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CHEMICAL PROPERTIES AND SENSORY PROFILE OF KOMBUCHA PREPARED FROM DIFFERENT POST-HARVEST PROCESSED ARABICA COFFEE

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Abstract: Kombucha, a fermented beverage traditionally produced using a symbiotic culture of bacteria and yeast (SCOBY), has gained considerable attention as a functional drink due to its potential health benefits. The growing demand for kombucha variants has stimulated the exploration of coffee as a substrate, with processing methods potentially influencing the biochemical and sensory characteristics of the final product. This study evaluated the chemical and sensory characteristics of kombucha produced from coffee beans processed using three methods (natural, washed, and honey processing) obtained from farmers in Magelang, Indonesia. Chemical analyses included antioxidant activity (AA), determined using the DPPH radical-scavenging method; total phenolic content (TPC), determined using a colorimetric method; total titratable acidity (TTA), determined by acid-base titration; caffeine content (CC), determined gravimetrically; and total soluble solids (TSS), measured using a refractometer. The results indicated no significant differences among the three coffee processing methods for any of the chemical parameters (AA, 45-49%; TPC, 1.51-1.67 mg GAE/g; TTA, 0.45-0.54%; and CC, 0.29-0.49%), except for TSS (11.0-12.6 °Brix), suggesting that SCOBY fermentation may have reduced differences in chemical composition regardless of the initial coffee processing method. Sensory evaluation was conducted using a hedonic test assessing aroma, taste, color, and overall acceptability, combined with the Check-All-That-Apply (CATA) method. The results revealed that kombucha produced from honey-processed coffee was associated with positive attributes such as citrus, floral, honey, and sparkling aromas, whereas the natural- and washed-processed variants were associated with woody, bitter, alcoholic, and refreshing attributes. Principal Coordinate Analysis of the CATA data indicated that consumer liking was positively correlated with refreshing, sparkling, and herbal descriptors. These findings suggest that, although the chemical profile did not differ significantly among the samples, the coffee processing method influenced the sensory profile of the resulting kombucha.

Key words: *arabica coffee, CATA, hedonic test, kombucha, SCOBY*

INTRODUCTION

Kombucha is a fermented beverage traditionally produced from sweetened black or green tea, although alternative substrates such as fruit juices, spice extracts, and other plant-based materials have also been explored through the metabolic activity of a symbiotic culture of bacteria and yeast (SCOBY) (Antolak et al., 2021). During fermentation, yeasts hydrolyze sucrose and convert the resulting sugars into ethanol and carbon dioxide (Wang et al., 2022), while acetic acid bacteria oxidize ethanol into acetic acid and other organic acids (Villarreal-Soto et al., 2018), and lactic acid bacteria contribute to the production of lactic acid and other metabolites. This complex microbial interaction produces a mildly acidic beverage with a relatively low alcohol content and a diverse composition of functional compounds (Antolak et al., 2021). The biological properties of kombucha are associated with phenolic compounds, organic acids, vitamins, enzymes, and amino acids that are either naturally present in the substrate or formed and transformed through microbial and enzymatic reactions during fermentation (Bortolomedi et al., 2022). Collectively, these compounds contribute to the reported functional potential of kombucha, including antioxidant, anti-inflammatory, antimicrobial, and anti-cancer activities, although their concentrations and biological effects are strongly influenced by the type of substrate, microbial composition, and fermentation conditions employed (Kitwetcharoen et al., 2023). Although kombucha is generally considered safe when properly produced and consumed, excessive consumption may pose potential health risks. Excessive intake has been associated with chemical acidosis due to the accumulation of organic acids, particularly in susceptible individuals (Ojo & de Smidt, 2023).

The composition of functional components and health benefits of kombucha depend on the type of raw materials used and the fermentation process involving the type of starter, fermentation duration, and temperature (Oliveira et al., 2022). To produce kombucha with more attractive sensory characteristics or better functional properties, many innovations have been carried out by utilizing various types of plant parts as raw materials for kombucha production derived from leaves, fruits, rhizomes, and others (Emiljanowicz & Malinowska-

Pańczyk 2020). Coffee beans, particularly Arabica, is a promising alternative substrate due to its richness in phenolic compounds, caffeine, and volatile constituents that may contribute to distinctive sensory attributes and potential health benefits.

Coffee post-harvest processing is commonly classified into dry, wet, and intermediate processing systems, represented respectively by the natural, washed, and honey methods. These methods differ primarily in the extent and duration of contact between the coffee beans and the surrounding skin, pulp, and mucilage (Nahuel & Isabel, 2023). In the natural process, whole cherries are dried with all fruit tissues intact, whereas washed processing involves depulping, microbial degradation of the remaining mucilage, washing, and subsequent drying (Hernández-Alcántara et al., 2026). The honey process represents an intermediate approach in which the skin and pulp are removed while a proportion of the sugar-rich mucilage remains attached to the beans during drying (Aswathi & Murthy, 2024). Consequently, these processing conditions regulate the transfer and biotransformation of sugars, organic acids, phenolic compounds, minerals, and volatile precursors between the fruit tissues and the beans, producing distinct chemical matrices as well as sensory profiles. Postharvest processing influences the biochemical composition of coffee beans, including chlorogenic acids, sugars, and lipids (Joët et al., 2010), which subsequently affects the sensory attributes of the brewed coffee. Natural-processed coffee has been reported to exhibit dominant fruity, spicy, sweet, and caramelized notes, honey-processed coffee tends to show nutty and roasted characteristics, while full-washed coffee generally lacks a dominant sensory attribute profile (Yulianti et al., 2023).

The influence of post-harvest processing extends beyond sensory characteristics, as natural, washed, honey, and fermentation-based methods can modify the bioactive, volatile, and elemental composition of green and roasted specialty coffee, even among samples originating from the same farm, indicating that each processing method may create a distinct and persistent chemical imprint within the coffee matrix (Várady et al., 2024). When these differently processed coffees are used as kombucha substrates, their contrasting concen-

trations and availability of fermentable sugars, soluble compounds, organic acids, phenolics, minerals, and aroma precursors may create different metabolic environments for the yeasts and bacteria within the SCOBY (Miranda et al., 2022). Such substrate-specific conditions may influence sugar utilization, microbial acid production, carbon dioxide and ethanol formation, polyphenol transformation, and the generation or retention of sensory-active volatile metabolites during fermentation (Chakravorty et al., 2016; Villarreal-Soto et al., 2018). However, it remains unclear whether SCOBY fermentation preserves, intensifies, or attenuates the chemical and sensory differences initially generated by coffee post-harvest processing. Therefore, rather than merely comparing the sensory characteristics of natural-, honey-, and washed-coffee kombucha, the present study investigates whether the post-harvest chemical imprint of the coffee substrate remains detectable after secondary fermentation and contributes to the differentiation of the resulting products. This unresolved relationship highlights the need for systematic sensory profiling to identify product characteristics that may not be adequately represented by conventional bulk chemical measurements. The development of coffee kombucha products requires a comprehensive sensory evaluation approach to understand the flavor profiles and organoleptic characteristics resulting from various coffee bean processing methods. One relevant sensory evaluation method used in this context is Check-All-That-Apply (CATA), a sensory data collection technique in which panelists are asked to select all attributes deemed appropriate to describe a product from a list of provided attributes (Ares et al., 2014; Rahawarin et al. 2026). This method is known to be efficient, easy for panelists to understand, and capable of producing rich sensory profiles without requiring intensive training like conventional descriptive methods, making it highly suitable for application in consumer-based studies with a large number of panelists (Varela & Ares, 2012; Dooley et al., 2010).

