Research Article

Sensory qualities and acceptability of kerson leaf herbal tea infused with blue ternate, lemon, and ginger: Potential for entrepreneurship and food innovation in hospitality

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Abstract

Herbal teas are caffeine-free infusions made from dehydrated edible plant parts, i.e., leaves, flowers, and roots, and are well known for their health benefits and unique flavor profiles. The drying process plays a vital role in preserving the aroma and flavor of these plant materials, ensuring quality and stability. The objective of the present study was to formulate and evaluate the sensory attributes of a new herbal tea made from dehydrated kerson leaves (*Muntingia calabura*), blended with blue ternate flowers (*Clitoria ternatea*), lemon (*Citrus limon*), and ginger (*Zingiber officinale*). The descriptive-quantitative experimental design was used to formulate three formulations (F1, F2, F3), which were evaluated according to color, aroma, flavor, and mouthfeel. Sixty panel members, comprising expert and non-expert panelists, evaluated the samples on a modified 5-point hedonic scale. Results showed that F2, which was a balanced combination of all ingredients, had the highest average scores for all sensory attributes. The addition of lemon and ginger improved the flavor and aroma, while Blue Ternate imparted a bright natural color. Statistical analysis showed that differences between the formulations were significant, with F2 being the most preferred. These findings support the use of locally available ingredients in the development of novel herbal beverages. The formulated tea demonstrates good sensory acceptability and shows potential for commercialization, particularly in the wellness and hospitality sectors, and as a community livelihood initiative. Overall, this study emphasizes the value of sensory evaluation in food innovation and highlights the potential of indigenous ingredients in beverage production.

Keywords: Blue ternate, Herbal tea, Kerson leaf, Sensory evaluation

INTRODUCTION

Tea is part of a long-standing global culture and is widely consumed for both its flavor and potential wellness benefits (Dholia, 2020; Long *et al*., 2023). It is the most widely consumed beverage in the world after water (Knite, 2014; Global Tea Report, 2024). Tea is an aromatic beverage prepared by pouring hot or boiling water over cured or fresh leaves of *Camellia sinensis*, an evergreen shrub native to China, India, and other East Asian countries. Occasionally, tea is also made from the leaves of *Camellia taliensis*. Different types of

tea display distinct sensory profiles, ranging from slightly bitter and astringent to sweet, floral, nutty, or grassy flavors (Long *et al*., 2023).

According to Dholia (2020), tea is classified based on its processing into four main types: green, oolong, black, and herbal tea. Oolong tea undergoes partial fermentation, while black tea is fully fermented. Green tea is produced from the leaves of *C. sinensis* through drying and steaming without fermentation. Herbal tea, on the other hand, originates from plants other than *Camellia spp.* and offers diverse flavors and health properties.

Herbal teas also known as herbal infusions and less commonly called *tisanes,* are beverages made from the infusion or decoction of herbs, spices, or other plant materials in hot water. Oftentimes herb tea, or the plain term tea is used as a reference to all sorts of herbal teas. Some herbal blends contain actual tea. According to Zhao, et. Al (2013), herbal tea is a commonly consumed beverage brewed from the leaves, flowers, seeds, fruits, stems and roots of plants species rather than *C. sinensis* which has been widely used for health care and diseases prevention for centuries. One of the most common herbal teas in the Philippines is Kerson Herbal Tea.

Kerson Tree *(Muntingia calabura)* is a shrub or tree up to 12-meter-tall with spreading branches. The leaves are alternate, distichous, oblong or lanc eolate 4-15 cm long and 1–6 cm wide, with toothed margin and covered in short hairs (Autor, R, 2015). The flowers are small (up to 3 cm wide), solitary or in inflorescences of two or three flowers, with five lanceolate sepals, hairy, five obovate white petals, many stamens with yellow anthers, and a smooth ovoid ovary. Fruit, an edible berry, is red at maturity, about 1.5 cm wide. The Kerson fruit is known to other countries as Jamaican cherry, Panama berry and Singapore cherry.

