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POMOLOGICAL AND CHEMICAL CHARACTERIZATION OF SOME SWEET CHERRY VARIETIES GROWN IN URBAN ORCHARD

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Abstract

The increasing interest in urban agriculture highlights the need for a comprehensive understanding of fruit quality parameters in urban orchards. This study aimed to investigate the pomological and chemical characteristics of four sweet cherry (Prunus avium L.) varieties, namely, 'Napoleon', 'Van', 'Boambe de Cotnari' and 'Stella' cultivated in an urban orchard. The investigated varieties were evaluated for key pomological traits, including fruit weight, size, firmness, and skin colour, as well as chemical attributes such as soluble solids content (°Brix), titratable acidity, pH, vitamin C, total phenolic compounds and total flavonoids. The results revealed significant varietal differences in both physical and chemical properties, with some varieties demonstrating exceptional balance between sweetness and acidity, making them highly suitable for fresh consumption. Furthermore, the urban growing environment was found to influence certain quality parameters, potentially due to microclimatic conditions. This research underscores the potential of urban orchards to produce high-quality sweet cherries while contributing to local food systems. Insights from this study may aid in the selection of cherry varieties best suited for urban cultivation, enhancing productivity and fruit quality.

Key words: *yield, fruit quality, Prunus avium, TSS, TA, phenolic content, vitamin C.*

INTRODUCTION

Sweet cherry (*Prunus avium* L.) is a highly valued fruit species cultivated for its exceptional taste, attractive appearance, and notable nutritional properties (Correia et al., 2017). As consumer demand increasingly shifts toward fresh, health-promoting products, the interest in sweet cherry has expanded beyond commercial orchards to include urban and peri-urban agricultural systems. Urban orchards, though limited in scale, offer unique microclimatic conditions and opportunities for sustainable fruit production close to consumer markets, contributing to food security, biodiversity, and environmental quality in urban landscapes (Lin et al., 2015; Ghahremani et al., 2024). In urban environments, the cultivation of fruit trees like sweet cherry presents both challenges and benefits. While urban heat islands, air pollution, and soil variability can influence crop performance, urban orchards often benefit from favorable microclimates, reduced pest pressure, and proximity to markets (Eeraerts et al., 2017). For successful cultivation, careful selection of cultivars is essential, especially those that exhibit both agronomic adaptability and desirable fruit quality under urban conditions. Evaluating the pomological traits, such as fruit size, firmness, total soluble solids, and acidity is essential for understanding fruit quality, market value, and consumer preference (Kappel et al., 1996; Boghean et al., 2025). Beyond appearance and taste, consumers and producers are increasingly interested in the functional quality of fruits, particularly their content of bioactive compounds like vitamin C, total phenolics, and flavonoids, which contribute to antioxidant activity and confer various health benefits (Sun-Waterhouse, 2011). These compounds play a vital role in neutralizing free radicals and are linked to reduced risks of chronic diseases such as cardiovascular conditions and certain cancers (Heim et al., 2002; Wu et al., 2004; Fatih et al., 2014). In sweet cherries, phenolic compounds are especially important contributors to antioxidant capacity, with flavonoids and anthocyanins providing not only nutritional benefits but also contributing to fruit colour and shelf-life (Moutinho-Pereira et al., 2007; Muskovics et al., 2006). These biochemical markers are strongly associated with health-promoting effects and are increasingly used to guide breeding programs and orchard management strategies (Gonçalves et al., 2024). Despite the growing interest in urban horticulture, data on the performance of sweet cherry cultivars under urban orchard conditions remain limited. Cultivar-specific responses to urban microenvironments, such as heat islands, soil heterogeneity, and localized air pollution which may lead to variability in fruit development, chemical composition, and overall fruit quality (Asănică et al., 2013; Orsini et al., 2013). Understanding these differences is essential for optimizing cultivar selection and orchard management practices adapted to urban environments. In this context, it has never been more important to provide a comprehensive evaluation of both pomological and chemical attributes to identify cultivars best suited for urban fruit production. Therefore, the current research aims to characterize and compare the pomological and chemical traits of four sweet cherry varieties, namely 'Napoleon', 'Van', 'Boambe de Cotnari', and 'Stella'grown in an urban orchard. Through detailed analysis of fruit morphology, taste-related parameters, and antioxidant profiles, this research seeks to provide a foundation for variety selection and quality optimization in urban horticulture systems.

