

Maturity and Picking Dates of Avocados Under Cyprus Conditions

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Introduction

Avocados unlike other fruits ripen only after they have been picked. The stage of maturity at harvest is very important because immature fruits will not ripen properly and will not attain an acceptable eating quality after harvest. To determine the best stage of maturity much work has been carried out in most avocado producing countries.

Oil content and picking dates have been the indices mostly studied in relation to avocado maturity and to sensory evaluation tests. In California the pioneering studies of Church and Chase (2) led to the first maturity regulation. According to the California Avocado Standard Bill the avocado fruit should have a minimum oil content of 8% by weight before being considered mature (1). Oil content as index of maturity is also used in Israel, Australia and other countries (3, 8). In Florida a comprehensive minimum picking date system is used whereby picking dates are assigned for each variety; this system was employed following the work of many researchers who showed that oil content could not be a satisfactory criterion under their conditions (4, 5, 7, 11). Young and Lee (11) in California also reported that an assigned picking date or growth rate would be much more reliable than oil content as an index of maturity.

Apart from oil content, fruit weight, fruit dry matter, fruit diameter, colour of seed coat, flesh appearance, soluble solids, and other physical and chemical properties were studied in assessing avocado maturity (6, 7, 8, 9, 10, 12, 13).

In Cyprus no work has been carried out on avocado maturity. Because of the importance of the time of harvest for the marketing of avocados, especially for export to Europe and the need to harvest fruits at the proper stage, work was conducted in order to determine the earliest picking dates for the most important avocado varieties grown in Cyprus. As reported in this paper, picking dates could be assigned based on oil content, days to ripening at 20°C and weight loss from harvest until softening.

Materials and Methods

Fruit source and sampling: Fruit were obtained from 9-year old trees (at the year of initiation of this work) of 'Fuerte', 'Ettinger', and 'Hass' varieties grafted on Mexican race rootstock at the government farm at Paphos (S. Western coast). To minimize variation, before the first picking, each season, an adequate number of uniform fruits were tagged on 20 trees per each variety. Picking started in August for 'Ettinger' and 'Fuerte' and in October for 'Hass' avocados and continued at weekly intervals. This work was repeated

3 consecutive years. Each sample consisted of 20 fruits of the initially tagged ones.

Studies for two consecutive years were also made on the maturity of 'Benik', 'Tova', 'Bacon', 'Arturo', 'Nabal', 'Maoz', 'Fugs', 'Horshim', 'Nachlat', 'Wurtz', 'Reed', 'Shomrat' and 'Lula' avocados. Fruits were obtained at random from trees, grown at the same farm at Paphos. Sample size and picking intervals were as above. Pickings started from August and continued through March, depending on variety.

After picking fruits were transferred to the laboratory of the Agricultural Research Institute at Nicosia for oil determinations, ripening, and other tests and observations.

Oil determinations: Ten fruits of each variety were used for oil determinations, employing the refractive index method developed in California (1). A cork borer 8mm diameter was used to make ten holes on each fruit from the surface of fruit till the seed. The green outer skin and seedcoats were removed. The cores were cut to 1mm and were passed through no. 20 sieve mesh. The sample was mixed and 2-3g. were taken for moisture determinations.

Five g. of the mixed sample were blended for 10 minutes with 5ml 1-chloronaphthalene and 200ml distilled water. After centrifugation of the sample the water was decanted. The precipitate was heated for some minutes until the yellow colour of the oil was apparent. The refractive index was measured at 25°C.

Chemical composition: Standard procedures were used for the mineral analysis, crude protein, dry matter, ash, and vitamin C (8). This analysis was done for two consecutive years during harvesting period for the 'Fuerte', 'Ettinger', and 'Hass' varieties.

Fruit ripening and assessment: Ten fruits of each sample were kept for ripening at 20° C. Fruits were inspected daily until they were soft-ripe and the number of days from picking to ripening were recorded. Records were also kept on fruit size, fruit weight, and weight loss. At softening palatability tests were made.

Results and Discussion

'Ettinger', 'Fuerte', and 'Hass' avocados

Oil content: Per cent oil content increased from August through December in 'Ettinger' and 'Fuerte' avocados and reached a maximum of 16% and 14% respectively (Figure 1a, 1b). Oil content in 'Hass' avocados increased from October and reached a maximum of 15% in February (Figure 1c). Although the trend in the increase of oil content during the sampling period was similar among the three seasons the absolute values varied from season to season. The bigger variation among seasons was found in 'Hass' avocados.