In the Philippines, it is commonly known as *aratiles* in the Luzon region, and *mansanitas* in the Visayas and Mindanao region. The tree grows amply in all parts of the Philippines and bears fruits in 2-3 years. The small flower is white, and the fruit that is developed turns to red when ripe. Because of its abundance, this tree specifically the leaves have been left unnoticed and disregarded. Many people are not aware of its health benefits and medicinal value. The leaf of this tree acts as a pain blocker. It also has strong anti-inflammatory benefits, reduces blood pressure and improves digestion which are beneficial for people suffering from the said illnesses. According to Abello (2019), Kerson (*Muntinguia calabura linn*) young and matured leaves can be developed into herbal tea due to its acceptability results. In addition to that, the Kerson (young and matured) leaves as herbal tea has antimicrobial property. Moreover, the antioxidant property of Kerson (young and matured) leaves which were tested through total phenolics as the gallic acid show's that both young and matured leaves have antioxidant activity.

Complementing Kerson leaves, Blue Ternate *(Clitoria ternatea)* is an ornamental perennial climber with conspicuous blue or white flowers, and it is commonly called 'blue ternate' and 'butterfly pea'. The flowers of this crop have almost similar shape of the human female genitals; hence, its Genus name Clitoria is derived from clitoris. As cited in various published articles, *C. ternatea* is known as a medicinal plant and is known to treat various diseases. Almost all parts of this plant are reported to have medicinal properties. This flower is commonly known as Asian pigeon-wings, bluebellvine, blue pea, butterfly pea blue ternate which is a native to South Asia and is part of the Fabaceae pea family. The blue tea plant has been used for ages for dyeing, cooking, and making cosmetics. There are various benefits that can be derived from the flower of blue ternate. It has natural antioxidants, helps improves blood circulation, helps prevent hair loss, and graying. It also cleanses blood, improves night vision, revitalizes skin and hair (Dizon, 2014)

Adding lemon (*Citrus limon*) to herbal tea not only enhances flavor but also increases health benefits. Lemon is a rich source of vitamin C and citric acid, which support immune function and digestive health. Its bright, tangy profile balances the earthy taste of herbs and contributes antimicrobial and antioxidant properties (Al-Ghafari *et al*., 2016). Likewise, ginger (*Zingiber officinale*) is widely used for its pungent flavor and medicinal compounds such as gingerols and shogaols, which exhibit strong anti-inflammatory and thermogenic effects. Ginger enhances herbal infusions with a warm, spicy note and supports metabolism, circulation, and digestive function (Makanjuola *et al*., 2015).

With consumers becoming more health-conscious, the demand for innovative and nutritious beverages is on the rise. The trend and foreseen need for drinks with health benefits present an opportune time to uncover another herbal tea flavor. Therefore, it is the objective of this study to develop a new variety of herbal tea made from Kerson leaves (*M. calabura*) infused with blue ternate (*C. ternatea*) flower, lemon (*C. limon*), and ginger (*Z. officinale*), and to determine its acceptability through the evaluation of sensory attributes such as color, flavor, aroma, and mouthfeel. This herbal tea is affordable, readily available, unique, healthy, and beneficial to the community, making it an ideal candidate for awareness and information dissemination. Moreover, this innovation serves as a practical basis for entrepreneurial endeavors and aligns with the needs of the hospitality sector by providing establishments with a new, health-oriented beverage option, while also creating opportunities for micro, small, and medium enterprises (MSMEs) to contribute to the growth and development

of the Philippine economy.

MATERIALS AND METHODS

Research design
This study employed a descriptive-quantitative research approach with an experimental
 design to explore the development of Kerson leaf (*M. calabura*) herbal tea infused with Blue Ternate flowers (*C. ternatea*), lemon (*C. limon*), and ginger (*Z.r officinale*) in various formulations. Laboratory techniques and standardized procedures were utilized to prepare and test the different tea formulations. Both descriptive and inferential statistical methods were applied to analyze the acceptability of the formulations. Sensory attributes were assessed using a five-point hedonic scale, based on the model developed by Peryam and Pilgrim (1952), where 1 corresponded to "Disliked Very Much" and 5 to "Liked Very Much." This scale, rather than a traditional Likert scale, was consistently used throughout the study, including in data collection instruments, analysis, and table legends, to evaluate respondents' preferences for color, flavor, aroma, and mouthfeel. The raw sensory evaluation data and analysis scripts used in this study are available from the corresponding author upon reasonable request, and all data have been anonymized to ensure participant confidentiality.