MATERIALS AND METHODS

Site location and plant material

The current research has been carried out during 2023-2024 in a private high-density urban orchard located in Cluj-Napoca (46°48'05.1"N; 23°37'32.4"E) at 430 m above sea level on the hill of Sfântu Gheorghe. Cluj-Napoca is known for its continental climate (Kottek et al., 2006) characterised by cold winter and hot summers with an annual average rainfall ranging from 600 to 700 mm and an annual average temperature of 8.9°C reflecting the city's humid continental climate (Climate-data, 2025). The sweet cherry trees were planted in 1997 at a distance of 5 m between the rows and 4 m between the trees within a row. The trees were grafted onto the same rootstock (Mahaleb) and the canopies were trained to the standard open vase grown under standard conditions of irrigation, fertilization, and pest and disease management practices (Table 1).

Table 1. Fertilization, pest and disease management practices applied in the orchard

No	Agricultural practice	Moment of application
1	Spraying with Funguran	dormant season
2	Spraying with Chorus and Optil	pink bud
3	Luna Care, Karate Zeon and urea	petal fall
4	Folicur Solo, Krima and $Ca(NO_3)_2$	beginning of ripening
5	Folicur Solo, Fastac and Optical	2 weeks before harvest

Fruits from four sweet cherry (*Prunus avium*) cultivars ('Napoleon', 'Van', 'Boambe de Cotnari' and 'Stella') were harvested at the commercial ripening stage (Figure 1).

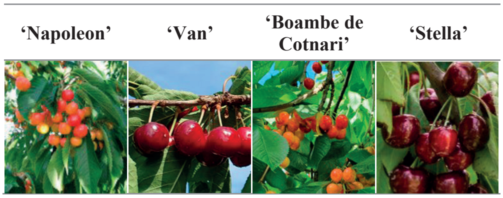

Figure 1. Sweet cherry varieties before harvest

Ten trees were randomly selected from each cultivar and 60 fruits/plant from different parts of the canopy were harvested and transferred immediately to the laboratory to determine the physical (fruit colour, width, thickness, length, weight and firmness) and chemical fruit quality parameters such as total soluble solid content (SSC), titratable acidity (TA), SSC/TA, pH, Vitamin C, total phenolic content (TPC), total flavonoid content (TFC) and antioxidant activity (DPPH). In addition, the physical traits of the stone and fruit peduncle were also determined followed by total yield/tree which was monitored at every harvest and summarized at the end of the harvesting period.

Determination of fruit colour

The chromatic characteristics of the harvested cherry fruits were analysed by the Colour Picker Software (Version 1.5.0) by using the CIE colour space as described by Acero et al., 2019. The CIE colour space is defined by L*, a* and b* coordinates which indicate lightness (L*)-black/white coordinate; a*-red/green coordinate, b*- yellow/blue coordinate (Gonçalves et al., 2007). Hue angle, which represents the dominant colour as perceived by an observer, was calculated as arctan (b*/a*). Chroma was obtained following the formulae: $\sqrt{a^{*2} + b^{*2}}$ (Jha, 2010). Each measurement is the average of two measurements performed on opposite points along the equatorial diameter of each cherry.

Physical traits of fruits, stone and peduncle

Fruit weight, length, width and thickness were determined with a digital balance and a digital caliper. Fruit firmness was determined by a hand-held penetrometer (Sekse & Wermund, 2008). Stone weight was determined after the mechanical extraction and cleaning of the stone. During data processing the stone/flesh ration was calculated and expressed as percentage. Peduncle length and weight were measured individually after detaching from the fruit using a digital balance and a ruler.

Chemical characteristics of sweet cherries

The soluble solid content was individually determined from each fruit. The fruits were squeezed and the fresh juice was used to read the SSC content on a digital Atago PAL-BX ACID refractometer (Tokyo, Japan) and expressed as °Brix (Esmaeili et al., 2019).

