Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Variation in Polyphenols and Antioxidant Activity of Different Fruit Parts of White Sapote (Casimiroa edulis)

Iressa Dasa
Ethiopian Institute of Agricultural Research (EIAR)
Wabi Bajo
wabib214@gmail.com

Ethiopian Institute of Agricultural Research (EIAR)

Article

Keywords: Casimiroa edulis, Fruit peel, Fruit seed, Flavonoids, Phenolics

Posted Date: November 17th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11398163/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

White sapote (Casimiroa edulis) is an underutilized fruit with potential for value-added food and beverage applications, offering a wealth of nutritional and bioactive substances. However, the specific profiles related to different parts and varieties are not well understood under Ethiopian agricultural conditions. This research assessed the physicochemical properties, total phenolic content (TPC), total flavonoid content (TFC), and DPPH radical-scavenging activity of various anatomical parts (fruit peel, seed, flesh, and whole fruit) among four varieties of casimiroa edulis (SEP-8, SEP-37, 56/66, and 64/8). The results showed that significant varietal differences were observed in TSS, pH, and TA. SEP-8 had the highest total soluble solids (20.2 °Brix) and titratable acidity (0.19%), along with the lowest pH (5.43), whereas variety 56/66 had the lowest TSS (16.9 °Brix) and TA (0.15%). Phytochemical analysis indicated considerable tissue-specific differences, with the fruit peel consistently identified as the primary source of bioactive compounds. The peel of variety 64/8 exhibited impressive levels of TFC (397.5 µg/g), TPC (458 µg/g), and DPPH scavenging activity (85.44%). Seeds also contained notable phenolic levels (289.5–346 µg/g, outperforming edible flesh in bioactive capacity. Comparing whole fruit to flesh, whole fruit consistently exhibited higher phenolic levels and free radical scavenging capacity (24.50 µg/g -43.03% vs. 14.55 µg/g -22.78%), driven largely by peel constituents. This finding highlights casimiroa edulis fruit potential for value-added food products processing, particularly the utilization of its by-products, such as peels and seeds, as functional and antioxidant-rich ingredients for food applications.

1. Introduction

White sapote (*Casimiroa edulis La Llave & Lex*.) is a fruit-bearing tree from the Rutaceae family, originally found in the mountainous regions of Mexico and Central America (Crane & Balerdi, 2018). It thrives in both tropical and subtropical climates (Satheesh, 2015). Various studies have documented the presence of Casimiroa edulis (CE) in different regions of Ethiopia. For example, it is referred to as Kasmire in the southern region (Satheesh, 2015) and is cultivated as a food source in home gardens in Dheeraa town, Arsi, in central Ethiopia (Regassa, 2013). Its integration into Ethiopian agricultural practices and the attributes of its edible fruit suggest that it could serve as an underutilized fruit resource for nutritional analysis and the development of value-added food products. Additionally, research has identified CE in the forested areas of the southeastern Rift Valley in Ethiopia (Wondimu et al., 2026), where these trees provide shade for coffee crops and their fruits serve as a food source.

Casimiroa Edulis is widely enjoyed across various regions globally for its nutritious fruit, which is abundant in sugars, proteins, ascorbic acid, phenols, carotenoids, polyunsaturated fatty acids, and minerals such as iron, copper, zinc, calcium, and potassium (Elkady et al., 2017). In many cultures, it has been traditionally utilized as a sleep aid due to its notable sedative-like properties. In addition to its nutritional benefits, casimiroa edulis is acknowledged for its bioactive compounds, such as phenolics, flavonoids, carotenoids, vitamin C, and essential minerals. Recent research has validated its phenolic content and antioxidant capabilities, with findings indicating that white sapote pulp contains roughly

48.7 mg GAE/100 g of total phenolics and exhibits significant antioxidant activity (Elbadrawy et al., 2025; Abo Taleb and Abdul Latif, 2023).

