International Journal of Agriculture and Biosciences 2025 xx(x): xx-xx.
https://doi.org/10.47278/journal.ijab/2025.075

RESEARCH ARTICLE
eISSN: 2306-3599; pISSN: 2305-6622

Evaluation of Major Elements, Physical Properties, and Hedonic Acceptance of Composite *Cucurbitaceae* Juice

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ABSTRACT

This study evaluated the major mineral content, physical characteristics, and sensory acceptability of composite juices formulated from different proportions of Cucurbitaceae fruits, including watermelon, cantaloupe melon, sky melon, and cucumber. The juice formulations consisted of three ratios of watermelon (W): cantaloupe melon (CM): sky melon (SM): cucumber (C), namely P1 (4:3:2:1), P2 (2:4:3:1) and P3 (4:2:1:3). Sensory evaluation involving 25 panelists was conducted to assess color, viscosity, taste, aroma, and overall acceptability. Physical and chemical properties analyzed included color values (L*, a*, b*), viscosity, total dissolved solids (TDS), pH, and mineral content (potassium, sodium, and phosphorus). The results showed significant differences ($P<0.05$) among the three formulations. P1 was the most preferred, receiving the highest scores for taste (3.89±0.33) and overall acceptability (3.68±0.56), which may be attributed to its balanced composition and higher watermelon proportion that enhanced sweetness and aroma. Physically, P1 also demonstrated the highest TDS, indicating a greater concentration of soluble solids. In terms of mineral content, P2 contained the highest potassium level (81.12mg/100g), while P3 had the highest sodium content (8.07mg/100g) and the lowest pH, indicating higher acidity. These findings suggest that formulation P1 (4:3:2:1) offers the most favorable combination of sensory quality, physical stability, and nutritional benefits, making it a promising functional beverage for supporting health and vitality.

Keywords: Composite, Cucurbitaceae, Juice, Major elements, Vitality.

Article History
Article # 25-140
Received: 25-Mar-25
Revised: 17-Apr-25
Accepted: 05-May-25
Online First: 16-May-25

INTRODUCTION

Around 41% of the Indonesian population, aged 15 to 49, are women of reproductive age in Indonesia, and they are a strategic group in the context of national health development. Productive-age women have an essential role in the family and society; they also often play dual roles as workers and household managers. This condition requires them to have good nutritional status in order to be able to carry out various responsibilities optimally. Lifestyle, dietary imbalances, and environmental stressors can contribute to fatigue, hormonal fluctuations, and reduced vitality of productive-age women (Cristea et al., 2020). Especially, dietary imbalances, such as low dietary diversity, can lead to poor nutritional status, increased body fat, and stress, contributing to fatigue, hormonal fluctuations, and reduced vitality in reproductive-age women (Iqbal et al., 2024). The Indonesian Ministry of Health, in collaboration with various agencies, has launched the Healthy and Productive Women Workers Movement (GP2SP) as a local implementation in supporting the international agreement of the Millennium Development Goals (MDGs) to fulfill fundamental human rights, especially women in developing countries (Saputra et al., 2024). One of the strategic solutions in making the GP2SP program a success is a healthy food consumption pattern that can be realized in the consumption of functional foods containing some major mineral elements

Cite this Article as: Susanti S, Denny HM, Nugraheni A, Kinasih ALF and Rachma YA, 2025. Evaluation of major elements, physical properties, and hedonic acceptance of composite *Cucurbitaceae* juice. International Journal of Agriculture and Biosciences xx(x): xx-xx. https://doi.org/10.47278/journal.ijab/2025.075

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resulting from the diversification of superior commodities in Indonesia, such as *Cucurbitaceae* fruit commodities (Chibisov et al., 2019).

