

# Quality of Pistachio Nuts as Affected by Time of Harvest<sup>1</sup>

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**Abstract.** Kernel dry weight and crude fat accumulation, as well as shell dehiscence and change in shell color, all indicated that the nut of pistachio (*Pistacia vera* L.) is physiologically mature at the time the hull separates easily from the shell. Harvesting prior to or after that critical point resulted in undeveloped kernels or in stained and unattractive shells, respectively. The data indicate that nuts of highest quality may be obtained by harvesting within a period of about one week.

The bulk of imported pistachio nuts is dyed red, as part of their processing, to conceal stained or otherwise unattractive shells. The dehulling procedure in California for domestically grown pistachios results in shells with little or no staining, and not necessarily requiring dyeing if harvesting is done at the proper time. Most pistachios produced in California, consequently, will reach the consumer in the "natural" or undyed state.

Maturity of pistachio nuts is manifest by a change in the skin (epicarp) from translucent to opaque, and a softening and loosening of the hull (epicarp and mesocarp) from the shell (endocarp). The nuts normally do not abscise from the trees at that time, but gradual drying and shriveling of the hulls occurs for several weeks. Thus, the time period during which pistachios of a single cultivar might be harvested is a month or more. The objective of the study reported here, however, was to determine the precise time at which pistachios should be harvested to ensure highest quality.

## Materials and Methods

Five 15-year-old trees of 'Kerman' growing at the Wolfskill Experimental Orchards, Winters, Ca, were used as a source of nut samples. Nut harvesting in the past generally has been at the time the hulls separated easily from the shells. This has occurred between the 4th and 14th of Sept. in each of the past 9 years. It was decided arbitrarily to harvest samples during a 2-month period, if possible, to determine changes in quality that might occur. Consequently, beginning on August 8 and continuing each week through Oct. 3, 1977, about 2 kg of nuts were picked at random from each of the 5 trees, and combined. Two random samples of 200 nuts each were used to determine the percentage with dehisced hulls, shriveled hulls, or both. An occasional 3rd determination was made when the percentages of the first 2 were not in close agreement. The nuts were then dehulled in a mechanical, abrasive-type vegetable peeler. After removing and discarding all blank nuts (easily detected by their white undehisced shells), the samples were dried to constant weight in a forced-draft dehydrator at 65°C.

Two 100-nut samples representing each harvest date were used to quantify quality factors such as weight, shell color, discoloration, and dehiscence. The degree of shell dehiscence is an important quality factor, as most pistachios are marketed in the shell. Dehisced shells are easily removed with the fingers of the consumer.

Crude fat determinations were made on duplicate 2-g samples of finely ground kernels of each harvest date. The samples were extracted for 16 hr with anhydrous ether in a fat extractor (manufactured by Laboratory Construction Company, Kansas City).

## Results

Dry wt per nut progressively increased each week to a

maximum of 1.46 g on Sept. 12, and generally remained at that level for the duration of sampling (Fig. 1). Since lignification of the shell had been completed at least 1 month prior to the first sampling, no dry weight changes occurred in that component throughout the experimental period. It was the progressive increase in dry wt to 0.70 g per kernel on Sept. 12, therefore, that was responsible for the increase in nut weight. Much of the increase in kernel weight was attributable to increase in crude fat. That component constituted 42.1% of kernel dry wt on Aug. 8, and progressively increased to 46.8% on Sept. 5, where it remained constant for the duration of sampling. Many kernels from nuts harvested prior to Sept. 5 were shriveled and undeveloped in appearance. Pellicle color of the kernel at the point of attachment to the funiculus was intensely bright magenta on Sept. 5 and 12. The color in this area progressively faded at each sampling date and became tinged with brown.

Easy separation of hulls from shells occurred in 26.3% of the nuts in the Aug. 22 sample (Table 1). Hull dehiscence had taken place in all nuts by Sept. 12 and 11.1% had begun to shrivel. The hulls of all nuts were considerably desiccated by the last sampling on Oct. 3.

The percentage of nuts with dehisced shells progressively increased from 30.3% at first sampling to 85.3% on Sept. 12, and remained constant thereafter (Table 1). About 15% of the shells failed to dehisce in 1977, the highest percentage in the past 3 years.