Therefore, the application of the CATA method used in this research to map and compare the sensory profile of Magelang Arabica coffee kombucha from the three processing methods systematically and based on consumer perception, while providing information that can be used as a basis for developing more

targeted products that are in accordance with market preferences. The aim of this research was to evaluate the chemical and sensory characteristics of kombucha produced from three coffee beans processing methods (natural, washed, and honey) obtained from farmers in Magelang, Indonesia.

MATERIALS AND METHODS

Raw materials and experimental design

Fully ripe red Arabica coffee cherries were obtained from a coffee farmer in Magelang Regency, Central Java, Indonesia. The cherries were manually sorted to remove immature, damaged, and defective fruits and were subsequently divided into three post-harvest processing treatments: natural, washed, and honey processing. Coffee beans obtained from each treatment were roasted, ground, and used as substrates for coffee kombucha production under identical fermentation conditions.

Following fermentation, the coffee kombucha samples were analyzed for total titratable acidity, total phenolic content, caffeine content, antioxidant activity, and total soluble solids. Sensory characteristics were evaluated using a seven-point hedonic test and the Check-All-That-Apply (CATA) method. The overall experimental procedure described in this section corresponds to the study design reported in the submitted manuscript.

Coffee post-harvest processing

The processing methods for fully washed, honey, and natural coffee in this study followed the procedure described by Yulianti et al. (2023) by modifying the length of the drying process. Whole coffee cherries assigned to the natural treatment were sun-dried for approximately three days with the skin, pulp, and mucilage intact, after which the dried fruit layers were removed by hulling. In the washed treatment, the cherries were mechanically depulped and the beans were immersed in water for 24 h to promote mucilage degradation, followed by thorough washing to remove any remaining mucilage. By contrast, honey-processed cherries were depulped without washing, allowing part of the mucilage to remain attached to the bean surface during a 24 h partial fermentation period. Following the respective treatments, all coffee beans were dried in a dehydrator at 40 °C for 24 h to obtain a

relatively uniform final moisture content. The sorted dry beans are roasted using a traditional roasting method using a manual pan/roaster with continuous stirring to ensure even heating and prevent scorching. The roasting process is carried out until the light-brown roasting degree is reached, which is visually indicated by the change in the color of the beans from their original color to a uniform light brown, accompanied by the appearance of a distinctive roasting aroma without the formation of an oil layer on the surface of the beans. After cooling to room temperature, the roasted beans were ground using a DK-60 coffee grinder, set at scale position #1 (corresponding to the Turkish grind label on the dial) to obtain a fine, granular coffee powder. The coffee powder is then stored in airtight containers until kombucha preparation.

Coffee kombucha preparation

Coffee kombucha was prepared according to Parhusip (2022), with modifications. Ground roasted coffee (55 g) was brewed with 1 L of water at 92.2–94.4 °C for 5 min. The resulting decoction was filtered to separate the coffee grounds from the liquid extract. Granulated sucrose was then added at a concentration of 10% (w/v), equivalent to 100 g/L, and dissolved while the infusion remained hot. The sweetened coffee infusion was cooled to approximately 25 °C and transferred into a sterile glass fermentation vessel. Each fermentation vessel was inoculated with a SCOBY measuring approximately 13–15 cm in diameter and 1 cm in thickness, together with 100 mL of liquid SCOBY starter (10%, v/v). The samples were fermented for 14 days at 25 °C under the same conditions for all post-harvest processing treatments.

Total titratable acidity

Total titratable acidity was determined by acid–base titration following (AOAC International, 2005) with slight modification. A total of 10 g sample was accurately weighed into a 250 mL Erlenmeyer flask. Then, the sample was subsequently diluted to a final volume of 250 mL using a 250 mL volumetric flask, which was used to ensure accurate volumetric dilution. From this solution, 25 mL was transferred into a 100 mL Erlenmeyer flask and 3–5 drops of phenolphthalein indicator were added. The solution was titrated with standardized 0.1 N NaOH until a faint pink

color persisted for at least 30 seconds. The acetic acid content was calculated according to the equation:

$$\text{Acetic Acid (\%)} = \frac{V_c \times N_{\text{NaOH}} \times 60.05}{m_s} \times 100$$

where V_c is the corrected titrant volume (mL), N_{NaOH} is the normality of NaOH, 60.05 is the equivalent weight of acetic acid (g/eq), and m_s the sample mass (g).

Total phenolic content

Total phenolic content was determined using the Folin–Denis colorimetric method (Singleton et al., 1999) with modifications, following the procedure described by Sudarmadji et al. (2010). A 5 g of homogenized coffee kombucha was transferred into a 100 mL volumetric flask and diluted to volume with distilled water. The suspension was filtered or centrifuged to obtain a clear filtrate. A 1 mL of the filtrate was transferred into a test tube and mixed with 0.5 mL of Folin–Denis reagent diluted at a ratio of 1:1 and 1 mL of saturated sodium carbonate solution. The mixture was incubated at room temperature for 10 min, diluted to a final volume of 10 mL with distilled water, and homogenized using a vortex mixer. Absorbance was measured at 730 nm using a UV–Vis spectrophotometer against a reagent blank containing distilled water, with the same amounts of Folin–Denis reagent and saturated Na_2CO_3 solution. The phenolic concentration was determined from a calibration curve prepared using gallic acid standard solutions and expressed as mg gallic acid equivalents (GAE) per gram of sample.

Caffeine Content

Caffeine content was performed using the Bailey–Andrew gravimetric method following Ikrawan et al. (2021). The sample was accurately weighed to 5 g, then mixed with 1 g magnesium oxide and 200 mL distilled water. The mixture was heated under reflux for 2 h and subsequently diluted to 250 mL with distilled water in a volumetric flask. An 100 mL of this solution was transferred into a beaker, followed by the addition of 10 mL sulfuric acid (1:9, v/v), and heated until the volume was reduced to 25 mL. The solution was then transferred into a separatory funnel, mixed with 10 mL sulfuric acid (1:99, v/v), and extracted successively with chloroform in portions of 10, 15, 20, and 25 mL, shaking vigo-

rously after each addition. Afterward, 5 mL of 1% potassium hydroxide solution was added, and the mixture was washed again with chloroform. Two distinct layers were formed: the lower chloroform layer containing caffeine and the upper aqueous layer containing non-caffeine components. The chloroform layer was collected and evaporated in an oven at 100 °C until a constant weight was obtained. The caffeine content was calculated gravimetrically using the following equation:

$$\text{Caffeine (\%)} = \frac{W_r \times F}{W_s} \times 100$$

where W_r is the weight of the dried caffeine residue (g), W_s is the initial sample weight (g), and F is the dilution factor.

