

MORICA (MORINGA–CARICA) HERBAL TEA: An Innovation in Herbal Tea Based on Carica Fruit and Moringa Leaves for The Health of The Indonesian Archipelago

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ABSTRACT

Indonesia's high biodiversity offers significant potential for the development of functional foods based on local resources. One such potential lies in the utilization of carica (*Carica pubescens*), a distinctive fruit from the Dieng Highlands, whose processing generates substantial peel waste that remains underutilized. At the same time, moringa leaves (*Moringa oleifera*) are recognized for their high nutritional and bioactive compound content, but are limited in consumer acceptance due to their strong grassy flavor. This study aimed to develop an herbal tea bag product combining moringa leaves and carica peel as a sustainable and functional local beverage. An applied research approach was employed through four stages: pre-production, production, analysis, and evaluation. The product was formulated using 2 g of dried moringa leaves and 0.7 g of dried carica peel per tea bag. The results showed that the integration of carica peel improved the sensory characteristics of moringa leaf tea without eliminating its herbal identity, while simultaneously adding value to agro-industrial waste. The production process yielded a practical, consistent, and easily reproducible tea bag product with acceptable sensory quality. This study demonstrates that MORICA Herbal Tea represents a viable model for functional food development that integrates waste utilization, sensory improvement, and sustainability, and provides a foundation for further product optimization and scale-up.

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INTRODUCTION

Indonesia is a country with high biodiversity, offering substantial potential for the development of functional foods based on local resources. One distinctive regional commodity is carica fruit (*Carica pubescens*), which grows optimally only in the Dieng Highlands, Wonosobo Regency. To date, carica has been widely utilized as a raw material for processed products such as candied fruit, syrup, and chips, which contribute to the local economy. However, these processing activities generate a considerable amount of peel waste whose utilization

remains very limited ([Sujarwoto et al., 2022](#)). Carica peel waste is generally not optimally managed and may potentially cause environmental problems. Meanwhile, sustainable development approaches require the optimization of all parts of raw materials. Therefore, the utilization of carica waste represents an important issue in the development of sustainable local agro-industry.

Along with increasing public awareness of health, the development of functional foods has become a key focus in modern food systems. Functional foods not only serve as sources of energy but also provide physiological health benefits. One rapidly growing category of functional food products is herbal beverages, particularly tea. Data from the Indonesian Central Bureau of Statistics indicate that tea consumption in Indonesia continues to increase ([BPS, 2023](#)). Nevertheless, the national tea market is still dominated by conventional black and green tea. This condition suggests that diversification of local herbal tea products remains relatively limited. Given its rich biodiversity, Indonesia has significant opportunities to develop herbal teas based on local ingredients. This potential creates space for innovation in herbal tea products with added health and economic value.

Moringa leaves (*Moringa oleifera*) are one of the local plant resources known for their high nutritional value and bioactive compound content. Moringa leaves contain various vitamins, such as vitamins A, B, and C, as well as essential minerals including calcium, iron, and magnesium, which play important roles in maintaining health ([National Institutes of Health, 2021](#)). Several studies have reported that consumption of moringa leaf tea can increase hemoglobin levels ([Hastuti & Sari, 2022](#)) and reduce blood glucose and cholesterol levels ([Irwandi et al., 2024](#); [Rofianti & Septiani, 2022](#)). Despite these benefits, the utilization of moringa leaves as an herbal beverage still faces a major challenge related to sensory attributes. The strong grassy flavor and characteristic aroma often result in low consumer acceptance ([Nuryani et al., 2023](#)). This issue poses a significant challenge in the market-oriented development of moringa leaf tea products.

Previous studies have shown that carica peel has potential as a functional food ingredient due to its content of dietary fiber, carbohydrates, and pectin ([Saputri, 2020](#)). In addition, carica peel has been reported to be rich in bioactive compounds such as flavonoids and vitamin C, which function as natural antioxidants ([Koul et al., 2022](#)). However, most existing studies focus on chemical characterization and the utilization of carica peel in conventional food products. Its application as a component of herbal beverages has been rarely explored. On the other hand, research on moringa leaf tea has largely emphasized health benefits, with limited attention given to improving flavor and consumer acceptance. This situation indicates a research gap in the development of herbal tea products that integrate health benefits with sensory quality.