The phenolic and flavonoid components of casimiroa edulis are partially responsible for its antioxidant capacity. Its peel and seed kernel have been found to contain a variety of phenolic compounds, such as pyrogallol, chlorogenic acid, p-hydroxybenzoic acid, catechin, epicatechin, and gallic acid (Elkady et al., 2017), indicating that variations in the phytochemical composition of fruit tissues may affect their antioxidant capacity. Its seeds and leaves have been shown to have anticonvulsant properties and to influence blood pressure, cardiac activity, and aortic muscular tone. Additionally, phenolic compounds, flavonoids, alkaloids, coumarins, and limonoids are present in the seed kernels (Awaad et al., 2008; Elkady et al., 2017).

Studies on fruit processing demonstrate casimiroa edulis's potential as a source of bioactive compounds. Recent studies on white sapote fruit and powder have also shown significant phenolic content and antioxidant activity, suggesting that processing and drying can affect the retention of these bioactive compounds. Genanew et al. (2022) reported measurable phenolic and flavonoid contents in casimiroa edulis juice produced in Ethiopia. The phytochemical richness of casimiroa edulis is further supported by recent research. Numerous phytochemicals, especially polyphenolic compounds like gallic acid and daidzein, have been found in its leaves and have been shown to have biological effects related to antioxidants (Gamal et al., 2026).

Despite growing evidence, little is known about the differences in antioxidant activity and polyphenol content between casimiroa edulis fruit tissues and varieties, especially in Ethiopia. While antioxidant activity is impacted by the total phenolic content and the makeup of individual phenolics and other antioxidant compounds, such variation may reflect variations in genotype, tissue, maturity, growing conditions, and processing. Thus, this study assessed the antioxidant activity, total phenolic and flavonoid contents of casimiroa edulis fruit, concentrating on variations between varieties as well as between whole fruit, seeds, peel, and edible flesh. The results will help characterize and possibly use white sapote as a source of bioactive compounds for food products with added value.

2. Materials and Methods

2.1 Casimiroa fruit collection and preparation

Four pipelines of White Sapote fruit were collected from Melkassa Agricultural Research Center tropical fruits experimental field. Well matured, healthy and ripe fruits were harvested, separated into peel, seed and flesh, and crushed into juice depending on the purpose of analysis.

2.2. Physicochemical parameters analysis

Juice volume, seed and peel weights of the fruit were determined by taking 2kg of ripe and healthy White Sapote. The fruit was carefully peeled and the pulp was crushed to form juice and then volume was

measured with a known volume of beaker. The peel and seeds were weighed by using laboratory scale balance and the reading recorded. Total soluble solids were determined using a refractometer and reported as degrees Brix (Brix). pH was measured with calibrated electronic pH meter. Titratable acidity (TA) was determined by titrating 5 mL juice sample diluted in 50 mL distilled water with 0.1 M sodium hydroxide to the endpoint (pH 8.2 ± 0.1 and phenolphthalein indicator turn to light pink) (Tyl & Sadler, 2017). Total acidity was calculated and expressed as % of citric acid equivalents per 100 mL (g CAE/100 mL) for casimiroa edulis juice.

$$titratable\ acidity\ (\%) = \frac{V * N * Equivalent\ weight * 100}{Vsample * 1000}$$

V volume of NaOH used (mL), N normality of NaOH, Vsample volume of sample (mL)

2.3. Total phenolic content

Total phenolic content of the fruit was determined using Folin-Ciocalteu method proposed by Arruda et al. (2017) with slight modification. About 500 mL methanolic extract of sample was mixed with 2 mL sodium carbonate (7.5%) and 2.5 mL aqueous solution of Folin-Ciocalteu (10%). The mixture was incubated at 50^{o}c for 5 minutes in water bath. The absorbance of the sample solution was read by spectrophotometry at 760 nm. The standard curve containing 10–90 μ.mL^{-1} gallic acids was constructed and used for the calculation of total phenols. The phenolic content was expressed as mg of gallic acid equivalents (GAE) per litre of sample.

2.4. Total flavonoids content

Determination of total flavonoids was done by following Method of Zhishen et al. (1999). About 100 μL of sample was mixed with 0.15 mL of $NaNO_2$ and left to react with each other for 5 minutes. Then, 0.15 mL of $AlCl_3$ was added to the mixture and kept reacting for a minute. Finally, 1mL NaOH and 1.2 mL water was also added and the absorbance of the sample was read by spectrophotometer at 510 nm. Total flavonoids of the sample was quantified from the standard curve made from catechin standard containing concentration of (10 to 150 mgL^{-1}), and was expressed as catechin equivalents.

