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Transforming Tropical Crops: Postharvest Processing and Enterprise Viability of MaCoMa Coffee Blend in Davao Oriental, Philippines

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Abstract

This study explored the development of a novel, non-caffeinated coffee alternative using underutilized tropical crops: marang seeds (*Artocarpus odoratissimus*), corn (*Zea mays*), and malunggay (*Moringa oleifera*) leaves. These crops are abundant in tropical regions, such as Banaybanay, Davao Oriental, Philippines, yet remain largely untapped for value-added food products. Marang, a seasonal fruit native to the Philippines, yields seeds rich in protein, fats, and carbohydrates, which are often discarded as waste. Corn, widely cultivated in the region, contributes dietary fiber and antioxidants, while malunggay leaves are celebrated for their dense micronutrient content, including iron, calcium, and vitamins A and C. The MaCoMa (**Ma**rang + **Co**rn + **Ma**lunggay) coffee blend was formulated through strategic post-harvest processing techniques, including roasting, drying, and blending, to enhance flavor, preserve nutrients, and extend shelf life. The research evaluated both scientific parameters, such as nutritional profiling and sensory attributes (appearance, aroma, taste, and texture), as well as business viability factors, including consumer acceptability and financial metrics. A sensory evaluation conducted with 200 respondents revealed high levels of acceptability, particularly in terms of aroma and taste. Economic analysis indicated a Return on Investment (ROI) of 7.84%, a net profit margin of 6.86%, and a payback period of 1.5 years, evidence of strong enterprise potential. A SWOT analysis highlighted key strengths, including local availability, nutritional benefits, affordability, and sustainability, while also noting challenges such as limited market awareness and shelf-life constraints. This project demonstrates the potential of transforming tropical crops into market-ready products that support community-based enterprises. The MaCoMa coffee blend offers a healthier alternative to conventional coffee, promotes agricultural innovation, reduces postharvest waste, and creates livelihood opportunities. Continued research into flavor variants, shelf-life stabilization, and regional marketing is recommended to scale its impact across tropical agricultural communities.

Keywords: agro-processing, *Artocarpus odoratissimus*, coffee substitute, *Moringa oleifera, Zea mays*

Introduction

The Philippines, blessed with rich biodiversity and fertile tropical landscapes, is home to a wide range of crops. Many of these, though nutritionally valuable and locally abundant, remain underutilized in food processing (Ong and Kim, 2017; Hossain et al., 2021). In regions like Davao Oriental, three such crops, marang (*Artocarpus odoratissimus*), corn (*Zea mays*), and malunggay (*Moringa oleifera*), are plentiful yet seldom explored beyond their raw or traditional culinary uses. Their potential for value-added processing, particularly in health-focused food and beverage products, remains largely untapped.

These tropical crops are not only nutrient-rich but also deeply embedded in the agricultural and cultural identity of rural communities. Marang, for example, is a seasonal fruit commonly found in Southeast Asia, particularly in Indonesia, Malaysia, and the Philippines (Alvarado, 2023). Marang is a tropical fruit characterized by its thick, spiky skin and soft, sweet, white, bulb-like segments inside. It is similar to jackfruit but has a distinct flavor and texture, often described as tasting like marshmallows. While the fruit's pulp is enjoyed fresh, its seeds are usually discarded (Noorfarahzilah et al., 2017; Ismail et al., 2021). Research has shown these seeds also contain antioxidant and antiproliferative compounds (Estudillo

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and Tolentino, 2024), suggesting considerable potential for functional food applications. However, to date, no published work has examined their use in coffee-like beverages.

Corn, another staple crop, plays a central role in global diets and is valued for its antioxidant and fiber content (Maulana et al., 2019; Deepak and Jayadeep, 2022; Amanjyoti et al., 2024; Suresh Babu et al., 2024). In processing, it produces nutrient-dense byproducts such as gluten meal, husks, and steep liquor, all of which have applications in food, feed, and industrial sectors (Jiao et al., 2022). Harnessing these byproducts not only improves resource efficiency but also reduces environmental waste. Roasted corn has been explored as a coffee substitute, offering a distinctive flavor and additional nutritional benefits (Reis et al., 2013; Ong et al., 2024).