Standard recipe and procedure
The herbal tea was prepared following the procedure and recipe of Morales *et al*. (n.d.), with modifications introduced to better align with the preferences of contemporary tea enthusiasts. Fresh Kerson leaves, Blue Ternate flowers, lemon, and ginger were thoroughly washed to remove impurities and patted dry with a clean cloth. Lemon and ginger were thinly sliced for even drying, and all ingredients were arranged in single layers on separate trays in a food dehydrator set at 80° C (176°F). Drying times were 3 hours for Kerson leaves and Blue Ternate flowers, 5 hours for ginger, and 6 hours for lemon slices, or until each ingredient was crisp and moisture-free. Once cooled, the dried components were processed individually in a food processor using the pulse setting to achieve a slightly coarse texture. Each 6x8 cm tea bag was filled with 1 teaspoon of dried Kerson leaves, ¼ teaspoon of dried Blue Ternate flowers, ½ teaspoon of dried ginger, and ½ teaspoon of dried lemon before being sealed. The tea bags were then stored in airtight, moisture-proof packaging and properly labeled. For sensory evaluation, one tea bag was brewed in newly boiled water at 100°C for 3 minutes to ensure consistency and reproducibility of the sensory experience, with steeping time adjustable according to personal preference.

Respondents
The respondents of this study were classified into two groups: experts and non-experts. The expert group comprised 20 faculty members from Cebu Technological University – Carmen Campus, specializing in Technology and Livelihood Education, Culinary Arts, and other food-handling or preparation-related courses. These experts were expected to possess advanced knowledge of food quality, preparation techniques, and sensory evaluation. The non-expert group consisted of 30 students enrolled in Technology and Livelihood Education and Hospitality Management programs, as well as 10 self-identified tea enthusiasts or general consumers. Although the students may have received some sensory training and possess heightened awareness of food and beverage qualities compared to the general population, they were considered "non-experts" relative to the faculty panel. Respondents were selected using purposive non-random sampling to ensure availability during the survey period and the timely completion of the study. Each participant received samples of Kerson Leaf (*M. calabura*) tea infused with Blue Ternate *(C. ternatea)* flower, lemon (*C. limon*), and ginger (*Z. officinale*), which were evaluated based on pre-determined sensory criteria. The composition of the non-expert group should be considered when interpreting the results, as students with some sensory experience may provide higher or more consistent ratings than a completely untrained consumer population. Consequently, generalizability of the findings to the broader public should be approached with caution, and future studies could include a larger and more diverse consumer panel to validate these results.

Methodology
A sensory evaluation instrument adapted from Singh-Ackbarali and Maharaj (2014) was utilized to determine the acceptability of the formulated herbal tea. The original tool assessed five attributes—appearance, aroma, taste, sweetness, and mouthfeel. For this study, the instrument was modified to focus on four key sensory attributes relevant to the product: color, flavor, aroma, and mouthfeel. Three formulations were tested: Formulation 1 (F1) contained 1 teaspoon of dried Kerson leaves; Formulation 2 (F2) included 1 teaspoon of dried Kerson leaves, ¼ teaspoon of dried Blue Ternate flowers, ½ teaspoon of dried lemon, and ½ teaspoon of dried ginger; and Formulation 3 (F3) consisted of 1 teaspoon of dried Kerson leaves, ½ teaspoon of dried Blue Ternate flowers, ¾ teaspoon of dried lemon, and ¾ teaspoon of dried ginger. Sensory attributes—color, flavor, aroma, and mouthfeel—were evaluated using the five-point hedonic scale where 1 = "Disliked Very Much," 2 = "Disliked Moderately," 3 = "Neither Liked nor Disliked," 4 = "Liked Moderately," and 5 = "Liked

Very Much." The adaptation involved customizing the instrument to include questions specific to herbal tea, such as natural color intensity, freshness of aroma, herbal flavor balance, and mouthfeel smoothness, with each attribute presented as a separate question. This approach ensures clarity, consistency, and replicability in the assessment of the sensory acceptability of the herbal tea formulations.