2.5. DPPH radical-scavenging activityy

Anti-oxidant activity (DPPH (2,2-diphenyl-1-picrylhydrazyl radical reduction-test) of the fruit samples was performed according to Roesler (2007). The anti-oxidant activity was determined following a modified method described by Brand-Williams et al. (1995) using DPPH. The casimiroa juice (0.1 g) was extracted with 1 mL methanol for two hours and centrifuged for 10 minutes at 3000 RPM. A 100 μL of the supernatant was added with 3.9 mL of 6*10 − 5 mol/L DPPH solution. The absorbance of the samples was read at 515 nm at 0 minute and 30 minutes using spectrophotometer (GENEYSIS UV, Madison, USA). Methanol was used as the blank, and antioxidant activity was calculated as % discoloration.

2.6. Statistical design and analysis

The experiment followed a completely randomized design. Analytical determinations were performed in triplicate. Data were analyzed by analysis of variance (ANOVA), and means were separated using Tukey's multiple-comparison test at the 5% significance level. Results are reported as mean ± standard deviation. Statistical analyses were performed using Minitab 16.

3. Results and Discussion

3.1. Color characteristic of the white sapote

The Table 1 reports the CIE L*, a*, and b* color parameters of flesh juice from four Casimiroa edulis varieties evaluated at Melkassa Agricultural Research Center. The results show clear variety-to-variety significant differences in lightness, redness/greenness and yellowness, indicating genetic or physiological variation in flesh color.

The L* value, which represents lightness on a scale of 0 (black) to 100 (white), varied from 60.71 to 66.19. SEP-8 had the highest L* value (66.19), followed by SEP-37 (62.95). 56/66 (60.94) and 64/8 (60.71) had significantly lower values. As a result, SEP-8 produced the lightest/brightest flesh juice, while 64/8 produced the darkest among the evaluated varieties. The relatively high L* values across all varieties indicate that the flesh juice was generally light in appearance rather than strongly pigmented one.

Table 1
Color properties of *Casimiroa edulis* (CE) flesh juice

Variety	L*	a*	b*
SEP-8	66.19 ± 0.17^{a}	2.09 ± 0.00^{b}	36.09 ± 0.14^{b}
SEP-37	62.95 ± 0.53^{b}	2.73 ± 0.09^{a}	40.53 ± 0.10^{ab}
56/66	60.94 ± 1.46^{bc}	0.19 ± 0.01^{d}	42.31 ± 3.47^{a}
64/8	60.71 ± 0.10^{c}	1.63 ± 0.02^{c}	44.81 ± 0.14^{a}

This range is broadly comparable with previously reported values for white sapote products. Abo Taleb and Abdul Latif (2023) reported an L* value of 59.71 for white sapote material. Relatively higher L* values observed in the Melkassa varieties, particularly SEP-8, may partly reflect the fact that the present analysis was performed on fresh flesh juice, whereas the comparison studies involved dried or processed material. Drying can substantially modify optical properties through water removal, pigment concentration and non-enzymatic browning.

The* values ranged from 0.19 to 2.73, with SEP-37 having the highest and variety 56/66 the lowest. SEP-8 and 64/8 showed intermediate values of 2.09 and 1.63, respectively. Recent research on white sapote processing demonstrates the importance of processing conditions in determining color. Daksa & Tolesa

(2024) found that drying and pre-drying treatments affected the quality of C. edulis slices, indicating that thermal treatment and pretreatment can alter the physicochemical properties of white sapote.

Regarding the b* values, variety 64/8 had the highest b* value (44.81), while SEP-8 had the lowest (36.09). The high b* value of variety 64/8 suggests that this variety had the most pronounced yellow coloration. García-Mateos et al. (2023), working with black sapote (*Diospyros digyna*), reported substantial variation in L*, a* and b* values depending on processing and pH, demonstrating that sapote fruit pigments can be highly responsive to processing conditions. Their reconstituted sapote powders showed L* values of approximately 66.77–84.84 and b* values of 39.41–67.71. The strong yellow component is consistent with recent observations of casimiroa edulis. The previous study have been reported that white sapote can occur as both white- and yellow-fleshed fruit and explicitly related flesh color to fruit skin color (Tolera et al., 2025).