Moringa oleifera, often referred to as a "superfood" or "miracle tree," is another crop with exceptional health credentials. Moringa in the Philippines is commonly known as malunggay. It's a fast-growing tree whose leaves, pods, and seeds are used in Filipino cuisine and traditional medicine. Moringa leaves are rich in vitamins, minerals, and bioactive compounds such as flavonoids and phenolic acids (Rasmani et al., 2020). Across the globe, moringa is valued both as a nutritious food and as a component of traditional medicine, where it is used to address conditions ranging from anemia and high blood pressure to respiratory ailments and digestive issues (Kaur et al., 2023; Srivastava et al., 2023). Despite moringa's well-documented benefits, there has been little research into transforming moringa leaves into shelf-stable, market-ready beverage products.

Considering this gap, the present study introduces the MaCoMa coffee blend, a non-caffeinated, plant-based beverage made from roasted marang seeds, corn, and malunggay leaves. The goal is to create a healthier coffee alternative that appeals to health-conscious consumers while addressing post-harvest waste and enhancing rural livelihoods. For communities in Banaybanay, Davao Oriental, where these crops are abundant, such a product could be both a nutritional innovation and a source of income.

This research is grounded in a dual purpose: to optimize the utilization of local agricultural resources and to develop food products that enhance nutrition while promoting economic growth. By applying targeted postharvest techniques, it seeks to transform underused tropical crops into viable, market-ready products, supporting sustainable agriculture, reducing losses, and empowering smallholder farmers.

The study focused on two main objectives: (1) evaluating the MaCoMa blend's nutritional composition and sensory qualities, and (2) assessing its commercial viability in terms of consumer acceptance and financial performance. Through this work, the study aims to demonstrate that indigenous crops can be reimagined into sustainable, health-promoting products with strong ties to local agricultural identity.

Materials and Methods

Study Area and Implementation

The processing and field evaluations took place in Purok Malinawon, Poblacion, Lupon, Davao Oriental, Philippines. This location was chosen for its convenient access to raw materials and its closeness to the intended consumer market. Under the supervision of the project proponents, two trained workers carried out the production process. The enterprise used a Gantt chart to organize and schedule activities over a one-year project cycle.

Raw Material Collection and Processing

All raw materials, marang seeds, corn kernels, and malunggay leaves, were sourced locally from Banaybanay and Lupon, Davao Oriental. Only fully matured, ripe marang fruits were harvested for seed processing. The seeds were carefully extracted from the fruits, thoroughly washed, and sun-dried for 24 hours to reduce their moisture content and prepare them for roasting. Marang seeds were extracted, washed, and sun-dried for six to eight hours under direct sunlight at a temperature of around 32 to 35ºC. They were then oven-roasted at 150ºC for 30 minutes to optimize flavor while minimizing nutrient loss. Corn kernels and air-dried malunggay leaves (50 g per batch) were also cleaned and prepared in a similar manner.

Roasting was carried out under controlled conditions: marang seeds and corn kernels were roasted to enhance flavor, promote Maillard reactions, and reduce microbial load, while malunggay leaves were air-dried at 28-32ºC for 48 hours in a shaded, well-ventilated area to protect heat-sensitive nutrients, then lightly roasted at 120ºC for 10 minutes. After roasting, each ingredient was ground separately using a mechanical grinder.

The powders were then combined according to a standardized formulation of 800 g roasted marang seed powder, 250 g roasted corn, and 50 g roasted malunggay powder, producing a blend composed

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of 72.73% marang seed, 22.73% corn, and 4.55% malunggay**,** chosen for its balanced flavor, texture, and nutritional profile. The final blend was packaged into sterilized 28 g sachets, labeled with nutritional information and storage instructions, and stored in a cool, dry place until further use. All procedures were conducted consistently to ensure uniformity and reproducibility of the final product.

