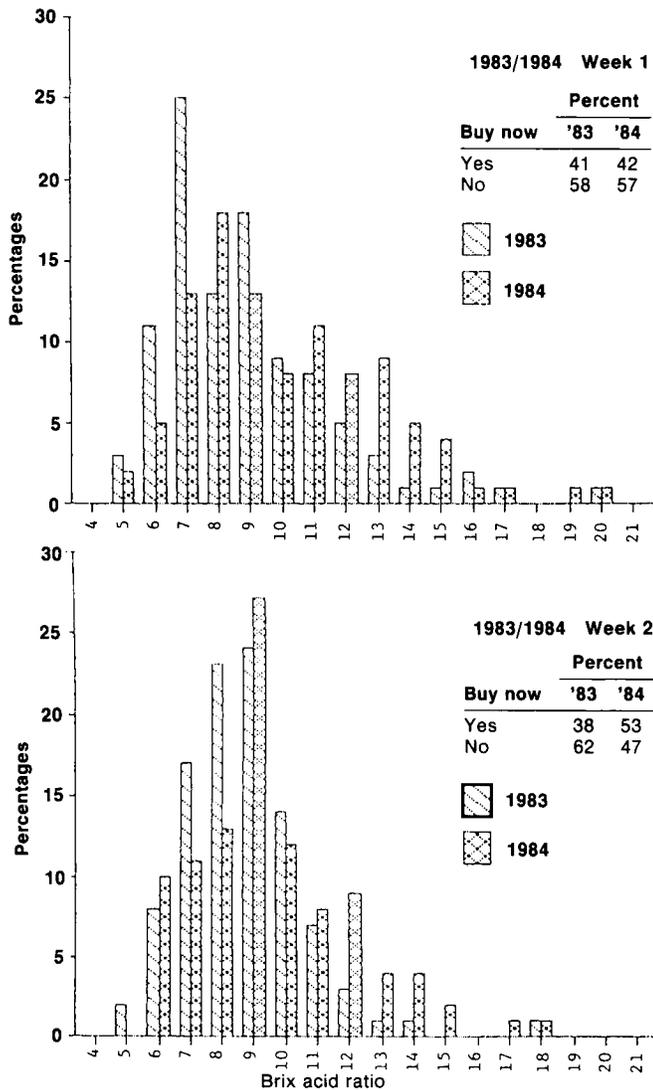


Fig. 1. Oranges for testing were sliced in half; consumer panelists tasted one half and the other was sent to a laboratory for analysis in weeks 1, 2, and 3 of the taste-tests. Ratios of sugar ($^{\circ}$ Brix) to acid

were higher earlier in the season in 1983 than in 1984. Consumer willingness to "buy now" generally corresponded to laboratory findings on orange maturity.

sumers in six of the seven participating counties and tested for sugar ($^{\circ}$ Brix) and acid. Chemical analysis showed that 39 percent of the oranges did not meet the minimum 8.1 ratio (fig. 1).

In the second week (November 28 - December 2, 1983), 115 individual samples were tested from five of the participating counties. The percentage of samples not meeting minimum standards declined to 26.9.

In the final week (December 13-16, 1983) 147 individual orange samples were tested, only 13 percent of which fell below the minimum maturity standard.

During the 1983 test periods, more than half of the consumers said they would not buy the oranges that were in the 7.5 to 7.0 ratio ranges (table 2).

In 1984, the sugar/acid ratios were higher earlier in the season than in 1983. This improvement could have resulted from factors such as earlier maturing fruit or better field testing for releasing fruit for market.

Consumer willingness to "buy now" over the two-year test period showed a consistent trend. As the season progressed the percentage of oranges reaching acceptable sugar/acid ratios rose, and the willingness to buy significantly increased.

Conclusions

The maturity standards required by state law for marketing oranges since passage of the California Fruit and Vegetable Quality Act in 1917 are based on both soluble solids (sugar), expressed as $^{\circ}$ Brix, and acid, expressed as percent titratable acid. The minimum acceptable maturity level for navel oranges is an 8 to 1 ratio of sugar to acid.

The findings in this study show: (1) a high percentage of fruit of low maturity early in the season, with sugar/acid ratios improving as the navel orange season progresses and (2) a trend suggesting that consumers prefer oranges above the 8.1 ratio set as the minimum maturity standard. The results indicate that improving

early-season navel orange quality might lead to increased consumer purchases.

Proposed actions to improve the quality of early-season navel oranges include:

(1) Modification of sampling and testing techniques used to determine maturity levels. For example, testing juice from individual fruits would be more accurate than analyzing a composite juice sample of several fruits.

(2) Closer supervision of field inspectors who approve fruit ready for market.

(3) Increasing the sugar/acid ratio specified by the minimum maturity standard from 8.1 to 9.1

Ernestine Ivans is Home Economist, University of California Cooperative Extension, Tulare County. Marie Ferree, now retired, was Consumer Marketing Specialist, Cooperative Extension, UC Davis. The authors gratefully acknowledge the assistance of participating Extension home economists. In California — Lola Lawson, San Joaquin County; Nancy Feldman, Tuolumne County, Dorothy Thurber, Sacramento County; Audrey Riley, Santa Cruz County; Mary Marshall, San Bernardino County; and Estella West, Santa Clara County. Out of state — Susan Russell, Texas; Ellen Mousin, New York; and Janet Usinger, Nevada.