3.2. Physico-chemical characteristics of the juice

The juice volume, seed weight, and peel weight did not differ significantly among varieties, although numerical differences were observed. Juice volume ranged from 560 to 593 mL, with SEP-8 demonstrating the highest value, whereas 64/8 had the lowest. Seed weight varied from 222 to 257 g, and peel weight ranged from 107.5 to 134 g, with 64/8 showing the highest peel weight. Although numerical differences were observed, the absence of statistical significance indicates that these variations were insufficient to establish meaningful differences among the evaluated varieties.

Table 2
Physico-chemical characteristics of casimiroa edulis fruit.

Variety	JV (mL)	SW (g)	PW (g)	TSS (^{0}brix)	pH	TA (%)	Sugar/acid
SEP-8	593^a	222^a	109.5^a	20.2^a	5.43^c	0.19^a	103.16^a
SEP-37	575^a	252.5^a	115^a	18.3^{bc}	5.45^c	0.17^{ab}	107.2^a
56/66	590^a	235^a	107.5^a	16.9^c	5.83^b	0.15^b	111.43^a
64/8	560^a	257^a	134^a	19.3^{ab}	6.06^a	0.16^b	115.81^a

JV, juice volume; SW, seed weight; PW, peel weight; TSS, total soluble solids; TA, titratable acidity

Chemical characteristics showed statistically significant difference among pipeline varieties. TSS content ranged from 16.9 to 20.2 °Brix, with SEP-8 showing the highest value (20.2 °Brix), indicating greater soluble solids and potentially higher sweetness, while 56/66 the lowest value (16.9 °Brix). The values were comparable with the 19.33 °Brix reported for fresh white sapote by Abo Taleb and Abdul Latif (2023), but higher than the 15.60 °Brix reported in white sapote pulp by Khalil et al. (2022). Such variation could be associated with genotype, maturity, growing conditions, and postharvest handling. Titratable acidity ranged from 0.15 to 0.19%, with SEP-8 showing the highest value. These values were

close to the 0.14% reported by Abo Taleb and Abdul Latif (2023) but lower than the 0.44% reported by Tolera et al. (2023). The pH values (5.43–6.06) were generally consistent with the low-acid character of white sapote; Khalil et al. (2022) reported pH 5.80. The inverse pattern between pH and titratable acidity was also evident, with SEP-8 showing the lowest pH and highest acidity, whereas 64/8 showed the highest pH. The increased TSS of SEP-8 maybe attributed to genotyping differences. This trait is advantageous for fresh consumption and juice processing because it contributes to consumer acceptability and sweetness.

The titratable acidity (TA) ranged from 0.15–0.19%, indicating mildly acidic fruits. SEP-8 had the highest TA (0.19%), while 56/66 had the lowest (0.15%). These values were lower than the 0.44% reported by Tolera et al. (2023), suggesting variation due to genotype, maturity, growing conditions, or postharvest handling. The slightly higher TA of SEP-8 may contribute to a more pronounced acidic taste, while the balance between sugars and acids influences overall fruit acceptability.

The pH values supported the TA findings, with SEP-8 and SEP-37 having the lowest pH (5.43 and 5.45), and 64/8 having the highest (6.06). Khalil et al. (2022) reported a pH of 5.80 for white sapote pulp, which is consistent with these values. The relatively high pH indicates that white sapote is a low-acid fruit. The inverse relationship between pH and TA was also evident, with SEP-8 having the highest TA and the lowest pH, and 64/8 having the lowest TA and highest pH. Although the sugar/acid ratio ranged from 103.16 to 115.81, the varieties did not differ significantly.