The final formulation used for consumer testing was selected after initial informal trials and careful consideration of nutritional balance. Several pilot ratios were tested at both the household and laboratory levels to determine the optimal combination for taste, aroma, and nutrient value. Ultimately, only the standardized mixture, as previously mentioned, was developed by the Researcher and was presented for formal sensory evaluation involving 200 respondents. This ratio was selected for its well-balanced flavor, consistent roasting results, and high nutrient density.

Scientific Evaluation

The nutritional composition of the MaCoMa coffee blend was determined through standard laboratory methods. Moisture content was measured using the oven-drying method at 105°C until a constant weight was achieved. Crude protein was determined using the Kjeldahl method, crude fat was extracted using the Soxhlet method with petroleum ether, and ash content was determined by incineration in a muffle furnace at 550°C until a constant weight was reached (AOAC, 2016). Carbohydrates were calculated by difference, subtracting the sum of moisture, protein, fat, and ash from 100% (FAO, 2003). Micronutrients, such as potassium, calcium, and iron, were measured using atomic absorption spectrophotometry (AAS). All analyses were performed in triplicate to ensure accuracy and reproducibility.

Sensory evaluation was conducted using a hedonic scale taste test, in which 200 respondents from the target market rated the product's aroma, taste, texture, color, and overall acceptability. This evaluation provided insight into consumer preferences and overall market acceptability of the MaCoMa coffee blend.

Enterprise Viability Assessment

To assess both consumer acceptance and business potential, a market survey was conducted through direct product sampling and the collection of feedback. Promotional activities included free tasting events and social media campaigns to introduce the product to the community. Pricing was determined based on production costs and an added markup, resulting in a suggested retail price of PHP 15.00 (approximately USD 0.26) per sachet. Other factors considered included projected sales, packaging appeal, shelf life, and potential market distribution channels.

Financial Analysis

A detailed financial analysis was conducted, which included calculations for returns on investment, net profit margin, payback period, and breakeven point. These measures provided a clear picture of the enterprise's profitability and long-term sustainability. The total investment estimate accounted for fixed capital costs, raw material expenses, labor, and other operational costs.

Results and Discussion

Postharvest Processing of Tropical Crops

The MaCoMa coffee blend was developed by applying targeted postharvest techniques to marang seeds, corn, and malunggay leaves. Each ingredient was processed in a manner that preserved its nutritional value, enhanced flavor and aroma, and extended its storage life.

Marang seeds, which are often discarded after the fruit is eaten, are naturally high in protein, carbohydrates, and healthy fats (Alvarado, 2023). This drying step reduced their moisture content and helped control microbial growth (Alp and Bulantekin, 2021; Lainufar et al., 2021). They were then roasted to develop a deep, earthy taste similar to coffee and to improve oxidative stability by limiting enzymatic activity (Das et al., 2023). Roasting also triggered the Maillard reaction, which added a rich color and enhanced aroma, key traits in coffee-style beverages (Kim, 2021; Cao et al., 2023; Marcolino et al., 2024).

Only fully mature dried corn kernels were selected to ensure optimal sweetness and carbohydrate content. For each batch, 250 g of corn kernels were processed. The kernels were thoroughly cleaned to remove debris and foreign materials, then sun-dried for 24 hours to reduce moisture content before roasting. After drying, the kernels were roasted under controlled conditions to enhance flavor and aroma, contributing to the overall smooth, full-bodied mouthfeel of the MaCoMa coffee blend. Following roasting, the kernels were ground separately using a mechanical grinder and later combined with roasted marang seed and malunggay leaf powders according to the standardized formulation. In many cultures, roasted corn has been used as a base for caffeine-free beverages because it is gentle on the

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digestive system and offers a light, stimulating effect. Within the MaCoMa blend, corn plays a balancing role, softening the more intense notes of marang and malunggay. The drying process, a standard step in both coffee and corn beverage production, is essential for preservation and flavor development (Pineda, 2025). Roasting corn also involves Maillard reactions and caramelization, both of which deepen the flavor and aroma. Controlling these reactions is crucial to achieving a nuanced and appealing taste, similar to the precision required in coffee roasting.

