Comparative Analysis of Metabolites and Color in *Prunus* Fruit

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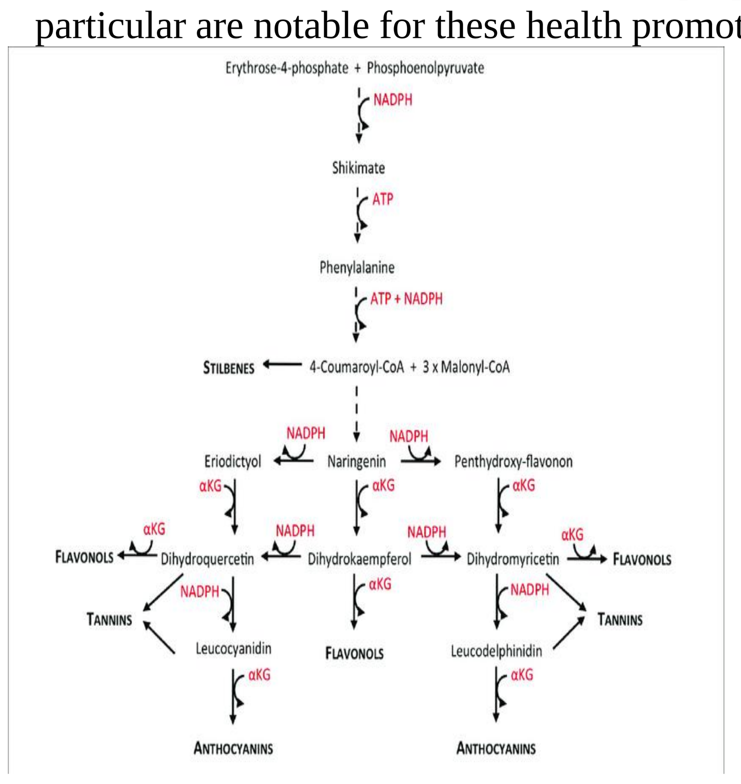
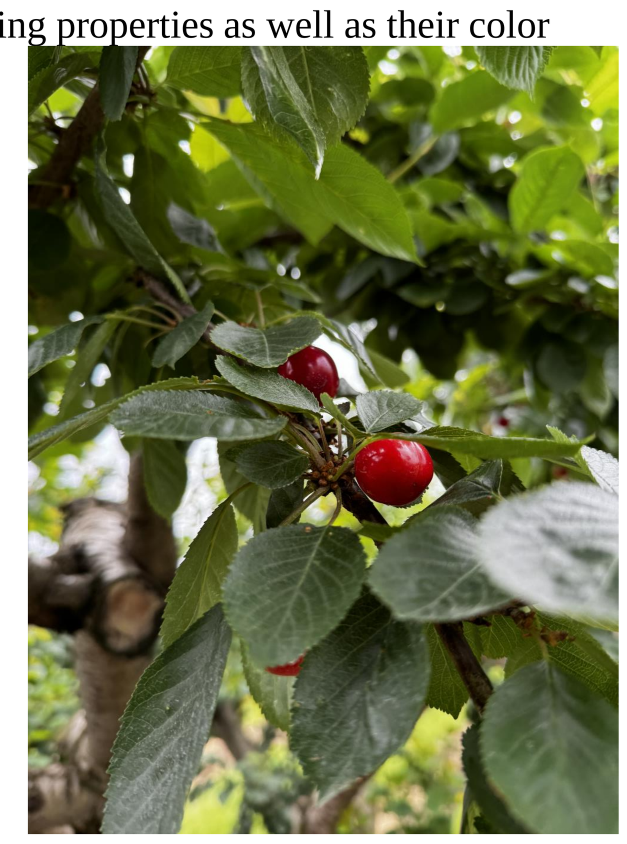
Introduction