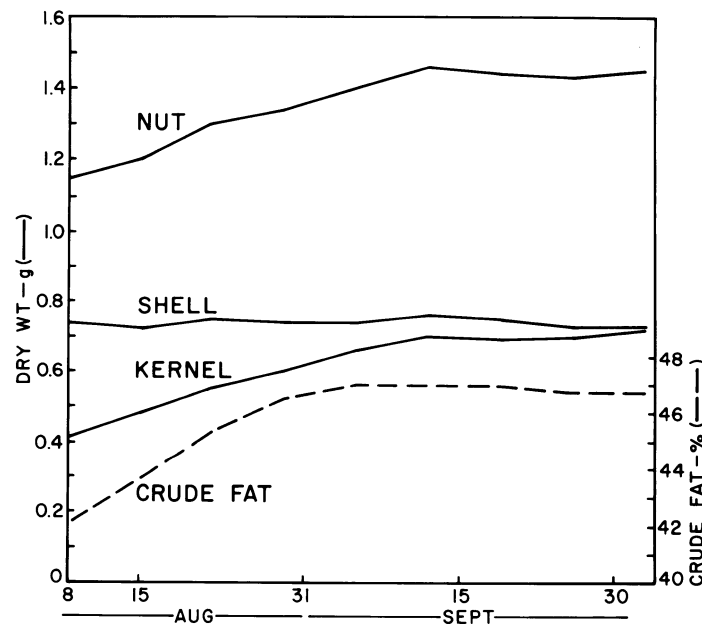


Fig. 1. Dry wt accumulation of shell, kernel, and whole pistachio nut (shell and kernel) and % crude fat of dry wt of kernel.

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Table 1. Pistachio hull and shell development associated with time of harvest.

Date of harvest	Nuts with		Shell color		Shells with stains	
	Dehisced hulls <sup>z</sup>	Dehisced shells	Green	Ivory	%	Degree <sup>y</sup>
	(%)	(%)	(%)	(%)		
Aug. 8	0	30.3	86.3	13.7	—	—
15	0	48.1	65.5	34.5	—	—
22	26.3	58.6	22.3	77.7	—	—
29	42.5	71.4	13.6	86.4	4.8	1
Sept. 5	88.1	84.5	2.1	97.9	16.3	1
12	100 (11.1% shriveled)	85.3	0	100	30.0	1
19	100 (43.3% shriveled)	84.7	0	100	36.7	2
26	100 (79.0% shriveled)	85.0	0	100	52.8	3
Oct. 3	100 (100% shriveled)	84.3	0	100	63.4	3

<sup>z</sup>Hulls that separated easily from the shells but not necessarily split open.

<sup>y</sup>Rated 1 (light), 2 (moderate), 3 (severe).

Nuts containing green pigments (presumably chlorophylls) in their shells progressively decreased from 86.3% on Aug. 8 to 0 on Sept. 12 (Table 1). Consequently, nuts with shells in which the chlorophylls had disappeared and were ivory colored after drying, progressively increased from 13.7% on Aug. 8 to 100% on Sept. 12.

A few nuts with light shell stains, primarily at their basal ends, were noted as early as the Aug. 29 sampling (Table 1). Although 30% of the nuts harvested on Sept. 12 had shells with stains, the degree of staining did not exceed the rating of "light." The percentage of nuts with stained shells progressively increased with each successive harvest, and the degree of staining also progressed from light to severe. More than half of the nuts harvested on Sept. 26 had severe shell stains.

## Discussion

Changes in each of the parameters thought to contribute to quality indicated that physiological maturity of the pistachio nut occurs at the time the hull separates easily from the shell. Dry wt and crude fat accumulation reached maximum values at that time. Also, shell dehiscence was maximum and the chlorophylls had disappeared. Harvesting before or after that critical period resulted in inferior nut quality. Harvesting prior to that time resulted in shriveled kernels that were deficient in dry wt, while harvesting afterward resulted in stained, unattractive shells. The data clearly indicate that to obtain highest nut quality, harvesting should be done as near as possible to the time at which the hulls separate from the shells.

Staining of the shell initially occurred at the basal end of the nut, around the point of attachment to the receptacle, and proceeded in time along the ventral side. As the stained areas did not deeply penetrate the shell, presumably the materials responsible (tannins etc.) were leached from adjacent ruptured cells of the hulls. Translocation of substances from hull to kernel, however, apparently occurs in the eastern black walnut (*Juglans nigra* L.) for both color and flavor of kernels were adversely affected by delaying hull removal (1).

The data regarding hull and shell dehiscence and shell color, indicate that there was a 4 to 5 week difference in physiological development among nuts of a given sample. For example, the hulls of some nuts dehisced during the week of Aug. 15 through 22, while others did not dehisce until sometime between Sept. 5 and 12. This indicates that pollination and fertilization may have occurred over an approximate period of 4 weeks or more. Spring of 1977 was unusually cool, and the period of bloom may have been relatively long. It is possible, therefore, that under different environmental conditions, more uniform development might occur which would result in a greater proportion of the nuts being in the physiological state that yields highest quality at the critical time of harvest.

## Literature Cited

1. Chase, S. B. 1942. The influence of delayed hulling on the color and quality of eastern black walnut kernels. *Proc. Amer. Soc. Hort. Sci.* 41:131-135.