Several recent studies have reported that carica peel extract can reduce the grassy flavor of moringa leaves ([Nuryani et al., 2023](#)), indicating a potential synergistic interaction between the two ingredients in producing products with higher consumer acceptability. Nevertheless, previous research has not specifically examined product development in the form of herbal tea bags. Moreover, product quality aspects—such as physical, chemical, and sensory characteristics—as well as production feasibility have not been comprehensively discussed. Therefore, there remains a research gap related to formulation development and quality evaluation of herbal tea bags based on moringa leaves and carica peel. The novelty of this study

lies in its integrative approach combining agro-industrial waste utilization with the development of ready-to-consume functional beverages.

Based on this analysis, the main research problems include the suboptimal utilization of carica peel waste and the low level of consumer acceptance of moringa leaf tea due to its grassy flavor. In addition, no effective and sustainable herbal tea bag formulation combining moringa leaves and carica peel has yet been established. Limited studies addressing product quality and production feasibility of such a combination further highlight the need for investigation. Therefore, this research is directed toward addressing these gaps through a product development approach based on local resources. This approach is expected to bridge research outcomes with potential industrial applications. Consequently, the formulation of research objectives becomes crucial.

This study aims to develop an herbal tea bag based on moringa leaves and carica peel as an innovation in local functional beverages. The specific objectives include developing an optimal tea bag formulation, evaluating product quality, and assessing production feasibility. In addition, this study aims to examine the role of carica peel in improving the sensory characteristics of moringa leaf tea. The results are expected to provide an alternative value-added utilization of agro-industrial waste. Furthermore, this study is expected to contribute to the diversification of local herbal tea products. Thus, the research has strong relevance both scientifically and practically.

This research is expected to contribute to the development of sustainable functional foods based on local resources. The utilization of carica peel supports waste reduction and circular economy principles. From a health perspective, the developed product has the potential to serve as a natural antioxidant source with metabolic health benefits. From an economic perspective, this study opens opportunities for the development of regional flagship products from Wonosobo. In addition, this research may serve as a scientific reference for the development of other herbal teas based on local ingredients. The urgency of this research continues to increase in line with the growing demand for natural and health-oriented products. Therefore, this study is expected to provide tangible contributions to both scientific advancement and innovation in functional food development.

METHODS

Research Approach

This study employed an entrepreneurial approach (*applied research*) oriented toward the development of innovative products based on local potential ([Ella et al., 2023](#)). This approach was selected because the research objective was not only to generate scientific knowledge but also to produce a tangible product with functional value and economic potential. The applied research approach allows for the integration of technical processing aspects, product quality evaluation, and production feasibility assessment. In addition, this approach is relevant to functional food development that emphasizes sustainability and the utilization of local resources. The research focus was directed toward addressing the problem of limited utilization of carica peel waste and the low consumer acceptance of moringa-based products. Therefore, this approach was considered appropriate for bridging academic research outcomes with practical and applicative needs.

Research Design

The study was conducted using a phased research design consisting of four main stages: pre-production, production, analysis, and evaluation. The pre-production stage involved a supplier survey to ensure the availability and quality of carica peel and moringa leaf raw materials, as well as the procurement and preparation of essential equipment. The production stage included washing of raw materials, drying at a controlled temperature of 50 °C, grinding, sieving, and packaging into tea bags ([Karabacak et al., 2018](#)). The analysis stage focused on evaluating the characteristics and quality of the herbal tea product obtained. The evaluation stage was directed at assessing the suitability of the product in relation to the research objectives and its potential production feasibility. This research design was systematically structured to ensure process reproducibility and traceability.

