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Dry Weight Method for Determination of Avocado Fruit Maturity

S. K. Lee and C. W. Coggins, Jr.

Postgraduate Research Plant Physiologist and Professor of Plant Physiology, Department of Botany and Plant Sciences, University of California, Riverside, respectively.

The minimum maturity standard for California avocados is 8% oil and the Halowax method is specified by state law (1). However, this method of oil determination presents some difficulties in accuracy, time, and expense (2). There is a very close relationship between the increase in percent oil and the increase in percent dry weight during avocado fruit development (3). If done properly, analysis of percent dry weight is so quick, accurate, and simple that analyses could be performed at home by most growers. Since dry weight is under consideration as the official avocado maturity standard for California, procedures used for dry weight determinations and results obtained in our 1981-82 dry weight/oil relationship studies are presented.

Apparatus

1. microwave oven
2. balance (sensitive to 0.01 g)
3. glass container
4. potato peeler

Procedures: All weights were recorded to the nearest 0.01 g.

1. The glass container was weighed and recorded (C).
2. The fruit was quartered longitudinally, and the seed, seedcoat, and peel were discarded.
3. The potato peeler was used to obtain slices of tissue from one cut surface, of each quarter.
4. Slices of tissue (approx. 10 g) were placed into the glass container.
5. The tissue, plus container, was weighed and recorded (F).
6. The container was placed in a microwave oven and the tissue was dried to a constant weight.
7. The container, plus dry tissue, was weighed and recorded (D).
8. Percent dry weight was calculated as shown:

$$\% \text{ dry weight} = \frac{D-C}{F-C} \times 100$$

C = weight of container

F = weight of fresh tissue plus container

D = weight of dry tissue plus container

We realize that some individuals who read this article will decide to obtain experience with dry weight determinations. While the procedure is simple, accurate results will not be obtained unless accurate weights for the container, the fresh tissue, and the dry tissue are obtained. This means that fresh and oven-dry tissue must be weighed rapidly and accurately. Fresh tissue will lose moisture to the air, and dry tissue will gain moisture from the air. The rate at which moisture will be lost or gained will depend, in large part, on the relative humidity of the air and on the surface-to-volume ratio of the avocado slices. Low humidity and high surface-to-volume ratios will increase water loss from the fresh tissue. High humidity and high surface-to-volume ratios will increase the rate at which moisture will accumulate in the oven-dry tissue. Likewise, accuracy will be lost if the tissue is heated so rapidly that it chars or if it is not heated sufficiently to remove all of the water.

The sensitivity of the balance influences the amount of fresh tissue needed. In our laboratory, we use a balance which accurately weighs 0.01 g. We use enough slices to give approx. 10 g of tissue. An alternative is to use a less sensitive balance and more tissue. For example, it would be appropriate to use many slices to give approx. 100 g if the balance has an accuracy of 0.1 g.

In addition to being able to use a less sensitive balance, it is possible to obtain accurate results by drying the tissue in a conventional oven set at 210 - 230°F. Drying time will depend on the actual temperature in the oven and the amount of tissue being dried. While drying in the microwave oven will occur in approx. 10 to 15 minutes, drying may require 5 hours in a conventional oven.

Because 8% oil is the existing legal standard, we determined the percent dry weight equivalent to 8% oil for five important cultivars from the major avocado-growing areas in California. Average percent dry weight at 8% oil varied from 18.8 to 20.0% for *Bacon*, from 18.4 to 19.6% for *Fuerte*, from 18.8 to 20.6% for *Hass*, from 18.5 to 19.6% for *Pinkerton*, and from 17.0 to 19.4% for *Zutano* fruit, depending on location.

In order to develop valid information regarding the relationship between dry weight and oil, studies were initiated relatively early in fruit development (prior to 4% oil) and were not terminated until oil content exceeded 12%. These data were then used to produce dry weight/oil regression equations which were used to generate the values shown in Table 1. These data showed that the average dry weight at 8% oil was 19.4% for *Bacon*, 19.1% for *Fuerte*, 19.8% for *Hass*, 18.9% for *Pinkerton*, and 18.4% for *Zutano* fruit. The overall average value for these five different cultivars was 19.1%.

