

## Extension Toolkit Notes

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ROP GRAPE Project funded by USAID administered by Chemonics International

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# Grape Berry Morphology and Dehydration (Raisining)

Notes Compiled from—

Christensen, L.P. 2000. Raisin production manual. Publication 3393. Univ. California, Agric. & Nat. Resources—Communication Services, Oakland, CA

Galet, P. 2000. General viticulture. English edition. Oenoplurimedia, Chaintré, France.

A cluster consists of a:

- peduncle (stalk) , which attaches the cluster to the shoot at a node position.
- rachis (stem system). The degree of branching and the length of the rachis vary. The final branches are the pedicels to which the berries are attached at the receptacle.

Berries are fed by vascular bundles in the pedicel that enter the berry as a group known as the axial vascular strand. They spread out just under the skin to form a peripheral vascular network. Two bundles from the central strand nourish the seed. If one removes a berry from the pedicel the vascular strand breaks off and leaves a brush on top of the receptacle.

Berry size can be described by categories.

Berry size			
Category	Diameter (mm)	Volume (ml)	100-Berry Weight (g)
1. Very Small	< 8	< 30	< 35
2. Small	8 – 12	31 - 100	36 – 110
3. Medium	13 – 18	101 – 300	111 – 330
4. Large	19 – 24	301 – 650	331 – 700
5. Very Large	>24	> 650	> 700

Category 1: berries of wild species; Categories 2 & 3: most wine grape varieties; Categories 4 and 5: most table grape varieties.

Berry anatomy.

The organs of a berry in cross-sectional view and arranged from outside to inside are:

- epicarp (external layer), which contains the skin
- mesocarp (middle layer), which forms the pulp and becomes the largest portion of the berry by volume

- endocarp (internal layer), which forms an inner wall between the pulp and seeds.
- Vascular bundles, which supply water and nutrients to the berry
- Seeds, located at the berry's center.

The grape skin is composed of the cuticle, the epidermis, and the hypodermis.

- Cuticle: continuous membrane of uniform thickness. It is covered with a fine, loose, waxy dust that comes off easily known as cuticular wax or bloom. The bloom is a highly prized attribute that gives berries an attractive appearance. It consists of partially overlapping flat wax platelets that are hydrophobic and help maintain the berries water content.
- Epidermis: a single layer of short regularly shaped cells.
- Hypodermis: consists of two series of cells. The first is 8 to 10 rows of pentagon- and hexagon-shaped cells. The second series of cells have much thinner membranes and swell up to five or six times their original diameter.

The pulp consists of 8 to 10 layers of cells that increase in size radially and become very large. At ripeness the cells gelatinize and are able to give up most of their juice under slight pressure or squeezing action. The cells contain large amounts of sugars and organic acids.

The vascular bundles are of three types: surface bundles, central bundles, and seed nursing bundles. Surface bundles extend along the surface of the berry just under the skin. Central bundles extend down into the pulp in a single group. Seed nursing bundles split off of the central bundles and attach to the seeds.

### Berry Dehydration

**Drying Process.** During drying, water in the grape berry moves through the cells to the cuticle. It must then pass as vapor through the wax platelets and escape from the outside surface. The berry's rate of water loss is governed by the rate of transfer at its surface. High berry temperature and low relative humidity increase the evaporative rate from the berry. High air temperature and rapid air movement lower relative humidity. Berry temperature is the most important factor in field drying.

Physical characteristics of the grapes also affect length of drying time. Larger berries and thicker skins increase drying time. Some varieties can take four times longer than other varieties to dry (24 – 30 days vs. 7 to 10 days).

**Drying Aids.** Drying aids can increase the drying rate two- or three-fold. Berries can be sprayed with a solution that is 1.25% (by weight) potassium carbonate and 1% (by volume) ethyl oleate. The ethyl oleate changes the primary structure of the waxy platelets pushing them apart and helping to establish a water conductivity link. Olive oil is often used in place of ethyl oleate in Turkey and Greece because of its great availability and similar properties due to high concentrations of oleates. The potassium carbonate neutralizes acids and is a necessary component of the drying aid.

Color Changes during Drying. Browning is caused by enzymatic and non-enzymatic reactions initiated through cell dehydration. The brown color results from the production of brown-black melanin pigments by the enzyme polyphenol oxidase (PPO). Browning begins at the skin and seed traces, where PPO is concentrated, and progresses throughout the pulp. Non-enzymatic browning is a much slower process caused by a reaction of sugars with protein.

Browning is increased with higher temperatures and slower drying. Rapid drying at cooler temperatures concentrates sugars that inhibit PPO activity and tends to maintain cellular integrity. Drying in the dark tends to maintain chlorophyll concentrations in the grape and gives raisins a green color.

Sulfur dioxide use. Sulfur dioxide is a reducing agent that prevents the enzymatic conversion of the phenolic compounds responsible for browning. It is used to produce light colored raisins.

Raisin sugaring. Sugaring is a physical-chemical disorder that occurs during prolonged storage. It appears as a white to yellowish-brown crystalline material (mostly fructose and glucose) on the raisin surface. It detracts from the attractiveness of a raisin's appearance and eating quality (the raisins will have a gritty texture to them). Fluctuating storage conditions—such as temperature and humidity—excessive handling, and high moisture content are thought to be causative factors of sugaring.

Understanding the processes involved to produce good quality raisins is necessary if one wants to improve the quality of raisin production. Extension agents should always base their recommendations to farmers on sound scientific reasoning and knowledge. Helping a farmer to produce better quality raisins starts with learning what takes place during the process.