Malunggay leaves, widely recognized as a local superfood (Rasmani et al., 2020), were included for their exceptional nutrient density. After harvesting, the leaves were air-dried to retain their bioactive compounds, then lightly roasted to reduce the grassy taste often associated with green leafy vegetables. This gentle roasting also allowed the malunggay to blend more harmoniously with the other ingredients. Beyond its contribution to flavor and color, malunggay brings health-promoting benefits and supports the growing demand for functional foods that boost immunity (Shivanna et al., 2024). Processing methods is very important in preserving the bioavailability of nutrients and polyphenols in moringa leaves (Srivastava et al., 2023), making careful handling essential for maintaining their therapeutic value. Meanwhile, corn kernels were air dried to remove surface moisture and roasted at the same temperature for 25 minutes, which enhanced their aroma and antioxidant properties (Yao et al., 2022).

While Pineda (2025) produced a coffee-style drink from corn and malunggay in three different formulations, with the most cost-effective containing 60% corn and 40% malunggay, the MaCoMa formulation improves on this concept by adding marang for greater flavor depth and nutritional value. The result is a more distinctive and health-focused beverage that remains affordable, locally sourced, and appealing to consumers who prefer to avoid caffeine. This positions MaCoMa as a competitive, profitable, and appealing option in the growing market for plant-based, nutrient-dense coffee alternatives.

To further improve consumer safety, especially for individuals taking medication, malunggay should be processed to reduce its fiber and antinutrient content, and its proportion in the blend should be carefully controlled. Clear preparation instructions and health advisories should be included in the packaging. By combining these measures with careful postharvest handling, the MaCoMa blend demonstrates how indigenous crops and food processing byproducts can be turned into a stable, market-ready drink that reduces food waste and supports rural development. Nutritionally, MaCoMa offers a clear advantage over regular brewed coffee, which is primarily known for its caffeine and antioxidants but contains minimal calories, protein, fat, and carbohydrates (Marcolino et al., 2024). In contrast, the MaCoMa blend delivers significant amounts of carbohydrates (59.2%), potassium (905.61 mg.100 g^{-1}), protein, and healthy fats from the marang seeds (Ismail et al., 2021). Corn adds energy and antioxidants like ferulic acid (Amanjyoti et al., 2024), while malunggay provides essential micronutrients including iron, calcium, vitamins A and C, and polyphenols such as quercetin and kaempferol (Srivastava et al., 2023; Kaur et al., 2023).

A projected nutrient profile for a 28 gram sachet, calculated from the ingredient proportions and reference values, is shown in Table 1. While exact amounts may shift slightly due to processing losses during roasting, the figures demonstrate MaCoMa's superior nutrient density compared to traditional coffee.

Table 1. Estimated nutritional comparison between MaCoMa coffee blend and brewed pure coffee.

Nutrient	MaCoMa coffee blend (28 g sachet)	Pure-brewed coffee (240 mL)
Calories	90–120 kcal	~2 kcal
Protein	3–5 g	0.3 g
Carbohydrates	15–20 g	0 g
Fat	1.5–4 g	0 g
Dietary fiber	2–3 g	0 g
Iron	10–15% RDA	0%
Calcium	5–10% RDA	0%
Vitamin A	8–12% RDA	0%
Vitamin C	6–10% RDA	0%
Potassium	250–350 mg	~116 mg

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This nutritional profile reinforces MaCoMa's identity as a functional beverage, offering tangible health benefits beyond caffeine stimulation. It is especially suitable for consumers seeking plant-based, nutrient-rich, and non-caffeinated alternatives to traditional coffee.

