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CHEMICAL AND PHYSICAL TESTS OF AVOCADO MATURITY

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The avocado maturity test that has been most widely used in Florida is to pick a few representative fruit and to allow them to soften. A very immature fruit will shrivel as it softens while mature fruits retain their form and attractive appearance. However, since the ultimate test of maturity should include the palatability of the ripened fruit as well as its appearance, the purpose of this investigation was to find an easily applied test that will give a reliable measure of the palatability.

This investigation* was done in cooperation with Dr. P. L. Harding of the Agricultural Marketing Service of the U. S. Department of Agriculture. Dr. Harding has been primarily concerned with establishing standards of palatability. His results to date are reported in the accompanying paper "The Relation of Maturity to Quality in Avocados." His palatability tests were run in Orlando on duplicates of samples used for oil content determination at Homestead.

In 1933 Stahl (1) made a rather thorough study of the chemical composition of Florida avocados. His work indicated that oil is the only chemical constituent that shows promise as a measure of maturity.

OIL CONTENT DETERMINATIONS

Since oil content is the only major chemical constituent of the avocado that changes appreciably as the fruit matures, an attempt was made to study all factors causing variability in oil content. It was hoped that oil content could be correlated with maturity, although it was recognized that the oil probably did not make important contributions to palatability. The method used for oil content determinations was an adaptation of the refractive index method used in California (2, 3). Instead of grinding the whole fruit, or a large portion of the fruit, small cylinders were taken by means of a cork borer. After removing the skin and seed coat, these cores were chopped in a small wooden bowl with a special chopper whose cutting edges consisted of five razor blades. When analyzing a composite of 10 fruit, it was only necessary to take one cylinder from each fruit.

Tests showed that there was no significant difference in oil content from the stem end to the blossom end. However, there were large variations from the skin to the seed. The highest oil content was generally in the yellowest part of the flesh. In some fruit the green part next to the skin had only half as much oil. If there was a white layer next to the seed coat, that was also low in oil. On account of these variations, it was believed to be easier to get representative samples from a small core than from the entire fruit. It would have been tedious to peel the entire fruit so as to avoid leaving some of the green

flesh. Direct comparisons of the use of whole fruit with the use of cores gave about 0.3% more oil when cores were used. That difference can be explained by the abnormally large proportion of the inner pulp contained in the cylindrical core. Since cores were used throughout this investigation, the difference is of no importance.

In testing hard fruits, the standard method was to mix the sample and Halowax oil with 200 ml. of water in a Waring Blendor until the pulp was disintegrated instead of using the shaking machine recommended in California. A portion of the mixture from the Waring Blendor was centrifuged in a 50 ml. conical bottom centrifuge tube and the water poured off the top of the tube. A stirring rod was used to make a hole in the pulp mat above the oil at the bottom of the tube and then the oil was poured out for a refractive index determination. A correction of 0.2% oil (accurate to about 0.1% on hard fruits) was added to the oil content determined in this way. The small amount of avocado oil dissolved in the water probably makes this correction necessary. When the fruits are soft, the correction is somewhat more than 0.2% so the shaking machine method was used for ripe fruits.

Most oil determinations were made on hard fruit within two days after picking. When the fruit softened, it generally increased a few tenths of a percent in oil content but the changes were quite inconsistent. Changes varying from a slight decrease to more than 1.0% increase were found.

In California, the oil content of the fruit has been found to be a satisfactory measure of maturity apparently because the varieties grown all have similar oil contents when mature. They can also make good estimates of the oil content of individual fruits by the appearance of the lenticels. This allows them to pick mature fruit selectively.

With Florida varieties, it has been impossible to estimate the oil content by the physical appearance of the fruit. In general, the oil content of Florida avocados increased about 1% in three weeks. The average oil content increased from about 3.5% on August 1 to 7.0% on November 1 and 10.0% on January 1. There was some difference between varieties; for example in October and November, Booth 8's generally had 1 or 2% less oil than Lulas; but these differences were less than the differences found between different fruits of the same variety.

The most disconcerting feature about oil content as a measure of maturity is the variation between individual fruits. In samples of 10 fruit of the same size from the same tree, the range of oil content averaged about 2.0% and was frequently as much as 3.0%. This is an unexplained random variation, since the sampling of tagged fruits showed as much as 3.0% difference in oil content between fruits of the same size that had been set at the same time within three feet of each other on the same tree. There also appeared to be a tendency for late-bloom fruit to mature as early as early-bloom fruit but the results on that point were inconclusive.

Statistical calculations showed that the mean of 10 values could be duplicated 95% of the time within about 0.5%. For example, a value of 6.0% would be significant within 5.5 to 6.5%. Therefore most measurements were made by using composites of 10 fruit.

A large number of comparisons between composites of large and small fruit with various mid-season varieties showed that 0.6% increase in oil content corresponded to 4

ounces increase in size.

Comparison of fruit from different trees of the same variety in the same grove showed apparent differences of more than 2.0% but there is some uncertainty about the significance of these figures. When comparing different groves, highly significant differences were sometimes found. Ten Lula trees in one block at the Sub-Tropical Experiment Station produced fruit on December 1, 1952 ranging from 10.0 to 12.6% oil, while fruit from 10 trees in another block ranged from 6.1 to 9.0%. Approximately the same difference was found the following year. Similar differences have been found between commercial groves, but attempts to correlate the results with cultural practices have been completely unsuccessful. There is some indication that the oil content is higher on fruit from small trees but there are exceptions to that rule.

Location in the area between South Miami and Homestead does not appear to be a factor, but some Lulas collected on October 21, 1953 at Lake Placid had 9.7% oil while the Lulas collected in Dade County at the same time ranged from 6.3 to 8.3%.

Numerous water and oil content determinations were made on individual fruits to get comparisons of oil content on the dry basis. The water content was found to be as variable as the oil content so comparisons of oil content on the dry basis were as inconsistent as on the "as received" basis. As an example of the values obtained, Booth 7's containing 6.6% oil were found to have water contents varying from 76 to 83%. When the oil content was higher, the water content was generally less.

There is no close correlation between oil content and the appearance of the fruit when it softens. Further investigation will be required to test the correlation of oil content with palatability. If it can be shown that there is a definite correlation between oil content and palatability of individual fruits, or if the fruit from groves with lower average oil content has a lower palatability, then oil content may be useful as an indication of maturity. If no such correlation can be found, then oil content should be entirely discarded as a measure of the maturity of Florida avocados.

PHYSICAL TESTS

A test that has been considered as a measure of maturity is the specific gravity of the whole fruit. This decreased from about 1.02 on a very immature avocado to as low as 0.90 on some varieties when mature. Attempts to tabulate these whole fruit specific gravities have given very erratic results, probably because of the variations in size of the seed cavity the low specific gravity is due to air between the cells of the fruit. When the air was removed by evacuation, the specific gravity was more than 1.0. Measuring the specific gravity of a section of pulp was not satisfactory since the pulp expanded when cut.

Pressure testing, such as is used with peaches and some other fruits showed very little difference between freshly picked avocados whether mature or immature.

CONCLUSIONS

At present, no physical or chemical test can be recommended as a measure of maturity for Florida avocados. The best maturity standard appears to be dates of picking which have been correlated with palatability and appearance of the ripened fruit.

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