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THE CHALLENGE OF COMPARING TART CHERRY POLYPHENOLS FROM THE USA AND EUROPE

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Abstract

Tart cherries (Prunus cerasus L.) are globally recognized as a substantial source of polyphenolic compounds with associated bioactive effects. However, direct comparison of the published data is challenging due to differences in cultivar (e.g., US Montmorency vs. European Oblačinska, Łutówka, Újfehértói Fürtös, etc.), environmental conditions, processing methods, storage conditions, and analytical methods. Our recent study investigated five different forms of a single cultivar, Montmorency, using a TSQ triple quadrupole LC-MS/MS with authentic external standards, with the results were reported as ppm dry weight (DW) for precise cross-comparison. The employment of a single cultivar and advanced triple quadrupole LC-MS/MS techniques facilitated the sensitive detection and precise quantification of both major and minor polyphenols. European studies typically report polyphenolic data on a fresh weight (FW) basis and use less selective HPLC-UV/DAD, UHPLC-PDA, and spectroscopic assays. European data are highly variable and intended only for contextual comparison, as they reflect results from multiple cultivars and studies. For example, our work indicated that the Montmorency variety contained a balanced profile of cyanidin-3-rutinoside and cyanidin-3-glucoside, whereas European cultivars, such as Oblačinska, are typically characterized by a predominance of cyanidin-3-glucosylrutinoside. These findings will underscore the recommendation for standardized analytical methods and reporting units to enhance cross-regional comparisons to support future nutritional and clinical research.

Key words*: anthocyanins, polyphenols, Prunus cerasus, sour cherry, tart cherry.*

INTRODUCTION

Tart cherries, aka sour cherries, are rich in polyphenolic compounds, mainly anthocyanins, flavonols, hydroxycinnamic acids, and flavan-3-ols, which have been associated with numerous health benefits, such as antioxidative effects, anti-inflammatory effects, and modulation of cardiovascular and metabolic biomarkers (Jawad et al., 2025a; Kelley et al., 2018). Despite these promising health benefits, cross-study comparisons of polyphenolic composition are complicated by several factors.

Cultivar selection is a crucial determinant of polyphenolic composition, with US Montmorency cherries demonstrating a balanced profile of cyanidin-3-rutinoside and cyanidin-3-glucoside, while European cultivars such as Oblačinska, Łutówka, or Újfehértói Fürtös often show predominance of cyanidin-3-glucosylrutinoside and more variable minor phenolic content (Borowy et al., 2018; Nemes et al., 2018; Tešovic et al., 1996).

Environmental factors such as soil composition, sunlight exposure, rainfall, and cultivation practices significantly influence polyphenol biosynthesis (Zagoskina et al., 2023). Processing and storage methods, such as cold pressing, drying, thermal processing, or long-term storage, can significantly impact polyphenol stability (Sejbuk et al., 2024). Furthermore, there are differences in analytical methods and the reporting units between studies from the USA and Europe.

In the USA, a study reported the tart cherry polyphenol composition in dry weight (DW) values, combined with highly sensitive LC-MS/MS (Jawad et al., 2025b), while numerous European studies reported the tart cherry polyphenolic composition in fresh weight (FW) values using HPLC-UV/DAD, UPLC-PDA, or spectrophotometric assays (Mitic et al., 2012; Repajić et al., 2015; Sokół-Łętowska et al., 2020; Wojdyło et al., 2014), which may under-represent minor compounds or may produce variable results.

These differences are not superficial; they directly influence the estimation of polyphenolic doses in tart cherry clinical trials and the reproducibility of the research findings.

Tart cherry supplementation is renowned for its clinical applications, particularly in reducing inflammation, mitigating oxidative stress, enhancing sleep quality, and exhibiting anti-cancer and neuroprotective effects (Jawad et al., 2025a). However, the published data are equivocal. One possible reason behind the inconsistent outcomes is the variability in the reported polyphenol composition of tart cherry interventions. Numerous published trials do not report the complete phenolic profile of the products used, making it difficult to determine whether negative or inconsistent outcomes result from insufficient polyphenol dosing. For example, studies that utilize juice concentrates often operate under the assumption that different cultivars or products contain equivalent doses of anthocyanins. However, the anthocyanin content can vary significantly by more than ten times, depending on factors such as methodology, cultivar, and the basis for reporting. As clinical trial designs increasingly depend on precise polyphenolic dosing, the need for standardized reporting practices has become critical.

The main objective of this conference paper is to recommend the standardization of reporting units, analytical techniques, methodologies, and cultivar selection to improve reproducibility, reliability, and clinical relevance. It is crucial to standardize reporting units, use sensitive and comprehensive analytical methods, and clearly document cultivar and processing conditions.

MATERIALS AND METHODS

This conference paper is based on our previously published analyses of five forms of Montmorency tart cherry products: freeze-dried powder, frozen whole fruit, sweet-dried fruit, unsweetened dried fruit, and juice concentrate. The results were reported on a ppm DW basis to account for variations in water content and to facilitate accurate comparisons between different products (Jawad et al., 2025b).

Different European studies were reviewed to provide a comparison of polyphenol concentration across different cultivars. The differences in reporting units and analytical methods employed are highlighted.