During the past 5 years, we have examined the relationship between the acceptability of avocados, as determined by trained taste test panels, and oil content. On the average, the percent oil at acceptable taste was 8.7% for *Bacon*, 10.0% for *Fuerte*, 11.2% for

Hass, 9.0% for *Pinkerton*, and 10.3% for *Zutano* fruit. An examination of Table 1 shows that equivalent dry weight percentages are 20% for *Bacon*, 21% for *Fuerte*, 22.8% for *Hass*, 20% for *Pinkerton*, and 20.2% for *Zutano* fruit.

Although these studies show that 8% oil is too low with respect to taste, other marketing factors must be taken into consideration during discussions of the adequacy of 8% oil (or an equivalent dry weight value) as a minimum maturity standard. Another point that should be considered is simplicity of the standard.

Dry weight is a simple, accurate, and fast method currently under consideration as a new maturity standard for avocados in California. While we collected considerable data in 1981-82 regarding the correlation between % dry weight and % oil, additional data on these and other cultivars are needed before decisions are made regarding new standards. Such a study is currently under way.

Acknowledgements

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Literature Cited

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Table 1. Percent oil versus percent dry weight.

% Oil	% Dry Weight ^z					
	<u>Bacon</u>	<u>Fuerte</u>	<u>Hass</u>	<u>Pinkerton</u>	<u>Zutano</u>	<u>Mean</u>
4.00	15.85	15.27	15.86	14.81	15.12	15.38
4.25	16.07	15.50	16.10	15.07	15.32	15.61
4.50	16.29	15.74	16.35	15.33	15.53	15.85
4.75	16.51	15.98	16.59	15.59	15.73	16.08
5.00	16.73	16.21	16.83	15.84	15.93	16.31
5.25	16.95	16.45	17.08	16.10	16.13	16.54
5.50	17.17	16.69	17.32	16.36	16.33	16.77
5.75	17.39	16.92	17.56	16.62	16.53	17.00
6.00	17.61	17.16	17.81	16.87	16.74	17.24
6.25	17.82	17.40	18.05	17.13	16.94	17.47
6.50	18.04	17.63	18.29	17.39	17.14	17.70
6.75	18.26	17.87	18.54	17.64	17.34	17.93
7.00	18.48	18.11	18.78	17.90	17.54	18.16
7.25	18.70	18.34	19.02	18.16	17.74	18.39
7.50	18.92	18.58	19.27	18.42	17.94	18.63
7.75	19.14	18.82	19.51	18.67	18.15	18.86
8.00	19.36	19.05	19.75	18.93	18.35	19.09
8.25	19.58	19.29	20.00	19.19	18.55	19.32
8.50	19.80	19.53	20.24	19.45	18.75	19.55
8.75	20.02	19.76	20.48	19.70	18.95	19.78
9.00	20.24	20.00	20.73	19.96	19.15	20.02
9.25	20.46	20.24	20.97	20.22	19.36	20.25
9.50	20.68	20.47	21.21	20.47	19.56	20.48
9.75	20.89	20.71	21.46	20.73	19.76	20.71
10.00	21.11	20.95	21.70	20.99	19.96	20.94
10.25	21.33	21.18	21.94	21.25	20.16	21.17
10.50	21.55	21.42	22.19	21.50	20.36	21.41
10.75	21.77	21.66	22.43	21.76	20.56	21.64
11.00	21.99	21.89	22.67	22.02	20.77	21.87
11.25	22.21	22.13	22.92	22.28	20.97	22.10
11.50	22.43	22.37	23.16	22.53	21.17	22.33
11.75	22.65	22.60	23.40	22.79	21.37	22.56
12.00	22.87	22.84	23.65	23.05	21.57	22.79

^z Best fit regression lines were calculated for each location studied (5 for Bacon, 6 for Fuerte, 6 for Hass, 3 for Pinkerton, and 7 for Zutano). Each percent dry weight value reported above for each of the 5 cultivars is based on these best fit regression lines. Thus, for Bacon fruit at 4.00 percent oil, percent dry weights from the 5 regression lines were 15.82, 14.65, 17.00, 15.46, and 16.33 percent. The average is 15.85 and is reported. All other variety values were calculated in a like fashion. In the right-hand column, means of the tabular values are shown.