Antioxidant Activity

The antioxidant activity of the sample was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay as described by Molyneux (2004) with slight modifications. A 1.00 g portion of the sample was accurately weighed and dissolved in methanol to prepare a stock solution of known concentration. An of 1.0 mL of the stock solution was transferred into a test tube and mixed with 1.0 mL of DPPH solution (200 µM, prepared in methanol). The reaction mixtures were incubated in the dark at room temperature for 30 min.

After incubation each tube was diluted to 5.0 mL with methanol and vortexed to homogenize. A reagent blank was prepared by mixing 1.0 mL DPPH solution with 4.0 mL methanol. Absorbance was measured at 517 nm using a UV-Vis spectrophotometer. Radical scavenging activity (RSA) was calculated as:

$$\text{Radical scavenging activity (\%)} = \frac{A_c - A_s}{A_c} \times 100$$

where A_c is the absorbance of the reagent blank (DPPH solution without sample) and A_s is the absorbance of the sample reaction mixture.

Total Soluble Solids

Total soluble solids (°Brix) were measured using a digital refractometer following Zhang et al., (2024). Approximately 5 g of homogenized sample was filtered to obtain a clear solution, and a drop of the filtrate was placed on the prism surface. The instrument was calibrated with distilled water before use. Rea-

dings were taken at 25 °C with automatic temperature compensation, and results were expressed directly as °Brix.

Sensory Profile

Sensory evaluation was conducted with 40 adult panelists who voluntarily agreed to participate in the study and provided written informed consent before the evaluation session. The three coffee kombucha samples were evaluated using hedonic and CATA methods. For the hedonic test, panelists assessed taste, aroma, color, and overall acceptability using a seven-point scale ranging from 1, corresponding to “dislike very much,” to 7, corresponding to “like very much.”. For the CATA evaluation, panelists assessed the presence or absence of 17 sensory attributes (Table 1): citric, fermented, floral, herbal, woody, honey, acid, bitter, sweet, alcoholic, vinegar, astringent, fizzy, refreshing, full-bodied, opaque, and sparkling. The 17 sensory attributes used in the CATA method were determined through a focus group discussion (FGD) and preliminary research among the research team, an approach consistent with that used in similar coffee-based kombucha sensory studies (Gunawan et al., 2026), and referring to the sensory lexicon coffee (Chambers et al., 2016) and sensory attributes reported for Arabica coffee with different postharvest processing (Yulianti et al., 2023).

Before evaluating the samples, the panelists identified the attributes they considered representative of an ideal coffee kombucha. They then tasted each sample and selected all terms that appropriately described their sensory perception of the product, following the approach described by Dooley et al. (2010). Sensory evaluation conducted in this study received ethical approval from the Faculty of Medicine, Universitas Diponegoro (011/EC/KEPK/FK-UNDIP/IV/2026).

Statistical analysis

Chemical and hedonic data were expressed as mean ± standard deviation and analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Differences among coffee kombucha samples produced from natural-, washed-, and honey-processed coffee were evaluated using one-way analysis of variance. When a significant treatment effect was detected, Duncan’s multiple range test was applied for mean separation.

Table 1.
Sensory attributes used in the CATA evaluation

No	Attribute	Operational definition
1	<i>Citric</i>	Aroma associated with orange
2	<i>Fermented</i>	Aroma associated with fermented products
3	<i>Floral</i>	Aroma associated with floral
4	<i>Herbal</i>	Aroma associated with various herbs
5	<i>Woody</i>	Aroma associated with wood
6	<i>Honey</i>	Aroma associated with honey
7	<i>Acid</i>	Basic taste associated with an acid solution
8	<i>Bitter</i>	Basic taste associated with bitter
9	<i>Sweet</i>	Basic taste stimulated by sucrose
10	<i>Alcoholic</i>	Flavor associated with alcohol
11	<i>Vinegar</i>	Flavor associated with vinegar or apple cider vinegar
12	<i>Astringent</i>	Dry/rough sensation in the mouth
13	<i>Fizzy</i>	Carbonated beverage sensation
14	<i>Refreshing</i>	Refreshing sensation
15	<i>Full Body</i>	Thick sensation / high concentration filling the mouth
16	<i>Opaque</i>	Appearance that is not transparent
17	<i>Sparkling</i>	Shiny/glittering appearance

Statistical significance was established at $p < 0.05$. CATA data were analyzed using XLSTAT 2019 (Addinsoft, Paris, France). Cochran's Q test was initially applied to determine whether the frequency of attribute selection differed significantly among the samples. Significant attributes were subsequently examined using multiple pairwise comparisons. Principal Coordinate Analysis was used to explore the relationships between sensory attributes and consumer liking, whereas Correspondence Analysis was applied to visualize associations between the coffee kombucha samples and their sensory descriptors (Ares & Jaeger, 2015; Munarko et al., 2025).

RESULTS AND DISCUSSION

Post-harvest processing is an important factor that can modify the chemical composition of agricultural commodities and consequently influence the characteristics of fermented beverages produced from these substrates (Yulianti et al., 2022). Difference in processing conditions can alter the availability and profile of phenolic compounds, sugar, organic acids, and other soluble constituents, which may subsequently undergo microbial transformation during fermentation. Such effects have also been observed in kombucha systems, where the type and composition of the fermentation substrate have been reported influence the content of phenolic compounds and other bioactive constituents in the resulting beverage (Bortolomedi et al., 2022; Miranda et al., 2022). During fermentation, substrate-derived

compounds may be degraded, transformed, or converted into new metabolites through the activity of yeasts and bacteria, and contributing to the final chemical composition of kombucha (Miranda et al., 2022; Zhang et al., 2021).

Previous studies on tea-based kombucha demonstrated that the type of tea and its processing can influence antioxidant capacity, phenolic compounds, and other chemical parameters; however, the magnitude and direction of these changes depend on the interaction between the initial substrate composition and fermentation process (Değirmencioglu et al., 2021; Jakubczyk et al., 2020). In coffee kombucha, Bueno et al. (2021) also demonstrated that fermentation altered physicochemical characteristics, including a decrease in pH and changes in titratable acidity and °Brix, while microbial composition shifted during fermentation. The chemical characteristics of Arabica coffee kombucha produced using different post-harvest methods are presented in Table 2. Based on these data, no significant differences ($p > 0.05$) were observed among the three post-harvest methods in terms of antioxidant activity and total phenolic content. Radical scavenging activity (RSA) is an important parameter for evaluating the functional potential of coffee kombucha, as it can be influenced by bioactive compounds derived from coffee, particularly phenolic compounds (Su et al., 2023). Previous studies have indicated that post-harvest processing methods, such as natural, washed, and honey, can influence the composition of bioactive compounds, including anti-

oxidant activity, total polyphenols, and total flavonoids. Yulianti et al. (2022) reported that natural, honey, and full-washed processing produced differences in caffeoylquinic acids and alkaloid profiles of Arabica coffee, while a subsequent study confirmed that each post-harvest process generated distinct chemical markers in green and roasted beans (Yulianti et al., 2023). For instance, Arabica coffee beans from Nicaragua processed using the washed method exhibited higher antioxidant activity, total polyphenols, and total flavonoids compared to those processed using the honey method (Várady et al., 2024). In the washed method, coffee cherries undergo a depulping process to remove the pulp, followed by a fermentation stage to degrade the mucilage layer. The beans are then thoroughly washed to ensure complete removal of mucilage before being dried to a moisture content of approximately 10-11%. In contrast, the honey method involves removing the outer skin and part of the pulp while retaining some mucilage on the beans, which are subsequently dried without a washing step. The retention of mucilage during drying facilitates prolonged interaction between the beans and residual fruit components. These mechanistic differences may influence the formation, transformation, and stability of bioactive compounds in coffee (Murthy & Naidu, 2012; Várady et al., 2024).