Materials and Instruments

The materials used in this study consisted of moringa leaves and carica peel obtained from local suppliers. The main instruments employed in the production process included a dehydrator, grinder, sealer, and tea bag packaging materials. The dehydrator was used to dry the raw materials at 50 °C in order to maintain the stability of bioactive compounds ([Karabacak et al., 2018](#)). The grinder was used to reduce the dried materials to a uniform particle size, followed by sieving to obtain an appropriate powder fraction for tea bag formulation. The sealer was utilized for packaging to preserve product quality and stability. All instruments were selected based on their suitability for the research objectives and the intended production scale.

Data Analysis

Data analysis was conducted using descriptive and evaluative methods in accordance with the applied nature of the study. Observational data collected at each stage of production were analyzed to describe the processing workflow and product characteristics. Product quality analysis included descriptive evaluation of physical characteristics, material uniformity, and sensory attributes. The analysis results were used to assess formulation suitability and the role of carica peel in improving the characteristics of moringa leaf tea products. In addition, production feasibility was evaluated based on process simplicity and potential scalability. The data were presented in the form of scientific narration and supporting tables as required. This analytical approach was selected to comprehensively and applicatively support the achievement of the research objectives.

RESULTS AND DISCUSSION

The development of MORICA Herbal Tea demonstrates that the combination of moringa leaves (*Moringa oleifera*) and carica peel (*Carica pubescens*) has the potential to produce a functional and sustainable herbal tea bag product based on local resources. The product was formulated using 2 g of dried moringa leaves and 0.7 g of dried carica peel per tea bag. This formulation was selected as an optimal balance between functional objectives and sensory acceptability, in line with the principles of functional food development, which emphasize that product characteristics—including sensory attributes—are key determinants of consumer acceptance of functional foods ([Baker et al., 2022](#)). Moringa leaves contribute as a source of

bioactive compounds, while carica peel functions as a sensory-balancing component as well as a value-added utilization of agro-industrial by-products.

The characteristics of the raw materials constitute an initial determinant of successful product development. Moringa leaves are known to contain high levels of vitamins, minerals, and phenolic compounds; however, they also exhibit a strong grassy or bitter flavor that often limits consumer acceptance (Hastuti & Sari, 2022; Leone et al., 2015). In contrast, carica peel has traditionally been treated as waste, despite containing dietary fiber, pectin, and phenolic compounds with potential application as functional food ingredients (Saputri, 2020; Pratiwi et al., 2025). The integration of these two materials demonstrates a complementary effect, whereby the sensory limitations of moringa leaves can be compensated for by the characteristics of carica peel. This approach supports the concept of food waste upcycling, which is increasingly applied in sustainable food development (Mirabella et al., 2014).

The applied production process plays a crucial role in maintaining product quality and consistency. Drying at 50 °C resulted in uniformly dried and stable materials without significant physical degradation. Moderate drying temperatures are known to effectively reduce moisture content while preserving the stability of bioactive compounds (Karabacak et al., 2018). Subsequent grinding and sieving produced relatively uniform particle sizes, which directly influence product homogeneity and the efficiency of bioactive compound extraction during infusion. Particle size uniformity is particularly important in tea bag products, as it affects the rate and consistency of functional compound release (Belitz et al., 2009). Thus, the production stages in this study were not merely procedural but formed part of an integrated quality control strategy. The overall production process is presented in Figure 1.



Figure 1. Production process of MORICA herbal tea

The formulation results further indicate that balancing health benefits and consumer preferences is a critical factor in functional food development. The dominance of moringa leaves without a balancing ingredient may reduce consumer preference due to their strong grassy flavor (Hastuti & Sari, 2022). The incorporation of carica peel in the MORICA Herbal Tea formulation was shown to mitigate this characteristic, consistent with the findings of Nuryani et al. (2023). Analytically, carica peel functions not only as a masking agent but also enriches the complexity of the herbal flavor profile. These findings support the view that functional food innovation must

incorporate sensory experience as a primary determinant of consumer adoption ([Ares & Jaeger, 2013](#); [Baker et al., 2022](#)).