Titratable acidity was determined by titrating 10 mL of cherry juice diluted with 40 mL of distilled water against 0.1 N NaOH using phenolphthalein as an indicator. Results were expressed as a percentage of malic acid equivalents as described by Usenik et al., (2008). After data collection the SCC/TA ratio was calculated to provide a comprehensive measure of fruit quality (Wu et al., 2020).

Active acidity of the fruits was expressed as pH of each sample and measured using a WTW 3310 pH meter as described by Henríquez et al., (2011).

The Vitamin C content of the fruits was ascertained using the 2,6-dichlorophenolindophenol (DCPIP) titrimetric method (AOAC, 2000). A known volume of juice was titrated against a standardized DCPIP solution until a persistent pink endpoint was observed. Results were calculated based on a calibration curve using ascorbic acid standards and expressed as mg ascorbic acid per 100 g fresh weight (FW).

The total phenolic content of the fruits was determined according to the Folin- Ciocalteu procedure as described by Singleton & Rossi (1965). An aliquot of fruit extract (0.5 mL) was mixed with 2.5 mL of 10% Folin-Ciocalteu reagent and 2 mL of 7.5% sodium carbonate. The mixture was incubated in the dark at room temperature for 30 minutes, and absorbance was measured at 765 nm using a UV–VIS spectrophotometer. Results were expressed as mg gallic acid equivalents (GAE) per 100 g FW.

The total flavonoid content was quantified by aluminium trichloride method using catechin as reference compound as previously described by Zhishen et al. (1999). The methanolic extracts were diluted with distilled water up to 5 ml, adding 300 µl of 5% $NaNO_2$ solution. After 5 minutes, the mixture was treated with 300 µl 10% $AlCl_3$ solution and kept in the dark for another 5 minutes, and then 2 ml of 1N NaOH solution and 6.4 ml of distilled water were added. After homogenization and 5 minutes of incubation the absorbance was read at 510 nm using a UV-VIS 1700 Shimadzu spectrophotometer, the total flavonoid content was calculated as quercetin equivalent from the calibration curve of quercetin standard solutions and expressed as milligrams of quercetin per 100 g of fresh weight.

The potential antioxidant activity of the sweet cherry varieties was determined based on the scavenging activity of the 70% aqueous methanol sweet cherry extracts of the stable 1,1`-diphenyl-2-picrylhydrazyl (DPPH) free radicals (Gonçalves, 2016). Over 90 µL of methanol extract 10 µl of distilled water and 3.9 ml of DPPH solutions were added. After 30 minutes of incubation in the dark, the absorbance was read at 515 nm using a UV-VIS spectrophotometer. DPPH-radical scavenging activity was expressed as the percentage inhibition activity and was calculated from [(A0–A1)/A0] x 100, where A0 is the absorbance of the control, and A1 is the absorbance of the extract assuming that the sample with the higher percentage has higher scavenging capacity (Kumaran & Karunakaran, 2007). All measurements were done in triplicate. The results were expressed as means of the triplicates.

Statistical analyses

Statistical significance was assessed by the analysis of variance followed by the comparison of means by Tukey's multiple range test a at $p<0.05$ using the statistical package SPSS

Version 20 (SPSS Inc., Chicago, IL, USA). Furthermore, Pearson's correlation was performed to reveal the relationships between chemical compounds and DPPH radical scavenging activity in the four sweet cherry cultivars.

RESULTS AND DISCUSSIONS

The results of this research highlight the varietal differences regarding the analysed physical and chemical traits of the sweet cherry varieties analysed.

Fruit colour

The chromatic parameters of sweet cherry fruits are presented in Table 2. The results indicate 'Napoleon' and 'Boambe de Cotnari' are significantly lighter and more colorful, while 'Van' and 'Stella' are darker and less saturated. These visual differences are also confirmed by significant differences found in all parameters between some cherry varieties. It is noticeable that in terms of lightness (L*), yellow/blue coordinate (b*), hue angle and chroma 'Napoleon' and 'Boambe de Cotnari' varieties are not significantly different (Table 2 and Figure 2). 'Napoleon' is a light-colored fruit (L* = 65.1) with high chroma (50.3) exhibiting a vibrant and bright skin colour. Moderate redness (a*) and yellowness (b*) indicate a strong red-yellow tone, while the low hue angle (0.7°) shows that the fruit is skewed strongly toward red. Significantly brighter and more colorful than 'Van' and 'Stella'. 'Boambe de Cotnari' has a very similar lightness (L* = 64.9) to 'Napoleon', but with the highest chroma (54.9) making it the most intense in color. High a* and b* values suggest a bright red-yellow tone. Low hue angle (0.8°) confirms strong red direction.