While the MaCoMa coffee blend offers notable nutritional and functional advantages, its health implications warrant careful consideration to ensure consumer safety and transparency. Some of its plant-based components naturally contain compounds that, in high amounts or with improper preparation, may pose potential risks. For instance, malunggay leaves contain anti-nutrients such as oxalates, phytates, and tannins, which can interfere with mineral absorption if not adequately reduced through thermal processing or fermentation (Rasmani et al., 2020; Srivastava et al., 2023). Marang seeds, although rich in protein and healthy fats, may have *allergenic potential* similar to other seeds and nuts, and thus should be introduced cautiously among sensitive individuals (Alvarado, 2023). Furthermore, bioactive compounds in malunggay can influence blood sugar and blood pressure regulation, which, while beneficial to most consumers, may interact with certain medications such as antihypertensives or hypoglycemics (Kaur et al., 2023).

To mitigate these risks, processing controls such as proper roasting, blanching, and standardized drying conditions are crucial for deactivating or minimizing anti-nutritional factors while retaining beneficial nutrients. Clear labeling and consumer guidance, including dosage information, preparation recommendations, and warnings for individuals with pre-existing medical conditions, are strongly recommended. By incorporating these safety measures, MaCoMa can promote both nutritional value and consumer well-being, providing a balanced, health-conscious beverage that aligns with food safety and functional nutrition standards.

Demographic Profile of Respondents

A total of 200 individuals participated in the sensory evaluation and market acceptability survey for the MaCoMa coffee blend. The respondents were selected using a purposive–convenience sampling technique, which is commonly applied in product development and sensory studies where participants must meet specific inclusion criteria such as age, availability, and willingness to evaluate food or beverage samples.

Participants were purposively chosen to include individuals who regularly consume coffee or related beverages, as their familiarity with taste and aroma would enable them to provide more meaningful feedback on the product's sensory qualities. Within this purposive framework, a convenience sampling approach was employed by recruiting participants from accessible locations, such as university campuses, local offices, and community centers, within the Davao Oriental area. This approach ensured sufficient participation while maintaining logistical feasibility for the researchers.

Of these respondents, 64% were women and 36% were men. The higher participation of female respondents reflects the composition of the sample for this study and does not imply any generalization about gender roles or preferences (Atreya et al., 2024; Bamishaiye et al., 2024). Their strong representation provides valuable insight into household consumer preferences, which is a key factor when assessing how well a product might be received in the market.

The respondents also represented a wide range of age groups (see Table 2). The largest share came from those aged 45 years and older, making up 19 percent of the total. Close behind were the 25 to 29 year old and 35 to 39 year old age groups, each accounting for 16 percent. The rest of the participants were spread across various age categories, providing the survey with a healthy mix of generational perspectives. This diversity enhances the reliability of the findings, as it reflects both established preferences and the evolving tastes of younger consumers, aligning with patterns observed in other studies on local food innovation (Chen et al., 2024).

Sensory Evaluation and Product Acceptability

The sensory evaluation of the MaCoMa coffee blend was conducted using a nine-point hedonic scale to assess consumer reactions to its appearance, taste, aroma, color, and overall appeal. The results, presented in Table 3, show a high level of acceptance across all attributes. Appearance received the highest score with an average rating of 8.34, followed closely by taste at 7.80 and aroma at 7.68. Both color and overall acceptability received a score of 7.91. These ratings place the product firmly within the "Like very much" to "Extremely like" range, indicating strong consumer approval.

Interestingly, although marang is known for its bold and distinctive flavor, participants did not report it as overpowering. On the contrary, the roasted marang taste seemed to enhance both the aroma and flavor, contributing to the high scores in these categories. The inclusion of roasted corn and lightly roasted malunggay helped soften and balance the richness of

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the marang, creating a smooth, well-rounded blend. This harmonious flavor profile suggests that marang's unique taste could be a key feature that potentially sets the MaCoMa blend apart in the market, particularly for consumers who want a flavorful, caffeine-free alternative to traditional coffee.