3.3. Phenolic and flavonoid composition and antioxidant activity of peel and seed

The results of total flavonoids, total phenols and DPPH antioxidant activity is presented in Table 3. Marked tissue and variety dependent differences were observed in TPC, TFC, and DPPH activity. The peel was the richest tissue in polyphenols and antioxidant activity. Peel TFC ranged from 16.5 to 397.5 µg/g, TPC from 196.5 to 458 µg/g, and DPPH activity from 26.58 to 85.44%. Variety 64/8 showed the highest values for all three measures, whereas SEP-8 showed the lowest. This strong variation indicates that genotype and tissue are important determinants of phytochemical accumulation.

Table 3
Total flavonoid, total phenolic and DPPH antioxidant activity of casimiroa edulis peel and seed

Variety	Fruit peel			Fruit seed		
	TF (µg/g)	TP (µg/g)	DPPH, %	TF(µg/g)	TP(µg/g)	DPPH (%)
SEP-8	16.5^{c}	196.5^{c}	26.58^{c}	27^{a}	332.5^{a}	46.84^{a}
SEP-37	129.5^{b}	320.5^{b}	70.25^{b}	13^{b}	293.5^{a}	24.68^{b}
56/66	122.5^{b}	319^{b}	68.35^{b}	17^{ab}	289.5^{a}	44.93^{a}
64/8	397.5^{a}	458^{a}	85.44^{a}	9^{b}	346^{a}	20.88^{b}
TF-total flavonoids, TP-Total phenolics						

Peel

The peel generally represented the richest tissue in polyphenolic compounds than the flesh. The seed also contained considerable amounts of phenolic compounds and exhibited stronger antioxidant activity than the flesh. These differences indicate that the distribution of secondary metabolites in casimiroa edulis is strongly dependent on both fruit tissue and genotype. The high antioxidant potential of the 64/8 pipeline peel is consistent with recent work showing that white sapote peel is a concentrated source of polyphenols and exhibits measurable radical-scavenging activity (Silva-Jara et al., 2026). Earlier chromatographic work also demonstrated diverse phenolic constituents in casimiroa edulis peel, including pyrogallol and other phenolic compounds (Elkady et al., 2017). Because peel is normally discarded during fresh consumption and processing, its high phytochemical content provides a basis for investigating it as a value-added ingredient.

In the peel, total flavonoid content (TFC) ranged from 16.5 to 397.5 µg/g, while total phenolic content (TPC) varied from 196.5 to 458 µg/g. The antioxidant activity measured by DPPH radical-scavenging activity ranged from 26.58 to 85.44%. Among the four pipelines, 64/8 exhibited the highest TFC (397.5 µg/g), TPC (458 µg/g), and DPPH activity (85.44%), whereas SEP-8 recorded the lowest values (16.5 µg/g, 196.5 µg/g, and 26.58%, respectively). SEP-37 and 56/66 showed intermediate but statistically similar TFC, TPC and DPPH values.

The particularly high phenolic and flavonoid concentrations in the peel of 64/8 suggest that it is an important reservoir of antioxidant phytochemicals in *casimora edulis*. This is consistent with Silva-Jara et al. (2026), who reported substantial polyphenolic and flavonoid contents and measurable DPPH radical-scavenging activity in white sapote peel extracts. The higher antioxidant activity observed in 64/8 may reflect varietal differences in phenolic biosynthesis, fruit maturity, environmental conditions, or the composition and structure of individual phenolic compounds.

Seeds

Seed TPC ranged from 289.5 to 346 µg/g, exceeding the flesh range of 169.5–237.5 µg/g. SEP-8 had the highest seed TFC (27 µg/g) and DPPH activity (46.84%), while 64/8 had the highest seed TPC (346 µg/g). The tissue-specific distribution of TPC agrees with previous evidence that C. edulis seed kernels contain phenolic and flavonoid compounds and exhibit antioxidant activity (Elkady et al., 2017). However, the seed should not be assumed to be suitable for direct food use without appropriate safety assessment; the present study establishes phytochemical potential rather than dietary safety. SEP-37 had intermediate TPC (293.5 µg/g) and lower TFC (13 µg/g) and DPPH activity (24.68%), while 56/66 had 289.5 µg/g TPC, 17 µg/g TFC and 44.93% DPPH activity.