Cucurbitaceae fruits, such as watermelon (*Citrullus lanatus*), cantaloupe melon (*Cucumis melo* var. cantalupensis), sky melon (a hybrid of Cucumis melo) and cucumber (*Cucumis sativus*), are extensively grown and consumed worldwide due to their refreshing flavor and high nutritional value. *Cucurbitaceae* family commodities contain major mineral elements such as potassium, sodium, and phosphor, which can support the vitality of women of productive age (Lvovna et al., 2023; Prabakaran et al., 2024). Potassium, high in melons, is an essential mineral that plays a vital role in maintaining electrolyte balance, blood pressure, and muscle and nerve function. Melon contains about 20,000 to 26,000mg/kg dry weight of potassium (Pulela et al., 2022). Adequate potassium intake can help prevent hypertension, which is often a health problem in adult women (Ali, 2023). Sodium, although often associated with the risk of hypertension if consumed excessively, remains an essential mineral in maintaining fluid balance and cell function (Mohamed et al., 2025). Cucumber contains the most sodium compared to melon and watermelon, namely 151mg/100g (Borecka & Karaś, 2025). Phosphorus is needed for the formation of bones and teeth and plays a role in energy metabolism and other cellular functions. Adequate phosphorus intake is important for maintaining bone health, especially for women at higher risk of osteoporosis (Martiniakova et al., 2022; Wagner, 2024). Watermelon contains higher phosphorus than other *Cucurbitaceae* commodities, namely around 11mg/g (Aderiye et al., 2020). Apart from that, *Cucurbitaceae* commodities also contain vitamins, lycopene, and amino acids such as citrulline and arginine (Assefa et al., 2020; Prabakaran et al., 2024). Amino acids arginine and citrulline in *Cucurbitaceae* commodities are essential the body's metabolic processes (Aguayo et al., 2021). In addition, it has antioxidant properties and a role in forming Nitric Oxide (NO), which can overcome various pathological conditions due to oxidative stress, such as hypertension, body tissue damage, and atherosclerosis, and improve athletic performance by optimizing glucose transport to muscles (Assefa et al., 2020; Oyovwi & Atere, 2024).

Several previous studies have found positive health effects from consuming various *Cucurbitaceae* commodities. Research by (Busuioc et al., 2020) indicates that juices from *Cucurbitaceae* species such as *Momordica charantia*, *Cucumis metuliferus, Benincasa hispida, and Trichosanthes cucumerina* are rich in polyphenol compounds, exhibit high antioxidant activity, and possess iron chelating properties. Watermelon contains abundant phytochemicals such as lycopene and citrulline, contributing to its potential health benefits in preventing or managing cardiovascular diseases, obesity, diabetes, and cancer. Regular consumption can support weight control, while its seeds, sprouts, and leaves also exhibit medicinal properties (Manivannan et al., 2020). Huerta-Reyes et al. (2022) state that most Cucurbitaceae commodities, including melon and cantaloupe, have good potential anti-diabetic, anti-inflammatory, and antioxidant effects. Oyovwi & Atere (2024) state that watermelon juice can potentially relieve sore muscles in athletes because of its high Citrulline and Arginine content. Some areas in West Africa have even relied on Cucurbitaceae commodities such as *Momordica* species and *Lagenaria breviflora* traditionally as medicine for diabetes and respiratory tract problems (Fajinmi et al., 2022).

Processing fruits from the Cucurbitaceae family into composite juice is one of the innovative approaches to increasing the added value and acceptability of this commodity as a source of functional food. Composite juice is a drink that mixes two or more types of fruits or vegetables to produce a richer and more balanced nutritional profile (Kaur et al., 2024). Mixing several species of the Cucurbitaceae family into a composite juice is an approach that is expected to increase nutritional value and health benefits more optimally compared to single consumption of only one type of fruit (Hussein et al., 2021). By combining various kinds of fruit, the nutritional composition in the juice can be more balanced and complementary, providing a synergistic effect in supporting body function. In addition, composite juice also has the potential to increase consumer acceptance because it has a more complex and refreshing taste and aroma derived from the four species of Cucurbitaceae commodities used (Adedokun et al., 2022; Pinto et al., 2022). Based on the various health benefits and its abundant production in Indonesia, processing Cucurbitaceae commodity fruit into composite juice can potentially increase the vitality and health of productive-age women in Indonesia. Therefore, this study aimed to examine the potential use of composite juice from the Cucurbitaceae family as a nutritious food component in supporting the implementation of the GP2SP program for productive-age working women, especially in the context of fulfilling the needs of major minerals (potassium, sodium, phosphorus) and functional nutritional components.