This high level of sensory approval is consistent with other functional beverage developments that utilize alternative ingredients. For instance, Al-Askari et al. (2024) reported that coffee substitutes made from date seeds were well received by consumers, particularly in terms of taste and aroma, findings that parallel Pineda's (2025) study. The favorable feedback gathered from MaCoMa's sensory evaluation further reinforces its market promise, positioning it as a viable, caffeine-free, nutrient-dense option for health-conscious consumers.

It is worth noting, however, that the sensory evaluation was conducted without a control or comparison sample. Respondents evaluated the MaCoMa coffee blend based solely on its sensory qualities, appearance, aroma, taste, color, and overall acceptability, without direct comparison to brewed coffee or other substitutes. This approach was deliberate, as the product was never intended to mimic traditional coffee but rather to stand as a distinct, non-caffeinated beverage with its own flavor and nutritional identity. Even so, the absence of a

Table 2. Demographic profile of the 200 respondents

Demographic	Frequency	Percentage (%)
Gender distribution		
Male	72	36
Female	128	64%
Total	200	100
Age distribution		
14 years old	6	3%
15 – 19 years old	10	5%
20 – 24 years old	24	12%
25 – 29 years old	32	16%
30 – 34 years old	30	15%
35 – 39 years old	32	16%
40 – 44 years old	28	14%
45 years old and above	38	19%
Total	200	100%

Table 3. Level of acceptability of the MaCoMa coffee blend based on different parameters

Parameter	Mean average	Adjectival rating	Descriptive interpretation
Appearance	8.34	Extremely like	The MACOMA coffee blend exhibits an exceptionally appealing appearance that meets consumer expectations for premium coffee products.
Taste	7.80	Like very much	The MACOMA coffee blend is characterized by a notably intense and well-balanced flavor profile.
Aroma	7.68	Like very much	The aroma of the MACOMA coffee blend is distinctly savory and contributes positively to its overall sensory quality.
Color	7.91	Like very much	The MACOMA coffee blend possesses a deep, dark color typical of high-quality roasted coffee.
General acceptability	7.91	Like very much	The MACOMA coffee blend demonstrates strong consumer acceptance, indicating favorable market potential.

Notes: The rating scale is based on the following: 8.0–9.0= Extremely high; 7.0–8.0= Very high; 6.0–7.0= Moderate high; 5.0–6.0= Slightly high; 4.1–5.0= Low; 3.1–4.0= Slightly low; 2.1–3.0= Moderate low; 1.1–2.0= Very low; 0.1–1.0= Extremely low.

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side-by-side comparison is a limitation, particularly when considering the preferences of regular coffee drinkers. Future research should include comparative testing with pure brewed coffee and other commercial alternatives to better contextualize MaCoMa's sensory performance and guide formulation refinements.

Financial Viability Assessment

The financial analysis of the MaCoMa coffee blend utilized standard industry indicators to evaluate the enterprise's potential. The first-year net profit margin of 6.86% reflects modest profitability, representing the portion of revenue remaining after covering all costs (data not shown). The financial analysis of the MaCoMa coffee blend enterprise indicates a return on investment (ROI) of 7.84%, based on an initial capital outlay of PHP 157,445.00 (USD 2,776.21). This ROI suggests a modest but favorable return for a small-scale, community-based food enterprise. The estimate assumes stable market conditions, consistent sales volume, and steady raw material costs throughout the first year of operation.

A preliminary sensitivity analysis indicates that profitability may vary depending on fluctuations in key variables, including green coffee bean prices, packaging costs, and retail demand. For instance, a 10% increase in raw material costs could reduce ROI by approximately 1–2 percentage points, while a corresponding rise in market price could improve returns. These factors highlight the importance of efficient cost management and dynamic pricing strategies.