Table 2. Chromatic characteristics of the analysed sweet cherry varieties

	Colour coordinates				
	L*	**a***	**b***	**Hue angle (h°)**	**Chroma (C*)**
'Napoleon'	65.1 ± 5.2 b	31.8 ± 5.9 a	39.0 ± 4.3 c	0.7 ± 0.1 a	50.3 ± 3.2 b
'Van'	43.4 ± 2.6 a	31.7 ± 3.2 a	4.4.0 ± 3.8 b	1.4 ± 0.1 b	32.0 ± 4.1 a
'Boambe de Cotnari'	64.9 ± 5.2 b	39 ± 6.7 b	38.6.0 ± 2.1 c	0.8 ± 0.1 a	54.9 ± 3.4 b
'Stella'	41.1 ± 4.0 a	30.5 ± 2.5 a	-7.1.0 ± 2.7 a	1.8 ± 0.1 c	31.3 ± 2.2 a

The results are expressed as meand±standard error (n=40). Different lowercase letters indicate statistically significant differences between varieties for each variable according to Tukey's HSD test, p<0.05.

The darkest fruit (L* = 41.1) with the lowest b* (–7.1) appeared to be 'Stella'. The highest hue angle (1.8°) reflects this cooler tone and is confirmed by the low value chroma (31.3) which denotes a duller and cooler fruit colour as compared to other varieties. Visually, 'Stella' appears dark red with a hint of purple/blue. However, data are limited on chromatic characteristics of sweet cherries, Acero et al., (2019) in a previous study reported similar chromatic coordinates for 'Van' variety.

'Napoleon'	**'Van'**	**'Boambe de Cotnari'**	**'Stella'**

Figure 2. Fruit skin colour of the investigated sweet cherry varieties

Physical traits of fruits, stone and peduncle

The physical characteristics of four sweet cherry (*Prunus avium* L.) varieties, namely 'Napoleon', 'Van', 'Boambe de Cotnari', and 'Stella' are summarized in Table 3. Significant varietal differences at $p < 0.05$ were observed in fruit size, weight, and yield per tree. The results show that 'Stella' had the largest fruit dimensions, with a mean width of 26.68 ± 0.21 mm, thickness of 23.00 ± 0.19 mm, and length of 24.96 ± 0.24 mm. These traits corresponded to the highest average fruit weight (10.34 ± 0.22 g), indicating this variety's potential for fresh market appeal due to its superior fruit size, a key consumer preference criterion (Habib et al., 2017; Romano et al., 2006). In comparison, Kappel et al. (2011) reported average fruit weights of 8.4 g for 'Bing' and 9.3 g for 'Lapins', placing 'Stella' above these commonly cultivated varieties. Other varieties such as 'Napoleon', 'Van', and 'Boambe de Cotnari' displayed similar values for fruit width and thickness, with no statistically significant differences. However, 'Boambe de Cotnari' and 'Van' showed slightly greater fruit length compared to 'Napoleon'. Fruit weight among these three varieties ranged from 7.76 g ('Van') to 8.22 g ('Napoleon'), all significantly lower than that of 'Stella'. Slightly higher values (8.25-8.60 g) for fruit weight for 'Van' variety has been reported by Sirbu et al. (2018) claiming that the position of fruits within trees' architecture may influence differently the fruit size and biochemical content of the fruits. In this regard, it was observed that fruit size was greater in the lower part of the tree crown. 'Napoleon', 'Van', and 'Boambe de Cotnari' exhibited comparable fruit widths (24.31-24.75 mm) and thicknesses (21.46-22.07 mm), with no statistically significant differences. However, 'Boambe de Cotnari' and 'Van' had slightly greater fruit lengths than 'Napoleon'. Fruit weight among these three cultivars ranged from 7.76 g ('Van') to 8.22 g ('Napoleon'), aligning closely with values reported by Giménez et al. (2014) and Girard et al. (1988) for similar mid-season cultivars in Mediterranean regions.