MATERIALS & METHODS

This research was conducted in the chemistry and food nutrition laboratory of Diponegoro University, Semarang City, Central Java Province, Indonesia (https://maps.app.goo.gl/ETADFXe84DHmdhP38).

Fruits Preparation

The main ingredients used are watermelon (*Citrullus lanatus*), cucumber (*Cucumis sativus*), cantaloupe melon (*Cucumis melo* var. cantalupensis), and sky melon (a hybrid of *Cucumis melo*), which were obtained from farmers in Semarang Regency. The fruits were selected based on their ripeness and quality. The fruits were then peeled, separated from the skin and seeds, washed, and blanched by dipping in hot water at 75°C for 1 minute based on (Windrayani et al., 2023) with slight adjustments to prevent physical changes and damage to the fruit.

Cucurbitaceae Composite Juice Making

The blanched fruit is mixed based on the predetermined treatment ratio, namely the ratio of watermelon (W): cantaloupe melon (CM): sky melon (SM): cucumber (C) 4:3:2:1 (P1), 2:4:3:1 (P2), and 4:2: 1:3 (P3). The mixed fruit was added to mineral water in a fruit-water ratio of 4:3 and then pureed with a blender for 20 seconds until smooth and juice-like based on (Alim et al., 2023) with a slight adjustment.

Cucurbitaceae Composite Juice Characteristics Analysis
Hedonic Value

Hedonic value analysis was carried out with 25 untrained panelists based on (Alves et al., 2021) with slight modification. The hedonic parameters tested include color, viscosity, taste, aroma, and overall. Standardized samples were provided to each panelist, and consistent conditions were maintained throughout all testing sessions. A structured questionnaire with a scale of 1 to 4 was used to rate each parameter, where one represented "dislike extremely" and four represented "like extremely." The panelists' palates were cleansed between samples to prevent cross-tasting.

Color (L*a*b*)

Measurements were made using the CIE L*a*b* color reader based on (Suriano et al., 2021). Each sample was placed in the instrument's measurement area, ensuring proper positioning to avoid shadowing or misalignment. L* (lightness), a* (red-green axis), and b* (yellow-blue axis) values were measured for each sample. At least three measurements were performed for each sample to account for variability. The L*a*b* values were recorded, and the average values for L, *a*, and b* were calculated.

Viscosity

The viscosity was analyzed using a Viscometer (Brookfield) based on (Putri et al., 2024). Set the desired speed using the up/down arrows and press the Set speed button at 20 rpm. Turn on the motor to rotate the spindle (size 6). The viscometer will measure the torque against the rotating spindle and convert it to viscosity units (typically centipoise or milliPascal seconds). Take readings at multiple speeds if necessary. It is not required to turn the motor off to change speeds.

Total Dissolved Solid

The TDS was analyzed using a TDS meter based on Wang (2021). The sample was placed in a clean container, and the TDS meter probe was immersed. The TDS value was read directly from the meter's display, indicating the sample's dissolved solids concentration. Multiple measurements were taken for each sample to ensure the consistency and reliability of the results.

pH

The pH was analyzed using a calibrated digital pH meter.