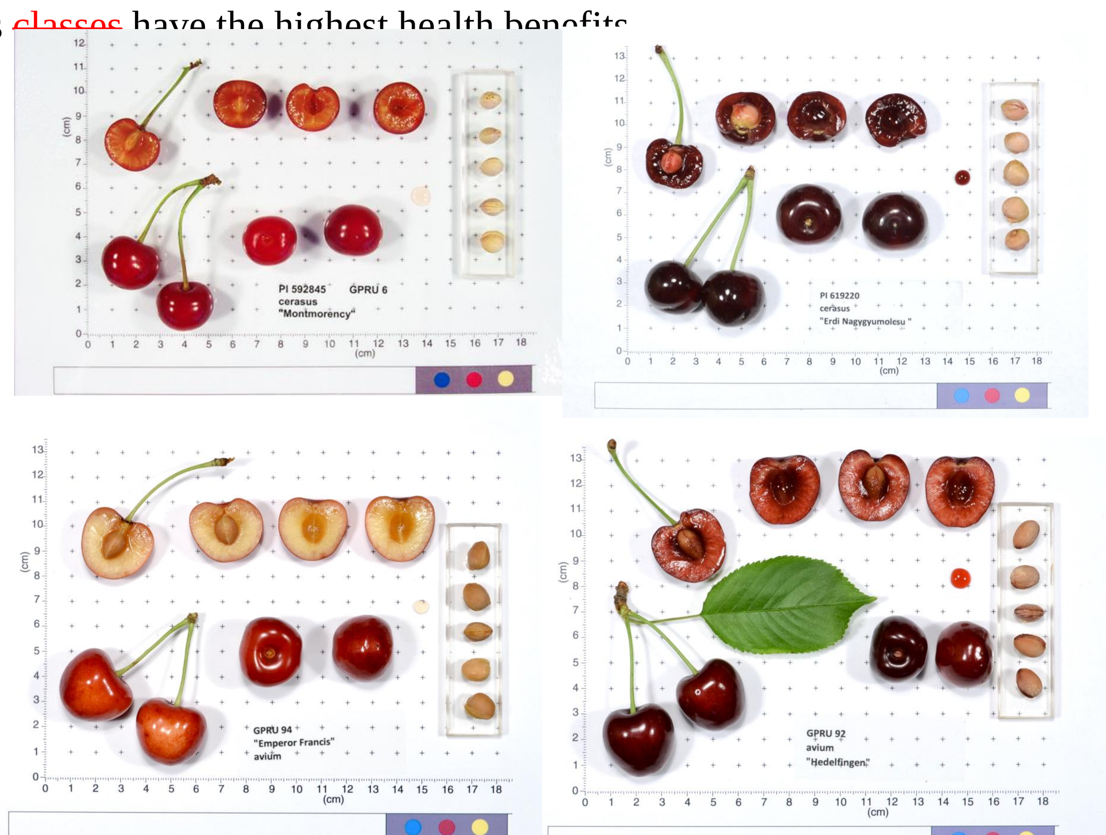
Despite a large number of delicious and resilient cherry accessions, only one dominates the European and American market: Montmorency. Despite its lower levels of anthocyanins and low resistance to yield-reducing factors, its fruits make up the majority of tart cherries produced and bought worldwide~~,~~ (USDA ARS). A greater understanding of cherry metabolites variation among cultivars can better point consumers and producers ~~of cherries~~ towards a variety of cherry accessions, instead of just one. There are many different qualities that make a cherry desirable: color, taste, and health benefits are just a few. These three characteristics are largely determined by variation in polyphenol concentrations and composition. These chemicals are secondary metabolites of plants, containing at least one benzene ring with at least one hydroxyl group (Belščak-Cvitanović, 2018). Secondary metabolites are compounds produced by plants that are not necessary for reproduction or growth directly but instead act as mechanisms of defense against UV radiation or pests. ~~Each of these classes carries with them structural and therefore functional differences.~~ Recently there has been a fascination within mainstream culture about polyphenols due to their antioxidant and free radical stabilization properties (Carvalho, 2024). Anthocyanins in particular are notable for these health promoting properties as well as their color



