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Mangrove Leaf Tea from Ceriops decandra: Sensory Evaluation and Nutritional Analysis

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ABSTRACT This study investigates the acceptability, sensory characteristics, and proximate analysis of mangrove leaf tea derived from Ceriops decandra (Griff.) Ding Hou. The objectives of the study were to assess the overall acceptability of the tea, identify its sensory attributes such as aroma, taste, and mouthfeel, and determine its nutritional profile. A sensory evaluation was conducted with 30 panelists, and the results showed high acceptability, with a mean score of 8.32 on a 9-point hedonic scale. The tea was favored for its herbal aroma and mild sweetness, though its astringent mouthfeel was noted by all participants. Proximate analysis revealed that the tea contained 12.28% moisture, 11.71% ash, 0.43% crude protein, 2.50% total fat, and 73.08% carbohydrates, with an energy content of 317 kcal per 100g. The tea's low fat and sugar content, combined with its high mineral profile, make it a healthy beverage option. The findings suggest that mangrove leaf tea has potential as a functional food, offering health benefits, particularly in managing diabetes and inflammation. However, further refinement of its sensory profile is recommended to enhance its broader appeal. Sustainable harvesting practices should also be emphasized to ensure the long-term viability of Ceriops decandra as a resource.

Keywords: mangrove forest, product innovation, palatability, taste, medicinal value

INTRODUCTION

The development of mangrove leaf tea from Ceriops decandra (Griff.) Ding Hou represents a notable intersection of traditional medicine and modern phytochemistry, leveraging the extensive medicinal properties associated with this mangrove species. Ceriops decandra has been traditionally used for various ailments, including diabetes, gastrointestinal disorders, and infections (Ahad et al., 2021; Mahmud et al., 2018). This historical use highlights the cultural significance and the existing empirical knowledge surrounding its therapeutic potential.

Research has identified bioactive compounds present in Ceriops decandra, including flavonoids, tannins, and phenolic acids, which are known for their antioxidant properties (Hossain et al., 2011; Mahmud et al., 2018). Studies have demonstrated that extracts from the leaves exhibit free radical scavenging capabilities and show antidiabetic effects, significantly reducing blood glucose levels in experimental models (Nabeel et al., 2010; Morales–Covarrubias et al., 2019). These findings suggest that a tea derived from Ceriops decandra leaves could provide health benefits through both regular consumption and specific therapeutic applications.

Moreover, the relevance of Ceriops decandra extends beyond traditional uses. Modern pharmacological studies indicate broad-spectrum activities against various health issues, reinforcing the idea of deriving tea from its leaves. Research has shown that Ceriops decandra leaves possess properties such as antinociceptive and anti-inflammatory activities, which support their formulation as a health-promoting tea (Ahad et al., 2021; Mahmud et al., 2018; Morales–Covarrubias et al., 2019). The leaf tea may provide a natural alternative for managing chronic conditions like diabetes and inflammation (Nabeel et al., 2010; Morales–Covarrubias et al., 2019).

Furthermore, the development of Ceriops decandra leaf tea aligns with trends favoring herbal and functional foods while emphasizing sustainability and the utilization of underappreciated local flora. The ecological significance of mangrove ecosystems underscores the need for sustainable harvesting practices to ensure the preservation of Ceriops decandra and its habitat. Studies on the ecological roles that mangroves play in their environments highlight their importance in coastal protection and biodiversity (Morales–Covarrubias et al., 2019; Wiradana et al., 2021).

Recent investigations, including molecular docking studies, suggest that the phenolic compounds in Ceriops decandra might act as effective α-amylase and α-glucosidase inhibitors, indicating potential utility in controlling postprandial blood glucose levels (Puspitasari et al., 2023). Thus, the proposed leaf tea can be viewed not just as a beverage but as a functional food with potential contributions to health care, particularly in managing diabetes and inflammatory conditions.

This study, therefore, aims to develop a new product from the leaves of the mangrove species C. decandra that may benefit the health concerns of human beings without degrading the plant population. The researchers will develop a mangrove tea, test its acceptability, and determine the sensory characteristics and the cost of its production.

Objectives:

Generally, the study was conducted to determine the Acceptability, Sensory Characterization, and Proximate Analysis of Mangrove Leaf Tea, which will utilize C. decandra:

1. To determine the overall acceptability of mangrove leaf tea.
2. To identify the sensory characteristics of mangrove leaf tea in terms of attributes as a tea, color, aroma, taste, and mouthfeel.
3. To determine the proximate analysis and nutritional facts of mangrove leaf tea.