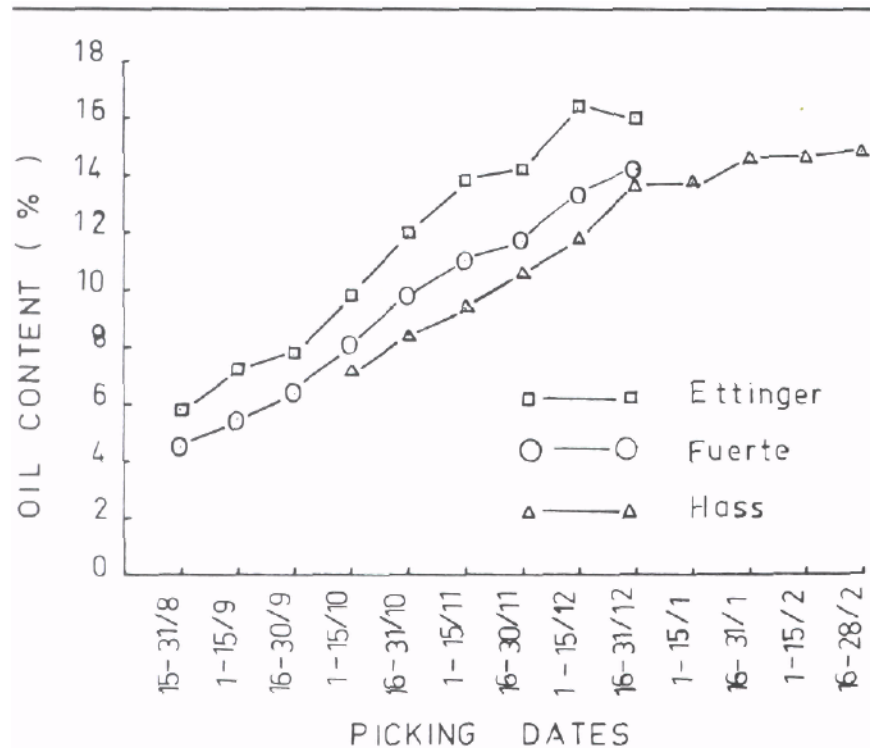


Figure 1. Oil content of 'Fuerte', 'Ettinger', and 'Hass' avocados at different picking dates. [Mean values for 3 consecutive years].

Days to ripening: In all varieties the number of days to ripening at 20°C decreased as the season advanced and oil content increased (Table 1). There was an inverse relationship between stage of maturity and days to ripening. In general fruit that required more than 10-11 days to ripen, was immature and resulted in a higher weight loss and shrinkage especially at the stem end.

Although the oil content of Ettinger fruits was higher than that of Fuerte, throughout the sampling period, Fuerte fruits matured earlier, i.e. at a lower oil content. 'Hass' avocados also ripened at a lower oil content than 'Ettinger'.

Weight loss during ripening: Weight losses ranged from 18% to 7% during the ripening period (Table 1). Fruit harvested immature had a higher rate of weight loss than mature fruit. As the oil content increased, weight loss decreased. It was shown that in all varieties mature fruits (which ripened normally) had an oil content of a higher nominal value than that of weight loss. Thus when the nominal value of weight loss was lower than that of the oil content, the fruit ripened normally at 20° C (Table 1) indicating that fruit was mature.

Picking dates. Palatability tests for all varieties showed that maturity at harvest (and ripening) was closely related to all factors studied (oil content, days to ripening, weight loss) but none of these factors could be singled out for determining the earliest picking date. From the data presented in Table 1 the following conclusions were drawn.

Table 1. Oil content, weight loss, and days to ripening of 'Ettinger', 'Fuerte', and 'Hass' avocados.

Date	Weight loss(%)			Oil content(%)			Days to ripen		
	1977	1978	1979	1977	1978	1979	1977	1978	1979
<u>ETTINGER</u>									
September 29	-	12.9	-	7.6	8.3	8.9	-	-	-
October 4	13.9	11.5	-	9.6	8.9	9.8	10.1	12.0	-
" 11	12.4	11.1	18.1	10.6	10.3	9.8	10.1	12.4	12.4
" 18	13.5	8.7	11.0	10.5	11.7	10.7	9.0	10.5	12.5
" 25	11.8	8.3	11.9	11.1	13.7	13.5	7.9	10.3	8.3
November 1	10.2	-	8.2	14.8	-	11.8	7.9	-	7.6
<u>FUERTE</u>									
September 29	12.8	12.8	17.3	6.6	8.3	6.1	11.5	10.3	12.4
October 4	9.5	11.5	11.5	7.6	9.5	6.8	9.4	9.4	11.6
" 11	9.3	11.1	11.4	7.7	9.1	8.1	8.5	9.3	9.4
" 18	8.7	8.7	8.9	7.9	9.1	8.3	8.1	9.5	10.9
" 25	7.6	8.3	9.0	10.1	11.2	9.6	7.2	8.6	10.3
November 1	8.0	-	7.0	10.3	-	9.0	7.5	-	7.6
<u>HASS</u>									
December 1	10.6	12.8	12.5	11.5	12.3	9.6	10.5	10.2	10.6
" 8	9.4	10.2	10.2	11.5	13.9	9.3	9.7	7.7	10.6
" 15	11.1	9.4	7.7	11.5	13.9	9.7	9.0	7.3	10.1
" 22	11.6	-	9.2	11.8	-	12.1	9.7	-	7.9
" 29	12.1	-	7.0	16.1	-	11.4	9.9	-	8.8
January 7	-	-	8.6	-	-	11.8	-	-	7.9