Minerals Content

The mineral content analysis using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) (Chen et al., 2022). First, samples are collected and prepared through acid digestion utilizing a mixture of nitric acid (HNO_3) and hydrochloric acid (HCl) to break down organic material and release minerals. The digested samples are then diluted with ultrapure deionized water for compatibility with the ICP-MS system. Calibration is performed using multi-element standard solutions to generate calibration curves, while internal standards are added to correct for variations during analysis. The sample is introduced into the nebulizer, which is transformed into an aerosol and carried by argon gas into the plasma torch at 6.000-10.000K, ionizing the elements. These ions are separated and quantified by their mass-to-charge (m/z) ratio. Quality control is maintained through blank samples, certified reference materials (CRMs) and spiked samples to verify accuracy and precision. The results are reported in mg/L or µg/L, with method validation ensuring linearity, sensitivity, and repeatability. This rigorous process provides reliable data on mineral content for nutritional analysis, regulatory compliance, and quality control.

RESULTS & DISCUSSION

The following presents the sensory, physical, and chemical analysis results of composite juices made with various proportions of Cucurbitaceae fruit. The results obtained include hedonic values (Table 1), color characteristics (Table 2), viscosity (Fig. 1), total dissolved solids (TDS) (Fig. 2), pH (Fig. 3), and mineral content (Table 3) of each variation of juice formulation. The data in the tables and graphs show significant differences between each juice formulation used.

Table 1: Hedonic value of composite juice with various proportions of Cucurbitaceae Fruits

Attribute	Various Proportion		
	P_1	P_2	P_3
Color	3.68±0.477b	3.60±0.500b	2.80±0.645a
Viscosity	3.64±0.490	3.52±0.510	3.44±0.507
Taste	3.89±0.331c	3.40±0.708b	2.56±0.507a
Aroma	3.69±0.477b	3.69±0.781b	2.88±0.781a
Overall	3.68±0.56a	2.80±0.59b	3.13±0.76b

*P1-3 is various proportions of watermelon (W), cantaloupe melon (CM), sky melon (SM), and cucumber (C) or W:CM:SM: C in the ratio of 4:3:2:1; 2:4:3:1, and 4:2:1:3 respectively. Data were expressed as means±SD, in which different alphabets in the same row significantly differ (P<0.05) among the various proportions. Different superscripts ($^{a,\ b,\ c}$) indicate significant differences between the values.

Table 2: Color of composite juice with various proportions of Cucurbitaceae Fruits

Color	Various Proportion		
	P_1	P_2	P_3
L*	27.91±0.95a	28.03±0.30a	29.47±0.36b
a*	15.19±0.30	12.08±5.38	7.13±7.37
b*	3.24±0.05a	3.23±0.10a	3.76±0.08b

P1-3 is various proportions of watermelon (W), cantaloupe melon (CM), sky melon (SM), and cucumber (C) or W:CM:SM: C in the ratio of 4:3:2:1; 2:4:3:1, and 4:2:1:3 respectively. L, a*, and b* are lightness, chromatic redness/greenness, and chromatic blueness/yellowness, respectively. Data were expressed as means±SD, in which different alphabetss in the same row significantly differ (P<0.05) among the various proportions. Different superscripts (a, b, c) indicate significant differences between the values.

Hedonic Value

The hedonic test was conducted on various proportions of *Cucurbitaceae* fruit-based composite juice to determine the most preferred formulation by panelists based on color, viscosity, taste, aroma, and overall product impression attributes (Table 1).

Table 3: Minerals Content of composite juice with various proportions of Cucurbitaceae Fruits

Elements	Various Proportion		
	P_1	P_2	P_3
Potassium (mg/100g)	69.23±0.30b	81.12±0.16a	50.70±0.29c
Sodium (mg/100g)	7.60±0.31b	6.83±0.05c	8.07±0.06a
Phosphor (mg/Kg)	47.64±0.75a	43.20±0.24b	32.19±0.26c

* P1-3 is various proportions of watermelon (W), cantaloupe melon (CM), sky melon (SM), and cucumber (C) or W:CM:SM: C in the ratio of 4:3:2:1; 2:4:3:1, and 4:2:1:3 respectively. Data were expressed as means±SD, in which different alphabets in the same row significantly differ (P<0.05) among the various proportions. Different superscripts (a, b, c) indicate significant differences between the values.