Data procedure

The study utilized the Input-Process-Output (IPO) design by Davis, W. M. (1998) as a conceptual framework for understanding systems and processes. According to Davis (1998), the model segments a system into three essential components: input, process, and output. In this study, the IPO technique guided the research toward achieving the expected results in the development of innovative food products. The input consisted of three formulations of Kerson leaf tea, each varying with Blue Ternate, dried lemon, and dried ginger at three different levels. It also included the perceptions of respondents, such as food experts and stakeholders from Cebu Technological University – Carmen Campus, regarding sensory attributes like color, flavor, aroma, and mouthfeel. By applying the IPO framework, the study demonstrates how systematic approaches can be used to innovate and enhance food products while considering both formulation variables and consumer feedback.

The process involved both experimental and descriptive methods. Experimental designs were used to manipulate and control variables in order to evaluate product outcomes, while descriptive sensory analysis was applied to systematically characterize product attributes such as color, aroma, flavor, and texture without altering conditions (Ruiz-Capillas *et al*., 2021; Marques *et al*., 2022). This included gathering the necessary materials for testing, selecting appropriate instruments, conducting sensory analysis, and collecting structured data for evaluation. The formulations were subjected to sensory evaluation for acceptability of the product using 5-Point Hedonic Scale and 5-Point Likert Scale. Analysis of Variance (ANOVA) was used to find out if there are significant differences among formulations as to color, flavor, aroma, and mouthfeel of the new variety of herbal tea.

Ethical considerations

Ethical considerations were observed to protect the evaluators and minimize potential risks, particularly those related to respondents' physical well-being, such as discomfort, pain, injury, or illness that could result from the research methods and procedures. Prior to the evaluation, identified experts, experienced consumer panelists, and stakeholders underwent a preliminary orientation on how to assess the various attributes of the product, including color, flavor, aroma, and mouth-

feel. The data collected from the evaluations were analyzed using Analysis of Variance (ANOVA) to determine statistical significance at the 5% level. The formulation of Kerson Leaf herbal tea infused with Blue Ternate flower, lemon, and ginger that received the highest preference will be selected for production, serving as a foundation for entrepreneurship and innovation initiatives in the hospitality sector.

Data analysis

Using the Jamovi statistical software (The Jamovi Project, 2021), descriptive and inferential statistics were used to analyze the data to ensure accurate and trustworthy results. A sensory evaluation of the Kerson leaf herbal tea infused with blue ternate flowers, lemon, and ginger was conducted, focusing on color, flavor, aroma, and mouthfeel. The sensory acceptability data, rated on a 5-point Likert scale (Likert, 1932), were analyzed using weighted means. Additionally, the Analysis of Variance (ANOVA) by Fisher (1925) was used to assess the statistical significance of mean differences among the three formulations. Tukey's Honest Significant Difference (HSD) test (Tukey, 1953) was employed to further examine the significance of differences between pairs of group means.

Although the 5-point Likert scale generates ordinal data, ANOVA was employed in this study because Likert-type sensory ratings with five or more response categories are widely treated as approximating interval data in sensory and consumer research. Prior to running ANOVA, the assumptions of normality of residuals and homogeneity of variances were examined and were satisfactorily met. ANOVA is also considered robust to moderate violations of normality. Furthermore, the suitability of non-parametric tests such as the Kruskal–Wallis test was considered, and the resulting patterns of differences were comparable, supporting the appropriateness of using ANOVA for the present data.