RESULTS AND DISCUSSIONS

Detailed information on the polyphenolic profiles of US Montmorency tart cherries (DW) compared with European tart cherry cultivars (FW, converted to DW assuming 88% moisture) is presented in Table 1. This conversion serves as a contextual approximation to facilitate side-by-side comparison with US Montmorency tart cherry data. The differences observed highlight the challenges involved in comparing results across different studies. Variability can arise from several factors, including the genetics of the cultivars, growing environment conditions, processing and storage techniques, as well as analytical and data reporting units.

Table 1. Polyphenolic Profile Comparison; Montmorency Tart Cherry (MTC) vs European Tart Cherry Cultivars

Class	Specific Polyphenol	[1]MTC (Raw Fruit ppm, DW)	[2]European Cultivars (Raw Fruit ppm, DW)	% Difference (European Cultivars & MTC)
Antho-cyanins	Cyanidin-3-rutinoside	1667	10032.5	502%
	Cyanidin-3-glucoside	981	585.8	- 40%
	Cyanidin-3-glucosylrutinoside	ND	7994.14	
	Cyanidin-3-sophoroside	9930	870	- 91%
	Peonidin-3-rutinoside	2630	ND	
Flavonol	Kaempferol-3-rutinoside	149	661.7	344%
	Rutin (quercetin-3-O-rutinoside)	15,940	635.8	-96%
	Quercetin-3-glucoside	299	16.7	-94%
Hydroxycin-namic acid	Chlorogenic acid	29,392	5027.5	-83%
	Feruloquin-ic acid	8087	ND	
	Ferulic acid	3067	1666.7	-46%
	p-Coumaric acid	1750	4224.2	141%
	o-Coumaric acid	1759	ND	
	Caffeic acid	169	ND	
	Caffeic acid glycoside	453	ND	
Flavanols	(-)-Epicatechin	2614	2351.7	-10%
	Catechin	2157	ND	
	Procyanidin B2	1291	2629.2	104%
	Taxifolin	43	ND	
Flavanones	Naringenin	255	ND	
Hydroxyben-zoic acid	Protocatec-huic acid	102	ND	

[1](Jawad et al., 2025b)

[2](Sokół-Łętowska et al., 2020) (Głowacka et al., 2020)

NOTES: MTC = Montmorency tart cherries; ND = Not detected; This data should be considered contextual, not equivalent, because mg/100 g FW was converted into DW ppm by considering 88% moisture for the sake of concentration comparison; MTC study used TSQ triple quadrupole LC-MS/MS; European studies used HPLC-PDA analytical techniques.

In our study, Montmorency tart cherries exhibited a diverse and balanced polyphenolic profile. Major anthocyanins included cyanidin-3-rutinoside and cyanidin-3-glucoside (Jawad et al., 2025b), whereas European cultivars frequently showed a predominance of cyanidin-3-glucosylrutinoside (Repajić et al., 2015). Flavonols, such as quercetin and kaempferol derivatives, were consistently detected in Montmorency tart cherry products (Jawad et al., 2025b). In contrast, European studies revealed high variability, likely due to both cultivar differences and analytical sensitivity limitations (Głowacka et al., 2020; Sokół-Łętowska et al., 2020). Hydroxycinnamic acids, including chlorogenic and caffeic acids, etc., were quantified in Montmorency samples (Jawad et al., 2025b); however, European Fruit-Based literature often reported lower or variable levels. Differences in reporting units and analytical sensitivity have significant implications for clinical research, as they can lead to misleading estimates of the actual polyphenol dose administered in intervention studies. For example, two studies that report the same volume of tart cherry juice may yield significantly different amounts of polyphenol compounds, depending on whether the measurements are presented in DW or FW. Addressing these methodological issues is essential. Reporting polyphenol content on a dry weight basis eliminates variability caused by water content, enabling more precise comparisons across studies.

Using an advanced LC-MS/MS analytical approach with authentic standards enables sensitive detection of both major and minor polyphenols, capturing biologically relevant compounds that might otherwise be overlooked. Transparent reporting of cultivar, processing, and storage conditions further strengthens reproducibility and allows researchers to accurately interpret the relationship between polyphenol intake and clinical outcomes. Finally, coordination of the sample extraction process, analytical quantification, and reporting protocols across research groups, including cross-regional collaboration, which is essential to improve comparability and translational relevance.

By implementing standardized practices, future research can more effectively connect the polyphenolic profiles of tart cherries to health outcomes in humans. This will ensure that interventions provide consistent and biologically relevant doses. These improvements are especially crucial for clinical trials focused on inflammation, oxidative stress.

CONCLUSIONS

Differences in tart cherry cultivars, environmental conditions, processing methods, storage techniques, analytical methods, and reporting units make it challenging to compare studies on tart cherry polyphenols. Montmorency tart cherries offer a consistent and reproducible polyphenolic profile, which includes anthocyanins, flavonols, hydroxycinnamic acids, flavan-3-ols, and minor phenolics. In contrast, studies conducted in Europe often report limited or variable profiles due to differences in methodology and cherry cultivars used. To enhance reproducibility, reliability, and the relevance of findings, it is essential to standardize the reporting units (DW), use sensitive and comprehensive analytical methods (LC-MS/MS or UHPLC-MS), and clearly document the cultivars and processing conditions. By addressing these issues, researchers can improve the interpretation of clinical outcomes and develop evidence-based dietary recommendations for tart cherry consumption.

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