Two non-mutually exclusive mechanisms may explain how coffee post-harvest processing influences the characteristics of the resulting kombucha. First, differences observed in the final products may arise from a substrate carry-over effect, whereby compounds generated or retained during natural, washed, and honey processing remain present after brewing and fermentation. Second, the initial composition of each coffee infusion may modulate SCOBY metabolism by altering the availability of fermentable substrates, micronutrients, phenolic compounds, and other growth-modulating constituents. Under the latter mechanism, differ-

ently processed coffees may affect microbial sugar utilization and the subsequent production of organic acids, ethanol, carbon dioxide, and volatile metabolites. Therefore, the final composition of coffee kombucha may reflect both the direct contribution of the coffee substrate and its interaction with microbial metabolism during fermentation (Chakravorty et al., 2016; Villarreal-Soto et al., 2018).

In addition, fermentation involving *Saccharomyces cerevisiae* (strain KNU18Y13) and *Saccharomycopsis fibuligera* has been reported to increase the phenolic content of Arabica coffee beans (Haile and Kang, 2019). In their natural form, phenolic compounds are often present in bound forms, typically conjugated with sugars, which limits their bioavailability. During fermentation, enzymatic activities associated with microbial metabolism facilitate the hydrolysis of these complexes, releasing simpler, soluble free phenolics that exhibit greater biological activity and are more readily absorbed (Shrestha et al., 2013; Ademiluyi & Obboh, 2011). Furthermore, the study demonstrated that fermented coffee beans contained significantly higher levels of flavonoids compared to unfermented beans. This increase in total flavonoid content may be attributed to the rise in acidity during fermentation, which promotes the release of bound flavonoid compounds and enhances their bioavailability (Adetuyi & Ibrahim, 2014). The antioxidant activity of coffee kombucha in the present study ranged from 45-49%, while TPC ranged from 1.51-1.67 mg GAE/g. Previous research on coffee kombucha has also demonstrated that fermentation can substantially modify phenolic compounds and antioxidant activity.

Kim et al. (2025) reported increases in TPC of approximately 2-fold in coffee kombucha after fermentation, reaching 7.54 ± 0.13 mg GAE/g coffee, together with increased antioxidant activity. Değirmencioğlu et al. (2021) compared kombucha produced from five tea types with

Table 2.
Chemical Profile of Arabica Coffee Kombucha

Process	Antioxidant activity (%) ^{ns}	Phenolic content (mg GAE/g) ^{ns}	Total titratable acidity (%) ^{ns}	Total Caffeine (%) ^{ns}	Brix (°)
Natural	45.48±4.20 ^a	1.53±0.23 ^a	0.54±0.06 ^a	0.34±0.12 ^a	12.65±0.24 ^b
Washed	49.50±3.65 ^a	1.67±0.16 ^a	0.45±0.08 ^a	0.38±0.09 ^a	11.18±0.29 ^a
Honey	45.03±2.62 ^a	1.51±0.04 ^a	0.52±0.11 ^a	0.29±0.04 ^a	11.60±0.52 ^a

Data are presented as mean ± standard deviation. Different superscript letters within the same column indicate significant differences among treatments ($p < 0.05$). ^{ns} indicates no significant difference among treatments ($p > 0.05$)

different processing characteristics, namely white, green, oolong, black, and puerh teas, and found differences in antioxidant capacity, total phenolic content, and phenolic bioaccessibility among the resulting beverages. Green tea kombucha exhibited the highest antioxidant capacity (4153.23 $\mu\text{mol TEAC/mL}$) and bioaccessibility (50.18%), while fermentation increased bioaccessibility by approximately 30-58%, depending on the tea type used. Nevertheless, the absence of significant differences in antioxidant activity and total phenolic content in this study may indicate a convergence of these bulk chemical parameters during SCOBY fermentation. Enzymes produced by yeasts and bacteria can hydrolyze bound phenolics, transform complex polyphenols into lower-molecular-weight compounds, and simultaneously promote the degradation or polymerization of other phenolic constituents. These concurrent reactions may attenuate the compositional differences initially generated by coffee post-harvest processing, resulting in comparable total phenolic contents and radical-scavenging activities after 14 days of fermentation (Jayabalan et al., 2014). However, similar endpoint values do not necessarily indicate that the three substrates followed identical transformation pathways. Because the phenolic content and antioxidant activity of the coffee infusions were not measured before fermentation or monitored over time, the present results cannot distinguish between similar initial compositions and fermentation-induced convergence. Thus, the findings support a possible homogenizing effect of SCOBY fermentation, but this interpretation should be considered mechanistic rather than conclusive.

Total titratable acidity represents the overall acid-neutralizing capacity of the beverage and primarily reflects the accumulation of organic acids produced during SCOBY fermentation, including acetic, gluconic, glucuronic, and, depending on the microbial composition, lactic acids (Jayabalan et al., 2014; Sanwal et al., 2023). Bueno et al. (2021) reported that coffee kombucha fermentation resulted in physicochemical changes, with pH decreasing from 4.01 to 3.51, titratable acidity increasing from 0.20 to 0.59%, and soluble solids decreasing from 12.83 to 12.16 $^{\circ}\text{Brix}$ after 8 days of fermentation at 23 $^{\circ}\text{C}$. These changes were attributed to microbial utilization of fermentable

substrates and the formation of organic acids during fermentation. In the present study, TTA ranged from 0.45 to 0.54% ($p > 0.05$). The absence of significant differences in endpoint TTA suggests that the three coffee substrates reached a comparable overall degree of acidification after 14 days. However, similar TTA values do not necessarily indicate identical fermentation behavior because the rate of acid production and the relative proportions of individual organic acids may still differ among treatments. For example, two samples may have comparable total acidity but contain different concentrations of acetic and gluconic acids, which differ in sensory threshold and metabolic origin. Therefore, the current results suggest convergence in total acid accumulation but do not exclude substrate-dependent differences in acidification kinetics or organic acid composition.