Table 2. Chemical composition of 'Fuerte', 'Ettinger', and 'Hass' avocados grown in Cyprus.

Variety	Oil Content %	Vitamin C mg/100g. f.w.	Per cent*					p.p.m.*						
			Dry matter	Ash	Protein	P	K	Ca	Fe	Zn	Cu	Mn	Na	Mg
Fuerte	8.31	4.68	24.27	1.68	9.94	0.193	2.71	253	15	19	14	4	496	684
Ettinger	10.42	5.00	25.41	2.69	8.41	0.150	2.19	290	13	17	11	4	879	673
Hass	11.49	12.57	25.60	2.11	8.97	0.182	2.47	351	13	16	11	9	473	645

* on a dry weight basis

'Ettinger': An oil content of more than 10% is required, and this is reached after the middle of October. Days to ripening were about 10 and weight loss less than 10 percent.

'Fuerte': This matures at least a week earlier than 'Ettinger'. Middle of October seems to be the safest picking date. At this date all criteria mentioned above were met, i.e. relation of oil content, weight loss, and days to ripening. Although fruits ripened to an acceptable quality at a lower oil content, a minimum oil content of 9% was found to be more adequate for picking.

'Hass': Fruit was mature during the first fortnight in December. Oil content for satisfactory ripening, meeting also the other two criteria (weight loss, days to ripening) varied from 9% to 13% (1979 and 1978 respectively).

Chemical composition: Data on vitamin C, dry matter, ash, protein, and elemental content are shown in Table 2. There were no significant differences in dry matter, ash, protein, P, K, Ca, Fe, Zn, Cu, and Mg content among 'Fuerte', 'Ettinger', and 'Hass' avocados. Vitamin C and Mn was double in Hass whereas Na was double in 'Ettinger' avocados.

Other varieties: Results obtained in 1983 and 1984 with the varieties 'Benik', 'Tova', 'Bacon', 'Arturo', 'Nabal', 'Maoz', 'Fugs', 'Horshim', 'Nachlat', 'Wurtz', 'Reed', 'Shomrat', and 'Lula' indicated that picking dates could be assigned using same criteria as in the case of 'Ettinger', 'Hass', and 'Fuerte' avocados. These dates together with minimum oil content suggested are shown in Table 3.

Table 3. Earliest dates and minimum oil content for picking of avocado varieties in Cyprus.

Variety	Earliest Picking Date	Minimum Oil Content %
Arturo	September - 3rd week	8.8
Bacon	October - 1st week	8.3
Fuerte	October - 2nd week	9.0
Ettinger	October - 3rd week	10.0
Tova	November - 1st week	9.2
Benik	November - 2nd week	8.0
Horshim	November - 4th week	9.2
Hass	December - 2nd week	9.0
Maoz	December - 3rd week	8.0
Fugs	December - 3rd week	8.0
Nachlat	December - 3rd week	8.8
Nabal	January - 1st week	8.5
Lula	January - 2nd week	8.6
Wurtz	February - 2nd week	9.5
Reed	March - 1st week	10.0
Shomrat	March - 3rd week	9.3

Summary

Work was conducted during 1977-1984 in order to determine the earliest picking dates for the avocado varieties grown in Cyprus. Picking dates selected were related to oil content, days to ripening at 20°C, and weight loss. 'Fuerte' fruits matured by the middle of October and minimum oil content for safe picking was 9%. 'Ettinger' fruits matured after the middle of October with an oil content above 10%. The fruit of 'Hass' variety was mature during the first fortnight of December but oil content was variable, with values ranged from 9% to 13%. For the above three varieties data on vitamin C, dry matter, ash, protein, and elemental content are given. Picking dates and oil content were also determined for the varieties Arturo, Bacon, Tova, Benik, Horshim, Maoz, Fugs, Nachlat, Nabal, Lula, Wurtz, Reed, and Shomrat.

This work has shown that, under Cyprus conditions, earliest safe picking dates could be assigned on the basis of oil content, days to ripening at 20°C, and weight loss in relation to oil content. All three factors seem to be interrelated.

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