RESULTS AND DISCUSSION

Herbal teas, also known as infusions, are commonly referred to as "non-Camellia sinensis derived infusions," prepared by steeping or boiling fresh or dried parts of edible plants. These beverages are gaining worldwide popularity due to their wide range of flavors, caffeine-free nature, and health benefits attributed to their high concentration of bioactive compounds (Liu *et al*., 2023; Long *et al*., 2023). As a wellness-oriented alternative, herbal teas appeal to consumers seeking natural remedies and functional beverages. Typically, the formulation of herbal teas involves blending various plant ingredients to achieve both nutritional and sensory benefits. The combination of Kerson leaves with Blue Ternate, lemon, and ginger enhances flavor, aroma, and visual appeal, consistent with recent findings on herbal tea

Table 1. Formulation for three different herbal tea blends

Materials	Formulations of kerson leaf herbal tea infused with blue ternate flowers, lemon and ginger		
	F_1	F_2	F_3
Kerson leaf (dried)	1 tsp.	1 tsp	1 tsp
Blue ternate flower (dried)	-.	¼ tsp.	½ tsp.
Lemon (dried)	-	½ tsp.	¾ tsp.
Ginger (dried)	-	½ tsp.	¾ tsp.

blends (Drake, 2023; Fiorentini *et al*., 2021; Stone, 2020). While previous studies have reported potential antioxidant benefits of these herbs individually or in combination (Liu *et al*., 2023; Long *et al*., 2023), the current study did not measure antioxidant activity. Future studies could evaluate these functional properties to complement sensory evaluation and provide a more comprehensive assessment of the tea's health-promoting potential.

In this study, three distinct herbal tea formulations—F1, F2, and F3—were developed and evaluated for sensory characteristics and consumer acceptability. Formulation 1 (F1) consisted solely of Kerson leaves (*M. calabura*), serving as the control or baseline. Formulations 2 (F2) and 3 (F3) incorporated additional ingredients such as Blue Ternate flowers (*C. ternatea*), lemon (*C. limon*), and ginger (*Z. officinale*), which are known for their health-enhancing and flavor-enhancing properties. The inclusion of these ingredients reflects the growing trend of combining visual appeal with functional benefits in modern tea products. Lemon and ginger contribute tangy and spicy notes, along with immune-boosting and digestive properties, while Blue Ternate provides vibrant coloration and calming effects.

As shown in Table 1, the formulations were carefully adjusted to highlight the impact of ingredient variations. Kerson Leaf remained constant at 1 teaspoon across all samples, ensuring a stable herbal base. In contrast, the infused ingredients varied: Blue Ternate Flower was absent in F1, introduced at ¼ teaspoon in F2, and increased to ½ teaspoon in F3. Similarly, lemon and ginger were added at ½ teaspoon in F2 and increased to ¾ teaspoon in F3. These incremental changes were designed to intensify the flavor, aroma, and visual profile of the tea. F1, being the simplest, offered a mild, earthy taste; F2 introduced subtle citrus and spice layers; and F3 delivered a richer and more complex sensory experience due to the higher concentration of all infused ingredients.

The sensory evaluation results emphasize how the progressive addition of herbal components enhances consumer acceptability. Studies by Drake (2023), Fiorentini *et al*. (2021), and Stone (2020) highlight the crucial role of sensory analysis in understanding consumer preferences. Sensory evaluation involves the scientific assessment of taste, aroma, appearance, and texture using human senses (Stone, 2020), providing insights for product optimization. The structured variation in tea formulations demonstrates the versatility of Kerson Leaf as a base ingredient, supporting scalable innovation. Table 1 thus serves not only as a recipe reference but also as a framework for developing community-based, health-promoting, and livelihood-generating beverages using locally available resources. These herbal tea products can be incorporated into hospitality offerings in hotels, spas, restaurants, and wellness resorts, aligning with wellness trends and enhancing guest experience.

While F1's aroma received the lowest scores and F3 showed variability in mouthfeel and color, these findings indicate opportunities for targeted improvements. Future research could adopt hypothesis-driven approaches to optimize sensory profiles, such as testing alternative ingredient ratios, exploring different drying or processing methods, or introducing complementary herbs and flavor enhancers to balance aroma, taste, and texture. These systematic investigations would not only refine product quality but also support the commercialization and market scalability of herbal tea formulations, ensuring they meet consumer expectations while promoting local ingredient utilization and entrepreneurship in the hospitality sector.

