

Index of Orange Fruit Maturity

compositional changes in the juice of Washington navel and Valencia oranges studied during development and ripening

Randolph T. Wedding and Raymond P. Horspool

The need for delivering to the market citrus fruits of the highest possible internal quality promoted interest in the possibility of the association of marketable quality with some measurable entity other than the commonly used ratio of total soluble solids to titratable acidity. In the course of investigations of the changes in nitrogenous constituents during the maturation of orange fruits, it was possible to gather data which demonstrate the changes in the concentration of certain constituents of the juice which occur during the development and ripening of these fruits.

A selected group of 20 trees, each of the Valencia and Washington navel varieties receiving the normal commercial orchard management practice in plantings at Riverside, were used to provide experimental material. A sample of 20 fruit—one from each tree—was picked in the Valencia plot at two-week intervals starting on the 17th of February 1953 and continuing until the 14th of September 1953. Samplings were started on the 24th of September 1953 in the navel plot and continued until the 26th of March 1954. After harvest, the fruit sample was brought into the laboratory and determinations made of total soluble solids, total titratable acidity, pH—relative alkalinity-acidity—and cloud—a

turbidity primarily due to insoluble pectic materials—as well as quantitative determinations of the free amino acids.

A summary of the data obtained in this manner for the Valencia orange samples is given in the graph at the lower left. The curves show the changes occurring in the ratio of soluble solids to acid, of gamma-amino butyric acid to acid, and of cloud to acid. It is indicated that under the conditions of this experiment, only the soluble solids-to-acid ratio gives a relatively smooth progression of increase with the passage of time during the maturation of the fruit. While there is a tendency for a general increase in value to occur in the cloud-to-acid ratio, and to a lesser extent with the amino butyric acid-to-acid ratio, the variation from sample to sample tends to be as large as the over-all change during the development of the fruit. This variation is thought to be due, at least in part, to the effect of transient environmental conditions—such as day and night temperatures, light intensity, water supply—on the concentration of the materials measured in the juice. The free amino acids found in the juice showed fluctuations in concentrations

from one sample to the next, although in a few cases there might have been a tendency for a general trend in concentration change with maturation.

The changes in the three ratios for the juice of navel oranges are shown in the graph at the lower right. The same situation obtained with these fruit, the soluble solids-to-acid ratio, is the only one of the three which appears to provide consistent enough results to serve as a reproducible measure of maturity for these fruit.

From these studies it appears that the presently used ratio of soluble solids to titratable acidity is the best available index of maturity of oranges. This ratio has the advantage that it is readily obtainable with equipment possessed by most packing houses. Other equipment and a higher degree of technical skill are required for the determination of such factors as pH, cloud, and the concentration of free amino acids.

Study of the changes in composition of citrus fruits during maturation is continuing.

Randolph T. Wedding is Assistant Plant Physiologist, University of California, Riverside.

Raymond P. Horspool is Senior Laboratory Technician, University of California, Riverside.

Changes in the ratios of certain constituents of Valencia oranges—left below—and of Washington navel oranges—right below—during ripening of the fruit.