Table 3. Physical fruit traits and productivity of the selected sweet cherry varieties

Variety name	Fruit width (mm)	Fruit thickness (mm)	Fruit length (mm)	Fruit weight (g)	Fruit firmness (kgf/cm^2)	Yield/tree (kg)
'Napoleon'	24.75±0.48 *a*	21.46±0.35 *a*	20.23±0.32 *a*	8.22±0.36 *a*	0.30±0.03 *c*	20.38±0.52 *a*
'Van'	24.31±0.28 *a*	21.76±0.21 *a*	21.03±0.28 *ab*	7.76±0.18 *a*	0.24±0.02 *b*	24.25±0.56 *b*
'Boambe de Cotnari'	24.38±0.28 *a*	22.07±0.21 *ab*	21.19±0.22 *b*	7.92±0.23 *a*	0.24±0.01 *b*	28.16±0.28 *c*
'Stella'	26.68±0.21 *b*	23.00±0.19 *b*	24.96±0.24 *c*	10.34±0.22 *b*	0.23±0.03 *a*	21.26±0.20 *a*

The results are expressed as meand±standard error (n=40). Different lowercase letters indicate statistically significant differences between varieties for each variable according to Tukey's HSD test, p<0.05.

Fruit firmness varied slightly among the four sweet cherry cultivars analyzed. 'Napoleon' exhibited the highest firmness value at 0.30 N, followed by 'Van' and 'Boambe de Cotnari' at 0.24 N, while 'Stella' showed the lowest firmness at 0.23 N. These differences, although modest, may have implications for postharvest handling and consumer preference. Firmer fruits like 'Napoleon' are generally more resistant to mechanical damage during harvesting and transportation, which can extend shelf life and reduce losses (Einhorn et al., 2013; Hampson et al., 2014). Conversely, the slightly softer texture of 'Stella' might be attractive to consumers who prefer a more tender bite but could be more susceptible to bruising and faster deterioration (Crisosto et al., 1995). Fruit firmness is influenced by several factors, including cell wall composition, water content, and cultivar genetics. The higher firmness observed in 'Napoleon' may be associated with greater cell wall integrity or lower enzymatic activity related to softening, as suggested by previous research on sweet cherries (Muskovics et al., 2006).

Considering the productivity of the trees, the results showed that out of the four investigated sweet cherry varieties, 'Boambe de Cotnari' achieved the highest yield per tree (28.16 ± 0.28 kg), significantly overperforming the other cultivars. This trait makes it a compelling candidate for high-output commercial orchards. In comparison, 'Van' yielded 24.25 ± 0.56 kg, while 'Napoleon' and 'Stella' had lower productivity at 20.38 ± 0.52 kg and 21.26 ± 0.20 kg, respectively. Usenik et al. (2011) similarly reported that high-yielding cultivars like

‘Kordia’ and ‘Regina’ often exhibit moderate fruit size but excellent productivity, being consistent with the results obtained in ‘Boambe de Cotnari’. These results highlight a typical negative correlation between fruit size and yield-where cultivars with larger fruits, like ‘Stella’, may have reduced overall productivity (Gonçalves et al., 2006).

Stone and peduncle characteristics are critical traits in the evaluation of sweet cherry varieties, as they directly influence both consumer acceptance and postharvest handling performance. Stone weight and the stone-to-flesh ratio affect the edible portion of the fruit, which is a key quality attribute for fresh consumption and processing industries (Kappel & MacDonald, 2007). Lower stone-to-flesh ratios are generally preferred, as they offer a greater proportion of consumable pulp relative to inedible seed. Peduncle attributes, especially length and weight, play an important role in fruit detachment resistance, shelf life, and visual appeal. Longer and firmer peduncles may enhance the resistance of cherries to mechanical injury and dehydration during storage and transport, contributing to better fruit quality and marketability (Demir & Kalyoncu, 2003). In this regard, the results revealed significant differences among the four cultivars at $p < 0.05$ (Table 4).