METHODOLOGY

Procurement of Raw Materials

The materials used were fresh C. Decandra leaves collected from the Cabano River. Other materials, such as tea bags, were purchased from…

Preparation of C. decandra leaf powder

At first, the leaves were sorted to reject unwanted, over-matured, and insect-affected portions of the leaves. The leaves were washed with slightly warm water to remove the dirt particles. The excess water was drained from the leaves. Before the actual drying process, all water molecules were checked to see if they had drained out or not. After the complete removal of water particles, the leaves were kept in a thin layer in a tray for the actual drying process. The leaf samples were spread on the tray and placed into the cabinet tray drier at 60°C for 4 hours (Sanjukta et.al., 2013). Then the dried leaves were ground to a fine powder using an attritional mill, sieved, and kept in an LDPE resealable bag and stored at room temperature.

Preparation of Mangrove Leaf Tea

The ground dried leaves were placed in a tea bag. Then the tea bag was soaked in one cup of hot water for 2-3 minutes before serving.

Tasting Panelists for Sensory Evaluation

Thirty (30) panelists from within the university community were invited to the test. It is composed of ten (10) faculty, ten (10) staff, and ten (10) students. This is to ensure the balanced representation of all the members of the university community.

Validity and reliability of the instrument

The instrument used was subjected to a face validation technique, also known as validation by jury opinion. This will require that the test instrument be presented to a jury of experts for their opinion as to whether or not the instrument could gather the needed data as intended.

Acceptability Test

Acceptability test of mangrove tea was conducted using the 9-Point Hedonic Scale, the most widely used scale for measuring food acceptability in the following intensity scale: Like extremely; Like very much; Like moderately; Like slightly; Neither like nor dislike; Dislike slightly; Dislike moderately; Dislike very much; and Dislike extremely.

The acceptability test was conducted at the GSU-Main Campus, Mclain, Buenavista, Guimaras. Each grounded dry mangrove leaf in a tea bag was placed in a metalized plastic pouch before they were brought to the venue. Then, to produce a tea, the tea bag with GDML was soaked in one (1) cup (236.59ml) of boiled water for 2-3 minutes before it was served to the taste panelist for acceptability.

Before the panel members started the evaluation, they were instructed as to what the evaluation was all about and the flow of the evaluation. Each member was provided with a pen and an evaluation sheet reflecting the 9-point hedonic scale for each treatment. This evaluation sheet was used to rate each treatment formulation using the scale. A total of thirty (30) panel members participated in the evaluation. The taste was scored based on its intensity scaled on a 9-point hedonic scale (9 = liked extremely, 8 = liked very much, 7 = like moderately, 6 = liked slightly, 5 = neither liked nor disliked, 4 = disliked slightly, 3 = disliked moderately, 2 = disliked very much, and 1 = disliked extremely).

On the sensory characterization, it was evaluated in terms of attributes as a tea (astringency, bitterness, floral, gassiness, and roasted grain); color (blackness, brownness, greenness, redness, sparkling, turbidity, and yellowness); aroma (citrus, ginger, herbal, and lemon grass); taste (bitter, bitter after taste, pungent after taste, sour, and sweet); and mouthfeel (astringency and tooth-etching).

Proximate Analysis of Mangrove Leaf Tea

The GDML was subjected to proximate and nutritional analysis. For proximate analysis, 100g of the GDML sample was placed in a metalized plastic pouch. For nutritional fact analysis, a 100 g sample was also prepared. These samples were sent to the DOST - Regional Standards and Testing Laboratory, Iloilo City. Parameters included in the proximate analysis are moisture, ash, crude protein, total fat, carbohydrate, and energy.

Moisture content was determined through loss on drying by the Oven Method, which was based on the Official Methods of Analysis of AOAC International (2016), 20th Ed. Official Method 930.04. Ash content was determined using the Gravimetric Method, which was based on the Official Methods of Analysis of AOAC International (2016), 20th Ed. Official Method 930.05. Crude protein content was determined by the Kjeldal Block Digestion Method and Steam Distillation, and Total fat content by the Soxhlet Method using Petroleum Ether with Acid Hydrolysis. The Carbohydrate content was computed by difference, using the formula: Carbohydrate = 100 – (sum of moisture, ash, protein, and fat). This formula was based on the Official Methods of Analysis of AOAC International (2016), 20th Ed. Official Method 986.35E. Energy in kilocalories per 100 g is the sum of protein, fat, and carbohydrate multiplied by the general Atwater factors 4-9-4. The methods described were performed by the DOST - Regional Standards and Testing Laboratory, Iloilo City.

Statistical Analysis

The data gathered was analyzed using mean and standard deviation.