The relatively high TPC of all seed samples indicates that the seed is another important phenolic-rich tissue of *casimiroa edulis*. This finding agrees with recent phytochemical literature emphasizing the presence of phenolic compounds in *casimiroa edulis* fruit by-products. A previous finding on phytochemical study of *casimiroa edulis* also identified polyphenols as an important component of the species' phytochemical profile and specifically recognized previous research demonstrating phenolic compounds in fruit peel and seed extracts (Domínguez-Delgado et al., 2026; Elkady et al., 2017). The present results provide evidence that the seed should not be considered merely a waste fraction but rather a potentially valuable source of bioactive compounds. Their chromatographic analysis also showed tissue-specific phenolic profiles, suggesting that differences in antioxidant activity may reflect both compound concentration and composition.

3.4. Phenolic and flavonoid composition and antioxidant activity of whole fruit and flesh

The phenolic and flavonoid contents and DPPH antioxidant activity of the casimiroa edulis fruit pipelines are shown In Table 4. Whole fruit and flesh also differed substantially among varieties in their Phenolic and flavonoid composition and antioxidant activity ($p < 0.05$).

Whole fruit

Whole-fruit TPC ranged from 204.5 to 274 µg/g, TFC from 21.0 to 96.5 µg/g, and DPPH activity from 24.50 to 43.03%. SEP-37 had the highest TFC (96.5 µg/g), whereas 56/66 and 64/8 had the highest TPC (274 µg/g). The strongest DPPH activity occurred in 56/66 (43.03%), while SEP-37, despite having the highest TFC, showed lower activity (24.50%). This lack of a simple correspondence between TFC and DPPH activity was observed. This finding indicates that antioxidant activity depends not only on total flavonoid content but also on the composition of individual phenolic compounds and other antioxidant constituents.

The relatively high phenolic content and antioxidant activity of whole fruit are consistent with recent evidence that *casimiroa edulis* is a source of diverse bioactive phenolic compounds. Previous investigation of C. edulis demonstrated that its fruit tissues contain appreciable amounts of phenolic and flavonoid compounds and exhibit antioxidant activity in DPPH and ABTS radical-scavenging assays (Elkady et al., 2017). A key finding in this study was the higher phenolic/flavonoid content and

antioxidant activity of whole fruit compared with flesh. For example, SEP-37 TF increased from 5.0 to 96.5 µg/g and DPPH activity from 18.35 to 24.50%, while 56/66 TP increased from 174.5 to 274 µg/g and DPPH activity from 14.55 to 43.03%. The marked DPPH increase in 56/66 despite its modest TF level suggests that non-flavonoid phenolics and other bioactive compounds contribute substantially to antioxidant activity. These varietal differences are relevant for breeding and food-utilization strategies.

Table 4
Total flavonoid and phenolic contents and DPPH radical-scavenging activity of Casimiroa edulis fruit flesh and whole fruit

Variety	Fruit flesh			Whole fruit		
	TF (µg/g)	TP (µg/g)	DPPH (%)	TF (µg/g)	TP (µg/g)	DPPH (%)
SEP-8	2.5^{a}	169.5^{b}	22.78^{a}	21^{a}	221^{b}	25.32^{b}
SEP-37	5^{a}	183.5^{b}	18.35^{ab}	96.5^{a}	204.5^{b}	24.5^{b}
56/66	6^{a}	174.5^{b}	14.55^{b}	45.5^{a}	274^{a}	43.03^{a}
64/8	4.5^{a}	237.5^{a}	22.15^{a}	46.5^{a}	274^{a}	31.01^{b}

Flesh

In flesh, TPC ranged from 169.5 to 237.5 µg/g, with 64/8 showing the highest value. TFC varied only from 2.5 to 6.0 µg/g and did not differ significantly among varieties. DPPH activity ranged from 14.55 to 22.78%, with SEP-8 and 64/8 showing the highest values. The relatively narrow TFC range, together with variation in DPPH activity, suggests that non-flavonoid phenolics and other antioxidant constituents may contribute to the observed radical-scavenging response. The lack of a consistent relationship between total phenolics and DPPH activity suggests that antioxidant capacity depends more on the qualitative composition of phenolic compounds than on their total concentration, as different polyphenols in *C. edulis* contribute to its biological activity (Gamal et al., 2025).

