



## Polyphenolic profiles detected in the ripe berries of *Vitis vinifera* germplasm

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**Background.** Polyphenolics are a diverse class of compounds present in grapes and wine. They contribute to sensory attributes such as color, mouthfeel, bitterness and astringency and include familiar compounds such as tannins, resveratrol and anthocyanins. In addition, many polyphenolics have been shown to have positive effects on human health, including anti-inflammatory and antioxidant activity. Although external factors such as viticultural practices and weather may affect their levels, genetic differences between varieties are expected to be of greater magnitude. Our goal was to quantify the levels of polyphenolics in a diverse collection table and wine grape cultivars (*V. vinifera*) to assess the full range of variation in polyphenolic compounds in grapes.

**Experimental design.** Ripe berries were sampled from 344 *V. vinifera* cultivars at the

USDA-ARS Vitis Clonal Repository in Davis, California, in 2008 and 2009. The samples included old and new cultivars and many well known table and wine grape cultivars from around the world. Berry color (green-yellow, pink, red, dark red-violet, blue-black or red-black) was scored. Berries were frozen and polyphenols extracted and analyzed using High Performance Liquid Chromatography (HPLC) to quantify 36 individual polyphenols.

**Results.** Colored grapes and wine grapes were higher in total polyphenolic content than green-yellow grapes because of the anthocyanins in their skins. Within colored grapes, darker color was associated with higher total polyphenolic content. Cultivars Royalty (United States, Corbeau (Italy), and Dornfelder (Germany) had the highest total polyphenol content, and several had twice the level of polyphenols found in Cabernet sauvignon and Pinot noir.



Figure 1. The USDA-ARS National Clonal Germplasm Repository in Davis, California, has over 3,000 types of wild and cultivated grapes (photo courtesy of the USDA-ARS Image Gallery).

As expected, anthocyanins were found primarily in colored cultivars. The average total content of anthocyanins in colored table grapes was significantly lower than that in colored wine grapes. Cultivars Dornfelder, Royalty, Corbeau had the highest levels of anthocyanins.

Flavanols—also known as flavan-3-ols—are the building blocks of tannins. On average, they were higher in wine grapes than in table grapes. U.S. variety Royalty, Portuguese variety Jampal, and Pirobelle (origin unknown) had the highest levels of flavanols.

Flavonols are important cofactors for color enhancement. Wine grapes had higher levels of these compounds than did table grapes. The cultivars with the highest flavonol levels were Touriga, Dornfelder, Mathilde, and Royalty.

Phenolic acids, such as hydroxybenzoic and hydroxycinnamic acids, contribute to bitterness and astringency. While they were present at lower levels than the other classes of polyphenolics in colored cultivars, they were a significant component of polyphenols in non-colored or green-yellow cultivars. Cultivars Rofar Vidor, Plavac Mali, Melon, and Touriga had highest levels of phenolic acids.

Resveratrol, which has been credited with human health benefits, was highest in table grape cultivars Coudsi and Rofar Vidor and French wine grape cultivars Corbeau and Corbu Blanc. In contrast, most well-known table and wine grapes including Thompson Seedless, Pinot noir and Chardonnay had much lower resveratrol levels. The level of resveratrol in Corbeau was almost 26 times the level in Pinot noir.

### **Conclusions:**

- Darker colored fruit has higher levels of anthocyanins and therefore also higher levels of total polyphenols
- Wine grapes, in general, had higher levels of total polyphenolic compounds than table grapes
- Individual cultivars with the highest levels of polyphenols could be used in breeding for polyphenol-enhanced wine and table grapes
- This data will be included in a database of nutrition- and health-related metabolites for *Vitis* species to accelerate the progress of gene discovery and breeding for fruit chemistry in grapevines

**The bottom line:** This survey illustrates the richness in polyphenolic compounds in *V. vinifera*, and the results can be used in breeding to improve phenolic traits in grapes.