Polyphenol Synthesis Pathway



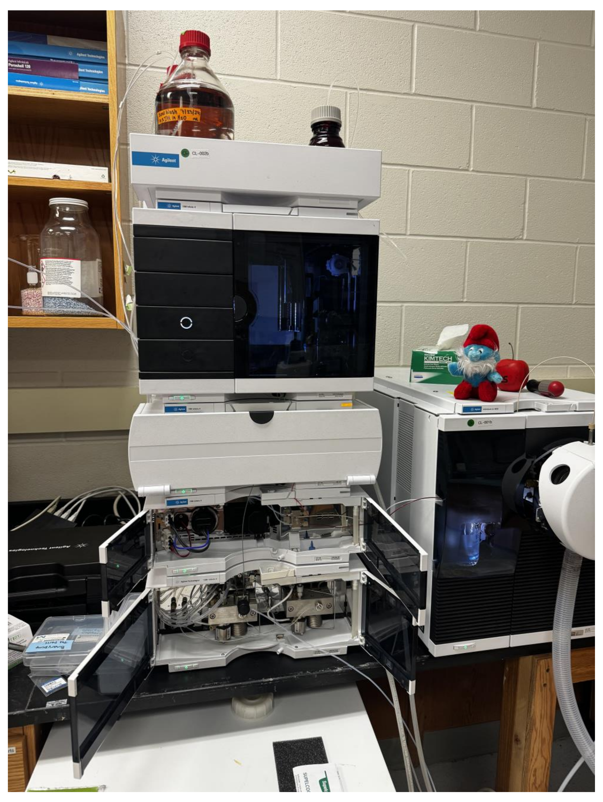
Given the 149 unique accessions within the USDA collection in Geneva, NY, it is possible to contrast and compare the levels of different polyphenols between different cultivars. The purpose of this collection is to maintain historic or unique accessions, and to identify the properties of each cultivar that distinguishes them from each other. The USDA cherry collection data was analyzed using High-Performance Liquid Chromatography-Mass Spectrometry (HPLC-MS) to assess which cherry cultivars~~,~~ and species ~~classes~~ have the highest health benefits



Materials and Methods

Three cherries were collected from each accession in 2023. Frozen cherry flesh was pulverized by the Geno/Grinder 2010. 0.5g of tissue was mixed with 1.5 ml of 70% MeOH, 2% Formic Acid solution, then shaken and centrifuged. The solution was filtered before running HPLC-MS. The data was processed using ~~the TartCherryUVMS2023 method, R~~ OpenLab CDS software, and results were analyzed in R Studio. Colorimeter data was collected from the 2024 harvest using a Konica Minolta CR-400 Chroma Meter.

MiniG Homogenizer



HPLC-MS

Results

~~Anthocyanins varied significantly among specific cherries species~~. ~~The analysis identified~~ Several cultivars with notably high anthocyanin levels were identified, namely, Lubskaya x P. maximowkzii, Bianca Rosata Di Piemonte, Csengodi Csokros, Almaz o.p, and Ljubskaja x P. maximovici. Montmorency was found to have lower levels of total anthocyanins and flavonols, but near-average levels of flavan-3-ols and hydroxycinnamic acids relative to other cultivars (Fig. 1). Total anthocyanin content also varied significantly across cherry species (p<0.001). The colorimetric analysis, combined with HPLC-MS data, provided insights into the correlation between fruit color and anthocyanin content. A significant negative correlation (Pearson's correlation coefficient = -0.47~~681~~, p-value < 0.001) was identified between cherry lightness and total anthocyanins. ~~To explore the variation in anthocyanin levels across cherry species, and ANOVA was conducted between Sum anthocyanins and cherry species. The results indicated a significant effect of species on anthocyanin levels (F(5,186) = 5.322, p < 0.001), suggesting that anthocyanin content varies~~ correla

