

# Comparison of blackberry polyphenols from blackberries grown in Virginia and the Pacific Northwest

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## Introduction

In recent years, there has been a growing trend toward healthier eating patterns, with consumers increasingly seeking natural or organic foods. Within this context, berries are among the most widely consumed fruits worldwide, largely due to their versatility. They can be consumed as fresh or frozen whole fruit, as well as in processed products such as yogurts, jams, and beverages (Moreno-Medina et al., 2022). They have gained increasing attention due to their potential health benefits, largely attributed to their high polyphenol content. Polyphenols are secondary plant metabolites that function as defense compounds against environmental stressors and predators. When regularly consumed, they may confer health benefits in humans and have been associated with the prevention of chronic diseases through their antioxidant and anti-inflammatory properties (Cladis et al., 2020).

Blackberries have attracted considerable interest due to their high polyphenol content, particularly anthocyanins, which are responsible for their characteristic purple-black color. They are especially rich in cyanidin-3-glucoside, a compound known for its strong antioxidant activity and potential health benefits, including associations with reduced risk of certain cancers, improved urinary tract health, enhanced cognitive function, and healthy aging. (Nile & Park, 2013; Subbiah et al., 2020)

The objective was to compare total phenolic content (TPC), total monomeric anthocyanins (TMA) in blackberry cultivars from Oregon and Virginia harvested in 2025, in order to evaluate the influence of cultivar and growing location on phenolic composition.

## **Methodology**

Blackberries were grown in Oregon and Virginia. In Oregon, 15 cultivars were cultivated and harvested at Oregon State University's North Willamette Valley Research and Extension Center (OSU-NWREC; Aurora, OR). In Virginia, 14 cultivars were collected from local farms across the state and the Hampton Roads AREC. Notably, five cultivars were common to both locations, enabling direct comparison between growing regions

Samples were freeze dried, powdered, and stored at -80 °C until analysis. Polyphenol extraction was done with an acidified aqueous methanol solution; total polyphenol content (TPC) was determined using the Folin–Ciocalteu method, and total monomeric anthocyanins (TMA) were quantified using a pH differential assay.

Data was analyzed using one-way ANOVA to evaluate differences in blackberry polyphenol content among cultivars within each location and between locations for cultivars present in both regions.

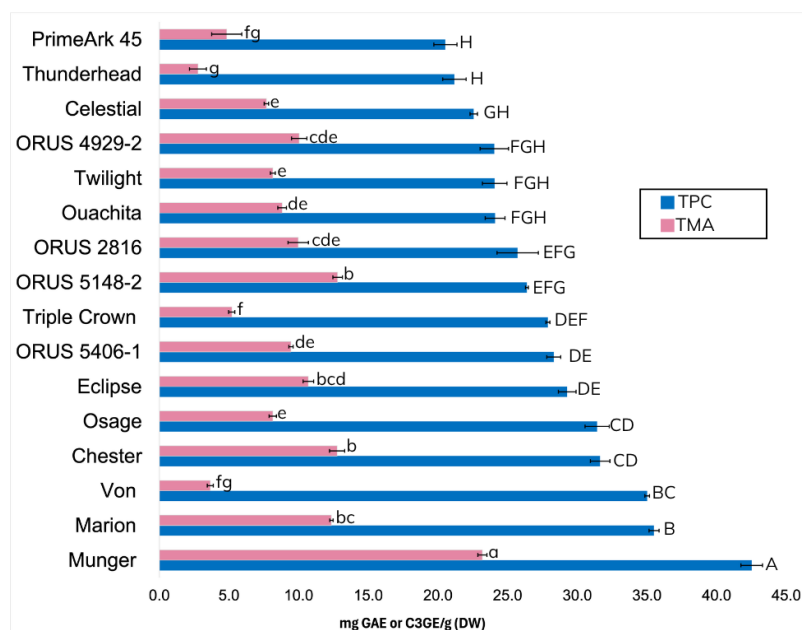
## **Results**

In Oregon-grown blackberries, (TPC) ranged from 20 to 35 mg GAE/g DW, while total anthocyanin content ranged from 2 to 12 mg C3G/g DW (Figure 1). 'Munger' exhibited higher values, with a TPC of 42 mg GAE/g DW and total anthocyanins of 23 mg C3G/g DW. However, it is important to note that 'Munger' is a black raspberry rather than a blackberry, and black raspberries are reported to have higher levels of phenolics and anthocyanins in the literature.