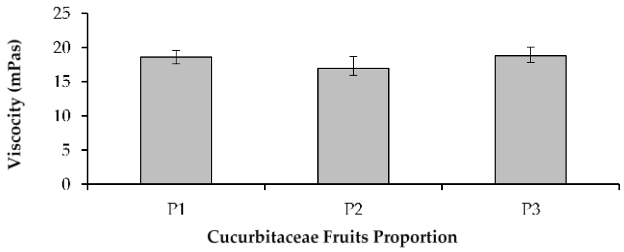

Fig. 1: Viscosity of composite juice with various proportions of Cucurbitaceae Fruits. P1-3 is various proportions of watermelon (W), cantaloupe melon (CM), sky melon (SM), and cucumber (C) or W:CM:SM: C in the ratio of 4:3:2:1; 2:4:3:1, and 4:2:1:3 respectively.

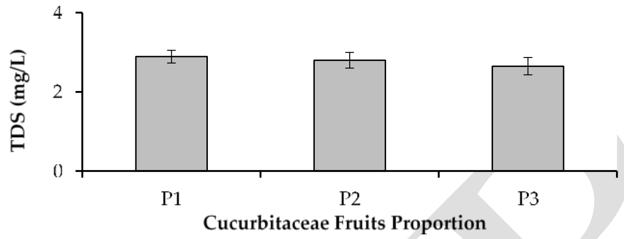

Fig. 2: Total Dissolved Solid (TDS) of composite juice with various proportions of Cucurbitaceae Fruits. P1-3 is various proportions of watermelon (W), cantaloupe melon (CM), sky melon (SM), and cucumber (C) or W:CM:SM: C in the ratio of 4:3:2:1; 2:4:3:1, and 4:2:1:3 respectively.

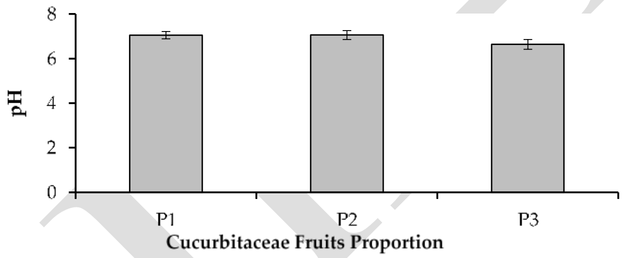

Fig. 3: pH of composite juice with various proportions of Cucurbitaceae Fruits. P1-3 is various proportions of (W), cantaloupe melon (CM), sky melon (SM), and cucumber (C) or W:CM:SM: C in the ratio of 4:3:2:1; 2:4:3:1, and 4:2:1:3 respectively.