Table 4. Physical traits of stone and peduncle of the selected sweet cherry varieties

Variety name	Stone weight (g)	Stone-flesh rate (%)	Peduncle length (mm)	Peduncle weight (g)
‘Napoleon’	0.48±0.01 *b*	6.05±0.19 *a*	3.38±0.12 *b*	0.04±0.00 *a*
‘Van’	0.45±0.01 *a*	5.79±0.16 *a*	2.88±0.06 *a*	0.07±0.00 *b*
‘Boambe de Cotnari’	0.52±0.01 *c*	6.69±0.15 *b*	3.88±0.09 *c*	0.07±0.00 *b*
‘Stella’	0.57±0.01 *d*	5.52±0.09 *a*	4.28±0.07 *d*	0.10±0.00 *c*

The results are expressed as meand±standard error (n=40). Different lowercase letters indicate statistically significant differences between varieties for each variable according to Tukey’s HSD test, p<0.05.

‘Stella’ exhibited the highest stone weight (0.57 ± 0.01 g), followed by ‘Boambe de Cotnari’ (0.52 ± 0.01 g), while ‘Van’ had the lowest (0.45 ± 0.01 g). However, the stone-flesh ratio, an important parameter for consumer appeal and fruit processing, was highest in ‘Boambe de Cotnari’ (6.69 ± 0.15%), suggesting a relatively larger proportion of stone to edible flesh. In contrast, ‘Stella’ had the lowest stone-flesh ratio (5.52 ± 0.09%), making it potentially more desirable for fresh consumption, as consumers typically prefer fruits with more flesh and smaller stones (Kappel & MacDonald, 2007).

Peduncle characteristics are important indicators of harvestability and market preference. ‘Stella’ displayed the longest peduncle (4.28 ± 0.07 mm) and the heaviest (0.10 ± 0.00 g), which may benefit mechanical harvesting and reduce fruit detachment during handling and transport. Conversely, ‘Van’ had the shortest and lightest peduncles (2.88 ± 0.06 mm; 0.07 ± 0.00 g), which could increase the likelihood of fruit drop and mechanical damage.

Longer peduncles are also associated with improved postharvest shelf life due to reduced risk of stem detachment and dehydration (Demir & Kalyoncu, 2003). These finding are in accordance with previous studies that emphasize the role of varietal differences in determining both consumer preference and postharvest behavior (Crisosto et al., 1999).

While ‘Stella’ offers favorable traits in terms of low stone-flesh ratio and longer peduncles, ‘Boambe de Cotnari’ combines a larger stone with moderate peduncle traits, potentially making it more suited to processing than fresh markets.

Chemical characteristics of sweet cherries

The results of the biochemical analyses showed significant variations in soluble solids content (SSC), titratable acidity (TA), SSC/TA ratio, and pH (Table 5). The SSC values ranged from 15.74 ± 0.29 °Brix in ‘Boambe de Cotnari’ to 18.73 ± 0.40 °Brix in ‘Stella’, indicating significant differences among cultivars ($p < 0.05$). ‘Stella’ exhibited the highest sugar concentration, consistent with findings in previous studies where higher SSC is often associated with enhanced consumer preference due to perceived sweetness (Muskovics et al., 2006; Serrano et al., 2005).

Table 5. Chemical characteristics of the sweet cherry varieties under study

Variety name	SSC (°Brix)	Titratable acidity (mg malic acid 100^{-1} mL)	TSS/TA	pH
'Napoleon'	18.12 ± 0.51 *b*	1.12 ± 0.01 *a*	16.11 ± 0.31 *c*	4.02 ± 0.01 *b*
'Van'	17.85 ± 0.39 *b*	1.35 ± 0.01 *b*	13.20 ± 0.11 *b*	4.11 ± 0.01 *c*
'Boambe de Cotnari'	15.74 ± 0.29 *a*	1.50 ± 0.01 *c*	10.47 ± 0.15 *a*	4.16 ± 0.02 *c*
'Stella'	18.73 ± 0.40 *c*	1.07 ± 0.01 *a*	17.49 ± 0.21 *d*	3.70 ± 0.01 *a*

The results are expressed as meand±standard error (n=40). Different lowercase letters indicate statistically significant differences between varieties for each variable according to Tukey's HSD test, p<0.05.

