

# Inside Wine: Tannins

## These naturally occurring compounds are fundamental to red-wine production

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Tannins have no smell or flavor, but they constitute a basic building block of red wines, contributing much to texture, balance and aging potential.

The tannin profile of a wine depends on a number of factors, including the grape variety, growing season and winemaker's decisions. If a wine, such as Beaujolais Nouveau, is meant for early consumption, it should have little tannin, while more powerful bottlings, such as Barolo and Shiraz, contain much more.

Tannins in wine are compounds that interact with and precipitate salivary proteins. When present in sufficient quantities in a wine, grape tannins cause a sensation of astringency in the mouth. Tannin levels in wines vary significantly. In California, Cabernet Sauvignon is the most tannic major varietal up to about 1,500 milligrams of tannins per liter (mg/l) with high-quality Napa Cabernet among the most tannic wines. California Pinot Noir has from 300 to 990 mg/l, with an average of about 340 mg/l, about half Cabernet's average. A Beaujolais Nouveau might have as little as 30 mg/l, whereas a top Australian Shiraz usually has a bit less than the finest Napa Cabernets; the Penfolds South Australia Grange 1998, for example, had 870 mg/l. White wines contain very low levels of grape tannins (if they contain any at all), though fermentation and aging in new barrels might impart trace amounts of oak tannins.

But the quantity of tannins that are present in a wine says only so much, because different wines with identical tannin levels may not taste equally tannic. Many factors influence tannin perception, such as residual sugar, pH, acidity and saliva levels. Lower acidity makes tannins seem less harsh, so wines made from riper grapes have a softer mouthfeel.

In bottled wine, tannins react with oxygen, thereby protecting the delicate fruity compounds against the destructive effects of oxidation. In the mouth, tannins create a drying sensation. The intensity of the sensation of astringency produced by tannins depends on both their quantity and chemical structure.

Tannins are located primarily in the skins and seeds (stems also contain tannins, but most red grapes are destemmed before fermentation). A large part of red-wine making involves an attempt to control tannin quantity and quality, making it essential to assess tannin maturity accurately as harvest approaches.

In general, producers employ two methods to measure tannin levels: sensory evaluation and lab tests.

Sensory evaluation is the most basic approach. "We're looking for velvety tannins in the skin and seeds," explains Stephen Henschke, winemaker at Henschke, based in Australia's Eden Valley. "There's definitely a progression. It goes from green, chewy and bitter to much softer — first chalky, then velvety as they ripen."

When winemakers "taste" for tannin ripeness, their focus is on texture, because tannins have no flavor. Sugar in red varieties presents some perception difficulties since it reduces one's ability to perceive astringency. "For me, it's difficult to judge just by tasting the grapes," says Jean-René Matignon, technical director at Château Pichon-Longueville-Baron, in Bordeaux's Pauillac region.

Matignon looks for tip-offs that signal tannin maturity, particularly dark skin color and ripe fruit flavors. At Pichon-Longueville-Baron, skin-color development is monitored with optical density tests. Cabernet Sauvignon is usually picked about 15 days after attaining maximum color; Merlot gets picked about five days after the color peaks.

Still, many winemakers prefer old-fashioned methods. "I chew the grape, looking for greenness and harsh tannins," says Laurie Hook, winemaker at Beringer Vineyards, based in St. Helena. "I then spit it out and mush it on my fingers to judge color. If the grape is not so ripe, the juice won't be very dark."

There are other useful visual clues, particularly seed color. As seeds ripen, they turn from green to brown. Seeds have a layer of cells on the outside that contains significant quantities of harsh tannins. As seeds darken, those tough tannins become less extractable during crushing, fermentation and pressing.

Ultimately, there is no fixed method for judging ideal tannin ripeness, because "ideal" ripeness varies with grape type, vineyard and growing season. Vine age, for example, is a major factor. The oldest vines used in the Henschke Hill of Grace Shiraz date to 1860, while the youngest are from 1989. Tannins in the young-vine fruit never achieve the suppleness found in fruit from old vines, regardless of how long the harvest is delayed. So Henschke's notion of "ideal" depends on which vine block he is assessing.

Vintners and researchers often measure tannin levels in fermenting and finished wines as well. Knowing tannin quantities helps vintners make judicious decisions during fermentation; unusually tannic grapes, for example, may require gentler extraction methods.

Appropriate tannin extraction is crucial to red-wine making. Producers rely on a variety of methods to regulate tannin levels. All things being equal, fermenting at higher temperatures extracts more tannins. Traditional techniques such as punching down the cap of skins and seeds into the fermenting juice (*pigeage*) and pumping juice over the cap (*remontage*) further facilitate extraction of tannin, color and flavor.

Length of maceration time is key. Tannins are alcohol-soluble, so as fermentation advances and alcohol levels climb, more tannins are extracted. In some cases, tannin levels become excessive if wines are fermented to dryness on the skins and seeds. John Alban, winemaker at Alban Vineyards in Edna Valley, usually presses his Syrah with about one-fourth of the sugar unfermented. "If we waited for dryness, the wines would be too coarse," he explains. Other vintners leave wine on the skins after fermentation stops — a technique known as postfermentation maceration — in order to achieve more

tannin extraction.

Barrel-aging also impacts tannin levels. For one thing, new oak leaches out a small amount of tannins into an aging wine. Even more significant, barrels are semipermeable to air, which promotes gradual oxygenation. High-end Napa Cabernet Sauvignons and Bordeaux, for example, may spend from 18 to 28 months in barrel, during which time oxygen reacts with tannins and softens them. A vintner's sense of tannin development in barrel is one of the main factors that determines when a wine should be bottled.

The finest red wines develop elegance and complexity while in the bottle. Tannins make long-term aging possible because they are a defense against oxidation. Some oxygen inevitably reaches wine in bottle, but tannins react with it and mitigate oxygen's typically harmful effects on wine. If tannin levels are inadequate and oxygen reacts with ethanol, it forms acetaldehyde, the compound that produces a flat, stale aroma.

Relatively little is known about the long-term evolution of tannins in bottle. Researchers at the University of California, Davis, found no measurable reduction in the tannin level of a Napa Cabernet tested at bottling and then three years later; no data has been published from longer-term experiments. But researchers believe that tannins bind with color pigments; those tannin-pigment polymers are less reactive with salivary proteins, so they feel less astringent, explaining why maturity brings added silkiness and mellowness to top-tier reds. (Color changes in maturing red wines occur not because of diminishing tannin levels but because of chemical changes in color compounds.)

Producers devote such efforts in the vineyard and the winery to maximizing tannin quality because it is fundamental to red wine quality. Tannins contribute to mouthfeel and texture, like the support structures of a building. If a red wine has loads of fruit and alcohol, but inadequate tannins, it will lack focus and definition. Indeed, most winemakers attribute much of the improvement in red wine over the past few years to better tannins. "I'm just much more aware of tannins now than I was 10 or 20 years ago, and how to manage the tannins in the vineyard," says Henschke.