A scale of 1 to 4 was used to rate each hedonic parameter, where one represented "dislike extremely" and four represented "like extremely." The data indicates that P1, with a ratio of 4:3:2:1 (watermelon: cantaloupe melon: sky melon: cucumber), achieves the highest scores across most attributes, particularly in taste and overall acceptability. This suggests that a higher ratio of watermelon and cantaloupe melon positively impacts the sensory properties of the mixture, with watermelon’s high sugar content and cantaloupe’s distinctive aroma playing crucial roles. The volatile compound 2,6-dimethyl-5-heptenal contributes to the unique flavor of fresh watermelon (Yang et al., 2021). In contrast, P2 (2:4:3:1) and P3 (4:2:1:3) exhibit lower scores in taste and aroma. The increased proportion of cantaloupe melon in P2 does not adequately compensate for the reduced watermelon content, possibly resulting in a less balanced flavor. In addition, melon is known to contain high phenolic compounds such as chlorogenic acid, gallic acid, and flavonoids (such as quercetin and kaempferol), which can provide an astringent sensation (Huang & Xu, 2021; Mallek-Ayadi et al., 2022). Melon also contains cucurbitacin compounds, triterpenoid compounds that contribute to the bitter and less fresh sensation, which can reduce the level of consumer preference for composite juice with a high melon concentration (Wang et al., 2023). Combining these compounds can affect the panelists' perception of preference for composite juice. Similarly, the higher cucumber content in P3 may dilute the mixture’s sweetness and aroma because of its high water content (Mallick, 2022). Cucumbers also contain typical flavour compounds, namely (E,Z)-2,6-nonadienal and (E)-2-nonenal and 2,4-heptadienal, which provide a typical "green" or fresh aroma like grass and melon (Zhang et al., 2022). The hedonic test scores showed that the panelists might not have liked the distinctive aroma of cucumber, which was too strong in the composite juice and created an unbalanced flavor character. The consistency, or viscosity, remains similar across all proportions, indicating that the fruit-to-cucumber ratios do not significantly affect this attribute. In conclusion, the 4:3:2:1 ratio in P1 stands out as the most favorable combination, delivering a balance of color, taste, and aroma that resonates well with overall acceptability. This understanding of sensory impacts can be beneficial for product development and optimizing fruit mixtures for consumer preferences.

Physical Characteristics

Color

The color of composite juice is related to the physical characteristics that affect the sensory value of composite juice. The color of composite juice was tested using the CIE L*a*b* color reader instrument. L* (lightness), a* (red-green axis), and b* (yellow-blue axis) values were measured for each sample (Table 2).

The color parameters (L*, a*, b*) elucidate the influence of fruit composition on the samples' lightness and color spectra (Table 2). P3 (4:2:1:3) exhibits the highest L* value, rendering it the lightest formulation, a characteristic of its elevated cucumber content. In contrast, P1 (4:3:2:1) and P2 (2:4:3:1) display comparable lightness levels, suggesting that the reduction in cucumber proportion moderates this parameter. The pronounced redness observed in P1 can be ascribed to its greater watermelon ratio, which imparts a more intense red hue. The fierce red hue in watermelons is attributed to the down-regulation of the lycopene β-cyclase (ClLCYB) gene, which leads to increased lycopene accumulation in the flesh, resulting in the characteristic red color of domesticated watermelons (Zhang et al., 2020). Conversely, P3, with the lowest redness value, reflects the dilution of red pigmentation due to its increased cucumber proportion (Mallick, 2022).

Furthermore, P3 exhibits the highest yellowness, likely arising from the combined influence of higher cantaloupe melon and cucumber content, while P1 and P2 maintain relatively similar b* values. These findings underscore that augmenting the watermelon proportion enhances the redness of the mixture, whereas increasing cucumber and cantaloupe melon contents results in a lighter and more yellow appearance (Dubinina et al., 2020). This nuanced understanding of the relationship between fruit composition and color attributes is essential for the precisely modulation of visual appeal in fruit-based products, ensuring consistency and alignment with consumer preferences.

Viscosity

The viscosity of composite juice reflects its texture and flow behavior, which is influenced by the fruit composition, soluble fiber content, and the interaction between fruit components and water (Salehi, 2020a).

In this study, the viscosity values across the three formulations (P1, P2 and P3) showed slight but insignificant differences, suggesting that varying the proportions of watermelon, cantaloupe melon, sky melon, and cucumber had minimal impact on thickness. The mechanical blending process using a blender breaks down fruit tissues and uniformly disperses their components, leading to consistent viscosity across all samples (Kaur et al., 2023; Nayak et al., 2023). Other factors, such as temperature and total dissolved solids (TDS), also influence the viscosity of the composite juice (Salehi, 2020b). Generally, higher TDS, as observed in P1 (Fig. 2), correlates with increased sugar content, which can slightly raise viscosity (Mahato et al., 2022). However, the high moisture content of watermelon may counteract this effect, maintaining a thinner consistency. Overall, the slight variations in viscosity indicate that all three formulations maintain an optimal texture suitable for consumer preference and processing efficiency.