TA values were lowest in 'Stella' (1.07 ± 0.01 mg malic acid/100 mL) and 'Napoleon' (1.12 ± 0.01 mg), while 'Boambe de Cotnari' had the highest acidity (1.50 ± 0.01 mg). Similar values have been reported by Skrzyński et al., (2016) for 'Napoleon' when analysing the chemical attributes of various sweet cherry cultivars. The differences in acidity may influence taste perception and shelf life, with higher TA potentially conferring greater microbial stability but less palatability (Crisosto et al., 2003).

SSC/TA ratio, a key indicator of flavor balance, varied significantly among the cultivars. 'Stella' recorded the highest ratio (17.49 ± 0.21), indicating a sweeter and more balanced taste, while 'Boambe de Cotnari' showed the lowest (10.47 ± 0.15), suggesting a more acidic flavor profile. The SSC/TA ratio is frequently used to assess fruit maturity and acceptability, with higher values generally favored by consumers (Kader, 2008). The pH ranged from 3.70 in 'Stella' to 4.16 in 'Boambe de Cotnari'. Interestingly, despite having the highest acidity, 'Boambe de Cotnari' also had the highest pH, potentially due to buffering compounds present in the juice matrix. This suggests that pH alone may not be a sufficient predictor of perceived acidity, aligning with prior findings (Mattheis & Fellman, 1999).

Assessing vitamin C levels among the selected sweet cherry varieties provide valuable insights into their potential health benefits and commercial appeal. The results indicate that 'Van' had the highest vitamin C content (9.52 ± 0.02 mg/100 g FW), while 'Stella' had the lowest (8.10 ± 0.03 mg/100 g FW) as shown in Table 6).

Table 6. Bio-chemical compounds and antioxidant activity of the investigated sweet cherry varieties

Variety name	Vitamin C (mg/100 g FW)	TPC (mg GAE/100 g FW)	TFC (mg QE/100 g FW)	DPPH (%)
'Napoleon'	8.51 ± 0.01 *b*	103.21 ±2.51 a	22.79 ± 0.99 b	25.1 ± 0.10 a
'Van'	9.52 ± 0.02 *d*	356.26 ±4.39 b	53.11 ± 2.36 d	45.8 ± 0.73 b
'Boambe de Cotnari'	8.93 ± 0.01 *c*	98.33 ± 2.29 a	9.92 ± 0.78 a	23.9 ± 0.12 a
'Stella'	8.10 ± 0.03 *a*	398.66 ± 3.19 b	40.22 ± 1.88 c	53.3 ± 0.16 c

The results are expressed as meand±standard error (n=40). Different lowercase letters indicate statistically significant differences between varieties for each variable according to Tukey's HSD test, p<0.05.

These values are within the typical range reported for sweet cherries (Muskovics et al., 2006). Vitamin C, an essential water-soluble antioxidant, contributes to the nutritional value of cherries and enhances their oxidative stress resistance (Wu et al., 2004). The differences observed may be attributed to genetic variability among cultivars as well as environmental and agronomic factors (Fenech et al., 2019). Phenolic compounds are crucial contributors to the antioxidant properties of fruits and have been linked to various health benefits, including anti-inflammatory and anticancer effects (Fonseca et al., 2021; Paskucza et al., 2021; Cuevas-Cianca et al., 2023).

The highest TPC was recorded in 'Stella' (398.66 ± 3.19 mg GAE/100 g FW) and 'Van' (356.26 ± 4.39 mg), while both 'Napoleon' and

'Boambe de Cotnari' exhibited significantly lower levels (103.21 ± 2.51 and 98.33 ± 2.29 mg, respectively) as presented in Table 6. These results are compatible with those obtained by Corneanu et al. (2021) who found very similar TPC in 'Van' (323.56 mg GAE/100 mL), 'Boambe de Cotnari' (92.25 mg GAE/100 mL) and 'Stella' (363.50 mg GAE/100 mL). The results align also with other previous findings that TPC is cultivar-dependent and often correlates with antioxidant capacity (Moutinho-Pereira et al., 2007).

Flavonoids are a subclass of phenolics with strong antioxidant activity, and their abundance enhances the nutraceutical quality of fruits (Heim et al., 2002; Nikolova et al., 2013).