The caffeine content in the present coffee kombucha ranged from 0.29-0.49%, which is consistent with previous evidence indicating that caffeine can remain relatively stable during coffee kombucha fermentation, although its concentration may vary depending on the coffee matrix and fermentation conditions (Kim et al., 2025). Microbial activity within the SCOBY culture can produce enzymes capable of degrading caffeine into simpler derivative compounds, thereby contributing to a reduction in caffeine levels during fermentation (Nasution et al., 2024). In addition, certain acetic acid bacteria have been reported to metabolize caffeine via the N-demethylation pathway, further supporting the occurrence of changes in caffeine content in the final product (Jang et al., 2026). However, caffeine is considered relatively stable during post-harvest processing of coffee. Therefore, variations in processing methods such as washed, natural, and honey do not necessarily result in significant differences in caffeine levels (Farah, 2012). This is consistent with the findings of the present study, in which different post-harvest methods showed no significant effect ($p > 0.05$) on the caffeine content of Arabica coffee kombucha (Sari et al., 2025). The comparable caffeine concentrations among treatments may therefore reflect either similar caffeine levels in the initial coffee infusions or a similar extent of caffeine transformation during fermentation. Although caffeine degradation by kombucha-associated microorganisms has been re-

ported, the absence of pre-fermentation caffeine measurements prevents direct estimation of caffeine degradation in the present study. Accordingly, the results demonstrate comparable residual caffeine concentrations after fermentation rather than confirming that the three substrates underwent identical caffeine metabolism.

In contrast to the other chemical parameters, total soluble solids differed significantly among treatments, with the natural coffee kombucha exhibiting the highest final °Brix value. The total soluble solids (TSS) of the coffee kombucha in the present study ranged from 11.0 to 12.6 °Brix. Bueno et al. (2021) reported a decrease in TSS from 12.83 ± 0.23 to 12.16 ± 0.51 °Brix after 8 days of coffee kombucha fermentation, whereas Sales et al. (2023) reported TSS values decreasing from 11.6 to 9.3 °Brix during 9 days of fermentation of coffee cascara kombucha. Because °Brix represents the combined contribution of sugars, organic acids, minerals, and other soluble constituents, the higher value should not be interpreted exclusively as a higher residual sugar concentration. Nevertheless, natural processing involves drying intact cherries, thereby prolonging contact between the beans and the sugar-rich pulp and mucilage. This extended contact may increase the transfer or retention of soluble compounds within the beans, which subsequently become extractable during brewing (Osorio et al., 2023; Yadav et al., 2021). The higher final °Brix of the natural treatment may therefore represent a substrate carry-over effect resulting from a greater initial concentration of extractable solids.

Alternatively, the difference in final °Brix may indicate that the coffee substrate influenced the extent of microbial substrate utilization during kombucha fermentation. Although an equal amount of sucrose was added to all treatments, the indigenous soluble compounds of each coffee infusion may have modified yeast and bacterial metabolism by providing different nutrient environments or by exerting stimu-

latory or inhibitory effects on microbial activity. Under this mechanism, the higher residual °Brix in the natural treatment could reflect either a higher initial concentration of soluble solids, a lower extent of sugar consumption, or a combination of both. Because initial °Brix, individual sugar concentrations, and their temporal changes were not determined, these mechanisms cannot be conclusively separated in the present study. Nevertheless, the significant difference in final °Brix suggests that the influence of coffee pro-processing was not completely eliminated by SCOBY fermentation. A hedonic test was conducted to evaluate panelists' acceptance of Arabica coffee kombucha produced using different post-harvest methods (washed, natural, and honey).

The observed parameters included sensory attributes such as taste, aroma, color, and overall acceptability (Table 3). Among these, the aroma attribute showed statistically significant differences ($p < 0.05$), with the natural post-harvest method differing significantly from the washed and honey methods. This finding indicates that the post-harvest method had a significant influence on the aroma characteristics of the resulting coffee kombucha. The higher level of panelists' preference for the aroma of the natural method is likely associated with the processing of whole coffee cherries, which enables natural fermentation between the beans and the fruit pulp during the drying stage (Murthy & Naidu, 2012). This process promotes the formation of more complex volatile compounds, including esters and alcohols, which contribute to a fruity and more intense aroma profile (Avalone et al., 2001).

Furthermore, these findings are consistent with the °Brix values, which showed that the natural treatment had the highest soluble solids content and differed significantly from the other treatments. The higher sugar content associated with the natural method may serve as a precursor for the formation of volatile com-

Table 3.
Hedonic acceptance of arabica coffee kombucha

Process	Taste ^{ns}	Aroma	Color ^{ns}	Overall acceptability ^{ns}
Natural	3.05 ^a	3.78 ^b	4.12 ^a	3.40 ^a
Washed	3.55 ^a	3.22 ^a	3.80 ^a	3.62 ^a
Honey	3.10 ^a	3.22 ^a	3.88 ^a	3.10 ^a

Values represent mean hedonic scores from 40 panelists using a seven-point scale. Different superscript letters within the same column indicate significant differences among samples ($p < 0.05$). ^{ns} indicates no significant difference ($p > 0.05$)

pounds during both post-harvest processing and kombucha fermentation. These volatile compounds play a critical role in defining aroma characteristics, contributing to a more complex aroma profile and, consequently, higher panelists' preference (Pajuelo-Muñoz et al., 2026).

The absence of significant differences in taste, color, and overall acceptability suggests that the effect of post-harvest processing on these hedonic responses was limited under the conditions evaluated.

However, non-significant results should not be interpreted as definitive evidence of sensory equivalence because relatively small product effects may have been obscured by inter-individual variation among consumers. Reporting effect sizes and confidence intervals would help clarify whether the observed differences were practically negligible or simply not detected at the available sample size.

Furthermore, the kombucha fermentation process promotes the production of organic acids, resulting in a decrease in pH and an increase in total acidity. Elevated acidity is known to be associated with stronger perceptions of sour-

ness, astringency, and vinegar-like notes, which can dominate the sensory profile and mask more subtle differences among treatments (Cohen et al., 2023).

Based on the results of the Cochran's Q test analysis with McNemar's multiple pairwise comparisons in Table 4, showed that of the 17 sensory attributes evaluated, only the attributes Woody ($p = 0.003$), Honey ($p = 0.000$), Acid ($p = 0.006$), Citric ($p = 0.028$), Vinegar ($p = 0.042$), and Opaque ($p = 0.032$) are significantly different at the 5% significance level, because the p-value for both attributes is less than 0.05.

The number of attributes that are not significantly different between the three coffee kombucha samples is likely caused by two main factors. First, this is related to the limitations of the CATA method, which only produces binary data, namely "1" for the presence and "0" for the absence of an attribute, so it is unable to measure attribute intensity continuously and consequently hinders the ability to discriminate between products that have close sensory profiles (Ares et al., 2014; Meyners & Castura, 2014).