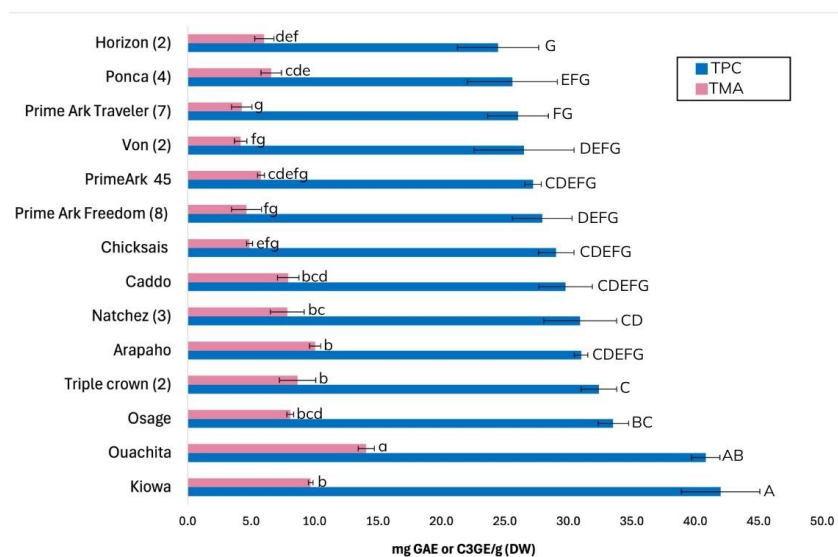
Compared to historical data from Oregon-grown blackberries (2002–2003), which reported higher TPC ranges, the values observed in this study are lower (Connor et al., 2005; Siriwoharn et al., 2004). These differences may be attributed to variations in environmental conditions over time, differences in analytical methodologies, and the use of moisture-based estimations (e.g., 88% moisture) in previous studies.

In Virginia-grown blackberries (Figure 2), total phenolic content (TPC) ranged from 20 to 42 mg GAE/g DW, while total monomeric anthocyanin content (TMA) ranged from 3 to 14 mg C3G/g DW. 'Kiowa' exhibited the highest TPC, whereas 'Ouachita' showed the highest anthocyanin content. It is important to note that multiple samples were analyzed for some cultivars, which may contribute to variability in the results. Overall, values from the 2025 Virginia harvest were

consistent with those observed in 2023 and 2024, where total phenolic content ranged from 13 to 39 mg GAE/g DW and total monomeric anthocyanins ranged from 4 to 29 mg C3G/g DW (unpublished data).



**Figure 1.** Total phenolic content (TPC) and total anthocyanin content (TMA) of Oregon-grown blackberries. Uppercase letters indicate significant differences in TPC, while lowercase letters indicate significant differences in TMA. Differences were determined by one-way ANOVA followed by Tukey’s test ( $p < 0.05$ ).



**Figure 2.** Total phenolic content (TPC) and total anthocyanin content (TMA) of Virginia-grown blackberries. Uppercase letters indicate significant differences in TPC, while lowercase letters indicate significant differences in TMA. Differences were determined by one-way ANOVA followed by Tukey’s test ( $p < 0.05$ ).

As shown in the figures, TPC and TMA were not correlated, suggesting independent accumulation patterns between phenolic compounds and anthocyanins.

When comparing the same cultivars grown in different regions, notable differences were observed. For total phenolic content (Table 1), ‘Ouachita’, ‘Triple Crown’, and ‘Prime-Ark 45’ grown in Virginia exhibited significantly higher values than those grown in Oregon. In contrast, ‘Von’ grown in Oregon showed significantly higher phenolic content than its Virginia counterpart, while ‘Osage’ showed no significant differences between locations. For TMA (Table 2), only ‘Ouachita’ and ‘Triple Crown’ grown in Virginia exhibited significantly higher anthocyanin levels compared to those grown in Oregon.

**Table 1.** Total phenolic content on same cultivar grown in Oregon and Virginia

Cultivar	Oregon	Virginia
Ouachita	24.1 ± 1.2	40.8 ± 1.2*
Triple Crown	27.9 ± 1.5	32.4 ± 1.4*
Osage	31.4 ± 2.6	33.5 ± 1.2
Von	35.1 ± 1.5*	26.5 ± 4.3
PrimeArk 45	20.5 ± 1.2	27.2 ± 0.6*

(\*) Indicates significant differences between Oregon and Virginia for the same cultivar (one-way ANOVA with Tukey’s test,  $p < 0.05$ ). Results are expressed as mg GAE/g dry weight (DW).

**Table 2.** Total monomeric anthocyanin content on same cultivar grown in Oregon and Virginia

Cultivar	Oregon	Virginia
Ouachita	8.8 ± 0.9	14.1 ± 0.6*
Triple Crown	5.2 ± 0.4	8.7 ± 1.7*
Osage	8.1 ± 1.3	8.1 ± 0.3
Von	3.6 ± 0.3	4.2 ± 0.1
PrimeArk 45	4.8 ± 0.5	5.7 ± 0.3

(\*) Indicates significant differences between Oregon and Virginia for the same cultivar (one-way ANOVA with Tukey’s test,  $p < 0.05$ ). Results are expressed as mg C3GE/g dry weight (DW).

When comparing cultivars across locations, we observed that some showed higher phenolic content in Virginia, while others performed better in Oregon. This suggests that certain cultivars are more sensitive to environmental conditions, while others appear to be more stable across different growing environments

In conclusion, both total polyphenol and anthocyanin content in blackberries are influenced by genetic factors as well as environmental conditions and agricultural practices. Factors such as fertilization, irrigation, and overall cultivation conditions can significantly affect the accumulation of these compounds.

Additionally, the lack of correlation between phenolic and anthocyanin content suggests that these compounds follow partially independent accumulation patterns within the fruit.

Overall, the selection of high-value cultivars, combined with optimized agricultural practices, can enhance the nutritional and functional quality of blackberry-based products. These findings highlight the importance of integrating cultivar selection with pre-harvest management to develop functional foods with improved bioactive profiles.

As a next step, individual phenolic compounds will be quantified using UPLC-MS/MS, allowing for a more detailed characterization of cultivar-specific phenolic profiles beyond total content.

## References

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