Total Dissolved Solid (TDS)

Total dissolved solids (TDS) reflect the concentration of soluble substances such as sugars, organic acids, and minerals in the juice (Rebello et al., 2020; Pushpalatha et al., 2022). In this study (Fig. 2), P1 had the highest TDS, followed by P2, while P3 showed the lowest value. The fruit composition largely influences this variation, as watermelon and cantaloupe melon dominate in P1 and are rich in fructose, glucose and sucrose, contributing to higher TDS levels (Gupta et al., 2023; Ranganathan et al., 2024).

In contrast, cucumber is more prevalent in P3, which has a high water content and fewer soluble solids, reducing the TDS. Mechanical homogenization also affects TDS by breaking down fruit cells and releasing soluble components (Kamble et al., 2022). The efficiency of this process ensures consistent extraction of sugars and organic acids, which are the primary contributors to TDS in the juice. The molecular interactions between sugars, organic acids, and water further influence TDS levels. Sugars bind with water molecules through hydrogen bonding, increasing the concentration of dissolved solids, while organic acids from melons and cucumbers contribute to the ionic load (Mutyam et al., 2021).

Additionally, polysaccharides like pectin in cantaloupe and sky melons can trap water, limiting the availability of free solutes and slightly reducing TDS in P2. TDS also impacts juice stability, as higher levels can reduce water activity, limiting microbial growth and extending shelf life (Tarafdar & Kaur, 2022). These findings suggest that P1's higher TDS makes it more appealing and flavorful, while P3's lower TDS results in a less concentrated and less preferred juice.

Chemical Characteristics
Potensial of Hidrogen (pH)

pH reflects the juice's acidity, an essential parameter in fruit juice products because it greatly affects taste characteristics, color stability, and chemical interactions between components (Guler & Candemir, 2020). In this composite juice formulation, pH balances the taste between fruits and controls synergistic or antagonistic effects between solutes such as acids, sugars, and minerals (Shi et al., 2022). pH is primarily influenced by the fruits' organic acid content and mineral composition (Miao et al., 2024).

In this study (Fig. 3), P1 had the highest pH (lowest acidity), while P3 had the lowest pH (highest acidity), with P2 falling in between. This variation is primarily due to the fruit proportions in each formulation. According to Umer et al. (2020), ripe watermelon, dominant in P1, contains lower levels of strong organic acids like malic acid and citric acid, resulting in a milder acidity and a higher pH. It was associated with higher total soluble sugar contents, particularly in accessions with high pH and TSS values (Beegum et al., 2022). Conversely, the increased cucumber content in P3 raises the concentration of stronger organic acids, leading to a lower pH. According to Trong et al. (2023), the total organic acid of cucumber was increased gradually during the maturation, reaching the maximum concentration of 53.13mg/100g. Ascorbic acid is cucumbers' dominant organic acid component (Trong et al., 2023; Ren et al., 2024). Minerals, like potassium, also play a buffering role; the higher potassium content in P2 may help neutralize some acidity, contributing to its intermediate pH value (Hussein, 2023). These interactions between organic acids and mineral buffers explain the pH differences across the three formulations.

Major Minerals Content

The major mineral content, such as potassium, sodium, and phosphorus, in the Cucurbitaceae composite juice, is essential in supporting the vitality of women of productive age. The major mineral value of *Cucurbitaceae* composite juice can be seen in Table 3.