Table 4.
Multiple pairwise comparisons

Attributes	p-values	Natural	Wash	Honey
Citric	0.028*	0.100 (a)	0.300 (a)	0.125 (a)
Fermented	0.116	0.600 (a)	0.750 (a)	0.775 (a)
Floral	0.565	0.050 (a)	0.100 (a)	0.050 (a)
Herbal	0.486	0.250 (a)	0.325 (a)	0.225 (a)
Woody	0.003*	0.400 (b)	0.100 (a)	0.275 (ab)
Honey	0.000*	0.100 (a)	0.425 (b)	0.150 (a)
Acid	0.006*	0.650 (a)	0.925 (b)	0.775 (ab)
Bitter	0.076	0.625 (a)	0.400 (a)	0.575 (a)
Sweet	0.202	0.150 (a)	0.250 (a)	0.150 (a)
Alcoholic	0.092	0.425 (a)	0.275 (a)	0.450 (a)
Vinegar	0.042*	0.650 (a)	0.825 (a)	0.625 (a)
Astringent	0.311	0.475 (a)	0.600 (a)	0.500 (a)
Fizzy	0.956	0.300 (a)	0.325 (a)	0.300 (a)
Refreshing	0.717	0.175 (a)	0.125 (a)	0.175 (a)
Full Body	0.522	0.550 (a)	0.475 (a)	0.575 (a)
Opaque	0.032*	0.975 (a)	0.825 (a)	0.950 (a)
Sparkling	0.092	0.125 (a)	0.250 (a)	0.100 (a)

Values represent the number and percentage of panelists who selected each attribute ($n = 40$). Overall differences among the three samples were evaluated using Cochran's Q test. For attributes with significant overall differences, pairwise comparisons were conducted using McNemar's test with an appropriate adjustment for multiple comparisons. Different superscript letters within the same row indicate significant pairwise differences ($p < 0.05$). Values in bold indicate significant overall differences based on Cochran's Q test

Second, although the three coffee kombucha samples fermented with the same SCOBY for 14 days and showed no significant difference in phenolic, antioxidant, total acid, and total caffeine content, the CATA results indicates that panelists were still able to distinguish the sensory profile associated with each processing method.

This suggest that sensory differentiation in coffe kombucha may not be strongly driven by these particular chemical parameter alone, but rather by volatile or flavor compounds not captured in the present chemical analysis. The use of the quantitative descriptive method (Quantitative Descriptive Analysis/QDA) with trained panelists has the potential to produce sharper discrimination in products with relatively homogeneous sensory profiles such as this coffee kombucha (Varela & Ares, 2012). Principal Coordinate Analysis (PCoA) analysis of the Check-All-That-Apply (CATA) data in Figure 1 showed that the sensory attributes of coffee kombucha are distributed into four quadrants that reflect the close relationship between product characteristics.

The Liking attribute (panelists' preference) is located adjacent to the Refreshing, Fizzy, and Fermented attributes on the positive side of F2 and close to the center of F1, which indicates that consumer acceptance of coffee kombucha is strongly influenced by the refreshing sensation, carbonation, and distinctive fermented taste.

The CATA method has proven effective in describing the sensory profile of fermented products quickly and relevantly for consumers, because it allows untrained panelists to describe their perceptions of the most prominent attributes (Ares et al., 2014).

The refreshing and fizzy sensation of kombucha results from the production of CO₂ during the fermentation process by yeast and acetic acid bacteria in the SCOBY, which significantly contributes to consumer acceptance (Villarreal-Soto et al., 2018). On the other hand, the attributes Alcoholic, Woody, Herbal, Bitter, Full Body, and Opaque clustered in the right quadrant (F1 positive), indicating that these attributes are related to the dominant coffee components, including polyphenols, caffeine, and melanoidins that contribute to the bitter taste, dark color (opaque), and body of

the beverage (Sunarharum et al., 2014; Iriondo-DeHond et al., 2021).

The sweet, floral, and honey attributes were positioned opposite to liking in the PCoA biplot, indicating that these three characteristics did not play a major role in determining panelists' preference for coffee kombucha, they are not what makes the product liked. This condition illustrates that panelists tended to prefer fermented products with sensory profiles dominated by fresh and carbonated sensations rather than sweetness or floral aromas.

Furthermore, the presence of overly prominent sweetness is thought to suppress the perception of freshness in the product, thus indirectly having a negative impact on overall panelist acceptance. Attributes with high negative connotations such as Vinegar, Acid, Astringent, and Citric are in the lower left quadrant (F1 and F2 negative), indicating that these attributes are in the opposite direction to Liking, so it can be interpreted that the intensity of excessive acidity (vinegar), astringent taste (astringent), and too strong floral aroma tend to reduce the level of panelists' liking for coffee kombucha. The dominance of excessive sour taste in kombucha generally occurs due to the accumulation of acetic acid, gluconic acid, and other organic acids produced during prolonged fermentation, so controlling fermentation time and temperature is a critical factor in producing a sensory profile that consumers like (Jayabalan et al., 2014). The astringent flavor of coffee kombucha is specifically associated with the tannin and chlorogenic compounds present in the coffee substrate, which interact with salivary proteins. Its intensity can be controlled by selecting the right coffee type and substrate concentration (Nurikasari et al., 2021). Overall, these CATA results indicate that the ideal coffee kombucha for consumers is one that balances refreshing fermentation characteristics with strong coffee characteristics, yet with measured and moderate levels of acidity and astringency.

This is consistent with the study of non-tea substrate-based kombucha optimization, which emphasized the importance of a balanced flavor profile in determining product acceptability (Chakravorty et al., 2016). Based on the results of the Correspondence Analysis (CA) through the symmetric plot in Figure 2, the F1 axis explains 93.95% of the data diversity, and

the F2 axis 6.05%, so that the total diversity that can be explained by both axes reaches 100%. This indicates that the mapping of sensory and product attributes in the biplot represents the CATA data very adequately. The CATA method is one of the consumer-based sensory evaluation approaches that has been widely used in the characterization of fer-

mented food products because it is able to capture panelists' perceptions spontaneously and efficiently without requiring intensive training (Ares *et al.*, 2014; Varela & Ares, 2012). The three coffee kombucha samples tested, namely natural, wash, and honey coffee-based, showed different distributions in the sensory space, although chemically, the phenolic, anti-

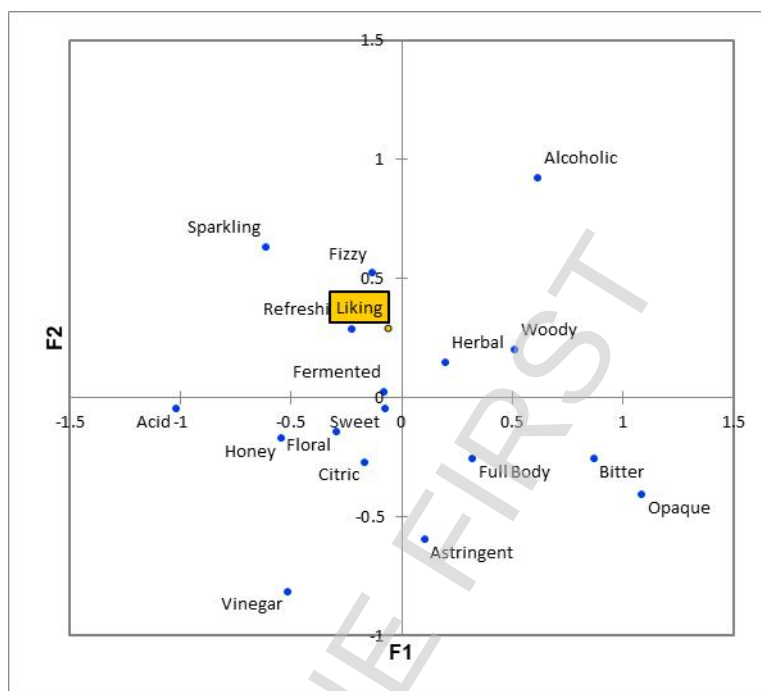


Figure 1. Principal coordinate analysis (PCoA) of Coffee Kombucha (correlation of sensory attributes with preferences)