In contrast, the differences in TF among flesh samples were not statistically significant. DPPH activity ranged from 14.55 to 22.78%, with SEP-8 and 64/8 showing the highest activity and 56/66 the lowest. The present flesh results are comparable with Khalil et al. (2022), who reported appreciable phenolic content and DPPH antioxidant activity in white sapote pulp, along with ascorbic acid and other bioactive compounds, highlighting its potential as an antioxidant-rich food ingredient. These findings aligns with the results of Elbadrawy et al. (2025), who investigated the nutritional and antioxidant properties of *casimiroa edulis* fruit and reported appreciable antioxidant potential in white sapote fruit. Generally, it was observed that both whole fruit and flesh contained phenolic and flavonoid compounds with measurable antioxidant activity, although their levels varied considerably among varieties. Whole fruit generally showed greater phytochemical richness than the flesh.

4. Conclusion

The four casimiora edulis varieties showed similar physical fruit characteristics but significant variation in physicochemical quality and antioxidant-related traits. SEP-8 showed the most favorable overall physicochemical characteristics, particularly its high juice volume, TSS, and acidity, while 64/8 had the highest peel weight and pH. Polyphenol accumulation was strongly dependent on fruit anatomical parts and variety, with peel showing the greatest overall TPC, TFC, and DPPH activity. The 64/8 peel was particularly promising, whereas seeds also contained substantially more phenolics than edible flesh. Whole fruit generally showed greater phytochemical content and antioxidant activity than flesh alone, highlighting the contribution of non-flesh tissues. These findings suggest that SEP-8 may be particularly suitable for juice processing and other value-added applications. Besides, it supports further investigation of casimiroa edulis peel and seed fractions for food and ingredient applications. Future studies should identify individual phenolic compounds and evaluate bioaccessibility, safety, processing stability, and biological relevance before functional-food or health claims are made.

Declarations

Conflict of Interest

The author declares no conflict of interest regarding the publication of this article.

Consent for publications

Not applicable

Funding

The authors received no direct funding for this manuscript

Author Contribution

I.D: Contributed to proposal development, data collection and organizing, mnuscript editing and reviewingW.B: Contributed to data analysis, manuscript draft, reviewing

Acknowledgement

Authors acknowledge Melkassa Agricultural Research Center for financial and facility support.

Data Availability

All data supporting the findings of this study are available within the paper

References

1. Abo Taleb, H. M. & Abdul Latif, M. M. Evaluation of physical and chemical properties of white sapote (*Casimiroa edulis*) fruits and powder. *Food Technol. Res. J.* **1** (3), 42–52. https://doi.org/10.21608/ftrj.2023.301862 (2023).
2. Arruda, H. S., Pereira, G. A. & Pastore, G. M. Optimization of extraction parameters of total phenolics from Annona crassiflora Mart.(Araticum) fruits using response surface methodology. *Food. Anal. Methods*. **10** (1), 100–110. https://doi.org/10.1007/s12161-016-0554-y (2017).
3. Awaad, A. S., El-Sayed, N. H., Maitland, D. J. & Mabry, T. J. Phenolic antioxidants from Casimiroa edulis. leaves. *Pharm. Biol.* **44** (4), 258–262. https://doi.org/10.1080/13880200600713899 (2006).
4. Brand-Williams, W., Cuvelier, M. E. & Berset, C. L. W. T. Use of a free radical method to evaluate antioxidant activity. *LWT-Food Sci. Technol.* **28** (1), 25–30. https://doi.org/10.1016/S0023-6438(95)80008-5 (1995).
5. Crane, J. H. & Balerdi, C. F. White Sapote Growing in the Home Landscape: HS1054/HS304, 11/2005. *EDIS* https://doi.org/10.32473/edis-hs304-2005 (2006). 2006(21.
6. Daksa, T. W. & Tolesa, G. N. Evaluation of selected drying models of white sapote (Casimiroa edulis L.) slices as affected by drying methods and pre-drying treatments. *Heliyon* **10** (2). 10.1016/j.heliyon.2024.e24440 (2024).
7. Domínguez-Delgado, C. L. et al. Casimiroa edulis Leaf Extract–Loaded PLGA Nanoparticles: Untargeted Phytochemical Profiling and Wound-Healing-Oriented Antioxidant/Occlusive Characterization. *Pharmaceutics* **18** (2), 249. https://doi.org/10.3390/pharmaceutics18020249 (2026).
8. Elbadrawy, E., Elkewawy, H. & Karam, A. Nutritional value of white sapote (*Casimiroa edulis*) fruit, its antioxidant and anti-inflammatory activities in diabetic rats. *Biol. Biomedical J.* **3** (1), 154–165. https://doi.org/10.21608/BBJ.2024.322444.1041 (2025).
9. Elkady, W. M., Ibrahim, E. A., Gonaid, M. H., Baz, E. & F. K Chemical profile and biological activity of Casimiroa Edulis non-edible fruits parts. *Adv. Pharm. Bull.* **7** (4), 655. 10.15171/apb.2017.079 (2017).
10. Gamal, M., Othman, S., Sabry, M. M., Hussein, M. A. & El Gizawy, H. A. Polyphenolics profile of *Casimiroa edulis* Llave. and evaluation of its hepatoprotective potential. *Curr. Bioact. Compd.* **22** (3), e15734072368019. https://doi.org/10.2174/0115734072368019250220042134 (2026).
11. Genanew, T. Z., Zegeye, A. & Banjaw, B. T. Characterization and optimization of *Casimiroa* (*Casimiroa edulis*) fruit juice using response surface methodology (RSM). *Int. J. Agricultural Sci. Food Technol.* **8** (2), 90–101. https://doi.org/10.17352/2455-815X.000150 (2022).
12. Khalil, O. S., Ismail, H. A. & Elkot, W. F. Physicochemical, functional and sensory properties of probiotic yoghurt flavored with white sapote fruit (Casimiroa edulis). *Journal of Food Science and*