The projected ROI and payback period demonstrate economic feasibility under baseline conditions yet remain contingent upon market stability and effective operational management. Such contextualized estimates make the enterprise financially promising while underscoring the need for continuous monitoring of input and market variables.

The asset turnover ratio of 39.11% suggests moderate efficiency in generating revenue from available assets. With a payback period of only 1.5 years, the investment could be recovered in a relatively short time, making it attractive to grassroots entrepreneurs and cooperatives with limited capital. Break-even analysis indicated that sales must reach at least 6,569 sachets per year at a break-even price of PHP 12.09 (USD 0.21) to avoid losses. Given the current retail price of PHP 15.00 (approximately USD 0.26), the product maintains a healthy profit margin, supported by a per-unit contribution margin of PHP 1.88 (approximately USD 0.033). These results suggest a sustainable business model, aligning with the performance of similar community-based food ventures in Southeast Asia (Rado et al., 2021; Suwanmaneepong et al., 2024).

Enterprise Potential and Socioeconomic Impact

The MaCoMa coffee blend addresses two pressing challenges: the underutilization of agricultural resources and limited livelihood options in rural areas. By transforming often discarded marang seeds and combining them with locally available corn and malunggay, the initiative creates a product that is both economically viable and nutritionally beneficial. More than a product, MaCoMa serves as a vehicle for community empowerment. It opens pathways for local farmers, women, and out-of-school youth to participate in the value chain, from sourcing raw materials to production and distribution. This aligns with the observations of Adeniyi et al. (2023), who noted the significant role small-scale agro-enterprises play in enhancing rural livelihoods and minimizing post-harvest losses.

The project's strengths lie in the abundance of local raw materials, its unique formulation, and its high nutritional content. Its use of simple, sustainable postharvest methods, such as sun drying and roasting, keeps costs low while reducing environmental impact. Challenges include limited market awareness during the early stages. Opportunities exist in the growing demand for health-oriented, caffeine-free beverages, as well as in diversifying the product line and building partnerships with cooperatives and wellness markets. Potential threats include competition from established coffee brands and fluctuations in marang supply, which may impact consistency.

Implications for Future Research and Enterprise Development

The findings affirm MaCoMa's technical, sensory, and financial feasibility as an innovative agro-processed product. Moving forward, research should focus on improving shelf life, possibly using natural preservatives or vacuum packaging, as suggested by recent studies on plant-based beverage preservation (Liu et al., 2023; Udayakumar et al., 2022). Developing new flavor profiles and specialized blends, such as diabetic-friendly or fortified options, could help capture niche markets.

Expanding sales channels to include both online platforms and physical retail outlets will also be essential. Effective branding, marketing, and consumer education will play a central role in ensuring sustained demand. McClements et al. (2021) emphasize that local food innovations flourish

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when backed by continuous promotion and reliable supply chains.

This study demonstrates that tropical crop by-products, when skillfully processed, can be transformed into marketable, nutritious, and sustainable goods that generate genuine livelihood opportunities. By combining postharvest innovation with entrepreneurship, MaCoMa offers a replicable model for other tropical regions seeking to unlock the value of their underutilized crops.

Conclusions

This study demonstrates the potential of tropical crops to be transformed into a profitable, nutrient-rich, and sustainable product. By utilizing the nutritional and sensory attributes of *Artocarpus odoratissimus* (marang) seeds, *Zea mays* (corn), and *Moringa oleifera* (malunggay), the MaCoMa coffee blend offers a practical approach to reducing food waste while supporting livelihood diversification in rural Davao Oriental. Sun-drying and roasting effectively preserved nutritional quality, enhanced flavor, and extended shelf life. Future work should focus on evaluating the blend's shelf-life stability, conducting comprehensive sensory assessments with broader consumer panels, and assessing potential health concerns such as anti-nutrients, allergens, and compound interactions. Comparative and market-based studies, integrating sensitivity to price, supply, and consumer acceptance, are also recommended to validate the product's scientific and commercial sustainability.

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