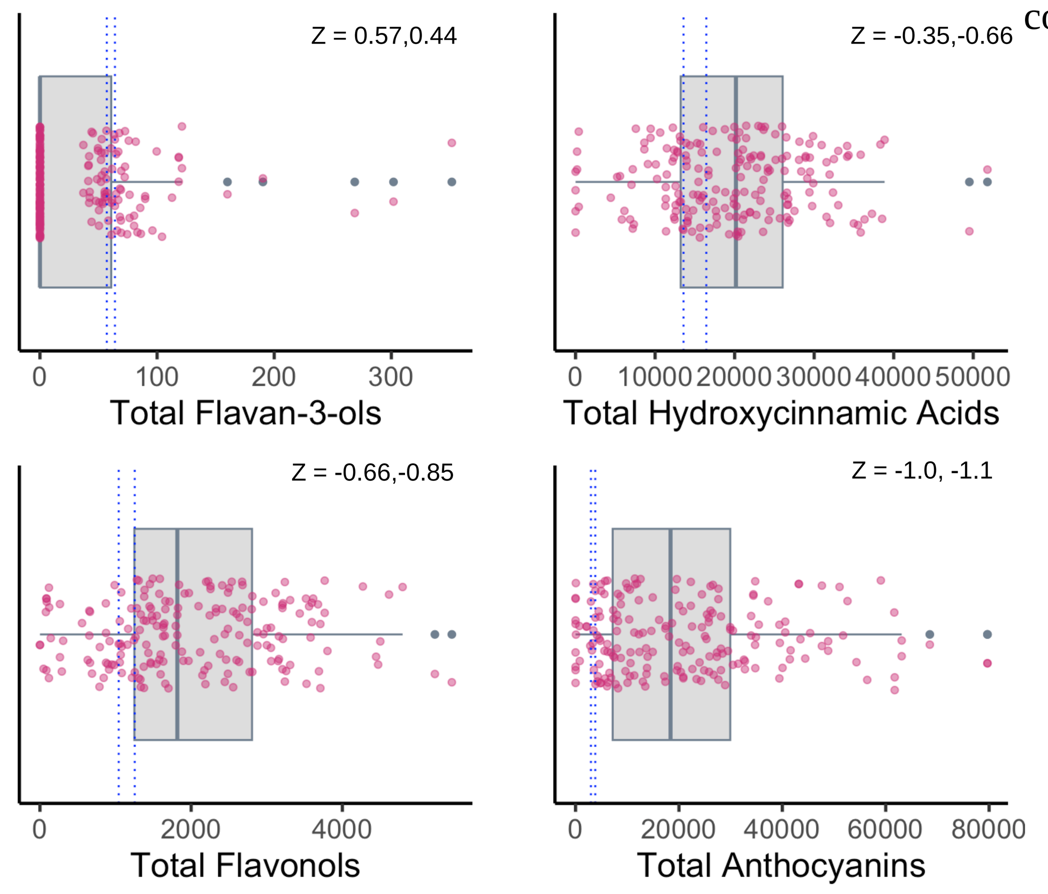


Figure 1. Total Cherry Polyphenol Distribution. Montmorency is represented by blue lines.