Table 2 presents the sensory evaluation results for the Kerson Leaf herbal tea formulation (F1) as assessed by both expert and non-expert panels. All four sensory attributes—Color, Flavor, Aroma, and Mouthfeel—received ratings within the "Liked a Little" range (3.41–4.20), except for Aroma, which fell under "Neither Liked nor Disliked." Non-expert participants consistently rated all attributes slightly higher than experts; for example, Color was rated 3.95 (SD = 0.639) by non-experts compared to 3.75 (SD = 0.851) by experts, and Flavor at 3.88 (SD = 0.404) versus 3.70 (SD = 0.801) by experts. This pattern suggests that the tea is generally well-received by a broader consumer group, though expert evaluation provides a more critical perspective.

Aroma received the lowest scores from both panels—3.0 (experts) and 3.38 (non-experts)—placing it in the

Table 2. Sensory analysis of F1 formulation

Attributes	Expert			Non-Expert		
	Mean	SD	VD	Mean	SD	VD
Color	3.75	0.851	Liked a Little	3.95	0.639	Liked a Little
Flavor	3.7	0.801	Liked a Little	3.88	0.404	Liked a Little
Aroma	3.0	1.12	Neither Liked nor Disliked	3.38	1.19	Neither Liked nor Disliked
Mouthfeel	3.95	1.23	Liked a Little	3.92	1.47	Liked a Little

Legend: 1-1.80 Dislike a Lot; 1.81-2.60 Dislike a Little; 2.61-3.40 Neither Liked nor Disliked; 3.41-4.20 Liked a Little; 4.21-5.0 Liked a

Table 3. Sensory analysis of F2 formulation

Attributes	Expert			Non-Expert		
	Mean	SD	VD	Mean	SD	VD
Color	4.75	0.550	Liked a Lot	4.90	0.304	Liked a Lot
Flavor	4.70	0.470	Liked a Lot	4.88	0.404	Liked a Lot
Aroma	4.8	0.523	Liked a Lot	4.72	0.847	Liked a Lot
Mouthfeel	4.65	0.671	Liked a Lot	4.88	0.463	Liked a Lot

Legend: 1-1.80 Dislike a Lot; 1.81-2.60 Dislike a Little; 2.61-3.40 Neither Liked nor Disliked; 3.41-4.20 Liked a Little; 4.21-5.0 Liked a Lot; VD – Verbal Description; SD – Standard Deviation

"Neither Liked nor Disliked" category, which indicates a neutral perception of scent rather than a clearly positive or intense aroma. This highlights a potential area for formulation improvement, such as adjusting the proportion of ginger or lemon to enhance the aromatic profile. The low standard deviation observed in non-expert ratings, particularly for Flavor (SD = 0.404), demonstrates a strong level of agreement among general consumers, whereas expert ratings showed greater variability, notably for Aroma (SD = 1.12) and Mouthfeel (SD = 1.23), likely due to their more refined sensory acuity. While F1 serves as a negative control, no positive commercial benchmark was included; therefore, any claims regarding mass-market acceptance or commercialization potential are presented cautiously. Nonetheless, the results suggest that, with targeted adjustments to Aroma and Mouthfeel, the tea formulation could appeal more strongly to health-conscious consumers. The use of locally sourced ingredients such as Kerson Leaf, Blue Ternate, and Ginger further positions the product favorably in sustainability-driven markets, supporting creative food innovation, local livelihoods, and potential integration into hospitality offerings (Jithpakdeepornrat *et al.*, 2024).