RESULTS AND DISCUSSIONS

General Acceptability

The mangrove leaf tea, with a mean acceptability score of 8.32 ± 1.23, suggests that the product is highly acceptable to the test panelists. The mean value of 8.32 indicates a favorable overall response to the tea, signaling that the majority of the panelists found the product quite appealing.

The standard deviation of 1.23 further reinforces the consistency of this positive evaluation. The relatively low standard deviation implies that most of the panelists' ratings clustered closely around the mean, suggesting a uniform appreciation for the tea across the group. This could indicate that the product has broad consumer appeal and is likely to be well-received by a wider audience.

Moreover, the 8.32 score aligns with a 9-point hedonic scale where a higher score typically indicates strong positive feedback. This implies that the mangrove leaf tea is considered to be in the "liked very much" range, making it a promising product for potential commercialization. The positive results reflect favorably on its taste and other attributes that were evaluated.

In a study of Ünal et al. (2016) in exploring the effects of various herbal teas on consumer acceptance, it was found that the optimal balance of taste and aroma characteristics inherent in Ceriops decandra tea contributes to higher scores in acceptability. The infusion process involving steeping dried leaves to extract their nutritional and flavor compounds produces a tea that is not only palatable but also rich in beneficial bioactive compounds, making it an attractive choice for health-conscious consumers (Boopathy et al., 2011).

Sensory Characteristics

The sensory characteristics of Mangrove tea reveal both appealing and challenging attributes that influence its overall reception. A significant majority of participants (86.7%) noted a grassy attribute, indicating that the tea's earthy flavor is prominent, which could attract herbal tea enthusiasts, although it may not appeal to everyone. The tea's yellow color, recognized by 80% of participants, provides a bright and refreshing visual that aligns with the expectations for herbal teas, though it may not be as universally enticing as its aroma or taste. The herbal aroma, appreciated by 90% of participants, is one of the strongest positive features, evoking freshness and natural qualities that align with consumer preferences for plant-based beverages. Regarding taste, 76.7% of participants found it sweet, suggesting that the tea offers a mild sweetness that could appeal to those who prefer their drinks with subtle, natural sweetness, but might be less attractive to those seeking a stronger sugary flavor. Perhaps the most distinctive aspect of the tea is its astringency, which was unanimously noted by all participants (100%), offering a bold mouthfeel that could be either a draw or deterrent depending on the consumer's tolerance for dry, sharp sensations.

The high percentage of people recognizing the astringent quality implies that it's an essential characteristic of the tea, but it could limit its broader appeal to those who are not accustomed to or do not enjoy this sensation. While the tea's strong herbal aroma and bright color are clear selling points, the astringency may require careful positioning in marketing, as it might not suit everyone's preference. Consequently, balancing this feature or educating consumers about its distinctive qualities could be crucial for appealing to a wider market. In conclusion, Mangrove tea's sensory profile suggests that it could succeed in niche markets for herbal teas but might need refinement to cater to broader consumer tastes.

Leaf maturity influences both the antioxidant properties and the overall flavor profile. Young leaves tend to have higher concentrations of bioactive compounds, including tannins and flavonoids, that contribute to astringency and depth of flavor (Sumartini et al., 2022; Hinokidani et al., 2020). Tannins can provide a textural element to the tea but may also lead to a slightly bitter taste if not brewed properly, emphasizing the need for appropriate preparation methods to optimize flavor extraction Fibrianto et al., 2024). The sensory attributes such as sweetness, bitterness, sourness, and astringency can vary widely based on these factors, highlighting the complexity of mangrove leaf tea Fibrianto et al., 2024).

Table 1. Sensory characteristics of mangrove leaf tea.

Sensory Characteristics	f	%
Attributes as a tea (Grassiness)	26	86.7
Color (Yellowness)	24	80.0
Aroma (Herbal)	27	90.0
Taste (Sweet)	23	76.7
Mouthfeel (Astringency)	30	100.0

Proximate Analysis

The proximate analysis of mangrove leaf tea reveals valuable information about its nutritional composition, which has potential health implications. With a moisture content of 12.28%, the tea retains a moderate amount of water, which is essential for maintaining flavor and freshness but requires proper storage to prevent spoilage. The ash content of 11.71% indicates that the tea is rich in minerals such as calcium, magnesium, and potassium, making it a potential source of essential micronutrients. Sumartini et al. (2022) and Sari et al. (2022), on their preliminary investigations, have reported that ash content in mangrove leaves can vary significantly, with values indicated between 15% and 36.59% This mineral richness is crucial as it contributes to various physiological processes and can enhance the health claims of the tea.