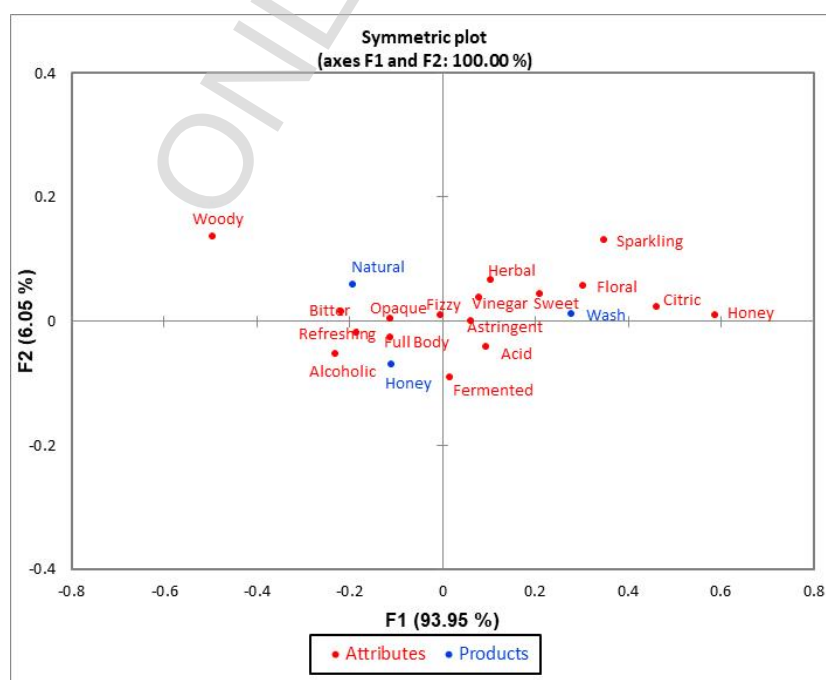


Figure 2. Symmetric plot showing the association between coffee kombucha and its sensory attributes

oxidant, total acid, and total caffeine contents of the three samples did not show significant differences. This indicates that the differences in sensory perception detected through CATA are more influenced by the volatile characteristics and specific flavor compounds of each coffee processing process compared to the measured chemical parameters, as it has been reported that minor aroma compounds such as esters, aldehydes, and ketones can have a significant sensory impact even though they are present in very small concentrations (Sunarharum et al., 2014).

Washed coffee kombucha was positioned on the positive side of F1 and was closely associated with the sparkling, citric, floral, and honey attributes. This distribution suggests that washed-processed coffee contributed a relatively clean, bright, and floral sensory profile, accompanied by a more clearly perceived acidity. During washed processing, the pulp and mucilage are removed before drying, thereby limiting prolonged contact between the beans and fruit-derived compounds. This reduced interaction generally produces coffee with greater flavour clarity, more pronounced acidity, and fewer heavy fermented or fruit-like notes than coffees processed with the fruit tissues retained (Joët et al., 2010; de Bruyn et al., 2016). The persistence of these attributes after SCOBY fermentation indicates that part of the sensory imprint generated during coffee post-harvest processing may remain detectable in the resulting kombucha.

In contrast, natural coffee kombucha was located in the upper-left region of the biplot, corresponding to negative F1 and positive F2, and was more closely associated with woody and bitter attributes. During natural processing, whole coffee cherries are dried with the pulp and mucilage intact, resulting in prolonged contact between the beans and the surrounding fruit tissues. This condition facilitates microbial and enzymatic transformations, as well as the transfer or retention of phenolic compounds, soluble constituents, and aroma precursors within the beans. Subsequent roasting may transform these precursors and promote melanoidin formation, contributing to a fuller body, increased bitterness, and more complex roasted or woody sensations (Iriondo-DeHond et al., 2021). Therefore, the position of the natural sample may reflect not only the direct carry-over of compounds formed during post-harvest processing, but also their subsequent transformation during

roasting and SCOBY fermentation. Nevertheless, because the biplot represents associative rather than causal relationships, instrumental analysis of volatile compounds and individual phenolics would be required to confirm the chemical mechanisms underlying these sensory differences.

The Honey coffee kombucha sample occupies the middle to the bottom right side of the biplot and is associated with the attributes Fermented, Acid, Astringent, and Vinegar, indicating that the 14-day fermentation process on the honey coffee substrate resulted in a more intense sensory perception of acidity and fermentation character. Although titrimetric measurements of total acid did not show significant differences between the three samples, the acidity perception detected by the panelists was likely influenced by the different composition of specific organic acids between the samples, where certain types of organic acids such as acetic acid have a much lower threshold than other acids so that they can be detected sensorily even though the total acid content is equal (Jayabalan et al., 2014; Villarreal-Soto et al., 2018).

The astringent taste strongly associated with the honey sample is thought to originate from the interaction between tannins and chlorogenic acids from the coffee substrate with salivary proteins, the intensity of which can increase with the duration of fermentation (Huang et al., 2021; Sunarharum et al., 2014). The attributes Refreshing, Alcoholic, and Full Body located near the center to the left side of the biplot appear to be associated with the Natural sample, indicating that natural coffee-based kombucha produces a more complex sensation with a relatively higher alcohol content due to the greater residual sugar content in the natural coffee substrate, as reported that substrates with higher initial sugar content tend to increase ethanol production by yeast in the SCOBY during fermentation (Chakravorty et al., 2016; Coton et al., 2017). The frequency of panelist responses (Figure 3) in the CATA evaluation confirmed the sensory distribution patterns identified in the PCoA analysis and previous multiple pairwise comparisons. In general, the fermented, acid, vinegar, and opaque attributes dominated the color intensity in the heatmap across almost all samples, indicating that the acid-fermentative character and cloudy appearance were the most prominent sensory profiles in coffee kombucha products.