In terms of TFC, 'Van' exhibited the highest TFC (53.11 ± 2.36 mg QE/100 g FW), followed by 'Stella' (40.22 ± 1.88 mg).

'Boambe de Cotnari' had the lowest TFC (9.92 ± 0.78 mg), indicating a much lower concentration of these bioactive compounds (Table 6).

The TFC pattern resulted was very similar to that of TPC, suggesting a strong interrelationship between these two parameters.

Antioxidant capacity, as measured by DPPH free radical scavenging, ranged from 23.9% in 'Boambe de Cotnari' to 53.3% in 'Stella'. 'Stella' and 'Van' (45.8%) showed considerably higher antioxidant activities, consistent with their elevated levels of phenolics and flavonoids. These findings reinforce the well-established correlation between polyphenolic content and antioxidant potential in sweet cherries (Serra et al., 2012). Meanwhile, the relatively low antioxidant capacity in 'Napoleon' and 'Boambe de Cotnari' reflects their modest bioactive compound profiles.

Pearson correlation analysis revealed strong associations among several biochemical traits and their relationship with antioxidant activity (DPPH). The most significant finding was the very strong positive correlation between total phenolic content (TPC) and DPPH activity ($r = 0.99$, $p < 0.05$), indicating that phenolics are the primary contributors to the antioxidant potential in sweet cherry fruits (Table 7). This is consistent with numerous studies highlighting phenolic compounds as major antioxidants in cherries and other fruits (Serra et al., 2012; Moutinho-Pereira et al., 2007).

Table 7. Pearson's correlation coefficients between chemical features of the sweet cherry varieties

Variables	SSC	TA	pH	Vit C	TPC	TFC	DPPH
TSS	1						
TA	-0.91	1					
pH	-0.74	0.83	1				
Vit C	-0.37	0.70	0.78	1			
TPC	0.64	-0.36	-0.60	0.01	1		
TFC	0.69	-0.32	-0.33	0.31	0.89	1	
DPPH	0.67	-0.43	-0.68	-0.09	0.99*	0.85	1

*Significant correlation at p<0.05. TSS-total soluble solid content; TA-titratable acidity; TPC-total phenolic content; TFC-total flavonoid content; DPPH-2,2′-diphenyl-1-Picrylhydrazyl.

A similarly strong positive correlation was observed between total flavonoid content (TFC) and DPPH ($r = 0.85$), supporting the role of flavonoids as key antioxidant constituents (Heim et al., 2002). The high intercorrelation between TPC and TFC ($r = 0.89$) suggests a substantial overlap in these two groups of compounds, both structurally and functionally, which collectively enhance the radical scavenging capacity of the fruit. In contrast, vitamin C showed no meaningful correlation with DPPH activity ($r = –0.09$), indicating a limited contribution of ascorbic acid to overall antioxidant potential in these cultivars. This finding confirms previous reports suggesting that in cherries, polyphenols are more influential contributors than vitamin C when determining antioxidant capacity (Wu et al., 2004; Muskovics et al., 2006).

Interestingly, soluble solids content (TSS) was moderately positively correlated with both TPC ($r = 0.64$) and DPPH ($r = 0.67$), suggesting that cultivars with higher sugar content may also have increased polyphenol accumulation, possibly due to shared metabolic pathways (Scalbert et al., 2005). On the other hand, titratable acidity (TA) showed a strong negative correlation with TSS (r = –0.91) and moderate negative correlation with DPPH (r = –0.43), while pH was negatively associated with DPPH (r = –0.68), reinforcing the idea that sweeter, less acidic fruits tend to exhibit greater antioxidant activity.

CONCLUSIONS

The pomological and chemical evaluation of the sweet cherry varieties grown in the urban orchard revealed significant variability in both morphological traits and biochemical composition among the studied cultivars. Differences in fruit size, firmness, soluble solids content, titratable acidity, and vitamin C levels highlights the influence of genetic factors and urban environmental conditions on fruit quality. These findings also shed light to the potential of specific varieties for urban horticulture based on their superior agronomic and nutritional characteristics. These insights are valuable to understand better the varietal performance in non-traditional growing environments and support informed selection for urban orchard planning, local consumption, and potential health benefits.

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