The composite juice formulations showed significant differences ($P<0.05$) in potassium (K), sodium (Na), and phosphorus (P) content across the three proportions. P2 contained the highest potassium (81.12mg/100g), while P3 had the highest sodium (8.07mg/100g), and P1 exhibited the greatest phosphorus concentration (47.64mg/kg). These differences can be attributed to the unique mineral profiles of the Cucurbitaceae fruits. Watermelon, abundant in P1, is known for its high phosphorus content due to its phosphate-based metabolic processes, impacting carotenoid concentration and affecting the fruit's color and sweetness (He et al., 2022). Meanwhile, cantaloupe melon, dominant in P2, is a rich source of potassium, a mineral critical for maintaining cellular function and electrolyte balance (da Cunha et al., 2020). The elevated sodium levels in P3 reflect the higher proportion of cucumber, which naturally contains more sodium ions than other fruits (Naseer et al., 2022). The variations observed indicate that the specific fruit composition directly affects the mineral profile of each juice formulation.

The bioavailability and functionality of these minerals are related to the increasing vitality of women of productive age. Potassium is key in regulating blood pressure, nerve signaling, and muscle contraction, making P2 formulation particularly beneficial for cardiovascular health (Chan et al., 2024). The higher phosphorus content in P1, which comes from the high concentration of watermelon, supports bone health, cellular energy production (via ATP synthesis), and acid-base homeostasis (Serna & Bergwitz, 2020). Sodium, while necessary for fluid balance and nerve function, is present at elevated levels in P3, which may raise concerns regarding hypertension if consumed in excess (Jaques et al., 2021). The variations in mineral content among the three formulations are significant because they offer distinct nutritional profiles tailored to different dietary needs.

Conclusion

The study on composite juice made from varying proportions of Cucurbitaceae fruits (watermelon, orange melon, green melon, and cucumber) demonstrates that fruit ratio significantly affects sensory attributes, physical characteristics, and major mineral content. Among the three formulations, P1 (4:3:2:1) was the most preferred, attributed to its balanced sweetness, attractive color, pleasant aroma, and overall higher consumer acceptance. This formulation also exhibited the highest total dissolved solids (TDS), indicating a richer concentration of natural sugars, and a higher pH, which contributes to lower acidity and a smoother taste. Although P2 (2:4:3:1) contained the highest potassium content and P3 (4:2:1:3) had the highest sodium content and acidity, P1 offered the most favorable combination of sensory quality and nutritional value. Therefore, P1 (4:3:2:1) is considered the optimal formulation for developing a composite juice with superior taste, appealing appearance, and well-balanced mineral composition.

DECLARATIONS

Funding: Funded by Universitas Diponegoro International Publication Research Scheme, grant number 973-24/UN7.D2/PP/IX/2024.

Acknowledgement: This research was funded by Universitas Diponegoro International Publication Research Scheme, grant number 973-24/UN7.D2/PP/IX/2024.

Conflicts of Interest: The authors declare no conflicts of interest.

Data Availability: All relevant data are included within the article.

Ethics Statement: This study did not require ethical review, as it did not involve sensitive human data or animal subjects. The hedonic test, involving untrained panelists, was conducted in accordance with the Indonesian National Standard (SNI) 01-2346-2006 regarding sensory evaluation methods. All participants were informed about the test's purpose and voluntarily agreed to participate. No personal identifying information was collected.

Author's Contribution: Each author has contributed to the research and preparation of this article. Conceptualization, Siti Susanti, and Yasmin Aulia Rachma; Methodology, Hanifa Maher Denny and Siti Susanti; Validation, Arwinda Nugraheni; Formal Analysis, Andina Lun Felita Kinasih and Yasmin Aulia Rachma.; Investigation, Yasmin Aulia Rachma.; Resources, Andina Lun Felita Kinasih.; Data Curation, Siti Susanti.; Writing – Original Draft Preparation, Yasmin Aulia Rachma.; Writing – Review & Editing, Yasmin Aulia Rachma and Siti Susanti; Visualization, Siti Susanti; Supervision, Siti Susanti.

Generative AI Statement: The authors declare that no Gen AI/DeepSeek was used in the writing/creation of this manuscript.

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