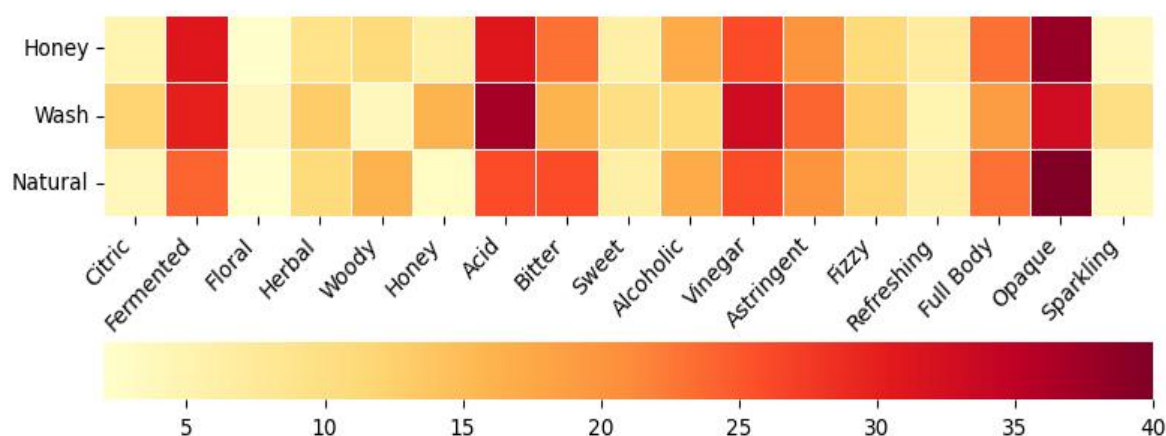


Figure 3. Heatmap of CATA frequencies

In general, the fermented, acid, vinegar, and opaque attributes dominated the color intensity in the heatmap across almost all samples, indicating that the acid-fermentative character and cloudy appearance were the most prominent sensory profiles in coffee kombucha products. The opaque attribute recorded the highest intensity across all treatments, especially in the Natural sample, reflecting the strong visual perception of the product's cloudiness perceived by the panelists. Meanwhile, the Washed coffee kombucha showed higher intensity in the acid and vinegar attributes, indicating a sharper and more acidic flavor character, while the Natural coffee kombucha tended to be prominent in the bitter, full-bodied, and opaque attributes, leading to a stronger body perception with higher flavor complexity due to the accumulation of polyphenol compounds during processing (Coton et al., 2017). Honey coffee kombucha on the other hand showed a more even distribution of attributes without extreme dominance of any particular attribute, so it can be associated with a relatively more harmonious and balanced sensory profile compared to the other two samples. Meanwhile, the attributes Floral, Citric, Sweet, Fizzy, Refreshing, and Sparkling showed low and uniform frequencies across samples marked by light yellow in the heatmap, indicating that these attributes were less prominent in the panelists' perception of the overall coffee kombucha product tested.

Overall, the CATA results complement the hedonic test data from 40 panelists by providing a more detailed descriptive picture of the specific sensory attributes that differentiate the three coffee kombucha samples, so that they can be used as a reference in determining the direc-

tion of product development that is more in line with consumer preferences.

CONCLUSIONS

Coffee beans post-harvest processing influenced the final characteristics of coffee kombucha selectively rather than uniformly. Natural-, washed-, and honey-processed coffee beans produced comparable total phenolic content, antioxidant activity, total titratable acidity, and caffeine levels after 14 days of SCOBY fermentation, suggesting that fermentation may have reduced differences in several bulk chemical parameters. In contrast, total soluble solids remained significantly higher in the natural coffee kombucha, indicating that some substrate-related characteristics persisted after fermentation.

Sensory responses were also affected more strongly at the descriptive level than at the hedonic level. The natural sample received a higher aroma score, whereas taste, color, and overall acceptability did not differ significantly among treatments. CATA profiling further identified significant variation in woody, honey, acid, citric, vinegar, and opaque attributes, demonstrating that post-harvest processing generated distinct sensory signatures despite the similarity of most measured chemical parameters. Consumer preference was more closely associated with refreshing and fizzy sensations, while excessive acidity, astringency, and vinegar-like characteristics were positioned away from liking.

Overall, the findings support a selective persistence of coffee substrate characteristics during kombucha fermentation: SCOBY activity may attenuate differences in major chemical in-

dicators while preserving differences in soluble solids and sensory-active properties. However, the present endpoint measurements cannot determine whether these effects resulted from the direct carry-over of coffee-derived compounds, substrate-dependent microbial biotransformation, or an interaction between both mechanisms. Future studies should therefore include pre-fermentation measurements and time-resolved analysis of individual sugars, organic acids, volatile compounds, ethanol, carbon dioxide, and microbial populations. Such information would clarify the mechanistic contribution of coffee post-harvest processing to fermentation behavior and support the targeted development of coffee kombucha with stronger sensory differentiation and improved consumer acceptance.

AUTHOR CONTRIBUTIONS

Conceptualization and original draft preparation, A.A., D.H., and K.I.L.; supervision and modification A.A., D.H., M.H.T., and K.I.L.; Methodology, A.A., and M.I.F.G.; Investigation, formal analysis, validation A.A., M.I.F.G., A.D.S., A.N.K., and H.Z.S

DATA AVAILABILITY STATEMENT

Data contained within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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ONLINE FIRST

HEMIJSKA SVOJSTVA I SENZORNI PROFIL INFUZIJE KOMBUHE PRIPREMLJENE OD RAZLIČITIH VRSTA ARABIKA KAVA POSLE ŽETVE

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Sažetak: Kombucha, fermentisano piće koje se tradicionalno proizvodi uz pomoć simbiotske kulture bakterija i kvasaca (SCOBY), privlači značajnu pažnju kao funkcionalni napitak zbog svojih potencijalnih zdravstvenih koristi. Rastuća potražnja za različitim vrstama kombuhe podstakla je istraživanje kafe kao supstrata, sa metodama obrade koje mogu uticati na biohemijske i senzorne karakteristike finalnog proizvoda. U studiji su analizirane hemijske i senzorne karakteristike kombuhe proizvedene sa tri metode obrade zrna kafe (natural, washed i honey) dobijenih od farmera u Magelangu, Indonezija. Hemijske analize obuhvatile su antioksidativnu aktivnost (AA), određenu primenom metode uklanjanja DPPH radikala; ukupan sadržaj fenolnih jedinjenja (TPC), određen kolorimetrijskom metodom; ukupnu titracionu kiselost (TTA), određenu kiselinom-baznom titracijom; sadržaj kofeina (CC), određen gravimetrijski; i ukupne rastvorljive materije (TSS), izmerene refraktometrom. Rezultati nisu pokazali značajne razlike između tri metode obrade kafe za sve hemijske parametre (AA 45-49%, TPC 1,51-1,67 mg GAE/g, TTA 0,45-0,54% i CC 0,29-0,49%, osim TSS 11-12,6°), što sugerise da SCOBY fermentacija može homogenizovati hemijski sastav bez obzira na početni metod obrade. Senzorna evaluacija je sprovedena hedonističkim testom kojim se procenjuje aroma, ukus, boja i ukupna prihvatljivost, u kombinaciji sa CATA (Check-All-That-Apply) metodom. Rezultati su pokazali da je kombucha proizvedena od honey-prerađene kafe bila povezana sa pozitivnim senzorskim deskriptorima, kao što su citrusna, cvetna i medna aroma, kao i aroma karakteristična za mineralnost, dok su varijante proizvedene od natural i washed-prerađene kafe bile povezane sa drvenastim, gorkim, alkoholnim i osvežavajućim deskriptorima. Analiza glavnih koordinata CATA podataka pokazala je da je sklonost potrošača pozitivno povezana sa osvežavajućim, penušavim i biljnim deskriptorima. Ovi nalazi sugerisu da, iako se hemijski profil nije značajno razlikovao, metod obrade kafe je uticao na senzorni profil kombuhe.

Ključne reči: kafa arabika, CATA, hedonistički test, kombucha, SCOBY

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