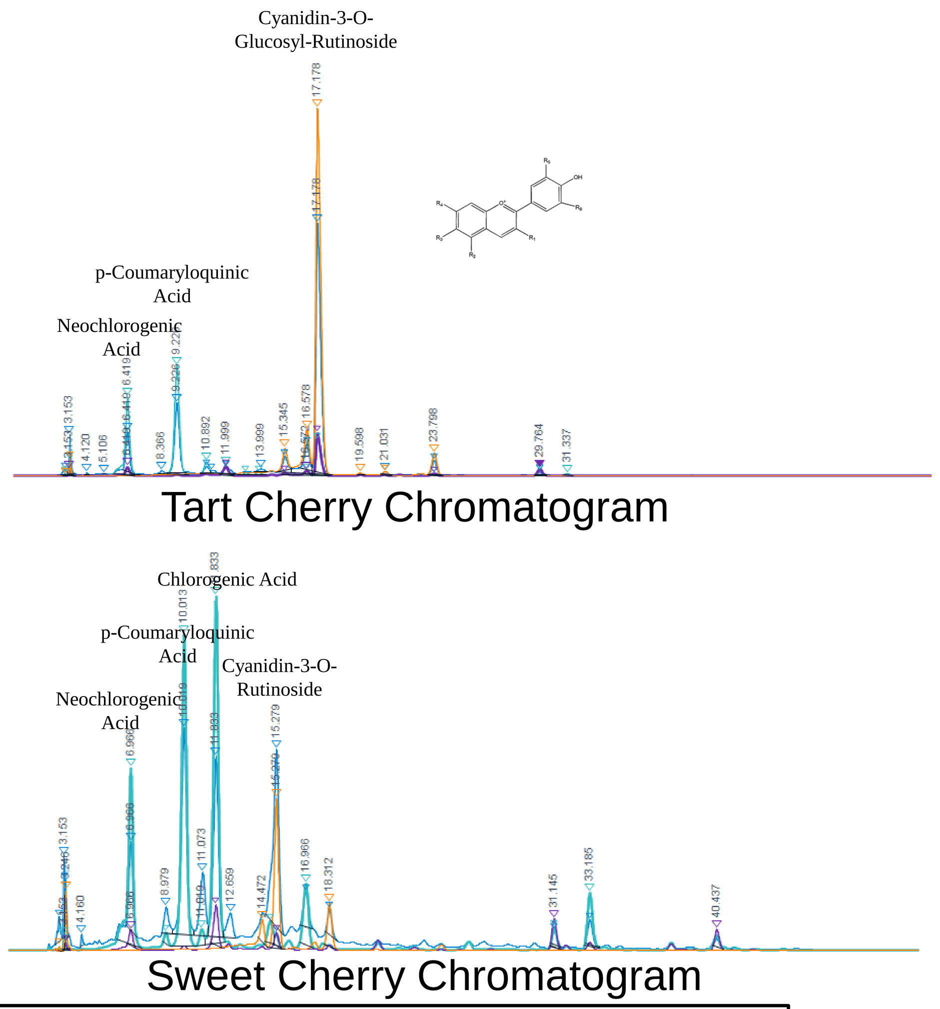


Figure 2. Tart (*Prunus cerasus*) vs Sweet (*P. avium*) Cherry Chromatograms

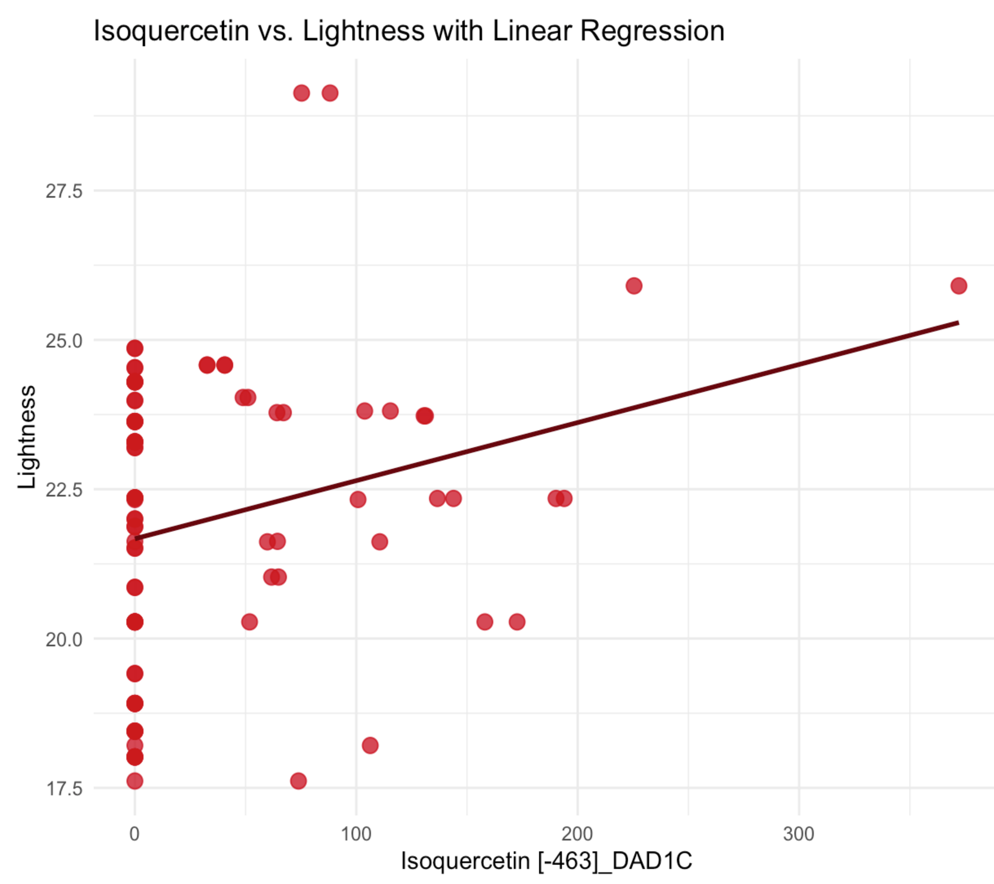


Figure 3. Total Isoquercetin in Relationship to Cherry Skin Lightness

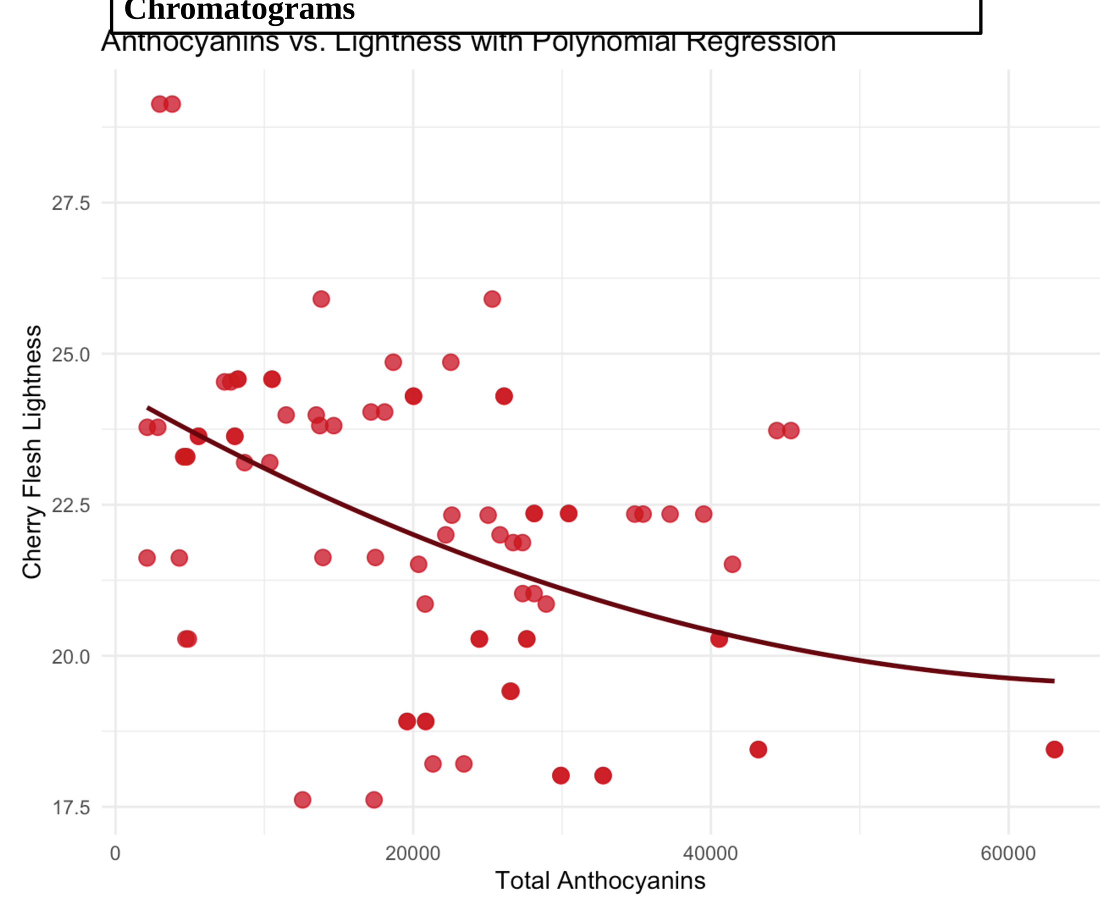


Figure 4. Total Anthocyanins in Relationship to Cherry Skin Lightness

Discussion

The findings of this analysis highlight variations in anthocyanin content across different cherry cultivars and species. As expected, there was a negative correlation between anthocyanin levels and fruit lightness ~~was observed~~. This suggests that darker fruit has more anthocyanin content. Interestingly, the metabolite that correlated the highest with cherry lightness was isoquercetin. This may be a result of the share synthesis pathway between flavonols and anthocyanins. If more intermediate compounds are converted to isoquercetin and other flavonols, less may be converted to anthocyanins and vice versa. More research needs to be done to support to further conclusions. Educating consumers about the health benefits associated with anthocyanins~~, and cherries with high amounts of them,~~ could diversify market preferences and promote lesser utilized cherry cultivars ~~species~~ with higher nutritional value. Given the variation in polyphenolic content among cherry species and cultivars, further research should be conducted on the positive benefits of drinking a variety of tart cherry juice, instead of just Montmorency.

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