Table 3 presents the sensory evaluation results for the F2 formulation of Kerson Leaf herbal tea infused with Blue Ternate, Lemon, and Ginger, showing highly favorable ratings from both expert and non-expert panels. All attributes—Color, Flavor, Aroma, and Mouthfeel—were rated within the "Liked a Lot" range (4.21–5.00). Experts gave particularly high ratings for Aroma (4.80), Flavor (4.70), and Color (4.75), indicating strong appeal to trained evaluators. Non-experts rated Color and Mouthfeel especially high at 4.90 and 4.88, respectively, reflecting excellent acceptance among general con-

sumers. The low standard deviations (SD) suggest a high level of consistency in ratings, particularly among non-experts for Color (SD = 0.304) and Mouthfeel (SD = 0.463), while expert SDs ranged from 0.470 to 0.671. Although the Aroma SD for non-experts (0.847) was slightly higher, it remains within acceptable limits, likely reflecting individual differences in scent perception. Contrary to previous inconsistent interpretations, F2's Mouthfeel scores indicate that this attribute was highly desirable, surpassing both F1 and F3, confirming the formulation's superior sensory balance.

The consistently high ratings across all sensory attributes demonstrate that the combination of Kerson Leaf with Blue Ternate, Lemon, and Ginger achieved an optimal flavor, aroma, and texture profile suitable for consumer acceptance. This underscores the value of sensory-driven product development and highlights the potential for commercialization. Beyond sensory evaluation, future research could explore economic feasibility, market scalability, and production optimization to transition the F2 formulation into a commercially viable herbal tea product. Investigating consumer willingness to pay, distribution channels, packaging design, and integration into hospitality offerings—such as hotels, spas, and wellness centers—would provide actionable insights for entrepreneurship and sustainable market entry. By aligning sensory appeal with local ingredient sourcing and innovative product positioning, the F2 formulation exemplifies a functional, health-oriented beverage with strong potential for community livelihood support and hospitality sector adoption (Isaskar *et al.*, 2021; Uygur, 2019; Byrne, 2020).

Table 4 presents the sensory evaluation results of the F3 formulation, revealing varied responses from both expert and non-expert panels. Across the four sensory

Table 4. Sensory analysis of F3 formulation

Attributes	Expert			Non-Expert		
	Mean	SD	VD	Mean	SD	VD
Color	4.0	1.21	Liked a Little	4.20	1.20	Liked a Little
Flavor	3.95	0.999	Liked a Little	4.10	1.13	Liked a Little
Aroma	4.65	0.587	Liked a Lot	4.63	0.740	Liked a Lot
Mouthfeel	3.6	1.54	Liked a Little	3.98	1.35	Liked a Little

Legend: 1-1.80 Dislike a Lot; 1.81-2.60 Dislike a Little; 2.61-3.40 Neither Liked nor Disliked; 3.41-4.20 Liked a Little; 4.21-5.0 Liked a Lot; VD – Verbal Description; SD – Standard Deviation

Table 5. Significant differences in respondents' perception

Characteristics	F-Value	P-Value	Comparisons of Groups	Post-Hoc P-Value
Color	21.4	<0.001	F1 vs F2	<0.001
			F1 vs F3	0.235
			F2 vs F3	. <0.001
Flavor	11.71	<0.001	F1 vs F2	<0.001
			F1 vs F3	0.204
			F2 vs F3	<0.001
Aroma	.76	<0.001	F1 vs F2	<0.001
			F1 vs F3	<0.001
			F2 vs F3	.757
Mouthfeel	4.99	<0.001	F1 vs F2	<0.001
			F1 vs F3	0.922
			F2 vs F3	<0.001

attributes—Color, Flavor, Aroma, and Mouthfeel—the ratings predominantly fall within the "Liked a Little" category (3.41–4.20). The notable exception is Aroma, which received significantly higher scores from both expert (4.65) and non-expert (4.63) panels, placing it in the "Liked a Lot" category. This suggests that Aroma is the most appealing and distinguishable attribute of the F3 formulation, potentially serving as a key driver of consumer interest. In contrast, attributes like Color, Flavor, and Mouthfeel scored more modestly, indicating general acceptability but also highlighting areas that may benefit from further improvement.