Technology, *59*(9), 3700-3710.10.1007/s13197-022-05393-5. (2022).

13. Regassa, R. Diversity and conservation status of some economically valued indigenous medicinal plants in Hawassa College of Teacher Education Campus, Southern Ethiopia. *Int. J. Adv. Res.* **1** (3), 308–328 (2013).
14. Satheesh, N. Review on distribution, nutritional and medicinal values of Casimiroa edulus llave-an underutilized fruit in Ethiopia. *Am-Euras J. Agric. Environ. Sci.* **15** (8), 1574–1583 (2015).
15. Silva-Jara, J. M. et al. Valorization of yellow, black, and white sapote peel byproducts: exploring their antioxidant, antimicrobial, and antibiofilm properties, along with computational mapping. *J. Chem. Technol. Biotechnol.* **101** (2), 433–448. https://doi.org/10.1002/jctb.70104 (2026).
16. Tolera, H., Abera, S., Tolesa, G. N. & Belachew, T. Effects of Zero Energy Evaporative Cooling Pads on the White Sapote (Casimiroa edulis L.) Fruit Quality and Storage Life. *J. Food Process. Preserv.* **2023** (1), 5401920. https://doi.org/10.1155/2023/5401920 (2023).
17. Tolera, H., Abera, S., Tolesa, G. N. & Belachew, T. Effect of Lemon and Ginger Extract in Cornstarch Edible Coating on Postharvest Quality and Shelf Life of White Sapote (Casimiroa edulis L.) Fruits. *J. Food Process. Preserv.* **2025** (1), 1004483. https://doi.org/10.1155/jfpp/1004483 (2025).
18. Tyl, C. & Sadler, G. D. pH and titratable acidity. In Food analysis (389–406). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-45776-5_22 (2017).
19. Wondimu, M. T., Yusuf, M. M., Gulti, M. B. & Gonfa, K. F. Unveiling woody species diversity and carbon storage potential of agroforestry systems in Southeast Ethiopia. *Ecol. Processes*. **15** (1), 29. https://doi.org/10.1186/s13717-026-00672-x (2026).
20. Zhishen, J., Mengcheng, T. & Jianming, W. The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. *Food Chem.* **64** (4), 555–559. https://doi.org/10.1016/S0308-8146(98)00102-2 (1999).

Figures



Figure 1

Processed CE fruit for analysis