Although the crude protein content is low at 0.43%, and the fat content is also modest at 2.50%, these levels are typical for plant-based beverages, which focus more on providing vitamins, minerals, and bioactive compounds rather than protein and fats. Gnanadesigan et al. (2012) stressed that the provided protein may contribute to the overall amino acid pool, offering additional metabolic benefits at low levels.

The high carbohydrate content (73.08%), primarily from sugars and fiber, suggests that the tea can provide energy and support digestion, with the added benefit of moderate sugar content (6.26%), making it a healthier alternative to sugary drinks. Sumartini et al. (2022) reported that several studies have indicated carbohydrate levels around 65.12%. High carbohydrate content potentially makes the tea a viable option for sustaining vitality, especially in regions where energy-dense foods may be scarce.

Finally, the energy content of 317 kcal per 100g shows that mangrove leaf tea can be a moderate source of calories, offering a natural energy boost. Overall, mangrove leaf tea, with its rich mineral profile and moderate sugar content, can serve as a nutritious, low-sugar beverage that supports energy, digestion, and overall health, making it a promising addition to a balanced diet. However, its moisture content requires proper storage to ensure its shelf life and freshness. According to Sari et al. (2022), studies have indicated an energy content that might range from 300 to 350 kcal per 100 g of dry leaf material. When infused, the beverage likely delivers a fraction of this energy, but its low caloric density makes it suitable for inclusion in low-calorie diets.

Table 2. Proximate analysis result of mangrove leaf tea.

Parameter	Result (g/100g)
Moisture	12.28
Ash	11.71
Crude Protein	0.43
Total Fat	2.50
Carbohydrate	73.08
Total Sugar	6.26
Energy	317 kcal/100g

Nutritional Facts

The nutritional analysis of mangrove tea reveals that a single serving (1 tea bag, 3g) contains only 10 kcal, with no calories coming from fat. The tea is free from total fat, making it a virtually fat-free beverage, which could be beneficial for individuals looking to manage their fat intake. The tea provides 2 grams of total carbohydrates per serving, with no sugar content, indicating that it has a very low glycemic index, making it suitable for those monitoring their blood sugar levels. The absence of protein further suggests that mangrove tea is not a significant source of this macronutrient. With no fat, sugar, or protein, the tea's main contribution to the diet is its minimal caloric value, positioning it as a refreshing, low-calorie beverage option. The lack of significant macronutrients in the tea implies that it may be best enjoyed for hydration, relaxation, or as a flavorful addition to a balanced diet rather than a primary nutritional source. This makes mangrove tea an ideal choice for those seeking a light, hydrating drink without added calories, sugars, or fats.

The tea made from Ceriops decandra leaves presents an opportunity for leveraging the nutritional and health-promoting properties associated with mangrove vegetation. The robust antioxidant profile, the presence of bioactive compounds like GABA, and the potential nutrient composition highlight its viability not only as a traditional beverage but also as a component of functional food formulations aimed at improving health and wellness (Boopathy et al., 2011; Hinokidani et al., 2020).

Table 3. Nutritional content of mangrove leaf tea.

NUTRITIONAL FACTS		
Serving size: 1 tea bag (3g)		
No. of Servings per pack: About 10		
		% RENI
Calories (kcal)	10	0
Calories from Fat (kcal)	0	
Total Fat (g)	0	
Total Carbohydrates (g)	2	
Sugar (g)	0	
Protein	0	0

CONCLUSIONS AND RECOMMENDATIONS

The development of mangrove leaf tea, derived from Ceriops decandra, demonstrates promising potential as a functional beverage with health benefits. The sensory evaluation results indicate that the tea is generally well-accepted, scoring highly in terms of overall taste and aroma. However, its distinct astringency could limit broader appeal, though this could be addressed through product positioning or consumer education. Nutritionally, the tea is low in calories, fat, and sugar, making it a viable option for health-conscious consumers, while its high mineral content offers potential health benefits, such as supporting bone health and improving digestion. Its natural sweetness and low glycemic index also position it as an ideal choice for those managing their blood sugar levels.

To maximize the potential of mangrove leaf tea, it is recommended to refine its formulation to appeal to a broader audience, particularly by adjusting the astringent taste or emphasizing its unique characteristics in marketing. Additionally, promoting the tea's health benefits, such as its antioxidant and anti-inflammatory properties, would help position it as a functional food. Sustainable harvesting practices should also be prioritized to ensure the long-term viability of Ceriops decandra as a resource. Further studies could explore different preparation methods or formulations to improve flavor while maintaining the tea's bioactive benefits.

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