In terms of product quality, MORICA Herbal Tea is presented in a practical and consistent tea bag form. Packaging in a standing pouch containing five tea bags (Figure 2) supports hygienic handling and visual appeal, both of which play important roles in shaping quality perception and consumer acceptance of herbal products ([Rundh, 2016](#); [Silayoi & Speece, 2007](#)). Although the characteristic aroma of moringa leaves remains detectable, its intensity is relatively more acceptable when combined with carica peel. This condition indicates that sensory improvement is gradual and does not require the complete elimination of the original ingredient character, but rather its balanced management. From a market-oriented perspective, these results strengthen the product's identity as a distinctive herbal tea that remains acceptable to consumers.



Figure 2. MORICA Herbal Tea packaging in a standing pouch

Visually and sensorily, the infusion of MORICA Herbal Tea exhibits a yellowish-green to clear brown color, reflecting the extraction of water-soluble compounds from moringa leaves and carica peel. The relatively clear infusion without coarse sediment indicates appropriate particle size distribution and effective sieving during processing (Figure 3). The aroma of the infusion is dominated by mild herbal notes with a fresh nuance, while the bitter and grassy taste typical of moringa leaves becomes softer after brewing. The presence of carica peel contributes to a more balanced flavor profile, resulting in a lighter and more pleasant infusion. These infusion characteristics indicate that the formulation and production process are capable of producing an herbal tea with stable and consistent sensory quality.



Figure 3. MORICA Herbal Tea infusion

Product feasibility evaluation using SWOT analysis indicates that MORICA Herbal Tea possesses strengths in its unique formulation, use of natural ingredients, and alignment with current health trends. Increasing consumer interest in herbal and natural food products represents a major opportunity for product development (BPS, 2023; WHO, 2019). However, in an increasingly competitive global herbal tea market, producers face growing challenges that require improved product quality, differentiation, and more effective marketing and consumer education strategies to meet diverse consumer needs and preferences (Carbone et al., 2025). This analysis emphasizes that the success of innovative products depends not only on ingredient quality but also on positioning strategy and value communication. The characteristics of MORICA Herbal Tea are summarized in Table 1.

Table 1. Characteristics of MORICA Herbal Tea

Aspect	Qualitative Observation
Product form	Herbal tea bag
Composition per tea bag	2 g moringa leaves + 0.7 g carica peel
Infusion color	Yellowish-green to clear brown
Aroma	Mild herbal moringa aroma
Practicality	High

From a health perspective, the combination of moringa leaves and carica peel provides relevant functional value. Consumption of moringa leaf tea has been reported to help reduce blood glucose and cholesterol levels (Irwandi et al., 2024; Rofianti & Septiani, 2022) and to support improvements in community nutritional status (Leone et al., 2015). Meanwhile, the flavonoid and vitamin C content of carica contribute to antioxidant activity that plays a role in mitigating oxidative stress (Koul et al., 2022). The integration of these health benefits positions MORICA Herbal Tea as a functional beverage aligned with recommendations for preventive health-oriented food development (WHO, 2019).

Overall, MORICA Herbal Tea represents a model for the development of functional foods based on local potential through an applied research approach. The utilization of carica peel waste

supports the principles of the circular economy and the reduction of agro-industrial waste (Saputri, 2020; Mirabella et al., 2014). The novelty of this study lies in its integrative approach, combining waste utilization, sensory improvement, and ready-to-consume product orientation within a single development framework. Consequently, this research provides both a scientific contribution in the form of a sustainable local herbal tea development model and a practical contribution to innovation in region-based functional food products.

CONCLUSION

This study demonstrates that the combination of moringa leaves and carica peel can be developed into MORICA Herbal Tea, a functional, practical, and sustainable herbal tea bag product based on local resources. The formulation of 2 g dried moringa leaves and 0.7 g dried carica peel per tea bag was able to improve the sensory acceptability of moringa-based products while simultaneously adding value to carica peel as an agro-industrial by-product. The applied research approach resulted in a relatively simple, consistent, and easily reproducible production process at a limited scale. The addition of carica peel contributed to reducing the characteristic grassy flavor of moringa leaves without eliminating the herbal identity of the product, thereby enhancing its potential consumer acceptance. In addition to supporting the principles of the circular economy, this study provides an initial scientific model for the development of locally based herbal tea products and serves as a foundation for further research and product upscaling.

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