Notably, the relatively high standard deviations, particularly in Mouthfeel (SD = 1.54 for experts and 1.35 for non-experts), suggest significant variation in how individuals perceived the texture. This inconsistency could stem from differences in ingredient concentration or the infusion method used in preparation. Similarly, elevated standard deviations in Color and Flavor—especially among non-experts—indicate a lack of uniformity in the sensory experience. On the other hand, Aroma exhibited the lowest SDs (0.587 for experts and 0.740 for non-experts), reinforcing its consistent positive perception across all evaluators.

Overall, the F3 formulation shows moderate sensory acceptability, with Aroma emerging as its most consistently appreciated feature. However, the variability in the other attributes raises concerns about the product's

consistency, which is critical in determining consumer satisfaction and brand loyalty. To enhance commercial viability, it is recommended to improve the formulation's mouthfeel and visual appeal while preserving its aromatic profile. These insights underscore the importance of refining sensory attributes to achieve a balanced and uniform consumer experience. As Meilgaard *et al*. (2016) emphasize, acceptance and preference for the sensory properties of food remain among the most influential factors shaping consumer food choices.

Table 5 reveals statistically significant differences in respondents' perceptions across various sensory attributes—color, flavor, aroma, and mouthfeel—among the three formulations (F1, F2, and F3), as indicated by the F-values and p-values all being less than 0.001. The data show that for color, there is a significant difference between F1 and F2, as well as between F2 and F3, while F1 and F3 do not significantly differ. This suggests that F2 had the most distinct color, either positively or negatively, which sets it apart from the others. For flavor, similar patterns were observed where F2 was perceived differently from both F1 and F3, again indicating a unique formulation profile that strongly impacted consumer perception.

For aroma, both F1 vs F2 and F1 vs F3 comparisons yielded highly significant differences, while F2 vs F3 did not, suggesting that F1 stands out in terms of aroma characteristics. This may imply that F1 either had a

more intense or more pleasant scent profile that the respondents clearly noticed. On the other hand, mouthfeel results revealed significant differences between F1 vs F2 and F2 vs F3, but not between F1 and F3. This again puts F2 in contrast with both F1 and F3, indicating that the texture or consistency of F2 was perceived as considerably different—potentially less desirable if the mean scores were lower.

These results have important implications for product development and optimization. The consistent significant differences involving F2 across all attributes suggest that this formulation either deviates from sensory expectations or incorporates an element that impacts overall acceptability. Product developers may need to revisit the ingredients or processing methods used in F2 to align it more closely with consumer preferences. Moreover, the sensory dominance of F1 in aroma and the comparable mouthfeel of F1 and F3 imply that these formulations might serve as better models for refinement and commercial viability. Understanding these sensory preferences can guide innovations that cater to targeted markets and enhance consumer satisfaction.

Conclusion

The present study examined the development and sensory acceptability of Kerson leaf (*M. calabura*) herbal tea infused with blue ternate (*C. ternatea*), lemon (*Citrus limon*), and ginger (*Z. officinale*), positioning the product as both a functional beverage and a viable opportunity for entrepreneurship and innovation within the hospitality sector. Among the three formulations tested, Formulation 2 (F2) received the highest acceptability scores from both expert and non-expert panels across all sensory attributes, particularly in color, flavor, aroma, and mouthfeel, all rated within the "Liked a Lot" category. The integration of lemon and ginger significantly enhanced the flavor profile, while the inclusion of Blue Ternate contributed to its visual and aromatic appeal.

The findings indicate that F2 offers an optimal balance of sensory attributes, making it a strong candidate for commercial production. Statistical analysis through ANOVA confirmed significant differences among the formulations, validating the importance of ingredient variation in achieving consumer satisfaction. Furthermore, the consistent positive evaluations across respondent groups highlight the potential for mass market appeal and scalability. This innovation not only demonstrates the potential of underutilized local resources—such as Kerson leaves—as functional beverage ingredients but also serves as a model for value-adding community-based products. The formulation's high acceptability supports its application in the hospitality sec-

tor, particularly for health-conscious consumers seeking herbal alternatives. Thus, the study reinforces the role of sensory-driven product development in empowering micro, small, and medium enterprises (MSMEs) while contributing to local economic development and food innovation in the Philippines.

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Conflict of interest
The authors declare that they have no conflict of interest.

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